# Thinking beyond the Tool

## Archaeological computing and the interpretive process

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# Commentary

## What Lies Beneath: Lifting the Lid on Archaeological Computing

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**Keywords:** Technology; Tools; McLuhan's Laws of Media; Tetradic Analysis; GIS

*'We shape our tools and thereafter our tools shape us' (Culkin 1968, 60).*

*'The most important thing about a technology is how it changes people' (Lenier 2011, 4).*

### 1. Thinking beyond the tool

What do we mean when we talk about 'thinking beyond the tool' in the context of archaeological computing? The brief for this volume was refreshingly clear and it is worth reiterating it here. The challenge was:

- to discuss the underlying theoretical concepts behind our methodological tools;
- to examine the extent to which constraints of these tools alter our perceptions and interpretations about the past;
- to investigate future directions from a theoretical perspective.

Earlier attempts to do likewise have met with mixed success (for example, Cooper and Richards 1985; Lock and Brown 2000; Huggett and Ross 2004a) and, amongst other things, demonstrated that thinking 'beyond tools' is not an easy thing to do. In the commentary introducing the 2004 collection, three different levels of approach were identified (Huggett and Ross 2004b):

1. the specific application, its implementation and use (for example, databases, GIS and viewshed analysis, agent-based modelling);
2. the origins and prospects of larger-scale systems (for example, online National Monuments Records, digital data archives);
3. the broader implications of information technologies within archaeology and how they are integrated into the subject.

By far the most frequent are levels 1 and 2, which are typically found throughout the broad range of publications relating to aspects of computer applications in archaeology. These quite properly consider questions of application and the nature of the underlying model as part of the critique of the research results generated by the analysis. More rarely they go 'beyond the tool' and consider the wider implications of the application, the constraints it may have imposed, the way the research questions may have been shaped by the tool, how the tool may have structured the research, and so on. Level 3 approaches are rarer still. As the common denominator between the three publications mentioned above and the present volume, I have sought various ways of looking at this subject in my own research, whether it is considering the implications of technological determinism (Huggett 2000), thinking about issues surrounding information handling and processing (Huggett 2004a), or using the metaphor of fetishism as a medium for thinking through some of the characteristics and implications of the technological tools archaeologists use, such as beguilement, disguise, mystery, and gender (Huggett 2004b).

On the face of it, therefore, aspects of 'thinking beyond the tool' are to some extent a characteristic of virtually all reflective computer-using archaeologists - if only because demonstrating the validity of our results is in part dependent on demonstrating a knowledgeable application of the tools we use. But is this sufficient? Focus on the application level risks losing sight of the broader context from which these applications are derived and within which they are used. Information technologies are socially charged: there are issues of control, surveillance, power, politics, order, and structure associated with them - which in turn influence how archaeological knowledge is created, represented, manipulated, modelled, and understood.

To some, this seems essentially irrelevant, either because it is believed to be self-evident or because the implications of the tools are not appreciated. For instance, in response to a paper arguing that computer-using archaeologists had largely ignored the consequences of the new information and communication technologies we have absorbed within our subject (Huggett 2004b), it was suggested that this approach 'reflects more closely those environments in which the technological contribution is

considered predominant and computer science, which is often the source of financial resources, is confined to the role of a tool, albeit one with wonderful solutions' (Moscati 2004, 13), and went on to argue that there has always been a clear vision of the effects of computer methodologies represented in the published range of papers and articles. In many respects, this underlined the very issues of beguilement and mystery that my paper sought (and hence presumably failed) to present: this broader approach is seen to be only relevant in circumstances where technology is the driver and the computer is reduced to a mere tool.

To others, this approach seems futile and pointless. As archaeologists, we work within a global environment predicated increasingly upon ubiquitous information technologies. Since we cannot avoid this, we cannot change this, cannot step aside from this, and are powerless to influence this, what then is the value or purpose of a broader investigation of the impact of these tools when we should be concentrating on how best to use them to enhance our understanding of the past?

I propose that the importance of standing back and taking this broader perspective is that, if the tools we use do change us, if they do affect what we do and how we do it, we should be paying attention to this. Culkin's statement cited at the outset of this paper (commonly erroneously associated with Marshall McLuhan) goes on to suggest that our tools shape the way we organise reality - and so by archaeological extension, how we organise and understand the past. As I've suggested elsewhere, through understanding how these technologies operate on us as well as for us, we can seek to ensure that they serve us better in what as archaeologists we already do, and help us initiate new and innovative ways of thinking about the past (Huggett 2004a). Indeed, I have argued that we have a responsibility to do this, since not to make the attempt means that we remain powerless consumers in the face of otherwise autonomous technologies (Huggett 2004b, 89).

Floridi offers an elegant analogy in the context of the growth of information and the need for a philosophical approach to it. which seems equally relevant in the context of archaeology:

'Our technological tree has been growing its far-reaching branches much more widely, rapidly, and chaotically than its conceptual, ethical, and cultural roots...The risk is that, like a tree with weak roots, further and healthier growth at the top might be impaired by a fragile foundation at the bottom...while technology keeps growing bottom-up, it is high time we start digging deeper, top-down, in order to expand and reinforce our conceptual understanding of our information age, of its nature, its less visible implications, and its impact on human and environmental welfare, and thus give ourselves a chance to anticipate difficulties, identify opportunities, and resolve problems, conflicts, and dilemmas' (Floridi 2009, 154).

In terms of the archaeological technological tree, most computer-using archaeologists can demonstrate that they are already thinking about their tools as they use them; however the top-down approach is largely absent and may be thought to be futile or irrelevant in the face of the bottom-up approaches which are already evident. Why might this be the case? Part of the answer may be found in considering what we mean by 'thinking beyond the tool' and how a 'tool' is defined.

## 2. An excursus on tools and technology

'Tool' is a term often encountered in relation to archaeological use of computers - not least in the title of this volume - and the context within which the term is used can be very revealing about attitudes to information technologies. In one sense, computers are referred to as tools alongside trowels, spades, and wheelbarrows. The computer forms part of the general tool-kit used by archaeologists, albeit a tool which functions in a variety of different ways: simultaneously a tool for writing, reading, drawing, mapping, storing, retrieving, communicating, analysing, reconstructing, integrating, and disseminating our data and information. Alternatively (or indeed, at the same time), 'tool' can be used in the context of software or a particular application - a database, a GIS, a 3D modeller, each of which will typically contain its own specialist tools for handling, processing, manipulating, and presenting data. 'Tool' may therefore refer to the hardware and all it consists of, or specifically to the software which runs on the hardware, or indeed to specific elements of the software itself - the term is frequently used in an ambiguous and fluid manner which gives rise to different interpretations of what it means to think 'beyond the tool' and whether or not this is a worthwhile endeavour.

This ambiguity in relation to the definition of a 'tool' in the context of information technology is not peculiar to archaeology. For example, Feibleman proposes that the design and construction of tools are the consequence of technology, and the subsequent use of the tool is associated with additional technology which determines how the tool is used (1967, 330). This additional technology includes instructions for the operation of the tool, and - crucially - directions and formulae for using it within the context for which it was designed. Although he is writing before the microcomputer revolution, Feibleman is aware of microcircuits (1967, 334), but significantly sees computers in the same light as gyroscopes and thermostats - instructions about the operation of the tool are built into it (1967, 335). This is in some respects reminiscent of Mumford's classic definition of the essential distinction between a machine and a tool as 'the degree of independence in the operation from the skill and motive power of the operator: the tool lends itself to manipulation, the machine to automatic action' (Mumford 1934, 10). Neither definition of tool fits the case of the computer particularly well, but a key distinction is that while Feibleman's definition places limitations on the function of the tool, Mumford allows

the use of the tool to be limited only by the skill and know-how of the operator. On the other hand, Feibleman employs a very broad concept of technology, rather than seeing it simply in more mechanistic terms. In both cases, the tool is more than simply a technical object: it achieves functionality through the skill of the user (Mumford) or the instructions embedded within it (Feibleman).

However, the 'tool' approach carries within it a tendency to make technology seem neutral - the equivalent of the aphorism that guns do not kill people, people kill people. A tool is neither good nor bad, but is capable of being put to good or bad use. As Mumford originally emphasised, what gives the tool direction is the user: the tool 'is in no position to give itself ends and is only the means of realising ends provided by human beings' (Verbeek 2005, 39). Consequently, the tool or technology is not itself at issue, only the way in which it has been implemented or used. This encourages a view of computer-based tools as theoretically neutral, essentially empty vessels into which data are poured, with interpretation only starting as analysis commences. Correspondingly, evaluations of the application of such tools and their results will tend to be limited by a lack of consideration of the social, cultural and philosophical issues associated with their use. Consequently the focus will be on a limited perspective of the tool or application rather than the wider picture.

Mitcham (1994, 156ff) provides a broader and more flexible framework for considering technology, building on the definitions of Marx, Heidegger, Ellul, Dessauer and others: technology as knowledge (techniques and know-how), as activity (making and using), and as object (the material technical artefacts themselves). A similar framework was earlier provided by MacKenzie and Wajcman (1985) in which technology comprises artefacts and technical systems, knowledge about these artefacts and systems, and the practices of handling them. Breaking the subject down like this provides a convenient structure for considering the technological computer tools archaeologists use. The categories are not mutually exclusive; they can provide different perspectives on the problem of thinking 'beyond the tool'.

*Technological knowledge* can constitute the body of knowledge which gives rise to technological artefacts - hence the computer as technological artefact is an implementation of computer technology (Carlson *et al.* 2010, 210). However, it can also be the know-how, rules of thumb, routines, sets of rules, and theories which in combination develop and shape the use of the technical artefact. These may give rise to regularities in use (customary behaviour and application) reinforced by training, teaching, and experience but may also be subverted and circumvented. Nor need they necessarily be evident. For example, Faulkner and Runde (2009, 446) distinguish three ways that rules may contribute causally to the determination of behaviour:

- people follow rules in a deliberate, conscious way (such as a recipe, a manual, etc.);
- people learn and internalise rules in such a way that they become essentially instinctive, but may be recoverable by the conscious mind (the improvisation of a jazz musician, for example);
- people behave in appropriate ways but this does not involve consciously or sub-consciously 'knowing' the rules (for instance, people conform with rules of grammar without being able to articulate them).

Identifying and deconstructing which of these may apply is important in understanding the context of a particular application.

*Technological activity* is, according to Mitcham, 'that pivotal event in which knowledge and volition unite to bring artefacts into existence or to use them; it is likewise the occasion for artefacts themselves to influence the mind and will' (1994, 209). Since technological activities include categories such as crafting, designing, manufacturing, and working, they are not strangers to archaeological investigation. The difference, perhaps, is that we are ourselves implicated in these activities which makes it difficult to stand as dispassionate, objective observers - indeed, turning the gaze inwards upon ourselves can quickly become an exercise in navel-gazing. However, Ihde argues that to some degree we must 'go native' and actually become informed participants, since this enables us to consider and perhaps influence the developmental phases of technologies, as well as already extant philosophies and their effects (2004, 91).

*Technological artefacts* should put archaeologists on familiar ground, accustomed as we are to artefact studies and the way that artefacts influence and structure society through human agency. Although technological artefacts can cover a whole realm of objects ranging from clothing and utensils through to machines and automata (Mitcham 1994, 162), we are concerned here with computer hardware and software and the way the availability, presence, and use of these can impact on the practice of archaeology. This goes beyond the physical nature of the artefact itself - for instance, it is more than a question of considering the impact of miniaturisation and mobility on application and use. For example, Kroes and Meijers (2006, 2) argue that technical artefacts have a dual nature - they can be described in complementary ways, neither of which can be subsumed beneath the other. There is the physical object itself, but importantly there are also the intended functions associated with that object (similar to Feibleman's 'additional' technology, for instance). However, there is also a third dimension: unintended functions - the use of the technical artefact in ways which differ from what was originally intended (Carlson *et al.* 2010, 210). These are at least as important as the intended or designed functionality as they add a degree of unpredictability into the equation: the impacts and influences may be hidden but these are also where serendipity and inspiration can live.

So thinking 'beyond tools' should involve more than simply accounting for and justifying the use of a particular application. Thinking about tools in terms of technological knowledge, activities, and objects emphasises the range of implicit, explicit, and tacit assumptions and beliefs wrapped within a social, political, and technical environment. Ultimately, these tools do not yet create themselves - we create them, improve them, refine them and ultimately accept or reject them. They augment and scaffold our thought and analysis, and consequently need to be approached in a considered, aware, and knowledgeable manner. With that in mind, to what extent do the papers in this volume make us, as archaeologists, and the IT tools we employ the focus of study?

## 3. A commentary on the papers

**Watterson** looks at how the act of assembling and presenting an archaeological reconstruction functions as an interpretative process at every level, from the development and creation of the models through to audience consumption and presentation. In the process, she argues that archaeologists on the whole are not exploiting the interpretative values of creative technologies to their full potential, and virtual reconstructions often appear as an afterthought with little research potential - they act more as a case study for the technology. Although the criticism has been made before, her reflective approach offers the prospect of a less mechanistic approach to reconstruction models.

**Frankland** picks up the theme of public consumption of virtual reconstructions and sets out to test the view that photo-realistic rendering removes the visual cues that the reconstruction is an interpretation and hence increases its authority. Three styles of presentation (hand-drawn sketch, watercolour, and photo-realistic) with three levels of detail were prepared and viewers' responses evaluated. Archaeological concerns seemed to be largely restricted to specialists - perhaps unsurprisingly the popular vote was generally for photo-realistic presentations and there seems to be a reasonable appreciation of the limits of interpretation. The most obvious question - which of the three styles was 'better' (by whatever gauge) - is not asked directly, only in conjunction with the three levels of detail, which perhaps suggests an area for further consideration. The analysis provides a welcome consideration of how we present reconstructions and an evaluation of the extent to which archaeological assumptions about public presentation methods are borne out.

**Cripps** responds directly to the editors' challenge, looking at a range of developments in archaeological spatial technologies in order to show how archaeological theory and technological practice can be reflexively related. He points to the way that archaeology has been quick to take up new technologies and techniques and suggests that this can sometimes be seen as neutral but may be problematic in other cases - a tantalising comment which is developed further in this commentary. He recognises the way in which practitioners from other disciplines draw on examples from archaeology while archaeologists take advantage of new developments in other fields, but the potential implications of this are not developed at this time. His suggestion that modern mass field data capture techniques represent a shift to indiscriminate data capture and consequently shifts interpretation from the point of data collection to a post-survey activity could represent a change in the kind of technological activities referred to above. However, mass field data capture still requires a range of decisions to be made about aspects of the survey procedure which, even if considered to be essentially practical, nevertheless have potential implications for the interpretative process. He offers the interesting prospect of complex spatial analysis tools becoming as commonplace as word processors and accessible to non-specialists: this raises the question of the extent to which the technological knowledge associated with these tools becomes regularised, tacit, with applications becoming procedural, even rule-based? The image of 'thinking spaces' constructed from semantically linked datasets is presented as a democratising tool, enhancing multivocality and allowing data and interpretations to be reviewed and challenged, although this follows a warning about the limitations of linked data, which, like all forms of data, are dependent on the intentions of the originator. As Cripps observes, this raises problems for the downstream consumers of such data, and it has close parallels with the idea of intended and unintended functions of technology which is worthy of further consideration.

**Katsianis** turns to the use of GIS for archaeological excavations, suggesting that digital technologies have really contributed successfully only to better management of excavation archives rather than to the collection and processing of data on site (for an alternative perspective, see, for instance, Warwick *et al.* 2009). In a review of excavation as knowledge production, digital information systems in excavation, and knowledge production practices in excavation, a range of issues are flagged including the 'distancing' effect of technology, changing techniques (such as the shift away from excavation diaries), and the quality of the excavation record and the consequences for subsequent analysis. All these have implications for both excavation practice and the use of digital technologies, and would be worthy of more detailed consideration than is possible here. He presents a conceptual model based on the 'What', 'Where', 'When' triptych which is already used across a variety of different application areas (including archaeological archives). Some of the issues raised about knowledge representation have been addressed by, for example, LP Archaeology's Archaeological Recording Kit (ARK)[1], as used by Dufton and Fenwick elsewhere in this volume. For example, in the 'What' discussion, the question of new entities arising that cannot be integrated into predefined categories can be handled in ARK through its 'fragments' model. The

[1] http://ark.lparchaeology.com/

'Where' discussion presents examples of 3D grids and b-rep models of excavation deposits, but there is no reference to the recording limitations that he refers to earlier which could have significant consequences for the resulting models. Clearly, the final implementation in ArcScene has some limitations in terms of its presentational and 3D capabilities, but the potential is clearly demonstrated. A detailed consideration of value would be worthwhile, especially given the conclusion that 'the effective introduction of new technologies in excavation is directly related to their role in reassessing and improving the ways we interact with reality to create knowledge about the past'.

**González-Pérez** presents an approach to the description of archaeological entities that avoids classification as an *a priori* mechanism, using instead the entity's properties as units of description. He argues that this avoids category bias and that classification can still be subsequently applied if desired. The discussion of inflexibility of category systems, in that they are incapable of recognising new variants and hence wrongly force entities into inappropriate categories is perfectly valid, and could be usefully compared with the capabilities of the ARK system referred to above. A typeless information modelling approach is outlined, which moves directly from the entity itself to identifying its properties, omitting its classification. The question therefore becomes which relevant properties define the entity rather what the entity actually is in the first place, and if required sets of properties can be linked subsequently to a classification. González-Pérez recognises that the determination of properties and the description of their values is a complex mix of cognitive processes, perhaps omitting that these properties do not necessarily arise naturally in the absence of categorisation. The determination of the properties of an object will, at least in part, be derived from past experience, *a priori* knowledge, comparison with others, and hence the typeless approach is not as truly objective as it might appear. In other words, some aspects of category will tend to be captured within the definition of properties. Whether we can really avoid classification like this remains questionable - arguably consciously or sub-consciously we classify or categorise what we see, identifying an object for what (we think) it is. Only when it is not recognised is recourse made to description in terms of properties alone, and even then these may arise through comparison with something which is known. González-Pérez recognises the problem that the cognitive processes employed in constructing properties are subject to bias to the same extent as those involved in categorisation, arguing that the problem is less since properties are atomised relative to category and do not determine the structure of the information in the way that categorisation does. However true this might be, there remains the issue that we categorise and identify things all the time and to do otherwise goes against natural thought processes and risks making early categorisation implicit rather than explicit. Ultimately, it would seem that the only way to record objects reliably through properties alone would be to attempt to record 'everything'.

**Wu and Lock** focus on the spatial construction of social relations, examining the relationship between the spatial and the social, applying Ingold's 'wayfaring' theory to demonstrate how social relations may be influenced by human agents moving around a settlement. The model incorporates access diagrams and space syntax as the basis for developing a meshwork of social relations. Least cost path analysis is used to reconstruct the pathways from a household which are then accumulated together to highlight the pathway density, with high density pathways suggesting more social interactions and *vice versa*. It is an elegant approach, and in terms of 'thinking beyond the tool' the paper is more a case of 'having thought beyond the tool', presenting what is effectively a new tool. Wu and Lock suggest that the focus of many spatial technologies is on location and order, and rarely are they used to investigate how people interact with the surrounding spatial structure, although much agent-based modelling seeks to do precisely that.

**Pethen** looks to develop an approach for integrating GIS and phenomenology in the analysis of ancient Egyptian ritual landscapes and mining sites. In a discussion of the relationship between GIS and phenomenological approaches to landscape, she suggests that the deterministic perspective of GIS is more to do with the way in which it is presented: a tendency for archaeological research questions to be used as GIS 'case studies', hence suggesting to phenomenologists who are predisposed to be distrustful of GIS that the technology is more important than the archaeological question. Furthermore, limitations in understanding landscape tend to be addressed by seeking more technological solutions - as is demonstrated here by Wu and Lock in a different context. She recognises the limitations of phenomenology and argues that both GIS and phenomenology require additional material to explore visual experience fully and to grapple with ancient perceptions of contemporary worlds. The method described relies on the presence of textual material to provide information on ancient attitudes and experience of landscape to ensure the work is theoretically sound - in this respect, what is being developed sounds not too dissimilar to the kind of historical GIS which would be recognised by GIS-using historians. The paper is explicitly a work in progress and hence steps back from the point of actual application which means that so far the strength of the argument remains untested, although one might suppose that the integration of textual sources within historical GIS more generally would provide some room for optimism.

**Verhagen and Jeneson** summarise an attempt to predict the course of a stretch of Roman road using least cost path analysis to find the optimal connections between two or more locations based on distance and effort. They suggest that in most cases it is hard to judge whether these models are good at predicting past routes since the physical evidence is usually limited. Indeed, in a detailed and introspective discussion, the result generated

conforms broadly to expectations although they express a lack of confidence in the results. Nevertheless, they see the positive benefits of attempting to model in terms of comparing different outcomes. Verhagen and Jeneson explicitly address 'thinking beyond the tool' although they felt that they were forced to think more *about* the tool than *beyond* it. They suggest we are still lacking the appropriate 'spatial language' and accompanying toolboxes, and feel that more energy should be invested in developing software tools that will allow us to more easily compare different theoretical perspectives. The emphasis is therefore once more on seeking technological solutions for archaeological problems.

**Fiz, Subias and Cuesta** outline an approach to modelling the landscape of Oxyrhynchus using a range of different sources. They describe the detailed collection and assembly of a variety of textual, cartographic, and satellite datasets in order to reconstruct the nineteenth-century landscape around ancient Oxyrhnchus in order to attempt to identify earlier features. An essentially descriptive account, this is an interesting exercise in source analysis and methodology and their results underline the importance of ground-truthing data.

**Dufton and Fenwick** see the development of web-based technologies as a way of integrating and disseminating burial and funerary data, as well as providing a tool for complex and spatial chronological analyses. Amongst other things, they argue that the standardisation of recording methodologies has created a significant gap between data and interpretation in site practice - as they say, restricting the contribution of the excavator to a series of prompted pro-forma fields often also has the unintended effect of denying them the interpretative voice. In many respects, therefore, their contribution aligns with those of Katsianis and González-Pérez in that they are seeking ways of modelling and structuring complex data. Their solution is found in the application of LP Archaeology's Archaeological Recording Kit, which employs a hybrid Entity-Attribute-Value data model grouping different categories of data 'fragments' (text strings, images, dates, actions, plans, locations, etc.) under a primary record identifier within a web-based environment. Given the other contributors elsewhere in this volume who share their search for greater flexibility in data representation, this model could have benefitted from a more detailed explanation of the methodology. Although Dufton and Fenwick note that other systems are under development, there is a high-profile alternative that is already highly developed. The Integrated Archaeological Data Base (IADB) has been in use for many years and developed as a comprehensive web-based excavation recording and post-excavation processing system through the Silchester VERA project (for instance, see Warwick *et al.* 2009 and example outcomes in Clarke *et al.* 2007). It would be interesting to see a comparison at different levels between IADB/VERA and ARK, since they represent two of the most developed systems in general archaeological use.

**Massung** examines the response of visitors to location-based media presentations at heritage sites. She recognises that prior research has typically concentrated on the capabilities and implementation of the technology, and instead focuses on whether there is actual visitor demand for such interpretations and what might be necessary to move the experience beyond experimental novelty. Questionnaire-based analysis at Bath's Roman Baths (in relation to existing audio tours) and a prototype location-based design at the Clifton Suspension Bridge showed that there was no difference between user preferences in terms of method of delivery. Although location-based media were not rated as a significant improvement in the delivery of information, neither were they significantly worse. Given the increasing use of location-aware smartphones, this is an interesting demonstration that new technological solutions will not necessarily be preferred, perhaps until they become more common elsewhere. Indeed, as Massung observes, the increased availability of mobile internet may mean visitors no longer need specially created 'tours' and 'guides', which would demonstrate an unanticipated outcome of the technology.

**Brughmans** discusses the application of social network analysis in archaeology. In the process, he highlights a range of issues including the challenge of deriving individual human behaviour indirectly through material remains, the reduction of social interactions to a limited number of variables, the inherent tautology in which the phenomenon under study becomes the technique used to study it, and the way that the methodology generally assumes knowledge of the whole network when reality limits this to local awareness of a restricted network. He proposes some archaeological solutions to these problems and argues that social network analysis holds considerable potential for understanding aspects of past societies, although a concrete archaeological example of the implementation of the tool would be welcome. Indeed, 'thinking beyond the tool' in some respects relates to ways of improving the tool in terms of dealing with its potential archaeological use.

## 4. Digging deeper

Robert Zemeckis' thriller/horror film *What Lies Beneath* received a mixed critical reception on its release in 2000: *Empire* magazine rather magnificently described it as '... an enjoyably giddy ride, certainly, but once you're back from the edge of your seat, you realise most of the creaks and groans are from the decomposing script'[2]. This collection of papers may provide a giddy ride but the scripts are rather better than the film in this case! However, revisiting the original objectives and considering the success of 'thinking beyond the tool', it is fair to say that the results are mixed. In many cases we tread familiar ground in the sense of reviews of specific applications and their implementation and use - only a

[2]http://www.empireonline.com/reviews/ReviewComplete.asp?FID=6237

few go beyond to consider the wider implications, constraints, effects, and impacts of these tools. Novelty of application and new technological solutions, commendable though they may be, are only part of 'thinking beyond the tool'. So how might we proceed? How can we break out of this cycle that has been evident for twenty-five years or more, in which we review our tools within the context of their application, but rarely look beyond them?

To reiterate Floridi's argument quoted earlier, we need to start digging deeper if we are to gain a greater understanding of the tools we use in the search for understanding the past. One approach would be to draw upon the kind of framework discussed above for thinking about technology. However, while it provides a useful means of considering technological knowledge, activities, and artefacts, it is perhaps insufficiently problem-oriented to help drive this question forward, especially if we are seeking to break out of a cycle in which these bigger issues are consistently not addressed. Of course, the risk in doing so is that we sail off onto a sea of generalisations about society and lose sight of the stuff of archaeology, in the process laying ourselves open to accusations of irrelevance. Somehow we need a means of digger deeper into the wider nature of our tools, tacit and implicit, while at the same time experience suggests we are most comfortable thinking about our tools within the immediate context of their applications.

One way of developing a greater critical scrutiny is to consider Marshall McLuhan's Laws of Media (presented posthumously in McLuhan and McLuhan 1988, but initially presented in McLuhan 1975, 1977) as a means of understanding the effects of our technological artefacts on ourselves and our practice. These are not laws as such - McLuhan saw them as exploratory tools or 'probes' that provide insights into the effects of a technology: they are more heuristic device than scientific method. According to McLuhan (1977, 175), there are four 'laws' or observations on the impacts of human artefacts on us:

- *Amplification*: what aspects of human function does it enhance or amplify?
- *Obsolescence*: what does it eclipse or supersede that had previously been extensively used?
- *Retrieval*: what was previously obsolescent but now comes back into use?
- *Reversal*: what does it reverse or flip into when developed to its full potential?

These 'laws' effectively captured and summarised all of McLuhan's earlier work and insights (Grosswiler 1996; Levinson 1999, 187). For example, using these laws, radio can be seen as enhancing access to mass audiences, it makes print obsolescent, it retrieves the town crier who had been largely obsolesced by print, and, when pushed to its technological limits, it flips into the audiovisual medium of television. As Levinson (1999, 188) emphasises, what this demonstrates is that the four laws rarely generate singular effects - radio cannot be reduced to the four impacts identified above: we can also see radio as making obsolete face-to-face conversation as well as the wiring and cables of the telephone and telegraph, for example. In the same way, depending on the starting point the computer can seen as the outcome of the reversal of the television, the book, the film theatre, and so on. Consequently, there is greater depth and complexity to the application of these heuristics than might at first be apparent. Levinson points to a resemblance with Hegel's dialectic (McLuhan 1977, 173, Levinson 1999, 192-3) in which a thesis or position is countered with an antithesis or opposite idea, with the best of both being brought together in a synthesis. Where McLuhan departs is in his use of retrieval, which provides a historical basis for predicting future impacts. In the process, Hegel's triad is developed into a tetrad by McLuhan (Figure 1).

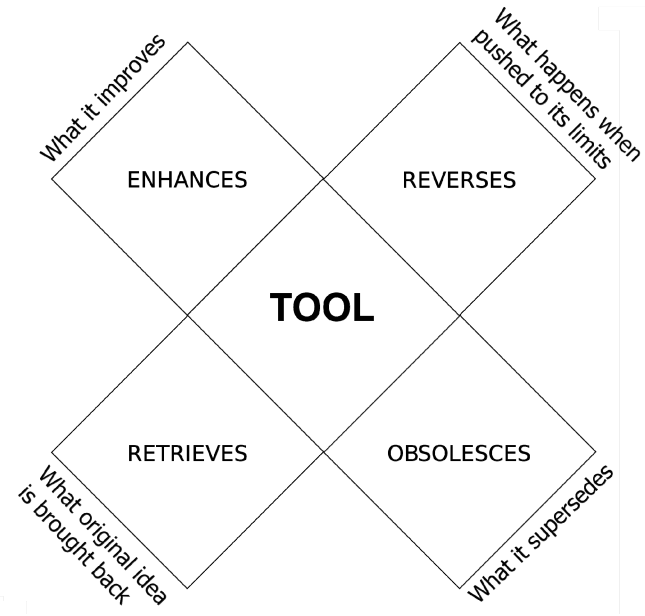


**Figure 22**Thinking about tools using McLuhan's tetrad.

The tetrad model brings out a series of inherent oppositions within the laws: as McLuhan observes, 'Retrieval is to Obsolescence as Amplification is to Reversal - and - Retrieval is to Amplification as Obsolescence is to Reversal' (1977, 177). Understanding what a tool enhances is increased by an appreciation of what it retrieves from the past; perceiving what a tool supersedes is heightened by thinking about what it reintroduces and builds upon.

This is only a very brief outline of McLuhan's laws and it is not claimed here that their application will create some kind of 'truth' - indeed, as Tyler (2008) emphasises, the laws of media do not lend themselves to falsifiability since illustrative examples can be readily stretched to fit. McLuhan himself saw the laws simply as a means of investigation, and it is in this light that they are presented here. McLuhan claimed that the laws represent 'an order

of thought and experience' (1975, 75), while Sui and Goodchild observe that 'As an exploratory probe resting on a set of questions, instead of a bounded theory, the tetrad will facilitate our simultaneous understanding and integral awareness' (2003, 10). The proposal here, therefore, is that answering these four questions aids in bringing the kind of critical scrutiny that is required in 'thinking beyond the tool'.

## 5. Thinking with tetrads

Although not widely applied beyond McLuhanite circles, these laws have been used as a means of addressing varied fields ranging from digital game theory (Tyler 2008), blogging (MacDougall 2005), hypertext (Moulthrop 1993), location-based services (Sui 2004), and social GIS (Sui and Goodchild 2003). By way of an example, the following discussion takes the tetradic analysis of GIS by Sui and Goodchild (2003) as a starting point, whilst applying an archaeological perspective.

*GIS enhance*

The introduction and use of GIS within archaeology has transformed our ability to handle locational data and in the process influenced everything from the management of excavation data through to National Monument Records. GIS make the integration of different categories of data feasible, even if collected under different spatial systems, and in the conjunction of these different data new information can be revealed. The business of creating maps has been made more accessible, even democratised. GIS also bring with them access to a host of different spatial and statistical analytical tools, placing a varied and complex toolbox at our fingertips and providing the facilities to expand the tool-set by developing new instruments for archaeological application. In many respects, the capability of GIS to incorporate and manipulate the range of data can be seen as a way of helping us handle the tide of information that threatens to swamp us. Ultimately, one might claim, with some justification, that GIS have been implicated in the transformation of the subject itself.

*GIS make obsolete*

GIS have made traditional map-making almost redundant - we rarely spend time preparing maps at drawing tables with permatrace, while letraset and leaky or blocked rotring pens are nostalgic memories. (Indeed, coincidentally, I have just converted my own traditional drafting table into a computer desk as a diversion whilst writing this paper). The widespread availability of digital data in repositories and archives makes it less necessary to seek out the data personally - Sui and Goodchild go further and point to a decline in traditional field techniques, reducing the current collection of primary data since so many secondary datasets are available (2003, 11), though this is perhaps rather less true of archaeology. Certainly data collection tasks that would previously have taken weeks or months in libraries trawling through journals and reports can now often be undertaken with a simple query to a database, followed by some manipulating and massaging to get the data into the desired form. More controversially, perhaps, Sui and Goodchild suggest that some analytical skills have also become obsolete through the use of GIS - the black box effect of button-clicking means that complex tasks can be undertaken with relatively little understanding of what is actually taking place – 'one of the consequences of access to powerful GIS tools may be a greater interest in *doing the thing right* rather than in *doing the right thing'* (2003, 11).

*GIS retrieve*

Classically GIS have been associated with a resurgence of processual and deterministic approaches in archaeology, revisiting the quantitative and scientific methods of the 1960s and 1970s and hence were, and in some respects still are, locked into methodologies from the past (see also Pethen, this volume). Additionally, Sui and Goodchild point to the use of GIS as bringing a re-emphasis on narrative and rhetoric - the ease of creation and availability of maps and images provide more than just visual cues since behind them are stories to be told: they have become 'rhetorical devices to create meaning and discourse' (2003, 12).

*GIS reverse into*

The way GIS model data imposes constraints and potentially excludes different representations of knowledge. Lock and Harris (2000, xvii) criticised the spatial determinism imposed by the requirements of points, lines, polygons, and pixels, for example, and complex data are required to be partitioned into layers. Important considerations such as positional uncertainty, boundary uncertainty, thematic uncertainty, and temporal and cognitive representations are handled with only limited degrees of success. Despite this, as many have commented, the outputs of GIS - like those of 3D modelling - can carry connotations of truth or fact, generating a false sense of what is real. Consequently there is a risk that 'computerisation of the natural and cultural may inevitably lead to the naturalisation and culturalisation of the computerised' (Sui and Goodchild 2003, 12) and we increasingly become trapped in particular modes of knowing, separated from the real world as well as the world of the past that we seek to access.

Doubtless there is room for discussion about what is and is not included - even which heading certain statements appear under - and it is clear there is no single answer to each question, but that is the point of the exercise. It also becomes apparent that, despite McLuhan's claim that all four laws apply simultaneously, it is difficult to respond fully to the law of reversal since we cannot yet know how things will develop in the future - we can only really comment on possible trajectories while at the same time attempting to avoid excessively dystopian overtones.

Having characterised a response to the four laws, we can then consider examples of the oppositions between them.

*Retrieval: Obsolescence*

An example here is the retrieval of processual, quantitative techniques versus the obsolescence of analytical skills (the development of the black box). As discussed elsewhere (Huggett 2004a), the conjunction of systems theory and the New Archaeology in the 1970s encouraged a mechanistic view of the world as represented most clearly in the computers which required a formalised, algorithmic, definition of tasks and data in order to facilitate the analyses. Increasingly user-friendliness, ease of data input, push-button applications, and the guarantee of (usually) attractive outputs can lead inexorably to a black box approach in which there is little understanding of the underlying systems required in order to use the tool, and which may in turn lead to invalid or inappropriate outcomes going unrecognised.

*Enhance: Reversal*

An obvious opposition is on the one hand the benefits of data management and manipulation, but on the other hand, the constraints imposed as a consequence of the data models applied. GIS facilitate handling of multiple large complex datasets, but they do so by requiring that data to be presented in particular ways. Consequently the application of computers in archaeology is predicated on the properties of the digital model (Lock 1995, 14) and that digital model is itself predicated on the properties of computers.

*Retrieval: Enhance*

Here the re-emphasis on storytelling and the use of imaging as rhetorical devices can be set against the enhancement of access to data and the ease with which it can be mapped and presented. GIS can arguably refocus away from the limitations of manual map-making and facilitate the communication of transformations and change through the transformation and changes between multiple images of data.

*Obsolescence: Reversal*

The obsolescence of traditional cartography versus the limitations of the means of representation exchanges the restrictions of manual illustration for the flexibility of computer-generated images, but in the process reveals the limits of representation which fall short of what we intend or require. In a similar manner, the obsolescence of lengthy and complex data collection processes as a result of the increased availability of digital data can be contrasted with the implications raised by increasing use and reliance on secondary computerised datasets which may be far removed from their original context of creation and use.

Considering oppositions like these draws to the surface often paradoxical or contradictory effects of using the tools and, at the same time, helps to understand those effects.

## 6. Conclusions

The GIS case study summarised here focuses on a tool in the sense of a single category of software used by archaeologists, and others could equally well be presented - databases or 3D modellers, for example. The same technique can also be applied to tools within such software packages (for example, constructing digital elevation models, or generating viewshed analyses) and to hardware applications (for example, the use of on-site tablet computers for recording, laser scanning for survey). For instance, using a tablet computer onsite can be seen to enhance through simplified interaction, and all data captured is born digital with potentially instant automatic data exchange and communication; it would obsolesce the laptop computer, the planning board, the context file and the day book; it would retrieve the drawing slate, the chalkboard, even the clay or stone tablet; and it would reverse through the risk of diversion - surreptitious use of Twitter and Facebook, games of Angry Birds, and so on. It is left to the reader to fill in the gaps or extend the example further, rather than labour the point that the technique is applicable at all levels and to all types of tool.

At the outset of this paper, it was argued that, although archaeologists are capable of thinking *about* their tools, and frequently do so in the context of specific applications or case studies (as exemplified by many of the cogent contributions in this volume), we seem to find it more difficult to think *beyond* the tool in order to consider the ways in which these tools impact upon us and our practice, shape our perceptions and alter our interpretations. One means of overcoming this limitation is to seek inspiration outside of archaeology itself and to recognise that other fields exist for the very purpose of considering the development, effects, and implications of new technologies. This in itself is not a novel proposal: for example, Denning (2000) highlights the potential of History and Philosophy of Science and Science and Technology Studies as sources of provocation for archaeologists. At the same time, however, it has to be recognised that it is possible to go too far in this respect - to lose sight of the archaeological objective. It is also possible to be overly utopian or dystopian in considering the impact and potential of these technologies and indeed utopianism is a frequent characteristic of archaeological discussions of technological tools. However, one of the advantages of the approach outlined here is the way in which utopian/dystopian perspectives are tempered through the application of these laws - a potential for utopianism in discussing enhancement and dystopianism in discussing reversal is balanced to a degree by consideration of retrieval and obsolescence.

No grand claims are made for the approach proposed here; the argument is simply that by applying these questions, or questions like them, it is possible to break

the mould which has been evident for the past twenty-five years in terms of published contributions that have sought to address this issue. In short, thinking outside the box can help us think beyond the tool.

## References


Carlsen, H., Dreborg, K., Godman, M., Hansson, S., Johansson, L. and Wikman-Svahn. P. 2010. Assessing socially disruptive technological change. *Technology in Society* 32, 209-18.

Clarke, A., Fulford, M., Rains, M. and Tootell, K. 2007. Silchester Roman town insula IX: the development of an urban property c. AD 40-50 - c. AD 250. *Internet Archaeology* 21. Available at: http://intarch.ac.uk /journal/issue21/silchester_index.html).

Cooper, M. and Richards, J. (eds) 1985. *Current Issues in Archaeological Computing*. Oxford.

Culkin, J. 1968. Each culture develops its own sense-ratio to meet the demands of its environment, in Stearn, G. (ed.) *McLuhan Hot and Cool*. 57-66. Harmondsworth.

Denning, K. 2000. Fuller's social epistemology: applied philosophy for archaeologists?, in Holtorf, C. and Karlsson, H. (eds) *Philosophy and archaeological practice: Perspectives for the 21st Century*. 203-214. Göteborg.

Faulkner, P. and Runde, J. 2009. On the identity of technological objects and user innovations in function. *Academy of Management Review* 34 (3), 442-462.

Feibleman, J. 1967. The Philosophy of tools. *Social Forces* 45 (3), 329-37.

Floridi, L. 2009. The information society and its philosophy: introduction to the special Issue on the philosophy of information. *The Information Society* 25 (3), 153-58.

Grosswiler, P. 1996. The dialectical methods of Marshall McLuhan, Marxism, and critical theory. *Canadian Journal of Communication* 21 (1). Available at: http://www.cjc-online.ca/index.php/journal/article/view Article/925/831.

Huggett, J. 2000. Computers and archaeological culture change, in Lock, G. and Brown, K. (eds), *On the Theory and Practice of Archaeological Computing*. 5-22. Oxford.

Huggett, J. 2004a. The Past in bits: towards an archaeology of information technology? *Internet Archaeology* 15. Available at:http://intarch.ac.uk/journal/ issue15/Huggett_index.html.

Huggett, J. 2004b. Archaeology and the new technological fetishism. *Archeologia e Calcolatori* 15, 81-92.

Huggett, J. and Ross, S. (eds) 2004a. *Archaeological informatics: beyond technology.* Special issue, *Internet Archaeology* 15. Available at: http://intarch.ac.uk/journal/ issue15/index.html

Huggett, J. and Ross, S. 2004b. Introduction. *Internet Archaeology* 15. Available at: http://intarch.ac.uk/ journal/issue15/inf_index.html

Ihde, D. 2004. Philosophy of technology, in Kemp, P. (ed.) *World and Worldhood*. 91-108. Netherlands, Springer.

Kroes, P. and Meijers, A. 2006. The dual nature of technical artefacts. *Studies in History and Philosophy of Science* 37, 1-4.

Lenier, J. 2011. *You are not a gadget: a manifesto*. London, Penguin Group.

Levinson, P. 1999. *Digital McLuhan: a guide to the information millennium*. London, Routledge.

Lock, G. 1995. Archaeological computing, archaeological theory, and moves towards contextualism, in Huggett, J. and Ryan, N. (eds) Proceeding of the conference *computer applications and quantitative methods in archaeology (CAA 1994)*. 13-18. Oxford.

Lock, G. and Brown, K. (eds) 2000. *On the theory and practice of archaeological computing.* Oxford.

Lock, G. and Harris, T. 2000. Introduction: return to Ravello, in Lock, G. (ed.) *Beyond the map: archaeology and spatial technologies.* xiii-xxv. Amsterdam

MacDougall , R. 2005. Identity, electronic ethos, and blogs: a technologic analysis of symbolic exchange on the new news medium. *American Behavioral Scientist* 49 (4), 575-599.

MacKenzie, D. and Wajcman, J. (eds) 1985. *The social shaping of technology*. London.

McLuhan, M. 1975. McLuhan's laws of the media. *Technology and Culture* 16 (1), 74-78.

McLuhan, M. 1977. Laws of the media. *Et cetera* 34 (2), 173-179.

McLuhan, M. and McLuhan, E. 1988. *Laws of media: the new science*. Toronto.

Moscati, P. 2004. Languages, communication, information technology: an introduction. *Archeologia e Calcolatori* 15, 11-22.

Moulthrop, S. 1993. You say you want a revolution? Hypertext and the laws of media, in Amiran, E. and Unsworth, J. (eds) *Essays in Postmodern Culture*. 69-97. Oxford.

Mumford, L. 1934. *Technics and civilisation*. New York.

Sui, D. 2004. The media and the messages of location-based services (LBS): death of distance or the revenge of geography? *Annals of GIS* 10 (2), 166-174.

Sui, D. and Goodchild, M. 2003. A tetradic analysis of GIS and society using McLuhan's law of the media. *The Canadian Geographer* 47 (1), 5-17.

Tyler, T. 2008. A procrustean probe, *Game Studies* 8 (2). Available at: http://gamestudies.org/0802/articles/tyler).

Verbeek, P. 2005. *What things do: philosophical reflections on technology, agency, and design*. Pennsylvania.

Warwick, C., Terras, M., Fisher, C., Baker, M., O'Riordan, E., Grove, M., Fulford, M., Clarke, A. and Rains, M. 2009. iTrench: a study of user reactions to the use of information technology in field archaeology. *Literary and Linguistic Computing* 24 (2), 211-223.