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ELECTRONIC INFORMATION SYSTEMS IN ARCHAEOLOGY. SOME NOTES AND COMMENTS

1. Introduction

Since about 1960, a wide variety of electronic 'tools', both hardware and software, have been invented, copied, and adapted to manage archaeological enterprises and analyze archaeological problems. Specialized journals, like this one, and *Quantitative Anthropology*, together with proceedings of regular meetings like the *Convegni Internazionali di Archeologia e Informatica*, the *CAA* conferences, and the symposia of Commission 4 of the *Union Internationale des Sciences Préhistoriques et Protohistoriques* contain a wealth of information on the subject. An overview of the development and quality of the applications of computers in archaeology, assuming that such an attempt would be useful, readily would fill a book. Faithful predictions about future developments in the field are almost impossible to make, given the fast evolution of technology. Moreover, perspectives on the role of archaeology in general and on the ways archaeological findings should be presented in particular strongly influence the manner in which archaeological information is collected, analyzed, stored, and disseminated.

In my opinion, we can divide archaeological projects into 'collection-oriented' ones, COP for short, 'planning-oriented ones', or POP, and 'research-oriented' ones, or ROP. By collection-oriented I mean an archaeology whose first task is to store and display to the public the information about our past. It is the kind of work accomplished by museums and libraries. One could say that its emphasis is on administration, not on investigation.

By planning-oriented I mean an archaeology which advises the government or whoever is responsible on the measures that should be taken to minimize or, better, to prevent the loss of the archaeological record in a world where large-scale landscape-construction is occurring almost everywhere. In order to perform its advising tasks, this archaeology develops methods and executes procedures, preferably non-destructive ones, for estimating the locations and values of archaeological resources (Groenewoudt 1994). This work, in general carried out by organisations for cultural resource management, puts emphasis on protecting the archaeological record as such, by means of administration and mapping.

By research-oriented I mean an archaeology whose first task is to interpret, to explain *why* the archaeological record is what it is and where it is, to construct models for the developments and changes that took place in the past, based on the archaeological record, and to discuss and publish the reasoning and its conclusions. It is the kind of work accomplished by the departments of archaeology in universities and comparable institutions.

In this paper I restrict myself to making some notes and comments on the use of electronic information systems (EIS, for short) in archaeology, based mainly on my own experiences over the last 20 years. I do this in the form of stating a number of theses, each followed by an explanation and/or defence. The last section of the paper shortly discusses some projects in which EIS are being used. To most readers, my theses probably will sound like platitudes or be self-evident. I hope, however, that some of them may be of some use to some readers…

2. An EIS is a necessary part of a research design, but not more than a part

Today, almost every archaeological project makes use of computers in some way or another. In order to do so effectively, it is necessary that the structure of the EIS is embedded within the overall research design. In that research design, the expectations of the role of the EIS in the project need to be defined, and, based on those expectations, the structure of the EIS, its hardware and software, as well as the procedures to be followed in 'filling' and using it, must be clearly stated.

In almost all situations, there will be a need for an *information manager*, not necessarily an archaeologist, with whom the archaeologist(s) responsible for the project can discuss the possibilities, desired properties, implementation and procedures of the EIS, before the start of the project as well as during its accomplishment. The presence of an information manager is, in my opinion, mandatory in all but the smallest archaeological projects. She/he should function directly under the project leader(s), and should have the power to veto approaches which would inhibit consistency in the structure of the EIS. In most cases, the information manager will also be the database administrator (see next section), who has the final responsibility for the database design, its maintenance, backup and access procedures.

What should *not* happen is that the EIS itself dictates (part of) the research design, which may occur because of either a lack of software and hardware or too much of it. In the first case, outdated equipment restricts the functionality of the EIS and, therefore, of the project as a whole. The solution is first to decide what the EIS should look like, given the goals of the project, and then to decide what hardware and software need to be purchased. In the second case, the information manager, archaeologically trained or not, adds components to the EIS which have no real purpose in the context of the project, but are only there to use the latest computer gadgets. The solution is simple: *consider the EIS a tool, not a toy.*

Another situation where it may look as if the EIS dictates the research design occurs when there are prescribed standards for the documentation of archaeological findings. This is common in much CRM-oriented work (Madsen 1997). This problem, however, lies more with the standards themselves than with the manner they have been implemented in an EIS.

3. The heart of an EIS is a flexible, relational database management system

The use of a relational database management system for the storage of information is becoming the rule in archaeology. Few, if any, archaeological projects are so small that a single ‘card file’ or ‘flat file’, electronic or not, suffices. A database which consists of a number of flat files, which are formally independent, is cumbersome and difficult to maintain. Hierarchical systems, still common in many governmental institutions, may allow very fast retrievals, but the hierarchical structure itself tends to be a straight jacket and is extremely complicated to change. In contrast, the relational model enables optimal structuring of the information, which, in turn, makes checking, correcting, and querying of the data a straightforward matter.

It is not too difficult to design a relational database for small to moderately sized projects. By ‘small to moderately sized’ I mean projects which need only a restricted number of tables in the database with few ‘many-to-many’ relationships. The design of a good relational database for larger projects is not a trivial task, however, particularly if the project consists of a number of related sub-projects, each of which addresses in an independent manner specific research questions, and/or if the project takes a number of years to be completed, during which there will be inevitably differences and changes in the manner the data are collected and analyzed. A good approach is to design separate databases for the sub-projects and consecutive campaigns to suit the specific needs of each of them. These databases should then be incorporated into a ‘meta-database’, querying of which makes it possible to combine the information from all different sources. An example of this flexible approach is the IDEA project (Andresen, Madsen 1996). The project’s information manager should serve as the database administrator of the ‘meta-database’ and should oversee the work of the database administrators – every database needs one! – of the sub-projects.

In archaeological practice it is important that, after its initial definition, a relational database can be easily updated – tables and columns can be added, deleted or changed without having to rebuild the entire structure. In the course of an archaeological project the database can grow with the addition of information resulting from more and more detailed investigations.

But problems can occur as well. At the time of the initial definition of a relational database, it is generally not too difficult to ensure that its tables are in the third normal form (e.g., Date 1986, chapter 17), a prerequisite for its frugality, and to guarantee its integrity. When various people, with varying skills in the art of database definition start to add tables to such a database, both frugality and integrity may suffer. Therefore, the database of a project *must* be managed by a trained database administrator, *for the full lifetime of the project*, who has the final word on what can be put into the database and how that must be done.

Whereas the databases of a project, possibly including the meta-database, are specifically created for the project, often by one or a few people, the *relational database management system* (RDBMS) into which the databases are put should be a generally accepted and available product with good support from the manufacturers and a 'life span' expected to be at least as long as the duration of the project. This condition is fulfilled only by some products from large, commercial companies, which can allot enough time and money to keep their products up-to-date, given the ever-changing hardware and operating systems.

No individual or small number of individuals, however smart they are and how wonderful their systems may be, can ever guarantee that their programming efforts will not be obsolete within a few years, or even months. But, the products of the large companies should be studied critically as well before selecting one to be used in a long-term project. One major condition is that an RDBMS *fully* supports the SQL (Structured Query Language) standards. This means, among other things, that the user of the system must be able to directly write, store, and execute commands written in standard SQL. The QBE (Query By Example) approach, where a retrieval is composed by pointing and clicking in some kind of menu is fine for many not too complicated queries, but in a number of situations the – high level – user needs to be able to write a query directly in SQL. Another condition, particularly when the EIS includes a meta-database, is that the RDBMS supports the use of object-oriented programming, so that many 'house keeping' tasks – the responsibility of the database administrator – can be accomplished with minimal effort.

4. There is an essential difference between spatial data and attribute data

I want to consider briefly the rather different natures of *attribute* data and *spatial* data. Attribute data, as the word says, consist of descriptions of the characteristics possessed by archaeological phenomena, using a well-defined and consistent method. They are most often stored as tables or catalogues. Spatial data, on the other hand, consist of the information about the location of archaeological or other phenomena and, therefore, on their spatial relationships. In ROP the 'unedited' field drawing is considered the spatial information. Of course, field drawings are themselves constructs whose quality heavily depends on the archaeological expertise to 'read' the surfaces and sections of an excavation. Photographically stored spatial information can be used to support the field drawings, but cannot replace them. Field drawings are physically stored as maps on different scales, which then can be digitized. In POP, particularly when projects are on a regional level, the spatial information tends to be derived from different sources – maps, air photographs, satellite data – with different resolution.

It is possible to have 'error free' attribute data in terms of the method employed, at least in theory, but it is not possible to have error free spatial data. There will always be differences between three-dimensional reality and our representations of it; the 'errors' not only include mistakes or faults, but also the statistical concept of variation (Heuvelink 1993, 23, following Burrough 1986). In particular in POP, when GIS modelling techniques for the construction of new maps are used and planning decisions are made on the basis of these maps, it is of utmost importance to be aware of the nature of the errors that are transferred from one map to another, because their presence can lead to decisions which are fatal to the archaeological record.

5. A Geographic Information System is not suited to be the heart of an EIS

The defining characteristic of a Geographic Information System (GIS) is that it stores and manipulates spatial data in either vector format or raster format. Non-spatial information is kept in separate tables which can be linked to the spatial data in various ways. Therefore, it can be tempting to build an EIS around a GIS, with the spatial information at the core of the enterprise. However, the capacities for the management of non-spatial information in the GISs I am somewhat familiar with (ArcInfo, Genamap, Idrisi, MapInfo), even those that allow attribute tables to be located in an external RDBMS, are quite restricted. Support of SQL, for example, ranges from incomplete to non-existent.

Moreover, the digitizing routines for entering spatial information seem to be a weak part of almost every GIS. There is another problem in constructing the EIS around a GIS, in particular in projects which involve excavation. To my knowledge, all GISs require that areas are completely bounded before any manipulation of the spatial information is possible. In an ongoing excavation it often occurs that parts of the edges of features have not yet been excavated or are indistinct. In the latter case, the manipulation of the spatial data in the database is exactly what is needed to help decide where a boundary should be.

For all these reasons, it seems to me that when a GIS is needed in a project it is better to use it as a specialized tool that gets its data from the EIS and stores its products back into the EIS again.

6. The amount and kind of standardization of description in an EIS is completely dependent on the research design

Standardization of description always has been a topic of discussion in archaeology, and probably will be so forever. After all, each description is a form of classification, and classification is one of the major themes in our discipline. A description is a, sometimes simple, classification, because assigning an interpretation or a name to an archaeological event – like "this is (the remnant of) a ditch", "this is a Mousterian point", "the size of the temper of this sherd is coarse" – is the identification of a real-world phenomenon into one of the classes of an ideational classification. A classification itself is "…an exhaustive set of mutually exclusive classes, where each class is defined as a number of properties" (Voorrips 1982), and the same should hold true for a descriptive system.

There are no 'natural' classifications or descriptions. At the same time, every archaeological project in COP, POP or ROP, on whatever scale, *must* develop a consistent system for description and storage. The definition of a classification or a descriptive system depends on the specific research goals, on the overall amount of knowledge about the phenomena which need to be identified into the system, on the convictions of the researcher, on the financial means, and, often, on the requirements of bureaucracy. It is interesting that most 'official' systems, by which I mean systems that somehow are supported by governmental bodies, seem to exist in the museum world and the world of rescue archaeology, the COP and the POP. Systems for excavations and surveys that can said to belong to the ROP rarely, if ever, have been forced into the use of general standards, and whenever this has happened it invariably proved to be a bad policy. No two projects are exactly the same, have exactly the same purposes, or have exactly the same type of data.

To communicate the 'why' of the decisions made about data description, be it to colleagues or to the public, it seems logical to make available in some form or another the research design for the project, which absolutely has to address this subject. The 'how' is communicated by the structures and dictionaries (code books) of the databases created.

Some descriptive systems can be shared by different projects, or within a large project by different sub-projects, but only on a very basic, most of the time administrative level. A common setup for the registration of geographical location, municipality, primary geological, pedological and geomorphological categories is feasible, as is a common setup for the documentation of the circumstances in which observations were made, like date, time, and weather conditions – although the choice between classes like 'hot', 'warm', and 'cool' for the registration of temperature is a rather subjective one. Also a descriptive system for primary material categories – ceramics, glass, stone, obsidian, flint, bone, wood, textiles – can be shared, as it is independent from research goals and real-world situations in that almost no special knowledge is required to make the identification, and the distinction is at the basis of nearly every archaeological enterprise.

In the end, it is a matter of *resolution*. A descriptive system that can be shared by different projects or sub-projects has a resolution that is sufficiently low to enable the users to unambiguously identify into it all the different observations made. It is part of the research design to select the resolution appropriate for the research goals, and to define descriptive systems consistent with that resolution.

Of course, different levels of resolution for different kinds of observations can be defined within a research design, but one should be aware that overall comparison of observations only can occur at the lowest level.

7. The use of a well-designed relational database in an EIS makes discussions about data encoding obsolete

It is sometimes disputed whether, when entering and storing data into an EIS, *codes* – numeric, mnemonic, or whatever – are to be preferred over more-or-less complete textual descriptions. When using a relational database, such disputes are unnecessary. First, when the database is well-designed, which means that its tables are in the third normal form, internal codes are used to prevent unwanted duplication of information. These codes, whose actual form is determined by the database designer, are the primary keys of separate tables, which at least should contain meaningful textual labels and/or mnemonics, but also can hold, or refer to, the complete textual descriptions. Second, in well-designed input- and report forms, it can be up to the user to decide what she/he wants to work with: code, mnemonic, textual label or full textual description.

8. A Geographic Information System is not necessarily the best tool for the entry, editing and storage of spatial data

The spatial data collected in the course of an archaeological project should be digitized and stored in the EIS as soon as possible. The major reason for this is the correction of mistakes. The length of time and the amount of effort required for correcting mistakes in a field situation is always an exponential function of the length of time between the making and the detection of a mistake. While this is true for all kinds of data, the situation is even worse for spatial data. Correction may be impossible because in the time between the making and the detection of the mistake the information necessary to correct it has been destroyed by the ongoing fieldwork. In order to be able to detect mistakes as soon as possible, digitizing the field drawings is not enough. They must be entered into the EIS which allows the archaeologist to combine the spatial information in various ways and to search for inconsistencies.

Another reason for immediately incorporating spatial data into the EIS is to allow the researcher to aggregate the data and to make decisions regarding the course of the project based on the outcomes of such aggregations. Whenever possible, preliminary outcomes of analyses of attribute data should be linked to the spatial data in this process.

Digitizing is a tedious procedure even under the best circumstances. Digitizing routines built into GISs tend not to be very user-friendly or sophisticated (e.g., Johnson 1996, chapter 9), and some GISs do not support digitizing at all. An example is Idrisi, the purchase of which so far (1997) includes the separate digitizing package Tosca. For digitizing plans and drawings of excavations, which are in a Cartesian coordinate system, packages like AutoCAD work much more smoothly, and it is not too complicated to transfer the digitized and cleaned data to a GIS. When dealing with spatial data covering larger areas, e.g. topographic maps, which are registered in some non-Cartesian coordinate system, the advantage of using the digitizing routines provided by a GIS is that, in general, the data are stored right-away as the accurate real-world coordinates.

An interesting development is the addition of GIS capacities to CAD systems. The package AutoCAD Map, for example, combines the full power of AutoCAD with all standard GIS functions, including the querying of attribute data located in an external relational database, and a limited number of analytical tools (Autodesk 1997). While not exactly cheap, such a combination makes the separate purchase of digitizing software and GIS software unnecessary, and simplifies the overall design of the EIS.

9. Archaeological analysis often requires special analytical tools which are not included in general program packages

The archaeologist who wants to describe and analyze archaeological data needs a fair knowledge of 'standard' statistical methods and familiarity with at least one general statistical program package. The initial steps usually involve uni- and bivariate analysis, but the characteristics of many of our data demand an approach along the lines of exploratory data analysis (EDA), a methodology which, by now, has been incorporated in many general statistical packages. All such packages permit the import and export of data in a variety of formats, and it is therefore not difficult to have an EIS communicate with them.

There are a number of archaeological problems, however, for which methods of analysis have been developed which are not, or incompletely covered by general packages. One of the first and probably best examples is *seriation*, but also various forms of cluster analysis and methods for the evaluation of the clusters 'found' by some analytical technique (e.g., KINTIGH 1988; WHALLON 1990), methods for estimating the number of vessels represented in a sample of sherds (ORTON, TYERS 1992), etc., are not generally available.

To a large extent, this problem is being addressed by the *Bonn Archaeological Statistics Package* (BASP), which tries to collect special archaeological analytical methods, to present them in a consistent manner, and to make them available at low costs to the archaeological community (SCOLLAR 1997). Like the general statistical packages, BASP recognizes a number of different data-formats. There may be other methods which an archaeologist wants to use in the context of a large project, however, which only exist as individual programs or in small program packages. If these require specific input formats and/or produces specifically formatted output, the information manager of the project may want to add an interface to the EIS which can handle the program's demands.

One would expect that every GIS contains routines for a variety of spatial analyses, but in practice the possibilities are restricted. Most spatial analyses are performed using raster-data, so it is not surprising that, for example, MapInfo has not much to offer in this respect. Idrisi, on the other hand, contains a fair amount of rather sophisticated analytical tools. ArcInfo has a module ArcGrid, which offers a number of raster-based analysis routines, but for specialized analytical work it is often linked to a special subset of the general statistics package S+, named S+SpatialStats (SPLUS 1997).

In my opinion, archaeology has not done much yet in the area of developing analytical tools for spatial analysis, although there are exceptions (e.g., KVAMME 1997; VERHAGEN, MCGLADE 1997). It might be worthwhile considering whether such tools can and should be incorporated in a package like BASP.

10. AN EIS IS NEITHER A CATALOGUE, NOR AN ARCHIVE

After the completion of a project, the results need to be made public in one form or another, and the collected information needs to be archived. It may be tempting to consider the EIS of a project as the replacement of the written monograph and/or catalogue and of the card files and drawings in the archive. This, however, would be overrating and underrating the function of an EIS simultaneously.

It would be *overrating*, because the EIS itself is not the instrument by which the information it contains gets interpreted, it only simplifies access to the information, and can be used to present relations between different kinds of information. It remains the task of the archaeologist, or other specialist, to provide the reasoning to explain the information and its relationships. It might be possible to add such reasoning and resulting interpretation to the EIS in the form of a knowledge base, structured along the lines set out by J.-C. Gardin (e.g., GARDIN 1987). Such an expanded EIS could indeed replace other forms of publication, but at present this seems still too far-fetched to me, however.

It would be *underrating*, because the capabilities of an EIS are much more than is needed for an archive. After all, an archive is 'only' our last resource for the recuperation of information that has been lost by some disaster, and, while it of course must be well-ordered, the multitude of manners in which data can be accessed in an EIS is not really functional in this respect.

At the same time, a well-structured EIS is an invaluable tool and resource for researchers, cataloguers, exhibition builders and archivists. It enables each of them to access with ease the data from their different points of view and to extract what they need for their specific purposes.

11. Discussion of some projects which use EIS and GIS

The six projects I have been asked to discuss – the short descriptions of them follow this paper – can be divided into three types. Four of them: 'Ateliers céramiques gallo-romains d'Argonne' (1), 'Archaeomedes' (2), 'Noord Oostelijke Verbinding Betuwelijn' (3), and 'Landscape and habitation along the Dutch Meuse-valley in the early Middle Ages' (4b) concern themselves solely with archaeology on the regional level. Project (1), (3) and (4b) are typically POP: their aim is the production of maps of archaeological potential, to be used in CRM-type decision making processes for protecting the archaeological heritage (1), (4b) and/or for the selection of sites to excavate (3). Basically, the method utilized in (1) and (3), and probably also in (4b), is a form of predictive modeling, with emphasis on environmental variables like soils and/or geology, distance to water, etc. Project (2) is more ROP, and its aim is not so much prediction as the investigation of the processes which led to (changes in) settlement pattern, a pattern that is apparently already known. Besides 'standard' analyses of distance to water and soil properties, the study of road networks play a role in the analysis as well.

All four projects use standards for description that were developed independently, and from the short overviews it is not clear whether or not this is a successful approach.

It is interesting to note that projects (1) and (3), both of which started in 1996 and use ArcInfo, as well as project (4b), which starts in 1995 and uses MapInfo, make no mention of a separate RDBMS for storing the attribute data, in contrast to project (2), which started in 1994 and uses GRASS in conjunction with a relational database in the RDBMS Informix. From the descriptions, one may infer that (1), (3) and (4b) are so small – in the sense I used the term in section 2 of this paper – that all attribute data can be handled by ArcInfo itself. If this inference is correct, I doubt whether in the long run this is a feasible approach, given the restricted capacities of ArcInfo to manipulate attribute data.

I want to add here that in Germany various POP-type projects are being undertaken by, among others, a foundation which is closely linked to the one under which auspices the projects (1) to (3) are running.

A second type of project, the 'Meuse Valley project' (4a) is a good example of ROP. It has a well-defined scientific purpose, the study of the beginnings of farming in a part of the Netherlands, and its investigations take place on at least two different levels, the region and the site level. As can be expected in ROP, the project has developed its own descriptive standards. The project description provides no details on the RDBMS or GIS, but from the investigators I learned that they use dBASE for their RDBMS and both MapInfo and Idrisi for a GIS. Spatial data are entered using AutoCAD and from there transferred to MapInfo or Idrisi. Spatial analyses concentrate on 'intuitive' pattern recognition. By picturing the results of various data transformations, the ones which lead to the best image enhancements are determined.

The third type of project, the 'Muro Tenente' project (5) is also an example of ROP, but at the site level only. It has a well-structured EIS, in which the various components are successfully integrated. Like (4a) the project has developed its own descriptive standards. It is interesting to note that, also like (4a), the entry of the spatial data is done by means of AutoCAD, followed by export to MapInfo for further treatment, and from there, for purposes of publication, to CorelDraw, a DTP package. Apparently, the qualities of MapInfo for the production of printable materials are considered insufficient. So far, the EIS in this project has been used mainly for the documentation of the project, and it is not clear from the description which, if any, spatial analyses may be carried out.

Altogether, this sample of six projects show that there are clear differences between ROP and POP approaches, in particular with regard to the use of 'external' standards. Second, the majority of the projects is of the POP-type. Here, unfortunately, on too many occasions:

> «…this type is, to a very high degree, a routine matter, which may be carried out with limited specific knowledge of the type of features and structures excavated. Those doing the excavations are archaeologists all right, but mostly they are not engaged in the job in any other way than performing the routines. It is the same procedure as last year, simply out of financial necessity rather than bad will.» (Madsen 1997).

This means that while such projects may be successful from the administrative point of view, their scientific value tends to be quite limited. EIS or not, this seems to me a dangerous development.

Third, the application of formal methods for spatial analysis is almost absent. To me this shows that archaeology is still at the beginning of a trajectory along which the spatial character of archaeological data increasingly will be taken into consideration. Fourth, none of the five projects discussed here seems to pay any attention to making the results of the investigations available to a wider audience. If this conclusion is correct, it is time for Dutch archaeology to do some reflection.

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Note

Some parts of this paper have been taken from a presentation in a seminar at the British Academy in June 1994, titled *The problems and potentials of electronic information for archaeology*, it being unclear whether the papers presented there will be published.

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RESULTS OF THE QUESTIONNAIRE GIS AND ARCHAEOLOGY

Project 1:

Title of the project: Ateliers céramiques gallo-romains d'Argonne.

Promoting institution: Université Paris I/Panthéon-Sorbonne (Histoire de l'Art et Archéologie) for the Service Regionaux de l'Archéologie de Lorraine et Champagne-Ardennes. RAAP is subcontractor in this project.

Year of beginning: 1996.

Foreseen term: 1998.

Geographic area: Argonne (NE France, between Reims and Verdun).

Excavation area: None yet.

Short description of the project: Primarily a field survey project, including geophysical survey, of Gallo-Roman ceramic kilns in the Argonne region. Aim is to produce a map of archaeological potential using GIS that can be used to formulate further research and elaborate measures for protection of the archaeology.

Hardware: Solair Sparc 20 workstation.

Software: ArcInfo 7.04.

Application of descriptive standards: French DRACAR system.

Application of Spatial Analysis: Analysis of location characteristics with regard to geology, topography and distance to water.

Other important information: The results of the project are for the moment confidential, but will eventually become availabe in GIS form for French archaeologists working in the area.

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Project 2

Title of the project: Archaeomedes (Understanding the Natural and Anthropogenic Causes of Land Degradation and Desertification in the Mediterranean Basin).

Promoting institution: University of Cambridge (Dept. of Archaeology) for Directorate General XII of the Commission of the European Union.

Year of beginning: 1994.

Foreseen term: 1998.

Geographic area: Southern Rhône Valley (France); subproject.

Excavation area: Not applicable.

Short description of the project: Statistical and spatial analysis of settlement characteristics for the Roman Period in order to understand the development of the settlement pattern through time for a large area.

Hardware: Solair Sparc 20 workstation.

Software: GRASS 4.1.

Application of descriptive standards: A database was developed in Informix that is compatible with the needs of the Archéo-Outil software that is used by the French archaeologists involved in the programme. Main concern for the data standard was its suitability for use with a technique called 'Analyse Factorielle de Correspondences'.

Application of Spatial Analysis: Distance analysis to streams and road networks; calculation of number of roads within a radius from the settlements; calculation of soil type properties within a radius from the settlements.

Other important information:

Address: Philip Verhagen, RAAP, Postbus 1347, 1000 BH Amsterdam, The Netherlands. Tel: +31 (20) 421 62 00, fax: +31 (20) 421 42 90.

E-mail: philip@raap2.ivambv.uva.nl

www address: http://raap2.ivambv.uva.nl/home_eng.html

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Project 3

Title of the project: Noord Oostelijke Verbinding Betuwelijn.

Promoting institution: Nederlandse Spoorwegen.

Year of beginning: 1996.

Foreseen term: 1997.

Geographic area: Provinces of Gelderland and Overijssel (East Netherlands).

Excavation area: In a later phase on the basis of the impact analysis.

Short description of the project: Archaeological impact analysis of new railroad.

Hardware: Solair Sparc 20 workstation.

Software: ArcInfo 7.04.

Application of descriptive standards: Dutch ARCHIS system.

Application of Spatial Analysis: Analysis of site location characteristics with regard to soil type, resulting in map of archaeological potential; impact analysis of different proposed railroad tracks by means of overlay and multi-criteria analysis.

Other important information: The results of this project are and will be confidential; the methods used are not.

Address: Philip Verhagen, RAAP, Postbus 1347, 1000 BH Amsterdam, The Netherlands. Tel: +31 (20) 421 62 00, fax: +31 (20) 421 42 90.

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Project 4a

Title of the project: Meuse Valley project.

Promoting institution: Faculty of Archaeology, Leiden University.

Year of beginning: 1985.

Foreseen term: Approx. 2000.

Geographic area: South-east of the Netherlands.

Excavation area: Several sites in the research area.

Short description of the project: Regional archaeological research on different spatial levels into the neolithisation process in the SE of the Netherlands.

Hardware: PC-based.

Software: Various Windows software packages and add-on's.

Application of descriptive standards: Special codebooks.

Application of Spatial Analysis: Formal statistics and mainly graphical analysis.

Other important information: Accounting for all the disturbing factors of our regional data in the regional reseach (geology, land-use, reseach) is one of the major goals of the project.

Address: Milco Wansleeben and Leo Verhart, Faculty of Archaeology, Leiden University, Reuvensplaats 4, 2311 BE Leiden, The Netherlands. Tel. (31) 71 5272930, fax. (31) 71 5272429.

E-mail:

www address:

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Project 4b

Title of the project: Landscape and habitation along the Dutch MeuseValley in the early middle ages.

Promoting institution: Free University, Amsterdam.

Year of beginning: 1995.

Foreseen term: 1998.

Geographic area: The area of the Meuse Valley located in the Netherlands between the localities Grave and Eysden.

Excavation area: No excavations are planned.

Short description of the project: The project aims at constructing a model (or models) of habitation and land-use in the period 400-1000 AD, focusing on the need for research in (near) future developments like archaeological heritage-management and/or policy-making.

Hardware: PC Compaq DeskPro 80486 DX.

Software: MapInfo 4.0 Professional.

Application of descriptive standards:

Application of Spatial Analysis: Yes (limited).

Other important information:

Address: R.H.P. Proos, State Service for Archaeological Investigations, Rijksdienst Oudheidkundig Bodemonderzoek, Kerkstraat 1, 3811 CV Amersfoort, The Netherlands. Tel: +31 33 4634233, fax: +31 33 4653235.

E-mail: RPROO.ARCHIS@NL, Rene.Proos@archis.nl

www address:

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Project 5

Title of the project: Excavation at Muro Tenente, Mesagne, Prov. Brindisi, Puglia, Italy.

Promoting institution: Archaeological Institute, Free University, Amsterdam.

Year of beginning: 1993.

Foreseen term: 2002.

Geographic area: Mesagne, Prov. Brindisi, Puglia, Italy.

Excavation area: Messapian city, 900-250 B.C.

Short description of the project: The history, expansions and functions of the city are studied by means of excavations of selected portions of the old city area, analyzing the archaeological remains (artifacts as well as ecofacts).

Hardware: 3 Personal computers, 2 tablets (A3), 1 scanner (A4), 3 inkjet colour plotters (A4), 1 BW laser printer (A4), 1 total station (tachymeter) + Psion handheld computer.

Software: MS-DOS 6.22; Windows 3.11, AutoCAD 12 for Windows, Surfer 6 (Golden Software), Access 2, MapInfo 4 professional, Excel 5, CorelDraw 5, Word 6, WordPerfect 6.1, Freehand.

Application of descriptive standards: Over the years, a number of administrative and analytical standards have been developed, and implementated in an Access relational database, which is linked to the spatial information, initially digitized under AutoCAD, and transferred to MapInfo for further analysis. Final cartographic output is produced using Freehand and CorelDraw.

Application of Spatial Analysis: Some forms of intra-site spatial analysis are in preparation.

Other important information: 1) After stripping the topsoil, a series of systematic corings over the total excavation area is made. The study of the sieve residuals of these corings are used to assess which parts of the excavation area are best suited for further digging. 2) Excavation and analysis data are immediately entered into the information system, enabling checking and, if necessary, the making of corrections.

Address: D.G. Yntema, Archeologisch Instituut van de Vrije Universiteit de Boelelaan 1105, Amsterdam.

E-mail:

www address: Not applicable.

ABSTRACT

This paper consists of some notes and comments on the use of electronic information systems in archaeology, in the form of stating a number of theses, each followed by an explanation and/or defense. Most of the theses pertain to the relationship among research design, relational database management system and geographical information system. The last section of the paper shortly discusses some projects in which electronic information systems are being used.