Manipulation of Archaeological Data as spatial Data and the Role of BIM and GIS

An overview from HS2 Phase 1, UK.

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Conserving our cultural heritage and historic environment as a legacy from the past for the next generations is an accepted value in sustainable approach to development. Such a vision has made archaeology research an integral part of the development process in the UK (Department for Business, Innovation & Skills, 2012). High Speed Two (HS2) Phase 1, is a new highspeed railway linking up London and the Midlands, which is comprised of the largest single archaeology programme ever undertaken in the UK. This paper will explain the role of GIS and BIM in manipulating archaeological spatial data in different lifecycles of this project.

Since 1960s revolutionary use of information and communication technology (ICT) for generating and processing information in surveys and studies has dramatically developed the role of digital data and computerisation in geography. Inevitably, this was borrowed in archaeological data manipulation, as well (Greene and Moore, 2010). Another aspect of any archaeological data is its association with location. Archaeology is among the fields in which "Place matters". Without location, any archaeological data are devoid of identity (Fig. 1). Geographical location is an integral part of archaeological surveys. Like any spatial data such as census data and land use data, archaeological data is captured across geographic space, and is joined with geometrical shapes, such as historic buildings, test pits, trial trenches, intervention areas, etc. in a specific location with certain geographical coordinate system.

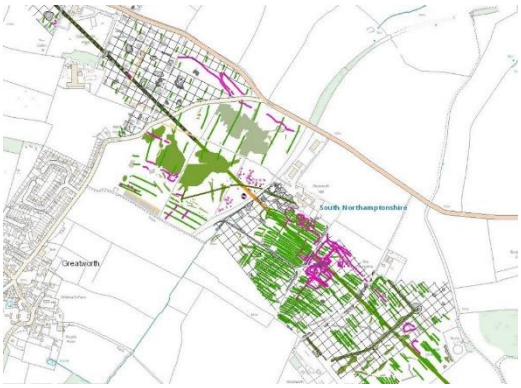

Fig. 1. Polygons and Lines GIS layers to represent a part of Interpretation of Geophysical Survey Results in Northamptonshire, HS2 Phase One, an example of visualisation of archaeological spatial data (© HS2 Ltd).

Processing of spatial data cannot be carried out without Geographic Information Systems (GIS). GIS is the science and art of systematic use of ICT. Archaeological data as geospatial data is captured/gathered from the features, existing or planned in the study area, in different GIS data layers. Various pieces of software and hardware such as sensors, cameras, drones, scanners, monitors, software packages, tools, printers, servers, video projectors, etc., systematically work together for capturing, gathering, cleaning, analysing, visualising/mapping, and delivery of Archaeological GIS data in different stages of archaeological surveys, including fieldwork, excavation, and post-excavation analysis (Green and Moor, 2010).

Where archaeological research is a part of a construction project, Building Information Modelling (BIM) can also be a valuable opportunity. BIM is a relatively new process for creating and managing information on construction projects across the project lifecycle, including design, construction, and operational stages (Department for Business, Innovation & Skills, 2012). BIM enables us to record and capture all archaeological assets, their hierarchy, and their interrelationship, alongside other construction elements.

Recorded and archiving archaeological assets in HS2 Phase 1 project provides us with a good example of using BIM and GIS in archaeological surveys (HS2 Ltd., 2017). As a subsystem of HS2's BIM, Historic Environment Research and Delivery Strategy (HERDS) has been established. Through HERDS strategy and help of GIS, a hierarchy of archaeological assets has been designed, which connects archaeological spatial data together, based on their interrelationship and their respective non-spatial supporting documents. For each archaeological asset a unique asset ID (UAID) has been designated in the system, and with using GIS, the location and geometry of assets have been recorded, and joined to their respective attribute table.

HS2 archaeological assets hierarchy comprises of five primary classes of assets. First, Location Specific Written Scheme of Investigation (LS-WSI) as areas of land that will largely be defined to meet construction needs, represented with polygon GIS layers; Second, Project Plans (PPs), as areas with specific packages of archaeological activities in order to achieve certain objectives of investigation, e.g. a series of geophysical survey, a building recording survey, archaeological excavation etc., which are all carried out in a certain piece of land, which its boundary is represented with polygon feature classes; In third level, there are Written Scheme of Investigation Interventions (WSI-Interventions), as the extents of single archaeological activities (e.g. a borehole survey, an individual trial trench), which again their boundary is recorded as polygon feature classes; Forth, Archaeological Features, as human-made non-portable elements with certain period, which their location and geometry are recorded as polygon GIS features. For example, an intervention area with trial trenching activity type, may uncover features such as post holes or ditches; Finally, Archaeological Objects e.g. hand axes, coins or brooches, found during archaeological investigations, which their location is represented with point GIS layers (Fig. 2).

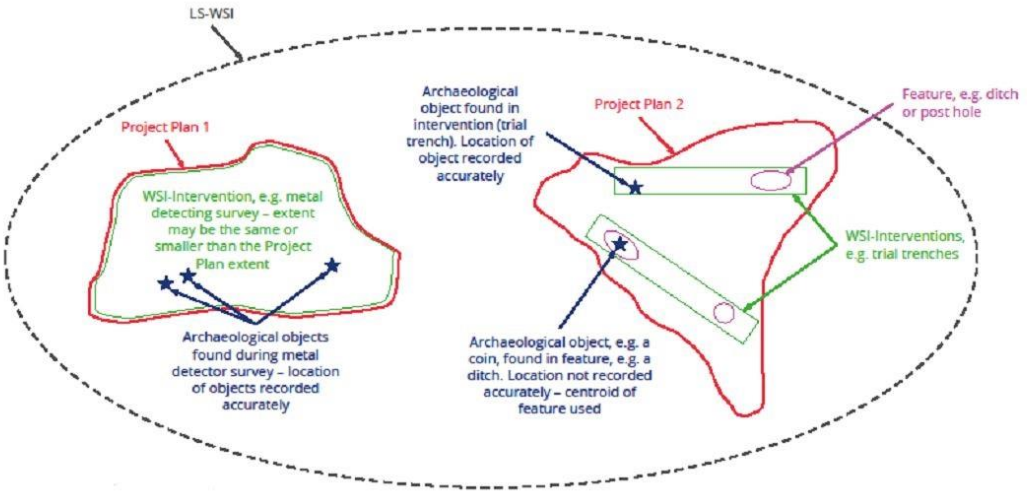

Fig. 2. HS2 HERDS spatial data hierarchy (© HS2 Ltd).

Such an efficient, transparent and readable data structure provides a lasting and valuable legacy for the lifecycle of the project. Also, an efficient integrated workflow has been created between contractors and their supply chain, HS2's Historic Environment team, and HS2 stakeholders, who benefit from those archaeological data in different lifecycles of archaeological spatial data, including data capturing, data cleaning and management, data analysis, data visualisation and data delivery (Fig. 3).

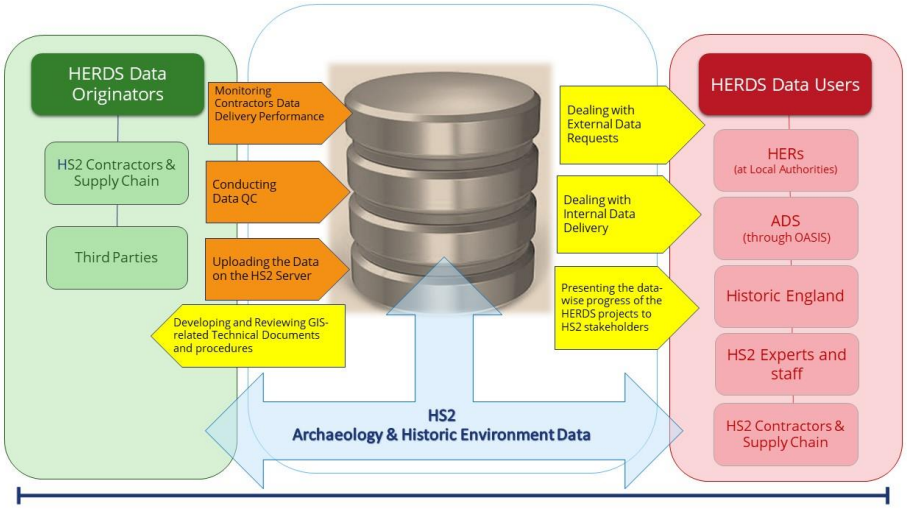

Fig. 3. HS2 Archaeological data lifecycle based on their Historic Environment Research and Delivery Strategy (© Author)

References

Department for Business, Innovation & Skills. (2012). '*Building information modelling*'. [Online] https://www.gov.uk/government/publications/building-information-modelling (Accessed: 20 August 2020).

Greene, K. and Moore, T. (2010). '*Archaeology: An Introduction*'. Fifth edition. Routledge. London and New York.

HS2 Ltd. (2017). *Historic Environment Research and Delivery Strategy*, [Online] https://www.gov.uk/government/publications/hs2-phase-one-historic-environment-research-and-delivery-strategy (Accessed: 20 August 2020).