Michael Rains

Silchester – A Virtual Research Environment for Archaeology

Abstract: The Silchester Virtual Research Environment (VRE) project was funded under stage 1 of the UK Joint Information Systems Committee (JISC) Virtual Research Environments programme. The project was designed to address three particular problems experienced by archaeologists in the context of the well established Silchester Insula IX Town Life Project at the University of Reading. Each of these problems related to a perceived "bottleneck" in the flow and management of data through the life of the project from excavation to publication. The first strand of the project examined possibilities for improving initial on-site data gathering, the second examined ways of providing interoperability between the various independent IADB servers, and the third aimed to foster greater engagement and closer involvement in the project amongst the large group of project co-workers.

Introduction

This paper will describe the development of a Virtual Research Environment (VRE) for archaeology based around the on-going large scale excavations at the Iron Age and Roman site of Silchester, Hampshire, UK (http://www.silchester.rdg.ac.uk). The VRE project was funded under the UK JISC's Virtual Research Environments programme (http://www.jisc.ac.uk/programme_vre.html) and is based at the University of Reading.

The Silchester project's data archives are contained within the Integrated Archaeological Database (IADB) system which is a web server based solution designed to manage all parts of the project record and the links between those parts. It is at the heart of the process of post-excavation analysis and research and is now being developed as the foundation for web publication of the excavation and its data archive. The principal aims of the Silchester VRE project were to improve information and data flow in three key areas of the excavation and post-excavation process. The first strand of the project examined possibilities for improving initial on-site data gathering through the use of a site-wide wireless network and hand-held tablet PCs and PDAs, the second examined ways of providing interoperability between the various independent IADB servers, and the third aimed to foster greater engagement and closer involvement in the project amongst the large group of project co-workers through the development of an on-line collaborative working environment.

On-Site Data Gathering

Many field workers have explored the use of successive generations of portable computing devices for the direct digital capture of archaeological data with varying degrees of success. At the forefront of this research in the UK for many years has been the Heslerton Parish Project of the Landscape Research Centre which began using what would now be seen as very primitive "enhanced" calculators on site in the early 1980s. The Landscape Research Centre's recent DigIT project has sought to evaluate the current state of the art in digital recording equipment and approaches (Powlesland 2007). Other recent work has included the use of various types of PDA linked to GPS receivers, particularly in the area of landscape archaeology (Van Leusen / Ryan 2001; Ryan / Van Leusen 2004).

As well as adding to this research through a small-scale trial of the use of various current hardware approaches to direct on-site digital data gathering, this part of the Silchester VRE project was also designed to contribute to the wider project aim of closer integration and collaboration between all project workers both on and off site, particularly during the annual excavation season.

The excavation site at Silchester is a "green field" site approximately 1 km from the nearest habitation. The excavation area (55 m^2) is not impeded by trees or standing walls or buildings. A range of temporary buildings (Portakabins) is provided along one side of the excavation area. A fixed line telephone connection is not available and not practicable. At the present time, the site is not covered by the 3G mobile network and 2G coverage is variable.

In 2005, a wired ADSL broadband connection was installed in a farm building approximately 1 km away from, and within line-of-sight of the Portakabins on site. A radio link extended the connection to site through the use of small directional aerials mounted on the gable end of the farm building and the roof of one of the Portakabins. A standard wireless access point was then used to provide wi-fi coverage over approximately 80% of the excavation area. As in previous seasons, several desktop and laptop computers were used within the site Portakabins, but now with direct Internet access, including to the IADB server in Reading. In addition, in both 2005 and 2006, a number of hand-held Tablet PCs and PDAs were tested.

The ADSL connection proved mainly reliable and those problems which did arise were generally not technology related. The benefits of maintaining full access to the IADB for all users, on and off site, throughout the excavation, and of providing wider Internet access, for example email, for on-site users cannot be overstated. This will be a lasting benefit to the Silchester project and will play a key role in realising the core VRE project aims of improved data management and closer collaboration.

Three Tablet PCs were tested: a rugged military style metal cased device with no keyboard costing c. £ 4000, a Toshiba convertible laptop/tablet machine, costing c. £ 1200, and a Samsung Q1 with detachable keyboard costing £ 800. One particular aspect of site recording, the drawing of individual context plans, which offered the potential of removing the need for post-excavation plan digitisation, was used to test them. In practise, all three were a failure. The devices were too heavy for prolonged use, the screens were unreadable in direct sunlight or even partial shade, and there were problems with the passive pen systems on the military style and Samsung machines.

For testing the PDAs, all of which were Hewlett Packard iPaq models, finds recording was selected as an area of the IADB where simple but useful data entry could be undertaken without the need for extensive text input. A simplified IADB user interface was created suitable for the small screens and limited functionality of the devices. The same screen readability problems were encountered as with the Tablet PCs, but here the most interesting issues were those concerned with the integration of new ways of working into existing on-site methodologies which had been developed and refined over a number of years. The PDA trial involved unique Find accession numbers being generated and assigned by the IADB server in response to requests from excavation supervisors using the PDAs, whereas in the past, these numbers had been issued manually by finds staff working in the finds recording Portakabin and later input to the IADB database. This change raised issues of "ownership" of process and status, particularly among finds staff.

The VRE project design posed the question: "Has the technology of Tablet PCs and PDAs reached a level at which they can make a significant contribution to excavation recording at a price which archaeologists can afford?". In general terms, this question was answered in the negative. However, the trial did demonstrate the importance to archaeologists of recognising and exploring these and other emergent technologies which may have a role in on-site data gathering. For example, a trial of digital paper and e-forms, which have the advantage from the user's point of view of looking familiar and "low-tech", will be undertaken during the 2007 season at Silchester.

Cross-Server Interoperability

The second stage of the project aimed to address the issue of cross-server interoperability. At the start of the project there were independently owned and managed IADB servers in York, Reading and Norwich. These have since been joined by servers in Southampton and Kemble. However there were no facilities for cross-server searches for, for example, Samian pottery, records of which are present in all the servers.

The major technical impediment to providing cross-server interoperability was the wide variety of firewalls and other barriers in operation on the various servers. Rather than follow the more traditional route of a server-side solution in which the servers "talk" directly to each other, it was decided to explore the possibility of a client-side solution in which the individual user's browser talks directly to each of the servers. What this envisaged was a browser script, in response to a user request, requesting data from each available server and then integrating the results into a coherent "answer" for presentation to the user. However, the "same origin policy" enforced by browsers prevents a web page script from interacting with pages fetched from other domains. To circumvent this, an AJAX programming technique known as "Javascript On Demand" has been used to load Javascript code with embedded data in

JavaScript Object Notation (JSON) format from the different servers. The embedded data obtained from each server can then be integrated and formatted as a response to the user.

A demonstrator of these techniques was developed within the IADB and this worked well in principle. In fact, the "Javascript On Demand" technique has now been used widely in other recent developments in the IADB. For cross-server searches, issues remain to be resolved with regard to searches which return large amounts of data. Further work is needed to develop more refined resource discovery methodologies which will produce more targeted searches producing more manageable result sets, which is normally what is required. Where large data sets do need to be retrieved in this way, techniques for packaging result sets into manageable "chunks" need to be developed.

Post-Excavation Research

A project such as Silchester involves a large number of people, both on-site and off. These include the core team, closely involved with the project, plus a much wider group of people, for example finds specialists, most of whom will only be involved part-time with the project. Many will be geographically dispersed, both from each other, from the site, and from relevant information held elsewhere. Some will work within institutions, academic or otherwise, while others will work alone outside of any institutional framework. This makes the exchange of ideas and interpretations, which are critical to the research process, very cumbersome. The third strand of the Silchester VRE project was aimed at developing the basis for a virtual solution to this problem.

Researchers have been describing approaches to virtual research environments in archaeology for many years without actually using the term. In 1995, Ryan argued that excavation recording systems "need to support […] exploratory research activities" by different members of the post-excavation team (Ryan 1995) and quoted similar comments by Richards from several years earlier (Richards 1991). In the same year, the present author wrote of the IADB forming the "factory floor" on which the process of post-excavation analysis takes place (Rains 1995). The advent of technologies commonly grouped under the umbrella term Web 2.0 allows us to take the development of virtual collaborative research environments forward to a new level.

The initial approach adopted by this project centred around the twin concepts of Views and Virtual Seminars. The View concept was seen as a way of encapsulating particular issues, research topics, or sub-projects within the larger Silchester project. Views would in effect be subsets of the wider IADB, wrappers for selected IADB resources and the links between them relevant to a particular research topic or sub-project. Views might overlap and share resources, or they might be nested, with one View forming part of a larger or wider one. Virtual Seminars would take place on-line and would involve the participation of invited project workers, including external specialists. At the core of the seminar would be one or more IADB Views presented on a virtual "whiteboard", linked to an online "chat" facility. Seminar participants would be able to explore and annotate the whiteboard and converse with other participants through the chat facility either in real time, or on an ad-hoc basis. A full transcript of each seminar would be retained so that it could be "replayed" or continued at a later date, and would become part of the project archive.

User testing of the prototype in summer 2005 revealed that, although the individual elements of the package could be useful, the overall approach was not what users wanted because it did not produce or contribute to the end products that users needed which were generally documents, many of them destined for web publication. It became clear that what was needed was a series of possibly overlapping or nested collaborative working environments, each addressing a particular research issue or sub-project.

In response to this the concept of the research domain was redefined to contain two different collections of IADB records or resources. The first of these collections, termed Key Resources, consists of existing IADB records relevant to the research domain. The Key Resources list provides easy access to stratigraphic matrix diagrams, object records, plans, images, etc. to which researchers might need to refer whilst working within the research domain. This is particularly useful for those researchers who might only work in the IADB on an intermittent basis and who are not as familiar as regular users with the techniques for resource location and retrieval within the IADB.

The second collection, referred to as Research Topics, also consists of a list of selected IADB records, but these records will normally be documents and they will normally be blank initially. These are the

building blocks of the end product of the research domain. For example, in a research domain directed at the production of an interim or assessment report, the Research Topics list might contain documents for, *inter alia*, each of the main categories of finds. The job of workers in the Research Domain is to write or complete these documents. The Research Topics list provides the "factory floor" on which the purpose of the Research Domain is carried forward.

During the second half of 2006, the revised Research Domain framework was extensively tested in a real world situation when it was used to produce a web publication covering one aspect of the Silchester project as part of the Archaeology Data Service/Internet Archaeology "Making the LEAP" programme (http://ads.ahds.ac.uk/project/leap/) which is funded by the UK Arts and Humanities Research Council under the ICT Strategy Programme. This involved three members of the core Silchester team plus twelve external specialists collaborating on the production of over 25 documents, all richly illustrated and with numerous links to other IADB items, within a Research Domain created within the IADB. Given that this was happening while the Research Domains software implementation was being developed, the results were highly positive. Significant improvements in data flow and handling were easy to see and there was closer collaboration with, and integration of, external specialists, especially those who fully adopted the Research Domain methodology. Particularly notable towards the end of the LEAP project was the efficiency of the process by which the completed pages were moved out of the IADB and on to Internet Archaeology. In view of the meaning of the Making the LEAP acronym (Linking Electronic Archives and Publications), it is particularly appropriate that this should have been the first practical test of the VRE Research Domain concept. The integration of narrative reports with raw archaeological databases, particularly dynamic databases of ongoing excavation projects such as Silchester, is a developing and challenging area of research. A solution is required which "nei-

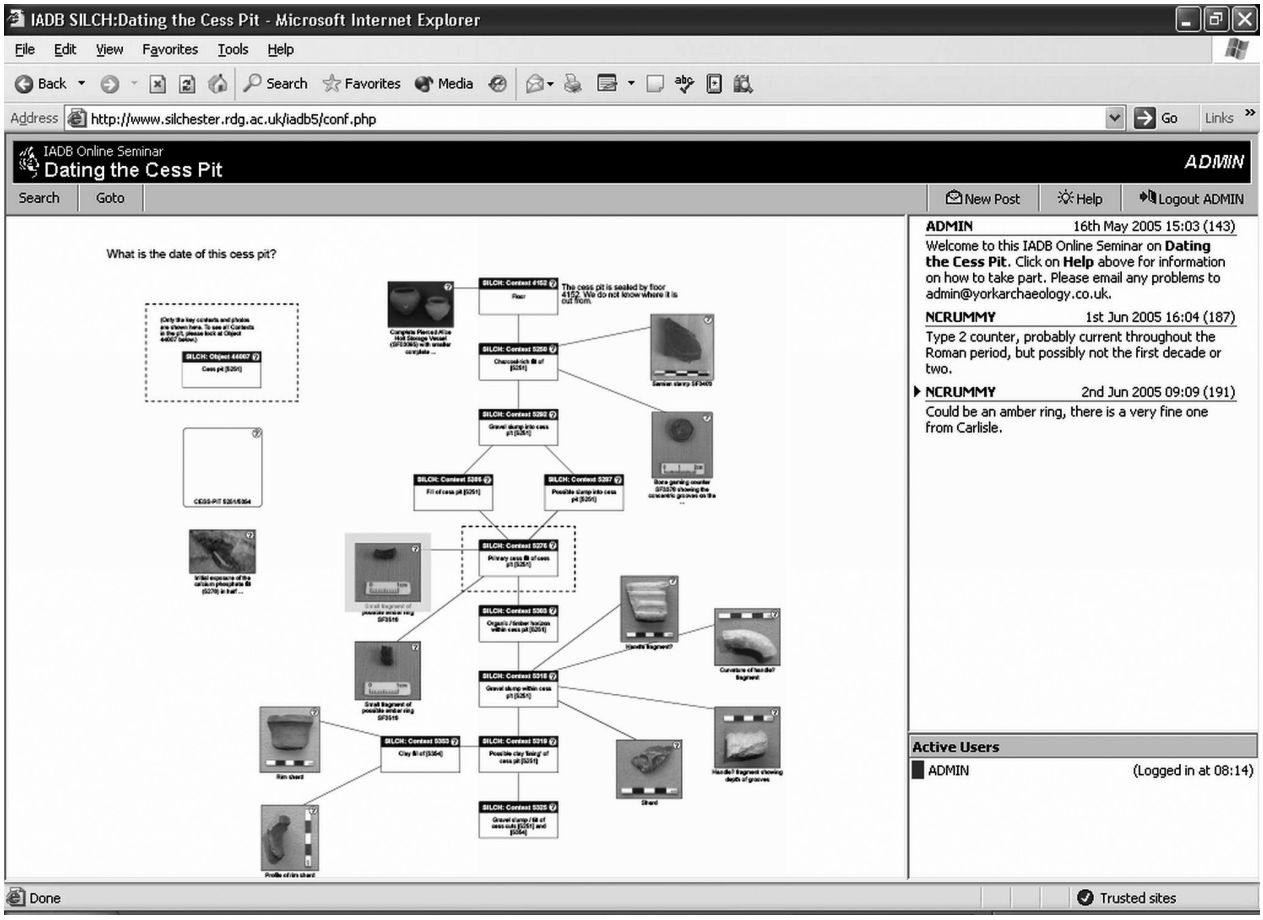

Fig. 1. An example online seminar.

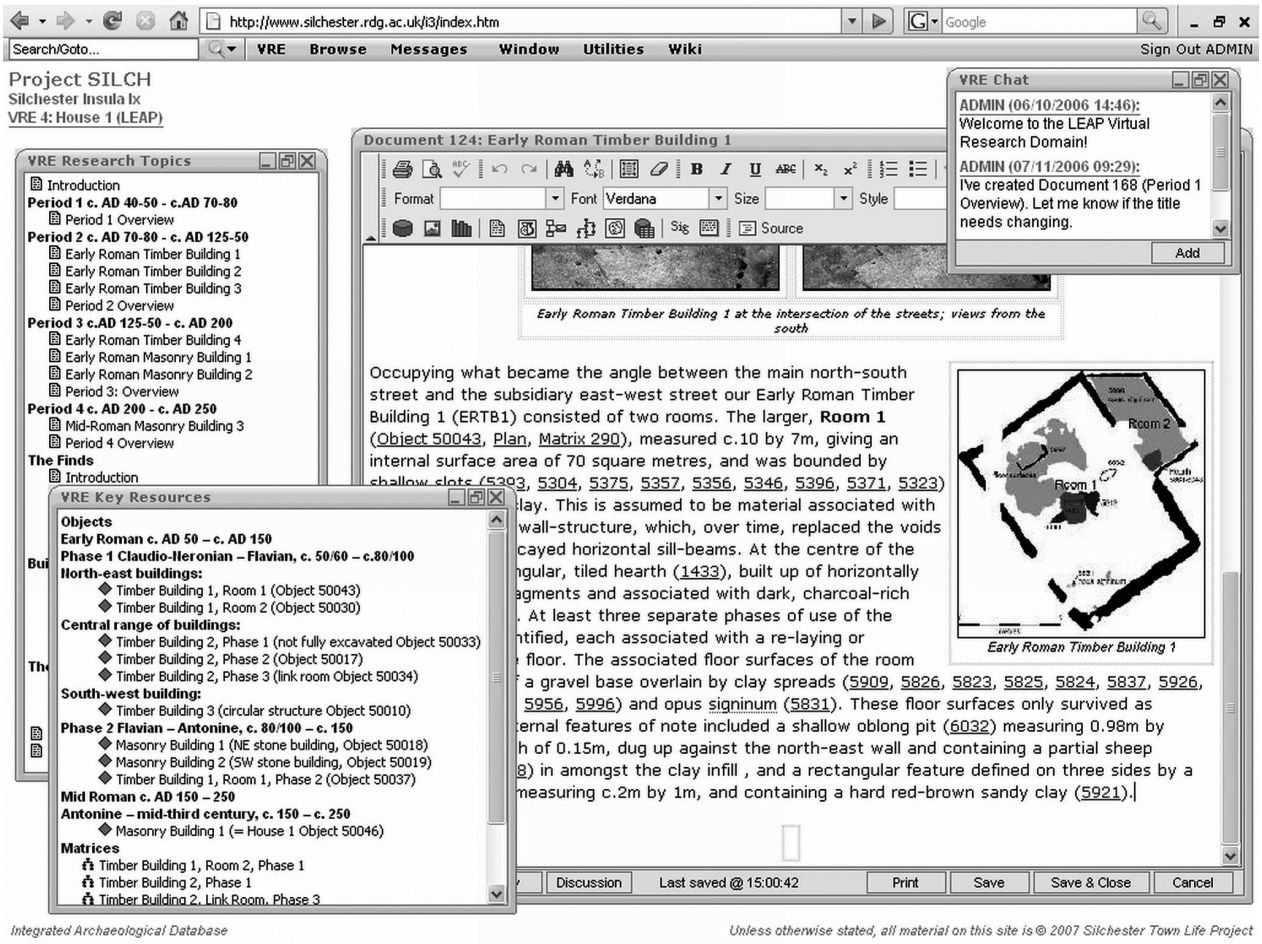

Fig. 2. The Silchester LEAP Virtual Research Domain showing the Research Topics list, Key Resources list, one of the Research Topic documents being edited, and the VRE chat window.

ther overwhelms with the amount of data nor mystifies with the hidden meaning of the data, yet does not simplify the complexities of the data and their interpretation" (Tringham 2004). The development and refinement of such a solution for Silchester will be a major focus for the future (Clarke / Fulford / Rains 2003).

Recent work has focused on the development of the stratigraphic matrix diagrams within the IADB into what at present are being called Enhanced Matrix Diagrams. It is now possible to add to these diagrams items other than contexts, such as images, documents, plans and, indeed, other matrix diagrams. This effectively turns the stratigraphic matrix diagram into a more general purpose visualisation tool for the archaeological project archive, similar to, but more powerful than, the View concept described above. By including editable documents, the diagram can function as a graphical interface to a Research Domain.

Conclusions

While the outcome of the trial of direct on-site digital data gathering was disappointing, the Virtual Research Domain concept has already significantly enhanced the processes of post-excavation research and publication at Silchester. The Silchester project has, in March 2007, been awarded a further two years funding by JISC under stage 2 of the VRE programme to continue development of the Silchester VRE in collaboration with the Department of Computing at Reading University and University College London. VRE2 will continue the trials of emergent hardware and software approaches to direct on-site digital data gathering and will take forward the development of the IADB into a portal for archaeological research.

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Michael Rains

York Archaeological Trust
47 Aldwark, York, YO1 7BX
United Kindom
admin@yorkarchaeology.co.uk