iTrench: A study of user reactions to the use of information technology in field archaeology

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Abstract

This article describes work undertaken by the VERA project to investigate how archaeologists work with information technology (IT) on excavation sites. We used a diary study to research the usual patterns of behaviour of archaeologists digging the Silchester Roman town site during the summer of 2007. Although recording had previously been undertaken using pen and paper, during the 2007 season a part of the dig was dedicated to trials of IT and archaeologists used digital pens and paper and Nokia N800 handheld PDAs to record their work. The goal of the trial was to see whether it was possible to record data from the dig whilst still on site, rather than waiting until after the excavation to enter it into the Integrated Archaeological Database (IADB) and to determine whether the archaeologists found the new technology helpful. The digital pens were a success, however, the N800s were not successful given the extreme conditions on site. Our findings confirmed that it was important that technology should fit in well with the work being undertaken rather than being used for its own sake, and should respect established work flows. We also found that the quality of data being entered was a recurrent concern as was the reliability of the infrastructure and equipment.

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1 Introduction

The goal of archaeological computing is to create a situation where 'the information flows seamlessly from excavation, through post-excavation to publication and archive' (Lock, 2003, p. 265). Accordingly, this article presents research conducted by the VERA project (Virtual Research Environments for Archaeology: http://vera.rdg.ac.uk) to identify how the use of advanced IT can move the work flow of excavation and post-excavation towards Lock's seamless flow of

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information. Below we describe the results of a study which aimed to investigate how archaeologists use information technology (IT) in the context of a field excavation. This study was undertaken by researchers at School of Library, Archive and Information Studies, University College London, (which is now known as the Department of Information Studies, UCL), who collaborate on the project with the School of Systems Engineering, and the Department of Archaeology, University of Reading.

VERA is funded by the JISC Virtual Research Environments Programme, Phase 2, (http://www.jisc.ac.uk/whatwedo/programmes/vre2.aspx) and runs from April 2007 until March 2009. We aim to produce a fully operational virtual research environment for the archaeological community. Our work is based on a research excavation of part of the large Roman town at Silchester, which aims to trace the site's development from its origins before the Roman Conquest to its abandonment in the fifth century AD (Clarke *et al.*, 2007). This complex urban site provides the material to populate the research environment, utilizing the Integrated Archaeological Data Base (IADB: http://www.iadb.co.uk/specialist/it.htm), an online database system for managing recording, analysis, archiving and online publication of archaeological finds, contexts and plans (Rains, 1995). The dig allows us to: study the use of advanced IT in an archaeological context; investigate the tasks carried out within archaeological excavations; ascertain how and where technology can be used to facilitate information flow within a dig; and inform the designers of the IADB how it may be adapted to allow integrated use of the tools in the trench itself.

One of the most fundamental concerns of the project is the issue of usability and appropriate design of advanced IT. Numerous studies have demonstrated that the successful uptake of IT depends heavily on understanding users and that if new systems do not fit into existing procedures and routines, uptake of the new technology will be poor.

> Publication after publication reaches the same conclusion: that technology is important but insufficient on its own for the success of ICT-enabled projects. Again and again technology projects fall down not because the hardware is unstable, but because different systems' architectures have been poorly scoped and designed. Without good change management and careful thought given to the people using the systems as well as the technology itself, ICT-enabled projects are unlikely to be successful . . . (Jones and Williams, 2005, p. 9)

The VERA project is using the Silchester excavation as a case study to: study the use of advanced IT in an archaeological context; investigate the tasks carried out within an excavation; ascertain how and where technologies can be used to facilitate information flow within a dig; and inform the developers of the user portal how it may be adapted to allow the integrated use of the tools in the trench itself and for post dig analysis.

2 Research Context

The vast amounts of data produced by modern excavations drives the demand for digital technology and born digital data. Archaeologists were quick to embrace IT to aid in research analysis and outputs (Laflin, 1982; Ross *et al.*, 1990; Reilly and Rahtz, 1992), and the use of IT is now central to the manipulation and display of archaeological data (Lock and Brown, 2000; McPherron and Dibble, 2002; Lock, 2003). However, the use of IT to aid field archaeology is in its relative infancy due to the physical characteristics of archaeological sites, and the difficulties of using IT in the outdoor environment. The use of IT to aid field archaeology has also often met with resistance from those who believe traditional methods are more appropriate (Backhouse, 2006).

With ever increasing amounts of data being generated by excavations, onsite databases are becoming increasingly necessary, for example at the excavations at Çatalhöyük in Turkey (http://www.catalhoyuk.com/database/catal/) and the site of Terminal 5 at Heathrow airport (http://www.framearch.co.uk/t5/), and some archaeologists have begun to use digital data input from total stations, PDAs, tablet PCs, digital cameras, digital callipers, digital pens, and barcodes (McPherron and Dibble,

2003; Dibble *et al.*, 2007; Eiteljorg, 1994). However, these tend to operate peripherally to the main business of excavation which continues to rely on pen and paper, pencil and permatrace (Chadwick, 1997). The use of digital technology in the field is especially challenging, because of the hostile environment. As Backhouse (2006) explains:

> It is a well known truism that any equipment that goes to site ends up broken. Digital cameras are dropped in buckets of water, mobile phones are buried in trial trenches, EDMs fall off cliffs. Archaeologists, it seems, cannot be trusted with equipments that use batteries without breaking something—electronic casualty rates in the field are very high.

The phrase 'preservation by record' is one that reverberates through modern archaeology (Planning Policy Guidance 16: Archaeology and planning)[1] and key to this concept is the reality that it is the archive that is analysed in post-excavation research and not the site itself. At many sites, such as Silchester, the paper records produced on site are then digitized so that they can be incorporated into the site database or final report (Andersen and Bilde, 2000; Powesland, 1998). Frequently this occurs only after the excavation has finished. For many excavations, therefore, the use of IT is restricted to the analysis stage rather than field recording.

However, this has led to a separation between the actual excavation and the recording and interpretation of data after it has ended. Although in reality interpretation of finds and contexts occurs from what Hodder (1997) calls 'the trowel's edge', he argues that the use of complex databases post-excavation can impose a highly codified process of data gathering on excavations, where interpretation is separate from acquisition of data. There is also the danger that excavations produce such a large amount of data that archaeologists may only begin to understand what they are working with when the digging has finished and the interpretation has taken place. However, ideally the use of IT on site should allow data to be interpreted using IT soon after acquisition and the results of this fed back to diggers to further aid their work (Beck and Beck, 2000). This ideal state is, however, not easy to achieve. Although efforts have been made to use technology to integrate excavation recording and interpretation since the late 1990s (Andrews *et al.*, 2000), as we shall argue, it remains difficult to achieve even with the most up to date technology. One of the aims of the VERA project is therefore to investigate the use of IT within the context of a field excavation and to ascertain if, and how, it may be appropriated to speed up the process of data recording, entry and access.

VERA also aims to develop a Virtual Research Environment in which we may integrate not only the collection, recording and interpretation of data, but can also publish results and make them available to the wider archaeological community. For example, a recent article about Silchester was able to use a snapshot of the IADB to allow readers to search the data upon which the article's conclusions were based (Clarke *et al.*, 2007). This kind of integration can only truly be achieved with a fully integrated and functional VRE. Previous projects such as Çatalhöyük have attempted to make some results available via their website, but a review of this website argues that what emerges is more like a digitized version of a traditional report (Jones, 2005). A fully functional VRE should allow us to make the kind of linkages between different types of data and reports on them that the review calls for, thereby allowing users to perform their own interpretation of data excavated on site.

3 Method

We used a diary study to gather information about the work patterns of different archaeological roles and the way that they are supported by both digital and analogue technologies. The study was carried out by the UCL team, at the Silchester dig during the summer of 2007. Context recording at Silchester has traditionally been undertaken using pre-printed context sheets and ballpoint pens. During the 2007 field season a defined area of the Silchester site was used to test the use of new technologies to support excavation. In this area archaeologists used digital pens and paper, (http://www.logitech.com/index.cfm/mice_pointers/digital_pen/devices/408&cl=us,en)

digital cameras, and Nokia N800 PDAs[2] (http://www.nokia.co.uk/A4305204). Diaries from this area were compared with those using traditional printed context sheets to record their work. A detailed record of the progress of both the dig and the study was kept on the VERA blog (http://vera.rdg.ac.uk/blog).

Diary studies are a form of participant observation that enable researchers to understand how people usually work. They can be used to identify areas that might be improved by the adoption of new working practices or technologies, and are usually carried out in a workplace setting (O'Hara *et al.*, 1998). Other forms of participant observation were used by the Revelation Project, whose members argue that this kind of ethnological approach is vital since:

> A real understanding of fieldwork recording systems from the perspective of those carrying out primary data collection will enable the design of digital systems which increase efficiency, access to information and data quality by meeting the information needs of the excavators, finds and environmental processing staff. (Cross and Crosby, forthcoming)

Diary study methods have primarily been used in Human Computer Interaction research (for example, Rieman, 1993; Brown *et al.*, 2000). During diary studies, participants are asked to keep a detailed record of their work over a short period of time. The participant records the activity that they are undertaking, what technologies they are using and any comments they have on problems or the progress of their work (Carter and Mankoff, 2005). Our use of this method helped us to understand the patterns of behaviour that archaeologists exhibited, and how technology can support these behaviours. Although they have been used in to study student use of IT and the work of humanities scholars (Rimmer *et al.*, 2008), the VERA project's use of diaries in the first instance of the use of this method to study field archaeology that we are aware of.

We also obtained contextual data about participants using a simple questionnaire. This elicited information about the diary survey participants (role, team, and status) and their experience of using the technology on site. A cross section of people representing different types of work and levels of experience were chosen. For example we included inexperienced and experienced excavators; members of the finds team, who process the discoveries made on site; those who produce plans of the site and visitor centre staff.

The data was transcribed and anonymized. Each diary and participant details sheet were identified by a participant number, (e.g. P4). The data was then analysed by two researchers to identify themes emerging from it.

4 Findings

4.1 Demographic data

Of the 70 people asked to participate, 33 returned completed questionnaires and diaries. Despite explanation of the reasons for the study, some people felt the diaries were covert attempts to check how hard they were working. These participants who resented being studied naturally produced less detailed data than more willing participants. There was also some feeling amongst the students that they already had to complete too much paperwork, so anything that was optional was inevitably considered to be a lower priority (Figs 1 and 2).

Most people on the site were digging, either as students or supervisors, who are professional archaeologists. Thus the number of returned questionnaires reflected this fact, as Figures 1 and 2 demonstrate.

4.2 Previous use of information technology

Very few of the participants (12%) had previous experience of technology on an archaeological site other than Silchester. Surprisingly, only 19% of the professional archaeologists claimed to have experience of using technology on a site other than Silchester.

There was some resistance to the use of new technology on the excavation, especially on the part of the more experienced archaeologists.

Fig. 1 Participant roles

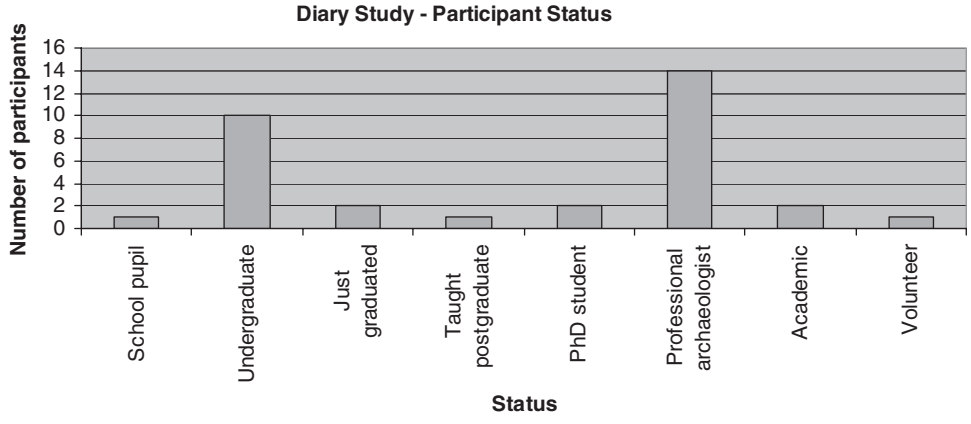

Fig. 2 Status of participants

Some felt that the conditions were too hostile for computer hardware and worried about the potential cost of damaged equipment.

> I think that a computerised version of our paper records is a good idea, but I feel that the environment that I work in doesn't really suit an electronic/computerised source. We work in muddy and wet conditions and expensive equipment may well be ruined. (P17)

Several participants remained convinced than pens, pencils and paper were the most appropriate technology for recording in the field.

> Pen and paper are the staple tools for the archaeologist—adaptable and widely available. (P32)
>
> Easy and quick to use and not in danger of breaking pen and paper. (P21)

4.3 Teaching

The Silchester site is run as a training excavation for Reading students and as a Field School for interested individuals. As many of the people on site have little or no experience of working on an archaeological site a great deal of teaching takes place throughout the season. Teaching is

undertaken by the project team, supervisors and assistant supervisors and occurs in both formal and informal situations. There is also a certain amount of peer-to-peer teaching as more experienced students share their expertise.

Formal teaching on site takes the form of scheduled on-site talks on various aspects of archaeological field skills and specialist areas (Introduction to Context Recording, Using an Archaeological Matrix, Use of Archaeological Tools, Presenting Silchester to the Public, Science@Silchester, Recognizing and Describing Soils in Archaeology, Roman Glass, Roman Finds in the Wider Context etc). Talks are delivered to small groups and are supported by handouts. Written documentation is also produced to support various tasks undertaken on site (Instructions on triangulation, Guide to digitizing plans, etc). However, the practical nature of archaeology and the constantly varying conditions on site mean that much of the teaching that occurs is situational (*ad hoc)*; this is referred to here as informal teaching.

Some of the informal teaching involved teaching people how to use the technology being used on site e.g. Nokia N800, digital pens, EDM (total station). While situational teaching has its strengths it is perhaps not the most effective way to teach people how to use unfamiliar technology.[3] As a result some participants felt that the way to use the technology was insufficiently explained.

> Wasn't made clear how pens interpret what's written—corrections complex and time consuming for interpretation etc. (P9)

The students themselves found it time consuming to learn new technology in the field.

> Digi-paper took some getting used to and as a result slowed me down. (P5)

Supervisors were concerned that new students found it challenging enough to learn about the archaeology without being confronted with unfamiliar technology

> Because the students are having to learn so much about the archaeology itself, it's just an extra complication to have to learn how to use digital pens, palm tops etc. (P3)

It was evident that extra training was needed especially for supervisors, so that they felt comfortable using IT before they were required to teach its use to the students. As a result the project ran an additional training session in the use of IT hardware before the start of the 2008 excavation, in addition to the usual archaeological training. It also became evident that having on site support in the use of technology was also vital in case of problems.

4.4 Technology for context recording

Recording is key to the excavation process and students at Silchester learn to complete context cards, to draw plans and sections, to take levels and to use an EDM (total station). During the 2007 field season a N800 Internet Tablet and digital pens were trialled for context recording in parallel with the more traditional pen and paper techniques.

Before the field test it was anticipated that there might be problems using the Nokia N800 on site. The VERA technical team were worried that the screen would be too reflective to be seen in bright sunlight, that the font size might be too small and that the stylus would be too small to be comfortable in the hand for extended use (https://vera.rdg.ac.uk/blog/?p=24). The diary study confirmed these concerns.

> Failing to use Nokia handheld—WiFi not working and sunlight OTT. Suggest attach 1–2 m parasol to Nokia? (P9)

The sketch facility of the N800 proved unsatisfactory as the quality of output was totally unacceptable. A questionnaire about the Nokia N800 (prepared by Emma O'Riordan from Reading University) also generated the following comments:

> The sketch function is awkward to use yet entertaining
>
> Not good for those with bad eyesight or wearing gloves
>
> I would use one outside if I could see the screen but I wouldn't sketch

The stylus was considered easier to use than the on screen keyboard which was considered 'fiddly' and even the larger touchscreen setting proved unpopular. Users predicted that the stylus would

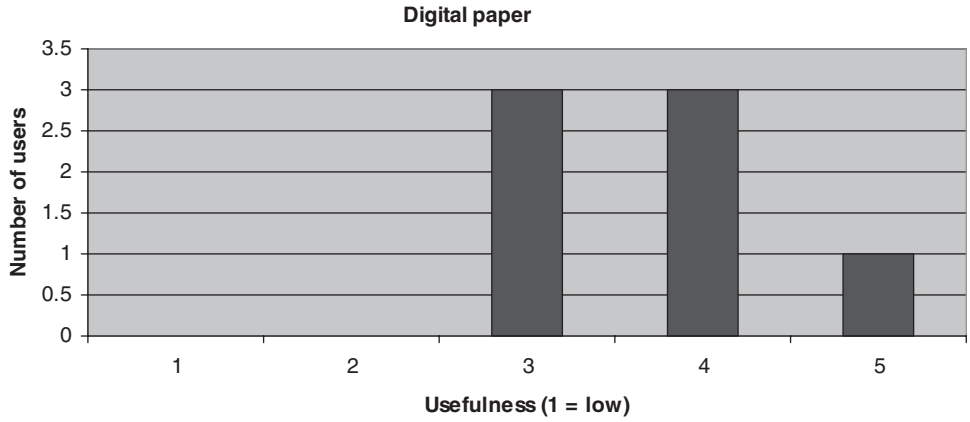

Fig. 3 Participant ratings for the usefulness of digital pens and paper

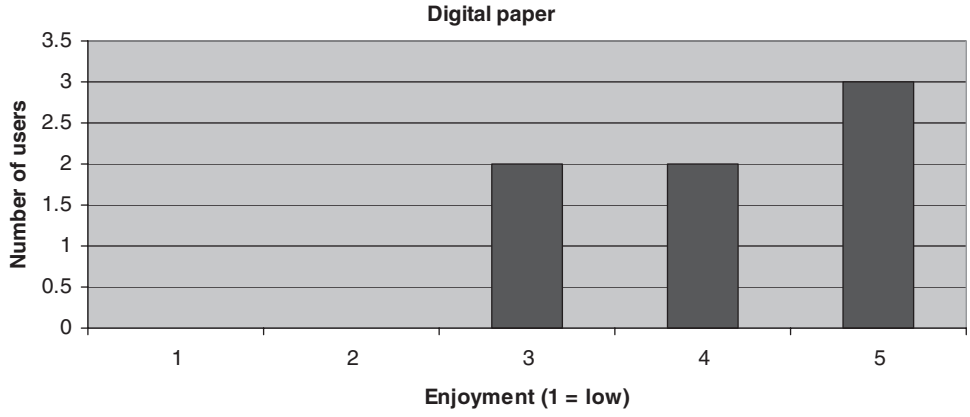

Fig. 4 Participant ratings of digital pens and paper in terms of how enjoyable they were to use

become quicker to use with practice and appreciated that the speed of editing was quick. However, there was a general concern that the Nokia N800 was not physically robust enough to endure the rigours of use on site.

The digital pens/paper were reviewed by seven of the study participants (Fig. 3).[4]

For the 2007 season five pens were taken to site, four of which were used by participants and one which was kept as a backup. Most participants enjoyed using the digital pens; one went as far as to describe them as 'amazing' (P10). Some appreciated their novelty, but many found that they were of real use in their work.

As Fig. 4 shows, participants enjoyed using the digital pens and paper. They found it easy to enter data, and the handwriting recognition software and uploading data to the IADB worked well, once an initial problem of overwriting previously loaded records had been overcome. Sketches of contexts were also more accurate and detailed when carried out using the digital pen, in contrast to the sketch function on the N800. There was some resistance from supervisors to the use of digital pens, generally stemming from concerns about data control (see below) and a desire to have physical data to hand.

The way in which digital pens record data is slightly at odds with the usual work flow patterns

of archaeologists. When data is recorded on traditional context sheets it is entered as it becomes available and sheets are kept until they are deemed to be completed. Amendments are made to the sheet as needed and the final sheet is often covered in scribbled amendments which are then sorted out at the data entry stage. Fields may not necessarily be filled out in order, and some might be left blank temporarily until more excavation has been done. Unfortunately it was uneconomic to have digital context sheets printed, so participants had to copy data in linear form into digital notebooks, and identify it with the database codes of individual fields. It was often difficult for diggers to remember what numeric codes referred to, so copies of context sheets were pasted into the front of the books.

> The digital paper is a great idea but more time consuming and less quality controlled because you are having to write down all the data headings as well as your information. (P22)

Digital books also do not allow the user to leave gaps to fill in later, so there is a possibility that some contexts may become spread over more than one digital book, especially if alterations had been made. There is also a danger that amendments to contexts already in the database might be missed if they were made at a later date. Pre-printed context sheets would suffer from some of the same problems as the digital books as they are designed to be filled in order, a practice most uncommon in field archaeology.

4.5 Planning and technology

Plans and sections of the site are traditionally drawn using permatrace (waterproof translucent plastic film) and pencil. Later plans are digitized using a standard graphics digitizing tablet and, in the case of Silchester, input into the IADB. As part of a previous phase of the research at Silchester, tablet PCs were used to draw plans in an effort to eliminate the time-consuming process of digitizing plans. The trial proved unsuccessful and during the 2007 season plans and sections were again drawn on permatrace. Plan drawing can be a time-consuming process that some archaeologists find frustrating [one participant (P15) was keen to have 'a machine that automatically draws plans for you']but permatrace is a robust medium that is also easy to use.

> Plus pencils and permatrace work in the rain, so we can keep on doing archaeology. (P29)

Thus in the hostile conditions of an excavation it appears that at present old technology and traditional methods are the most effective when planning is required.

4.6 Finds

The finds team was represented in the diary study by two supervisors and two trainees. Previous attempts had been made to use IT for finds processing, but without conducting a user survey first. Unfortunately the experiment had not been a success, and this had left the team wary of IT. As a result they shared the perfectly reasonable view that technology should only be used where it was necessary. Thus there was great support for digital cameras, but little enthusiasm for trialling any further technology.

> A digital camera is essential for recording finds as often their original appearance can change as they dry out. Pen and paper—essential tool for finds. This allows for changes and withstands the mud/water and dirt that comes into the finds hut. (P17)

Finds are initially recorded in the field by the excavator and the nature of this recording varies with the nature of the find. They then pass to the finds hut where they are processed. The supervisors/assistant supervisors on the finds team supervise and teach the students that are rostered to work in finds. Processing includes being washing, sorting, identification, marking, recording and boxing-up. The processing produces its own data and this is currently recorded as a paper record. The processing also involves checking against existing records. Identification of finds commonly involves checking them against other sources of data such as reference books, the internet or discussion with other archaeologists.

> Went to use computer to see if I could learn anything there but ran into an ex-supervisor

who had studied burials and got info from him. (P8)

The finds team also use an offsite network of supporting specialists who are contacted in a variety of (unspecified) ways. There is potential here for the application of technology such as video conferencing, skypeing, however, problems were caused by a lack of availability of the internet on site (see discussion of reliability below). Following the problems with the Nokia N800 in the trench, it has been suggested that these might in future years be used by the finds team for just such access to external experts.

Another very important issue for the finds team was the ownership and control of their data. It is imperative that the finds records are easily accessible as the finds team are frequently called upon to put together groups of object for talks, photography, VIP visits etc. The team therefore need to know that information is correct and easily accessible, and at present this is more easily done from paper records than from a database, when internet connections are unreliable and computers scarce.

4.7 Small finds

Small finds are those which are relatively rare, such as coins or brooches. At Silchester they are recorded in three dimensions and an EDM or total station is generally used for this task. The use of EDMs makes 3D recording very quick and (when used correctly) accurate but it is challenging to maintain the link between co-ordinates, object and small finds number throughout subsequent processing and analysis (Eiteljorg, 1994). There may be some potential to use technology at this stage to minimize mislabelling or transcription errors (see Dibble *et al*., 2007 on the use of barcodes on archaeological projects). EDMs are standard equipment on the majority of modern excavations and their usefulness was not investigated in this study. However, they are large and relatively expensive, which precludes having a large number on site and there may be more demand to use them than it is possible to supply as this quotation demonstrates:

> Showing a participant how to do the full process of small find inc 3D co-ords (**with tapes, EDM queue too long**) and photo. (P9) (our emphasis)

4.8 Science

The science team was represented in the diary study by two participants involve with XRF sampling (X-ray Fluorescence, used for elemental analysis of artefacts) and one participant involved with environmental sampling. Both types of sampling generate their own recording which at present is done using pen and paper. One of the participants (P2) involved with XRF sampling recorded making a data spreadsheet to fill in on site.

Environmental samples are initially recorded in the field by the archaeologist who takes them and then they are passed to the environmental hut where they are processed. This processing includes flotation, sieving, sorting and, of course, further recording. The processing is carried out by supervisors/assistant supervisors and the students that are rostered to assist. The nature of the work involved with processing the environmental samples means that there is a lot of water and mud around. At present recording is in the form of a paper record and labelling is done using waterproof pens. The participant suggested that the current recording procedure was the most appropriate one given the working environment.

> Pen and paper is used all the time in environmental, for filling in the register to sample forms. I would say that it is uneconomical for any higher technologies, for example adding into the database as we go, as it would be used infrequently compared with other sections of the site. (P20)

> Apart from pens going missing it is the easiest and quickest way to record what we do in environmental. (P20)

There is potential for using digital pens and paper for recording samples and it would be interesting to consider using barcodes for environmental samples.

5 Discussion

As we have seen, studies of diarists on different parts of the site brought to light different views on the use of IT. In some areas, such as the trench, participants found digital pens helpful, but were disappointed with the Nokia N800s. In others such as environmental archaeology and planning the conditions mean that at present traditional pen and paper recording are most appropriate. It is vital to stress that the aim of the VERA project was not to impose the use of IT upon archaeologists, but to determine the ideal technology for any given activity, and thus such findings are neither surprising nor disappointing.

The diaries also brought to light some overarching issues concerning the use of digital recording and IT in field archaeology which we discuss below.

5.1 Data quality

Silchester is the largest urban excavation currently ongoing in the UK and as such produces a huge quantity of data. With so many people lacking previous experience it is of paramount importance that supervisors are able to monitor the quality of the data being recorded. Students are required to have their context cards, plans and sections checked by a supervisor and this system has worked effectively for numerous years. The digital books created some anxiety for supervisors for a number of reasons and as a result students were asked to complete both traditional context cards and the digital book. Unlike the printed context sheets students are required to write all the field names into the digital books and although guide sheets were provided supervisors worried that some fields might be missed out.

> Digital paper—interesting technology and works in itself but lack of printed categories makes it VERY unsuitable for use within this environment as checking each update is infeasible Technology has potential to be useful in a situation where recording is being done by one person or by someone who is more familiar with the recording system. (P30)

Supervisors were also concerned about their control over the data quality, particularly as students often omitted to get the digital books checked, despite there being a system in place in the trench. Often the realization that a context had not been recorded as checked only came to light at the digital pen input stage.

> Also say that plans were automatically and immediately transferred to computer, how can supervisors check them? I don't know if that's how it will work but it's just a thought. (P3)

There was also some concern that students using the digital books would learn the codes for fields in the IADB without really understanding the archaeology behind it. Not learning to complete typical context sheets might also leave students unprepared for working on other archaeological sites.

The issue of data reliability is a crucial one in archaeology. In subsequent interviews with users of the IADB we encountered repeated concerns about the quality of the data itself. Interviewees stressed that it was vital that they were able to trust the information upon which they were basing their interpretations, and that one of the few drawbacks of the IADB for a user was occasionally poor quality data. The technology alone was of little value if there was any doubt about the information contained within it. It is of course, possible for data entered by hand onto a printed context card to be of poor quality, and this problem is not caused by the use of IT, but if the use of digital paper makes it harder to check the accuracy of recording then there is an immediate threat to data integrity. It has therefore become evident that checking mechanisms that ensure data quality are vital, and that IT use must work within these established routines. Thus in future years it is evident that we need to undertake further research about how to integrate the use of digital recording into digging activities with the smallest possible disruption to data verification routines.

5.2 Reliability

The reliability of any technology is obviously of great importance but perhaps never more so than

in a field situation. Silchester itself is located within easy reach of various amenities but many archaeological excavations must rely entirely on the equipment they take with them. For scholars who are used to working in an office or even at home, with good internet connectivity and easy access to computers and power to run them, it can be hard to imagine how difficult it can be to gain access to basic IT infrastructure. At Silchester electricity for the entire dig had to be provided by a small generator, which consequently suffered repeated problems from being overloaded (https://vera.rdg.ac.uk/blog/?p=91). Thus, any computers used on site added to the power drain, and since most diggers camp on site there was little opportunity to recharge laptops. Internet access was provided by WiFi. However, the router was situated in a barn several hundred metres away from the trench (https://vera.rdg.ac.uk/blog/?p=373) and there were numerous problems with the signal (https://vera.rdg.ac.uk/blog/?p=40). This tended to make internet access slow and unreliable. This means in infrastructural terms alone the use of IT on such a dig is likely to be fraught with difficulty.

However, despite their awareness of the difficulty of conditions, participants therefore expressed frustration at the site infrastructure, specifically the unreliability of computers and the WiFi internet. These are technologies that participants are used to using off site so assessments of them are likely to be particularly harsh if they fail to come up to standard.

> Pen and paper is always trustworthy, as the desktop computers are slow or crash—hence the '3' rating. The internet resources are great and I can use them often. (P7)

> Computers onsite are slow. Also internet does not stretch to finds hut and we are not supplied with a generator to run any computer we are provided with. (P28)

This is significant, since frustration with the existing technology tended to predispose participants to mistrust suggestions of introducing new technologies. This demonstrates that even infrastructural issues, which in most environments are largely taken for granted, may have a significant impact of the trust that users have for IT and thus is consequent uptake in field archaeology. As a result of this realization, the VERA technical team at Reading have made continual efforts to improve the reliability of the kit and to increase its capacity. Indeed one of their major recommendations for future years was the need for a much larger generator. Similar, relatively simple solutions to such problems might also be addressed by providing more IT kit, such as more digital pens, laptops and ideally more powerful WiFi.

5.3 Costs and pragmatics

Within our larger observations, it is also important to stress that when asked about the use of IT the archaeologists were talking about an ideal situation, which unfortunately seldom exists, especially in terms of the costs of excavations. Thus some of the decisions taken reflect the costs of running such a huge dig. In an ideal world, for example, we might have liked to give each digger his or her own digital pen and context card on digital paper, but the cost of this would have been prohibitive.

It is also important to consider costs in terms of time, which must be weighed against the concerns expressed above about data quality. One of the main reasons for using IT for context recording at Silchester was to allow data to be entered more quickly than in previous years. The previous situation meant that scholars could not start working on the data from that year's dig until several months after the excavation had finished, since data was being manually copied from written context records to the database. Thus there is a huge saving in terms of time if records can be entered on site. Once again the choice of IT may emerge as the good enough solution, which if not perfect in the eyes of its users will allow enough data to be entered at an acceptable level of quality for it to be useful by archaeologists working on the Silchester data. These are not easy decisions to make, and it is evident that the data we have gathered must be weighed against questions of cost in both time and money when decisions about the use of IT on site are taken.

6 Conclusion

If new technologies to be accepted they need to fit within established work patterns and to fulfil a perceived need. However, the introduction of new technologies must be carefully managed and supported lest they alienate the very people they are supposed to be helping. As a result we conducted a diary study to identify the work patterns on the dig, and investigated the way that technology was used, and its perceived successes and remaining problems. It was also vital that we did not adopt a mindlessly promotional attitude, or were seen as championing technology for its own sake. So for example it was important to acknowledge that the limitations of the Nokia N800s made them unsuitable for use in the trench. In some areas we may also conclude that at present traditional methods are most appropriate, but the trials of digital pens suggest that they may be helpful in enabling data to be collected more effectively and recorded more quickly. It was also evident that many of the archaeologists enjoyed using them, which is likely to help with their integration into the work of the site.

It has also become evident that IT must fit in well with established patterns of work. The quality of the archive is also of paramount importance for any further work and the diary study illustrated the importance of maintaining existing mechanisms for checking and controlling data. In the existing paper systems students are required to have their context cards, plans and sections checked by a supervisor and this system has worked effectively for numerous years. During the 2007 field season the quality control applied to the paper record did not always operate with the same rigour for the digital books and this created some anxiety for supervisors. This is an issue that we shall need to be aware of in future digging seasons.

The reliability of any technology is of great importance in a field situation. Many archaeological excavations are on much more remote sites than Silchester and archaeologists must rely entirely on the equipment they take with them. Participants in the diary study expressed frustration at the site infrastructure, specifically the unreliability of computers and the WiFi internet. These are technologies that participants are used to using off site so assessments of them are likely to be particularly harsh if they fail to come up to standard.

We may therefore conclude that it is possible to use IT in some aspects of field archaeology, where appropriate. Due attention must also be paid to issue of data quality, the reliability of technology and to established work flows. However, the seamless integration of data recording analysis and feedback to those on site remains a challenging problem that is yet to be solved. We hope that the VERA project will be able to make some contribution towards the achievement of this goal.

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Notes

1 PPG16, paragraph 13. If physical preservation *in situ* is not feasible, an archaeological excavation for the purposes of 'preservation by record', may be an acceptable alternative (see also paragraphs 24 and 25). From the archaeological point of view this should be regarded as a second best option. The science of archaeology is developing rapidly. Excavation means the total destruction of evidence (apart from removable artefacts) from which future techniques could almost certainly extract more information than is currently possible. Excavation is also expensive and time-consuming, and discoveries may have to be evaluated in a hurry against an inadequate research framework. The preservation *in situ* of important archaeological remains is therefore nearly always to be preferred.

2 https://vera.rdg.ac.uk/blog/?p=24

3 Help sheets were inserted into the books. These included instructions for use, the field code list from the IADB and answers to some faqs. The help sheets were amended as new issue/questions became apparent.

4 One of the three ratings came from P13, a participant who clearly did not want to take part in the study, which makes the quantitative results a little more negative than the comments suggest.