

## CHAPTER 14

# MANAGING THE SPATIAL DIMENSION OF THE EUROPEAN ARCHAEOLOGICAL RESOURCE. TRENDS AND PERSPECTIVES

DAVID W. WHEATLEY

*University of Southampton, United Kingdom*

LEONARDO GARCÍA SANJUÁN

*University of Seville, Spain*

### I. INTRODUCTION

In the late 1960s Swedish archaeologist C.A. Moberg claimed that research and management of the European archaeological resource were entering a new stage characterised by the super-abundance of information, which in turn produced the challenge of an 'archaeographic crisis'. The accumulation of data and archival material from rescue excavations and the explosion in the volume of scientific data in archaeological research were the two main factors leading to such an unprecedented increase in information (Moberg, 1987:13). Almost thirty five years on, it is hard not to be impressed by the predictive sharpness of Moberg's statement. Both curatorial and research-oriented interventions (excavations or otherwise) have continued to be carried out at an increased rate, as the evidence discussed throughout this book shows. Archaeological Resource Management (ARM) and scientific organisations responsible for such interventions have become firmly established in many more European countries and regions (as they have world-wide). At the same time, archaeological data analysis practice now comprises techniques that derive from a vast range of scientific disciplines ranging from physics to chemistry, geology, soil science, medicine, biology, etc. This trend towards a significantly expanded concept of what constitutes *archaeological data*, only incipient at the time Moberg made his forecast, has now become mainstream. A survey carried out in the early 1990s, before the rapid growth of Internet access, suggested that an average of 3000 books on archaeological subjects were being published in the world per year, just in English (Runnels, 1994:358).

Archaeological data have continued to accumulate at a faster and faster pace in more and more places while expectations about the accessibility and usability of those data have also risen dramatically. The extension of computer networks in the last decade, particularly the Internet, has created a true *culture* of readily available, retrievable and usable data which is quietly permeating all areas of society. Moreover, the very existence of Internet, which as Kilbride points out (this volume), is not only expanding but doing so at an increasing rate, is acting as an stimulus for a further expansion in the amount of information available for the user. Put simply, the more readily available users expect information to be (faster data transfer, more user-friendly interfaces, etc.), the larger the amounts of information that will be made accessible to them. Archaeological organisations and users are already beginning to feel the effects of this paradox. In Chapter 12 of this volume, Hansen and Dam have shown how, as soon as the Danish national database of archaeological sites went on-line in 1997, the system became so popular among profes-

sional and general users alike that an immediate wish for its further expansion was inevitably felt.

Archaeological organisations whether primarily research (universities, institutes, schools) or management (museums, archaeological units, ministries), are together in this. Although ARM bodies may be more directly responsible for storing, curating and disseminating data pertaining to the material evidence of our past, there is an inevitable feedback with research-oriented organisations. These not only produce large amounts of data themselves, but also have a requirement for existing source data to answer new scientific questions. In this respect, ARM and research oriented organisations are like Siamese twins: they may have different agendas and be legally and (to some extent) functionally independent, but they inherently share the same bloodstream of information. Moreover, cultural heritage does not necessarily respect national boundaries so that the interpretation and curation of cultural heritage ethically and practically requires us to consider supra-national datasets.

This book has dealt with Sites and Monuments Records (SMRs), that is to say one of the basic components of that bloodstream of information that flows between archaeological organisations. Because they provide the fundamental empirical basis for the existence of an archaeological heritage in need of protection (Kristiansen, 1989:28; Leech, 1993:200), it has been widely acknowledged that SMRs may be regarded as the backbone of ARM. More specifically, this book has considered the spatial dimension of SMRs. This involves us in a variety of areas including archaeological ground reconnaissance, the spatial definition, structure and density of the archaeological evidence, as well as the integration of spatial and other kinds of data. Of most immediate concern has been the introduction of Geographic Information Systems (GIS) and issues related to supra-national (in this case European) cooperation. The discussions presented in the first part of this book, as well as in other reviews on the subject (Larsen, 1992; Leech, 1993; Hansen, 1993; Harris & Lock, 1995; Wheatley, 1995; Van Leusen, 1995; García Sanjuán & Wheatley, 1999; Hansen & Quine, 1999; etc.) all suggest that, when these areas are considered, current European SMRs display not only varying conceptual frameworks, but also rather different stages of development, both in the breadth and depth of the data (Figure 14.1).

This can be seen, for example, in the variation in territorial and/or chronological scope of regional and national inventories of sites. Predominant epistemological and theoretical traditions on one hand, and political and ideological agendas on the other, have exerted a profound influence on the present configuration of regional and national SMRs, whether at an institutional, methodological or even terminological level. To take one example that is further discussed below, archaeological survey has not been given the same epistemological status or the same administrative priority everywhere in Europe. In SMR terms, this means that in many regions and countries the amount of territory that has been thoroughly surveyed is far from satisfactory and therefore a large proportion of the archaeological resource remains unknown and therefore unprotected. Similarly, ideological and political pressures derived from the process of construction of national identities have led to subtle patterns of over- or under-representation of specific periods or cultures from the past.

This is also reflected in the variable accuracy, sophistication and complexity of the data recorded for each archaeological entity. Advanced SMRs handle large quantities or archive material including historical maps and documents, images, grey literature related

to fieldwork interventions, etc. This material presents its own important methodological issues, such as the development of criteria for selection, standardisation, storage and preservation of data. Again, very different situations can be observed across Europe. Countries or regions with longer SMRs traditions are currently putting into practice sophisticated approaches and tools to ensure the safekeeping and retrievability of the information attached to SMRs. The UK's Archaeological Data Service (ADS) is leading an innovative way towards interoperation of databases storing heritage documentation. In those countries and regions where SMRs have started later, more emphasis is currently being placed on the elaboration of an homogeneous and systematic database of sites. Here, the attachment of documentary information tends to be considered a secondary priority, to be dealt with at a later stage.

Although progress in both these areas is equally fundamental, limited availability of means and resources has caused many ARM institutions to give preference to one or another. If we think of the quality of data as the 'depth' of the archive, and the extent of coverage throughout the landscape as 'breadth', then the evidence discussed below suggests that, for many European regions SMRs still represent a somewhat shallow and narrow record of the real density and distribution of our archaeological heritage.

## 2. THE SPATIAL REPRESENTATION

### 2.a. Recording Entities

As the previous chapters of this book have shown, the spatial conceptualisation and definition of the archaeological resource throughout European SMRs is varied and dynamic. Many of the systems described above (like for instance the Austrian, Irish or Portuguese) rely principally on the conventional notion of 'archaeological site' to refer to a cluster of material remains that is functionally meaningful for the understanding of human past activities. This, however, is seldom unaccompanied by awareness of the inherent limitations that this concept has. Thus, describing the site-based Irish SMR, de Buitler acknowledges that, of itself the notion of site as a spatial entity is insufficient to describe complex clusters of material remains for which some sub-elements would constitute records (i.e. *sites*) in their own right, had they been found in isolation.

The complexity of legal and administrative issues in heritage protection, the steady accumulation of different kinds of archaeological interventions in the same area, or simply a desire to progress from the conceptual limitations of this notion of *site* (to promote better understanding of archaeological landscapes and territories, for example) have all led to the construction of more sophisticated conceptual frameworks. Kuna (this volume, Chapter 3) has made an interesting critique of the notion of site for ARM purposes that links up coherently with other 'siteless' or 'non-site' approaches to survey and spatial analysis (Thomas, 1975; Foley 1981; Dunnell & Dancey, 1983; Gallant, 1986). According to the experience described by Kuna, the more intensely surveyed a given area is, the more difficult and unrealistic becomes the exercise of spatially delimiting discrete sites. Hence, the Bohemian SMR has been entirely conceived as a database of *archaeological individual observational events* (such as for example a sampling of surface artefacts in a given polygon, or an archaeologically monitored segment of a long-distance trench) and not sites. The

TABLE 14.1. Designation and Definition of Recording Entities in Some European SMRs.

| Country or region | Source                 | Recording entities | Definition                                                                                                                                                                       |
|-------------------|------------------------|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Andalusia         | Fernández, this volume | ISOLATED FIND      | Scatter of artefacts and/or architectural elements lacking systematic association.                                                                                               |
|                   |                        | UNIT               | Part of archaeological sites that satisfy at least one of a series of legal, planning or functional criteria.                                                                    |
|                   |                        | SITE               | Spatially continuous set of material remains derived from human activity that request the fundamental use of archaeological methodology for their analysis.                      |
|                   |                        | AREA               | Set of archaeological sites that appear integrated within a landscape characterised by specific cultural values.                                                                 |
| Czech Republic    | Kuna, this volume      | EVENT              | Spatially or chronologically related archaeological field observations (e.g. surface artefact collection within a given polygon, one season of a long-term open-area excavation) |
| Holland           | Wiemer, this volume    | OBSERVATION        | One or more artefacts or features                                                                                                                                                |
|                   |                        | COMPLEX            | Spatially delimited area in which artefacts or features have been found present that refer to a certain functional use of the area within an certain chronological scale.        |
|                   |                        | MONUMENT           | Management zones defined in terms of archaeological value.                                                                                                                       |
| Romania           | Oberlander, 2000       | SITE               | Place in which archaeological finds have been uncovered                                                                                                                          |
|                   |                        | ENSEMBLE           | Archaeological discovery characterised by an specific location and dating –e.g. a necropolis                                                                                     |
|                   |                        | COMPLEX            | Group of archaeological discoveries with a relationship between them, characterised by the same dating, location and function –e.g. dwelling, grave                              |
|                   |                        | OBJECT             | Individual archaeological find, which may or may not be part of a complex –e.g. a ceramic pot, a weapon.                                                                         |

relationships of the observational events recorded for a given geographic area (in terms of topology and ultimately past cultural processes), are only examined when the database is queried for specific professional reasons.

The *Archis* system (Wiemer this volume) is another good example of this gradual departure from the notion of *site*. In the conceptual framework developed for the Dutch

SMR, the archaeological evidence is broken down into *observations* (which describe one or more artefacts or features), *complexes* (sets of observations that display a certain functional patterning within an specific chronological scale) and *monuments* (management zones defined in terms of archaeological value).

In the UK too, there has also been a trend away from a simple notion of the 'site' as the fundamental unit of archaeological recording. Here, ARM is closely integrated within planning legislation and the most comprehensive SMRs are maintained as numerous independent local databases (usually at the level of counties), used to provide planning advice and control. The highly distributed nature of SMRs in the UK has led to much variation in both data quality and implementation. In the past, several SMRs sought to overcome the limitations of site-based recording by utilising complementary spatially-referenced entities including "land plots" (Robinson, 1993:141) individual "items of information" (Lang & Stead, 1992:73) "findspots" (isolated artefacts or finds) or "cropmarks" (Lang & Stead, 1993; Lang, 1992; 1993). More recently many of the SMRs have adopted *Historic Buildings Sites and Monuments Records* (HBSMR) software, commercially produced by the *exeGesIS* company (<http://www.esdm.co.uk/>). As with some of the other systems discussed above, HBSMR is based on a data model that recognises a variety of recording units that are ultimately based on *observational events*. In addition, the system permits heritage managers to define more traditional units of recording such as *sites*, *monuments* and *sources of information* and these can be linked with a choice of GIS platforms. The *National Archaeological Record* (NMR) in the UK is based on a similarly event-based data model.

Other European SMRs have chosen to maintain the conventional notion of *site*, but within wider frameworks. One example is the Andalusian SMR (Fernández, this volume), which includes four different types of archaeological entities defined by their spatial properties. These are referred to as *isolated finds* (scatters of artefacts or architectural elements lacking systematic association), *units* (parts of archaeological sites that satisfy at least one of a series of legal, planning or functional criteria), *sites* (spatially continuous sets of material remains derived from human activity that request the fundamental use of archaeological methodology for their analysis) and *areas* (sets of archaeological sites that appear integrated within a landscape characterised by specific cultural values).

Although diverse, each of these conceptual schemes goes beyond the traditional notion of the *site*, arranging the physical entities that integrate the archaeological record according to more sophisticated parameters, such as the nature of the *observational acts* or *events* through which the archaeological remains are known, or through the evaluation of their *importance*. Such parameters were not present when the concept of *site* was coined in the XIXth century, and their incorporation to contemporary archaeological practice reflects the new needs that the management agenda is experiencing.

Not only is the concept of archaeological site being increasingly challenged by alternative conceptual frameworks, but the distinction between *archaeological sites* and *historical monuments* is becoming increasingly blurred as well (Cumming & Gilman, 2001). The conventional definition of an archaeological site proposed by ICOMOS explicitly underlined the relevance of archaeology as the main source of scientific information in order to distinguish it from standing historic buildings (Björnstad, 1989:72). Paradoxically, archaeological principles and methods are increasingly being used in the study of standing historical buildings, since they allow the establishment of construction sequences, patterns

of refurbishment, etc. Whether they are underground and prehistoric or extant and in use, architectural features require a rather similar sequence of interpretative acts for their inclusion within an SMR. Such a sequence inevitably departs from accurate geo-referencing, and progresses through spatial delimitation and geometric representation, description (whether textual, photographic or otherwise) and finally to input into a working information system.

There is evidence that the conceptual separation of *archaeological* and *architectural* sites (and monuments) may obscure, rather than clarify, certain aspects of data processing within SMRs. Perhaps a good example of this is the trajectory followed by the English Royal Commission on the Historical Monuments (RCHME, now part of English Heritage) in terminological standardisation. In a first stage, the RCHME compiled two separate thesauri of archaeological (RCHME, 1986) and architectural (RCHME, 1989) terms, as well as a thesaurus of archaeological site types (RCHME, 1992; Beagrie & Abercromby, 1992). These documents were mostly aimed at providing some coherence to the county-based English SMRs that were using, at that time, independently-generated vocabularies for data description. More recently, however, this *disciplinary* approach that separated archaeological and architectural terms has been replaced by a more *thematic* approach whereby architectural and archaeological terms are united in different thematic thesauri devoted to, for example, types of buildings (RCHME-EH, 1995; 1998) or construction materials (RCHME-EH, 1995).

A more anecdotal (but equally illustrative) example derives from the experience of the *Andalusian Institute of the Historical Heritage*. When begun in the early eighties, the design of its SMR databases conceived of *archaeological sites* and *architectural monuments* (basically standing buildings medieval or later) as separate databases, and the task of their design was given to archaeologists and architects respectively. As both databases were conceived to operate within a GIS right from the start, archaeologists started to search their existing card-index records to collect the co-ordinates of all known sites. Architects, however, soon met an unexpected difficulty: their paper archives only specified the geographic location of historic buildings by the street name, building number and postcode. No co-ordinates were cited anywhere. As they soon painfully realised, that made their information far more difficult to use within a GIS and a long process –still under way– of data capture was begun to obtain the necessary geo-referencing for historical buildings. In this case, separate recording traditions in archaeology and architecture had shown archaeological data to be more suited for computerised management.

Taken together, these examples suggest that, even prior to any work of identification or spatial location, the modelling, conceptualisation and structuring of archaeological evidence may have a significant impact in the way the archaeological resource is read throughout the landscape.

## 2.b. Geo-referencing and geometric representation

Beyond the conceptualisation of the archaeological evidence lies the issue of representational accuracy. If no ARM policy can be conceived without the inventorying of archaeological events, it is equally true that no ARM policy can be efficient or successful without good information about the exact location, shape and extent of those events.

More specifically, as Murray has stressed (this volume, Chapter 13), geo-referencing is a vital means to integrate archaeological data in contemporary SMRs. It is therefore not surprising that poor geo-referencing (mainly from inaccurate paper-based records) is so often mentioned as a significant problem. According to Bugalhão (this volume, Chapter 8), high error levels were found in the co-ordinates of Portuguese archaeological sites when data input into a GIS started in the mid-1990s, and at present it has been possible to correct only 20% of them. The same problem was found when the Andalusian inventory of sites was first migrated into a GIS (Amores *et alii*, 1999). This issue is obviously likely to appear whenever old SMR records are transferred into GIS for the first time and can be addressed through the systematic updating of the data by either 'corrective' field survey or from air photography (although both of these are expensive and time-consuming). Data collected in the future, with geo-referenced databases specifically in mind, may present fewer problems, particularly as GPS technology becomes more widely available. However, although geo-referencing should arguably not be a significant issue in the long run, good-quality geo-referencing is so critical in granting the efficient functioning of a SMR, that no chances should be taken at any stage of the data processing. Geo-referencing errors may derive not only from old records or the fieldwork stage, but also from the input stage, so that automatic error-detecting routines embodied within the SMR system, such as that described in Chapter 1 as part of the Andalusian ARQUEOS system, may prove extremely useful.

As well as the precise location within a standard cartographic grid, the spatial representation of the archaeological resource often involves its representation in geometric forms. This requires an exercise in simplification whereby, for example, the imprecise edges of a continuous flow of evidence are transformed into discrete geometric forms, such as points, lines or polygons. Ideally, the spatial representation of archaeological entities within SMRs should be based on precise data such as plans of documented features (walls, causeways, trenches, etc.), geophysical images of the buried evidence, or georeferenced micro-topographic plans. Due to their high cost, however, these types of data are normally only available for a minority of specially protected sites (monuments of national importance, world heritage sites, etc.). Regardless the nature of the recording entities, therefore, there is inevitably a considerable level of representational generalisation derived from the use of a fixed set of geometric forms.

At present, the most widely used form of geometric representation across European SMRs seems to be the point representation: single pairs of co-ordinates. Point representations obviously cannot account for many properties of archaeological entities such as topography, shape or extension. The fact that they clearly predominate in the majority of regions and countries discussed in the first part of this book can be explained in two ways. Firstly, they are a more straightforward and less costly way to spatially represent an entity and secondly, the unavailability of precise cartography in old records made the representation of sites as points a necessity. Partly, of course, this is simply a product of the scale of analysis: at a cartographic scale greater than 1:20:000 it is impossible to delimit many archaeological entities in a geometric form other than a point. Within the Austrian SMR, archaeological sites are often represented as a 'collection of points with a varying probability to meet phenomena of archaeological interest' (Mayer this volume, Chapter 2). Arguably, within a GIS point entities may be provided with safety buffers in

order to minimise the risk of severe size under-estimation that could lead to unmitigated damage or destruction.

Alongside point representation, most European SMRs also store polygonal representations of some archaeological entities. It goes without saying that, although they account far more thoroughly for the extension and shape of the evidence, polygonal representations require more detailed on-field observations, which makes them more costly to obtain.

### 3. THE SPATIAL DENSITY

The quantitative evaluation of European SMR records has not proven very straightforward. The problems that some European ARM organisations have found in quantifying their regional or national inventories of archaeological sites (e.g. Lang, 1995:77; Roorda & Wiemer, 1992:117) derive mainly from inconsistencies in the spatial definition of the recording entities. Table 14.2 shows an approximation of the variability in recorded densities of archaeological sites (or *archaeological entities*) per square kilometre in a number of European regions and countries. Although this is a crude estimate with, in some cases, some doubt as to the comparability of the numbers cited, the table does suggest a marked difference between the highest and lowest densities of recorded archaeology between these regions.

TABLE 14.2. Recorded Densities of Archaeological Sites in Europe.

| Country or region | Extension               | Number of recorded sites | Average site density | Source                           |
|-------------------|-------------------------|--------------------------|----------------------|----------------------------------|
| Denmark           | 43,100 Km <sup>2</sup>  | c. 150,000               | 3.480                | Hansen & Dam, this volume        |
| Holland           | 33,889 Km <sup>2</sup>  | c. 60,000                | 1.770                | Wiemer, this volume              |
| Ireland           | 70,280 Km <sup>2</sup>  | c. 120,000               | 1.707                | Buitler, this volume             |
| Poland            | 312,685 Km <sup>2</sup> | c. 450,000               | 1.439                | Prinke, this volume              |
| Scotland          | 78,779 Km <sup>2</sup>  | c. 110,000               | 1.396                | Murray, personal com.            |
| Czech Republic    | 78,864 Km <sup>2</sup>  | c. 60,000                | 0.760                | Kuna, this volume                |
| Styria (Austria)  | 1,860 Km <sup>2</sup>   | c. 1,200                 | 0.645                | Fuchs & Kainz, 1999              |
| France            | 547,030 Km <sup>2</sup> | c. 310,000               | 0.566                | Cottenceau & Hanois, this volume |
| Madrid (Spain)    | 7,995 Km <sup>2</sup>   | c. 4,500                 | 0.562                | Ruiz Zapatero & Jimeno, 1999     |
| Portugal          | 91,951 Km <sup>2</sup>  | c. 13,500                | 0.146                | Bugalhao, this volume            |
| Andalusia (Spain) | 87,268 Km <sup>2</sup>  | c. 12,000                | 0.137                | Fernández, this volume           |
| Romania           | 237,500 Km <sup>2</sup> | c. 22,500                | 0.094                | Oberlander, 2000                 |

Site density as shown in table 14.2 is a function of a complex set of variables. Firstly, it must in part be a product of demographic and settlement conditions in the past: if the archaeological record is in some way a relic of past human activities, then the current observed density of sites must have some correlation with the settlement dynamics that the region has undergone in time. To take an extreme example, there seems to have been no human settlement in Iceland until the Viking colonisations of the IXth century AD (Olafsson, 1999:75). In most northern European regions this date can be pushed back at least to the Mesolithic, while in many other regions human presence dates to

the Lower Palaeolithic, more than a million years ago. If only because of the accumulation of human activity over longer time spans, we should therefore expect to find higher site densities in, say, France, than in Iceland.

Secondly, site density must partly be a product of environmental and post-depositional factors such as erosion rates, land-use and state of preservation. Some Mediterranean regions are currently undergoing heavy soil loss caused by erosion rates much higher than those recorded in central or northern Europe. Over long time spans, regions subject to archaeologically damaging pattern of land-use (such as mining) may be expected to display lower densities of sites.

Thirdly and most significantly, however, these recorded site densities are a product of the intensity of territorial reconnaissance, in turn related to disciplinary traditions that may have put more or less emphasis on systematic surface survey and on the recording of the archaeological resource. It cannot be entirely coincidental that, in table 14.2, Denmark appears as the European country with the highest recorded site density, with almost 3.5 sites per square kilometre, 24 and 25 times higher than that recorded in Portugal (0.14 sites/Km<sup>2</sup>) and Andalusia (0.13 sites/Km<sup>2</sup>) respectively. Even the gap between the observed density in Denmark and other European countries or regions with a fairly high recorded density of sites, such as the Netherlands (1.77), Ireland (1.70), Poland (1.43) or Scotland (1.39), is sufficiently great to require further explanation. This explanation is almost certain to be found in the historical tradition of Danish archaeology. Denmark has an unusually long history of systematic recording of the archaeological heritage that dates back to the XIXth century. Lacking the long history of dense urban settlement that most Mediterranean regions have, Denmark has done (and since this is a book of European scope, let us indulge on the jargon of our common bureaucracy) her *homework* in terms of sites and monuments record.

In this respect, the density of recorded archaeology in regions with longer surveying and inventorying traditions might act as a referent for those with more recent and/or less developed traditions. Let us assume, for a moment, that Portugal and Andalusia have not had a radically different scale, intensity or temporal depth of occupation to Holland. There is, after all, little reason to think otherwise. We may then extrapolate the average site density for Holland to this region, and we would conclude that there must be around a third of a million unrecorded archaeological sites, in the sense of sites that would have been recorded had these regions been subject to similar levels of survey to the Netherlands. Taken together, Portugal and Andalusia account for about one third of the area of the whole Iberian Peninsula. It is chastening to imagine the fraction of that potential archaeological resource will ever be recorded.

Of course, accurate quantitative spatial evaluations of European regional and national resources depend on the definition of the recording entities as discussed above (what are we counting?). But they also depend on the adequate control of surveying criteria and strategies. It is virtually a truism to say that surveying is a prerequisite for the location and identification of the archaeological heritage. And yet, until recently many national traditions regarded survey as a second-class form of fieldwork when compared with excavation. Archaeological survey has greatly increased its epistemological status within the discipline in the last thirty years, yet there are claims that SMRs do not adequately control the conditions, methods and procedures under which surveys are carried out, which

is fact vital for a correct quantitative assessment of the archaeological resource. For those countries and regions where there is enormous potential for unrecorded sites, the development of efficient and thorough programmes of surface survey is crucial. Newer spatial and survey technologies such as GPS may help greatly to achieve such programmes with accuracy.

#### 4. COMPUTER CONFIGURATIONS

The European regional and national SMRs discussed in this book are all implemented as carefully developed computer systems, some of which have an interesting history of their own. In Denmark, England, France, Holland, Poland or Scotland the computerisation of inventories of archaeological sites was started in the 1970s and has gone through successive stages, the most recent of which is characterised by the introduction of GIS. At present some GIS-oriented SMR systems have worked successfully for a number of years and are being constantly upgraded and enriched with different kinds of information. Table 14.3 shows some information on the prevalent DBMS and GIS software configurations in a number of European SMRs. Systems which started development in the 1970s or 1980s seem to have opted for software deriving from larger scale computer systems, such as ORACLE (France, Scotland) and Informix (Holland), with a variety of software for spatial data handling. By contrast, software designed for personal computers, such as the ubiquitous Microsoft Access (for alphanumeric data) coupled with ESRI Arc/View or MapInfo (for spatial visualisation and analysis) have become more popular among those systems developed in the later half of the 1990s.

**TABLE 14.3. Computer Configurations Used in Some European SMRs.**

| Country or region | Software configuration                                                              | Source                           |
|-------------------|-------------------------------------------------------------------------------------|----------------------------------|
| Denmark           | In-house application                                                                | Hansen & Dam, this volume        |
| Austria           | Foxpro; GEO-CADdy (customised application)                                          | Maier, this volume               |
| Poland            | FoxPro; MapInfo & MapBasic                                                          | Prinke, this volume              |
| Holland           | Informix & Grass (Customised application)                                           | Roorda & Wiemer, 1992            |
| Ireland           | MS ACCESS; Arc Info & Arc View; Visual Basic & MapObject customised browser; ERDAS. | Buitler, this volume             |
| Slovenia          | MS ACCESS; Arc Info & Arc View; Idrisi; Erdas                                       | Veljanovski, 2000                |
| Czech Republic    | MS ACCESS; Arc View                                                                 | Kuna, this volume                |
| Andalusia         | MS ACCESS; Arc View (Avenue & Visual Basic customised application)                  | Fernández, this volume           |
| Flanders          | MS ACCESS; Arc-View                                                                 | Meylemans & Meganck, 2001        |
| Saxony            | MS ACCESS; Informix; SICAD                                                          | Goldner, 2000                    |
| France            | ORACLE; Arc View                                                                    | Cottenceau & Hanois, this volume |
| Portugal          | ORACLE; Arc View                                                                    | Bugalhao, this volume            |
| Scotland          | ORACLE; Arc View                                                                    | Murray, this volume              |
| Slovakia          | Paradox; IRAS; GEOVEC                                                               | Kuzma, 2000                      |

Of course, the wider availability of GIS software has contributed enormously to a much more sophisticated and rigorous treatment of the spatial component of the archaeological resource. GIS is now so universally regarded as the natural successor or partner to DBMS in ARM (Wheatley & Gillings, 2001:217) that most debates at present are more focused on compatibility of data and standards for data integration than on issues of software selection or compatibility (Murray, Chapter 13).

Although GIS has changed some aspects of SMRs data management and processing (Wheatley, 1995), however, it is certainly not problem-free. From the software developer's viewpoint, González (this volume, Chapter 10) points out three fundamental conditions that should be met for the successful application of GIS to archaeological problems. These are that (i) technological issues should be intentionally hidden from end users, (ii) a thorough modernisation of source code and development practices should take place, and (iii) an honest marketing approach must be used. According to him, more effort should also be made to enhance user interfaces and usability as well as to solve the shortcomings of commercially available GIS software such as, for example, the need to handle separate map sheets for different scales or areas.

Many of the limitations of GIS in archaeological management derive from the fact that the majority of software used by archaeologists is general-purpose in nature, having been neither developed nor modified specifically for archaeological purposes. Many of the indices and coefficients most widely used in archaeological spatial analysis, for example, are currently not easily available in commercial GIS software (García Sanjuán & Wheatley, 1999:217). Further constraints on the application of GIS technology for ARM stem from the availability and cost of digital cartography. Various authors have pointed out in the preceding chapters that this may lead to a noticeable gap between those organisations working in regions where digital cartography is freely (or semi-freely) available and those working where mapping agencies charge commercial rates.

#### 5. TOWARDS SUPRA-NATIONAL SMRs

The discussions presented in this book, and in this chapter oscillate between two poles of a paradox. At one end there is the realisation of the important differences that exist in the way that archaeological spatial information is handled in Europe, both between countries and between regions within the same country. These differences stem from local and national traditions that have shaped the practice of archaeology as a discipline and their existence has created the healthy diversity of approaches and theoretical traditions that in turn contribute to making archaeology such a dynamic and exciting discipline in which to work. At the other end, however, there is a growing awareness that archaeology is a single discipline, that management and research problems are inseparably linked and that we need to develop new approaches to the description and storage of data at a supra-national scale. Kilbride (this volume, Chapter 11) expresses this well when he argues that, from the researcher's viewpoint, modern European boundaries can feel like anachronistic obstacles to the understanding of cultural and social processes that took place in a past in which such divisions did not exist. Whether we are concerned, for example, with the origins of the Neolithic, with the interpretation of megalithic architecture, the nature of Roman urban settlements or the formation of medieval maritime networks

we must be concerned with supra-national archaeological datasets. From the heritage manager's viewpoint, too, trans-nationality can only result in positive outcomes: the sharing of professional practice, greater transmission of novel ideas and approaches and greater understanding of the wider context of our regional archaeological heritage and our management practices.

Over the last decade, a number of initiatives have increasingly begun to emphasise the importance of European supra-national approaches to archaeological information. Some of these initiatives have covered issues relevant for a trans-national approach to SMRs such as legislation (COE, 1992;1997), data structure (CIDOC, 1995; Oberlander, 1995; Quine, 1999) vocabulary (1995) and Internet access (Van Leusen & Prinke, 2001). Table 14.4 gives some examples of projects and initiatives relevant for a European perspective to SMRs.

**TABLE 14.4. Initiatives Relevant for a European Approach to SMRs.**

| Initiative                    | Purpose                                          | Sponsor                                                                                              | Reference                                                                                                   |
|-------------------------------|--------------------------------------------------|------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|
| ArchTerra                     | Archaeological Network                           | European Union INCO 977054 under Copernicus Programme                                                | <a href="http://archterra.cilea.it/">http://archterra.cilea.it/</a>                                         |
| ARENA                         | Archaeological Resources Europe Networked Access | European Union                                                                                       | Hansen & Dam, this volume                                                                                   |
| ARGE                          | Archaeological Resources Guide for Europe        | European Union SOCRATES Project ArcheoNet (1997-1998); and the EC-INCO project ArchTerra (1999-2000) | <a href="http://odur.let.rug.nl/arge/">http://odur.let.rug.nl/arge/</a>                                     |
| ASWG                          | Archaeological Sites Working Group               | Unesco. CIDOC                                                                                        | <a href="http://cidoc.natmus.dk/">http://cidoc.natmus.dk/</a>                                               |
| DUBLIN CORE METADATA STANDARD | Interoperable online metadata standards          |                                                                                                      | Miller & Greenstein (1997)<br><a href="http://dublincore.org/">http://dublincore.org/</a>                   |
| HEREIN                        | European Heritage Network. Thesaurus             | European Union                                                                                       | <a href="http://www.european-heritage.net/en/index.html">http://www.european-heritage.net/en/index.html</a> |

Out of the six initiatives listed, five look directly into increasing the connectivity of archaeological organisations through the Internet. While HEREIN has proposed a general network of organisations involved in heritage management, ARGE has successfully become a main portal for specifically archaeological web resources. More interestingly for the aims of this book, the ARENA initiative (2001-2004) seeks to establish for the first time a network of inter-operated digital archaeological archives involving a number of European partners. As Kilbride (this volume, Chapter 11) has shown, the technology to inter-operate discrete SMR databases across different countries, as the ADS has been doing in the UK, is already available. The main obstacle for the establishment of such inter-operable data-

bases in the future is likely to be language, a hurdle that can only be overcome through investment in, for example, multi-lingual glossaries and thesauri.

These initiatives are paving the way for future co-operation in the domain of GIS and SMRs, and were the background to the Seville workshop. The workshop itself provided an opportunity to discuss ideas and share experiences, but in the end there is a clear need within European SMRs for more comprehensive and permanent mechanisms for the exchange of ideas, professional practice and experience. This would be best achieved through the establishment of formal networks of research and management institutions involved in the integration of GIS within archaeology and in the handling of SMR data. The advantages of such networks would be threefold. Firstly, institutions from different countries (and institutions from different regions within the same country) have been dealing with similar problems with little of co-ordination, and permanent networking will permit the sharing of experience and hence avoid duplicity of effort in solving these shared problems. Secondly, southern and eastern European regions often deal with vast archaeological resources with very limited means and out-of-date procedures. The Seville workshop attempted to bring together participants from a variety of European regions such that the experience of northern European institutions might be available to those European institutions with a lesser degree of experience –in other words promoting *cohesion*. Finally, networking in this field would contribute greatly to bridging the artificial gap that currently separates research and management institutions that are involved in the study and protection of archaeological evidence.

There is little doubt that future joint or harmonised European ARM policies will demand greater efforts towards such effort in trans-national co-ordination and cohesion and these may be expected to include many of the aspects dealt with in this book: quality control, standardisation of core data structures and vocabulary (multilingual glossaries), on-line accessibility, designation of recording entities, geo-referencing criteria and cartographic representation.

## 6. CONCLUSION

This book has been devoted to scrutinising the prevailing trends in the management of the spatial dimension of European SMRs. Although enormous progress has been made in the last century, in many European regions and countries SMRs are still a pale reflection of the underlying heritage resource. Therefore a great challenge lies ahead if we want to effectively to record the spatial dimension of the European cultural resource, and this is a prerequisite of its meaningful interpretation. This is not only a challenge of numbers, but also of organisation. As Murray has pointed out, this is a formidable three-fold task. First, we need to deal with ever growing amounts of data; secondly we need systems with enough flexibility to integrate not just inventories of sites but also other kinds of information and, finally, we need to provide satisfactory accessibility to the data to both general public and professionals who operate from remote digital locations. Management of the spatial dimension of SMRs permeates all of these tasks, posing a set of similar questions throughout different European regions and countries. This demands establishment of further mechanism of co-operation between all European partners.

## 7. REFERENCES

- Amores, F.; García Sanjuán, L.; Hurtado, V. & Rodríguez, M.C. (1999): "Geographic Information Systems and Archaeological Resource Management in Andalusia (Spain)". In Barceló, J.A.; Briz, I. & Vila, A. (Eds.): *New Techniques for Old Times. Computer Applications in Archaeology 1998*. BAR International Series, 351-358. Oxford. Archaeopress.
- Beagrie, N. & Abercromby, D. (1992): "The archaeological site types thesaurus". *Thesauri for Museum Documentation. MDA Occasional Paper* 18.
- CIDOC (1995): *Draft International Core Data Standard for Archaeological Sites and Monuments*. Paris. CIDOC (Comité International pour la Documentation Scientifique).
- CoE (1992): *European Convention on the Protection of the Archaeological Heritage* (La Valetta 16.I.1992). *European Treaty Series* 143. Strasbourg. Council of Europe.
- CoE (1995): *European Bronze Age Monuments. A Multilingual Glossary of Archaeological Terminology. A Draft covering Denmark, France, The Netherlands, The Republic of Ireland and The United Kingdom*. Amersfoot. Council of Europe Glossary 557.
- CoE (1997): *Compendium of Basic Texts of the Council of Europe in the Field of Cultural Heritage*. Strasbourg. Council of Europe.
- Cumming, P. & Gilman, P. (2001): "SMR in Essex and Kent". Paper Presented at the PLANARCH Conference (Chelmsford, United Kingdom, May 2001).
- Dunnell, R.C. & Dancey, W.S. (1983): "The siteless survey: a regional scale data collection strategy". In Schiffer, M.B. (Ed.): *Advances in Archaeological Method and Theory* 6, 267-287.
- Foley, R. (1981): "A model of regional archaeological structure". *Proceedings of the Prehistoric Society* vol. 37 (1), 138-166.
- Fuchs, G. & Kainz, I. (1999): "The archaeological survey of Austria". In Quine, G. & Hansen, H.J. (Eds.): *Our Fragile Heritage. Documenting the Past for the Future*, 83-96. Copenhagen. The National Museum of Denmark.
- Gallant, T.W. (1986): "Background noise and site definition: a contribution to survey methodology". *Journal of Field Archaeology* 13, 403-418.
- García Sanjuán, L. & Wheatley, D.W. (1999): "The state of the Arc: differential rates of adoption of GIS for European Heritage Management". *European Journal of Archaeology* vol. 2 (2), 201-228. London. Sage Publications.
- Goldner, R. (2000): "Germany. Department of Archaeological Heritage in Saxony" Unpublished Document Submitted to the Seville Workshop (Seville, June 27th-30th 2000).
- Hansen, J.H. (1993): "European archaeological databases: problems and prospects". In Andresen, J.; Madsen, T. & Scollar, I. (Eds.): *Computing the Past. Proceedings of the 1992 CAA Conference (Aarhus, March 1992)*, 229-237. Aarhus. Aarhus University Press.
- Hansen, J.H. & Quine, G. (1999): *Our Fragile Heritage. Documenting the Past for the Future*. Copenhagen. National Museum of Denmark.
- Harris, T.M. & Lock, G.R. (1995): "Toward and evaluation of GIS in European archaeology: the past, present and future of theory and applications". In Lock, G. & Stancic, Z. (Eds.): *Archaeology and Geographical Information Systems. A European Perspective*. London. Taylor and Francis.
- Kristiansen, K. (1989): "Perspectives on the archaeological heritage: history and future". In Cleere, H. (Ed.): *Archaeological Heritage Management in the Modern World. One World Archaeology Series* 9, 23-29. Unwin Hyman. London.

- Kuzma, I. (2001): "Slovakia. ARM at the Institute of Archaeology, Academy of Sciences". Unpublished Document Submitted to the Seville Workshop (Seville, June 27th-30th 2000).
- Lang, N.A. (1992): "Sites and Monuments Records in Great Britain". In Larsen, C.V. (Ed.): *Sites and Monuments. National Archaeological Records*, 171-183. Copenhagen. National Museum of Denmark.
- Lang, N.A. (1993): "From model to machine: procurement and implementation of Geographical Information Systems for County Sites and Monuments Records". In Andresen, J.; Madsen, T. & Scollar, I. (Eds.): *Computing the Past. Proceedings of the 1992 CAA Conference (Aarhus, March 1992)*, 167-176. Aarhus. Aarhus University Press.
- Lang, N. & Stead, S. (1992): "Sites and Monuments records in England. Theory and Practice". In Lock, G. & Moffet, J. (Eds.): *Computer Applications and Quantitative Methods in Archaeology 1991*, 69-76. BAR International Series 577. Oxford. Tempus Reparatum.
- Larsen, C.V. (Ed.) (1992): *Sites and Monuments. National Archaeological Record*. Copenhagen. The National Museum of Denmark.
- Leech, R. (1993): "Sites and Monuments: National Archaeological Records". *Journal of European Archaeology* vol. 1 (2), 201-204.
- Meylemans, E. & Meganck, M. (2001): "SMR in Flanders". Paper Presented at the PLANARCH Conference (Chelmsford, United Kingdom, May 2001).
- Miller, P. & Greenstein, D. (Eds.) (1997): *Discovering Online Resources Across the Arts and Humanities. A Practical Implementation of the Dublin Core*. London. Arts and Humanities Data Service.
- Moberg, C.A. (1987): *Introducción a la Arqueología*. Madrid. Cátedra [First Edition (1968): *Introduktion till Arkeologi*. Stockholm. Natur och Kultur].
- Oberländer, I. (1995): "CIDOC Archaeological Sites Working Group Report". *CIDOC Newsletter* 6. Paris. ICOM.
- Oberländer, I. (2000): "Romania. CIMEC, Institute for the Cultural Memory" Unpublished Document Submitted to the Seville Workshop (Seville, June 27th-30th 2000).
- Olafsson, G. (1999): "Recording standards for archaeological field surveys in Iceland". In Quine, G. & Hansen, H.J. (Eds.): *Our Fragile Heritage. Documenting the Past for the Future*, 75-81. Copenhagen. The National Museum of Denmark.
- Quine, G. (1999): "The CIDOC standard: an international data standard for recording archaeological sites and monuments". In Hansen, H.J. & Quine, G. (Eds.): *Our Fragile Heritage. Documenting the Past for the Future*. Copenhagen. National Museum of Denmark.
- RCHME (1986): *Thesaurus of Archaeological Terms*. London. RCHME.
- RCHME (1989): *Revised Thesaurus of Architectural Terms*. London. RCHME.
- RCHME (1992): *Thesaurus of Archaeological Site Types*. London. RCHME.
- RCHME (1996): *Thesaurus of Building Materials*. Swindon. RCHME.
- RCHME-EH (1995): *Thesaurus of Monument Types. A Standard for Use in Archaeological and Architectural Records*. Swindon. RCHME & English Heritage.
- RCHME-EH (1998): *MIDAS. A Manual and Data Standard for Monument Inventories*. Swindon. RCHME & English Heritage.
- Robinson, H. (1993): "The archaeological implications of a computerised integrated National Heritage Information System". In Andresen, J.; Madsen, T. & Scollar, I. (Eds.): *Computing the Past. Proceedings of the 1992 CAA Conference (Aarhus, March 1992)*, 139-150. Aarhus. Aarhus University Press.



- Roorda, I. & Wiemer, R. (1992): "The ARCHIS Project: Towards a New National Archaeological Record in the Netherlands". Larsen, C.V. (Ed.): *Sites and Monuments. National Archaeological Record*, 117-122. Copenhagen. The National Museum of Denmark.
- Ruiz Zapatero, G. & Jimeno, A. (1999): "Archaeological inventories in Spain: problems and solutions in a decentralized country". In Quine, G. & Hansen, H.J. (Eds.): *Our Fragile Heritage. Documenting the Past for the Future*, 35-50. Copenhagen. The National Museum of Denmark.
- Runnels, C. (1994): "The place of book reviews in the professional literature". *Journal of Field Archaeology* 21, 357-360. Boston.
- Thomas, D.H. (1975): "Non site sampling in archaeology: up the creek without a site". In Mueller, J.W. (Ed.): *Sampling in Archaeology*, 61-81. Tucson. University of Arizona Press.
- Van Leusen, P.M. (1995): "GIS and Archaeological Resource Management. A European Agenda". In Lock, G. & Stancic, Z. (Eds.): *Archaeology and Geographical Information Systems. A European Perspective*. London. Taylor and Francis.
- Van Leusen, M. & Prinke, A. (2001): "ArchTerra: extending the European Archaeology Web over Bulgaria, Romania and Poland". In Stancic, Z. & Veljanovski, T. (Eds.): *Computing Archaeology for Understanding the Past. Computer Applications in Archaeology 2000*. BAR International Series 931, 323-325. Oxford. Archaeopress.
- Veljanovski, T. (2000): "Slovenia. ARM at the Scientific Centre of the Slovenian Academy of Sciences and Arts". Unpublished Document Submitted to the Seville Workshop (Seville, June 27th-30th 2000).
- Wheatley, D. (1995): "The impact of information technology on the practice of archaeological management". In Cooper, M.A.; Firth, A.; Carman, J. & Wheatley, D. (Eds.): *Managing Archaeology*, 163-174. London. Routledge.
- Wheatley, D. & Gillings, M. (2001): *Spatial Technology and Archaeology. The Archaeological Applications of GIS*. London. Taylor and Francis.