Standardisation: the key to archaeological data quality

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Introduction

Since 1992 The ROB (Dutch State Service for the archaeological heritage) is maintaining an archaeological sites and monuments records. This system, called Archis, has been developed in co-operation with three university archaeology institutes (Amsterdam, Groningen and Leiden). Archis was based on the GRASS GIS and an Informix database and was entirely designed and developed by own staff.
The database design was to a large extent based on the system that was used previously, a paper form which was filled-in following specific syntax rules. This paper form was then entered into a freetext database system ("STAIRS") and thus information on archaeological finds and findspots could be retrieved.
Initially, this was the only information that was registered in Archis. These so called *archaeological observations* originated from several very different sources. In fact, an observation can be the description of a single artefact or a summary of a complete excavation and everything in between (Roorda, 1992). Since 1994 however, also data concerning archaeological monuments are managed through Archis.
In the design of the database much attention has been paid to quality. In fact the database structure was highly normalised, and therefore many attributes where to be filled in by means of lookup lists.
Nevertheless, we have received a lot of complaints, especially concerning the quality of the data concerning the archaeological observations. Obviously something has not worked out as it should be. What went wrong?

What is quality?

Quality can be described as (de Heer, 1991):

"the complex of properties of a product or service that make the product or service fulfil expectations or demands".

This means that quality is not an objective property of a product, but that it is something that is related to the view of the user of the product, the client. Thus in terms of data it means that the data itself do not have to be "correct", as long as the user of the data has the appropriate expectations to this data, which means he knows the data have to be used with certain precautions.
Quality in this sense is related to individual items in a dataset but of course is also connected to datasets, which is another type of product. In general quality aspects for individual items also refer to datasets, although the way these aspects are expressed may differ. So how can quality be measured either to items or datasets?

Quality aspect	Individual item	Dataset
Complete	All attributes completed	All (expected) items present
Correct	No errors in attributes	No errors in attributes
Accurate	Highest possible accuracy in attributes	--
Consistent	--	Individual items are

		comparable
Structured	Item is properly structured	Items are properly structured

As one can see some quality aspects refer to both individuals and datasets while others only relate to one of them. Usually it is not very difficult to measure quality in terms of completeness, consistency and so on, but to manage quality, that's another issue.
Standardisation is the main instrument for managing quality (Simons, 1994). This means not only standardisation of database structures, but also of definitions, thesauri, processes and procedures. Implementation of such a *quality system* also requires quality control and if necessary, adjustment of standards. What may complicate quality management in the case of data, is the ease of re-utilisation of especially digital data. Often, conversions and transformations of datasets apparently create new information, however due to loss of documentation and metadata this newly created "information" is easily abused. We don't use a table fan as screw propellor either, do we?

Quality and Archis

As is mentioned before, the base-dataset of Archis consists of the structured registration of archaeological observations. Currently some 60.000 observations are registered. Many of these observations have been derived from either the paper archive of the ROB or the STAIRS freetext database. The origin of these observations is diverse, the oldest observation dates from 1590, the most recent one has been recorded yesterday. In figure 1 the number of observations per decade is given. It is obvious that the number of recorded observations doubles every 10 years between 1930 and 1990. this reflects the growing interest for archaeology on the one hand, but also the intensity of urbanisation, growth of infrastructure and the development of agricultural techniques.
The high number of observations in the 1980's is the result of the starting activities of contract archaeologists. Initially each and every artefact that was found was recorded as a separate observation. A big problem especially with older observations is the accuracy of the location. Since accuracy is registered in the database it is possible to relate this attribute to the age of the observation. Figure 2 clearly shows an increasing accuracy in more recent observations. In our paper archives we even have location descriptions like "1/2 hours walk in south-east direction starting at the church of ….". It is clear that it is very difficult to attach accurate co-ordinates to these kinds of descriptions. Marketing research has shown that accurate location information is considered of major importance. This makes 11.000 of our 60.000 observations in fact useless for spatial analysis (von Meijenfeldt, 1999).
As diverse is the way these observations where made. Many of them where found by accident, e.g. some kind of construction work was going on. Others are the result of field surveys or excavations. In figure 3 The relation between the origin of the observation ("acquisition") and the number of observations is given.
Finally, the person who has described the find can be used as a "quality index". Generally speaking a professional archaeologist should be a better guarantee for quality than an amateur archaeologist. Unfortunately it is not possible to derive information on this subject out of the Archis database.

What is discussed so far is metadata. In the above examples I have used this kind of information to illustrate the diversity of our data. But what about the actual archaeological information? Eventually, each observation is meant to describe what

has been found. To describe the artefacts and features the Archaeological Base Register has been developed. In this “register” of each possible artefact or feature the material type is given in combination with a general and a more specific description. Each individual find can be registered using a combination of these three attributes. For each -from an archaeological point of view- possible combination also the corresponding range in archaeological dates is given. This so called validation table is used in the Archis application to check the consistency of the entered data. But again, it is still possible to register an artefact using “unknown” for material type, general description or specification, thus creating room for more inconsistency. About 20% of the observations contain an artefact description which is more or less worthless because it says nothing more then that something has been found somewhere. Figure 4 shows the relation between the number of artefacts and the number of observations. Many observations (50%) only describe one or just a few artefacts. These observations hardly contribute to the archaeological explanation of the location.
Although the dataset that has been collected during the last decades is impressive in its size, its usefulness for spatial analysis or evaluation and selection is very limited, due to the unbalance and therefore varying quality of the data. Because the sources of many of our data simply do not exist anymore, it will be impossible to improve the quality of the dataset. In itself the concept of observation is a perfect mechanism for collecting data. Since the observation describe what has been observed and not what is probably present, the resulting dataset however is only useful as a reference data source and as a starting point for interpretation and synthesis.

The archaeological monument

The archaeological monument is defined to delimit the management zone around one or more archaeological *objects*. The monument is not described in archaeological terms but instead presents the history of an area in terms of events. The first event in the lifecycle of a monument is its evaluation. At this moment the archaeological value is initially determined, Complete destruction of the archaeological features leads to a re-evaluation, which by definition ends the life of a monument. The value of a monument can either be of:

- *Very high archaeological value*: areas of national archaeological importance, either legally protected or qualified for legal protection.
- *High archaeological value*: areas of regional archaeological importance
- *Basic archaeological value*: areas of archaeological importance but affected by erosion or degradation either by natural or anthropogenic activities.

The evaluation is based on several criteria, e.g. information value, visibility, relation with research agenda, rarity and representativity. The latter two however require a quantitative framework, since both relate to the number of existing and comparable objects either within the archaeological region or within the whole country. Although currently the process of evaluation is more or less standardised, in the recent past this was obviously not the case. The areas that together comprise the

archaeological monuments map are the result of 30 years of surveying and research by different people, with different backgrounds and varying knowledge. Since 1994 the map of archaeological monuments is being updated in co-operation with provincial authorities (Zoetbrood et al, 1997). However, each province having its own archaeological policy, the demands on the archaeological maps also vary according to province. In many provinces even areas with *expected* archaeological value are part of the monuments data set. Besides, the boundaries of archaeological monuments can be influenced by political forces, which means that the extent of a monument is often the maximum feasible. This makes the monuments dataset of limited use for many analysis purposes. The dataset apparently does not represent the content of the *soil archive* as it is called.
At present new monuments are evaluated according to guidelines in the *Standard archaeological monuments map*. The main issues in these guidelines are:

- All monuments are connected to at least one observation registered in ARCHIS
- On each area of *high archaeological value* at least a sample auger survey has been done, in order to determine physical quality and extent of the monument
- On each area of *very high archaeological value* at least a systematic auger survey or a trial excavation has been done

In this new standard there is no room for areas with expected archeological value. The areas in this category will be evaluated to determine whether remains are (still) present or have completely disappeared. In the first case the area will be designated an archaeological value, in the latter case the monument will be dropped from the monuments list.
As has been stated earlier, the monument is a management zone. But what is being managed? Earlier in this paragraph the term *object* has been mentioned. This *object* however is not defined. Although there is of course a relation between an observation and a monument, this is a n:m relation, which means on the one hand that one observation belongs to one or more monuments and on the other that a monument can have one or more observations. This type of relation often indicates that a concept or entity between the two related entities is missing. In our case we have defined this missing link as the *archaeological complex*.

The archaeological complex

As has been illustrated, in itself the archaeological observation is of limited use for spatial or quantitative analysis, either for scientific or cultural resource management purposes. The *monument* is a management zone and as such neither suitable for the analysis of archaeological issues. It was therefore necessary to introduce another concept, which eliminates the disadvantages of the observation and the monument and at the same time can act as a useful basis for analysis. Here we have introduced the archaeological complex:

The archaeological complex can be defined as a spatial delimited area in which artefacts or features have been found present that refer to a certain functional use of the area within a certain archaeological time scale.

Expected complex type is recorded as part of the observation. However this is meant to be a preliminary complex type. After all, the describer is not necessary aware of

other observations that were done at the same location. Therefore this person is never capable of getting an overview of the information. Nevertheless it is useful to record also the finders' opinion, which can then be used as an indication for the ultimate interpretation of the complex. Figure 5 shows the (spatial) relationship between complex and observation. Although it seems as if the observation as a whole contributes to the interpretation of the archaeological complex, this is not the whole truth. Each observation describes one or more artefacts or features. Each of this artefact has an archaeological period assigned to it, as well as a proposed complex type. Within one observation different complexes can be described. So to form a complex, the finds of one or more observations can belong to one or more complexes (figure 6). In database terms there is a n:m relation between observation and complex. The linking element between the two is the artefact.
Since the observation including the artefacts are the starting point, defined complexes are the result of an evaluation process of the artefacts.
Now that the concept of complex is defined we would like to create a dataset that complies to the quality demands which have been mentioned in relation to datasets.

The new dataset has to be complete.
Because the complex dataset will be based on the observations dataset, it will be as complete as the observations.

The new dataset has to be correct
Since it will be based on an existing database, we will clearly define the criteria that transforms one or more observations into a complex.

The new dataset has to be accurate
Information that does not comply to required accuracy demands will not be used as a basis for interpretation. These accuracy demands will be defined

The new dataset has to be consistent
The measurements mentioned will (hopefully) result in a consistent database

The new dataset has to be properly structured
Since the dataset has been redesigned recently according to users' demands, we have to assume that this is the case.

Standardisation is the key issue in the definition process of complexes. The main step in this process is to determine which artefacts and features contribute to the definition of the complex. To achieve this we have developed a decision model, which leads the user to the eventual complex type. To support the user, each complex type is well defined so that there can be no misunderstanding about the interpretation of name of the complex type. Besides, each complex type is assigned to a functional class. Here we distinguish *burials, economic activities, settlements and defensive structures, infrastructure* and *religion.*
The decision model has been worked-out in a series of questions. By answering these questions, either with "yes", "no" or even "not sure", an eventual complex type, as well as a quality index is generated. The quality index is an indicator for the rate of certainty, a value of one being very uncertain and a value of 4 being certain. Currently the decision model is in a phase of testing. When definitive it will be incorporated in *Archis*.

Conclusions

As stated above, both observations and monuments have quality issues. Many of these have arisen due to improper use of the data. Although the quality of the observation data itself also plays an important role, it is impossible to improve quality of individual items when the original data sources no longer exist.
What we have to accept is the diversity of base archaeological data. In this sense the data reflect archaeological reality, many sites being hardly surveyed and few being completely excavated. We will have to take this into account when using this raw data.
As has been illustrated the sources of these archaeological observations are diverse. This makes it very difficult to enforce certain quality measurements. Nevertheless new Dutch legislation requires that professional organisations that work within the framework of this legislation are obliged to provide archaeological information in conformity with ROB-specifications. However, observations resulting from activities outside the framework of *Malta*, can be registered as in the early days, on the back of a cigar box.
Concerning complexes and monuments, quality regarding content is guaranteed by introducing standard procedures and guidelines. Since Information on both complexes and monuments is managed by ROB staff, it is easy to implement these procedures and guidelines in the administrative organisation. What remains is a quality check of previously evaluated monuments and complexes. In particular the evaluation of areas of potential archaeological value requires an enormous financial injection.

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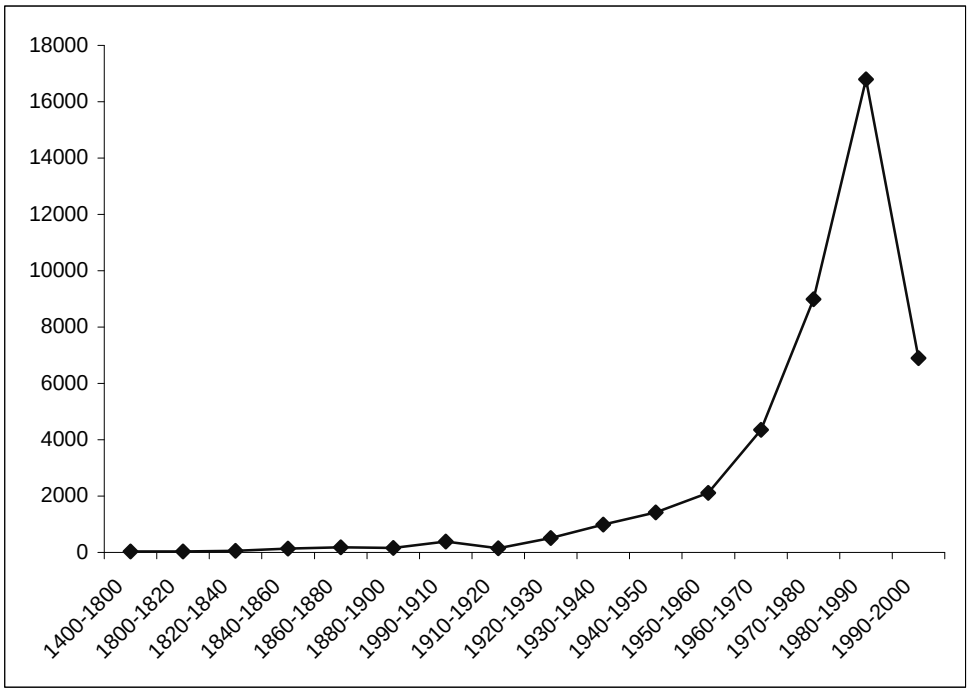

Figure 1: number of observations (y-axis) per period (x-axis)

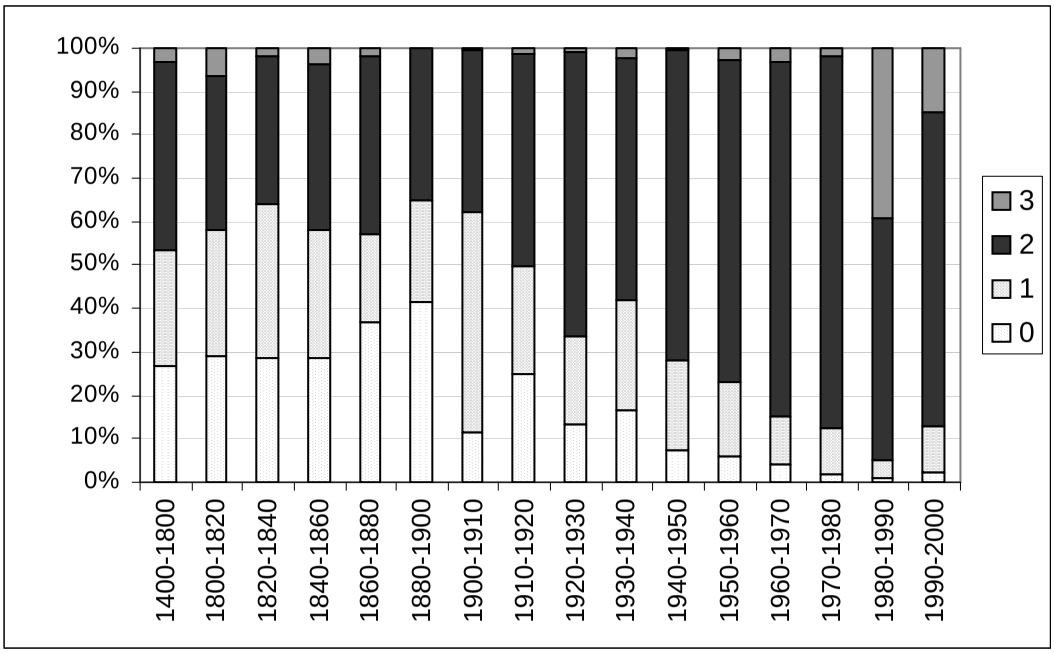

Figure 2: observations: age vs scale (accuracy). 0=1:1.000.000, 1=1:100.000, 2=1:10.000, 3=1:1000

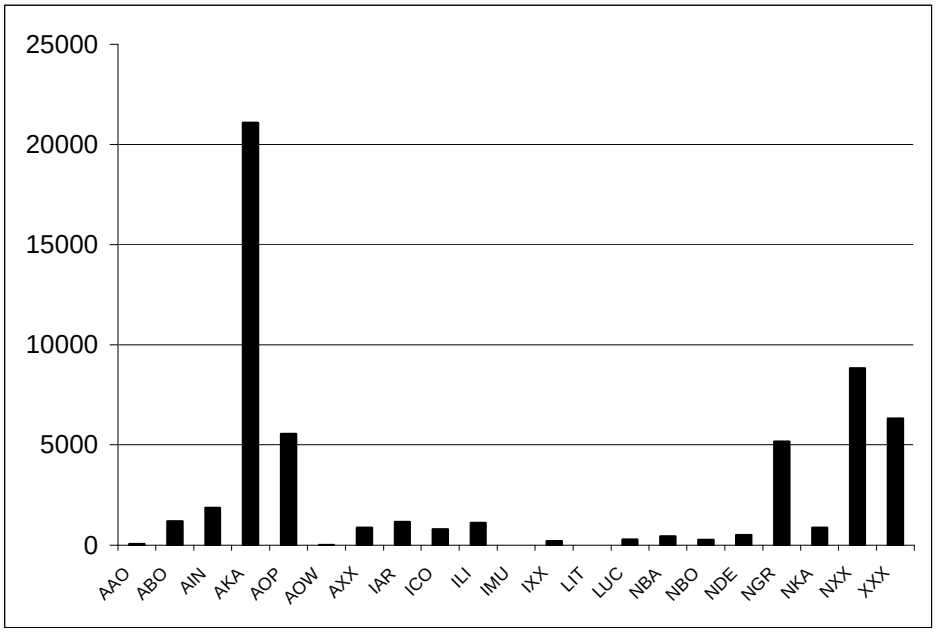

figure 3: Number of observations in relation to acquisition. Legend: AAO=sample excavation, ABO=arch. auger survey, AIN=arch.inspection, AKA=flield survey, AOP=excavation, AOW=maritime archaeology, AXX=archaeology, unknown, IAR=archive, ICO=correspondence, ILI=literature, IMU=museum, LUC=areal photography, NBA=dredging, NBO=non archaeological auger survey, NDE=metal detector, NGR=non arch. excavation, NKA=non arch. survey, NXX=non arch. unkown, XXX=unkown

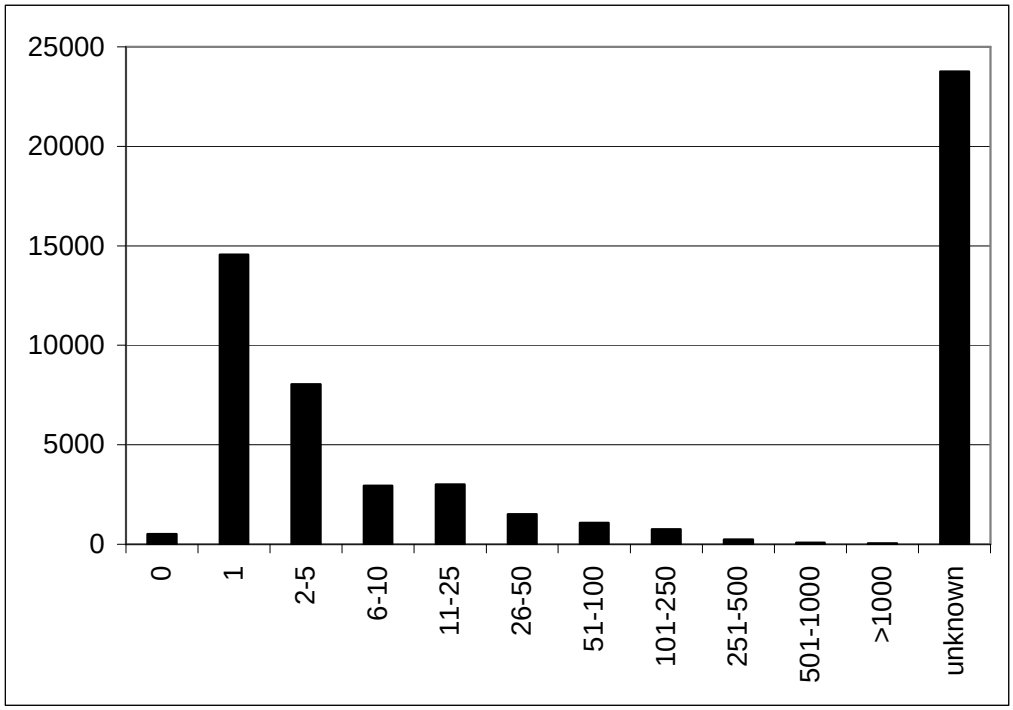

figure 4: number of artefacts (finds and features, x-axis) related to the number of observations.

figure 5. Map showing the spatial relations between observation, complex and monument.

Observation 1	Artefact 1	Complex 1	not assigned
	Artefact 2		Monument 1
	Artefact 3		
	Artefact 4		
	Artefact 5	Complex 2	
	Artefact 6		
Observation 2	Artefact 1		
	Artefact 2		
	Artefact 3		
	Artefact 4		not assigned
Observation 3	Artefact 1	Complex 3	
	Artefact 2		
	Artefact 3		
	Artefact 4		

figure 6: database relations between observations, artefacts, complexes and monuments