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Looking at intra-site GIS

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14.1 Introduction

One of the major features of archaeological Geographical Information System (GIS) applications is their scale: characteristically, GIS are applied at the landscape level, and there are comparatively few examples of their use at the within-site level. It seems to be generally recognised that while GIS are useful, they are rarely used to any great extent for site-based analyses, with applications concentrating instead on landscape and other large scale studies. Both in print and on the electronic discussion lists,[1] there seems to have grown a general consensus of agreement as to why this situation should have arisen, and it is this consensus that this paper seeks to address. In particular, a recent paper by Biswell *et al.* (1995) has proposed some reasons for the apparently poor take-up of intra-site GIS, pointing to the quality of the site data that is collected amongst other things, but this seems unlikely to be the whole story. This paper will use some recent work carried out at Symon's Castle, a motte and bailey castle in Powys, Wales, to examine some of the issues and problems encountered in using GIS in combination with an excavation database.

14.2 A case study

Symon's Castle is a thirteenth century motte and bailey castle on the Welsh borders which over a ten year period has seen the total excavation of both the bailey area and the motte (Arnold & Huggett in prep.).[2] Like many castles of its type in the border area, it was of a fairly temporary nature, but unlike many of the motte and baileys scattered around, it can be placed firmly within an historical and archaeological framework, and indeed, it can be placed within a medieval landscape centred on Henry III's castle at Montgomery and its earthwork predecessor at Hen Domen, itself the subject of a lengthy research excavation (Higham & Barker 1992, pp. 326–347).

Symon's Castle was probably garrisoned for the first time by a knight called Symon de Parco in 1231. It was situated within an area of forest and beside the medieval road that would have carried supplies of timber and lime from the forest to the building works associated with the construction of the new royal castle at Montgomery. Once the royal castle was completed in 1233, Symon's Castle was handed over to the constable of Montgomery Castle and seems likely to have been abandoned shortly thereafter. Certainly the archaeological evidence is consistent with a castle that was built, occupied and abandoned within a five year period and possibly much less. Consequently, excavation offered the chance to look at a snapshot of life within a small medieval castle which had been undisturbed since its abandonment.

Apart from the castle defences, which around the motte consisted of a stone-faced clay rampart which is still visible, the structural evidence was extremely slight, with very few earth-fast timbers. The archaeological evidence consisted primarily of artefacts, and ironically, given the nature of the site, these were recovered in large quantities. The motte-top excavation, consisting of a relatively small area of less than 22m × 27m, produced over 10,000 individually recorded artefacts. As they were recovered, there were distinct indications of patterning in their distribution, but their quantity and concentration meant it was impossible to investigate them in any detail.

This was particularly important since a large proportion of the artefacts seem to be of direct structural relevance. Some 3000 of these artefacts are fragments of burnt daub, many of which bear the impressions of wood grain on their flat surfaces, and a number of fragments are characterised by several flat surfaces, either stepped or at right angles to each other. These are interpreted as being derived from horizontally planked timber framed structures which were caulked on their inner faces with daub. In addition, nearly 700 nails of a variety of shapes and forms were recovered, most associated with woodworking and in particular for fastening planking, and around 1200 fragments of lead, mostly tiny droplets of molten lead, but also small fragments of lead sheet and one or two large 'splats'. There were also over 500 pieces of medieval pottery — in a number of cases, pots discovered where they had been dropped and broken — plus the usual smattering of less common items, *e.g.*, some loose change, some buckles and some ironwork, including knife blades and arrowheads *etc.*

Simply producing plots of these artefact distribu-

tions was of little use — there were simply too many items to make an ordinary distribution plot meaningful beyond the observation of some extremely large concentrations. Yet this information was vital to the understanding of the layout, organisation and nature of use of the site given the lack of structural evidence. On the face of it, GIS seemed to offer the prospect of providing some tools that might be useful to that end.

14.3 The problem with intra-site GIS

Looking around for pointers on using a GIS for within-site analyses a few years ago, it was striking that there were very few examples around, apart from Dominic Powlesland's Geosys/Gsys-based work at West Heslerton. More striking is that today examples of intra-site GIS are still quite rare. The key question is: why should this situation exist? Certainly there are many examples of large-scale analysis using GIS on a landscape scale, but for some reason there are comparatively few examples at the within-site scale. Those that do exist often seem to use GIS as little more than a graphical database, with the GIS element largely reduced to map display. The recent volume edited by Gary Lock and Zoran Stančič (1995) seems to underline the point. Of the relatively few GIS-based site analyses reported there, it is doubtful whether the majority needed a GIS to achieve what they describe, and in only a couple of cases is it really apparent that the application of a GIS made a material difference to the kind of analysis undertaken or the results reported. Similarly, in the CAA95 proceedings (Kamermans & Fennema 1996) there is only one paper specifically on intra-site analysis, and it is concerned with a churchyard study rather than a typical excavation (Mytum 1996).

One of the papers (Biswell *et al.* 1995) took the opportunity to look beyond their immediate study of Shepton Mallet at reasons why the use of GIS on within-site studies is so restricted. They pointed to three problems in particular which are discussed below.

14.3.1 The nature of GIS dissemination in archaeology

Most archaeological users of GIS seem to have research interests related to large-scale survey and landscape analyses rather than smaller scale within site analysis. Biswell *et al.* (1995, p. 269) ask why such people should be more interested in GIS than those who are more active in site-based research, but to a considerable extent this seems to be largely a reflection of archaeological interests rather than something specifically related to whether to use GIS or not. Landscape archaeology and cultural resource management have been very much the 'in thing' both in terms of research and the public face of archaeology over the last five years or so, and so it is perhaps inevitable that GIS are more closely identified with these approaches at present.

14.3.2 The nature of GIS analytical modules

More fundamentally, Biswell *et al.* (1995, p. 269) suggest that the majority of GIS analytical modules are designed specifically for landscape analyses — not all that surprising given their origins. Consequently, it can be argued, GIS do not provide the tools appropriate for within-site analysis. Two points come to mind here. First, conceiving of within-site data as broadly equivalent to landscape data viewed through the wrong end of a telescope has interesting theoretical possibilities; after all, thinking of an excavation area as a landscape upon and within which activities took place is not far-fetched at all. Indeed, having raised this issue as a 'problem' Biswell *et al.* (1995, pp. 270ff) go on to argue that many spatial analytical procedures used at landscape level are equally applicable at site level. Secondly, however, there is no denying that there is a change in scale from, say, sites to artefacts, that perhaps does requires a different set of tools which do not wholly exist as yet — for instance, there is little point in performing viewshed analysis on a pottery distribution! It may be that as a result of this lack of tools which are related to specifically within-site analyses, much intra-site GIS seems to involve little more than mapping artefact distribution patterns and accompanying structures in the absence of appropriate tools. Of course, this begs the question that archaeologists can define and agree on the types of tools required for handling this kind of data.

14.3.3 The nature of archaeological excavation data

This is the most significant factor for Biswell *et al.* (1995, pp. 270–71), and they draw a contrast between the relatively simplistic data and analyses at the landscape level and the high cost and complexity associated with excavation data. They point to the expense of collecting and processing site-based spatial data, and furthermore, the lack of consensus among archaeologists about what constitute minimal data collection requirements. Effectively, the finger of blame is being pointed fairly and squarely at the structure (or lack of it) of British field archaeology. This is a theme picked up in the discussions on the `gisarch` email discussion list set up after the GIS and Archaeology meeting held in Newcastle at the end of January 1996. Contributors from both sides of the Atlantic suggested that the problems lay not so much with GIS themselves but primarily with structural issues, and the arguments seem to fall into two distinct, but not mutually exclusive, camps.

Commercial archaeology

Factors such as the structure of funding in the UK, relationships with developers and the competitive tendering process (amongst others) are all implicated in the poor take-up of site-based GIS, primarily, it seems, because of the cost implications. In other words, since it is not a requirement upon archaeologists to record artefact data in three dimensions, a tender which incorporates such a recording level (for example) will lose out to one which simply employs the finds tray per context principle. High recording standards and the commercial realities of field archaeology in the 1990s do not sit well together, and hence, it is argued, provides a fundamental limitation on the application of within-site GIS.

Recording standards

This leads on from the previous argument — in the absence of agreed standards, the commercial funding of field archaeology tends inexorably towards the lowest common denominator, with archaeological data collection strategies defined in terms of largely non-archaeological constraints. This is a question not so much of how information should be recorded (a familiar recurring bugbear of archaeological computing) but what information should be recorded. So the argument seems to be that until archaeologists can agree on a standard to which all work is conducted, and which is enforced by professional bodies and government inspectors, within-site GIS applications will be costed out of the market place.

14.4 Where does intra-site GIS go from here?

So far, all this seems to make a great deal of sense. Archaeologists are not using GIS, not because they don't want to, but because the dread ogre of commercialisation means they are unable to undertake work at the level that professionally archaeologists would agree is necessary. In any open competitive marketplace, professional standards are often the first casualty. However, there would seem to be a problem with this perspective.

What all this implies is that the application of GIS requires some kind of minimum level of information which is generally above that which is commonly available. Exactly what this level of information might be is nowhere specified, although Biswell *et al.* specifically mention the need for decent two-dimensional artefact data (1995, p. 284). It might, therefore, be not unreasonable to suggest that artefact data also be associated with contexts, and so on — a conception of some kind of 'ideal' data set for which GIS applications can start to be created. But just how realistic is this? In many respects this approach has the whole issue back to front — it starts to sound as if GIS considerations are driving the argument, when it should be the other way round: archaeological questions should be driving the recording procedures and subsequent post-excavation analysis, and the relevance or otherwise of GIS analyses is determined not so much by the recording level but by the archaeological questions themselves. Only in this way can we be reasonably sure that archaeological questions are driving the GIS analyses, rather than the GIS tools themselves driving the archaeological analyses.

Up to a point, there is no site that cannot benefit in some way from GIS. If the level of recording is insufficient for some types of analysis, at the very least the linkage between database and graphics system will be of benefit to most, and indeed this seems to be the characteristic of many GIS within-site analyses. For instance, the absence of 2-D artefact data does not preclude the application of a GIS to that data set — it merely constrains the questions that can be asked. A site where artefacts are recorded on a context basis alone (as in many urban excavations, for example) is equally amenable to GIS analysis: polygon data rather than point data is used and hence some potential resolution is lost. Nor do sites have to have the same degree of complexity or recording level in order to address similar questions. To underline this point, the data sets derived from Shepton Mallet (Biswell *et al.* 1995, p. 272) and Symon's Castle can be compared. Excavations at Shepton Mallet covered around 2.5 hectares compared with approximately $500m^2$ on the motte at Symon's Castle. At Shepton Mallet, around 44,000 artefacts were recorded in 3D compared to over 10,000 artefacts recorded at Symon's Castle. Over 20,000 contexts were identified at Shepton Mallet, whereas at Symon's Castle only 23 identifiable contexts were recorded on the motte. Both sites were excavated under quite different circumstances — Shepton Mallet was a rescue excavation whereas Symon's Castle was a research excavation. So which is the more complex site? Symon's Castle has more artefacts per square centimetre, but then Shepton Mallet has rather more contexts to deal with. Of course, this is a meaningless question — both sites were excavated and recorded to professional standards but under quite different conditions. Yet in both cases, GIS was used (apart from other things) to locate buildings which had been destroyed or which otherwise left little identifiable traces together with other associated activity areas. In other words, while the data sets are rather different, the questions being asked are quite similar, and it is these that lend themselves to a GIS approach, not a particular style or level of recording. The archaeological questions or analytical destinies determine both the recording methods adopted (or lead to them being adapted in the light of experience) and the analyses that are undertaken (and hence the tools, GIS or otherwise, that are appropriate). The archaeologist and the data drive the analytical tools, not *vice versa.*

Figure 14.1: Symon's Castle. A 'typical' CAD-derived distribution plot of lead in the area of a rectangular structure associated with the bridge on the motte.

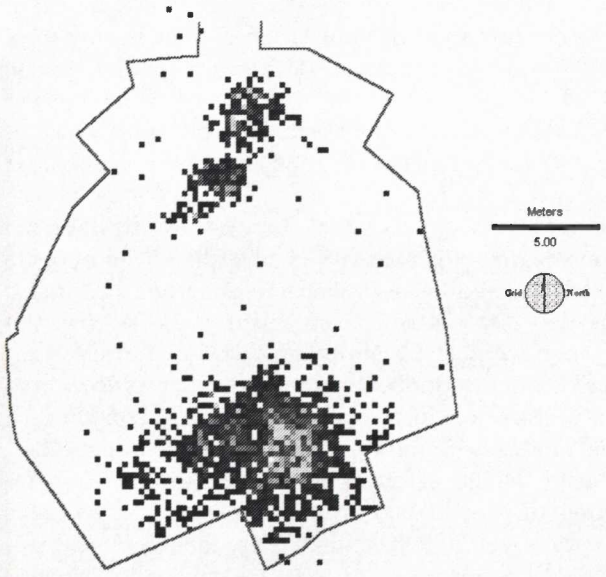

Figure 14.2: Symon's Castle. An incidence matrix of daub fragments sampled on a 25cm grid. High concentrations suggest the location of buildings.

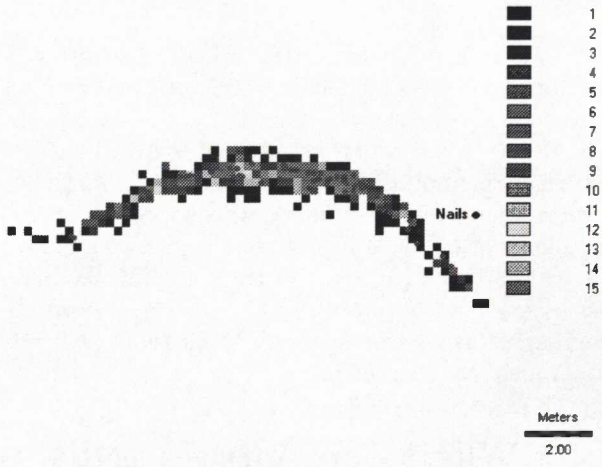

Figure 14.3: Symon's Castle. An E–W profile through the southern-most structure identified in Figure 14.2. The incidence matrix represents daub fragments sampled on a 25cm grid with locations of nails superimposed.

Figure 14.4: Symon's Castle. A provisional interpretation of the location of structures on the motte. The incidence matrix is populated by artefact types which have the highest frequency within each 25cm grid square.

For example, at Symon's Castle, artefact data were recorded in 3D because it was by and large the only data that was recoverable given the nature of the site. During excavation it became quite clear that the 2D location of artefacts was significant, but only in the sense that locations of types of material became predictable and the suspicion developed that this was related to the presence of otherwise invisible structures. Plotting the point distributions in a CAD package did little more than confirm the suspicion, but the sheer quantity and density of data meant that little sense could be made of the patterns (Figure 14.1). Contouring the data within the IDRISI GIS produced the reverse effect — depending on the interval chosen, patterning was too diffuse or too inexact to be meaningful in terms of the identification of structures and activity areas. In the end, rasterising the point data to form incidence matrices enabled clearer patterns and distinctions to be identified by generating artefact counts within 1m, 0.5m, 0.25m or smaller grid squares (Figure 14.2). At a basic level, this provided a visualisation method at a range of resolutions which meant that the distributions were more amenable to examination and interpretation. The 3D artefact data could also be used to construct cross-sections in the absence of identifiable context information which could then be used to test theories about building location and destruction (Figure 14.3). The end result is the identification of the location of at least one, and possibly two buildings, along with a probable cooking area, together with a greater understanding of the structural elements which did survive as identifiable contexts (Figure 14.4).

Symon's Castle is an example of a fairly ordinary site whose recording methodology was changed to suit the conditions, with a clearly identifiable set of questions that GIS tools could be suitably applied to. It is far from ideal in many respects — the lack of context information in particular — but that does not make it any the less appropriate in GIS terms. The data was not recorded with a GIS application in mind, but with certain archaeological questions which it was found could subsequently be addressed (and still are being addressed) with a GIS.

14.5 Conclusions

It may be that the commercial issues are being ignored here, and the case study presented is certainly derived from a site excavated under privileged research conditions, but it is argued that the reasons for the comparatively poor uptake of GIS for within-site analysis have to be sought elsewhere, rather than simply claiming that archaeologists do not record their data in enough detail because the powers that be will not fund archaeology properly. The issue is not funding, or the lack of it, or poorly recorded data, but whether archaeologists can demonstrate whether or not we have the type of questions that GIS can help with.

So, why aren't more site-based analyses carried out using GIS? Financial issues may have a role here, not in terms of levels of recording but the cost of purchasing and operating a GIS in hardware and software terms. However, a still more significant factor may be that GIS have yet to fully justify themselves — very few published sites have demonstrably benefited from the application of a GIS as yet, whereas rather more can point to the advantageous use of databases and perhaps CAD systems. The publication of a site like Symon's Castle is not likely to be of much help here as an exemplar, but the gradual appearance of site reports which do use GIS, like Symon's Castle and Shepton Mallet, may steadily erode any resistance. Of course, a big bang approach might be more immediately successful — a large-scale research excavation project which has a high quality and range of data and recording both to demonstrate fully the use of GIS on a within-site basis and, perhaps more importantly, to develop analytical tools specifically targeted at within-site analysis. But the bottom line is that this will not happen of its own accord, and in terms of techniques, tools and levels of recording, GIS needs to be seen to move towards archaeology, rather than expect archaeology to move towards it. It is not a tool which requires special data or conditions, but can make a real contribution to the analysis of any site. The challenge therefore is that GIS for within-site analysis should not be relegated to a category shared by 3D reconstruction modelling — of great interest, but fundamentally limited by inadequacies in recording methods. Instead, GIS should be viewed alongside databases and CAD as appropriate and valuable components in the standard computing toolkit within the present methodological context, rather than some hoped-for future one.

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Notes

1. See the GISARCH e-mail discussion list archive at `http://www.mailbase.ac.uk/lists/gisarch/archive.html`.
2. See also `http://www.gla.ac.uk/archaeology/staff/jwh/symon/symon.html`.

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