11. Towards a new archaeological information system in the Netherlands

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11.1 Introduction

The development of a new archaeological information system should be viewed in the light of the foundation of a Dutch archaeological centre of expertise, called ARCHIS, in which the Universities of Amsterdam (I.P.P.), Groningen (B.A.I.), Leiden (I.P.L.) and the State Service for Archaeological Investigations (R.O.B.) participate. A request for financial support for four years was granted by the Ministry of Education and Sciences in 1988.

11.2 Aims of ARCHIS

The aim of the centre is to realise and maintain an archaeological information system on behalf of Dutch archaeologists on the one hand and institutions which are involved in environmental planning on a local, regional or national scale on the other.

To achieve this goal the centre of expertise will concentrate its activities on:

- the development and maintenance of an information system for the documentation of all Dutch archaeological sites, including sites that are protected by law (scheduled monuments). All these data will be stored in a central database;
- the development or acquisition of tools for accessing relevant cartographic information, like topographical maps, soil maps and palaeogeographical maps;
- the development or acquisition of tools for analysis and in particular geographical/spatial analysis of the archaeological data.

The situation in the Netherlands is that the documentation of archaeological sites is rather fragmented and scattered. There are several archives containing information about sites: all archaeological institutions as well as the state and regional (or provincial) museums have their own archaeological record. It is impossible to determine the exact number of sites of most of these handwritten archives due to their heterogeneous contents and the lack of administrative data with regard to their extent. However, at this moment about 20,000 sites are described in the largest computerised archive, called the 'Central Archaeological Archive'. This archive was founded in 1975 and mainly contains information about sites which has been collected and recorded from 1975 on. A second computerised archaeological record is maintained by RAAP, a foundation which specializes in archaeological field surveys. This archive contains approximately 10,000 site descriptions. We can only make a rough estimate of the total number of sites in the Netherlands: approximately 60,000–70,000 sites.

Many of these archives are using different archive-entries and/or site-identifications which do not refer to each other. This is, for example, the case with the archive which contains information about scheduled monuments (the Central Monuments Archive) and the largest archive recording archaeological sites (the Central Archaeological Archive).

As the quality and content of the data is also quite diverse, problems arise when using and interpreting those data. It is clear that a fast retrieval of all available information is impossible and that collecting and standardising the data becomes a time-consuming activity. For these reasons the need for standardisation and completing the archaeological record of all Dutch sites was strongly felt by the participants.

Because of the fact that an increasing number of the archaeological sites in the Netherlands are endangered by town expansion, reallotment, soil pollution and modern agricultural techniques, such as keeping the groundwater level extremely low or deep-ploughing, it becomes more and more necessary to protect these sites and to take efficient preventive action against further destruction. One way to achieve this is to make cultural resource management an integral and structural part of environmental policy. Therefore an exchange of information between archaeologists and these institutions should be intensified. It is also necessary that cultural resource management has quick access to all relevant data about archaeological sites. By linking archaeological sites to scheduled monuments and storing this information into a central database ARCHIS realizes this integration.

The introduction of a GIS offers a lot of new archaeological approaches and applications: spatial and statistical analyses of the archaeological data in combination with digitized spatial information become possible. The development of predictive models is another possibility (Wansleeben 1988; Soonius & Ankum 1991).

ARCHIS is based on four major components:

- hardware;
- the relational database management system INFORMIX;
- the raster-based geographical information system GRASS (Geographical Resources Analyses Support System);
- 'DBTOOLS', the tools which act as an interface between the database and the GIS.

11.3 Hardware

A schematic representation of the organisation of ARCHIS and the available configurations is given in

Fig. 11.1. The main system is based on a Concurrent MC6450 minicomputer. Currently three ascii-terminals and two graphics workstations are connected to this machine. The mini-computer has a 5¼" disk drive, a ¼" 150 MByte tapestreamer and a ½" tape-unit. The internal storage capacity is 1200 Mbyte. The archaeological institutions of the three universities have SUN-IPC workstations with some additional storage capacity installed. They will also have a connection to the central database by means of SURFNET, a national university data communication network. All machines use the UNIX operating system.

11.4 The INFORMIX software package

INFORMIX database products, developed by Informix Software Inc. of Menlo Park, California, are based on the client/server architecture. A set of tools form together a complete relational database management system including application tools. The database engine (or server) handles all data management, including the storage and retrieval of data. The three universities will work with the INFORMIX-SE (Standard Engine) database engine, while the State Service for Archaeological Investigations (ROB) will make use of the INFORMIX-ONLINE database engine. This engine offers the possibility to store scanned images as database fields and to handle multiple distributed databases. For this latter capability INFORMIX-STAR is also required. The application tools INFORMIX-4GL and INFORMIX-SQL provide the user interface to build or run applications. INFORMIX-NET and INFORMIX-STAR provide the client/server capabilities.

As far as the archaeological data in the database are concerned three concepts are essential:

1. Data concerning cultural resource management: the MONUMENTS, which are areas with one or more archaeological sites. Monuments are areas which are protected or should be protected by law because of their outstanding scientific and cultural values. The boundaries of monuments are clearly defined. In the GIS monuments are represented as polygons.

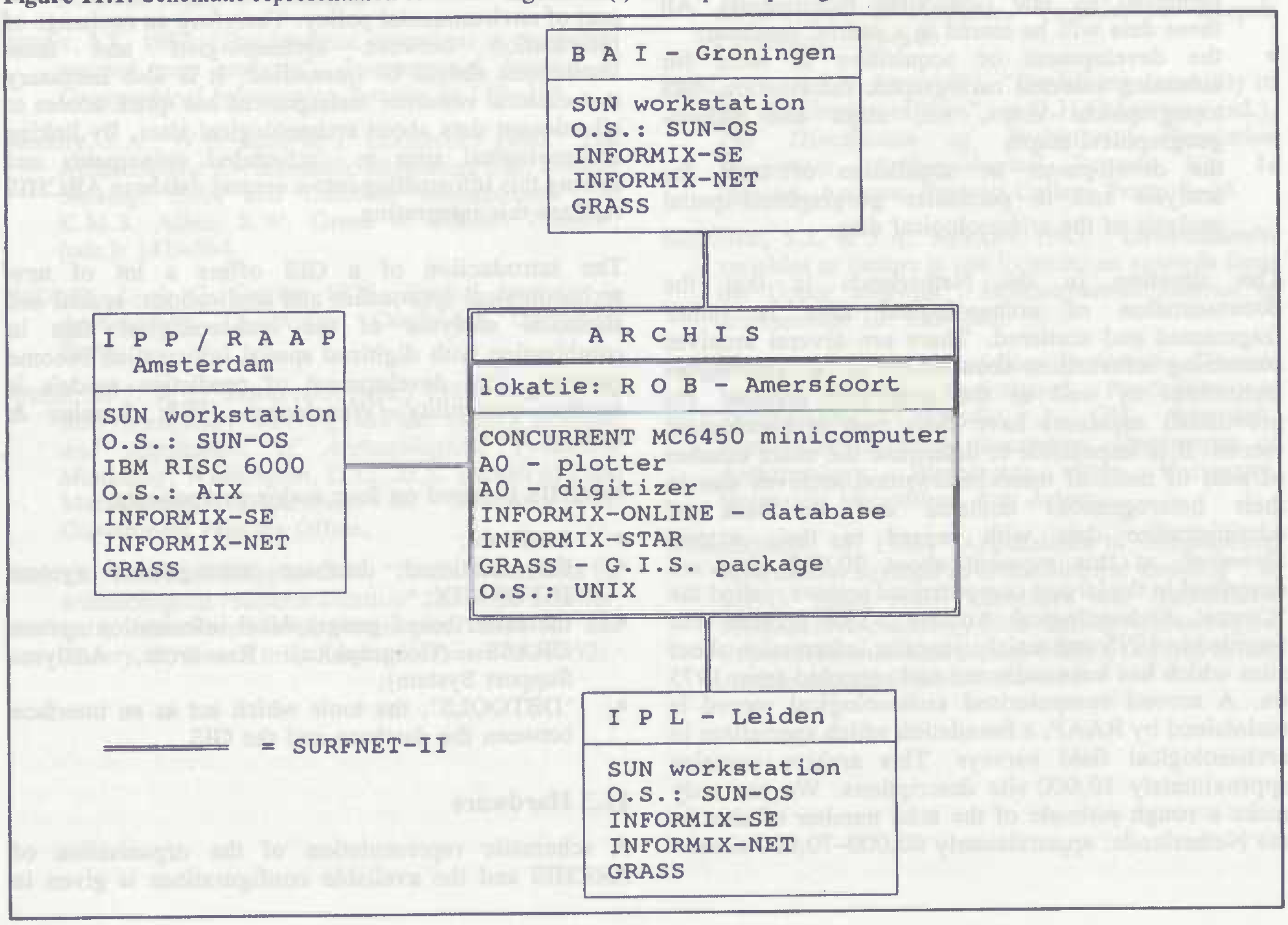
   Most of the data with regard to cultural resource management have an administrative character such as owner, protector, description, additional protection, offences, licences, appeals, inspections, as well as permits to excavate.

2. Data concerning the documentation of archaeological sites, called OBSERVATIONS.

   In the ARCHIS system sites are viewed as findspots: they are characterised by only one pair of X and Y coordinates. In the GIS findspots are therefore represented as point elements.

   An OBSERVATION contains all the information from a certain findspot at a certain moment. This view implies that it is possible to record the same findspot more than once in the database (the values for attributes like date of collecting, date of recording and find-circumstances being different).

Figure 11.1: Schematic representation of the configuration(s) at the participating institutions.



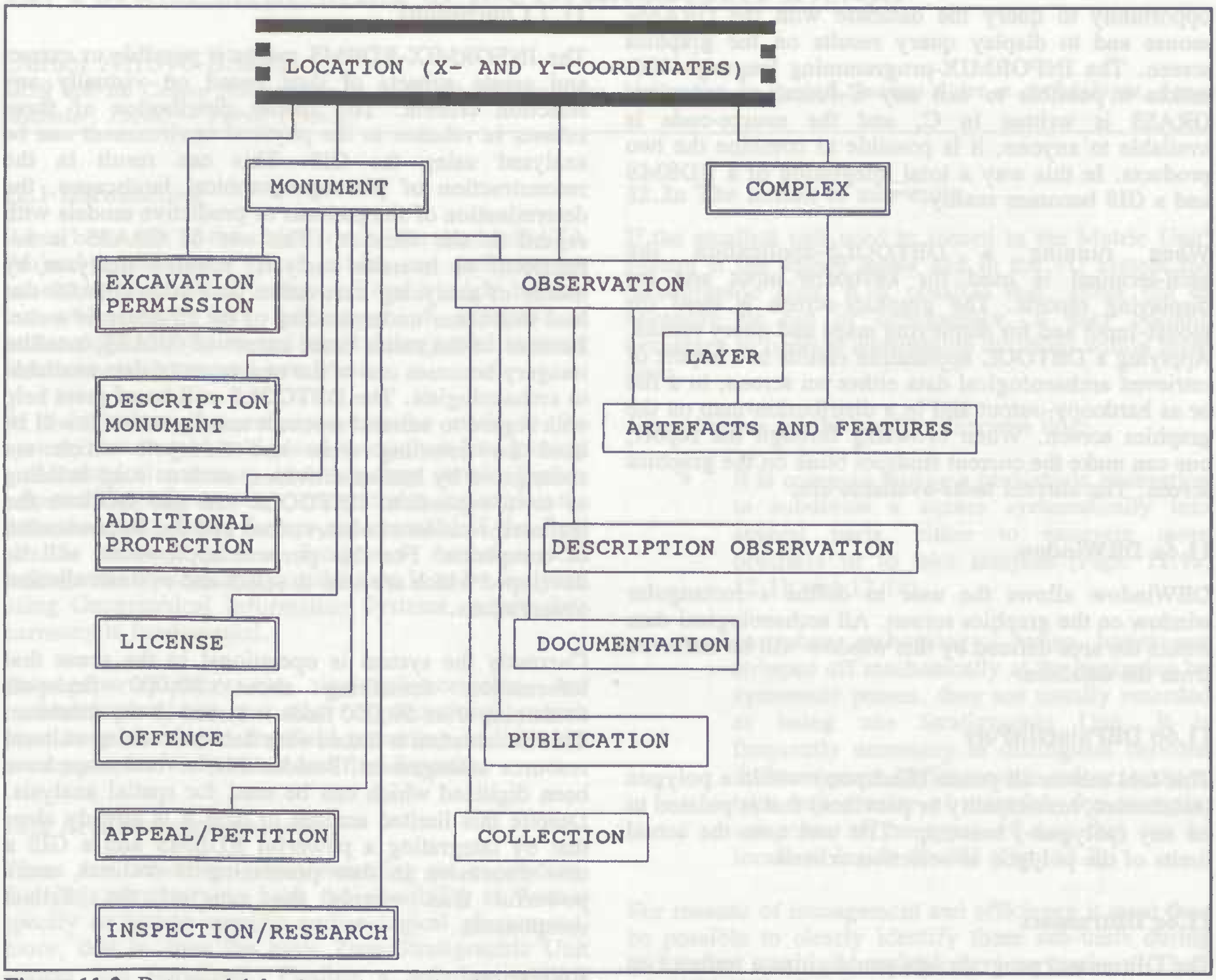


Figure 11.2: Data model for the archaeological information system "ARCHIS".

Besides administrative data like finder, method of acquisition, find-circumstances, this information comprises also stratigraphy, artefacts and features, publications, sorts of documentation and collections.

3. A COMPLEX comprises the interpretation of one or more findspots into a functional entity in terms of settlement, camp, industry, workshop or cemetery.

   As the interpretation can change in time, due to new archaeological insights or additional information about (new) findspots, complexes should be regarded as changeable entities. In that respect complexes differ from observations which contain the observed raw data.

Fig. 11.2 shows the relational data model of the database with its main tables. By making use of fixed mnemonic codes we are able to minimize the amount of errors during data-entry, as well as to standardize the archaeological data in the database.

11.5 The Geographical Information System GRASS

Because of the spatial nature of archaeological data a GIS called GRASS is incorporated in the ARCHIS-system. GRASS is developed by US-CERL, the United States Army Corps of Engineers Construction Engineering Research Laboratory (1989). Although GRASS software is public domain, it offers a wide range of high standard programs for processing spatial data. Because the source code of the package is available, every GRASS user is able to develop and add new programs. Since CERL is responsible for new releases of GRASS, every new tool is screened thoroughly before it becomes part of the new release. GRASS runs only on UNIX systems and is primarily a raster-based GIS. Therefore it is possible to analyse satellite images or other remote sensed digital data, and even scanned maps. Besides these there are several vector handling capabilities such as conversion from vector to raster and vice versa. For archaeological research a site-analysis module is incorporated in GRASS. This module is developed for analyzing point-data in relation to areas.

11.6 DBTOOLS

The most powerful component, called 'DBTOOLS' is written by Jim Farley, an archaeologist/software engineer at the Arkansas Archaeological Survey in Fayetteville USA, where the same kind of system is operational (Farley 1988; Williams *et al.* 1990). The software which he developed links the INFORMIX-RDBMS and the GRASS-GIS. This gives the opportunity to query the database with the GRASS-mouse and to display query results on the graphics screen. The INFORMIX-programming language 4GL makes it possible to call any C-function, and since GRASS is written in C, and the source-code is available to anyone, it is possible to combine the two products. In this way a total integration of a RDBMS and a GIS becomes reality.

When running a DBTOOLS-application the ascii-terminal is used for keyboard input and for displaying reports. The graphics-screen is used for mouse-input and for displaying maps and query results. Applying a DBTOOL application results in a report of retrieved archaeological data either on screen, in a file or as hardcopy-output and in a distribution-map on the graphics screen. When browsing through the report, one can make the current findspot blink on the graphics screen. The current tools available are:

11.6a DBWindow

DBWindow allows the user to define a rectangular window on the graphics screen. All archaeological data within the area defined by this window will be retrieved from the database.

11.6b DBPointsInPoly

This tool selects all points (findspots) within a polygon (monument, municipality or province) that is pointed to on any (polygon-) basemap. The tool uses the actual limits of the polygon as selection criteria.

11.6c DBtransect

The DBtransect program lets you digitize a transect on the graphics screen. One can enter the width of the transect to create a buffer around the transect. Findspots within this bufferzone will be retrieved from the database.

11.6d DBWhatPoint

This tool will search the database for every findspot within a given distance from a digitized point on the graphics screen.

11.6e DBWhatPoly

The DBWhatPoly tool will retrieve information from the database about a monument (digitized as a polygon) that is pointed to on the graphics screen.

11.6f DBShowPoints

Any selection from the database made by an SQL-query can be displayed on the graphics screen instantaneously.

11.6g DBPointsToArea

DBPointsToArea will update a database table based on actual boundaries of a polygon-map (e.g. soils, municipalities).

11.7 Conclusions

The INFORMIX-RDBMS makes it possible to extract and create subsets of data based on virtually any selection criteria. The spatial distribution of these subsets in relation to the physical environment can be analysed using the GIS. This can result in the reconstruction of palaeogeographical landscapes, the determination of site patterns or predictive models with regard to site location. The use of GRASS is not restricted to intersite analysis: intrasite analyses by means of analyzing excavation data with GRASS can lead to a better understanding of the structure of a site. Because of the raster based nature of GRASS, satellite imagery becomes one of the new types of data available to archaeologists. The DBTOOLS will be of great help with regard to cultural resource management. It will be used for detecting areas and findspots which are endangered by human activities, such as road building or town expansion. DBTOOLS can also facilitate the (re)interpretation of observations and the determination of complexes. For this purpose applications will be developed which are able to select and evaluate distinct observations.

Currently the system is operational in the sense that information describing about 20,000 findspots containing over 50,000 finds is stored in the database. This information is linked with data concerning cultural resource management. Besides this, several maps have been digitized which can be used for spatial analysis. Despite this limited amount of data it is already clear that by integrating a powerful RDBMS and a GIS a new dimension in data processing is realised, more powerful than merely the sum of the distinct components.

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