Holy Grail or Poison Chalice?
Challenges in Implementing Digital Excavation Recording

Sarah Cross May and Vicky Crosby

English Heritage, Centre for Archaeology, Portsmouth, UK
{Sarah.May, Vicky.Crosby}@english-heritage.org.uk

Abstract. The direct production of a digital record during excavation, which can be used for all stages of work through to publication, has been seen by many in the field as a Holy Grail. Many archaeologists are wary of the use of handheld computers for recording, and input the digital record from paper forms. For implementation of digital recording to be successful it needs to support the complex work patterns of archaeological teams in the lab and the field. Poorly conceived implementation turns digital recording into a 'poison chalice'. The paper will describe challenges facing the English Heritage Centre for Archaeology in the implementation of paper free recording in our excavations. It will also present research which adresses these challenges.
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1. Introduction

Direct digital recording would greatly facilitate the creation of digital reports and archives worthy of dissemination, but it will only be truly powerful when it is widely welcomed. Technological developments such as tablet PC's, Wi-fi networks, and improved interface design make this a real possibilty. But these technologies will only be useful when they support the work practices current in the field. Paper systems allow flexibility and 'fudges', for digital systems to be implemented we need to know where and why these 'fudges' exist and how they can be avoided, facilitated or obviated in a digital system.

"The Holy Grail of unit computing is the Integrated Information System where information flows seamlessly from excavation, through post-excavation to publication and archive, offering an efficient process that would give a competitive edge to any organisation managing to achieve it. In theory this is possible, as any consultant will tell you, and indeed different levels of success have been claimed (Rains 1995, Beck 2000 for example) although the real picture is more likely to be one of ad hoc development within an environment of under resourcing, a lack of expertise and intense time constraints". (Lock 2003 p 265)

Many archaeologists see the direct production of a digital record during excavation as a Holy Grail. They argue that such a record, used for all stages of work through to publication, will greatly improve efficiency, aid analysis, and result in higher quality outputs sooner. But the Holy Grail was mystical, elusive, dangerous – and ultimately unachievable. And many archaeologists are wary of the use of handheld computers for recording, regarding the physical records as the 'real' and 'secure' archive for fieldwork. Computer systems may be viewed as inevitably restrictive, and digitisation seen as an optional extra, perhaps a useful way to manipulate some data or to act as security copies. And there is little doubt that poorly conceived implementation could turn digital recording into a 'poison chalice'.

There are technological and business related challenges to implementing digital recording, but in this paper we are primarily concerned with conceptual and practical challenges relating to the archaeological process. It is increasingly recognised that our recording systems are far from a passive method of creating an archive. They are dynamic part of our epistemological system, and changing them without reference to current work practice can be dangerous (Mantzourani and Vavouranakis 2003).

1.1 The Revelation Approach

In 2002 EH set up the Revelation project, with the aim of providing a coherent digital information system that will make the capture, analysis and dissemination of EH research faster and more effective. At CAA 2003 we described the structure of the project and reported on some technical trials for digital drawing (May and Cross 2004).

For implementation of digital recording to be successful it needs to support the complex work patterns of archaeological teams in the lab and the field. This is our main focus – real investigation of real practices, not what 'should' be done.

Much of the literature regarding excavation recording systems focusses on the hardware and software of the system (eg. Anacona et al 1999, Laurenza and Pistolu 2002). Less attention has been paid to the work practices and procedures which it facillitates, and which will be an integral part of a functioning system. There are a number of manuals explaining how recording 'should' proceed, but fewer describing what actually happens. While team dynamics are discussed in the field, there is much less on the role for the team in other stages of a project. This has become a topic of interest in the software world. "Organisations have been mystified as to why ICTs have failed to deliver promised productivity benefits, only to find that they have paid insufficient attention to the social infrastructure in which these new tools are embedded" (Hutton 2003).

In this paper we present results from 'participant observation' of an excavation in summer 2003 and from formal user needs discussions with project teams.

2. Project Requirements

Our initial Assessment (Cross et al forthcoming) has identified the following issues across the organization and indeed across the sector:

- the use of IT is opportunistic rather than strategic
- Information Systems are often task or user specific
- proliferation of systems leads to multiple methodology and sometimes therefore non-comparable data
- our data is not readily accessible for synthesis and dissemination

We also need to remember that we aren't moving from paper to digital – it is a hybrid system. At English Heritage, most our data becomes digital but not all of it is used in digital form. We record on paper and drawing film as well as through survey instruments. We analyse on screen as well as on hard copy.

2.1 Efficiency

The hybrid systems of recording, analysis and dissemination that we use at the moment are remarkably inefficient. Double handling is rife. Information is recorded and copied many times, requiring manual input, reformatting and quality checks to be repeated. The also leads to problems with version control and out of date data, causing further delays. Because our systems aren't integrated, people are often delayed in their work waiting for data to be transferred through these cumbersome processes. Since each part of the system is designed for the immediate users, key data can be missed entirely, or recorded in a less useful manner than subsequent users need.

All of these factors delay completion of our projects, and produce archives which are difficult to reuse for later synthetic work. Like any organisation, English Heritage is keen to reduce inefficiency, and this is a major motivation behind the Revelation project.

2.2 Access

In addition to supporting our working practice and making projects turnaround faster, we have an obligation, as a public body, to increase access to our work for a wide range of audiences. The system should facilitate rapid publication as academic and more popular books, but it should also allow the online dissemination of our complete archive – for professional and public consumption. Further, digital recording in the field with a well designed system will allow visitors to excavations (an audience which is constantly growing) to have access to up to date results which explain the explorations they see unfolding before them.

2.3 Integration

Integration is key to the Revelation project but, of course, it is also a 'buzzword' that people use to mean many things (Lock 2003). The integration may relate to different types of functions (Huggett 1989), different data types (Ryan, 1995), or the material from different projects (Arroyo-Bishop and Lantada Zarzosa 1992). Some papers put an emphasis on the definition of data types that are suitable for archaeology, allowing greater precision in the description of space (Ryan 1992) and time (Cheetham and Haigh 1992).

The work that goes into any project comes from a range of people in different circumstances. Often these people are isolated in time and in space, have very different working practices, and are even addressing different research questions. Further, many different researchers may approach the same place or body of data from different approaches with different methods, questions and audiences.

We believe, however, that the data is much more powerful in the context of all the work, than any one element. This means that our users need to work in an integrated fashion and access the data and tools appropriate to a large range of tasks. This does not require a single monolithic system but the relations between different elements should feel seamless to the user.

3. Methodology

Although there are many well established archaeological Information Systems none of them fully meets the requirements of our circumstances. To define these more fully and plan for implementation, we need a detailed understanding of our research processes.

3.1 Current State of Knowledge

The impression is that archaeological computing is in a continuing state of ongoing development, "Archaeological Computing is in a liminal time" (Lock 2003: 263). In fact, looking at the scope of the literature over the last 30 years, this has always been the case. Some of this sense of being on the cusp of great things is connected to the discourse surrounding IT in general, which is closely tied to 'progressivist' narratives. (Huggett 2000). People publishing in archaeological computing are more interested in development than implementation.

There is very little published that gives a 'from Dig to Dissemination' overview of Information Systems in archaeology. Much is written on how to record (Roskams 2001), some on interpretation in the field (Hodder 1999, Lucas 2001), some on phasing and the assessment (Roskams, 2000), almost nothing on analysis. The most general overviews relate to Digital Dissemination and Archiving Systems. (Cross et al forthcoming:. 23–24)

"Despite a critical awareness of the problems of excavation and publication, there has been little comparable criticism of the processes involved in post-excavation…Post-excavation practices remain untheorised and incoherent; post-excavation is simply a stage between the tasks of excavation and publication" (Jones 2002, 46).

Additionally, the emphasis is on the experience and work of individuals. The role, nature and support of teams is barely discussed at all. The material on 'dynamics' that exists is

heavily focussed on theory (Hamilton 2000, Bender et al 1997), which makes it difficult to identify patterns in relationships.

3.2 Traditional Methods

Although we hope to improve some aspects of our working practice, we clearly need a detailed understanding of those practices before we can proceed.
In our efforts to fill in the gaps we identified in the literature we began with fairly traditional methods of soliciting user needs and requirements. We began by holding structured discussions with focus groups consisting of project teams at different stages of the project lifecyle. These were very helpful in identifying issues regarding data flow, team work, and communication. We followed these with a questionnaire to a broader group. This produced so much information that our greatest challenge was in synthesizing and summarising the results into a usable report.
Nonetheless, these methods mostly helped us to a better understanding of issues we were already aware of. People answered the questions we put to them, discussed the topics we raised. To identify the problems we were not aware of we needed to ensure that we captured 'what actually happens'.

3.3 Participant Observation

Participant observation is a method borrowed from Social Anthropology, where it forms the core of most fieldwork (Bohannan 1992). The method is characterized by a balance between the distanced stance of an outsider and the engaged stance of a participant. The participant observer has research questions that she wants to answer, but the answers come through participating in the group, through watching and through asking.
Recently this method has been employed in archaeological settings by people interested in the generation of knowledge. Unfortunately, most of this work has been more focused on high level theory than detailed process (eg. Holtorf 2002). In our case, the purpose of the work is seeing past how it 'ought to be' either according to the manual or as people feel they should tell you they do it! Although you ask questions, you also learn from watching and doing.
Our use of participant observation has followed two strands. Firstly, fieldwork observation was carried out during excavations of a badger-damaged round barrow on Salisbury Plain in the autumn of 2003. The primary aim was to observe how information was recorded on site, and compare this with an initial data flow model created based on the proforma sheets of the CfA recording system.
The observer participated in the excavation as a site assistant, while informally watching and asking questions of other site staff. There were also more structured discussions with several members of the team, in which specific aspects of the model were examined. A detailed description of the observed data flows was prepared, and areas where they could be improved in were noted. A simple digital indexing system was tried out and its usefulness evaluated, especially relating to finds recording. The report forms an appendix to the Revelation Assessment Report (Cross et al forthcoming).
A second observer made shorter observations of later stages of work. This allowed us to extend our understanding in a short space of time.
A drawback of the shorter observations was that there was less scope for active engagement. This limited the knowledge that could be gained and put pressure on the 'informant' or person doing the work. One of these people said "this isn't the way I'd usually do it; I haven't cursed at all yet" Ideally, the later stages should be studied in the longer style we used in the field. We hope to pursue this in the coming years.

4. Results

Space does not permit a full report of our results, especially since many of them deal with the specific flow of attention, thought and movement during individual tasks. Although they have some bearing on data structure, this level of results will be particularly useful when designing interfaces. Here we summarize the highlights, especially those which have bearing on the scope of the project and how it meets its requirements.
Many of our results reflect the problems with hybrid systems, the potential pitfalls of digital system and the opportunities we need to grasp. The key to acting on these is to study the work of individuals, but remember that the 'team' is the real user.
"A group of people interacting with one another will exhibit behaviors that cannot be predicted by examining the individuals in isolation, peculiarly social effects like flaming and trolling or concerns about trust and reputation. This means that designing software for group-as-user is a problem that can't be attacked in the same way as designing a word processor or a graphics tool" (Shirky 2003).

4.1 Barriers to Access and Integration

The main current problems centre on data access and version control. In an attempt to broaden access multiple copies of both hard copy documents and digital files exist, leading to the inevitable difficulty of rationalizing changes. The implications of these problems with version control can be immense. For example, if the phasing of a site changes, other specialists often have to rework their analysis often under pressure of deadlines.

Communication

While this situation relies on constant communication for projects to keep running, most of this communication is informal. When colleagues are working together on site, or in the same office, 'chatting' is a major factor in the success of a project. When separated by time or space communication can break down. Colleagues may not know which data they can share; or they may be unaware of similarities and differences in their interpretations.
Filling in a form (digital or paper) can not replace talking. On an excavation there are formal conversations and meetings; shouted comments, contexts numbers and opinions from trench to trench; discussions at tea break and in the pub; the ongoing chat between two people digging beside one another. It's easy all too easy for non-field specialists to get left out of

this communication. Most of it drops away when we leave the field, to be replaced by phone calls, memos, reports.
Happily, communications software is one of the most rapidly expanding parts of the software world. The challenge is to find software which encourages the different types of communication we need.

Ownership

Ownership of data has two sides, control and responsibility. In a hybrid system, exercising responsibility is often a matter of maintaining control. When data is passed from one team member to another, it can be altered, pushed beyond its limits or misunderstood. This could be deliberate but misguided editing, accidental changes or even deletion.
This is accepted by people at the bottom of the hierarchy. You fill in a context sheet and know it will be used by others with no reference to you. But some team members have professional reputations riding on their data sets, and yet ownership and responsibilities are not always clear. Reinforcing ownership and responsibilities with an effective system of permissions is vital. One person told us:
"Usually there's an unspoken division of responsibilities, where I'll be asked to sort out the TST because it's "technical", while the Project Directors retain control of the dumpy level since it's a "traditional" field tool that they are comfortable with."
Many people expressed concern that digital data entry would lead to information being recorded 'too soon', before the process of validation takes place. Clearly, tracking validation is a key function of IS in many industries. In archaeology 'computerising' a record is viewed as creating a final record. This perception needs to be challenged.
Tracking numbers and records, checking and validation are a huge focus of current system. Indices play a big role in this, and each group has its own indices. This takes a lot of time and can go wrong, leading to double numbering or even missing records. Nonetheless, indices will remain important part of the process because they provide a quick method of getting information and basic cross referencing.

Confidence

Confidence falls into three aspects; can I trust the data I have been given? Can I trust the person I give my data to use it within its limits? And can I trust the system I use to transfer the data accurately and reliably?
The first two are an extension of the issue of ownership. We know what confidence we can have in those things we create or take ownership of. When we try to integrate many data sets the overall confidence level drops. This in turn discourages both seeking and granting access. Establishing clear ownership and validation as part of the data structure should increase people's confidence in the data they receive and make them more willing to share their own.
The last is a matter of reliability. Paper and pen rarely break down. Most people associated digital systems with anxieties about losing data – sometimes based on experience! Of course, this can happen with paper, often with no backup. Indeed, most users don't backup regularly until they have lost something important. The challenge is to design robust systems, where backup requires little effort from the user.

4.2 Informal Systems and 'Fudges'

The data flow model tested was based on the proforma system of codified field recording, seen largely from the post-excavation perspective. Among the clearest results of the participant observation was that this idealised model represented only part of the data flow on site, and at times misrepresented it. Much information was held and moved more informally, on labels or by word of mouth. Notes were kept in personal note books or on bits of paper stuffed into pockets – some but not all of this ended up in the site record. Flows could be the reverse of the expected – rather than relationships on context records being used to compile matrices, working matrices were often used to sort out the stratigraphy before the information was put onto context sheets. Indexes, often largely dismissed as a device to prevent double numbering, were seen to be a crucial source of information on site, being one of the few record types generally available to all staff.
The work demonstrated there are three distinct (though overlapping) areas of recording:

- information needed by the field staff as they excavate and record the site
- information needed for on-site interpretation as the work progresses
- the site records required for post-excavation work – the primary 'product' of the fieldwork stage

Poor access to information by field staff had unexpected consequences. Some staff stressed the value of making context sheet sketches which were simply copies of the site drawings. Their usefulness in the field was felt to justify the time spent. Drawings were an important source of data for completing context records and working matrices, though neither relationship showed in the initial data model. The brief description of a context written on the index when a number was allocated is essentially poor quality short term information – but was routinely transferred to finds records because it is the only data readily available to the site staff creating the initial finds sheets. The finds indexes were used by excavators to check their listing of finds on a context sheet – but this could not be done easily as the sheets were removed to the finds hut as soon as they were full, as they were also needed for checking and transfer of information there.
Double entry of data was a general outcome of the existing system. It was often described as a quality check, but in practice it rarely involved independent recording of data. Usually it replaced access to the primary record – writing a list of finds numbers onto a context sheet was the only way of ensuring availability of the information during the fieldwork, for on-site interpretation, and during record completion. Observation has allowed this process to be better understood. Seeing the order in which information was captured and how it was subsequently copied and used indicates what should be regarded as the primary data, and how it needs to be made available to other site staff. Double entry rarely operated as a

cross check, and instead became a time-consuming additional task, carried out largely due to fear that the original information would be unavailable or even lost.

Discussions of digital recording often stress its value in facilitating post-excavation analysis and dissemination. These results point to the ways in which digital (or partly digital recording systems) can aid the fieldwork process by ensuring access to information. Both written records and drawings need to be available to site staff. 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.

4.3 The Team

One of our most striking results is that 'the team' is not only poorly supported by the current systems, it is barely acknowledged after leaving the field. And yet all archaeological work is collaborative. Each individual's effort is reaching for a group goal. "If a group has a goal, how can we understand the way the software supports that goal? This is a complicated question, not least because the conditions that foster good group work, such as clear decision-making process, may well upset some of the individual participants. Most of our methods for soliciting user feedback assume, usually implicitly, that the individual's reaction to the software is the critical factor. This tilts software and interface design towards single-user assumptions, even when the software's most important user is a group"(Shirky 2003).

Existing practice often emphasises the flow of information from technician to specialist, yet during fieldwork the flow from technician to technician can be crucial in compiling a high quality data set efficiently. For example, even the simple site indexes database trialled in this work greatly improved the data available to staff carrying out finds or environmental processing, saving considerable time and improving the information they passed on to the project specialists.

People focus on the task at hand – this is a predictable result of the intensity of our work. We use systems to hold these different periods of intensity together. Ad hoc Information Systems are the manifestation of this 'task focus'. People design systems to meet their own needs, often showing considerable creativity and ingenuity. But other people's needs are rarely taken into account. This may be because the designers don't understand other people's needs, or because they can only make time for work that speeds up their own analysis.

Most individual tasks are supported but they often either take extra effort, or require it at another stage in the process. For example, our plans are scanned upon return from the field which facilitates 'heads up' digitizing for rapid production of internal reports. But the scanning process is quite time consuming, especially when plans are dirty, or when there are problems with on site record keeping. People creating plans, or using them do not take the scanning into account.

Conversely, people work with different rhythms of intensity. People need to 'zoom' in and out of a task – concentrating on detail and then looking at the overview. This can take place within their own work, or viewing the work of a colleague. Even discussion with a team member can provide a welcome break, without becoming an interruption.

5. Conclusions

IS for archaeology should be about using data dynamically not just creating an archive. This requires a business analysis which really reflects the work flow, social structure and goals of the work. Participant observation is a powerful tool in conducting such an analysis. The main challenges are maintaining flexibility, responsibility and ownership. These are vital for building confidence in data sharing and digital systems. The main opportunities are communication, access, tracking/validation. Fortunately, all of these are rapid developing parts of the commercial software market.

All of this is a matter of open mindedness, not magic. If systems don't reflect the working practice and restrict professional judgment, they will not be used and data will be lost. Conversely, systems which are overly complex are less stable. An unreliable system is the real fear. These 'poison chalices' would make the current hybrid situation worse. Professionally designed systems which are based on detailed knowledge of work practice should address these issues. But archaeologists need to take responsibility for understanding our own work practice. This issues is the real quest for the Holy Grail.

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