

GIS AND ARCHAEOLOGY IN FRANCE

1. INTRODUCTION

To the “GIS in Archaeology” questionnaire sent by the Istituto per l’archeologia etrusco-italica of the CNR to French addresses, no answers were received and due to the short time then left to prepare a paper for this European panorama, a more direct inquiry thus became indispensable. French archaeology has always had its particularities, especially in contrast with its Anglo-Saxon counterparts, so even this initiative was to be confronted by some time honoured Gaelic customs.

Interest in new techniques is usually not immediate, and participation with others to forward them, is not prevalent. Regular presentation of interim, or status reports, is rarely heard of before the final, albeit usually excellent, results are ultimately published¹. This state of affairs unfortunately prevails at all levels, be it administrative, educational, or in research, and this has made it particularly difficult to trace those archaeologists who are interested in, and effectively implementing, GIS techniques in French archaeology.

2. SOME GENERAL COMMENTS

Even though no GIS forms were returned, in light of what has been subsequently accounted for, several general comments can be advanced for some of the questions asked:

Title of project: Almost no project has a GIS specific name, as its use is seen as being part of a general research project and not as a project in itself. The most important exceptions to this rule are the Ministry of Culture’s Drakar/Scala project and the Centre National de la Recherche Scientifique’s (CNRS) ArchéoDATA System.

Promoting institution: Here again, research credits have been almost always been given to archaeological projects where GIS is only one of the analytical components and not the basic research project in itself.

Foreseen term: Other than archaeological interventions limited specifically in time, as is usually the case for most rescue interventions, there seems to be no specific end to most of the projects. All of the archaeological surveys,

¹ Of the several hundred papers presented, or articles in print, on GIS use in archaeology, only a tiny handful are French.

most important type of project currently undertaken in France, have by definition no end as they are constantly being modified by new information on known or new sites. Some projects do however use the survey data for limited studies, but these, and their results, are practically always directly incorporated into the general survey system as a further enhancement to its database.

Geographic and excavation area: Here without a doubt, all projects have specific areas of study and analysis, but how could this be any other way for GIS to work. Most administrative bodies cover only the area where their responsibility and jurisdiction are pre-eminent, while long term research projects (i.e. CNRS, etc.) will cover areas concerned by their unique investigations.

Large scale rescue projects, such as those for highways and high speed train lines, have tried to analyse factors that could bring together data from the initial pre-excavation stages of intensive archaeological survey, and later, information generated from the many excavations undertaken as construction work cuts its swath through the countryside. Isolated rescue excavations have mostly experimented in trying to see what new insight could be generated using limited GIS on an intra-site basis. These excavations have in general been hindered by limited budgets and time to be able to carry out any successful GIS implementation. On the other hand, the archaeologists who undertake these initiatives continue to experiment with GIS in successive excavations, building on previous experiences. This on-hand training should be particularly important to the development of GIS in the “real world” rescue excavation context.

Application of descriptive standards: The only generalised descriptive standards are those given by the Ministry of Culture for the French archaeological survey. These standards have been contested over the years and recently, in particular with the arrival of the ArcInfo software, work has undergone into making site information more GIS conscience.

Most research bodies have however not used these standards, other than to recuperate basic site and topographical data, and have preferred to scrap the Ministry’s standards and develop a set of standards more adapted to spatial analysis.

3. HARDWARE CONSIDERATIONS

Computer use in French archaeology has had a rather atypical development compared to other countries. Until the arrival of the PC in the first half of the 1980’s, little use of computers was to be found. The CNRS, though research grants in the middle 1980’s, permitted a few laboratories to

equip themselves with a few IBM compatible PCs, but especially with Apple Macintoshes. Generalised use of computers in French archaeology has come rather late, being only in the early 1990's when computers began to become common on most archaeological excavations and for managing and administering sites and monuments.

Today, if the ministry level services are mainly UNIX or Windows / Intel based systems, it must be understood that most regional and local archaeological bodies, as well as those computers in university and archaeological research units (CNRS), are mainly based on Apple Macintosh hardware platforms. This is also true for the excavation units managed by the Association pour les Fouilles Archéologiques Nationales (AFAN), which account for the majority of the archaeological rescue interventions carried out in France.

4. SOFTWARE CONSIDERATIONS

The choice of specific GIS software in French archaeology has been influenced, or conditioned, by many external factors, most of which have been independent of any real thought out or reasoned choice by the interested parties themselves.

We can define the GIS software choices in three general categories:

- The first being those imposed through some form of administrative constraint and accepted to be able to obtain peer acceptance of the proposed project. The choice here has been repeatedly ESRI's tandem ArcInfo / ArcView. It has to be said that the French distributors were the only, for many years, to be able to guarantee the kind of support expected by administrations for implementing and maintaining long term installations.
- The second reason for choosing a particular program being for some administrative or financial benefit, i.e. because it was free or that the data was already pre-paid or licensed by the administrative body, making its use particularly enticing. Several archaeological choices have been made following local, departmental, or regional decisions. Quite a few of these regional authorities chose the French MacMap software, later called MaxMap when it became Mac/PC compatible. The demise of MaxMap has however put MapInfo and another French product, GeoConcept, in much more favourable positions.
- Thirdly, an open situation, where sufficient funds were available, and where research priorities could be put forward without immediate constraints on results, or the form these results should take, pervading on the initial choice. Most of the choices have here been for MapInfo, although SPANS, GRASS, IDRISI, etc. have also been used.

All institutional, and most informed users in general, stipulated that the software used should be compatible with ArcInfo data files and be able to import and export in the AutoCAD defined dxf. format.

The databases used have varied considerably, with Oracle running on UNIX workstations at the Ministry of Culture down to some Paradox and Access on PCs. By far the most commonly used database is the flat-file Claris FileMaker 2.1, and older versions running on Apple Macintosh computers. More recently, a relational 3.0 version is also available for the Windows environment and has been used for cross-platform work. Some excavations do use the programmable ACI 4th Dimension relational database for added flexibility and where multiple procedures are necessary to prepare data. This last database is also Windows / MacOS compatible.

5. ORIGINS OF GIS USE IN FRENCH ARCHAEOLOGY

The origins of archaeologically oriented GIS use in France is relatively recent compared seminary work carried out in the United States and later in some parts of Europe. The reasons for this are relatively clear and are none other than the lack of the basic means of implementing this new technology. What was seen in the late 1970's to have such considerable potential for archa n the middle to late 1980's, through research grants from the Centre National de la Recherche Scientifique (CNRS) and the University of Paris.

6. GIS AND ARCHAEOLOGY

Sous-Direction de l'Archéologie, Ministère de la Culture

The Ministry of Culture, through the Sub-Direction of Archaeology, has in the last years progressively implemented a policy to introduce into its regional offices (DRAC) the possibility of exploiting their part² of the national archaeological survey using GIS techniques.

The national survey has been computerised using Oracle software on a Sun workstation. The GIS application chosen a few years ago was ESRI's ArcInfo, not necessarily because it was necessarily ideally suited, but because, from the administrative point of view, it was indispensable to use software that had solid administrative references, and above all, could count on solid assistance and maintenance from the software's editor and its representative in France.

Due to the inherent complexity of the software involved, a computer programmer from the ministry's computer division was assigned to work

² French legislation at present only permits consultation, by someone in an administrative region, of only that region's archaeological records. As a consequence, this state of affairs only permits studies to be conducted on a regional, or localised, basis.

with the archaeological conservator in charge of the project and develop and oversee each facet of the project.

Local consultation and management of data at the regional offices runs on PC ArcInfo and was programmed by using successive ArcView templates. Although this is neither the most efficient, nor the most effective, possible exploitation of a GIS such as ArcInfo, the software's exceptionally high learning curve made it impossible, from a practical point of view, to use without the help of experienced technicians.

Service régional de l'archéologie, DRAC, Picardie

In 1993 a study was initiated in collaboration with the Ministry of Culture and using their ArcInfo software. The initial aim was the correlation of geographical features and archaeological sites along the River Somme in the Picardie region, situated in Northern France (GUILLOT, LEROY 1995). This study has looked into the distribution of Gallo-Roman and prehistoric sites and found them to be different. They have also compared the Palaeolithic and Mesolithic site distributions in view of natural geology and hydrographic considerations.

Service régional de l'archéologie, DRAC, Lorraine

The year 1997 has seen the start of a program to computerise the regional archaeological survey using the basic data held on the Ministry of Culture national database. This data will be substantially enhanced with additional archaeological, geographical and geological information so that meaningful results can be obtained from the use of GIS. The first studies to be undertaken will be for the series *Carte Archéologique de la Gaule*, with the Meuse-Lorraine region, and for the Roman occupation of the region. The study will be carried out using MapInfo on Apple Macintosh computers.

Laboratoire Départemental d'Archéologie du Val-de-Marne

The Laboratory was one of the main participants in the development of the archaeological survey section of the ArchéoDATA System and as such was predisposed to participating in the Archaeological Information System aspects of its development. From the beginning, GIS was seen as an integrator of different sources of archaeological and other related data, and all work was organised to conform to certain standards so as to make it compatible with other work carried out at the laboratory and with excavation work carried out under their supervision.

The LDA was one of the first administrative institutions to implement the use of GIS techniques into its daily work. As they are responsible for communicating information concerning risk zones of known, or potential, ar-

archaeological remains to urban planners and construction companies, an efficient interface with the archaeological survey was necessary. Using MapInfo software, all of the regions sites were recorded along with all high probability sectors such as the river fronts along the Seine and the Marne rivers, which are known to have been highly populated during Neolithic times.

The computers used to run the MapInfo GIS software are Apple Macintoshes. Because the regions cartography was done on InterGraph computers and software, a Macintosh version of MicroStation is used for all excavation and regional maps. The Laboratory is looking into the possibilities of MicroStation GeoGraphics software. The regional cartographic service has finished digitising its 1:5000 maps and is now working on the 1:2000 maps, which will give excellent precision to future survey output, especially when integrated with excavation data. The Val-de-Marne administration has also bought Michelin computer maps of the Val-de-Marne region.

This laboratory has been the first regional administration to create a web site and it has begun to put digital maps where there is a risk to archaeological remains on the Internet (see University of Paris VIII).

Service Départemental d'Archéologie du Val d'Oise (SDAVO)

The use of GIS for archaeological research was introduced about six years ago after a meeting with the Conseil d'Architecture Urbanisme Evaluation du Val-d'Oise (CAVE) and who had recently acquired MaxMap licences and digitised regional map data. The possibilities for archaeology became immediately clear and it was decided to take this opportunity to implement it for the regional Val-d'Oise service.

Since then several long term projects have been considered and various collaborations initiated. The first of these was the archaeological survey, which today is actualised to present site knowledge and is used in general as the basis for most research work. This availability has made that most studies remain totally compatible with the survey and that data can be later easily introduced into a common database.

Several research projects concerning the region have been undertaken since then. The digitalization of the Napoleonic cadastral survey was undertaken several years ago and will be completed for the spring of 1998. Initial work has already revealed many interesting features which are being analysed with the objective of reintroducing them as new data to be again re-processed. One particularly interesting project (KRIER, SUMÈRA, WABONT 1996) has been the comparisons between archaeological data, archives, cartographic and geomorphological documents using GIS and carried out in municipalities of Beaumont-sur-Oise, Bernes, Bruyères and Persan.

In view of the demise of the MaxMap software, the SDAVO is currently re-evaluating its GIS strategy and because they want to continue with

readily usable software, GeoConcepts and MapInfo appear to be the logical alternatives.

Université de Tours François Rablais, "Maîtrise des Sciences et Techniques en Archéologie", in collaboration with the CNRS

Their projects are mainly based on the evolution of the region during the medieval period and include the regional archaeological survey of the Touraine region, the evolution of parishes and ecclesiastical limits and the variation of cadastres. Excavation recording of a medieval chapel at Ussé and the analysis of cemetery's development have given rise to GIS possibilities in these domains.

After several years of evaluating the possibilities of GIS for their research programs, they acquired MapInfo software in 1996 to run on their Apple Macintosh computers and use AutoCAD digitised maps for their cartography.

Université de Paris I, Panthéon – Sorbonne, UFR 03 Art et Archéologie

This university department answered favourably to a research grant extended by Service régional de l'archéologie of Lorraine for the project "Les ateliers céramiques Gallo-Romains d'Argonne". Along with the Foundation RAAP of the University of Amsterdam (NL), they have been obtaining all the available topographical, geological maps to scale 1:25000 and are working to gather data for those maps that do not exist, such as pedology. The study should be able to give new insights into the distribution of sites and patterns of commerce of this very important area of production.

Université de Paris VIII, Saint-Denis, IPT – Centre de Recherche

The Laboratoire d'Analyse et d'Applications de Méthodes et Méthodologie Archéologique of the university's Centre de Recherche and the Informatique Pour Tous department, undertook in 1997 to put on-line an Internet server for the Laboratoire Départemental d'Archéologie du Val-de-Marne. One of the main features was to have information, for the general public, on the archaeological survey of the Val-de-Marne, illustrated by a series of maps representing the region at different periods.

However, a more interesting experience evolved from this work when the idea of putting GIS generated maps of potential risk sites on that server directed this time at a more specific public, urban planners, promoters, builders and construction companies. Although the maps are sufficiently vague so as they cannot to be used for potential robbing of archaeological sites, the buffered areas are sufficient to give a precise idea of potential risk to archaeological remains in a given zone. It is expected to have complete cartog-

raphy on-line by the spring of 1998.

CNRS Paris based research units

At the end of 1997, most of the CNRS's Paris based research teams will move to the Maison de l'Archéologie "René Ginouvès" on the grounds of the University of Paris X Nanterre faculty. This new building will be equipped with computers and networks which have not been readily accessible to archaeologists until now. The in-house availability of UNIX workstations and the suitable software, co-ordinated by a specialised staff, should permit considerable development of GIS use, especially high-level analysis using advanced software.

The following three research units, currently housed in the University of Paris I locals at the Institut d'Art et Archéologie building, will be moving to Nanterre Maison de l'Archéologie:

– UPR 7532 du CNRS (équipe 12 du CRA) "*L'Europe protohistorique, de la sédentaire à l'Etat*"

This research team has been, from its very founding, one of the foremost users of new archaeological concepts and methods, and with the arrival of GIS for archaeological analysis, it was immediately taken up. Although beginning with MapInfo to become accustomed to the concepts and possibilities, they found that the analyses they were eventually seeking, would be constrained with this software. Being fully Apple Macintosh equipped, the choice of high-end software was GRASS.

They have been working on the Vallée de l'Aisne region, North-East of Paris, since the 1970's and have accumulated a great deal of varied data. The use of GIS has permitted the integration of this data into models of Neolithic development. They have also been working on the intra-spatial aspects of Neolithic buildings.

– UPR 9032 du CNRS (équipe 41 du CRA) "*Du village à l'Etat au Proche-et Moyen-Orient*"

The first use of GIS for archaeology were implemented nearly ten years ago in collaboration with the GS-72 of the CNRS (later GDR 880) in the development of the ArchéoDATA Project (ARROYO-BISHOP 1989). Using early MapInfo software for DOS, a test was done using archaeological survey data from the Ile-de-France region, and the conclusive results then obtained, have made GIS use a constant feature. The most important concept to be developed was the use of the GIS structure to base the Archaeological Information System (AIS) concept which has been developed since then (ARROYO-BISHOP 1989, 1991, 1994; ARROYO-BISHOP, LANTADA ZARZOSA 1992).

Considerable work was carried out to adequately structure the archaeological data to be processed, this being that an archaeological implementation of GIS techniques imposes a higher degree of integration than is normally the case in our discipline. The problematics can be resumed as wanting to manage *something somewhere at sometime*. All three of these “S” have to be managed effectively to arrive at optimal results (ARROYO-BISHOP 1996). Models for manipulating data on a spatially oriented inter- and intra-site basis, on the temporal level, as well as the means for structuring successive hierarchical levels of object data, have been developed over the years.

The GIS software that is available are Tydac’s SPANS 5.2, MapInfo for Macintosh and Windows. AutoCAD and MicroStation on PCs are used for map input, and AutoCAD Map has been evaluated for archaeological work.

Some of the members of the team have been working for many years at the protohistoric period excavations at Ras-al-Junayz in the Sultanate of Oman. They have used GIS to test several line of sight theories about inter-site relationships. This work has later been extended to a much larger scale through several intensive archaeological field surveys in the region. The government of the Sultanate has expressed interest that this research team should undertake a full archaeological survey of the country and that it should be managed with GIS software. There has also been under study, with Turkmenistan authorities, of a project to carry out development of a predictive site system for the archaeological survey, based on GIS techniques.

The software used has been PC based IDRISI although some work has been tried with Windows based MapInfo. Considerable development work has gone into programming AutoCAD to give it data management functions pertinent to archaeological excavations.

– UPR 7541 du CNRS (équipe 20 du CRA) “Archéologie de la Syrie du Sud et de la zone de Pétra (Jourdanie)”

Two of this research teams members have worked on the distribution of archaeological sites running GeoConcept software and using Apple Macintosh computers. For entering cartographic data, Macintosh MiniCAD 5 software is used.

Equipe de Recherches sur le Château de Vincennes et la Banlieu-est, Ministère de l’Education National, Ministère de la Culture (CICV)

This interministerial research unit was set up in 1991 to carry out research work during the Vincennes castle’s restoration in Paris. Large scale excavation work was undertaken on the site of the royal manor which predated the castle’s construction and part of ArchéoDATA’s “Spatial Entities” were tested there. Especially interesting were the comparison of the con-

tents of Entities such as rooms, spaces, or even the use of multi-level spatial entities, the “Structured Spatial Entities”, such as the manor’s internal water distribution system and then combined with the process of bringing the water itself to the manor from the river.

The castle’s ongoing restoration also offered the unique opportunity of recording at arms length all of the castle’s stonework, which presented the possibility of recording such variables as size, geology, marks as well as spatial position for each stone block. The data was processed in 2 and 3D views, and several models which appeared to be common logic were refuted and other views were scientifically confirmed.

This research unit has had mixed PC and Macintosh hardware platforms from the beginning and has used MacSpin, MapInfo, AutoCAD and MicroStation software.

Association pour le Développement de l’Archéologie à Chartres (ADAC).

This body has managed archaeological excavation and research for the city of Chartres for the last fifteen years and has recently taken over the co-ordination and management of the “Maison de l’Archéologie de Chartres”. The principal use of GIS has been for managing the cities archaeological resources and providing precise information to the city authorities on potential dangers to remains when undertaking decisions on city planning. Work has also been carried out into spatial distribution of archaeological remains, and in particular the distribution of burials and artefacts in Roman/Medieval cemeteries.

The material used here has been MapInfo software running on Apple Macintosh computers. Some cartography work has also been done using AutoCAD on PCs to prepare dxf. files to transfer to MapInfo.

Association pour les Fouilles Archéologiques Nationales (AFAN).

This entity was created almost twenty years ago by the department in charge of archaeology at the Ministry of Culture (Sous-Direction de l’Archéologie or SDA) to manage funds given by urban promoters and construction companies for archaeological rescue excavations prior to building. The better known projects have been the Louvre excavations in Paris, as well as many highways and the high-speed train (TGV) lines. Today almost 1000 interventions are carried out every year under AFAN management.

No specific guidelines have been given by the AFAN management on the use, or the possibilities, of GIS to excavation work, and as such site managers are free to use what techniques they deem necessary, or of interest, to their own excavations. A few have however tried, over the last few years, to implement spatial management to better their comprehension of the ves-

tiges excavated. Two different levels of intervention have been used, due mainly to the type of project being undertaken; single excavations, or multiple excavations, as in the case of highway, where anywhere from tens to hundreds of archaeological remains are identified.

Some of the experiences being carried out within the excavations of the AFAN:

– *Aéroport de Charles de Gaulle, Roissy-en-France:*

The doubling of the runways at the largest French airport has created a very interesting opportunity to test and develop GIS techniques to conditions found in rescue excavations. The persons in charge of documentary section of the project consider that it brings together several important conditions, two large extensions of land, numerous excavations, and the length of time necessary to work out different experiences. This is seen as making it possible to assay GIS's usefulness and pertinence to the sector of rescue archaeology. Not only are the questions of what is important in GIS, but also of what is really important and really useful, in the limited time imparted, to the excavation and to the final report. Also being looked into are what documents, and what usefulness, will the documents be to researchers in future years.

The unit will be working closely with the Service Départemental d'Archéologie du Val d'Oise and will use their standards so that all the data recorded will be incorporated into the regions archaeological survey. As a consequence the software and hardware will be MaxMap on Apple Macintoshes.

– *Tramway de Montpellier, Montpellier:*

This particular project, being carried out in an old Roman city in Southern France, is also a multiple excavation intervention. It is important to note that Montpellier is very important university city and that it has one of the main geographical research centres. It was then quite natural that an agreement should be reached to have some assistance in setting up and using GIS.

The excavation team undertook the development of a 4th Dimension (ACI, France) database to handle excavation work and to transfer data to MapInfo on an Apple MacIntosh computer. The collaboration with the university has made it possible to dispose of an abundant collection of maps, especially those concerning past cadastres, thus making it possible to embark on several studies on the evolution of the landscape, correlating them with excavation and other data.

– *Autoroute A-16, fouille de St.-Sauveur:*

This excavation was part of a number carried out during A-16 high-

way construction. GIS analysis was used to carry out the distribution of skeletal remains at the scene of a collective burial. MaxMap software on an Apple Macintosh was used.

– *Autoroute A-89 en Aquitaine:*

This highway is being constructed in the South-West and it is planned that a topographer be put in charge of a GIS to co-ordinate the inter-site data relations between the archaeological survey and the rescue excavations. The survey information will come from both the Ministry of Cultures ArcInfo database, and from the survey work³ carried out prior to construction by the A-89 unit itself. This undertaking would be most systematic implementation of GIS to a lineal inter-site construction project. The projected software / hardware configuration will be PC ArcInfo running ArcView 3.

7. CONCLUSION

The cases presented represent a partial and incomplete view of the application of Geographical Information Systems to archaeological research in France. Others experiences exist, such as those in Lyon and to the South in the Provence region, but insufficient information has made it impossible to comment on them. What can be said is that while the use of GIS is still not in generalised use, it is important to note that considerable thought and work has gone into, and continues today to go into, research to find efficient and pertinent ways of implementing GIS concepts to archaeology.

It is probably in two distinct areas of the Archaeological Information System concept, that we will see, in France, considerable consolidation in the years to come. These will be for the large scale integration of data on regional and national levels, and on the other end of the scale, with the generalisation of the Archaeological Information Systems to manage intra-site excavation recording and analysis. The structuring and distribution of archaeological and related data through the AIS, will provide a framework for fundamental research.

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³ Prior to beginning a highway or train line project, archive data is researched to a distance of one kilometre on each side of the proposed construction. Field survey work is then carried out to a distance of three hundred meters, and sites excavated to fifty meters, both on each side of proposed construction work.

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ABSTRACT

Due to the limited response to the CNR questionnaire on GIS use in French

archaeology this paper cannot expect to give either the full extent of implementation, nor fully document its impact on this field of research. It has been however possible to extrapolate general trends, and even with the limited time left, to situate the development of several projects and undertakings.

The most important implementation of GIS is the Ministry of Culture's nationwide SCALA program for the French archaeological survey, and the most comprehensive, the CNRS's ArchéoDATA Archaeological Information System (AIS). The majority of the smaller projects are in three sectors, regional governmental archaeological offices, the CNRS research laboratories and archaeological field units. As the majority of the GIS projects are undertaken by small teams that are looking for flexibility and autonomy, the general trend in hardware/software configurations has been away from elaborate centralised systems and towards micro-computer based installations, with the combination usually being MapInfo running on PCs and Macintoshes.

While the use of GIS is still not generalised in French archaeology, it is important to note that considerable research is going into innovative ways of implementing GIS concepts to archaeology and that important results can be expected in the years to come.