SEVENTH FRAMEWORK PROGRAMME FP7

ICT-2011-600545

D1.1 Definition of stakeholders and future scenarios

Deliverable No.		**D1.1**	
Work package No.	**WP8**	Work package Title	**Project Management**
Authors		**Sally Shalloe, Mirabelle D'Cruz, Natasa Lackovic, Sue Cobb, Charles Crook, (UNott); Craig Alexander, Christopher Chippindale, Giovanna Bellandi, Fred Baker (CAM), Alex Kulik (BUW), Tiziana Cittadini, Paolo Medici (CCSP).**	
Status (F = Final; D = Draft)		**Final**	
File Name:		**3D-PITOTI_ D1.1 Definition of stakeholders and future scenarios .docx**	
Date		**November 2013**	
Dissemination level (PU = Public; RE = Restricted; CO = Confidential)		**PU**	

Version	Date	Comments
1.0	Nov. 1st, 2013	Initial draft for review by PMB and consortium
2.0	Nov. 13th, 2013	Final draft submitted to PC
2.2	Nov. 22nd, 2013	Final approval from PMB

Keywords	Stakeholders, personas, scenarios
Deliverable leader	Name: Sally Shalloe Partner: UNott Contact: sally.shalloe@nottingham.ac.uk

Table of Contents

List of Tables

List of Figures

Glossary of Terms

ArcTron	Arctron 3D Vermessungstechnik-und Softwareentwicklungs Gmbh, Germany
BUW	Bauhaus-Universität Weimar, Germany
CAM	The Chancellor, Masters And Scholars Of The University Of Cambridge, UK
CCSP	Associazione Centro Camuno Di Studipreistorici Ed Etnologici, Italy
FHSTP	Fachhochschule St. Poelten Forschungs Gmbh, Austria
TUG	Technische Universitaet Graz, Austria
UNott	University of Nottingham, UK
WP	Work Package

Executive Summary

This is the public deliverable D1.1 Definition of stakeholders and future scenarios, of the FP7 project **3D-PITOTI (ICT-600545)**. This work was carried out as part of WP1 Requirements and Specification, in particular work related to T1.1 Current practices in archaeological research and T1.2 Definition of the stakeholders and generation of future scenarios.

This deliverable report summarizes the practices in archaeological research into Pitoti. It includes references to current practices, knowledge, analyses, dissemination methods and previous 3D recordings. The report then describes the methodologies used to capture user requirements and provides a summary of the key results. The user groups on which the project focuses are then defined, providing personas and future scenarios related to visualisation and interaction requirements for the delivery of the scanned data of the Pitoti when the user is not in the field i.e. users of the 3D-PITOTI system who would not be at the actual locations of the rock-art. The 'user-in-the-field' is presented in D2.1 Requirements of 3D-PITOTI scanner (Schaich et al. 2013). This report concludes with a list of requirements to be discussed within the consortium in order to agree the specification of the 3D-PITOTI system related to the user interactive visualisation techniques (to be reported in D1.2 Specification of the 3D-PITOTI system in month 12).

1 Introduction

This is the public deliverable D1.1 Definition of stakeholders and future scenarios of the FP7 project **3D-PITOTI (ICT-600545)**. This work was carried out as part of Workpackage (WP1) Requirements and Specification, in particular work related to Task 1.1 Current practices in archaeological research and Task T1.2 Definition of the stakeholders and generation of future scenarios.

The term 'Pitoti' is used in this report to refer to the rock-art which occurs at various prehistoric, protohistoric and medieval sites in Valcamonica, in the Province of Brescia, Northern Italy. The name means, *inter alia*, 'little puppet' in the local dialect and we have adopted this name for the project because it expresses both the authenticity of the art and the new approach we are taking in this work.

The objectives of T1.1 Current practices in archaeological research are to review relevant current knowledge and current practice in data collection and analysis of rock-art in Valcamonica, including:

- State of current recording and knowledge of Pitoti over the several decades of work in the valley
- State of current academic knowledge and analysis of Pitoti
- Content and means by which knowledge of Pitoti is made available to students and a broad public
- Tests that have been previously made of 3D recording by team members and others.

The objectives of T1.2 Definition of the stakeholders and generation of future scenarios are to:

- Work closely with consortium partners (CAM, CCSP) representing two of our target end user groups - archaeologists and museum/visitor centre curators to identify and define requirements for the technology development
- To involve representatives of wider public audiences, including school children and members of the general public in defining their requirements for appropriate presentation/delivery methods for a variety of case examples
- To define a set of personas and future scenarios which describe the ways in which archaeologists and the wider set of user groups could use concepts developed in the 3D-PITOTI project.

The deliverable is structured in the following way. Section 2 presents the current practices in archaeological research about Pitoti. It includes references to the current practices, knowledge, analyses, dissemination methods and previous 3D recordings. Section 3 describes the methodologies used to capture requirements and provides a summary of the key results. Section 4 defines the user groups within the scope of the project, providing personas and future scenarios related to visualisation and interaction requirements for the delivery of the scanned data of the Pitoti when the user is not in the field. (User-in-the-field is presented in D2.1 Requirements of 3D-PITOTI scanner, Schaich et al. 2013). Section 5 concludes with a list of requirements to be discussed within the consortium in order to agree the specification of the 3D-PITOTI system related to the user interactive visualisation techniques (to be reported D1.2 Specification of the 3D-PITOTI system).

2 Current practices in archaeological research into Pitoti

In this section, we present summaries of current rock-art recording methods applied to the Pitoti; the theories advanced to explain the creation of the images, the modes of dissemination employed to reach both academic and non-academic audiences, and prior use of 3D recording technologies on the Pitoti of Valcamonica.

2.1 Current state of art of Pitoti recording in Valcamonica

2.1.1 Overview

Beyond photography, a tool common to all archaeologists (and not just the rock-art researcher!) in the field, the recording of Pitoti in Valcamonica has employed different techniques: drawing, rubbing (*frottage*), casts and, finally, tracing (Marretta, 2009a, Poggiani Keller, 2009b).

2.1.2 Earlier methods

Drawing the image on a separate piece of paper (not in contact with the rock surface) at, usually, a reduced scale, copying freehand from the rock-art panel, or with reference to a grid placed over the surface, was the main method at the dawn of rock-art research in general, especially for reproducing paintings in caves (Breuil, 1952). In Valcamonica it was employed mainly in the 1930s by German researchers (Cervícek, 1976, Weyersberg, 1938) and, with a few notable later users (Rivetta, 1966), was rapidly abandoned during the early 1960s in favour of the tracing technique. The German Frobenius Institute expeditions in the 1930's were methodologically important, because they used paints to produce a coloured and not just a black and white reproduction of the art. The painters were trained artists and not so much archaeologists. This methodology has not been revived.

Rubbing is still extensively used for recording Scandinavian rock-art (for example Milstreu and Prøhl, 2009) and involves placing a sheet of soft paper on the decorated surface while a solid colouring block is 'rubbed' over it. The paper picks up the pigment on its high spots, while its low spots remain uncoloured. The rapid result is a clear image, though there is much skill involved in knowing how hard to press and how to rub evenly. Rubbings are the same size as the original, and the paper follows the surface morphology of the rock. They capture, when done well, the texture of the peck-marks in the rock surface, whereas a tracing is more obviously an interpretation.

In the 1920s and 1930s, at both Mont Bego (now in France, then in Italy) and in Valcamonica, 3D records were made by means of plaster casts, a laborious method requiring large quantities of heavy plaster to be carried up to the decorated surfaces, and then the resulting heavy and fragile casts to be carried back down. A new casting method came into use in the later 20th century, using latex rubber. It has higher resolution and fidelity to the close detail of the textured surface than do plaster casts, but too often, surfaces have been badly damaged by this method, leaving visible scars of large pale areas where the cast was made. Although superb casts are still made by specialized experts, especially in France, the method is now discredited for general use on conservation grounds.

2.1.3 Present state of the art among the recording techniques: tracing

In Valcamonica the dominant technique since the 1960s has been to make same-size tracings on plastic or acetate sheeting (Anati, 1960b, Anati, 1960a, Anati, 1976). This flexible and transparent material is placed on the rock, generally in overlapping separate pieces of about 60x90 cm in size. The figures are traced onto it in felt-tip permanent pen together with any natural features, cracks and hollows deemed relevant. Since both the ink and the sheeting are not thought to be durable and stable, it has been common to copy these tracings on to paper or another more stable transparent medium. Formerly this was done through re-tracing by hand. Now this workflow has been abandoned in favour of photographing or scanning the tracing, then stitching together the separate shapes into a composite for a group of figures or a whole surface in a digital processing environment.

Early tracing on to transparent sheeting in Valcamonica, from the 1960s to the 1980s, sought simply to distinguish the pecked figure from the 'ground' of the natural rock by drawing a line to mark the boundary (for example Anati, 1975). The pecked areas so identified were then filled in with solid black, and the final result is solid black against solid white.

This approach, however, gives no information regarding the depth, character, 'texture' or detail of the pecking. To remedy this, a second-generation method of tracing was developed (from the 1990s onwards). Instead of drawing a simple line round the outline or edge of the figure, the recorder makes repeated 'stipples' with the drawing pen, seeking to capture the character of the individual peck-marks with individual marks made by the pen (Arcà et al., 2008, Marretta, 2011, Sansoni and Gavaldo, 2009b). In the hands of trained professionals this method does capture something of that difference, but it remains a 2D method. Along with the variety of the stippling goes a diligent observation, individual peck-mark by peck-mark, of the edge of the figure. A fine record made this way conveys the irregularity of the figures and their outlines, whereas the former drawn line too often smoothed them into too neat a form. Accordingly, the former "drawn" tracing method does not convey well the ambiguity of the forms, whereas the stippling method does. Stippling is much slower and labour-intensive.

2.2 Current academic knowledge and analysis of Pitoti

More than a century of research in Valcamonica has left us with a mass of data and a series of competing interpretations of the Pitoti. As the production of Pitoti spanned at least a few millennia — up to 8 or 9 millennia in the view of some researchers but, at the very least, from around 3500 BC to the Late Middle Ages — it seems futile to seek a grand unifying theory of their production: what does a medieval soldier have in common with an Iron Age shepherd?

That said, a variety of theories have been advanced and continue to be advanced (see, for example, Alexander, 2011) as to why the Pitoti were produced and what they mean. Perhaps the two most widespread interpretations are those of Emanuel Anati and Raffaele De Marinis & Angelo Fossati. The former (for example, Anati, 1964) has, over the years, developed a comprehensive view of rock-art as a reflection of humanity's developing religious ideas and sensibilities. Anati uses insights from ethnography, psychoanalysis and other disciplines as part of his research: his eventual aim is the "decoding" of rock-art, not only in Valcamonica but also throughout the world.

The views of De Marinis (1988) and Fossati — the latter being responsible for considerable elaborations (Fossati, 1991, Fossati, 2008) of the initial theory — tend to focus on ritual and, in particular, initiation rites for male aristocratic warriors during the Iron Age (when at least two-thirds of the Pitoti were created) and separate male and female ritual spheres during the Bronze Age. Fossati's theory involves the production of, in particular, the relatively common images of warriors as a component of Iron Age initiation rites.

Another idea, initially proposed by Anati but taken up with vigour by Ausilio Priuli (see, for example, Priuli, 2006), is that the middle part of Valcamonica was a sacred place as a result of the proximity of two mountains of around 2,500 m in height, Pizzo Badile Camuno to the east and La Concarena to the west, which exhibit a sort of "corona effect" under certain atmospheric conditions. The presence of these mountains, according to this theory, led people to make sacred engravings on the rocks — the Pitoti.

In other areas near Valcamonica — in Val Brembana (BG) to the west and in the Val di Fiemme (TN) to the east — we have ethnographic and ethno-historical evidence of Pitoti-like imagery being created by shepherds (Bassi, 2008, Bazzanella et al., 2012). In Val Brembana the images were carved into the rocks as recently as 1961 by shepherds spending time away from home in the summer pastures — the paper by Bassi contains an interview with the shepherd who made the 1961 carving. In the Val di Fiemme the images are typically made with red ochre rather than carved and date from the mid-1600s to the mid-1900s.

Alexander (2011) has argued in his PhD thesis that the Iron Age Pitoti of Valcamonica are also the work of shepherds, hunters and gatherers of wild foods. The argument is based on a reconstruction of the

demography and the socio-economic geography of the valley but also draws support from the ethnographic and ethno-historical research cited above.

When the later Pitoti, in particular those from the medieval era, are considered it is common to see them as manifestations of Christianity: there are many images of crosses and keys, the latter being — according to the religious view —a symbol of Saint Peter (Sansoni et al, 1993). However, other scholarly voices have, more recently, claimed that the keys are symbols of civic power (see Gastaldi, 2009).

Frederick Baker suggests the total collection of sites represents a "form of 3D proto-cinema…In the full light of day, the shallow engravings are barely visible, but in the early morning an evening, when the light skims across the top of the Alps, shadows suddenly make the peck marks pop out" (Brahic 2013). This concept has been researched with special reference to the existence of the simple animation techniques within the graphic language of the Pitoti (Kren, Baker & Chippindale 2012. Chippindale & Baker 2012).

It is fair to say that we still have a way to go in developing a fully satisfactory explanation for the production of Pitoti in the various eras from the Chalcolithic to the Medieval: recent research has emphasised the variation in imagery at small spatial scales. Marretta (2007) has shown how different types of bird image have distinct spatial distributions while Alexander (2011) has shown that motifs appear in distinct groupings in different locations. Such work is important because prior researchers have assumed that all variation in the Pitoti is diachronic (occurs across time)whereas the presence of such spatial patterns as described above suggests that at least some variation is also synchronic (occurring at the same time but across space).

2.3 Dissemination of Pitoti knowledge to students and wider public

Knowledge of the Pitoti has been disseminated in various forms, each of which will be briefly discussed below:

- Articles in academic journals, both refereed and otherwise
- Papers in the acts of various conferences
- Books, both academic and those aimed at a broader audience
- University lectures
- Permanent museum displays
- Temporary exhibitions
- Information panels and leaflets at Pitoti sites designated as local, regional or national parks
- Guided visits to Pitoti sites designated as local, regional or national parks.

Many academic journal articles have been published regarding the Pitoti of Valcamonica: most have focussed on presenting the images from particular sites and their interpretation in terms of the alternative theories outlined above (for example Anati, 1966, Fossati, 1993, Arcà, 2005). There have been fewer articles or books relating specifically to recording methodology (notably Anati, 1974). Instead, methodology tends to be subsumed within an article presenting a new site or, alternatively, is simply taken for granted.

The papers published in academic journals are, at least in recent years, most likely outnumbered by those published in the acts of various conferences, chief amongst which are the various Valcamonica Symposia hosted by Professor Anati over the past few decades (for example Marretta, 2007, Marretta, 2009b, Marretta, 2009c, Marretta and Solano, 2009). Valcamonica rock-art has also been discussed at other international conferences such as Computer Applications in Archaeology (Alexander, 2008).

Books have been very important in the dissemination of knowledge. Indeed, Professor Anati's pioneering book — published in French, then Italian and then English in the early 1960s (Anati, 1960a, Anati, 1964) —

can credibly be argued to have brought the rock-art of Valcamonica to an international academic audience. Prior work, although some had been undertaken by North European researchers, had mostly been the province of Italian scholars. Anati has also written books for a more general public. Few books have been published that focus solely on Valcamonica Pitoti beyond those of Anati and associated researchers (Sansoni, 1987, Sansoni and Gavaldo, 1995, Sansoni and Gavaldo, 2009a). In English the only one would seem to be Lynne Bevan's PhD thesis (Bevan, 2006). Other books — typically edited volumes — have included chapters on Valcamonica (for example Arcà, 2000, Fossati, 2002).

While many university lecture courses include mention of the Valcamonica Pitoti there seems to be only one that features them extensively — that taught by Angelo Fossati at the Università Cattolica del Sacro Cuore at the Brescia campus.

Permanent museum displays devoted to the Pitoti are found only in Valcamonica: the Nadro museum associated with the Riserva Naturale Incisioni Rupestri di Ceto, Cimbergo, Paspardo and the small museum at the Parco Archeologico Comunale di Seradina-Bedolina in Capo di Ponte. In both cases the displays feature primarily plaster casts of the Pitoti and so are 3D rather than 2D in their focus. The museum at Seradina-Bedolina was opened only recently as a way to showcase the plaster casts made by a local man, Battista Maffessoli in collaboration with various scholars. A new Museo Archeologico Nazionale della Preistoria will open in Capo di Ponte — possible before the end of 2013 — and will feature displays focussed on the prehistory of Valcamonica, obviously including the Pitoti.

There has been a series of recent temporary exhibitions related to the Pitoti. The first exhibition (Brescia 2009) focused strongly on the history of research in the valley and featured many original documents and photographs (Poggiani Keller, 2009a). The second "P•I•T•O•T•I. Digital rock-art from Prehistoric Europe" (Chippindale & Baker 2012) was held in Milan (2012), Cambridge (2013) and Capo di Ponte (2013). A variety of digital and 3D technologies were used to present and analyse the Pitoti in new ways to the public: there were multi-touch tables, spherical panoramic fly-throughs of the valley, ambient cinema (Wappel 2012), animations (Kren, Baker & Chippindale 2012) and 3D prints (Karnapke 2012). In the course of the Cambridge exhibition a one-day Pitoti seminar was held at the McDonald Insititute for Archaeological Research. In 2012 Marcel Karnapke held a personal exhibition of 3D Pitoti prints at the Bauhaus in Weimar (Von der Gönna 2013).

"Pitoti – Aliens aus der Vergangenheit", an "Ambient Cinema" installation" directed by Frederick Baker was shown at the Klangturm in St Pölten, Austria in 2010. The Paleaeophonics festival at Edinburgh University 2011 saw the premiere of Frederick Baker's Media Opera "Pitoti. Echoes of the Echoes", Music: Hannes Raffaseder, Narration: Christopher Chippindale, Horns: Albin Paulus and Peter Mußler, Visuals: Frederick Baker. This work was repeated in September 2011 in an extended version, with a choir and live dancers, as part of EU Researcher's Night at the University of Applied Sciences in St Pölten, Austria. (Wald 2011). This event also saw the premiere of the Pitoti multi-touch table developed by a team led by Marcus Seidl and Peter Judmaier (Seidl et al. 2011. Egger et al 2013).

The national parks — Cemmo, Naquane — have leaflets for visitors, sometimes also in foreign languages. Other parks, such as Seradina-Bedolina, have signage that points out important images and gives an idea of chronology. The texts are typically in Italian and English.

A large number of visitors to the valley are Italian schoolchildren and they will invariably be shown around by a local guide who will point out the most important images and explain some of the theories about their production. Groups other than schoolchildren are also sometimes accompanied by a guide but tend more often to be self-guided and to rely on the park signage described above.

Given all the media described above one would expect the Pitoti to be better-known outside Italy than they are. Once people have seen the images they tend to be enthusiastic about seeing more and telling like-minded friends. The current author (Alexander) after presenting a paper at a conference in Cambridge had a long discussion about the prospect of bringing British tourists to the valley with a person involved in heritage tourism: she had not previously known of the Pitoti and had attended the conference with a view to hearing other papers. However, after seeing some images of the Pitoti she was immediately convinced that Valcamonica would be of interest to UK-based tourists with an interest in archaeology.

2.4 Previous 3D recording of Pitoti (as of November, 2013)

In Valcamonica attempts to record the 3D structure of Pitoti or whole rocks have been carried out only occasionally prior to the current project. After some tests with photogrammetry on Bedolina R. 1 and on the Cemmo boulders performed by the *Soprintendenza per i Beni Archeologici della Lombardia* during the 1990s as part of their internal 'Project IR' (Poggiani Keller et al., 2007 p. 125), recordings by laser scanner of selected panels were made by a team of Scandinavian experts as part of a EU funded project called 'Rock-Care Project' (see Fig. 2.4 in Goldhahn, 2008) in 2000-2001. After the discovery of a new, large geometric composition in Bedolina (Marretta, 2006) the *Soprintendenza per i Beni Archeologici della Lombardia* commissioned the scanning of the surface (R. 7) by laser-scanning (Zefinetti and Peverelli, 2009), but no in-depth article of the outcome have been published to date.

A team from the Università di Cagliari in Sardinia has undertaken some scanning recently in the Capo di Ponte area: nothing has been published yet. Members of the current project consortium — ArcTron and TUG — have carried out scanning at various scales and with diverse technologies which has dramatically increased the total number of existing 3D scans:

- Entire area around Capo di Ponte
    - Microlight-based photogrammetry
    - UAV-based photogrammetry (selected areas only)

- Seradina I:
    - Rock 12
        - Terrestrial laser scanning of entire rock
        - UAV-based photogrammetry of entire rock
        - Structure from Motion imaging of individual Pitoti
        - Structured light scanning of individual Pitoti
    - Rock 25
        - Structure from Motion imaging of individual Pitoti
    - Rock 57
        - Structure from Motion imaging of individual Pitoti
- Seradina II:
    - Rock 28
        - Structure from Motion imaging of individual Pitoti
- Foppe di Nadro:
    - Rock 24
        - Terrestrial laser scanning of entire rock
        - UAV-based photogrammetry of entire rock
        - Structured light scanning of individual Pitoti
        - Structure from Motion imaging of individual Pitoti
- Naquane:
    - Rock 50

        - Structure from Motion imaging of individual Pitoti
- Ossimo 8 stela
    - Terrestrial laser scanning of entire stela and surroundings
    - Structured light scanning of individual elements
- Sellero (location with a rougher rock surface than that found in the Capo di Ponte area):
    - Rock 2/3:
        - Terrestrial laser scanning of entire rock
        - UAV-based photogrammetry of entire rock
        - Structure from Motion imaging of individual Pitoti

For further information, see ANNEX I: Bibliography for further reading.

3 Methodologies for requirements capture for 3D-PITOTI interactive visualisation

A number of appropriate human-centred design approaches were used to elicit needs and requirements from our target user groups (archaeologists, school children and museum visitors) including: literature review, workshops, interviews, focus groups, questionnaires and analysis of data from previous Pitoti related exhibitions and visitors to Valcamonica. A summary of the methods is shown in Table 3-1 below.

Table 3-1: Summary of methods used to define requirements

ID	Title	Location	Date	Type of participants	Methods
WS1	Identification of stakeholders workshop	Valcamonica, Italy	11th March, 2013	23 stakeholders (archaeologists, engineers, 3D scanning and technology experts)	Individual work task, Group discussion
WS2	Computer-supported archaeology workshop	Weimar, Germany	17th September, 2013	7 external archaeologists, 5 archaeologists within the consortium	Presentations, hands-on interaction, observation checklist, feedback questionnaires, small group and open discussion
INT1.1	Interview with UK teacher	Nottingham, UK	18th July , 2013	1 teacher (key stage 2)	Semi-structured interview
INT1.2	Interview with UK teacher	Small town primary school, Matlock Bath,	22nd July, 2013	1 teacher (key stage 1)	Semi-structured interview
INT1.3	Interviews with UK teachers	Small town primary school, Matlock Bath,	22nd July 2013	2 teachers (key stage 1)	Semi-structured interview
INT1.4	Interview with UK teachers	Urban primary school, Nottingham,UK	22nd July, 2013	1 teacher (key stage 2)	Semi-structured interview

ID	Title	Location	Date	Type of participants	Methods
INT1.5	Interviews with UK teachers	Suburban primary school, Leicester, UK	3rd, October 2013	2 teachers (key stage 1 and 2)	Semi-structured interview
INT1.6	Interviews with UK teachers	Suburban primary school, Leicester	3rd October, 2013	2 teachers (key stage 1 and 2)	Semi-structured interview
INT1.7	Interview with UK teachers	Primary supply teacher, Nottinghamshire, UK	4th October, 2013	1 teacher ((key stage 1)	Semi-structured interview
INT1.8	Interview with UK teacher	Urban secondary school, Nottingham, UK	7th October, 2013	1 English teacher	Semi-structured interview
INT1.9	Interview with Italian teacher	Valcamonica, Italy	2th October, 2013	1 primary school teacher	Semi-structured interview
INT1.10	Interview with Italian teacher	Valcamonica, Italy	2th October, 2013	1 teaching assistant primary school	Semi-structured interview
INT1.11	Interview with Italian teacher	Valcamonica, Italy	8th October, 2013	1 primary school teacher	Semi-structured interview
INT1.12	Interview with Italian teacher	Valcamonica, Italy	8th October, 2013	1 primary school teacher	Semi-structured interview
INT1.13	Interview with Italian teacher	Valcamonica, Italy	3th October, 2013	1 primary school teacher	Semi-structured interview
INT1.14	Interview with Italian teacher	Valcamonica, Italy	7th October, 2013	1 primary school teacher	Semi-structured interview
INT1.15	Interview with Italian teacher	Valcamonica, Italy	7th October, 2013	1 primary school teacher	Semi-structured interview
INT1.16	Interview with Italian teacher	Valcamonica, Italy	8th October, 2013	1 primary school teacher	Semi-structured interview
INT2	Interview with curator of Nottingham University Museum	Nottingham, UK	27th September, 2013	1 curator	Interview
INT3	Interview with community archaeologists	Nottingham, UK	23rd July 2013	2 archaeologists	Interview
DAT1	Analysis of data from previous Pitoti related exhibitions and visits to Valcamonica	Cambridge, UK, Milan, Italy; Valcamonica, Italy	Various dates in 2012 and 2013	Museum visitors and curators	Data analysis
QN1 (Questionnaire	Analysing and presenting information on rock-art questionnaire	On-line	26th September to 4th October, 2013	21 archaeologists	On-line questionnaire

WS = Workshop; INT = interview; QN = Questionnaire; DAT=data analysis

3.1 Workshops with relevant stakeholders

As part of our Kick-Off meeting in Valcamonica (see D8.1, Cobb, Shalloe and D'Cruz, 2013) we organised an initial workshop (WS1) on 11th March, 2013 with our consortium partners. The partners represented a variety of relevant stakeholders (i.e. all those who will use, be affected by or work on the development of the 3D-PITOTI system). It was necessary to agree who the relevant stakeholders of the project could be and how we would involve them in the design of the system. The potential stakeholders were grouped as: archaeologists, scientists, technology developers, museum curators and education centre visitors, schools and youth groups, and the wider general public reached through websites. The participants were asked to list who they knew in these groups and how we could contact them to be involved. A list was generated and discussed and it was agreed who to involve for subsequent workshops and questionnaires for the activities in WP1.

Following over 500 invitations sent to contacts from the archaeological field (private companies, universities, state authorities and research institutes in Germany, Europe and worldwide), a workshop was held in Weimar, Germany on 17th September, 2013 (WS2) hosted by the Bauhaus-Universität Weimar. Representatives from all partner organisations took part in the workshop along with seven archaeologists, external to the project, from universities and institutes across Germany.

The objectives of the workshop were, first, to introduce the various 3D scanning and visualisation techniques proposed by the project and, second, to explore the scanned data from Valcamonica using the various display technologies and visualisation techniques currently developed by the project partners. User needs and requirements were collected on the scanning technologies (to be reported in D2.1 Requirements of 3D-PITOTI scanner) and on the data processing and data visualisation techniques.

3.1.1 Demonstrations and workshop on interactive visualisation techniques

The lab space at Weimar was set up to demonstrate the types of interactive visualisation technologies that are envisaged as being developed in WP5 of the project. These include a 3D multi-user system for co-located collaborative analysis, a multi-user multi-touch presentation system and efficient interaction techniques for the exploration and analysis of scanned rock engravings. The concept of the "Scientists' lab" as set out in the DoW is illustrated in Figure 3-1.

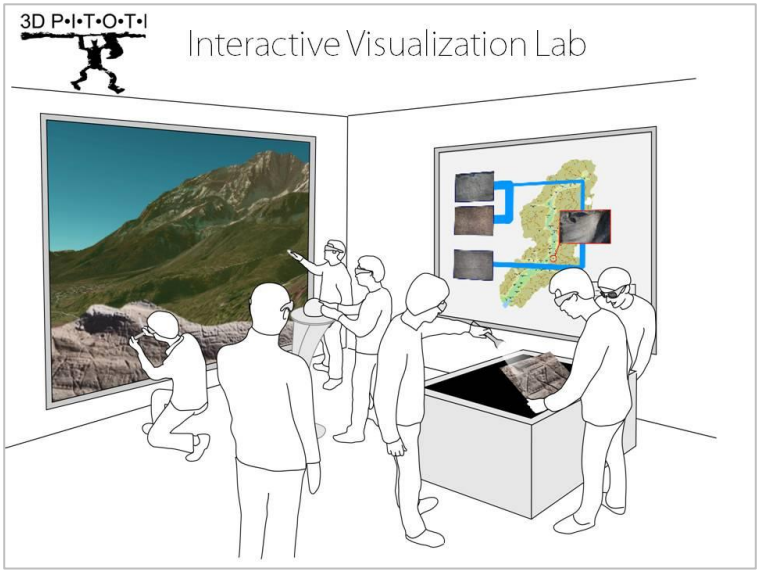

Figure 3-1 Concept of the 3D-PITOTI Scientist's lab (DoW, p.10) showing multi-user 3D wall projection and table top displays

The agenda for the workshop is shown in ANNEX II: Agenda for computer-supported archaeology workshop.

Each visualisation display is described in Table 3-2 along with; the topics for each of the demonstrations, the functionalities that participants would experience, and the content, i.e. the high resolution scans of both a selection of Pitoti and of parts of the Valcamonica landscape that were collected by project partners earlier in the year.

Table 3-2 Visualisation displays demonstrated at workshop in Weimar

	Demo Station	Description	Topics	Functionality	Content
1.	C1x6 - Six-User 3D Projection Display	A six-user 3D display for the collaborative exploration of the scanned Pitoti	Geometric features, Measurement & visualization tools	Scaling, Prop-based manipulation, Measurement grid, Relief cutting, Shader lens, Virtual light source	Detailed scans of 'Spaceman' and 'Archer' Pitoti
2.	Two-User 3D Projection Display	A two-user 3D display the collaborative exploration of the scanned Pitoti	Geometric features, Virtual lighting,	Virtual light source, Drawing tool for annotations, Virtual magnifying glass	Detailed scan of 'Spaceman' and 'Archer' Pitoti
3.	Quad-HD Tabletop Display	LCD-monitor with 4X HD resolution. This was set up in table configuration to show the illustrative rendering techniques	Illustrative visualization techniques	Visualization of local engraving depth, Visualization of local surface curvature	Detailed scan of 'Spaceman', 'Archer' & Camunian rose Pitoti
4.	Single-User Quad-HD 3D Display	LCD-monitor with 4X HD resolution. This was setup in vertical orientation with anaglyph stereo	High resolution 3D display	Prop-based manipulation, Virtual light source	Detailed scan of 'Spaceman', 'Archer' & Camunian rose Pitoti
5.	Desktop PC	High resolution real time point cloud visualisation	Raw point scans of valleylandscape and mid-scale rock surface	Basic navigation	Valcamonica Scan, Seradina 12

User feedback on the visualisation technologies was collected by project partners during the individual demonstration activities at each of the displays and during subsequent discussion sessions. Participants also completed a short questionnaire at the end of the workshop to provide us with broader feedback on their thoughts about the usefulness of 3D visualisations of rock-art and whether they felt that multi-user 3D displays could be useful for collaborative analysis.

The main issues related to the use of each of the visualisation technologies within the context of archaeological research and teaching highlighted by the participants are shown below.

1. Multi-user DLP system

Stereoscopic multi-user systems provide multiple users with individual views of a virtual environment. Each user is tracked and can move freely in front of the display while perceiving perspectively correct views of the virtual scene. During the workshop, we showed two 3D detail scans of pitoti that could be switched back and forth. The users could rotate the 3D representation of the rock surface using a large trackball in front of the display. They were further provided with a scaling tool for detailed analysis. A virtual coin was placed on the scan as a reference of scale.


Figure 3-2 Users of the multi-user DLP display

Positive aspects highlighted

- Each user is tracked so you can see the virtual environment from your 'true' view point
- You are able to use your hands to point to things you want to highlight
- The image is compelling
- Users are able to select and highlight individual Pitoti
- Users really appreciated being able to use the 'torch' and pointer to highlight aspects and to help in detailed examination of the Pitoti.

Negative aspects highlighted

- Some users found the 3D glasses uncomfortable to use and for some moving through the virtual environment made them feel dizzy.
- Some of the images were not very sharp
- Some 'ghosting' (fuzzy images) was experienced

Other comments from participants

- Users felt it would be helpful to combine some of the other visualization options from the other demonstrations into this display
- Issues were raised about the size of the data set and the necessary processing and storage capacity of the computers running the system
- Some users wanted to be able to see the individual peck marks in the Pitoti at this level of visualization

2. Multi-user LCD screen

This two-user LCD display is a multi-user stereo system based on shuttered LCD-projectors and polarisation. The combination of these separation techniques allows the presentation of two stereoscopic views on a single projection screen in the same way as the multi-user DLP screen.

During the workshop, we showed two 3D detail scans of pitoti that could be switched back and forth. Instead of global view navigation functionality as provided at the six-user 3D display, we provided our test

users with hand held interaction devices here that could be used as a virtual magnifying glass and a pen for drawing annotations on the virtual 3D rock surface.

Figure 3-3 Users interacting with the multi-user LCD screen

Positive aspects highlighted

- Users felt it was very impressive and found it intuitive to use
- Some felt that it provided a view that they had never seen before
- They liked the drawing function and found it useful to mark points of interest for further exploration with another system.
- Users commented that it would be good for collaboration as users were working together to explore an artefact.

Negative aspects highlighted

- Some found the headset too big
- There were some usability issues with interaction controls. Some found the postures they had to adopt were awkward and they were not able to maintain them for long periods
- Some users found it difficult to keep the image magnifier still and had difficulty with precision interactions.

Other comments from participants

- It would be good to integrate magnifier control into the headset (controls on the side)
- It would be helpful if you could freeze the magnified view.

3. Quad HD table

The quad HD table is a high resolution LCD screen in tabletop configuration. Several users can gather around the device and interact with the 2D content. At the current state of the project, multitouch interaction techniques were not implemented. Instead a team member from BUW operated the application with mouse input.

During the workshop we showed early prototypes of illustrative visualization techniques on this display and discussed possible use cases and user requirements for future developments. More specifically, we showcased a colour-coded depth map and a visualization of surface normal. Both visualization techniques were meant to emphasize small geometric details of the scans. Feedback was collected by observers as shown in Figure 3-4.

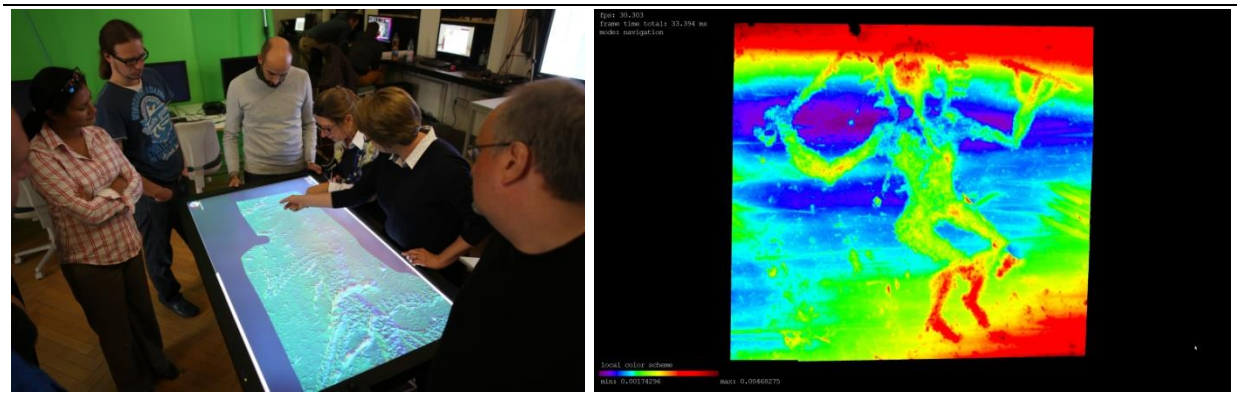

Figure 3-4 Quad HD table demonstration

Positive aspects highlighted

- The colour mapping showing the pecking depth elicited very positive reactions
- The ability to very clearly see filiform images was well received by the participants
- Participants felt the ability to 'paint' the Pitoti would be a useful didactic tool

Negative aspects highlighted

- The data should not be on a flat surface but on a surface formed to represent the contours of the original stone.
- If it is to be used as a multi-user touch table, the ability to freeze views would be useful
- Not many negative things came up – probably because the system was operated by an expert from the BU Weimar, so usability issues with interaction were not explored in any depth.

Other comments from participants

- Scaling to original size would be useful
- Displaying a profile generated from a "cut" through the virtual stone would be useful
- Some participants would like to be able to create and extract ad-hoc histograms and statistics regarding things like pecking density, pecking depth etc
- Some participants commented that they would like to be able to to put an annotation within the rendered image and save this annotation.
- Others felt it would be useful to be able to change the shape of the lens from a circle to a polygon
- Participants felt it would be very useful to be able to save and export images from the system for use in publications
- Others wanted the system to illustrate the angle of the peck marks and to be able to adjust the lighting angle to represent a particular time of day/year.

4. Quad HD stereo

A 56" LCD-Display offering 4 times HD resolution was set up for the visual analysis of the 3D scans. 3D stereo display was implemented based on chromatic colour filters (anaglyph stereo). Users were able to choose between 2D visualization and interactive 3D stereo. In both cases they were able to move and rotate the 3D scanusing a handheld prop that represented the scan. There was a separate hand held 'torch' device which allowed the 3D scan to be lit from different angles as shown in Figure 3-5.

Figure 3-5 Quad HD display

Positive aspects highlighted

- Users liked the flashlight
- Users liked the size of the screen and the exceptionally good image quality, especially as the filiform engravings were easily seen
- Some users found the interaction intuitive
- They appreciated being able to rotate the scan in 360°
- Some users felt it would be very useful in a museum context and the 3D viewing option gave an enhanced experience
- Filiforms show up very well even without the flashlight and some users commented that they could see the images far more clearly than when looking at them on the rocks.

Negative aspects highlighted

- Some users commented that the 3D image (anaglyph stereo) took some time for their eyes/brains to adjust to
- Others commented that there was no reference scale
- Others did not like that it was not a collaborative tool
- Some users found difficulty with navigation and with manipulating the interaction device.

Other comments

- Some participants said they would like to be able to adjust scale and colour (as possible with some of the other visualisation technologies demonstrated) so there would be no need to move to another workstation/display
- One participant commented that it would be very good for Egyptian rock-art as there is strong sunlight all day and so it is very difficult to see the images except at dawn
- Another participant felt it would be good to have no lighting information present by default in the texture, leaving lighting to be entirely user-determined, and to be able to control the specular level of the light source (torch).

5. Standard monitor showing point cloud visualisation

This demo station consisted of a desktop PC with high resolution monitor (2560*1440 px) which showed a real-time point cloud rendering of the raw scanning data from the valley (about 4 billion points), as seen in Figure 3-6. An experimental LOD-based rendering method was used to make the real-time rendering possible.

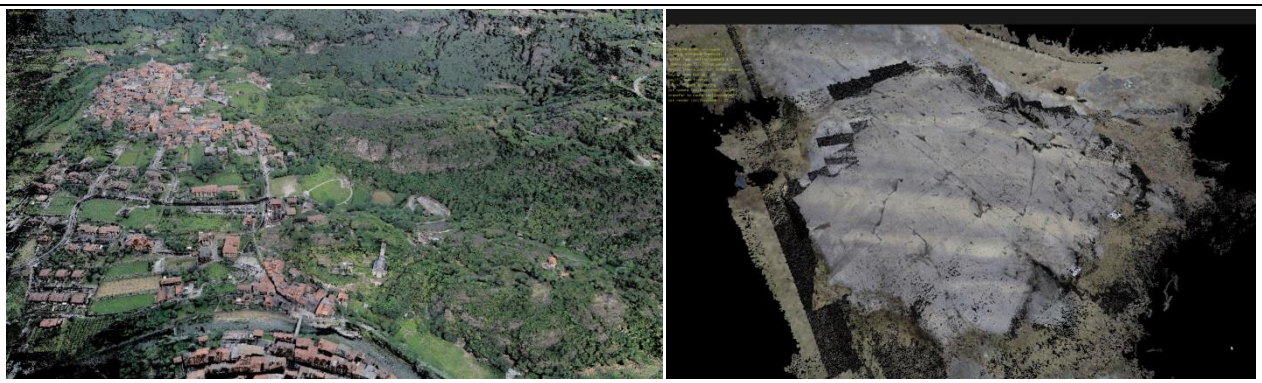

Figure 3-6 Point cloud rendering of raw scanning data

Positive aspects highlighted

- Participants commented that it provided a very fluent display of the large data sets
- They found it useful for visualization on less powerful PCs/consumer PCs

Negative aspects highlighted

- There was no information about ground resolution
- Some participants found the controls not so easy to handle

Observer comments

- Orientation difficult (maybe at least display a compass)
- No “real purpose” for scientific studies, rather background technology
- For archaeologists less impressive, more for technical partners, who know about the difficulty of visualizing such large amounts of data.

At the end of the workshop, the external participants were given short questionnaires to explore their view on using 3D visualisations for analysis of rock-art and on multi-user displays for collaborative analysis. The findings from the questionnaires are summarised below.

Do you consider interactive 3D visualisations of rock-art and similar data beneficial for their analysis?

Yes - 6
No - 0

Q1 What are the benefits?

- Context of macro-structure/geo-information can directly be provided with the detailed scans
- Multi-user discussions using 3D data in combination with data fusion and metadata interpretation
- Visual analysis of an *in situ* object (in case of destruction of the site)
- The scans can be used to support restorations of archaeological artefacts, virtual restorations are an option
- The scalability of the scans (2)
- The ability to vary lighting conditions (2)
- Enables ‘slicing’ of images
- Could be used for the reconstruction of former landscapes
- Enables interactive and collaborative work
- Helps with raising awareness with public presentations
- Allows detailed analysis (depending on data resolution)

- Allows detailed comparisons between panels
- Allows engravings to be seen alongside each other for comparison.

Q2 What are the limitations?

- Scans in the field are often acquired under uncontrolled lighting conditions
- Huge data volumes could lead to resolution and computer performance issues
- Better for recording and presenting data – the analysis apart from micro scale information needs further information to be presented
- Shutter glasses are disturbing
- 3D glasses are cumbersome
- Very costly
- A lot of expert knowledge of the system is needed
- Problems of scale and comparison between figures/panels
- Accounting for curvature of rock face.

Q3. Do you consider illustrative visualisations (highlighting specific parameters like height, curvature etc) beneficial for the analysis and discussion of engraved structures?

Yes - 6
No - 0

Which parameters would you like to highlight? (number of responses are shown in brackets)

- Maximum curvature
- Curvature
- Height (3)
- Depth (4)
- Width (2)
- 3D distances
- Height differences (2)
- Contours (2)
- Different resolutions (level of detail)
- Combination of polygon data and CAD
- Presenting different groups of figures from different stages of exploration or time periods on different levels
- Aspect
- Erosion impact
- Annotation
- Direction of pecking
- Length of peckmarks
- Full range of morphometric data (quantitative analysis of form)
- Frequency
- Creating measurable cross sections though rock-art panels
- It would be useful to show data on histograms as well as on visualisation (CAM).

During the final discussion session, other comments made by participants included that they felt that the technologies would be very good for teaching and for public engagement. Some participants said they would like to be able to 're-create the landscapes from the past' to visualise the environments in which the engravings were created. Some mentioned that the ability to take the data into the field with them would be helpful (e.g. to have 3D scans on mobile phones or tablet PCs) and that the ability to share data for collaborative analysis would help with research and teaching. One of the requirements our workshop participants found most important was a possibility to capture findings they made in the immersive 3D analysis system into more traditional media for the scientific exchange in journal articles and conference proceedings.

3.1.2 Workshop on data processing

Project partners from FHSTP gave a presentation on the planned data processing in the project highlighting the following issues that they will be considering for the data processing and shape segmentation. The topics covered in the presentation were:

1. Segmentation
    a. Highlighting of pecked areas, to see them from a distance
    b. Shape classification e.g. Man, House, Deer, Hunter, Orant, etc
2. Analysis of pecking styles (to be presented visually and numerically) for example:
    a. Frequency
    b. Size
    c. Depth
    d. Slope
    e. Curvature (and change thereof)
    f. Continuity
3. Similarities and differences across multiple dimensions.

A discussion followed as to how the participants felt that data processing and shape segmentation could be used by them in their analysis and research. Feedback from the participants was collected during the discussion and it included the following points:

Data processing

- Participants wanted the data processing to be able to show the density of pecked regions (e.g. using a heat map)
- They need to know areas/figures and also marking practices (e.g. random peck marks) as these may also be interesting
- Participants wanted to be able to ' isolate' figures but were also interested in other surface information
- Scratch marks are interesting and so should be included in the analysis
- "Rubbed out" areas are also interesting
- Participants will want to put a lot of data through the system so the project needs to trial the system on large data sets
- Participants want to be able to put their own images / 3D scans into the system
- They would like the system to tell them what different peck marks and line types are present in a scanned image
- The felt that shape recognition can be good for counting large number of images / types etc.
- The system needs to be able to deal with superimposed images and linked images

- It would be good if the system could distinguish between pecking styles
- Ultimately some participants would like to know whether images were made at the same time or added at different times or created by different people
- Participants want the system to record whether they believe individual images also belong together as a composition
- They would like to be able to record the location of images in relation to the next similar figure/where it is located
- The system needs to allow the users to define a group of figures as constituting a scene e.g. "Two archers".

3.2 Interviews with teachers in the UK and Italy

3.2.1 Artefact-Based Educational Design (ABED)

We approached the exploration of user requirements in the field of education from the perspective of artefact-based educational design (ABED). This approach is developed from Lackovic (2010) and Lackovic, Crook, Cobb, D'Cruz, Shalloe and Eastgate (forthcoming). It also builds on creative cross-curricular pedagogy approaches by Professor Pat Thomson and the University of Nottingham research team and the local artists' team[1].

The main premise of ABED is to organise learning around artefacts with the emphasis on students' interactive engagement with those artefacts with an opportunity to express themselves creatively. Artefacts can range from physical manipulatives and materials (e.g. everyday objects, paper, rope, wire, coloured markers, 2D Pitoti drawings, photographs and so on) to complex 3D environments and their affordances (e.g. 3D-Pitoti environments). Such a kind of learning is seen to be particularly appropriate for museum-school collaboration. It also suggests an educational framework for national heritage sites (such as Valcamonica) could be useful.

Figure 3-7 presents "ingredients"(foci) of artefact-based educational design (ABED). These are not presented in any particular order since this "ordering" depends on the teacher and it is expected that ingredients inform each other. A teacher's planning involves considering this interconnectedness of the ingredients.

[1] http://www.getwet.org.uk/

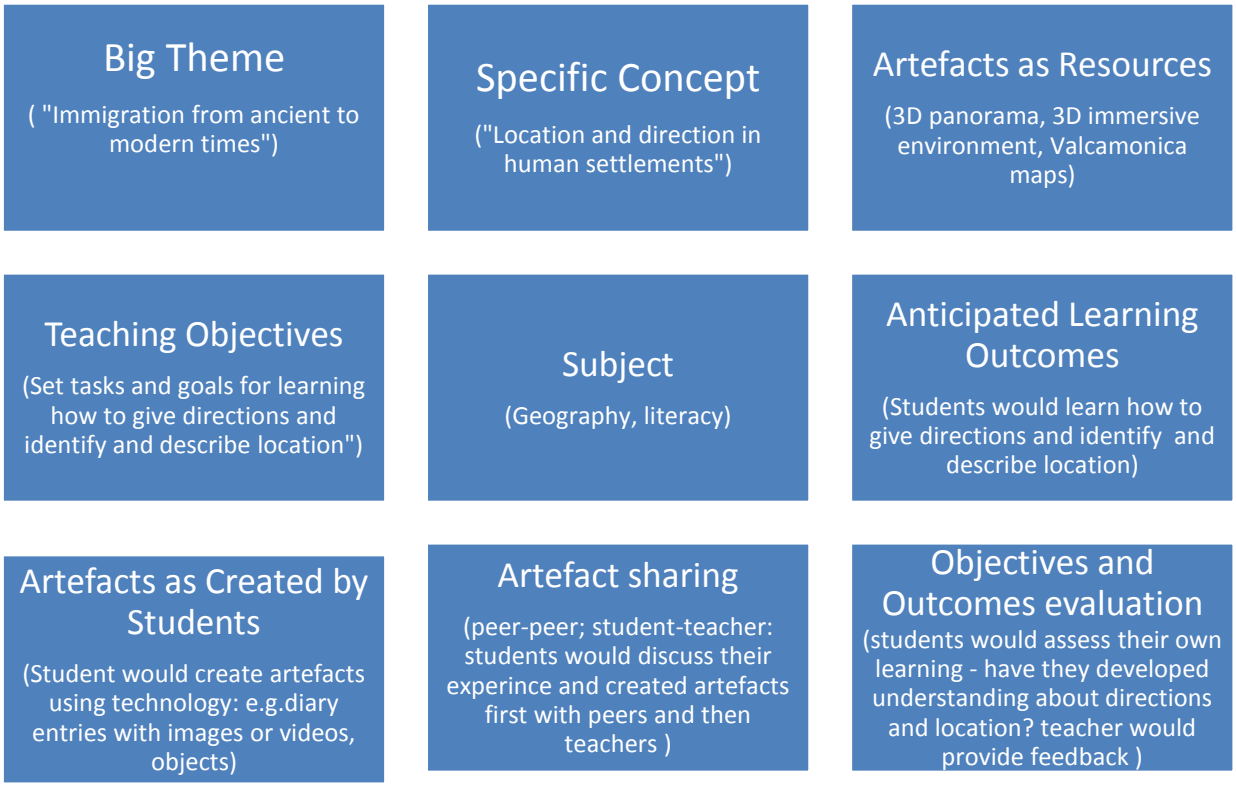

Figure 3-7: Artefact-based educational design ingredients and examples related to Pitoti artefacts

A teacher might be expected to start with a big theme, a subject and teaching objectives, but she/he might also want to start by thinking about the tasks, activities and then decide on the specific concept and objectives. The activity would commonly end with the evaluation part. The framework supports the teaching of more than one subject under one specific concept and multiple subjects under one big theme. Therefore, ABED is a framework for cross-curricular teaching and learning. This framework is envisaged to be the basis on which teachers organise educational activities with 3D technology. Students' interactive experience with 3D technology is at the very centre of this design. ABED serves as an educational framework for students' experience with 2D and 3D artefacts and technology. We developed teacher interviews building on this framework.

3.2.2 Teacher interviews, UK (July to October, 2013)

As a part of defining schoolchildren and teacher requirements relevant to Pitoti artefacts and 3D technologies, we decided to interview a selection of teachers employed within the region of Nottingham and its immediate surroundings. We contacted a selection of 20 teachers who we had access to via University mailing lists. Of these, 12 teachers agreed to participate in an interview which commonly took between 45 minutes and 1 hour 30 minutes, depending on the participant and contextual circumstances.

We obtained ethics approval from the School of Education ethics committee for conducting this research.Therefore we complied with ethical standards as defined by the British Educational Research Association (see ANNEX III: Project information sheet and consent form).

We conducted two sets of interviews in phase 1 and phase 2. Phase 1 aimed to explore teacher-perceived educational benefits for schoolchildren based on cross-curricular teaching and learning relating to Pitoti artefacts (the art and figures). Phase 1 research aims were:

- To identify teachers' resource needs in teaching different subjects
- To understand whether and how the Pitoti theme (prehistoric rock-art and relevant information) and Pitoti-related artefacts can resource inter-disciplinary curriculum and teaching within different subjects.

Phase 2 focused on the potential and use of 3D technologies being developed within the project. Phase 2 added the following research aims to those of Phase 1:

- To suggest what kinds of 3D representations and technologies (e.g. 3D interactive models, 3D panoramic views, 3D televisions, augmented reality) teachers can identify as desirable to help with teaching: What would that technology do?
- To understand whether teachers see any potential and use for the technologies developed within the 3D Pitoti project for teaching and learning across subjects: How would they develop them to meet their needs and enhance the learning experience?

The schedules for the interviews can be found in ANNEX IV: 3D-PITOTI interview schedule.

3.2.3 Teacher interviews, Italy (September to October, 2013)

Archeocamuni educational professionals conducted interviews with teachers in Italy who visited Valcamonica as a part of school educational excursions. Archeocamuni was created in 1989 as a not-for-profit society and then turned into a business company in 1992. Archeocamuni is located in Capo di Ponte (Brescia, Italy),at the entrance of the *Parco* Nazionale delle Incisioni Rupestri di Naquane. Its primary goal is the organisation and management of services (guided tours, educational labs on prehistory and rock art) for schools, tourists and groups coming to Valcamonica to visit the many rock-art sites, in particular the Naquane National Rock-art Park in Capo di Ponte and the other parks in the same area. Among the various groups operating in Valcamonica, Archeocamuni aims to focus primarily on education and the dissemination of knowledge about prehistoric art to schools and children, on the organisation of personalized rock-art trips and on meeting the special needs of overseas visitors (English, French and German speaking guides). Archeocamuni has its own facilities where several kinds of activities take place: labs on rock-art documentation, labs on simulated blacksmithing, labs on simulated archaeological excavation, etc. All the labs take place in Capo di Ponte, a few hundred meters from the main rock-art sites.

Archeocamuni organise visits to the rock-art parks, suggest appropriate labs for the students according to age and educational background,send out educational materials (texts, photos, etc.) to teachers in order to help them get ready for the visit and to use in follow on lessons after the visit. The average number of visiting teachers per year (i.e. a school year: September-June) is between 1200 and 1400. 85% of the visits take place during spring (March-June), while the remaining 15% occur during September-October. The months with the highest presence of schools are April and May (65% of total visits). During the last school year (2012-2013) Archeocamuni hosted visits by 25,000 children.

The interviewers contacted a significant number of teachers prior to their visit to Valcamonica to identify those who would be willing to participate. Eventually, 8 teachers were interviewed on site (prior or after their visits to Archeocamuni and various Valcamonica sites). The interviews took place in October 2013 during the school visits organised at the beginning of the school year (September). The interviews with teachers lasted 30 minutes on average and took place in the offices of Archeomanuni in parallel with the educational activities undertaken by students in the Archeocamuni labs. In two cases the interviews took place at schools.
Archeocamuni followed the same interview schedule as developed for Phase 2 in the case of UK semi-structured interviews, translated into Italian. However, the teachers had a rather limited time to talk with

the aforementioned interviewers, hence some interviews did not cover all the questions and most questions were covered in a style of idea briefing rather than an elaborated answer (commonly between one and a few sentences in response to questions). The responses are still valuable and provide an insight into how teachers in Italy whose schools arranged to send pupils on an excursion to Valcamonica identify needs and opportunities related to Pitoti-artefact based education and 3D technologies.

3.2.4 Summary of results

All the teachers endorsed the educational potential of 3D-Pitoti technology. However, it was also noted that the use of any technology in education, including 3D-Pitoti technology, depended on embedding technology within pedagogical activities and design. As one participant stated:

"Technology isn't revolutionary; it's evolutionary. Whatever teachers have been doing for the last two thousand years they will find a way of working with every new resource you can give them. This (3D immersive environment and touch table) is a superior resource but the pedagogical skills are still there and still necessary. Therefore, the role of the teacher is crucial in facilitating and orchestrating the use of technology to meet educational needs."

The following is a summary of the key points from the discussions with teachers.

1) Source for cross-curricular teaching and learning

The teachers all agreed that the available artefacts related to Valcamonica's rock-art (Pitoti) ranging from 2D pictorial representations and maps to 3D models and environments, can be a useful resource for organising cross-curricular activities at primary school level. They provided examples of pedagogical activities organised around Pitoti artefacts and how they can support teaching and learning across various subjects, notably:

- English and literacy (e.g. descriptive accounts of the environment, storytelling and writing during and after the exploration)
- Art and design (e.g. different kinds of art developed by different kinds of people)
- Information and Communication Technology (ICT)
- History (e.g. everyday life in those times/technological and social development)
- Geography (e.g. environmental changes and transformations, nature, ecology, migration of people)
- Maths (e.g. what ancient people knew about geometry)
- Italian (e.g. language and cultural exchanges)
- Science (e.g. scientific phenomena of the time)
- Physical education
- Music (e.g. prehistoric meaning, dance, musical instruments).

(For further examples, see ANNEX V: Cross-curricular teaching and learning relating to Pitoti artefacts: examples of themes and subjects, for a list of possibilities).

2) 3D technology captures students' imagination and attention

Children at Primary level are very active and most are exposed to computer-based technologies on a daily basis at school and at home through the internet and 2D/3D video games. The teachers felt that the children would enjoy interacting with technologies and 3D. Although one participant noted that the best learning approach would be to combine the use of technologies with the open air and nature.

3) Provides a more constructive learning experience

The use of 3D technologies provides a more constructive learning experience for children, shifting the teacher's role to the one who guides and facilitates self-discovery. One participant noted that organising,

planning and facilitating activities is crucial; group work with or without technology (related to Pitoti or not) is seen by some as one of the best educational strategies.

3.3 On-line questionnaire for archaeologists and researchers

An on-line questionnaire was sent out to the list of contacts from the archaeological field (private companies, universities, state authorities and research institutes in Germany, Europe and worldwide). The questionnaire was designed to collect data on the methods, media and tools respondents were currently using for displaying, analysing and presenting data on their areas of archaeological interest. The data would be used to help understand how the 3D-PITOTI toolkit could help support archaeologists in their work addressing some of the limitations of current methods and tools whilst ensuring that useful features are included. Twenty one responses were received. The types of organisations the respondents worked for are shown in Figure 3-8. Of the respondents who worked for an academic institution, roughly half classified themselves as academic staff and the other half as research staff. All of the participants who attended the workshop in Weimar (WS2) also completed the questionnaire and all the data collected is collated below.

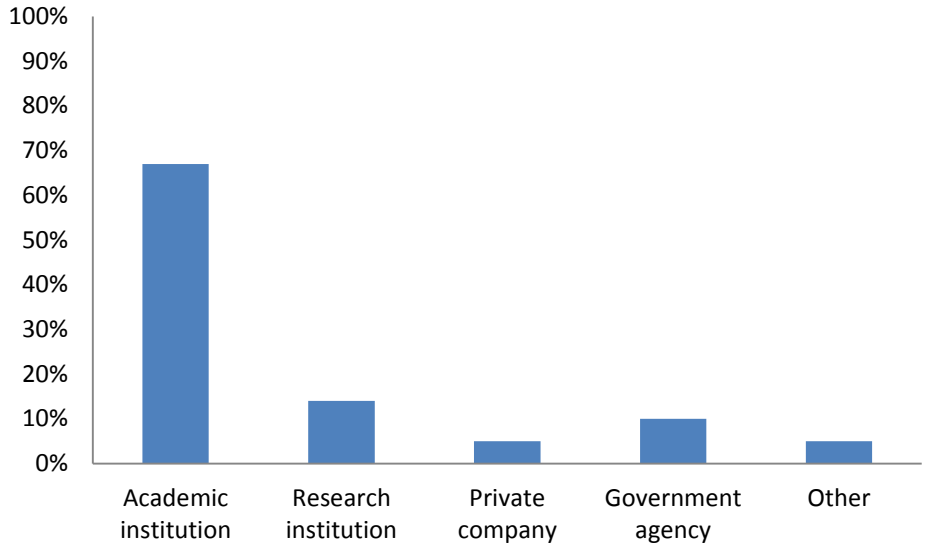

Figure 3-8 Types of institutions respondents worked for

The areas of academic and research interests of the respondents are shown in Figure 3-9

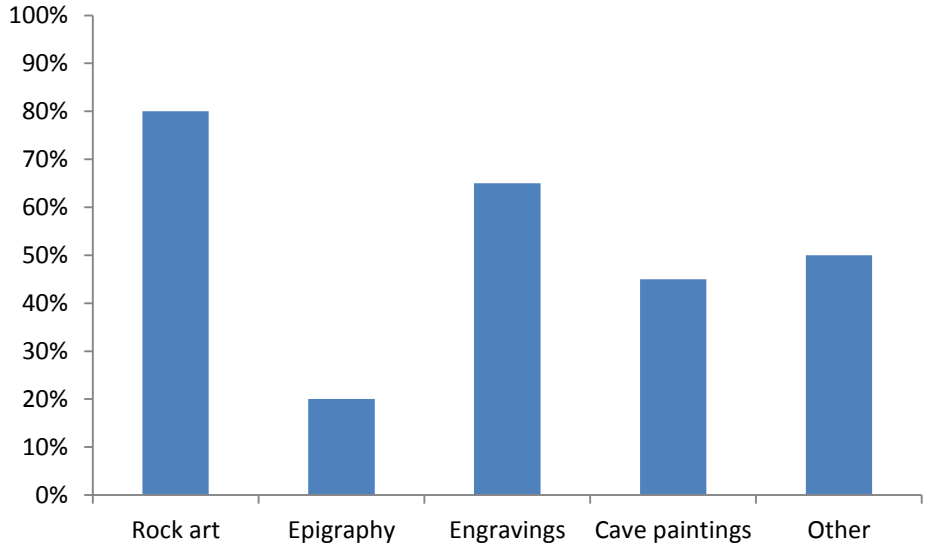

Figure 3-9 Academic and research areas of interest of respondents

The 'other' areas of interest included portable art, 3D documentation on various scales, graffiti, geoglyphs, sculpted stones, mountain archaeology and the context and taxonomy of 'rock' sites. Participants were asked about the methods, media or tools they had used for displaying, analysing and presenting the data about their areas of interest. The results, shown in Figure 3-10 , indicate that photography, photogrammetry and digital scans were most commonly used and 40% also used statistical methods. Other methods used included: tracing, microscopes, reflectance transformation imaging (RTI) and laser scanning.

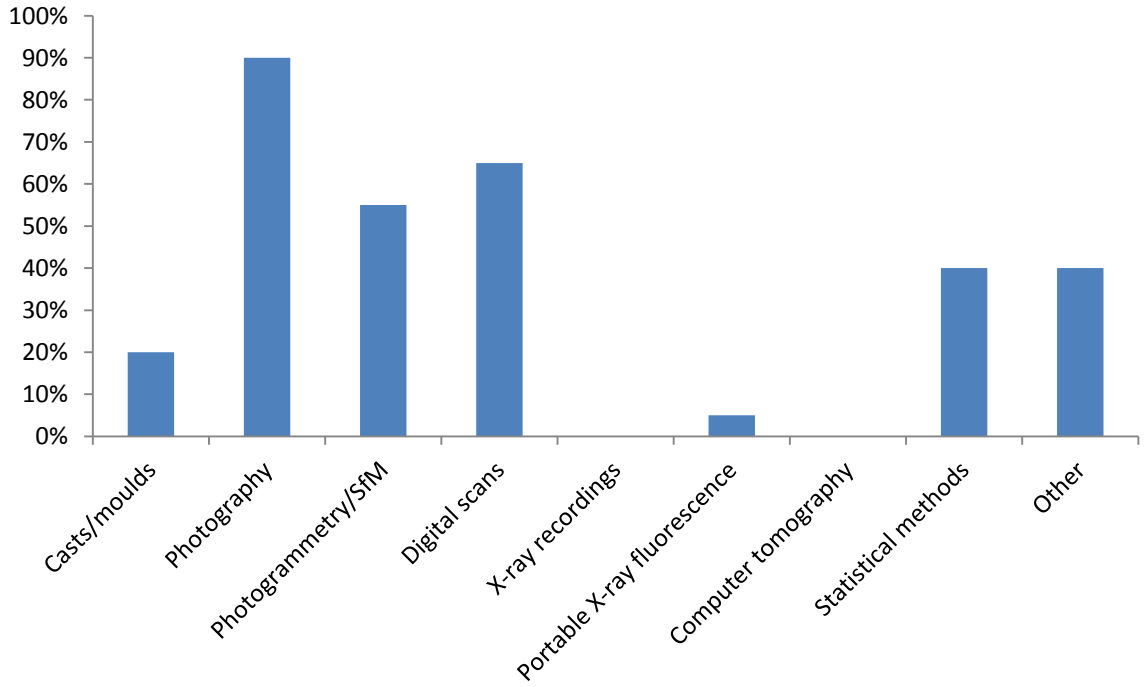

Figure 3-10 Percentage of respondents using each methods or tools

Respondents were asked to rate their levels of satisfaction with a range of attributes of each of the methods and tools they used and to provide any further comments about each method and tool. Ratings were made on a five point scale from 'very dissatisfied' to 'very satisfied'. The attributes assessed were accuracy, room for interpretation, speed of use, ease of use, interweaving of acquisition and analysis, separation of acquisition and analysis and support for teamwork/discussion. The most common findings about each of the tools and methods used are discussed individually below:

- Casts/moulds – the majority of users rated this method as satisfactory for most attributes apart from ease of use which was rated more negatively and speed of use which was rated more positively.
- Photography – the majority of those who used photography rated it as neutral or satisfactory for all of the attributes although the ratings for 'support for teamwork/discussion' and 'separation of analysis and acquisition' were generally rated as neutral or unsatisfactory.
- Photogrammetry / structure from motion (SFM) – again the majority of ratings were neutral or satisfactory on all attributes and one comment received was that it was useful for handling rock-art panels but not the individual engravings themselves.
- Digital scans – respondents generally rated their level of satisfaction with this method as satisfactory or very satisfactory for accuracy, speed of use, separation of analysis and acquisition and support for teamwork/discussion but almost half said they were dissatisfied with the ease of use.
- Portable x-ray fluorescence (pXRF) – only one respondent used this method and was dissatisfied on all aspects of use.
- Statistical methods – almost all of the participants rated the attributes for statistical methods as neutral or satisfactory.

Other methods discussed were tracing and drawings and the benefits of these were their low cost and precision (for tracings). However, it was recognised by those who used these techniques that they were highly subjective and only provided 2D data. A further problem raised with tracings and drawings is that users have to deal with an interpretation which is often based on the available light at the time of recording, the knowledge/skill of the person doing the recording etc. Respondents felt that a way to view the images other than seeing them *in situ* and with different light angles (like in RTI) would be helpful.

Finally participants were asked to rate the relevance of some of the physical characteristics of their data sources to their work. Ratings were made on a five point scale of relevance from 'not at all relevant' to 'very relevant' to their work. The findings are shown in Table 3-3 with the highest number of ratings highlighted.

Table 3-3 Relevance rating of physical characteristics of data (n=17) with the highest number of ratings highlighted.

Question	Not at all relevant (1)	2	3	4	Very relevant (5)
Size of the artwork/engraving	1	1	4	5	6
The location	1	0	0	7	9
Natural lighting conditions	1	2	4	2	7
Surrounding vegetation	3	3	2	4	5
The climate	1	5	5	4	2
Surrounding sites	1	1	6	4	5
Orientation of the artwork/engraving	1	1	6	4	5
Contours of the site	2	2	5	3	5
Depth of the engraving	0	2	3	7	5
3D relief	0	1	5	4	7
Shape of the 'canvas'	0	1	4	6	6
Material of the 'canvas'	0	3	4	4	6
Colour	0	2	1	10	4
Age of the artwork/engraving	1	1	3	6	6

These data show that all of the characteristics listed in Table 3-3 were generally rated as relevant or higher on the rating scale apart from climate, which was rated as either relevant or below. This indicates that archaeologists would find it useful if the 3D-PITOTI toolkit would be able to collect, help with interpretation of and/or display some of these physical characteristics of their data.

3.4 Interviews with museum curators and local government archaeologists

Interviews were carried out in Nottingham with museum curators and local government archaeologists to identify and define requirements for technology development and appropriate presentation delivery methods for a variety of case examples.

3.4.1 Museum curator, UK

The curator of the University of Nottingham Museum of Archaeology was interviewed (INT2) to find out how she thought the 3D public presentation platforms proposed by the project could be used to help museum visitors interpret and interact with the Pitoti figures and the environment in which they occur. At present, the museum carries out significant outreach work with members of the public and local schools. Work with members of the public is through visitors to the University museum and through engagement with local archaeology interest groups such as the East Midlands Section of the British Council for Archaeology. Work with schools includes staff members and students engaging in education based activities using 'hands on' exhibits where children learn about life in previous ages as well as learning about archaeological techniques. Some equipment used for 'hands on' activities is taken out to schools and youth groups as well as being used within the museum space. Activities are designed around learning objectives linked to the national curriculum. The curator has had experience using a touch table at exhibitions to explore cultural heritage resources and felt that it was a very engaging tool. She is keen to explore the use of new technologies within the museum environment with a wide range of users. She felt that new technologies can help improve the accessibility of cultural artefacts to a wider audience through the use of multimedia and web based technologies.

The curator felt that the 3D multi-user touch table and 3D representations of Pitoti on web sites would be of significant help in engaging the public and schoolchildren in learning about Pitoti and the people who made them. A touch table could be located within the museum. Pre-history is covered within Key Stage 2 History and covers both cultures in Britain and the wider world. She also liked the idea of being able to use 3D prints of Pitoti and other engravings as part of multi-sensory exhibits.

3.4.2 Local government archaeologists, UK

Interviews took place with a community archaeologist and an archaeologist at Nottinghamshire County Council (INT3) who has responsibility for the Nottinghamshire Historic Environment Record, a database of information on archaeological sites and finds, historic buildings and historic landscapes in Nottinghamshire. This database forms part of a network of similar records across the United Kingdom and includes sites dating from the Palaeolithic (about 500,000 years ago through to about 12,000 years ago) through to the 20th Century. The archaeology team at NCC aim to encourage people to engage with their cultural heritage and along with hosting public activities and helping other groups organise cultural heritage engagement events. They also aim to increase public involvement in local archaeological activities throughout the county.

The aspects of the 3D-PITOTI project they felt could help significantly in their work were the development of the intelligent data processing and data integration techniques and the development of the rock-art scanner along with the post-processing toolkit. Although there is relatively little engraved rock-art in Nottinghamshire (compared to Valcamonica), there is considerable interest in other engravings such as graffiti in churches, on other public monuments and on natural surfaces. Engraving and graffiti also occur in difficult to access places so scanning and visualisation would allow greater access to the public and researchers. Another area where 3D scanning could be used is for graveyard surveys, especially to help decode hard to read inscriptions due to stone degradation and poor viewing conditions (most gravestones are east facing, so light conditions are sub-optimal). Automatic text/image recognition would be invaluable to help with cataloguing and data could also be used for condition surveys and monitoring. At present they rely on written, subjective descriptions which are often inaccurate. Graveyard surveys/on-line scans would significantly improve public access to family history records which are very important and currently enjoy a lot of public interest. Other points raised by the archaeologists were the opportunities to use 3D scans to bring out more detail for research and analysis, the ability to display 3D data on public websites to help the public visualise cultural artefacts and the possibility of allowing virtual visits to fragile historical sites which are closed to the public.

The final part of the interview explored the use of a smartphone application. The archaeologists said they would welcome a handheld/tablet application that could be used on history/heritage walks to display data such as: objects that had been found in particular locations; 'hidden' structures e.g. the tunnels under Nottingham; items that are hard to see with the naked eye e.g. engravings.

3.5 Data from previous Pitoti related exhibitions and visits to Valcamonica

Data was collected from the project partners who were involved in the exhibitions in Milan, Italy and Cambridge, UK (DAT1) which presented the PITOTI project (www.Pitoti.org) funded by the EC Culture Programme. The exhibition in Milan was held between the 2nd October to 4th November, 2012, at the Triennale di Milano, Triennale Design Museum, Milan, Italy.The exhibition in Cambridge took place on 6th to the 23rd of March at the University Museum of Archaeology and Anthropology, Cambridge, UK as part of the Cambridge Science Festival. The exhibition was then moved to Citta della Cultura, Capo di Ponte, Italy for 15 days. The exhibition was a multimedia digital exhibition wherein the displays showed how the rock engravings were being filmed, photographed, animated, and re-presented in the 21st century with new

digital graphic technologies. In total, 21,100 people visited the exhibition in Milan, 1,830 visited the exhibition in Cambridge and 485 in Capo di Ponte.

The exhibition contained a number of exhibits including a multi-user touch table, panoramic photographs, animations, an ambient cinema exhibit, and a sound based exhibit (see Figure 3-11).

Figure 3-11: Pitoti exhibition

The touch table allowed users to zoom into an image of rock engravings from Seradina, explore the Pitoti which appear on the rock face and access simple games by clicking on specific areas on the interface. The games included: re-creating a Pitoti (jigsaw based game), using arrows and arrow figures to 'shoot' deer and herding oxen using dogs. Further archaeological information about the Pitoti could be accessed by clicking an image of an archaeologist on the screen. The spherical panoramic photographs were displayed on a large screen and could be navigated around using a joystick. Animations of the Pitoti were displayed on screen, running in a loop and the ambient cinema exhibit involved an immersive sound experience of a mixture of documentary film, animation and Pitoti inspired art whilst the sound exhibit showcased sounds made using instruments available in prehistory. Feedback from visitors to the exhibition was very positive, with school groups especially enjoying the interactive touch table exhibits and others stating that they found the whole exhibition very creative.

Visitors to the exhibition in Cambridge left many very positive comments in the visitor's book. These included that the exhibition was very original, interactive and great fun. Many commented that it was an interesting way to explore archaeological artefacts and enjoyed being able to experience something of a site far away in Italy. Many children commented that the games were fun. Visitors appreciated that technology was being used creatively to help them imagine what the engravings represented and to help them see and learn about the tools, weapons and instruments used by people in the past. The use of 3D printing was liked and other visitors commented that they felt the exhibition brought the 'past to life'.

Data on visitor numbers to see the rock-art in situ in Valcamonica, Italy show that across the following sites: Parco Comunale delle Incisioni Rupestri di Luine, Riserva naturale (Ceto, Cimbergo and Paspardo), Parco Nazionale delle Incisioni Rupestri di Naquane, Parco Archeologico Nazionale dei Massi di Cemmo, Parco Archeologico Comunale di Seradina-Bedolina, Parco Comunale Archeologico e Minerario di Sellero and Parco Archeologio Comunale di Sonico, a total of 67,400 people visited during 2012. Of these 33,273 consisted of groups of school children aged between 6 and 17 years and approximately 4,000 were overseas visitors. This data shows that there is a large target group, including children, for any interactive exhibits that may be developed for visitors to Valcamonica and for on-line data to help visitors prepare for their visit and for accessing materials during and after their visit. Hands-on technologies developed in the project will need to be robust enough to cope with large numbers of users and cater for visitors from different countries and of a wide variety of ages.

4 3D-PITOTI Personas and future scenarios of use

Personas are a way to assist developers of technologies to understand the characteristics of typical users of a system (Lawson et al, 2012, Cooper, 1999). They are useful as often the developer is not a typical user and a system might otherwise be designed with usability issues which were not foreseen. They are descriptions which can include an example name, image and user characteristics (e.g. job role, experience, attitudes, competences, etc.). These personas, along with a set of requirements captured from real users, can be used to generate future scenarios of use. These scenarios, illustrating future visions of how the system could be used, are based on the expectations and desires of all the stakeholders involved in the project.

4.1 Archaeologist personas

The example personas selected for the project are based on the expertise within the consortium and the requirements captured. They consist of 2 types of archaeologists – experts in rock-art and experts in landscapes. The scenarios of use are specifically related to their activities when they are off-site or away from the subject they are investigating. We are using the term "user-in-the-lab" to describe these scenarios as it relates to our vision of a 3D-PITOTI scientists' lab (as described in Figure 3-1).

4.1.1 Scenarios of Archaeologist "users-in-the-lab" (A)

Use Case 1 (A_UC1): Use of 3D-PITOTI by rock-art expert for analysis, presentation and publication

Maria[2]

Maria is 53 years old and has been studying rock-art for over 30 years. She is a rock-art expert working in a University. She often uses her work in her lectures but is currently compiling a book on Appenine rock-art. She only has experience of using tracings, photographs and videos to record images but finds the limitations in the amount of fine detail provided to be very frustrating. Such methods also fail to capture the three-dimensionality of the images, particularly the way that they use the natural shape of the rock surface to enhance their impact. She also finds that students - who do most of the tracing work - will often miss finely scratched filiform images on the rock.

Maria is fortunate as she now has access at the University to high definition visualisation tools as provided by 3D-PITOTI. She is able to upload her scanned data acquired from the 3D-PITOTI scanner in the field. The 3D-PITOTI post-processing tool enables her to isolate specific images and features of the surrounding rock "canvas". For example, she is interested in:

- Images of similar shape and size
- Images of people, animals or objects such as houses and wheels
- The co-presence of certain types of image in a particular area of the surface
- The possibility that the images are randomly distributed on the surface
- Better understanding the superimposition of images
- Share and discuss her findings with colleagues
- Publish her findings with illustrative images and scientific proof

Maria is using a large screen high definition monitor to **view two scanned images to compare**. She is investigating whether they might have been produced by the **same person in the same time period.** She is able to view in a **higher resolution and at a closer range** than possible in reality. She can **zoom in and out** of the images and **extract different parts**. She can even **turn the image over** to see its negative as this sometimes can provide better visualisation.

[2] Image courtesy of Stockimages/ FreeDigitalPhotos.net

	Maria visually examines the peck marks using the **virtual magnifying glass to see further detail.** A **heat map of graduated colours** shows her the absolute and relative depth of the markings. **Statistical information in both raw form and as histograms** is provided showing pecking depths and slopes. A **virtual sliding scale** shows the relative size of the image. A **virtual torch** enables her to **add light with various spectral compositions and from various angles** while a **virtual 24 hour clock and calendar** allows her to view the images at different times of the day and year. She is looking for which marks are natural (such as those created by glacial activity) and which have been engraved. She **highlights an area** which she thinks is important with **a virtual marker** and leaves a **small digital note on the scanned image** as a memory aid. These can be **saved as a session** using the file save function. (Later, Maria can **reload this session** to view the notes and discuss with colleagues.) Looking at the highlighted area she decides to **capture as a compressed image** so that she can use it in her publications. Another feature that is of immense help in both analysis and publication is the ability to **overlay existing - sometimes historic - photographs over the 3D imagery** and compare the state of preservation and visibility of the images. Maria wants to know what **type of rock** this was engraved on and any vegetation cover, e.g. moss and lichen. She searches through the **information bank associated with the image** which she has populated through many years of research. This includes: previous sessions of notes; details of the location of this image; previous photos and scans; videos; scholarly references and so on. When discussing with colleagues, Maria finds it useful to use the touch table as many people can gather around and view form many angles. She can reload her previous session with the notes and perhaps **view other people's notes** on the image.

Use Case 2 (A_UC2): Use of large-scale 3D immersive virtual environment by Landscape expert for analysis and presentation

Enrico[3]

Enrico is 35 years old and a landscape archaeologist. He works for a company that undertakes archaeological analyses, usually working with a university or a heritage management body and deploying sophisticated technology to gather 3D data. He has a particular interest in understanding how and why people chose particular locations in the landscape, whether as places to live or as places to make rock-art, and the relationships amongst those two types of places. Whilst Maria's interests typically scan the range from a few square millimetres to a few square metres, Enrico's interests typically span the range from a hectare or so up to many square kilometres.

Enrico's company has purchased the 3D-PITOTI system. Whilst he has little direct use for the scanner itself, the multi-scale 3D landscape visualisation and GIS functionality of the system are immensely useful in his work.

Enrico's company has recently worked with Maria's university on a simple project to map the pitoti in a particular location comprising 6 square kilometres of valley floor and slopes. The main aim was to create a database that allowed the user to query and **display - in both 2D and 3D mode - the location and density of different pitoti image types** across the study area. Obviously this database also allowed the user to study the **temporal evolution of pitoti production sites**. The project also included a simulation mode that showed the **patterns of sunlight and shadow in the valley at different times of day and year**.

The project with Maria's university was slightly unusual in that it involved the use of a pre-existing model of the landscape. More often than not, Enrico and his colleagues have to create their own **digital landscape models**, uploading high-resolution data from **terrestrial laser scanners, aerial photogrammetry and LiD**AR to the 3D-PITOTI system. Once the data are processed and integrated into the **multi-scale** 3D-PITOTI system Enrico's work typically involves the **GIS (Geographical Information Systems) functionality** of the 3D-PITOTI system.

The most basic function - and perhaps the most useful when preparing materials for audiences of non-specialists like the museum-going public - is the **ability to view the territory first as a "normal" 2D map** with contour lines and then to **"grow" this map into a 3D model of the landscape** with **photorealistic detail** which the viewer can **"fly" through using a joystick** controller. The public are also typically intrigued by **viewshed analyses** that show the landscape visible to an observer standing in a particular place. Beyond these very basic functions, the ability to calculate all the **standard landscape variables** - slope, aspect, insolation - and to **identify sites within a given range** of a particular site or landscape feature using either **simple distance or an anisotropic [4]cost-distance measure** is as useful as it is in every other GIS. The 3D-PITOTI system is also tightly **integrated with R**, a leading FOSS statistical package, allowing Enrico to readily employ the powerful geo-statistical functions of that programme.

[3] Image courtesy of Stockimages/ FreeDigitalPhotos.net
[4] Having properties that differ according to the direction of measurement.

4.2 School teacher personas

The types of personas selected for the project are related to children in an educational context and how they would use 3D-PITOTI resources specifically within schools as part of an inter-disciplinary curriculum. The personas are related to teachers in Primary schools as they currently organise activities of cross-curricular nature (Kerry, 2010) more often than in other educational stages, although such approaches to learning could be developed at any level (e.g. Savage, 2010; Barnes, 2011). Cross-curricular teaching and learning organises the teaching and learning of concepts in different subjects around particular broad umbrella themes which are then explored and developed to provide learning experiences which can offer exploration of more than one subject.

Savage (2010, p. 8) defines cross-curricular teaching and learning as:

"…characterised by sensitivity towards, and a synthesis of, knowledge and understanding from various subject areas. These inform an enriched pedagogy that promotes an approach to learning which embraces and explores this wider sensitivity through various methods."

Such themes could be, for example, "the vital importance of water in human lives"[5] , "environmental sustainability", "the sea", "travelling", "food" and so on. In the case of Pitoti, some big themes offered by the participating teachers were: "The human tree", "Participating through art".

We chose two examples of use cases in the UK and three in Italy where we investigated the educational potential of the 3D-Pitoti artefacts to illustrate examples of teachers' needs and vision in terms of the developed 3D-Pitoti technology. The scenarios of use are specifically related to activities as part of the curriculum and therefore we are using the term "user-in-the-classroom" to describe them.

[5] See the project "WET"'s website: http://www.getwet.org.uk/

4.2.1 Scenarios of school teachers "user-in-the-classroom" (T)

Use case 3 (T_UC1): Use of immersive 3D Pitoti virtual environment for **educational design enhancement and cross-curricula teaching**	
Angela[6] 	Angela is a primary school teacher teaching Key stage 2 (ages 7-11). Her school is situated in the suburban area of an English city with the population of roughly 300,000. Angela is 50 and she did her degree in History. She has had 30 years of teaching experience She thinks that particular technology features and pedagogical design (activities) would allow all children and teachers to have a more educational experience with a multi-user immersive 3D computer generated environment. There are 30 children within the classroom, divided into small groups of 5 to enable each child to have some interaction with the technology. Anglela believes that the children would benefit from the following five aspects of using such an environment: 1) Virtual guides The children are guided **through the valley** by a **virtual 'local of the time'** who could give them **instructions of things to do** or **provide information** about the rock carvings. **They use their 3D glasses** and **view a large monito**r. 2) Trail and record leaving Children can use a **digital notepad** so that they can leave **personal or team flags**. This record would not change the environment but the "traces" the children leave can be **recorded and saved** so that they can be discussed later in class. English and Literacy development could benefit from such an immersive environment since children could develop their vocabulary via **descriptive accounts** of the environment, **storytelling** and **writing** during and after the exploration. 3) Creative exploration and environment re-design Angela feels that the children need to **interact with the environment creatively** and need tools **to enhance role playing**, such as playing an archaeologist or being part of a research expedition. The children are guided to a scenario where they have particular tasks to complete. For example, the Pitoti are covered in dust and using a **virtual magnifying glass and brushes** they uncover the Pitoti as part of their discovery. Using a **virtual torch** they can then illuminate parts to see more clearly. Using a **virtual camera** they can capture what they have uncovered and further explore on a table touch screen. 4) Addition of sensations, e.g. haptics, sound, animation and smell Angela believes that an immersive experience could be enhanced with **different sensations**. The children love cinematic experiences, the feeling of "being in a film". In the virtual environment, the children are able to **select different Pitoti** and activate **animated scenes**, **sounds**, **smells** or **feel the rock surface** to understand more about what the image may be portraying. 5) Addition of timelines Angela knows that children experience difficulties in understanding timelines, sequentiality and the properties of particular historical periods. The children are able to **select the virtual timeline** and **visualise the Valcamonica Pitoti environment through the ages** during the prehistoric period, in Roman times or join a Pitoti picnic in the 1930's.

[6] The picture downloaded from http://pixabay.com/; http://creativecommons.org/publicdomain/zero/1.0/

Use case 4 (T_UC2): Use of immersive 3D Pitoti virtual environment for cross curricular teaching via "treasure hunt" game concept

Peter[7]

Peter is 28. He is a Key stage 1 primary school teacher with 3 years of teaching experience. He works as supply teacher at the moment covering schools in the region of Nottinghamshire. He did a degree in archaeology and then completed teacher training.

Peter likes the idea of panoramic view exploration of the environment for teaching English (creative writing) and Geography. He thinks that **annotating the virtual environment** is a good idea. He also thinks that it would be useful for children to develop a possibility for **creation of their own annotations**. He likes the Valcamonica **panoramic view** since most schools would have a white board and a projector to show Pitoti 3 D panorama.

Peter also likes that the Pitoti technologies facilitate **the teacher's role as the guide** of the children's excitement to other learning experiences in a 3D world. He thinks that the children would always need a task challenge. Peter uses the 3D immersive environment for a **treasure hunt** to cover particular syllabus themes in creative writing and geography.

English and literacy: creative writing
The children take **snapshots of things** during the treasure hunt and then explain afterwards why they chose to take the pictures that they did and why they found them interesting; this would all be set in relation to some subject learning/goal. Peter likens this particular opportunity of **3D panorama and immersive setting** to the primary syllabus around *describing settings to encourage descriptive language.*

Geography: Locations and directions
The children immerse themselves and become **familiar with the site and its geographical location as a whole.** It lends itself well to thinking about geography and aspects like 'where does the sun rise?' – 'It rises in the east.' Peter tells the children to walk towards the east and this contextualises the site. Peter asks 'what direction is the river from this point of the site?' That would get children to *understand the geographical location and gain a sense of direction.*

Enhancing children's experience:
Peter's view resonates well with the views of Angela: he also has ideas for features that would enhance students' educational experience: 1) **Possibility for trail and record leaving**: e.g. notepads and 2) the possibility to add sensations: sound and animation. Children's experience would be enhanced with **animation and sounds**; they could have the **sensation of a moving, living environment** and the trees swaying and the sounds of the birds in stereo.

[7] The picture downloaded from www.freedigitalphotos.net, Attribution: by stockimages, published on 19 April 2012 Stock Photo - image ID: 10080536

4.2.2 Scenario of use: Italian Teachers user-in-the-classroom

Use Case 5 (IT_UC1): The use of Pitoti for cross curricular teaching, animated story telling and role playing	
Paola[8] 	Paola teaches all subjects in an elementary school in the city of Turin, one of the big cities in Italy. She is 59 and has taught for 35 years. At the moment she teaches 3 rd year elementary students (8/9 years old). Paola's school is eager to participate in new projects, she jokes that sometimes they are too eager! Her school is a religious school. They have participated in external collaborative projects and she finds the experience interesting and demanding. Paola would like to use Pitoti and 3D technology as long as the use of technology is shaped to meet educational goals; otherwise, the teacher argues, it might trivialise the subject. She would like the children in her class to access the Pitoti content using **iPads or tablets** in a similar manner to the **touch table top**. She would use the content in the following ways: 1) Cross-curricular teaching Paola would **use exploring Pitoti - rock-art** as a starting point to teach all the subjects in school; these subjects can be taught via the idea of how the *Camuni* people lived long ago in Valcamonica. 2) **Film or animated fantasy** stories Children like the 3D quality of technology, especially if it has the quality of a film/animation. Animated (fantasy) stories would be stimulating for children and the film-like quality and definition of the images, their precision and colours. 3) Role playing: The children would **adopt a role of an archaeologist/explorer/scientist**. Children could feel like they are working as professional scholars on these subjects, identifying themselves with the study of prehistory.

[8] The picture downloaded from **www.freedigitalphotos.net**; Attribution: By **stockimages**, published on 16 September 2013 Stock Photo - image ID: 100201705

Use Case 6 (IT_UC2): 3D-PITOTI for Cross-curricular teaching	
Octavia[9] 	Octavia is 50 and teaches in an elementary school in a rural area in the region of Lombardy, not far from Valcamonica. She teaches English, currently to 3 rd year elementary students (8/9 years old). She has taught for 25 years. Octavia's school arranges for their students to visit Valcamonica in collaboration with external organisations (such as Archeocamuni) every year. Her students learn about the Pitoti, the lives of the people who made them and also about archaeological methods through 'hands-on' activities at the Archeocamuni labs and in the parks where they visit the Pitoti. Octavia feels that it is best to mix activities supported by technology with activities in the open-air amid nature; in the case of the Pitoti, to her it seems best to visit Valcamonica and see the pitoti in their natural environment and to do the **technology-supported activities** before and after the visit. Octavia thinks that the way in which students can benefit most form 3D Pitoti technology is by having a chance to see characters they have studied in books and seen on the rocks then **come alive on the screen, in 3D**. She believes this is something that will certainly get children's attention and aid their concentration on the subject. In her elementary school, she does not have 3D televisions or access to more sophisticated technologies so Octavia would like to **access 3D models and scans through the internet** for use before and after the visit to the valley. When taking the children to Valcamonica it is sometimes difficult to get close to the Pitoti due to bad weather. She would like the children to be able to **access more sophisticated 3D technologies** in the labs or in the visitor centre to experience a **virtual visit** when a real one is difficult and also to enable children to **experience other Pitoti which are less accessible**.

4.3 Museum and visitor centre personas

The types of personas selected for the project are related to the general public in an entertainment/leisure context, specifically museum-goers and users of park visitor centres. The personas are related to museum curators in the UK (UNott, CAM) and at the visitor centres in Valcamonica, Italy (CCSP, Archaeocamuni). The scenarios of use are specifically related to potential engagement requirements of 3D-PITOTI resources (e.g. entertainment, edutainment, education) and are described using the term "user-in-the-museum".

[9] The picture downloaded from www.freedigitalphotos.net; Attribution: By photostock, published on 24 June 2011 Stock Photo - image ID: 10046791

4.3.1 Scenarios of Museum curators "user-in-the-museum" (M)

Use Case 7 (M_UC1): 3D-PITOTI interactive touch table for engraved graffiti in UK Museum	
Stella[10] 	Stella is the curator of a Museum of Archaeology in the UK. She studied archaeology at University and worked as a researcher after she graduated. Stella is very keen on using new technologies both within the visitors to her museum and as an archaeologist. Stella also helps out with research and field work with her local archaeology group in her spare time. She is hosting an exhibition exploring the engraved graffiti that occurs in the extensive system of limestone caves under the city. It is known that the caves have been used since the 1st century AD. Some of the caves can be visited but most are under private houses and businesses and are either used for storage or are in an unsafe condition or are otherwise inaccessible. Although the cave system itself has been mapped, the graffiti in the caves has not been catalogued or recorded but holds fascinating insights into the lives of the people who used the caves from the medieval period up to the present day. Using the 3D-PITOTI toolkit she has set up an exhibition about engraved graffiti in caves. Stella has an interactive touch table in the museum into which she can **upload 3D scans** of the graffiti from the caves **along with an interactive map** of the cave network. The 3D scans are already **annotated with the location of the graffiti, the letters and numbers that appear** which have been grouped into dates and recognisable words. Stella and her colleagues, with the help of the local archaeology group, have **annotated the scans with additional data** about what they think the graffiti refers to and information about what the cave was used for in the past. They have also **tagged the scans with links to other documents** about the caves, **images** of the caves themselves and of other **digital artefacts** related to the cave site. When a visitor approaches the touch table, they see a map of the city and can **use finger gestures to zoom** into the map to a particular location where there is a **symbol indicating graffiti**. As they zoom closer in to the location, an image of the cave appears and, as they continue zooming in, they can see the image of the graffiti. They can **select the graffiti image** by tapping on it and the 3D scanned image appears. The visitor can **use touch gestures to rotate the image and also select a virtual 'torch' to shine on the scanned image to highlight the engraving**. The visitor can also access a **search function** and use an on-screen keypad to search for a particular word or date. All of the 3D scans which have the word or date appearing in them are **highlighted on the map** of the city as coloured icons. The visitor can then explore them in turn visually and have an option to save the results of their search as a document which they can upload to their **smartphone using Bluetooth or wireless technology**. Visitors could also **create a 3D print** of an engraving if they wished. Stella has also developed a **web site** where visitors can **download the 3D models** of the scanned graffiti, **search** for words and numbers and have the results returned either as an annotated list or highlighted on a map of the city. Users of the web site can download the map they have created to use when visiting the city. Users can also download a **smartphone app** which shows visitors the **location of graffiti close to their location** and enables them to **access the 3D model and associated data**. Stella would also like to be able to host an exhibition about the Pitoti which occur in Valcamonica, Italy so the touch table exhibit should be **configurable to allow the use of other data**. In North Nottinghamshire there are caves which contain prehistoric engraved rock-art and Stella would like to be able to add in more 3D data to use with the touch table which would allow visitors to explore scans and to compare this to the art in Valcamonica.

[10] Image courtesy of stockimages at www.freedigitalphotos.net

Use Case 8 (M_UC2): 3D-PITOTI for edutainment at Italian visitor's centre

Domenico[11]

Domenico is the curator of the new visitor centre in Valcamonica. He studied history at University then did a master's degree in museum studies. He is keen to embrace new technologies and wants to encourage more people to visit the area. Domenico is very interested in how to engage visitors to learn more about the area, the Pitoti and the lives of the people who made them. He expects to have a large number of visitors to the centre each year, half of which will be parties of schoolchildren. Others include university students, academics and researchers along with the general public. He wants to make sure that the exhibits in the visitor centre are robust and cater to the varying needs of the visitors e.g. to facilitate education through play but also to support serious academic study. He wants to be able to allow all visitors to explore the Pitoti and the environment in which they occur especially when physical access to the rocks is difficult: for example, if the weather is bad or if the visitor is less physically able to reach the sites. In these cases the visitor can experience the rock-art sites using 3D technology.

Domenico wants to support the work of teachers who bring the students to Valcamonica to visit the Pitoti with activities that meet the requirements of their curriculum subjects but also to allow students to explore the Pitoti for themselves and bring elements of creativity and fun to the visitors centre. He believes that 'hands-on' exhibits are important in helping people engage with the material and also in helping visitors to enjoy their visit. Domenico also recognises that for academics and researchers, the visitors centre can be an important resource for more in-depth study and hopes that the centre will be home to an extensive archive of materials, including images, scans, maps and photographs relating the region.

When people come to the visitor centre, they will be able to use **touch tables**, a 3D **multi-user virtual reality system** and individual **high definition screens** to learn about the Pitoti and the areas in which they occur. If there are large numbers of schoolchildren due to visit, Domenico will be able to load in a number of **interactive games** which allow the children to interact with **3D scans** of Pitoti using a **range of touch gestures**. Games will include **grouping the Pitoti into particular themes** (e.g. farming or hunting) and **making them 'move'**. The children will be able to use tools to **change the colour** of the Pitoti, **adjust the lighting** and **rotate the scanned images**. Other interactive displays will allow groups of visitors to virtually visit a number of the rock-art sites in the valley using 3D multi-user virtual reality system. They will be able to **choose which site** to explore and will be able to travel through the virtual environment, seeing other landmarks and Pitoti on the way. They will be able to **select particular Pitoti** to explore in depth.

Domenico would like the exhibits to show the Pitoti in a **range of lighting and weather conditions**, mimicking real life and also to enable users to explore the Pitoti themselves by **adjusting the viewing conditions**. He would also like exhibits which show **the valley and the locations of the Pitoti** and would **allow visitors to explore the area virtually**. **The exhibits must be accessible for everyone**. The web site for the visitors centre should provide content to help encourage people to visit the valley and the centre by providing examples of the Pitoti and a 'taster' of some of the exhibits. Academics and researchers visiting the centre should be able to access the archive of materials which should include **3D models of the Pitoti.** Domenico would like visitors to be able to **download a smartphone application** for them to use whilst visiting the rock-art sites so they can access more detailed information about the Pitoti and access **interactive maps to guide them to other rock-art sites** in the area.

[11] Image courtesy of stockimages at www.freedigitalphotos.net

5 Conclusions

This deliverable provides a resource for the consortium outlining current practices in archaeological research related to Pitoti, as well as presenting future scenarios for the target user groups – archaeologists, school children and museum visitors – as they employ the visualisation tools to carry out a variety of activities.

Following a review of relevant literature (presented in section 2), a list of methodologies used to capture requirements was outlined in Section 3. This included: two workshops (WS1, WS2), 18 interviews with teachers from the UK and Italy (INT1 - 16, INT2, INT3), analysis of visitor data from previous exhibitions (DAT1) and an on-line questionnaire (QN1). The results of these methods were summarised with the key findings highlighted.

These findings were used to compile the future scenarios for our target groups – archaeologists, schoolchildren and museum visitors – reported in Section 4. The personas for archaeologists were selected based on our consortium members and the participants of the archaeology workshop (WS2). For the scenarios related to schoolchildren, the personas of teachers have been used to describe how pitoti and 3D technologies could be used in a classroom. For scenarios related to museum visitors, the personas of museum curators have been used to describe how the pitoti content and the technology could be used as part of an exhibition. These future scenarios enable the technology developers to understand how the target users might use the pitoti and 3D technologies. From these scenarios a number of use cases have been highlighted as follows:

Use Case 1 (A_UC1): Use of 3D-PITOTI by rock-art expert for analysis, presentation and publication
Use Case 2 (A_UC2): Use of large-scale 3D immersive virtual environment by landscape expert for analysis and presentation
Use Case 3 (T_UC1): Use of immersive 3D Pitoti virtual environment for educational design enhancement and cross-curricula teaching
Use Case 4 (T_UC2): Use of immersive 3D Pitoti virtual environment for cross curricular teaching via “treasure hunt“game concept
Use Case 5 (IT_UC1): The use of Pitoti for cross curricular teaching, animated story telling and role playing
Use Case 6 (IT_UC2): 3D-PITOTI for cross-curricular teaching
Use Case 7 (M_UC1): 3D-PITOTI interactive touch table for engraved graffiti in UK museum
Use Case 8 (M_UC2): 3D-PITOTI for edutainment at Italian visitor’s centre

Within these use cases, a number of requirements can be extracted. These are presented in Table 5-1 below.

Table 5-1: List of requirements by use case.

Use case title	Source of information	Requirements
A_UC1: Use of 3D-PITOTI by Rock-art expert for analysis, presentation and publication	WS1, WS2, QN1	• View two or more scanned images to compare • Identify the same artist in the same time period • View at higher resolution • View at closer range • Zoom in and out of the images • Extract different parts. • Turn the image over • Use a virtual magnifying glass to see further detail. • A heat map of graduated colours shows her

		the absolute and relative depth of the markings. • Statistical information in both raw form and as histograms. • Virtual sliding scale shows the relative size of the image. • A virtual torch to add light with various spectral compositions and from various angles • Virtual 24 hour clock and calendar highlights an area a virtual marker • Add a digital note on the scanned image • Save interaction as a session • Reload a session • Capture data as a compressed image • Overlay existing photographs over the 3D imagery • Know the type of rock, vegetation cover etc e.g. moss and lichen • Access information bank associated with the image • View other people's notes on the image
A_UC2: Use of large-scale 3D immersive virtual environment by landscape expert for analysis and presentation	WS1, WS2, QN1	• Database that allowed the user to query and display - in both 2D and 3D mode - the location and density of different pitoti image types • Study the temporal evolution of pitoti production sites. • Simulation mode that showed the patterns of sunlight and shadow in the valley at different times of day and year. • Create own digital landscape model using high-resolution data from terrestrial laser scanners, aerial photogrammetry and LiDAR • Multi-scale system • GIS (Geographical Information Systems) functionality • Ability to view the territory as a 'normal' 2D map with contour lines • 'Grow' this map into a 3D model of the landscape • Photorealistic detail • 'Fly' through using a joystick controller • Viewshed analyses to show the landscape visible to an observer standing in a particular place • Ability to calculate all the standard landscape variables - slope, aspect, insolation • Identify sites within a given range using simple distance or an anisotropic[12] cost-distance measure • Integrated with R, a FOSS statistical package

[12] Having properties that differ according to the direction of measurement.

T_UC1: Use of immersive 3D Pitoti virtual environment for educational design enhancement and cross-curricula teaching	INT1.1 – INT1.8	• Be guided through the valley by a virtual 'local of the time' to provide information • Use their 3D glasses and view a large monitor. • Digital notepad function • Add personal or team flags that can be recorded and saved • Add descriptive accounts • Interact with the environment creatively • Tools to enhance role playing, such as playing an archaeologist • Virtual archaeology tools e.g. magnifying glass, brushes • Virtual torch • Virtual camera • Addition of sensations, e.g. haptics/touch, sound, animation and smell • Include a virtual timeline to visualise the Valcamonica Pitoti environment through the ages
T_UC2: Use of immersive 3D Pitoti virtual environment for cross curricular teaching via "treasure hunt" game concept	INT1.1 – INT1.8	• Ability to annotate the environment creation of their own annotations • 2D panoramic view of environment • Treasure hunt to help learning • Snapshots of things • 3D panoramic view and immersive setting • Show geographical location as a whole e.g. where sun sets and rises, compass settings etc. • Possibility for trail and record leaving • Include animation and sounds
IT_UC1: The use of Pitoti for cross curricular teaching, animated story telling and role playing	INT1.9-INT1.16	• Access the Pitoti content usingor tablets in a manner of a touch table top. • Create a film or animated fantasy • Users can adopt a role of an archaeologist/explorer/scientist
IT_UC2: 3D-PITOTI for Cross-curricular teaching	INT1.9-INT1.16	• Technology-supported activities before and after • Access 3D models and scans through the internet access more sophisticated 3D technologies • Virtual visit • Experience other, less accessible, Pitoti • Have accessible exhibits and media
M_UC1: 3D-PITOTI interactive touch table for engraved graffiti in UK Museum	INT2, INT3	• Upload 3D scans with an interactive map into touch table • Scans annotated with their location • Be able to annotate/tag the scans with additional data • Tag the scans with links to documents, images and other digital artefacts • Use finger gestures to zoom • Display a symbol indicating engraving location on map • Select the graffiti image and the 3D scanned image appears.

		• Use touch gestures to rotate the image • Virtual 'torch' to shine on the scanned image to highlight the engraving • On-screen keypad and all results are highlighted on the map • Save the results of their search as a document which they can upload to their smartphone using Bluetooth or wireless technology. • Create a 3D print of an engraving • Download 3D models from web site • Access the 3D model and associated data through the web • Smartphone app to show location of graffiti close to their current location • Touch table to be configurable to allow the use of other data.
M_UC2: 3D-PITOTI for edutainment at Italian visitor's centre	INT2, INT3	• A 3D multi-user virtual reality system individual high definition screens • Interactive games to allow the children to interact with 3D scans • Use a range of touch gestures on touch table • Games to include grouping the Pitoti into particular themes e.g. farming or hunting and making them 'move'. • Virtual tools to change the colour of the Pitoti • Able to adjust the lighting on images • Rotate the scanned images. • Choose which archeological site to explore • 'Travel' through the virtual environment, seeing other landmarks and Pitoti • Select particular Pitoti to explore in depth • Show Pitoti in range of lighting and weather conditions, • Users to adjust viewing conditions • Show the valley and the locations of the Pitoti • Technology able to be used by everyone • Smartphone application to access interactive maps to guide visitors to the rock-art sites and provide information

These requirements will be discussed amongst the consortium members and prioritised to determine which will be developed within the scope of the project. This will be reported in D1.2 Specification of 3D-PITOTI system, and the assessment criteria for success in meeting these aims will be reported in D6.1 Evaluation methods and plan (both submitted in Feb, 2014).

References

ALEXANDER, C. 2008. The Bedolina map – an exploratory network analysis. In: POSLUSCHNY, A., LAMBERS, K. & HERZOG, I. (eds.) Layers of perception: proceedings of the 35th international conference on Computer Applications and Quantitative Methods in Archaeology (CAA), Berlin, Germany, April 2-6, 2007. Bonn, Germany: Dr Rudolf Habelt GmbH.
ALEXANDER, C. 2011. Valley of Pitoti: GIS-based socio-spatial analysis of rock-art in Valcamonica (BS), Lombardy, Italy. Ph.D, University of Cambridge.
ANATI, E. 1960a. La civilisation du Val Camonica, Paris, France, Arthaud.
ANATI, E. 1960b. La Grande Roche de Naquane, Paris, Masson.
ANATI, E. 1964. Camonica Valley: a depiction of village life in the Alps to the birth of Christ as revealed by thousands of newly found rock carvings, London, UK, Jonathan Cape.
ANATI, E. 1966. Rapporto. Bolletino del Centro Camuno di Studi Preistorici, 2, 23-42.
ANATI, E. 1974. Methods of recordings and analysing rock engravings. In: MARSTRANDER, S. (ed.) Acts of the International Symposium on Rock Art: lectures at Hankø 6-12 August, 1972. Oslo: Universitetsforlaget.
ANATI, E. 1975. Evoluzione e stile nell'arte rupestre camuna, Capo di Ponte, Edizioni del Centro.
ANATI, E. 1976. Metodi di rilevamento e di analisi dell'arte rupestre, Capo di Ponte, Edizioni del Centro.
ARCÀ, A. 2000. Agricultural landscapes in Neolithic and Copper Age engravings of Valcamonica and Mt. Bégo rock art. In: NASH, G. (ed.) Signifying place and space: world perspectives of rock art and landscape. Oxford, UK: Archaeopress.
ARCÀ, A. 2005. Archeologia rupestre in Valcamonica: Dos Cüi, un caso di studio. Rivista di Scienze Preistoriche, 40, 323–384.
ARCÀ, A., CASINI, S., DE MARINIS, R. & FOSSATI, A. 2008. Arte rupestre, metodi di documentazione: storia, problematiche e nuove prospettive. Rivista di Scienze Preistoriche, LVIII, 351-384.
BARNES, J., 2011. *Cross-curricular learning 3-14*, Sage Publications.
BASSI, S. 2008. Le incisioni rupestri storiche di Carona (Bergamo). La roccia 1 di Le Torbiere. Notizie Archeologiche Bergomense, 16, 249–278.
BAZZANELLA, M., PISONI, L. & TONIUTTI, L. 2012. Montagne dipinte: le scritte dei pastori fiemmesi tra etnoarcheologia e studi dicultura materiale. Archeologia Postmedievale.
BEVAN, L. 2006. Warriors and worshippers: reconstructing gender and gender relations in the prehistoric rock art of Naquane National Park, Valcamonica, Brescia, northern Italy, Oxford, UK, Archaeopress.
BRADLEY_Skoglund_Wehlin_2010_CSA.pdf>.
BRAHIC, C. 2013. Virtual traveller: Beam a live, 3D you into the world. London, New Scientist April Issue Nr. 2912
BREUIL, H. 1952. Quatre cents siècles d'art pariétal; les cavernes ornées de l'âge du renne, Montignac, Dordogne, Centre d'études et de documentation préhistoriques.
CERVÍCEK, P. 1976. Catalogue of the rock art collection of the Frobenius Institute, Wiesbaden, Steiner.
CHIPPINDALE, C & BAKER, F. 2012. PITOTI. Digital rock-art from prehistoric Europe: heritage, film, archaeology. Arte rupestre digitale dell'Europa prehistorica: beni culturali, film, archaeologia. Milano, Skira Editore
COBB, S., SHALLOE, S. and D'CRUZ, M. (2013) D8.1 Kick-off meeting, Valcamonica: Organisation and outcomes of the first project meeting. Public deliverable D8.1 of the FP7 EU-funded project 3D-PITOTI (ICT-600545) http://www.3d-Pitoti.eu.
COOPER, A. (1999) The Inmates are Running the Asylum. SAMS, 1999
DE MARINIS, R. 1988. I Camuni. In: PUGLIESE CARATELLI, G. (ed.) Italia omnium terrarum alumna - la civiltà dei Veneti, Reti, Liguri, Celti, Piceni, Umbri, Latini, Campani e Iapigi. Milano (MI), Italy: Libri Scheiwiller
EGGER, U., M. SEIDL, P. JUDMAIER, F. BAKER, C. CHIPPINDALE, M. GRUBINGER, N. JAX, G. SEIDL, and C.
FOSSATI, A. 1991. L'Età del Ferro nelle incisioni rupestri della Valcamonica. In: LA GUARDIA, R. (ed.) Immagini di una aristocrazia dell'Età del Ferro nell'arte rupestre Camuna. Milano (MI), Italy: Comune di Milano, Settore Cultura e Spettacolo, Raccolte Archeologiche e Numismatiche.

FOSSATI, A. 1993. Discovery of pictographs in Valcamonica. International Newsletter on Rock Art (INORA), 6, 1.
FOSSATI, A. 2002. Landscape representations on boulders and menhirs in the Valcamonica-Valtellina area, Alpine Italy. In: NASH, G. & CHIPPINDALE, C. (eds.) European landscapes of rock-art. London, UK: Routledge.
FOSSATI, A. 2008. Following Arianna's thread: symbolic figures at female rock art sites at Naquane and In Valle, Valcamonica, Italy. In: NASH, G. & CHILDREN, G. (eds.) The archaeology of semiotics and the social order of things. Oxford, UK: Archaeopress.
GASTALDI, C. 2009. Le Chiavi. In:SANSONI, U. & GAVALDO, S. (eds.) 2009a. Lucus rupestris: sei millenni d'arte rupestre a Campanine di Cimbergo, Capo di Ponte (BS), Italy: Edizioni del Centro.pp. 363-366
GOLDHAHN, J. 2008. Rock art studies in northernmost Europe, 2000–2004. In: BAHN, P. G., FRANKLIN, N. & STRECKER, M. (eds.) Rock Art Studies – News of the World 3. Oxford: Oxbow Books.
KARNAPKE, M. 2012. Human computer interaction for the digital representation of cultural heritage.
KERRY, T., 2010. *Cross-curricular teaching in the primary school: Planning and facilitating imaginative lessons*, Taylor & Francis US.
KREN, M. ,BAKER, F. & CHIPPINDALE C. 2012. Pitoti – Eine Bewegungsanalyse der prehistorischen Felskunst von Valcamonica anhand von Animation und Grafik. Wien, Mitteillungen der Anthropologischen Gesellschaft in Wien (MAGW) Band 142, S. 1-28.
LACKOVIC, N. (2010) 'Creating and reading images: towards a communication framework for Higher Education learning' Seminar.net - *International Journal of Media, Technology and Lifelong Learning*, 6(1) Link:http://seminar.net/index.php/home/75/134-creating-and-reading-images-towards-a-communication-framework-for-higher-education-learning.
LACKOVIC, N, CROOK, C., COBB, S., SHALLOE, S., D'CRUZ, M. And Eastgate, R (forthcoming) "Artefact-based educational design: embedding artefacts and 3D technology in teaching and learning", to be submitted to British Journal of Educational Technology.
LAWSON, G., HERMAWATI, S., D'CRUZ, M., COBB, S. and SHALLOE, S. (2012) Human Factors research methods in the design and evaluation of applied virtual environments. Tijdschrift voor Ergonomie: (Dutch Journal of Ergonomics). 37(3), 5-10.
MARRETTA, A. 2006. Scoperta di due nuove rocce con "composizioni topografiche" nel Parco Archeologico Comunale di Seradina-Bedolina. B. C. Notizie (Notiziario del Centro Camuno di Studi Preistorici), 2006, 30-40.
MARRETTA, A. 2007. Forma, funzione e territorio nell'arte rupestre camuna: il caso delle figure ornitomorfe. In: ANATI, E. (ed.) XXII Valcamonica Symposium: rock art in the frame of the cultural heritage of mankind. Capo di Ponte (BS), Italy: Edizioni del Centro.
MARRETTA, A. 2009a. Appunti per una storia delle ricerche sull'arte rupestre della Valcamonica. In: AA.VV. (ed.) Valcamonica preistorica, un patrimonio dell'umanità (catalogo della mostra). Capo di Ponte: Edizioni del Centro.
MARRETTA, A. 2009b. Il Coren di Redondo (Capo di Ponte, Valcamonia): alcuni dati preliminari su una nuova area con incisioni rupestri del versante occidentale. In: ANATI, E. (ed.) XXIII Valcamonica Symposium 2009: making history of prehistory - the role of rock art. Capo di Ponte (BS), Italy: Edizioni del Centro.
MARRETTA, A. 2009c. Il Coren di Redondo (Capo di Ponte, Valcamonica): alcuni dati preliminari su una nuova area con incisioni rupestri del versante occidentale. In: ANATI, E. (ed.) XXIII Valcamonica Symposium 2009: making history of prehistory - the role of rock art. Capo di Ponte (BS), Italy: Edizioni del Centro.
MARRETTA, A. 2011. L'arte rupestre del Coren di Redondo (Capo di Ponte, Valcamonica): novità e conferme dall'analisi integrale di un'area del versante occidentale. In: ANATI, E. (ed.) Valcamonica Symposium 2011 (preatti). Capo di Ponte: Edizioni del Centro.
MARRETTA, A. & SOLANO, S. 2009. Pagine di pietra: iscrizioni e raffigurazioni a Berzo Demo, Loc. Loa (Valcamonica). In: ANATI, E. (ed.) XXIII Valcamonica Symposium 2009: making history of prehistory - the role of rock art. Capo di Ponte (BS), Italy: Edizioni del Centro.
MILSTREU, G. & PRØHL, H. 2009. Kalleby, Finntorp, Ryk, Tanumshede, Tanums Hällristningsmuseum Underslös.
POGGIANI KELLER, R. (ed.) 2009a. La valle delle incisioni, Brescia (BS), Italy: Tipografia Camuna.

POGGIANI KELLER, R. (ed.) 2009b. La Valle delle Incisioni: 1909-2009 cento anni di scoperte, 1979-2009 trenta anni con l'UNESCO in Valle Camonica (catalogo della mostra), Brescia: Palazzo Martinengo.
POGGIANI KELLER, R., LIBORIO, C. & RUGGIERO, G. 2007. Arte rupestre della Valle Camonica - Sito Unesco n. 94: 2005- Piano di Gestione, Bergamo, Soprintendenza per i Beni Archeologici della Lombardia.
PRIULI, A. 2006. Incisioni rupestri della Val Camonica, Scarmagno (TO), Italy.
RIVETTA, G. 1966. La roccia del Dos Cui di Nadro. BCSP (Bollettino del Centro Camuno di Studi Preistorici), 1, 55-64.
SANSONI, U. 1987. L'Arte rupestre di Sellero, Capo di Ponte (BS), Italy, Edizioni del Centro.
SANSONI, U., GAVALDI, S. & LORENZI, R.A. 1993. Medioevo sulla roccia. Archeologia Viva vol. XII, no. 40, pp. 33-38, 45-47 .
SANSONI, U. & GAVALDO, S. 1995. L'Arte rupestre del Pià d'Ort - la vicenda di un santuario preistorico Alpino, Capo di Ponte (BS), Italy, Edizioni del Centro.
SANSONI, U. & GAVALDO, S. (eds.) 2009a. Lucus rupestris: sei millenni d'arte rupestre a Campanine di Cimbergo, Capo di Ponte (BS), Italy: Edizioni del Centro.
SANSONI, U. & GAVALDO, S. 2009b. Lucus rupestris: sei millenni d'arte rupestre a Campanine di Cimbergo, Capo di Ponte, Edizioni del Centro.
SAVAGE, J., 2010. *Cross-Curricular Teaching and Learning in the Secondary School*, Taylor & Francis US.
SEIDL, M., P. JUDMAIER, F. BAKER, C. CHIPPINDALE, U. EGGER, N. JAX, C. WEIS, M. GRUBINGER, and G. SEIDL, 2011 "Multi-touch Rocks: Playing with Tangible Virtual Heritage in the Museum – First User Tests", *VAST11: The 12th International Symposium on Virtual Reality, Archaeology and Intelligent Cultural Heritage - Short Papers*, Prato, Italy, Eurographics Association, pp. 73-76, 2011.
WALD, C. 2011. Revived echoes augment research results. London, New Scientist. Issue 2834. 12th October.
WAPPEL, A. 2012. Ambient Cinema. Eine Analyse am Beispiel des Filmes Pitoti. Diplom Arbeit. University of Applied Sciences, St Pölten.
WEYERSBERG, M. 1938. Felsbilder im Valcamonica. In: WEYERSBERG, M. & SCHULZ, A. (eds.) Vorgeschichtliche Südeuropas. Frankfurt am Main: Institut für Kulturmorphologie
VON DER GÖNNA, C. 2013 Interview with prize-winner Marcel Karnapke. Bauhaus Journal 2012/2013. Weimar, Bauhaus Universität.

SCHAICH, M., REIMER, K., JAHNKE, P., RAHRIG, M., PINZ, A., HOLLER, G., ALEXANDER, C. (2013) Requirements of the 3D Pitoti Scanner. Confidential Deliverable D2.1 of the European Seventh Framework project 3D-PITOTI (ICT-2011-600545) http://3d-pitoti.eu/WEYERSBERG, M. 1938. Felsbilder im Valcamonica. In: WEYERSBERG, M. & SCHULZ, A. (eds.) Vorgeschichtliche Südeuropas. Frankfurt am Main: Institut für Kulturmorphologie
ZEFINETTI, E. C. & PEVERELLI, P. 2009. New technology for rock art documentation by the Soprintendenza for Archaeological Heritage of Lombardia: Laser Scanner in Valle Camonica (Italy). In: POGGIANI KELLER, R., DIMITRIADIS, G., LIBORIO, C. & RUGGIERO, M. G. (eds.) Proceedings of the XV World Congress UISPP (Lisbon, 4-9 September 2006). Session 29: Rock Art Data Base. New methods and guidelines in archiving and cataloguing. Oxford: Archaeopress.

ANNEX I: Bibliography for further reading

The following articles and books represent the last 5 years of Valcamonica scholarship. A more extensive bibliography, dating back to the earliest research in the valley, is available upon request.

ALEXANDER, C. 2008. The Bedolina Map – An exploratory network analysis. *In:* POSLUSCHNY, A., LAMBERS, K. & HERZOG, I. (eds.) *Layers of Perception. Proceedings of the 35th Computer Applications and Quantitative Methods in Archaeology Conference, Berlin, Germany, April 2-6 2007.* Bonn: Habelt, 366-371.
ALEXANDER, C. 2009. The exercise of power in rock-art: the case of superimposition of images at Pià d'Ort, Valcamonica. *In:* NASH, G. & GHEORGHIU, D. (eds.) *The archaeology of people and territoriality.* Budapest: Archaeolingua Press, ---.
ALEXANDER, C. 2011. *Valley of Pitoti: GIS-based socio-spatial analysis of Iron Age rock-art in Valcamonica (BS), Lombardy, Italy.* Ph.D. Thesis, University of Cambridge.
ANATI, E. 2009. Il parco archeologico e minerario di Sellero. *In:* CITTADINI, T., SANSONI, U. & ZANETTA, M. (eds.) *Il parco comunale archeologico e minerario di Sellero. Guida ai percorsi di visita.* Capo di Ponte: Edizioni del Centro, 8-11.
ANATI, E. 2009. In memoria di Giovan Battista Belotti. *In:* AA.VV. (ed.) *Valcamonica preistorica, un patrimonio dell'umanità (catalogo della mostra).* Capo di Ponte: Edizioni del Centro, 49.
ANATI, E. 2009. L'art rupestre du Valcamonica: évolution et signification. Une vision panoramique d'après l'état actuel de la recherche. *L'Anthropologie,* 113**,** 930-968.
ANATI, E. 2009. The way of life recorded in the rock art of Valcamonica. *Adoranten,* 2008**,** 13-35.
ANATI, E. & FRADKIN, A. 2008. Deciphering mythological narrations in the rock art of Valcamonica: the rock of the phallus. *In:* ANATI, E. (ed.) *Proceedings of the XV UISPP World Congress (Lisbon, 4-9 September 2006) / Actes du XV Congrès Mondial (Lisbonne, 4-9 Septembre 2006) Vol. 16, Session C27: Prehistoric Art and Ideology* Oxford: Archaeopress, 3-12.
ANATI, E. & FRADKIN, A. 2009. Le rocce istoriate della Valle Camonica. *In:* AA.VV. (ed.) *Capo di Ponte: guida turistica.* Capo di Ponte: Comune di Capo di Ponte - Agenzia Turistico Culturale, 18-24.
ANATI, E. & FRADKIN, A. 2009. Le rocce istoriate della Valle Camonica. *In:* AA.VV. (ed.) *Valcamonica preistorica, un patrimonio dell'umanità (catalogo della mostra).* Capo di Ponte: Edizioni del Centro, 11-14.
ARCÀ, A. 2009. Monte Bego e Valcamonica, confronto fra le più antiche le fasi istoriative. Dal Neolitico al Bronzo Antico, parallelismi e differenze tra *marvegie* e *Pitoti* dei due poli dell'arte rupestre alpina. *Rivista di Scienze Preistoriche,* LIX**,** 265-306.
ARCÀ, A. 2011. Sovrapposizioni e associazioni nello studio e negli studi di arte rupestre della Valcamonica e dell'arco alpino. *Notizie Archeologiche Bergomensi,* 19**,** 101-116.
ARCÀ, A. 2012. EuroPreArt, segni del passato e memorie del presente. European prehistoric art, www.europreart.net. *Preistoria Alpina: Atti della XLII Riunione Scientifica: l'Arte Preistorica In Italia, Trento, Riva del Garda, Valcamonica, 9-13 ottobre 2007 - Sezione Arte Rupestre Postglaciale,* 46**,** 167-170.
ARCÀ, A., CASINI, S., DE MARINIS, R. C. & FOSSATI, A. E. 2008. Arte rupestre, metodi di documentazione: storia, problematiche e nuove prospettive. *Rivista di Scienze Preistoriche,* LVIII**,** 351-384.
BASSI, S. 2012. La Roccia 3 della località Plas (Capitello dei due Pini), Paspardo - Valcamonica. Esempio di arte rupestre tra prei-storia ed epoca storica. *Preistoria Alpina: Atti della XLII Riunione Scientifica: l'Arte Preistorica In Italia, Trento, Riva del Garda, Valcamonica, 9-13 ottobre 2007 - Sezione Arte Rupestre Postglaciale,* 46**,** 135-138.
BASSI, S. & BELLANDI, G. 2009. L'applicazione delle metodologie di rilievo dell'arte rupestre della Valcamonica nella documentazione di graffiti su affresco. *Bullettin d'Etudes Préhistoriques et Archeologiques Alpines,* XX**,** 257-264.
BOANO, R. & RABINO MASSA, E. 2008. Casts of the prehistoric rock engravings of Val Camonica housed in the Museum of Anthropology and Ethnography of the University of Turin. *Man in India,* 88**,** 353-356.
BORGONOVO, Y. 2009. Le incisioni di canidi e palette nell'arte rupestre della Valcamonica come gesto rituale del sacro. *Bullettin d'Etudes Préhistoriques et Archeologiques Alpines,* XX**,** 175-192.

BORGONOVO, Y. & GHISLANDI, S. 2012. La roccia 35 di Foppe di Nadro. *Preistoria Alpina: Atti della XLII Riunione Scientifica: l'Arte Preistorica In Italia, Trento, Riva del Garda, Valcamonica, 9-13 ottobre 2007 - Sezione Arte Rupestre Postglaciale,* 46**,** 143-144.
BOSSONI, L. 2009. Le figure di ascia della prima età del Ferro nell'arte rupestre della Valcamonica. *Bullettin d'Etudes Préhistoriques et Archeologiques Alpines,* XX**,** 193-204.
BRUNOD, G. 2008. Rock art in Valcamonica, Paspardo, Brescia, Italy — A prehistoric alpine calendar. *Man in India,* 88**,** 215-222.
CAPARDONI, M. 2009. Boscatelle: una nuova area istoriata in Valcamonica. Sintesi preliminare. *BCSP (Bollettino del Centro Camuno di Studi Preistorici),* 35**,** 142-143.
CAPARDONI, M. 2012. Boscatelle: una nuova area istoriata in Valcamonica. Sintesi preliminare. *Preistoria Alpina: Atti della XLII Riunione Scientifica: l'Arte Preistorica In Italia, Trento, Riva del Garda, Valcamonica, 9-13 ottobre 2007 - Sezione Arte Rupestre Postglaciale,* 46**,** 145-148.
CASINI, S. 2012. I monoliti istoriati con simbologia femminile della Valcamonica e della Valtellina. *Preistoria Alpina: Atti della XLII Riunione Scientifica: l'Arte Preistorica In Italia, Trento, Riva del Garda, Valcamonica, 9-13 ottobre 2007 - Sezione Arte Rupestre Postglaciale,* 46**,** 285-288.
CASINI, S. & FOSSATI, A. E. 2012. Le stele incise della Valtellina: analisi delle peculiarità alla luce dei nuovi ritrovamenti. *Preistoria Alpina: Atti della XLII Riunione Scientifica: l'Arte Preistorica In Italia, Trento, Riva del Garda, Valcamonica, 9-13 ottobre 2007 - Sezione Arte Rupestre Postglaciale,* 46**,** 199-208.
CHIODI, C. & BELLANDI, G. 2012. La roccia 2 di Castagneto (Paspardo, Valcamonica): segni della guerra, segni della terra. *Preistoria Alpina: Atti della XLII Riunione Scientifica: l'Arte Preistorica In Italia, Trento, Riva del Garda, Valcamonica, 9-13 ottobre 2007 - Sezione Arte Rupestre Postglaciale,* 46**,** 77-82.
CHIPPINDALE, C. & BAKER, F. 2012. *PITOTI: digital rock-art from prehistoric Europe: heritage, film, archaeology / Arte rupestre digitale dell'Europa preistorica: beni culturali, film, archeologia,* Milano, Skira.
CITTADINI, T. 2009. Il progetto del Parco Comunale Archeologico e Minerario di Sellero. *BCSP (Bollettino del Centro Camuno di Studi Preistorici),* 35**,** 167-168.
CITTADINI, T. 2009. L'arte rupestre camuna e l'Europa. *In:* AA.VV. (ed.) *Capo di Ponte: guida turistica.* Capo di Ponte: Comune di Capo di Ponte - Agenzia Turistico Culturale, 29-30.
CITTADINI, T. 2009. L'eredità mineraria di Sellero e le miniere di Carona. *In:* CITTADINI, T., SANSONI, U. & ZANETTA, M. (eds.) *Il parco comunale archeologico e minerario di Sellero. Guida ai percorsi di visita.* Capo di Ponte: Edizioni del Centro, 61-62.
CITTADINI, T., SANSONI, U. & ZANETTA, M. 2009. *Il parco comunale archeologico e minerario di Sellero. Guida ai percorsi di visita,* Capo di Ponte, Edizioni del Centro.
COIMBRA, F. & DUBAL, L. 2008. On the symbolism of net patterned and ruled rectangles from the Neolithic to the Iron Age. *In:* ANATI, E. (ed.) *Proceedings of the XV UISPP World Congress (Lisbon, 4-9 September 2006) / Actes du XV Congrès Mondial (Lisbonne, 4-9 Septembre 2006) Vol. 25, Session W34: Symbolism in rock art* Oxford: Archaeopress, ---.
CROCI, M. 2009. Le scene di caccia nell'arte rupestre dello stile IV di Valcamonica. *Bullettin d'Etudes Préhistoriques et Archeologiques Alpines,* XX**,** 235-247.
DAFFARA, S. 2009. Le figure ornitomorfe nell'arte rupestre della Valcamonica. *Bullettin d'Etudes Préhistoriques et Archeologiques Alpines,* XX**,** 205-216.
DE MARINIS, R. C. & CASINI, S. 2009. Des pierres et des dieux: l'art rupestre de la Valteline et du Valcamonica. *Le Globe,* 149**,** 61-92.
DE MARINIS, R. C. & FOSSATI, A. E. 2012. A che punto è lo studio dell'arte rupestre della Valcamonica. *Preistoria Alpina: Atti della XLII Riunione Scientifica: l'Arte Preistorica In Italia, Trento, Riva del Garda, Valcamonica, 9-13 ottobre 2007 - Sezione Arte Rupestre Postglaciale,* 46**,** 17-44.
DE MARINIS, R. C. & FOSSATI, A. E. 2012. La stele Cemmo 3. *Preistoria Alpina: Atti della XLII Riunione Scientifica: l'Arte Preistorica In Italia, Trento, Riva del Garda, Valcamonica, 9-13 ottobre 2007 - Sezione Arte Rupestre Postglaciale,* 46**,** 281-284.
FEDELE, F. 2008. Statue-menhirs, human remains and mana at the Ossimo 'Anvòia' ceremonial site, Val Camonica. *Journal of Mediterranean Archaeology,* 21**,** 57-79.

FEDELE, F. 2011. Origini dell'ideologia cerimoniale centroalpina dell'età del Rame: una "fase zero" di IV millennio? *Notizie Archeologiche Bergomensi,* 19**,** 77-100.
FEDELE, F. 2012. Diffusione della trazione animale in Europa: il ruolo informativo e ideologico delle raffigurazioni rupestri centroalpine. *Preistoria Alpina: Atti della XLII Riunione Scientifica: l'Arte Preistorica In Italia, Trento, Riva del Garda, Valcamonica, 9-13 ottobre 2007 - Sezione Arte Rupestre Postglaciale,* 46**,** 55-66.
FEDELE, F. & FOSSATI, A. E. 2012. L'area cerimoniale di Anvòia a Ossimo, Valcamonica: i monoliti simbolici e il loro contesto. *Preistoria Alpina: Atti della XLII Riunione Scientifica: l'Arte Preistorica In Italia, Trento, Riva del Garda, Valcamonica, 9-13 ottobre 2007 - Sezione Arte Rupestre Postglaciale,* 46**,** 187-198.
FEDELE, F. & FOSSATI, A. E. 2012. Massi, menhir e stele: alcuni particolari monoliti simbolici dal sito cerimoniale calcolitico di Anvòia a Ossimo (Valcamonica). *Preistoria Alpina: Atti della XLII Riunione Scientifica: l'Arte Preistorica In Italia, Trento, Riva del Garda, Valcamonica, 9-13 ottobre 2007 - Sezione Arte Rupestre Postglaciale,* 46**,** 279-280.
FOSSATI, A. E. 2008. Shield and warriors: similarities and differences in the rock art of Bear Gulch, Montana, and Valcamonica-Valtellina, Italy. *American Indian rock art,* 34**,** 105-122.
FOSSATI, A. E. 2009. Il Parco Archeologico Comunale di Seradina e Bedolina. *In:* AA.VV. (ed.) *Capo di Ponte: guida turistica.* Capo di Ponte: Comune di Capo di Ponte - Agenzia Turistico Culturale, 43-52.
FOSSATI, A. E. 2009. Ricerche svolte a Paspardo (Bs) nella campagna archeologica estiva 2008. *BCSP (Bollettino del Centro Camuno di Studi Preistorici),* 35**,** 150-155.
FOSSATI, A. E. 2011. Possiamo riconoscere l'autore delle incisioni rupestri della Valcamonica? Il Maestro di Paspardo ed altri "artisti" tra VI e V sec. a.C. *Notizie Archeologiche Bergomensi,* 19**,** 357-373.
FOSSATI, A. E. 2012. L'analisi del degrado delle rocce incise della Valcamonica attraverso la metodologia proposta dalla Carta del Rischio del Patrimonio Culturale. *Preistoria Alpina: Atti della XLII Riunione Scientifica: l'Arte Preistorica In Italia, Trento, Riva del Garda, Valcamonica, 9-13 ottobre 2007 - Sezione Arte Rupestre Postglaciale,* 46**,** 157-160.
GALBIATI, A. 2009. Un grande museo all'aperto da visitare con la guida. *In:* AA.VV. (ed.) *Capo di Ponte: guida turistica.* Capo di Ponte: Comune di Capo di Ponte - Agenzia Turistico Culturale, 41-42.
GASTALDI, C. 2009. Armati, cavalieri e altri antropomorfi. *In:* SANSONI, U. & GAVALDO, S. (eds.) *Lucus rupestris: sei millenni d'arte rupestre a Campanine di Cimbergo.* Capo di Ponte: Edizioni del Centro, 345-350.
GASTALDI, C. 2009. Cimbergo tra XII e XVI sec.: una breve nota storica. *In:* SANSONI, U. & GAVALDO, S. (eds.) *Lucus rupestris: sei millenni d'arte rupestre a Campanine di Cimbergo.* Capo di Ponte: Edizioni del Centro, 341-344.
GASTALDI, C. 2009. Le chiavi. *In:* SANSONI, U. & GAVALDO, S. (eds.) *Lucus rupestris: sei millenni d'arte rupestre a Campanine di Cimbergo.* Capo di Ponte: Edizioni del Centro, 363-366.
GASTALDI, C. 2009. Le rocce perdute. *In:* SANSONI, U. & GAVALDO, S. (eds.) *Lucus rupestris: sei millenni d'arte rupestre a Campanine di Cimbergo.* Capo di Ponte: Edizioni del Centro, 250.
GASTALDI, C. 2009. Segni schematici: il linguaggio universale dell'arte rupestre. *In:* SANSONI, U. & GAVALDO, S. (eds.) *Lucus rupestris: sei millenni d'arte rupestre a Campanine di Cimbergo.* Capo di Ponte: Edizioni del Centro, 377-378.
GASTALDI, C. 2009. Storia delle ricerche. *In:* SANSONI, U. & GAVALDO, S. (eds.) *Lucus rupestris: sei millenni d'arte rupestre a Campanine di Cimbergo.* Capo di Ponte: Edizioni del Centro, 23-26.
GASTALDI, C. & TROLETTI, F. 2009. Date e iscrizioni. *In:* SANSONI, U. & GAVALDO, S. (eds.) *Lucus rupestris: sei millenni d'arte rupestre a Campanine di Cimbergo.* Capo di Ponte: Edizioni del Centro, 367-368.
GASTALDI, C. & TROLETTI, F. 2009. La Fase IV: l'età storica. *In:* SANSONI, U. & GAVALDO, S. (eds.) *Lucus rupestris: sei millenni d'arte rupestre a Campanine di Cimbergo.* Capo di Ponte: Edizioni del Centro, 339-340.
GAVALDO, S. 2009. L'impronta di piede. *In:* SANSONI, U. & GAVALDO, S. (eds.) *Lucus rupestris: sei millenni d'arte rupestre a Campanine di Cimbergo.* Capo di Ponte: Edizioni del Centro, 299-304.
GAVALDO, S. 2009. Relazione campo archeologico estivo 2006. *BCSP (Bollettino del Centro Camuno di Studi Preistorici),* 35**,** 131-136.
GAVALDO, S. 2009. Relazione campo archeologico estivo 2007. *BCSP (Bollettino del Centro Camuno di Studi Preistorici),* 35**,** 137-141.

GAVALDO, S. 2012. La figura del labirinto in Valcamonica: sintesi e confronti. *Preistoria Alpina: Atti della XLII Riunione Scientifica: l'Arte Preistorica In Italia, Trento, Riva del Garda, Valcamonica, 9-13 ottobre 2007 - Sezione Arte Rupestre Postglaciale,* 46**,** 67-76.
GAVALDO, S. 2012. Le impronte di piedi nell'arte rupestre camuna e i confronti in altre fonti iconografiche. *Preistoria Alpina: Atti della XLII Riunione Scientifica: l'Arte Preistorica In Italia, Trento, Riva del Garda, Valcamonica, 9-13 ottobre 2007 - Sezione Arte Rupestre Postglaciale,* 46**,** 127-130.
GAVALDO, S. & SANSONI, U. 2009. La Fase I: dal tardo Neolitico al Calcolitico iniziale. *In:* SANSONI, U. & GAVALDO, S. (eds.) *Lucus rupestris: sei millenni d'arte rupestre a Campanine di Cimbergo.* Capo di Ponte: Edizioni del Centro, 251-261.
GHISLANDI, S. 2009. La "cometa" di Foppe di Nadro (BS): analisi delle figure di coppelle della roccia 35. *Bullettin d'Etudes Préhistoriques et Archeologiques Alpines,* XX**,** 249-256.
LIGAS, V. 2012. Documentazione e analisi della roccia n.18 di Seradina III, Capo di Ponte - Valcamonica. *Preistoria Alpina: Atti della XLII Riunione Scientifica: l'Arte Preistorica In Italia, Trento, Riva del Garda, Valcamonica, 9-13 ottobre 2007 - Sezione Arte Rupestre Postglaciale,* 46**,** 139-142.
LOPATTA, A. 2009. *Hausdarstellungen auf Felsbildern des Valcamonica.* Albert-Ludwigs-Universität.
MANELLA, F. 2009. Ricordo di Battista Maffessoli, ambasciatore della nostra terra. *In:* AA.VV. (ed.) *Valcamonica preistorica, un patrimonio dell'umanità (catalogo della mostra).* Capo di Ponte: Edizioni del Centro, 32.
MARCHESINI, S. 2011. Alla ricerca del modello perduto. Sulla genesi dell'alfabeto camuno. *Palaeohispanica,* 11**,** 155-171.
MARRETTA, A. 2009. Appunti per una storia delle ricerche sull'arte rupestre della Valcamonica. *In:* AA.VV. (ed.) *Valcamonica preistorica, un patrimonio dell'umanità (catalogo della mostra).* Capo di Ponte: Edizioni del Centro, 19-89.
MARRETTA, A. 2009. Battista Maffessoli, una vita per le incisioni rupestri. *In:* POGGIANI KELLER, R. (ed.) *La Valle delle Incisioni: 1909-2009 cento anni di scoperte, 1979-2009 trenta anni con l'UNESCO in Valle Camonica (catalogo della mostra).* Brescia: Palazzo Martinengo, 148-150.
MARRETTA, A. 2009. Cento anni di ricerche. *In:* AA.VV. (ed.) *Capo di Ponte: guida turistica.* Capo di Ponte: Comune di Capo di Ponte - Agenzia Turistico Culturale, 25-28.
MARRETTA, A. 2009. Digging the Past: one hundred years of research on Valcamonica rock art. *Adoranten,* 2008**,** 36-54.
MARRETTA, A. 2009. Il Coren di Redondo (Capo di Ponte, Valcamonica): alcuni dati preliminari su una nuova area con incisioni rupestri del versante occidentale. *In:* ANATI, E. (ed.) *Valcamonica Symposium 2009: fare Storia dalla Preistoria. Capo di Ponte 28-2 novembre 2009 (preatti).* Capo di Ponte: Edizioni del Centro, 231-242.
MARRETTA, A. 2009. Il gruppo del Museo di Scienze Naturali di Brescia: Laeng, Süss e la valorizzazione dei petroglifi camuni. *In:* POGGIANI KELLER, R. (ed.) *Atti del Convegno "Cinquantenario del Parco di Naquane: protagonisti, tendenze prospettive nella storia delle ricerche sull'arte rupestre camuna" , Capo di Ponte, 6-7-8 ottobre 2005.* (in stampa).
MARRETTA, A. 2009. La scoperta in ambito locale. *In:* POGGIANI KELLER, R. (ed.) *Atti del Convegno "Cinquantenario del Parco di Naquane: protagonisti, tendenze prospettive nella storia delle ricerche sull'arte rupestre camuna" , Capo di Ponte, 6-7-8 ottobre 2005.* (in stampa).
MARRETTA, A. 2009. Le tappe della Storia. *In:* AA.VV. (ed.) *Valcamonica preistorica, un patrimonio dell'umanità (catalogo della mostra).* Capo di Ponte: Edizioni del Centro, 95-111.
MARRETTA, A. 2009. *Valcamonica preistorica, un patrimonio dell'umanità (catalogo della mostra),* Capo di Ponte, Edizioni del Centro.
MARRETTA, A. 2009. Zurla, un formidabile sito d'arte rupestre alpina. *In:* SEGLIE, D. (ed.) *Atti del "2ndo Congresso Internazionale Ricerche Paletnologiche nelle Alpi Occidentali", Pinerolo (TO), 17-18-19 Ottobre 2003.* CD-ROM ed. Pinerolo: Cesmap.
MARRETTA, A. 2010. L'arte rupestre della Valcamonica: una fonte archeologica eccezionale. *In:* MARRETTA, A. & CITTADINI, T. (eds.) *I parchi con arte rupestre della Valcamonica. Guida ai percorsi di visita.* Capo di Ponte: Edizioni del Centro, 8-29.

MARRETTA, A. 2011. L'arte rupestre del Coren di Redondo (Capo di Ponte, Valcamonica): novità e conferme dall'analisi integrale di un'area del versante occidentale. *In:* ANATI, E. (ed.) *Valcamonica Symposium 2011 (preatti).* Capo di Ponte: Edizioni del Centro, 285-293.
MARRETTA, A. & ABENANTE, D. 2009. Una guida locale: il caso di Battista Maffessoli. *In:* POGGIANI KELLER, R. (ed.) *Atti del Convegno "Cinquantenario del Parco di Naquane: protagonisti, tendenze prospettive nella storia delle ricerche sull'arte rupestre camuna" , Capo di Ponte, 6-7-8 ottobre 2005.* (in stampa).
MARRETTA, A. & CITTADINI, T. 2010. *I parchi con arte rupestre della Valcamonica. Guida ai percorsi di visita,* Capo di Ponte, Edizioni del Centro.
MARRETTA, A. & CITTADINI, T. 2011. *Valcamonica rock art parks. Guide to visiting routes,* Capo di Ponte, Edizioni del Centro.
MARRETTA, A., MARTINOTTI, A. & COLELLA, M. 2011. Nuove metodologie di documentazione e analisi di sequenze istoriative su due frammenti litici con graffiti protostorici da Piancogno (Valcamonica, Bs). *In:* ANATI, E. (ed.) *Valcamonica Symposium 2011 (preatti).* Capo di Ponte: Edizioni del Centro, 294-305.
MARRETTA, A., MARTINOTTI, A. & COLELLA, M. 2012. Un'esperienza di procedura documentativa e analitica informatizzata di tecniche e sequenze istoriative su due frammenti litici con graffiti protostorici da Piancogno (Valcamonica, BS). *Archeologia Postmedievale,* 16**,** ---.
MARRETTA, A. & VILLA, B. 2009. Gualtiero Laeng e la *querelle* sulle prime segnalazioni. *In:* POGGIANI KELLER, R. (ed.) *Atti del Convegno "Cinquantenario del Parco di Naquane: protagonisti, tendenze prospettive nella storia delle ricerche sull'arte rupestre camuna" , Capo di Ponte, 6-7-8 ottobre 2005.* (in stampa).
MARTINI, F., BAGLIONI, L. & RUGGIERO, M. G. 2009. Alle origini dell'arte rupestre camuna. *In:* POGGIANI KELLER, R. (ed.) *La Valle delle Incisioni: 1909-2009 cento anni di scoperte, 1979-2009 trenta anni con l'UNESCO in Valle Camonica (catalogo della mostra).* Brescia: Palazzo Martinengo, 183-196.
MARTINOTTI, A. 2009. Iconografia delle "rappresentazioni topografiche" in Valtellina tra Eneolitico ed età del Bronzo. *BCSP (Bollettino del Centro Camuno di Studi Preistorici),* 35**,** 99-130.
MARTINOTTI, A. 2009. Il simbolismo dell'ascia. *In:* SANSONI, U. & GAVALDO, S. (eds.) *Lucus rupestris: sei millenni d'arte rupestre a Campanine di Cimbergo.* Capo di Ponte: Edizioni del Centro, 316-323.
MARTINOTTI, A. 2009. Le figure di paletta. *In:* SANSONI, U. & GAVALDO, S. (eds.) *Lucus rupestris: sei millenni d'arte rupestre a Campanine di Cimbergo.* Capo di Ponte: Edizioni del Centro, 313-315.
MARTINOTTI, A. 2009. Le iscrizioni preromane. *In:* SANSONI, U. & GAVALDO, S. (eds.) *Lucus rupestris: sei millenni d'arte rupestre a Campanine di Cimbergo.* Capo di Ponte: Edizioni del Centro, 324-338.
MARTINOTTI, A. 2012. Simbolismo ed evoluzione dello "scutiforme topografico" nella tradizione rupestre preistorica di Valtellina (Lombardia). *Preistoria Alpina: Atti della XLII Riunione Scientifica: l'Arte Preistorica In Italia, Trento, Riva del Garda, Valcamonica, 9-13 ottobre 2007 - Sezione Arte Rupestre Postglaciale,* 46**,** 161-162.
MORELLO, F. 2009. Le figure incomplete nello stile IV di Valcamonica (Età del Ferro): studio preliminare. *Bullettin d'Etudes Préhistoriques et Archeologiques Alpines,* XX**,** 217-233.
POGGIANI KELLER, R. 2009. Cemmo: il sito storico della scoperta dell'arte rupestre e le novità delle ricerche in corso. *In:* POGGIANI KELLER, R. (ed.) *La Valle delle Incisioni: 1909-2009 cento anni di scoperte, 1979-2009 trenta anni con l'UNESCO in Valle Camonica (catalogo della mostra).* Brescia: Palazzo Martinengo, 211-221.
POGGIANI KELLER, R. 2009. Idoli e rituali ancestrali nei santuari megalitici (IV-III millennio a.C. - età storica). *In:* POGGIANI KELLER, R. (ed.) *La Valle delle Incisioni: 1909-2009 cento anni di scoperte, 1979-2009 trenta anni con l'UNESCO in Valle Camonica (catalogo della mostra).* Brescia: Palazzo Martinengo, 203-210.
POGGIANI KELLER, R. 2009. Il santuario di Ossimo-Pat. *In:* POGGIANI KELLER, R. (ed.) *La Valle delle Incisioni: 1909-2009 cento anni di scoperte, 1979-2009 trenta anni con l'UNESCO in Valle Camonica (catalogo della mostra).* Brescia: Palazzo Martinengo, 223-235.
POGGIANI KELLER, R. (ed.) 2009. *La Valle delle Incisioni: 1909-2009 cento anni di scoperte, 1979-2009 trenta anni con l'UNESCO in Valle Camonica (catalogo della mostra),* Brescia: Palazzo Martinengo.
POGGIANI KELLER, R. 2009. Les Parcs d'art rupestre en Lombardie, Italie: organisation, conservation et méthodes de documentation. *In:* DIMITRIADIS, G., SEGLIE, D. & MUNOZ, G. (eds.) *Proceedings of the XV*

World Congress UISPP (Lisbon, 4-9 September 2006). Session 30: Rock Art and Museum. Oxford: Archaeopress, -.
POGGIANI KELLER, R., DIMITRIADIS, G., COIMBRA, F., LIBORIO, C. & RUGGIERO, M. G. 2009. *Rock art data base: new methods and guidelines in archiving and cataloguing. Proceedings of the XV World Congress (Lisbon, 4-9 September 2006),* Oxford, Archaeopress.
POGGIANI KELLER, R., FERRONI, A. M., LIBORIO, C. & RUGGIERO, M. G. 2009. 1979: primo sito italiano del Patrimonio Mondiale UNESCO. *In:* POGGIANI KELLER, R. (ed.) *La Valle delle Incisioni: 1909-2009 cento anni di scoperte, 1979-2009 trenta anni con l'UNESCO in Valle Camonica (catalogo della mostra).* Brescia: Palazzo Martinengo, 163-170.
POGGIANI KELLER, R., LIBORIO, C. & RUGGIERO, M. G. 2009. Cenni sullo sviluppo dell'arte rupestre. una premessa alla visita delle incisioni di Valle Camonica. *In:* POGGIANI KELLER, R. (ed.) *La Valle delle Incisioni: 1909-2009 cento anni di scoperte, 1979-2009 trenta anni con l'UNESCO in Valle Camonica (catalogo della mostra).* Brescia: Palazzo Martinengo, 237-242.
POGGIANI KELLER, R., LIBORIO, C. & RUGGIERO, M. G. 2009. Dal 1980. Ricerche e studi "a tutto campo". *In:* POGGIANI KELLER, R. (ed.) *La Valle delle Incisioni: 1909-2009 cento anni di scoperte, 1979-2009 trenta anni con l'UNESCO in Valle Camonica (catalogo della mostra).* Brescia: Palazzo Martinengo, 171-180.
POGGIANI KELLER, R., LIBORIO, C. & RUGGIERO, M. G. 2009. Il Parco Archeologico Nazionale di Naquane. *In:* AA.VV. (ed.) *Capo di Ponte: guida turistica.* Capo di Ponte: Comune di Capo di Ponte - Agenzia Turistico Culturale, 31-40.
POGGIANI KELLER, R., LIBORIO, C. & RUGGIERO, M. G. 2009. Valle Camonica (Italy). The Rock Art database by the Ministry of Cultural Heritage and Activities-Soprintendenza for Archaeological Heritage of Lombardia: from Ir Project to Irweb. *In:* POGGIANI KELLER, R., DIMITRIADIS, G., LIBORIO, C. & RUGGIERO, M. G. (eds.) *Proceedings of the XV World Congress UISPP (Lisbon, 4-9 September 2006). Session 29: Rock Art Data Base. New methods and guidelines in archiving and cataloguing.* Oxford: Archaeopress, -.
POGGIANI KELLER, R., LIBORIO, C. & RUGGIERO, M. G. 2012. Tutela e documentazione dell'arte rupestre lombarda: irweb.it per un archivio informatizzato. *Preistoria Alpina: Atti della XLII Riunione Scientifica: l'Arte Preistorica In Italia, Trento, Riva del Garda, Valcamonica, 9-13 ottobre 2007 - Sezione Arte Rupestre Postglaciale,* 46**,** 163-166.
POGGIANI KELLER, R., MAGRI, F. & RUGGIERO, M. G. 2012. Arte schematica da un contesto della media età del Ferro: Cevo-Dos Curù (BS). *Preistoria Alpina: Atti della XLII Riunione Scientifica: l'Arte Preistorica In Italia, Trento, Riva del Garda, Valcamonica, 9-13 ottobre 2007 - Sezione Arte Rupestre Postglaciale,* 46**,** 369-372.
POGGIANI KELLER, R. & RUGGIERO, M. G. 2009. Il Parco Archeologico Nazionale dei Massi di Cemmo. *In:* AA.VV. (ed.) *Capo di Ponte: guida turistica.* Capo di Ponte: Comune di Capo di Ponte - Agenzia Turistico Culturale, 53-60.
PORTERI, F. 2012. L'arte rupestre della Valcamonica: nuovi indizi di portati culturali etruschi. *Preistoria Alpina: Atti della XLII Riunione Scientifica: l'Arte Preistorica In Italia, Trento, Riva del Garda, Valcamonica, 9-13 ottobre 2007 - Sezione Arte Rupestre Postglaciale,* 46**,** 149-152.
PRIULI, A. 2009. L'utilità dell'archeologia sperimentale per meglio comprendere l'arte rupestre. *In:* AA.VV. (ed.) *Capo di Ponte: guida turistica.* Capo di Ponte: Comune di Capo di Ponte - Agenzia Turistico Culturale, 71-80.
PRIULI, A. 2010. *Etnoarcheologia in alta Valle Camonica e il mistero dei villaggi scomparsi: tra incisioni rupestri, luoghi di culto e insediamenti umani antichi,* Ponte di Legno, Unione dei Comuni dell'Alta Valle Camonica.
RAMPINELLI ROTA, A. 2009. Ricordo di Walther Laeng. *In:* AA.VV. (ed.) *Valcamonica preistorica, un patrimonio dell'umanità (catalogo della mostra).* Capo di Ponte: Edizioni del Centro, 31.
ROBB, J. 2008. Tradition and agency: human body representations in later prehistoric Europe. *World Archaeology,* 40**,** 332 - 353.
ROBB, J. 2009. People of Stone: stelae, personhood, and society in Prehistoric Europe. *Journal of Archaeological Method and Theory,* 16**,** 162-183.

ROSSI, G. 2009. Le figure ornitomorfe: analisi distributiva e ipotesi interpretative. *In:* SANSONI, U. & GAVALDO, S. (eds.) *Lucus rupestris: sei millenni d'arte rupestre a Campanine di Cimbergo.* Capo di Ponte: Edizioni del Centro, 305-308.
ROSSI, G. 2009. Studio, confronto e ipotesi interpretative delle figure a carattere fantastico-mitologico. *In:* SANSONI, U. & GAVALDO, S. (eds.) *Lucus rupestris: sei millenni d'arte rupestre a Campanine di Cimbergo.* Capo di Ponte: Edizioni del Centro, 309-312.
ROSSI, G. & CITTADINI, T. 2009. Cenni a proposito della viabilità storica. *In:* SANSONI, U. & GAVALDO, S. (eds.) *Lucus rupestris: sei millenni d'arte rupestre a Campanine di Cimbergo.* Capo di Ponte: Edizioni del Centro, 379-384.
ROSSI, G. & ZANETTA, M. 2009. La "Roccia del Carro" di Campanine di Cimbergo. *BCSP (Bollettino del Centro Camuno di Studi Preistorici),* 35**,** 164-166.
ROSSI, G. & ZANETTA, M. 2009. Le rocce istoriate: corpus e schede. *In:* SANSONI, U. & GAVALDO, S. (eds.) *Lucus rupestris: sei millenni d'arte rupestre a Campanine di Cimbergo.* Capo di Ponte: Edizioni del Centro, 27-249.
RUGGIERO, M. G. 2009. Arte rupestre e fotografia d'autore. La Valle delle Incisioni attraverso l'obiettivo di Emmanuel Breteau. *In:* AA.VV. (ed.) *Capo di Ponte: guida turistica.* Capo di Ponte: Comune di Capo di Ponte - Agenzia Turistico Culturale, 243-266.
RUGGIERO, M. G. 2009. I calchi come strumento di divulgazione fuori dalla valle. *In:* POGGIANI KELLER, R. (ed.) *La Valle delle Incisioni: 1909-2009 cento anni di scoperte, 1979-2009 trenta anni con l'UNESCO in Valle Camonica (catalogo della mostra).* Brescia: Palazzo Martinengo, 126.
SANSONI, U. 2008. Simboli al femminile: linee parallele e a volta nell'arte rupestre Calcolitica. *In:* ANATI, E. (ed.) *Proceedings of the XV UISPP World Congress (Lisbon, 4-9 September 2006) / Actes du XV Congrès Mondial (Lisbonne, 4-9 Septembre 2006) Vol. 16, Session C27: Prehistoric Art and Ideology* Oxford: Archaeopress, ---.
SANSONI, U. 2009. Arature e ritualità. *In:* SANSONI, U. & GAVALDO, S. (eds.) *Lucus rupestris: sei millenni d'arte rupestre a Campanine di Cimbergo.* Capo di Ponte: Edizioni del Centro, 262-264.
SANSONI, U. 2009. Arte rupestre a Malonno. *BCSP (Bollettino del Centro Camuno di Studi Preistorici),* 35**,** 160-163.
SANSONI, U. 2009. Carpene, l'area dei giganti: la dea, le rose, l'Esus. *In:* CITTADINI, T., SANSONI, U. & ZANETTA, M. (eds.) *Il parco comunale archeologico e minerario di Sellero. Guida ai percorsi di visita.* Capo di Ponte: Edizioni del Centro, 12-19.
SANSONI, U. 2009. Il carro a due ruote: la ritualità dell'età del Bronzo. *In:* SANSONI, U. & GAVALDO, S. (eds.) *Lucus rupestris: sei millenni d'arte rupestre a Campanine di Cimbergo.* Capo di Ponte: Edizioni del Centro, 270-272.
SANSONI, U. 2009. Il contesto rupestre. *In:* CITTADINI, T., SANSONI, U. & ZANETTA, M. (eds.) *Il parco comunale archeologico e minerario di Sellero. Guida ai percorsi di visita.* Capo di Ponte: Edizioni del Centro, 50-59.
SANSONI, U. 2009. Il sito: quadro dell'area e problemi aperti. *In:* SANSONI, U. & GAVALDO, S. (eds.) *Lucus rupestris: sei millenni d'arte rupestre a Campanine di Cimbergo.* Capo di Ponte: Edizioni del Centro, 15-22.
SANSONI, U. 2009. La Fase II: dal Calcolitico Medio al Bronzo Recente. *In:* SANSONI, U. & GAVALDO, S. (eds.) *Lucus rupestris: sei millenni d'arte rupestre a Campanine di Cimbergo.* Capo di Ponte: Edizioni del Centro, 265-270.
SANSONI, U. 2009. La Fase III: dal Bronzo Finale all'età di Roma. *In:* SANSONI, U. & GAVALDO, S. (eds.) *Lucus rupestris: sei millenni d'arte rupestre a Campanine di Cimbergo.* Capo di Ponte: Edizioni del Centro, 273-282.
SANSONI, U. 2009. La Stele Furloni. Nuovo rinvenimento calcolitico a Malegno. *BCSP (Bollettino del Centro Camuno di Studi Preistorici),* 35**,** 95-98.
SANSONI, U. 2009. L'area istoriata di Pagherina-Dos del Pater. *In:* AA.VV. (ed.) *Capo di Ponte: guida turistica.* Capo di Ponte: Comune di Capo di Ponte - Agenzia Turistico Culturale, 68-70.
SANSONI, U. 2009. Le nuove scoperte nel territorio capontino. *In:* AA.VV. (ed.) *Capo di Ponte: guida turistica.* Capo di Ponte: Comune di Capo di Ponte - Agenzia Turistico Culturale, 61-67.

SANSONI, U. 2009. Note sul territorio capontino nella Preistoria e le nuove aree rupestri di Pagherina e Dos del Pater. *BCSP (Bollettino del Centro Camuno di Studi Preistorici),* 35**,** 85-94.
SANSONI, U. 2009. The value of life in the images of Prehistory in Europe. *Adoranten,* 2008**,** 55-64.
SANSONI, U. 2012. Lo stato della ricerca sul contesto rupestre della Valcamonica: sintesi sulle scoperte, gli studi tematici ed i caratteri di zona. *Preistoria Alpina: Atti della XLII Riunione Scientifica: l'Arte Preistorica In Italia, Trento, Riva del Garda, Valcamonica, 9-13 ottobre 2007 - Sezione Arte Rupestre Postglaciale,* 46**,** 45-54.
SANSONI, U. & GAVALDO, S. 2009. *Lucus rupestris: sei millenni d'arte rupestre a Campanine di Cimbergo,* Capo di Ponte, Edizioni del Centro.
SANSONI, U. & ZANETTA, M. 2009. L'evoluzione dell'arte rupestre a Carpene di Sellero. *In:* CITTADINI, T., SANSONI, U. & ZANETTA, M. (eds.) *Il parco comunale archeologico e minerario di Sellero. Guida ai percorsi di visita.* Capo di Ponte: Edizioni del Centro, 22-33.
SAVARDI, E. 2009. Le figure di "capanne": tipologie e confronti. *In:* SANSONI, U. & GAVALDO, S. (eds.) *Lucus rupestris: sei millenni d'arte rupestre a Campanine di Cimbergo.* Capo di Ponte: Edizioni del Centro, 291-298.
SAVARDI, E. 2009. Nuove scoperte in Alta Valcamonica. *BCSP (Bollettino del Centro Camuno di Studi Preistorici),* 35**,** 159-159.
SAVARDI, E. 2012. Simbolo e rito nelle figure di "capanna" in Valcamonica. *Preistoria Alpina: Atti della XLII Riunione Scientifica: l'Arte Preistorica In Italia, Trento, Riva del Garda, Valcamonica, 9-13 ottobre 2007 - Sezione Arte Rupestre Postglaciale,* 46**,** 131-134.
SOLANO, S. & MARRETTA, A. 2009. Pagine di Pietra: iscrizioni e raffigurazioni a Berzo-Demo, loc. Loa (Valcamonica). *In:* ANATI, E. (ed.) *Valcamonica Symposium 2009: fare Storia dalla Preistoria. Capo di Ponte 28-2 novembre 2009 (preatti).* Capo di Ponte: Edizioni del Centro, 324-335.
SOLANO, S. & SIMONOTTI, F. 2008. *Berzo Demo: un abitato alpino fra età del Ferro e romanizzazione,* Berzo Demo, Comune di Berzo Demo.
STIG HANSEN, B. 2009. Newly found prehistoric paintings in Val Camonica? *Adoranten,* 2008**,** 120-121.
TARANTINI, M. 2009. "Alpinisti! Visitate la Valle Camonica!". *In:* POGGIANI KELLER, R. (ed.) *La Valle delle Incisioni: 1909-2009 cento anni di scoperte, 1979-2009 trenta anni con l'UNESCO in Valle Camonica (catalogo della mostra).* Brescia: Palazzo Martinengo, 49-59.
TARANTINI, M. 2009. Documentari, romanzi e immagini attorno all'arte rupestre. *In:* POGGIANI KELLER, R. (ed.) *La Valle delle Incisioni: 1909-2009 cento anni di scoperte, 1979-2009 trenta anni con l'UNESCO in Valle Camonica (catalogo della mostra).* Brescia: Palazzo Martinengo, 151-161.
TARANTINI, M. 2009. Gli anni della valorizzazione. L'attività dei naturalisti bresciani. *In:* POGGIANI KELLER, R. (ed.) *La Valle delle Incisioni: 1909-2009 cento anni di scoperte, 1979-2009 trenta anni con l'UNESCO in Valle Camonica (catalogo della mostra).* Brescia: Palazzo Martinengo, 113-127.
TARANTINI, M. 2009. Interpretare l'arte attraverso la comparazione. *In:* POGGIANI KELLER, R. (ed.) *La Valle delle Incisioni: 1909-2009 cento anni di scoperte, 1979-2009 trenta anni con l'UNESCO in Valle Camonica (catalogo della mostra).* Brescia: Palazzo Martinengo, 93-100.
TARANTINI, M. 2009. La scoperta della Valle: l'exploit degli anni '30. *In:* POGGIANI KELLER, R. (ed.) *La Valle delle Incisioni: 1909-2009 cento anni di scoperte, 1979-2009 trenta anni con l'UNESCO in Valle Camonica (catalogo della mostra).* Brescia: Palazzo Martinengo, 77-92.
TARANTINI, M. 2009. L'arte camuna tra III Reich e Fascismo. *In:* POGGIANI KELLER, R. (ed.) *La Valle delle Incisioni: 1909-2009 cento anni di scoperte, 1979-2009 trenta anni con l'UNESCO in Valle Camonica (catalogo della mostra).* Brescia: Palazzo Martinengo, 101-112.
TARANTINI, M. 2009. Le ricerche sull'arte rupestre della Valle Camonica. Le vicende e il contesto. *In:* POGGIANI KELLER, R. (ed.) *La Valle delle Incisioni: 1909-2009 cento anni di scoperte, 1979-2009 trenta anni con l'UNESCO in Valle Camonica (catalogo della mostra).* Brescia: Palazzo Martinengo, 23-48.
TARANTINI, M. 2009. Una nuova fase: Emmanuel Anati e il Centro Camuno di Studi Preistorici. *In:* POGGIANI KELLER, R. (ed.) *La Valle delle Incisioni: 1909-2009 cento anni di scoperte, 1979-2009 trenta anni con l'UNESCO in Valle Camonica (catalogo della mostra).* Brescia: Palazzo Martinengo, 137-147.

TARANTINI, M. & POGGIANI KELLER, R. 2009. La "riscoperta" dei Massi di Cemmo. *In:* POGGIANI KELLER, R. (ed.) *La Valle delle Incisioni: 1909-2009 cento anni di scoperte, 1979-2009 trenta anni con l'UNESCO in Valle Camonica (catalogo della mostra).* Brescia: Palazzo Martinengo, 61-75.
TARANTINI, M. & POGGIANI KELLER, R. 2009. L'istituzione del Parco Nazionale delle Incisioni Rupestri di Naquane. *In:* POGGIANI KELLER, R. (ed.) *La Valle delle Incisioni: 1909-2009 cento anni di scoperte, 1979-2009 trenta anni con l'UNESCO in Valle Camonica (catalogo della mostra).* Brescia: Palazzo Martinengo, 129-136.
TONINELLI, E. 2009. Le figure solari nelle statue-stele dell'età del Rame in Valcamonica e Valtellina. *Bullettin d'Etudes Préhistoriques et Archeologiques Alpines,* XX**,** 161-174.
TROLETTI, F. 2009. Araldica ed elementi vegetali. *In:* SANSONI, U. & GAVALDO, S. (eds.) *Lucus rupestris: sei millenni d'arte rupestre a Campanine di Cimbergo.* Capo di Ponte: Edizioni del Centro, 375-376.
TROLETTI, F. 2009. Storie di croci, di santi e di diavoli. *In:* SANSONI, U. & GAVALDO, S. (eds.) *Lucus rupestris: sei millenni d'arte rupestre a Campanine di Cimbergo.* Capo di Ponte: Edizioni del Centro, 369-372.
TROLETTI, F. 2009. Torri e castelli: la nuova "prospettiva" militare. *In:* SANSONI, U. & GAVALDO, S. (eds.) *Lucus rupestris: sei millenni d'arte rupestre a Campanine di Cimbergo.* Capo di Ponte: Edizioni del Centro, 355-359.
TROLETTI, F. & GASTALDI, C. 2009. I patiboli. *In:* SANSONI, U. & GAVALDO, S. (eds.) *Lucus rupestris: sei millenni d'arte rupestre a Campanine di Cimbergo.* Capo di Ponte: Edizioni del Centro, 351-354.
ZANETTA, M. 2009. La figura dell'armato: analisi tipologica e ipotesi interpretative. *In:* SANSONI, U. & GAVALDO, S. (eds.) *Lucus rupestris: sei millenni d'arte rupestre a Campanine di Cimbergo.* Capo di Ponte: Edizioni del Centro, 283-290.
ZANETTA, M. 2009. L'area archeologica di Carpene di Sellero. *In:* CITTADINI, T., SANSONI, U. & ZANETTA, M. (eds.) *Il parco comunale archeologico e minerario di Sellero. Guida ai percorsi di visita.* Capo di Ponte: Edizioni del Centro, 34-49.
ZANETTA, M. 2009. Relazione campo archeologico estivo 2008. *BCSP (Bollettino del Centro Camuno di Studi Preistorici),* 35**,** 144-149.
ZANETTA, M. 2009. Storia delle ricerche. *In:* CITTADINI, T., SANSONI, U. & ZANETTA, M. (eds.) *Il parco comunale archeologico e minerario di Sellero. Guida ai percorsi di visita.* Capo di Ponte: Edizioni del Centro, 20-21.
ZANETTA, M. 2012. Le scene di duello nell'arte rupestre camuna. *Preistoria Alpina: Atti della XLII Riunione Scientifica: l'Arte Preistorica In Italia, Trento, Riva del Garda, Valcamonica, 9-13 ottobre 2007 - Sezione Arte Rupestre Postglaciale,* 46**,** 153-156.
ZEFINETTI, E. C. & PEVERELLI, P. 2009. New technology for rock art documentation by the Soprintendenza for Archaeological Heritage of Lombardia: Laser Scanner in Valle Camonica (Italy). *In:* POGGIANI KELLER, R., DIMITRIADIS, G., LIBORIO, C. & RUGGIERO, M. G. (eds.) *Proceedings of the XV World Congress UISPP (Lisbon, 4-9 September 2006). Session 29: Rock Art Data Base. New methods and guidelines in archiving and cataloguing.* Oxford: Archaeopress, -.

ANNEX II: Agenda for computer-supported archaeology workshop

Workshop on Computer Supported Archaeology

Bauhaus-Universität Weimar, 17th September, 2013

AGENDA

10:30 – 11:00 Arrival

Coffee, water, juice, fruits and biscuits will be available throughout the workshop.

11:00 – 11:30 Welcome and objectives (BUW / UNOTT)

Welcome to the 3D-Pitoti workshop,
Welcome to Bauhaus-Universität Weimar,
Short introduction by each participant

11:30 – 11:45 Introduction to the visualization lab (BUW)

Participants will see a slideshow to inform them about what they will see during each demonstration. This includes mentioning the current limitations of our technologies (resolution, brightness, image dynamics etc).

11:45 – 12:45 Visualization technology demonstrations (BUW)

This session aims to demonstrate advantages of 3D Scanning and Visualization. The workshop participants are invited to explore scanning data from Val Camonica using various display technologies and visualization techniques. Each demonstration is shown to one or two users at a time with about ten minutes time per demo. Each demo is presented by at least one person from the BUW. An additional observer from other partners will record user feedback at demo stations 1, 2 and 3.

	Display	Topics	Functionality	Content	No. of Users
1.	Multi-User DLP	Geometric features, Measurement & visualization tools	Scaling, Prop-based manipulation, Measurement grid, Relief cutting, Shader lens, Virtual light source	Detail scan of Spaceman / Archer	2 VIP users, 1 presenter, 1 additional slot, 1 evaluator
2.	Multi-User LCD	Geometric features, Virtual lighting	Virtual light source	Detail scan of Spaceman / Archer	2 users, no presenter, 1 advisor, 1 evaluator
3.	Quad HD Table	Illustrative visualization techniques	Visualization of local engraving depth, Visualization of local surface curvature	Detail scan of Spaceman, Archer, Camunian rose	2 users, 1 presenter, 1 evaluator
4.	Quad HD Stereo	High resolution 3D display	Prop-based manipulation, Virtual light source	Detail scan of Spaceman, Archer, Camunian rose	1 user, no presenter, 1 advisor
5.	Standard Monitor	Point scans of Valley, Mid-scale rock surface	Basic navigation	Val Camonica Scan, Seradina 12	1 or 2 users, no presenter, 1 advisor

12:45 – 13:30 Lunch & Poster Feedback

Buffet lunch will be provided next to the lab. The demonstrations will remain accessible during lunch.

13:30 – 14:15 Workshop on scanning technologies (ArcTron 3D)

Slideshow presentation of scanning technologies using Val Camonica as an example

14:15 – 15:00 Workshop on data processing (FHSTP)

Slideshow presentation of planned data processing in the project:

Participants will be asked to note their opinions during the presentation. After the presentation we will go into the lab and show visualization techniques that relate the data processing.

15:00 – 15:30 Coffee and demos in the lab

Demonstrations in the lab:

	Display	Topics	Functionality	Content	No. of Users
1.	Multi-User DLP	Integrated exploration of Virtual Valcamonica, Use of preprocessed data	Multiscale navigation, Orientation aids, highlights, Virtual Photos	Valcamonica Model (not the scan)	5 users, 1 presenter, 1 evaluator
2.	Quad HD	Multidimensional comparison of similarities and differences	Parallel Coordinates	Some existing dataset (probably notebooks)	5 users, 1 presenter, 1 evaluator
3.	Quad HD Table	Illustrative visualization techniques	Visualization of local engraving depth, Visualization of local surface curvature	Detail scan of Spaceman, Archer, Camunian rose	2 users, 1 presenter, 1 evaluator

Project partners to record user feedback during the sessions

15:15 – 16:00 Evaluation of interactive visualization techniques (BUW / UNOTT)

Participants will be asked to discuss the visualization techniques in small group and note their opinions. At the end we will have a focus group interview to evaluate the advantages, limitations and potentials of the visualization techniques, technical aspects, relevance to archaeologists and interaction techniques.

16:00 – 16:30 Feedback discussion (UNOTT)

16:30 Thank you and close (UNOTT)

19:00 Joint Dinner

ANNEX III: Project information sheet and consent form

"3 D Pitoti": project information sheet

- The aim of this research study is to understand user requirements and needs when it comes to the resources and potential within "3 D Pitoti" project which focuses on exploration of pre-historic rock art (rock engravings of for example humans, animals, nature, daily activities, life style).
- I am kindly asking for approximately 1 hour of your time (possibly a little bit more) to express your opinion on potential value of this project and its resources for your teaching and learning. During that time you'll be asked to write and perform a type of concept mapping exercise.
- You will be audio recorded. If you agree, I would video record your hands while you are performing the mapping exercise.
- The data will be uploaded and stored on my University computer under a protected password in accordance with BERA ethical standards. I shall share the data with other researchers on the project who are equally obliged to protect the privacy and anonymity of the data. Once I upload the data I'll erase it from my recording devices. I shall not use or publish any data without consulting you. If I publish any data, your name will never be mentioned or your identity revealed.
- Participating in this research is completely voluntary; you are at liberty to withdraw at any time without prejudice or negative consequences.
- You may contact the researcher or ethics co-ordinator at any time if you wish to do so.

Kind regards,
Natasa Lackovic

Natasa Lackovic psxnl1@nottingham.ac.uk +44(0) 7789803828, B3, School of Education, The Exchange, Jubilee campus, Wollaton Road, Nottingham, NG8 1B

Professor Charles Crook, Charles.Crook@nottingham.ac.uk, B30, School of Education , The Exchange building, Jubilee campus, Wollaton Road, Nottingham, NG8 1BB

Professor Sue Cobb, Sue.Cobb@nottingham. Associate Professor, Human Factors Research Group, Department M3, Faculty of Engineering, University of Nottingham, University Park, Nottingham.NG7 2RD. UK

The School's Research Ethics Coordinators:

Professor John Morgan	**Dr Julio Gimenez**	**Dr David Murphy**
+44 (0)115 951 4420	+44 (0)115 9514407	+44 (0)115 846 6455

Participant consent form

Project title "3 D Pitoti"

Researcher's name: Natasa Lackovic

- I have read the Participant Information Sheet and the nature and purpose of the research project has been explained to me. I understand and agree to take part.
- I understand the purpose of the research project and my involvement in it.
- I understand that I may withdraw from the research project at any stage and that this will not affect my status now or in the future.
- I understand that while information gained during the study may be published, I will not be identified and my personal details will remain confidential.
- I understand that I will be audiotaped / videotaped during the interview.
- I understand that data will be stored on researcher's computer under a protected password in accordance with BERA ethical standards.
- I understand that I may contact the researcher if I require further information about the research, and that I may contact the Research Ethics Coordinator of the School of Education, University of Nottingham, if I wish to make a complaint relating to my involvement in the research.

Signed ..... (research participant)

Print name ..... **Date** .....

Contact details:
Natasa Lackovic, psxnl1@nottingham.ac.uk, B3, School of Education, The Exchange building, Jubilee campus, Wollaton Road, Nottingham, NG8 1BB

Professor Charles Crook, Charles.Crook@nottingham.ac.uk, B30, School of Education , The Exchange building, Jubilee campus, Wollaton Road, Nottingham, NG8 1BB

Professor Sue Cobb, Sue.Cobb@nottingham. Associate Professor, Human Factors Research Group, Department M3, Faculty of Engineering, University of Nottingham, University Park, Nottingham.NG7 2RD. UK
School of Education Research Ethics Coordinators: Professor John Morgan
+44 (0)115 951 4486, Dr Julio Gimenez +44 (0)115 9514407, Dr David Murphy
+44 (0)115 846 6455

ANNEX IV: 3D-PITOTI interview schedule

Pitoti interview schedule Phase 1
Resources to show to the teachers:

- A selection of scanned pages from Valcamonica book, authored by Dr Baker and Dr Chippindale;
- Dr Baker's Pitoti animation;
- 3D Pitoti representations and learning packs provided by Archeocamuni, Valcamonica.

Introduction/Background:
I am going to briefly explain the project and what we see in it for education and then I would like to hear your opinion on how it might work and what kind of curriculum and teaching needs you can identify that the project might possibly meet. We are interested to identify teachers' opinions in relation to the teaching and learning potential of 2- and 3D images and animations based on the prehistoric rock art in Camonica valley in Italy. Here are some pictures of those engravings (show pictures, comment, explain).

The rock engravings are unique in the world in terms of the number of figures representing mainly people, animals, tools, houses and the nature (trees). We believe that this rock art can be related to other forms of rock art and other archaeological heritage in Britain and wider as well as that it can be transformed into a cross-curricular learning framework for primary schools.

We are interested in teachers' opinions since we see a potential of designing activities with teachers around bigger themes embodied in Pitoti rock art, for example: senses and sensing the world, the dimension of space and time, the importance of light and solar power, exploring the environment, lifestyle, development of tools, agriculture.

All those themes are big and they could be possibly geared towards particular curriculum requirements and subjects, including history, geography, design and technology, art and design, English (literacy), ICT, science. But that is me talking, it would be interesting to hear what you think and that is why I am here. So, we will talk about what you think how your curriculum and teaching needs could possibly be matched with the potential of Pitoti project resources and whether and how a cross-curriculum approach of this kind could help.

Questions:
1) Which key stage do you teach?
2) What is your school's view on getting involved in external and collaborative teaching and learning projects? Have you been a part of any? Are you aware of any?
3) Have you collaborated with any artists or academics, relating to the design of learning activities?
4) Have you been involved in any cross-curricular teaching design?
5) Could you comment on the potential of developing a cross-curricular framework of activities for children in the following subjects (will refer to boxes with particular subjects – see page 12)
Could prehistoric 2D and 3D representations and animations serve as resource for creative cross-curriculum activities; If so, how? (the teacher would be asked to think whether any curricular requirements and themes could be transformed into activities around Pitoti).
6) What do you think the children would be interested in?
7) What they would be able to learn?
8) Could we try together to identify some bigger themes which would then be related to subject needs and then identify a theme within a subject and possible activities and resources (similar to Papplewick concept mapping). Would you fill in these cards (I'll have cut out cards) so that we see a progression of possible ideas in a teaching and learning design?
A big theme could be for example:

- "Environmental sustainability";

- "The importance of solar power";
- "Humans and tools creation"

Pitoti ideas boxes – Key Stage 1 (example)

Maths	**History**	**English**
Geography	**Art and design** **Design and technology**	**Music**
Physical education	**ICT**	**Science**

Pitoti interview schedule Phase 2

1. **Artefacts to be shown to the teachers**

Phase 1) artefacts
Phase 2) artefacts – addition to Phase 1:

- Photographs of the technology developed (the interviewer explains this);
- Links with example of 3D artefacts (museums): http://hampson.cast.uark.edu/browse.htm – this one is about museum 3D artefact collection for possible exploration/play.

http://rockart.ncl.ac.uk/interactive/interactive_learningjourneys.htm
under "Games" heading: possible games around the topic of rock art;

- Link to 3D panorama http://www.airpano.ru/files/White-Sea-Russia/2-2 (3D panorama)

3D technology-focus main semi-structured questions and elaborated sub-questions:
1) Now, imagine that you can use any technology to support the teaching activities around Pitoti, can you suggest:

- what those technologies could be?
- what kind of function could they have?
- what would they allow you to do?
- what would they allow the children to do?

2) These are photographs of some technologies developed related to Pitoti – they are focused on providing 3D experience to users (show photographs of the technologies and explain what those can do); and these

are some links to 3D visualisations developed by museums and 3D panorama (show links to 3D museum presentations) and 3D panorama:
3D artefacts: http://hampson.cast.uark.edu/browse.htm – this one is about museum 3D artefact collection for possible exploration/play; http://rockart.ncl.ac.uk/interactive/interactive_learningjourneys.htm under "Games" heading: possible games around the topic of rock art 3D panorama http://www.airpano.ru/files/White-Sea-Russia/2-2 .

- Can you think of ways of using it to support teaching and learning and, if so, what would they be?
- Is there anything about those technologies that you find interesting and useful?
- What kind of interaction property would you add to these visualisations to make it more educational (for example: a particular task, a possible game)?
- What would the children do?
- What do you anticipate that they might like about it?
- What do you like and dislike about it?

3) What kind of technology would you like to have?
What would it be able to allow children to do? What would its features be? What curriculum focus/goals would that support?

ANNEX V: Cross-curricular teaching and learning relating to Pitoti artefacts: examples of themes and subjects

Subject	Subject concept and/or activity with 2D and 3D Pitoti artefacts
English/Italian and literacy	• Using the pictures (of Pitoti) to make storyboards, make a story (what is happening?) • Creative writing • Report writing • Communication in general • Using descriptive adjectives • Pen friends for learning Italian/English (Italian-English school collaboration) : could be though e-mails or through informal letter writing • Writing leaflets • Narrative and character building • Vocabulary building • Giving instruction and direction
History	• Comparison: life circumstances then and now • Timelines • Agriculture, activities within human settlements throughout history • Comparison of different pre-historic art sites • Re-creating pre-historic community activities (creating tools and then using them) • Having a visit from an archaeologist to discuss pre-history • Migration of people from ancient to modern times • Traditions, customs, beliefs
Geography	• Mountain ranges • Hills • Rocks • Physical vs. human geography • Identification and comparison of different pre-historic art sites • Manipulating maps; reading maps; creating maps • The world map: Locations (of pre-historic settlements and art in the UK and worldwide) • Directions (compass; south-west-north-east) • Where people migrated from, where to and why • Ecology and nature: environmental changes and transformations as depicted and in relation to what we know about prehistoric times • Italy (peninsula/position/seaside, etc.)
Maths	• Shapes (circle, triangle) • Measure (measuring figures) • Distance (calculating distance) • Fractions • Geometry (angles) • Numeracy • Maths through history (sign and symbols) • Multiplying and division with figures (scenes)
ICT	• Re-creating digital images • Digital representation (2D and 3D) manipulation • How things (technology) works • E-mail • Skype (for communication with another school) • Creating moving images (software);

	• Apps and software to use and explore Pitoti
Art and design	• Drawing • Painting (still life) • Pottery • Creating prehistoric tools • Imagining prehistoric dishes • Creating clay or wood figures • Etching technique • Art with mud (outside the school) • Patterns and prints based on Pitoti
Music	• Creating instruments and using them • Prehistoric sounds • Creating a prehistoric song and rhymes ("Walk like a Pitotian" as inspired by "Walk like an Egyptian" by The Bangles) • Drumming (exploring different rhythms) • History of music (prehistory-Renaissance-modern) • Music from Italy
Science	• Types of rock and materials; their composition • What the science of those prehistoric people was like
Physical education	• Monitor heart rates while using prehistoric tools • Physical exercises that mimic prehistoric activities: chasing animals, hunting animals, collecting food from the nature; pushing, pulling, targeting • "Pitoti" yoga positions • Using body to (re)create rock art scenes