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FORUM

The Challenges and Opportunities for Mega-Infrastructure Projects and Archaeology

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In March 2009, construction work started on the first brand new London underground railway line for a generation. As the Mayor of London pushed the button on the first pile drive in Canary Wharf at the heart of London's Docklands financial centre, the £15 billion, 9 year construction project was formally underway. So where was archaeology on that day? Who had responsibility for ensuring that damage to the 2,000 year old city, founded under the Roman Empire in the middle of the 1st century AD and subsequently developed through the medieval period into one of the world's best known urban centres, was avoided and that appropriate measures would be taken to protect this priceless asset from unnecessary harm? How were opportunities to enhance the academic and public understanding of the city's past going to be met, and eventually displayed? How will the critical juxtapositions of development programmes and public budgets versus archaeological preservation play out when perhaps, the inevitable unexpected find occurs, and hard and fast decisions are needed to balance these competing interests?

This forum hopes to highlight these challenges and opportunities. It endeavours to put forward some fundamental, some practical and some more complex approaches to managing archaeological risk and maximising benefits from archaeological research and preservation in the context of a large infrastructure project. This paper focuses on a particular and current UK project as its case study whilst referencing others in the recent experience of the author. Increasingly, the lessons learnt from major infrastructure projects across the world and the resulting changes to practice are being adopted within the infrastructure planning and development sector. The author hopes that the respondents to the paper will be able to describe their own experiences in this field. Together the resulting papers will accumulate a picture of how archaeology and mega-projects may be able to progress within a mutually beneficial arena where knowledge and study of the past helps create new sustainable development, and where professional archaeologists are able to take an equal place at the negotiating table in order to achieve balanced outcomes for the historic environment as a whole.

Early Planning

We would anticipate that at the early planning stages of a mega-project, cultural heritage interests had been taken into account, and that the full range of known heritage assets (whether designated or not) had been mapped and highlighted in order to guide engineering and planning teams to the least destructive route. For Crossrail this process

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began with appointment of archaeological consultants in 2004 as part of the team developing the Environmental Statement (ES) as required by the European Environmental Impact Assessment (EIA) regulations (EU 1985). As with other recent major projects of national significance, permission for construction was sought, not through the usual planning process, but through a UK Government specific Act of Parliament (Crossrail 2008a). The archaeological assessment was focussed on known remains and included proposals for mitigation (avoidance, reduction, compensation). Importantly, key stakeholders, including national and local government agencies responsible for the well-being of the historic environment, were able to contribute at this stage through a detailed process of consultation and submission of alternatives during the examination of the scheme in Parliament (Crossrail n. d).

Preparing for Unexpected Finds

The archaeological information in the ES was accompanied by an information paper (Crossrail 2007) and Generic Archaeology Project Design or 'Written Scheme of Investigation (WSI)' (Crossrail 2008b) which summarised, in brief, what the process of assessment and consultation had concluded about dealing with archaeological remains. The Crossrail Act set out a presumption that the remains identified by the project EIA process would be either preserved in situ where feasible (avoid and reduce impact) or be recorded and removed (compensation). Crucially, it also provided a clear statement on how unexpected finds of national significance would be dealt with. This places a responsibility on Crossrail Ltd to either preserve such remains in situ (through a revised engineering design where feasible) or "allow a period commensurate with the construction timetable, but not less than 28 days, for archaeological excavations to be undertaken on the site to achieve preservation by record". Furthermore, where English Heritage (the UK government's advisor for archaeology) notifies the UK Secretary of State for Transport "that remains investigated under these provisions are of exceptional national importance, he/she may after consulting Crossrail Ltd, extend the period of time available for lifting, recording and excavation, or to take steps that are feasible in engineering terms to preserve the remains in-situ (Crossrail 2007).

Setting out Requirements for Archaeology

As important as these basic terms of reference and commitments are for providing a framework within which to develop a more detailed project design, experience shows that the broad and often generic nature of these commitments made on paper are satisfactory for gaining the relevant permissions. However if they are to be successfully enforced, there are a number of fundamental issues to address prior to the start of actual construction works.

When the detailed design for Crossrail started in 2008, a fairly superficial understanding of the archaeological risk had been documented. The desk study work undertaken for the ES was able to highlight four categories of archaeological risk, and apply these to the 40 construction sites required for the central area of the project. A quantification of the time required at each site was also estimated, suggesting to construction schedulers that they should allow, for example, 4 weeks here or 6 months there, for archaeological investigation to be completed. This was a very significant development, for as we shall see below, the most important challenge for archaeologists who are engaged with large construction projects is to communicate useful and quantifiable information to colleagues in construction management in a form that they can use. Merely suggesting that a location has a 'high potential or risk' for archaeological remains of a certain type is virtually useless to ensure that the message is received and acted on by project planners who require quantifiable data (volume, time and cost) to plan

the many complex interfaces between tasks. Without quantifiable data from an early stage, recognition of the archaeology may well be lost in the construction planners' 'may never happen' category.

Ownership of risk is vital to ensure that it is identified and quantified, and that relevant mitigation measures are then added to the project schedule. Mega-projects often involve different approaches to risk. Fundamental to the participation of archaeologists is how the project risk is to be shared out between the client organisation, the engineering organisations appointed to develop the design, the contractors who will build the infrastructure and the enabling works contractors who will prepare the sites for the main construction phase. Different contract forms are in use depending on the nature of the project, its funding structure, and the local political and regulatory framework (Barber et al 2008).

Importance of Central Contracts

Large infrastructure projects are characterised by complex multiple contract interfaces, with many phased works taking place within the same locations at different times. As there is an inherent uncertainty when planning for archaeology, the client organisation or their development partner often elect to own the archaeological risk. This also makes good sense for the archaeology and provides opportunity for continuity and consistency to be built in. In effect this means that archaeology is designed and delivered by a project archaeologist appointed by the client organisation and firmly embedded within the project management structure. On Crossrail this was addressed by the formation of a central archaeological framework contract (as opposed to transferring that responsibility to the each main contractor). The contract is supervised by the project archaeologist, and is split into geographic areas. An archaeology contractor was appointed to each area following a tender competition, and that contractor is undertaking all archaeological investigation works. During the process, each archaeology contractor will interface and work alongside many different civil contractors within the same locations at different times. This not only provides continuity and consistency but also ample opportunity for the archaeology contractor to develop collaborative ways of working through developing long term relationships.

An alternative to the above model is to delegate the archaeological risk separately to each main contractor. This often occurs where a design and build contract is selected by the client organisation. Unless the project comprises a single main contractor and location, the drawback of this approach is clear. On a major project which is dealing with multiple locations, this scenario would mean that the main contractors would each be responsible for procuring the necessary archaeological contract and with multiple contractors working alongside each other, one can just imagine the potential for unnecessary confusion and discontinuity as parts of sites are archaeologically tested by one firm, handed to others for further investigation and potentially to even a third for completion of site works. Who then draws all the results together in post-excavation analysis and publication would be anybody's guess.

Effectively Predicting and Quantifying the Impact of archaeological Finds

Having set out how the archaeology programme was to be organised, the next fundamental action was to develop the detailed archaeological design for each of the 40 construction sites. This was achieved as an integral part of developing the civil engineering detailed design for construction contracts (RIBA 2013). Each engineering consultant team was required to include a design archaeologist whose job was to develop the scope, specification, outputs and programme integrated with the construction sequence. In the UK this document is known as the site specific written scheme of inves-

tigation (WSI). The purpose of this crucial document is to sequentially define what detailed desk-based assessment, site deposit modelling and site evaluation by specific sample excavation is required to define the scope of archaeological work and how it will be achieved. In an ideal world, the final outcome of this process should be a fully quantified scope of further archaeological works, integrated into the construction programme with agreed timescales and methods required to achieve the investigation and recording of each site (the mitigation).

Communicating Archaeological Requirements to Project Teams

One of the main challenges to archaeologists engaged on large complex projects is to ensure that the site evaluation and subsequent mitigation requirements are effectively communicated to other project teams. What we have found through experience is that numerical quantification is fundamental to that success. Lengthy descriptions of the archaeological and historic background of a particular location will readily communicate the significance of the proposed investigations to an audience of archaeologists. However, it is more important for colleagues in construction teams that the WSI address the type of quantified data that is essential to procurement professionals, construction managers and project managers. What we mean by that is the quantity of material that needs to be excavated (cubic metres), the time it will take to remove it (in person hours, days, weeks or months), and the resources (temporary works, plant, labour, materials) that will be required to be supplied by the main contractor to achieve the work. The essential point is that if a task (an archaeological evaluation or excavation for example) cannot be measured in these ways and that relevant data taken from a WSI cannot be transferred in that format into the main contract requirements, the scope of work may be left aside by procurement professionals as something which cannot be measured and therefore cannot be included in the baseline programme for construction tenders.

Given the uncertainties inherent in archaeological work, archaeologists themselves have often been reluctant to provide these types of predictions, especially at the earlier stages of project planning. However it is just at those stages when this data is most important. The way the majority of civil construction contracts are formed and managed (e. g. NEC 3 n. d, CESMM4 n. d) provides very well for changes to occur. Items quantified on the schedule are expected to go up or down. What is less readily acceptable, and can have a detrimental impact on project schedules and budgets, is the late inclusion of an item that has not previously been listed. So whether or not sufficient archaeological data is available at that time, we suggest that archaeologists must use their professional judgement to provide those numbers at the outset, and that those numbers can be subject to change and revision as the project stages progress.

Thorough desk study and deposit modelling – accessing difficult to reach places – under buildings, roads and deeply buried soils

Of course these types of predictions are always going to be more accurate and useful when the archaeologist is speaking from an informed position. It is perhaps fairly common for vital site evaluation works to be deferred in locations where significant cost constraints exist, both logistical and those with perceived cost constraints. However a simple cost/benefit/programme approach can help determine the future impact of not doing anything. During early discussions on the Crossrail project between construction planners and archaeologists it was established that delays due to archaeology in certain project phases would result in disproportionate cost increases and programme impacts. For example, two additional weeks on a site for one of the enabling works contracts may add £30,000 to the project cost. Factor in that same delay to a main works pil-

ing contract and that figure might be multiplied ten or twenty times. So where building basements could be accessed, roads closed and temporary works installed for very deep investigations, or expensive protection works undertaken for utilities that were 'still in the way', these actions have been taken with the full understanding that there was a clear programme and cost advantage to making that investment early on and that the increased costs of some of those investigations were an insurance against future and more costly delays.

Understanding Construction Phasing and Critical Programme Path

It may be extremely difficult for archaeologists to visualise the construction sequence in complex projects especially in urban environments. No amount of 'archaeological procedures', primarily written of course for other archaeologists and regulators, will help archaeologists grasp how their designs can be achieved and be properly integrated into construction programmes. Practical solutions should see the lead archaeologist attending design and construction review meetings and workshops with engineering teams as well as setting up regular specific archaeology workshops with construction management teams to look in detail at the quantification, scope and specific timing issues for archaeology works and the activities that are required to take place preceding, concurrently and succeeding the presence of archaeologists on site. Also the in-depth exploration of the project programme critical path, and the issues which affect it, is an everyday topic for a construction team that has bought into a fully integrated way of working. Integrated teams focus on building relationships, trust and the ability to find balanced solutions. It is not an exaggeration to say that those professional working relationships are the most important challenge for archaeology in mega-projects. Archaeologists need to convince the project directors, the cost engineers, the construction managers and site teams, not only that the works are required (by law, condition or commitment) but that successfully achieved, with their professional help, can enhance the value of the product they are building. These issues are discussed further and illustrated in Carver (2010), Carver et al (2011), Carver (2013).

Opportunities for Lessons Learnt

As we have seen, there are plenty of challenges for archaeologists involved in large civil engineering projects. Ensuring that these are overcome and that value is added to the outcomes is an essential part of the major project process. Major projects are often undertaken over long time periods, across a relatively wide geographic area with differing archaeologies. There is therefore an inherent opportunity within these frameworks to develop new methods, set new benchmarks, and communicate lessons learned to the professional, academic and public sectors.

Between 1998 and 2004, the construction of the Channel Tunnel Rail Link (CTRL, now known as High Speed 1) presented a number of opportunities for development of professional standards. Spatial data derived from the many site evaluations (geophysical surveys, surface artefact collections, trial trench surveys) and subsequent detailed excavation plans, was able to make a significant contribution to studies into efficiency and effectiveness of predictive methods in archaeology (Hey and Lacey 2001). The vast and diverse scope of the post-excavation programme for CTRL also presented opportunities to investigate approaches to synthetic models for post-excavation (Carver 2003) and a comprehensive approach to digital archives (Garner 2003). Further industry research, combining experiences from professionals across many different construction sectors has been summarised by Barber et al. (2008) and specific guidance for how major projects affect historic landscapes has been produced by the Highways Agency in the UK following re-evaluation of several major pro-

jects (Carver et al 2007). In the aviation sector, work by Framework Archaeology (2010) at Heathrow has sought to set new standards in archaeological site recording and analysis and intepretation.

Promoting the Profession

These examples, amongst many others, demonstrate how archaeologists involved in large projects can take the opportunity to drive forward approaches to the planning, procurement and supervision of evaluation and mitigation works. The placing of archaeologists alongside peers in planning and construction, rather than being the occasional visitors on these projects, allows the topic to be elevated amongst other environmental and sustainability issues. This helps derive long lasting benefits to archaeological research and conservation of the wider historic environment. In the UK the CEEQUAL (2012) scheme is a voluntary process of construction industry assessment and awards, that now includes archaeology and the historic environment as one of nine topics to be monitored and scored. Fundamental to these developments is how these opportunities allow archaeologists to engage and learn from other professions in the workplace, to gain vital new skills in engineering, planning, programme controls, finance, contract procurement and business administration. A better understanding of these issues can perhaps allow archaeologists to begin to communicate with the right language and emphasis in order to successfully negotiate a balanced approach to archaeological research and conservation.

Promoting the Discoveries

Finally, and importantly, large projects have the inherent potential for significant finds of local, regional and national interest. These discoveries are likely to be of interest to the public and provide excellent opportunities to engage effectively with local communities through outreach and education programmes. Whether these comprise publications, site visits, exhibitions, online information, talks, permanent interpretation or opportunities for students and non-professionals to engage in research, they all contribute actively to the dissemination of new information about the past and the ultimate goal of providing an educational legacy from investment in archaeology programmes. When combined with a media programme, the resulting focus of attention can also bring indisputable benefits to the finding organisation and their operational business whether state run or private (see Crossrail websmite n. d for examples).

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