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Bridging between Archeologists and Civil Engineers via E-learning

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Abstract

Interaction between archeologists and civil engineers has become one of the critical issues in construction planning and management as the scale of infrastructure construction increases with the needs of increasing population. Unfortunately, such a topic is not covered by any university curriculum neither at undergraduate nor graduate level. In order to fill this gap, a Leonardo da Vinci (LdV) project entitled: "Archaeology and Construction Engineering Skills (ACES)" was started in 2007 and completed in November 2009. The main aims of the project are to deepen and broaden professional understandings between two professional sectors – civil engineers and archaeologists. A vocational training course and handbooks were prepared in four languages as part of the project. The training is conducted in an assisted distance training mode. It means all training materials are provided online and the training process is supervised by a teacher. The training process is composed of a lecture and discussion forum. This paper presents the results of the project.

Keywords: *Archaeology; Construction; E-learning; Leonardo da Vinci; Management*

1 Introduction

Archaeology is the study of past human cultures through the analysis of material remains (landscapes, sites, monuments / buildings and artefacts) that people have left behind. In some countries this may include the earliest evidence of human activity to the present day; in others there may be a cut-off date after which remains are not considered to be archaeology. Archaeological remains can include upstanding and ruined buildings, earthworks, buried sites, extant and buried landscapes, artefacts and palaeo-environmental remains, on land and underwater. Archaeological remains may be encountered almost anywhere and may have implications for most types of development site.

Archaeological remains are part of our shared cultural heritage. Their study helps us to understand the world around us at a local, national and international level through developing our understanding of how that world has developed. Understanding the archaeological remains and landscapes around us, often referred to as the historic environment, contributes to our sense of identity and place and helps us engage and interact with our communities. Archaeological remains are environmental assets and should be considered as part of sustainable development policies. They are also non-renewable; once damaged or removed they cannot be replaced and their potential to enhance our understanding of past human cultures is lost.

By developing a better understanding of archaeology, its terminology and the way it is carried out, construction engineers will be able to understand the archaeological process better and integrate archaeological considerations more effectively into the development programme. Better integration of archaeological considerations into the development process has the potential to save both time and money but may also have other, public relations

benefits for the developer such as generating favourable publicity for the development, showing a commitment to sustainable development and generation of community support.

The project seeks to broaden the understanding of professional archaeologists and to help them to recognize the needs and concerns of the engineering sector and also to help members of the construction engineering industry break through the professional mystique of archaeology. The aim of the project is very definitely not to train archaeologists to act as engineers or *vice versa*, but to improve understandings and capabilities to allow individuals and organisations in the two sectors to work together more efficiently.

Many success or failure examples from all over the world may be given about the conflict of these two sectors. Two case studies are presented in this paper: The Marmaray Project in İstanbul, Turkey and the Yamal-Europe gas pipeline project in Poland in order to illustrate some issues and gains from the collaboration of archaeologists and civil engineers in projects.

Learning management systems (LMS) are used for e-learning purposes. LMS have an important place in web-based or distant learning. LMS can be identified as software or web-based technology that provides planning, evaluating, and practicing the learning process. Currently, more than 60 different providers exist for learning management systems (Wikipedia, 2010). Moodle (http://moodle.org/), one of the most common and free, can be given as an example which has been used in many other applications (e.g., Toprak et al., 2008). Significant progress has been achieved in recent years regarding Learning Management System (LMS) softwares from being just a simple education recording system to serve as integrated systems which can manage all human resources, personnel and student information needs along with providing education within whole institution. In this project, e-learning courses for asynchronous distance lectures are provided through Edumatic system managed by Adam Mickiewicz University (Poland).

2 ACES Project

Archaeology and Construction Engineering Skills, also known as 'ACES', is a project funded with support from the European Commission through the Leonardo da Vinci fund of the EC's Lifelong Learning Programme. The Leonardo da Vinci programme which funds a wide range of actions, notably cross-border mobility initiatives; co-operation projects to develop and spread innovation; and thematic networks. The potential beneficiaries are similarly wide – from trainees in initial vocational training, to people already in the labour market, as well as VET professionals and private or public organizations active in this field. Leonardo da Vinci enables VET organizations to work with European partners, exchange best practices, increasing the expertise of their staff and respond to the teaching and learning needs of people. It therefore supports efforts to make vocational education more attractive to young people. By helping European citizens to acquire new skills, knowledge and qualifications, the programme also aims to bolster the competitiveness of the European labour market (European Commission, 2009).

This project brings together archaeologists and engineers from four very different European countries – Turkey, Poland, Norway and the UK - to support improvements in quality and innovation in professional, vocational, education and training by developing relevant and innovative e-learning content. The project web site address is www.aces-project.eu.

The partnership in ACES is a combination of sectoral professional organisations, research organisations, social partners, university training providers and employers. The bodies in the partnership are key representatives of the sectors of construction engineering and archaeology in four states, with the addition of a transnational body, the European Association of Archaeologists (EAA), whose role is the valorisation of the Project and its outcomes. In addition to EAA, project partners are as follows: Institute of Field Archaeologists (United Kingdom)-The Promoter, Gifford (United Kingdom), Pamukkale University (Turkey), Erbil Project Consulting Engineering, Co. Ltd (Turkey), Sintef – Byggforsk, the Foundation for Scientific and Industrial Research at the Norwegian Institute of Technology (Norway), Riksantikvaren, Directorate for Cultural Heritage (Norway), Polish – British Construction Partnership (PBCP) (Poland), Polskie Stowarzyszenie Menedżerów Budownictwa (PSMB), Polish Association of Building Managers (Poland), Adam Mickiewicz University (Poland),

The target sectors for the project are engineering, archaeological practice and training providers. Within these sectors, the target groups are professional archaeologists, professional construction engineers, students of archaeology and engineering, planners, decision makers, employers of small and medium enterprises.

In order to discuss issues related to archaeology and civil engineering, an ACES industry panel meeting was conducted at Pamukkale University, Denizli, Turkey on April 2, 2008 (Toprak, et al., 2010). The panelists were Prof. Dr. Ahmet A. TIRPAN, archeologist and architect, Selçuk University; Bekir USTA, civil engineer, MARMARAY Railway Tunnel Project, AVRASYA Consult, İstanbul; Prof. Dr. Nejat BİLGEN, archeologist, Dumlupınar University, Eskisehir and Asst. Prof. Dr. Ahmet YARAŞ, archeologist, Trakya University, Edirne. The panel was a joint activity between Pamukkale University and Chamber of Civil Engineers, Denizli and about 100 Civil engineers, and about 100 academicians-students participated. The discussions and general results of the panel are presented in (Toprak, et al., 2010).

The project found it important to present case studies to show some issues and good practice from each of the partner countries. Two of them are presented briefly herein to give a glimpse. Others can be found in (Toprak, et al., 2010) and on the e-learning platform.

2.1 The Marmaray Project

The Marmaray Project involves a full upgrade of the worn out commuter rail system in Istanbul, connecting Halkali on the European side with Gebze on the Asian side with an uninterrupted, modern, high-capacity commuter rail system. Two existing railway tracks on both sides of Bosphorus will be fully upgraded to three tracks and connected to each other through a two track railway tunnel under İstanbul and the Bosphorus. The line goes underground at Yedikule, continues through the Yenikapi and Sirkeci new underground stations, passes under the Bosphorus, connects to the Uskudar new underground station and emerges at Sogutlucesme (Fig. 1).

Figure 1. Map of the Marmaray Project (Lykke and Belkaya, 2005; Usta, 2008).

The co-operation between construction and archaeology was extensive during the project. It is considered one of the success stories and resulted in gains both in terms of the project and the archaeological and cultural heritage. Many discoveries were made. The archaeological studies at the sites excavated as part of the Marmaray Project had important ramifications. It was shown that the history of Istanbul went back as early as 8000 B.C. Furthermore, the first harbour archaeological excavation in Turkey with such an extensive coverage was performed during Marmaray Project. Many archaeological discoveries were made during the harbour excavations. It is known that similar harbours exist in different parts of Turkey. It is expected that the experience gained here will contribute to many harbour excavations in other parts of Turkey (Figs. 2 to 4).

Highlights of best practices in Marmaray Project are given in below:

- The strategy of co-operation between archeology and construction had been determined before construction began
- A budget for archeological works was identified at the outset
- Archaeologists were working continuously on the site of construction
- Some delays and changes to the project were accommodated during construction to protect archaeological remains
- Archaeological artifacts were protected and exhibited at various museums

Figure 2. Archaeological excavation of the chapel found in the construction of Marmaray (Usta, 2008).

Figure 3. Archaeological excavations in the shaft of a metro station (Usta, 2008).

Figure 4. Ship wrecks discovered in the Marmaray excavations (Usta, 2008).

2.2 The Yamal-Europe Gas Pipeline Project

The transit gas pipeline Yamal-Europe connects Western Europe with rich deposits of natural gas on the Yamal peninsula. Its total length is about 4000km. The construction in Poland was carried out by EuRoPol GAZ and the first field survey was undertaken between 1993-94. Before the start of construction and assembly work, the investor financed rescue excavations along the pipeline route. This resulted in the discovery of a range of archaeological sites ranging from the Late Paleolithic to the Middle Ages. Altogether, hundreds of camp sites, settlements, inhumation and cremation cemeteries along with several sacred objects were discovered and recorded.

The rescue excavation was the first project on this scale since 1989 and set new standards for rescue works in the context of the commercialization of archaeological fieldwork and the rapid growth of large investments in the whole country (Fig. 5).

The most serious problems facing rescue excavation in the initial period after 1989 was the far from satisfactory legal system and method of financing such research. In carrying out the provisions of the law on the Protection of Cultural Property of 15 February 1962 and the European Convention on the Protection of the Archaeological Heritage of 1992, EuRoPol GAZ, not only covered its legal obligations but also anticipated some solutions that have since been adopted by a new law on the protection of monuments in 2003. This project resulted in development of a comprehensive research programme to protect the cultural heritage.

The organizational practice, research design and results of the Yamal gas pipeline project led to the formulation of a number of imperative applications. New statutory regulations adopted the principle that 'who that destroys pays'. It was considered that rescue archaeological work should cover all endangered sites and the methods of excavation and documentation should comply with standards set up for research excavations. The final result should be in the form of full analysis and publication of material obtained during excavations.

The Yamal gas pipeline launched a new model of close cooperation between the investor and the archaeologists organizing and carrying out rescue excavations. This was the first time archaeological research was undertaken in such a systematic manner. The adopted principle stated that each archaeological site on the pipeline route would be properly excavated, recovered materials would be fully studied and then protected and, whenever possible, put on display. Experience gained during this project was subsequently used and developed in the course of rescue excavation in connection with the emerging network of motorways and express roads.

Figure 5. Rescue excavation on the route of Yamal-Europe gas pipeline (Source: Arek Marciniak)

3 E-learning Material and Platform

A vocational training course and handbooks were prepared in four languages as part of the project. The partners first worked on the English version of the training material. After finishing the common English product, translations took place and national flavors were added to national training materials. The training is conducted in an assisted distance training mode. It means all training materials are provided online and the training process is supervised by a teacher. The training process is composed of the training materials and discussion forum.

E-learning courses for asynchronous distance lectures is provided through e-learning platform (Edumatic system) managed by Adam Mickiewicz University (Poland). The e-learning platform and the three options given to ACES trainees in Turkish are shown in Fig. 6.

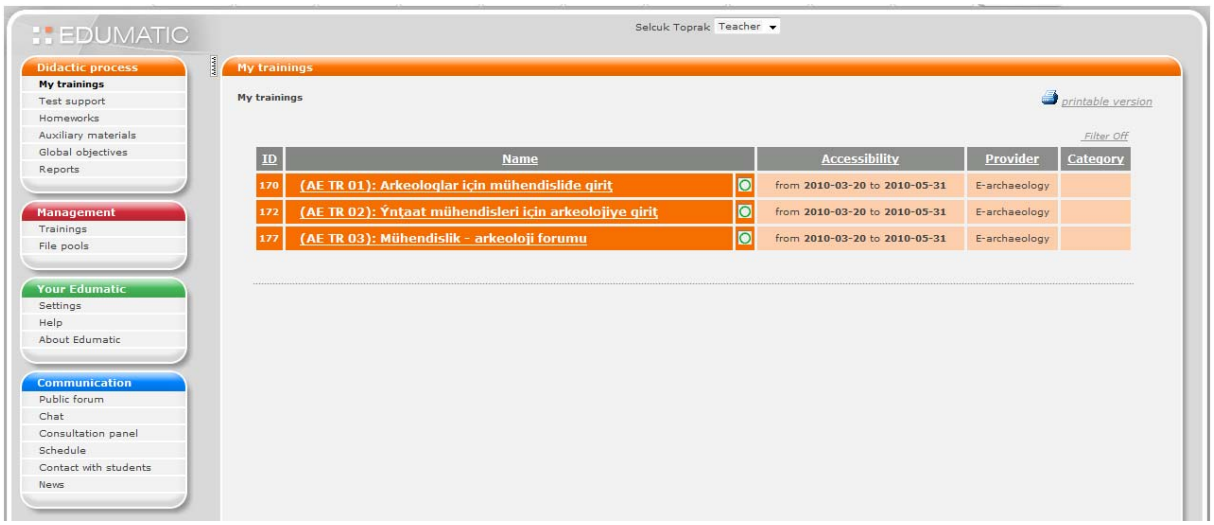


Figure 6. E-learning platform and the training options in ACES for engineers and archaeologists

The training is composed of two asynchronous distance lectures of "introduction to engineering for archaeologists" and "introduction to archaeology for civil engineers". This comprises individual work of the trainee of his/her choice with multimedia and interactive e-learning course. It is supplemented by asynchronous distance conversation that is a collective work of trainees at the discussion forum named as "engineering-archaeology forum". Although the courses are separate for archaeologists and engineers, the forum is common. "Introduction to engineering for archaeologists" course provides the basic introductory knowledge, necessary for archaeologists to understand construction technology and management. "Introduction to archaeology for civil engineers" course aims to help members of the civil engineering industry break through the professional mystique of archaeology.

The trainee need be equipped with the following elements to participate at the training:

- Computer with internet connection
- Web browser: Internet Explorer (version 6.0, or higher) / Mozilla Firefox (version 2.0 or higher) with Adobe flash player plug-in (version 8.0 or higher)
- Personal e-mail account (recommended),
- Word processor (MS Word / OpenOffice),
- PDF documents reader i.e. Acrobat Reader.

It is assumed that the trainee is able to use all softwares and tools as presented above.

Each of the two courses is comprised of modules. The term 'modularisation' has a long history and was, and is, used to describe the process of manufacturing final products in a simple and effective way and at reasonable costs. Within this perspective, the term 'module' refers to a part of a building, a system or product. A building or a system is composed of a multitude of modules each of which is indispensable for the operation of the entire system. Both terms are used as organisational and methodological principles in vocational education and training development. In accordance with these concepts, training modules can be composed like 'building blocks' in various ways according to the training needs and characteristics of the target group(s), and the time available for training. Even if the wall-building metaphor of "building blocks" is generally used to express the process of

modularisation and the creation of a modular structure, it is worth underlying that modules as "building blocks" are in no way to be interpreted as a simple segmentation of blocks of contents embedded in the curriculum description (Toprak, et al., 2010).

Table 1 shows the modules and SCOs for the course named "introduction to archaeology for civil engineers". Each module consists of several and meaningful SCOs. Sharable Content Object (SCO) is defined as the atomic entity of a Learning Management Sharable Content Object Reference Model (SCORM). Table 2 shows the modules and SCOs for the course named "introduction to engineering for archaeologists".

After entering the training, the trainee can click the course title to start learning from e-learning course (feature 1), can see if there any auxiliary materials (handbooks, articles, publications, photos) for the training uploaded by the teacher (feature 2), can check if there are any news sent by the teacher (feature 3), and can enter the discussion forum (see Fig. 7).

As shown in Fig. 8a, after entering the course, the trainee can use buttons (feature 1) to navigate trough the course. The course tree (feature 2) indicates where the trainee is at the moment. The chart shows the trainee how many learning objects of the course he/she has already completed (feature 3). "x" button (feature 4) can be used to get back to the training details, "Home" button (feature 5) can be used to get to the training list, and "Logout" button (feature 5) can be used to log out from the system.

After clicking the title of the forum on the training details screen, the trainee enter the forum (Fig.8b). There may be many topics on one forum and trainee can click the title of the topic of interest and reply to any posts. Exercises and questions are an important part of e-learning and are provided for each SCO (Fig. 8c).

Table 1. Modules of introduction to archaeology for civil engineers training

MODULE 1. ARCHAEOLOGY AND ITS LEGAL AND ORGANIZATIONAL FRAMEWORK	
SCO1 What is Archaeology? Why does it matter?	**SCO2** International framework
SCO3 Licensing and Standards	**SCO4** Roles and responsibilities of archaeological organisations
SCO5 Stewardship of the historic environment	
MODULE 2. ARCHAEOLOGICAL SITES IN LANDSCAPE	
SCO6 Types of Sites - non portable	**SCO7** Types of Sites – Portable
SCO8 Degrees of importance	**SCO9** Types of development - introduction
SCO10 Types of development – Greenfield	**SCO11** Types of development – Brownfield
SCO12 Types of development – Bluefield	**SCO13** Types of development – Marine
MODULE 3. ARCHAEOLOGICAL PROCESS	
SCO14 Archaeological techniques - introduction	**SCO15** Archaeological techniques - non-invasive
SCO16 Archaeological techniques - invasive	**SCO17** Archaeological techniques - excavation
SCO18 Archaeological techniques - sampling	**SCO19** Post-excavation – Analysis
SCO20 Post-excavation – Publication	**SCO21** Post-excavation– Public archaeology
MODULE 4. ARCHAEOLOGICAL PROJECT COMPLETION	
SCO22 Timescale and risk overview	**SCO23** Feasibility and design
SCO24 Application stage	**SCO25** Enabling works
SCO26 Construction	
MODULE 5. ARCHAEOLOGICAL CASE STUDIES	
SCO27 Case Studies Norway Poland Turkey UK	

Table 2. Modules of introduction to engineering for archaeologists training

MODULE 1. ENGINEERING COURSE FOR ARCHAEOLOGISTS – INTRODUCTION	
SCO 1 Introduction, objectives of training,planning and authorities	
MODULE 2. CONTRACTUAL ISSUES	
SCO2 Who's who in the construction project	**SCO3** Procurement routes / Types of contracts
SCO4 Public clients	**SCO5** Private clients
MODULE 3. TECHNOLOGICAL ASPECTS	
SCO6 Engineering Soils	**SCO7** Plant and Machinery
SCO8 In ground structures in rural areas	**SCO9** In ground structures in urban areas
MODULE 4. HEALTH, SAFETY AND ENVIRONMENT PROTECTION	
SCO10 Health and Safety	**SCO11** Contaminated Land
MODULE 5. RUNNING THE CONSTRUCTION INVESTMENT PROJECT	
SCO12 Stages in the building project – including timescales	**SCO13** Design process
SCO14 Pre-planning desk top investigations.	**SCO15** Geotechnical Evaluation
SCO16 Environmental Evaluation	**SCO17** Site investigation techniques
SCO18 Risk management	**SCO19** Physical Mitigation strategies
SCO20 Contractual aspects of Mitigation	
MODULE 6. IMPORTANCE OF ARCHAEOLOGISTS AND ENGINEERS CO-OPERATION	
SCO21 Pre-excavation ground modeling	**SCO22** Construction - Advanced works
SCO23 Construction - Concurrent working	**SCO24** Construction - Watching brief
MODULE 7. CASE STUDIES	
SCO25 Engineering Works in a Historic Landscape Context - Fulham Palace (UK)	**SCO26** Urban (brown field) – Poland
SCO27 Best practice Norway- Marine (Oslo Project)	**SCO28** Turkey – Subterranean (Marmaray Project)

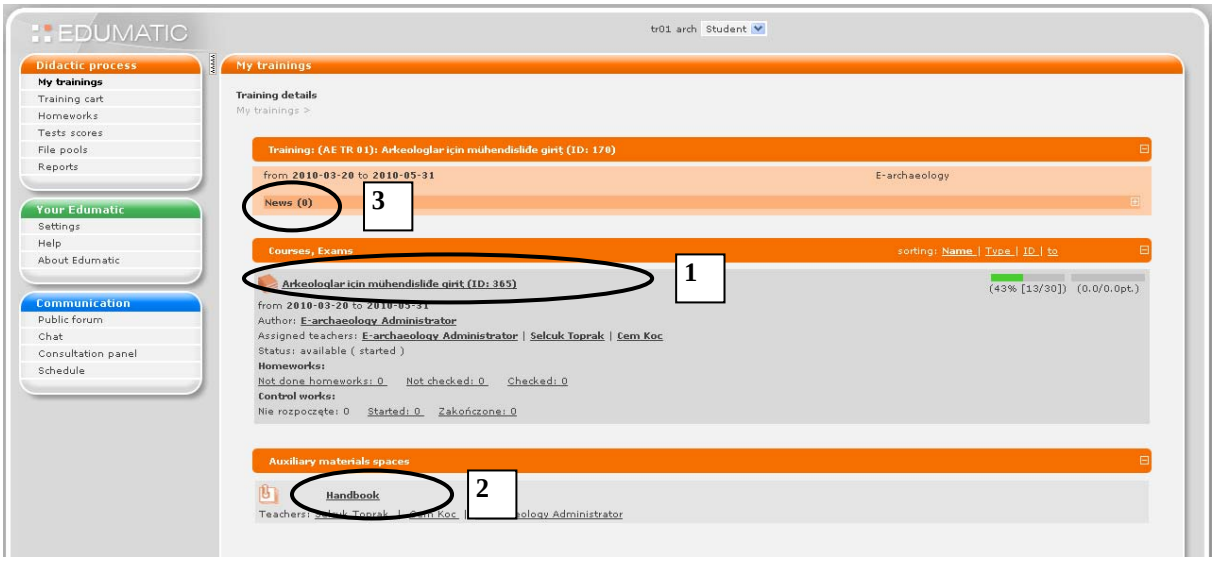
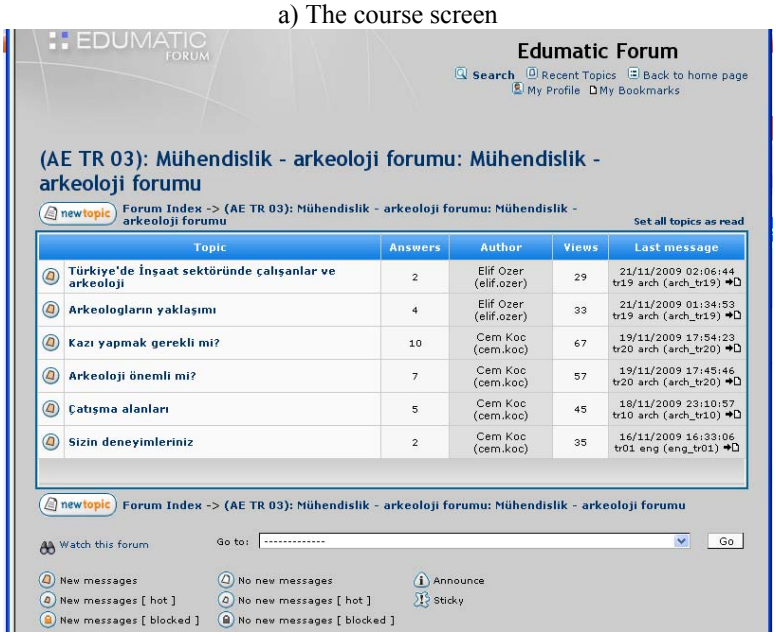


Figure 7. The course, news and auxiliary material sections at e-learning platform of ACES

a) The course screen



b) Forum

c) Exercises

Figure 8. The training in ACES e-learning platform.

Pilot testing of the e-learning material was performed in four countries including Turkey. A successful completion of the training involves: i) Study of e-learning course, ii) Preparation of at least two entries into the discussion on the "Engineering-archaeology forum" positively evaluated by the teacher. 22 trainees participated in "introduction to archaeology for civil engineers" and 22 different trainees participated in "introduction to engineering for archaeologists" courses. Their response was positive.

4 Conclusions

The course is the response to the need for better understanding of professional co-operation between archaeologists and engineers working together on construction projects. This lack of understanding can have financial and environmental impacts as projects can become delayed with ensuing costs a direct consequence and as archaeological remains can be unnecessarily damaged or destroyed. Because of the relatively 'hidden' nature of archaeological deposits, the degree to which they might be impacted upon by a construction engineering project can be difficult to predict. This has led to archaeological remains being seen as unpredictable obstacles and the work of archaeologists on those remains as an unpredictable burden, in terms of time and cost. This unpredictability leads to uncertainty - a risk - and so mitigation strategies are needed to reduce this uncertainty. The key means by which this uncertainty can be reduced is through the integration of archaeologists with the engineering team and through the application of both archaeologists' and civil engineers' skills and competencies in managing construction projects. Improved skills in the two sectors will reduce the environmental impact of construction engineering projects on Archaeological remains.

The project seeks to broaden the understanding of professional archaeologists and to help them to recognise the needs and concerns of the engineering sector and also to help members of the construction engineering industry break through the professional mystique of archaeology. The aim of the project is very definitely not to train archaeologists to act as engineers or *vice versa*, but to improve understandings and capabilities to allow individuals and organisations in the two sectors to work together more efficiently.

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