Use of Informatics at the Százhalombatta Tell Excavation

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There are several definitions of informatics, one states that informatics is the science which deals with the *generation, transmission, storage and evaluation of information*. Another states that informatics is none other than *data processing through computers*. The most elaborate definition states that informatics is the science of computer information systems, which supplies theory, approaches and methods for the planing of systems, their development, organisation, and operation. It includes the technical, constitutional and personal aspects of processing, storing, and forwarding information (Márkus 2005; Internet: Google).

When we started the Százhalombatta Archaeological eXpedition (SAX for short) it was clear for us that there will be an immense amount of diverse information continuously generated from this excavation. We needed computers and programmes that could handle the constant *generation, transmission, storage and evaluation of the incoming data (information)*. So with this priority aim in view we looked for our co-operative partners and were lucky enough to meet our main Swedish partner, Professor Kristian Kristiansen. He on the other had was looking for a site with a complexity of layers and *data processing possibilities* to try out the then recently developed and sophisticated archaeological database programme (Kristiansen 2000).

The running and organisation of any international project is not easy, but it is especially difficult when the areas of co-operation are so diverse like in the case of an archaeological project. Where the need of common understanding goes far beyond the relatively simple definition of aims. These aims have to be reached through different fields of work covering actual fieldwork, excavating, documenting, data processing, and interpreting. In the Százhalombatta project it took us two seasons to workout and agree-on an outline of co-operation and common understanding. This lay the basis for an even larger international co-operation, where three more universities (Southampton, Cambridge and Oslo) and their laboratories could join our work (Kristiansen 2005).

Before the step by step introduction of the excavation procedures together with the computer based data recording and processing we would like to introduce some of the *theory, approaches and methods we applied for the planning of the system*. We realised that with the wide range of data processing possibilities introduced by informatics into archaeology an entirely new set of questions can be pursued.

The **traditional questions** an archaeologist asks when starting to excavate a tell are:
– How long was the occupation period?
– The people of which culture or cultures settled there?
– What was their connection to their neighbouring cultural complexes? (imports)
– What types of ceramics are used? What is their chronology?
– What type of houses did they live in?
– What kind of artefacts were within a given cultural layer?
– Was it fortified?
– Etc.

These questions can be grouped around three main frameworks: **chronology, typology** and **building structures**.

At Százhalombatta we are in such a position that we know the answer to the majority of the above mentioned questions, thanks to the previous excavations (Kovács 1969; Poroszlai 1993, 1996, 2000; Vicze 2001). But our meticulous excavation and documentation system, soil and micromorphological sampling strategies allow us to ask **new questions**, and seek answers to them. Some of these questions are:

– What were the functions of the different spaces within the house?
– Where were the sleeping, storing, cooking, food processing areas within the houses?
– Are there differences among the houses? Is there a difference in the use of space within them?
– When were the crops harvested?
– Where were the crops stored and prepared for food?

– Where were the animals kept?
– What kind of animals were kept on site?
– What was the nature of the activities outside houses?
– What was happening and how was space used on the settlement as a whole?

These questions can be grouped around three main frameworks: **function, activities** and **social composition**.

In the Carpathian Basin our archaeological research has reached a stage, where most of the traditional questions had been answered more or less satisfactorily (Bóna 1992, and the bibliography used there). Naturally there is place as well as possibility, to refine our present results and knowledge, but to be able to add new information we have to ask new sets of questions. For new sets of questions, new approaches and new methods are needed. The new methods are time-consuming and expensive. Therefore team-work is vital and the preplanning of such expenses as basic and necessary part of the excavation is also very important. In other words the archaeologist has to accept the fact that the excavation does not proceed as fast as before and that the excavation budget should include laboratory processing and the specialist's wage. Pre-planning and choosing the types of questions beforehand becomes essential. Excavation should not be for the excavation's sake but must concentrate on research questions!

Now turning back to our new set of questions. Most of them focus on the house and the activities around the house. Household archaeology means that the house and its surroundings are looked upon as the initial scene for the basic economic and social life of prehistoric society. Activities connected to the everyday life and the social organisation of each household affect the construction of space both inside and outside houses (Hodder 1990, 53). Tracing, identifying, and understanding the remains of these activities is the main aim of household archaeology.

Keeping the above-mentioned theoretical framework in mind the following on-site excavation procedures were worked out.

The excavation's 20 m by 20 m trench was dived into a 2 m by 2 m grid system, where this block is the basic and largest excavation unit (*Fig. 1*). All the finds are excavated, documented, and packed from within these basic entities. These create the main framework for both digital and manual documentation. As these are our largest excavation units we are applying this division for excavating mixed, in-between layers or general fill. Each 2x2 square has its own documentation-sheet, where the excavator notes the amount of soil removed, the number and type of find-bags, the exact co-ordinates of the soil sample (one taken from the general matrix of each unit) and the characteristics of the soil (*Fig. 2*). Everything is documented, all changes and occurrences, stake-holes, post holes, smaller features every single one is measured and drawn on the other side of the sheet. Although we are hand-excavating everything, it is still not possible to have full control of the finer finds. To have a clear view of find types of all sizes we dry-sieve one full wheelbarrow (50 l) of soil from each unit through a mash-size of 1,5 cm. This way we are ensuring that we have a good control sample from the smallest finds that might evade the excavator's attention. All finds from the sieve are packed separately with a special mark to enable comparative and larger scale of spatial analysis of find-occurrences.

The next step or level of excavation is the uncovering procedure of the archaeological features smaller than 3–4 m in width or diameter. These features most commonly are hearths, ovens, special working areas, house-floor or house-debris fragments. These types of features are considered as one unit, they are excavated, documented and the find material from them is treated accordingly. The excavation procedure is that of an archaeological feature, i.e. all removed soil is measured and sieved, and the finds are packed. The same recording sheet is used to ensure coherent data recording, the narrative description will explain the characteristics of the feature.

The third level of excavation procedure is related to houses. The identification of the outline of the house or its debris is followed by the subdivision of the whole feature into 1 m by 1 m squares. From here onwards this is the basic excavation unit. All removed soil is sieved, 10 l soil samples taken, all tools, pots, larger charcoal are immediately measured to their find places and registered into the database of the total-station. This way the spatial three-dimensional reconstruction of each and every special find within the house and the 1 by 1 m square is ensured.

In case the outline of a pit is recognised and its identification number is given the following procedure is conducted. All the removed soil is sieved. If the pit is smaller than 1 m in diameter, then it is hand excavated layer by layer and all soil changes are documented on the recording sheet, opening new find bags and soil samples with each newly identified layer. In case the pit is larger than 1 m in diameter, then it is cut into halves. The first half is excavated regardless of inner layers and after having the side and bottom of the pit identified the profile of the other half is drawn, with all its layers identified, characterised and numbered. After the documentation of the profile is done, the second half of the pit is excavated according to the identified layers, taking soil samples from every layer and keeping the find materials separated as well. In case the fill layer yields less than 10 litres of soil then all of it is taken for a sample with a note of its exact amount.

Postholes and stake-holes are given their own identification numbers, are marked on the recording sheet of the given square (either 2x2 or 1x1) and the total amount of soil from them is taken for flotation (Vicze 2004).

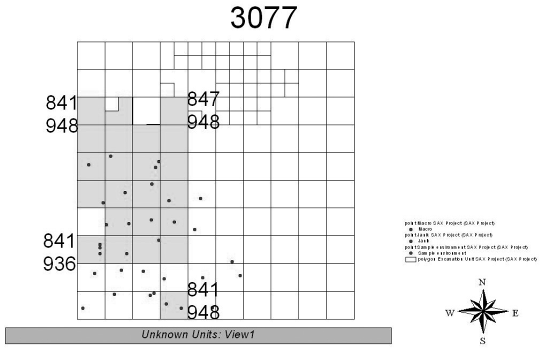

Fig. 1. The 20 m by 20 m trench divided into the 2 m by 2 m excavation units.

Majority of the above mentioned new set of questions relies on the possibility of computer based documentation and a thorough and complete sampling strategy. This is very important, as the information gained from the soil samples proves to be seminal in the understanding of the environment, the different activities, and uses of space on site (Renfrew–Bahn 1991, 212–217.). It was known that the site is rich in charred remains, so the sample size of 10 litres (one bucket-full) was agreed as being sufficient. In order to be able to have the largest freedom for comparative studies it was agreed that soil samples are taken from the general matrix of all excavation units (from the smallest to the largest). Each 2x2, 1x1, pit-layer, oven, hearth, special area, postholes and stake-holes etc. will have their individual soil sample, all recorded by the total station in the site's GIS database. Annually we are taking 4–500 soil samples, which after being floated yield two types of finds. One is the so-called light fractions. They are called light because they are the ones that float on the surface and are collected by a very small mesh-sized sieve at the mouth of the barrel. These contain the macro-botanical finds, like charred seeds, food remains, charcoal, which are processed by the archaeobotanist. The other find type is the so-called heavy fractions. These are the small finds that remain at the bottom of the sieve after all the soil has been washed out. Like heavier seeds as peas or nutshells, miniscule flint fragments, bronze droppings, fragments of pottery, small bones etc. The heavy fractions are considered to be a new find type, which enable several new approaches and questions for the archaeologist (Hester–Shafer–Feder 1997, 136–137.). In addition to the archaeobotanical and archaeological examination of the soil samples some soil-micromorphological samples were taken into account to investigate the structure of the matrix of the soil in question (French 2003). With comparative analysis we are hoping to be able to notice the slightest possible difference in space use within areas.

In the following is a short introduction to the type of analysis that can be achieved with the application of computers and the small finds. The areas outside and between houses have never really been studied during previous excavations, although much of the activities of the prehistoric inhabitants have been carried out at these places. At Százhalombatta during the first seasons of excavation we found an open area which was constructed of clay, was plastered several times and had the basic characteristics of a house floor, but without postholes and hearths. As the excavation proceeded, it turned out to be a constructed kind of "piazza or plaza" with low find density. We thought this area to be a special working area. To check and scientifically prove our interpretation we decided to study and compare the small finds (i.e. the heavy and light fractions) of this layer and that of other two subsequent layers lying vertically below this open area, which appeared to have different kinds of fill. The next layer beneath the same area was called a "general fill" it contained all the typical characteristics of such fills. Its composition was much looser, it was not so compact, the comprising material was not homogeneous there were scattered clay lumps, and had an ashy-sandy content. The find density was higher than that of the "piazza", but still comparatively low. The next layer we decided to include into our comparative examination was a very thick layer full of organic material, rich brown in colour, full of big pieces of animal bones and ceramic sherds. The whole area and fill seemed to be a "midden" (garbage heap) (Sørensen – Vicze in print).

So here we have three overlying layers with distinct differences. We decided to use the micro evidence to investigate the detailed characteristics of these fills and features to fine-tune the interpretations of how they functioned within the site. They can provide an important insight into the general layout of the tell, particularly how a densely settled space as the tell is organised. With this detailed analysis we hope to establish the range of activities associated with different types of space both horizontally and vertically. The actual question is what was going on in this area during the different phases of the settlement.

The small finds recovered from the heavy fractions are used as the basis for investigating what activities were associated with this area, through the proportions of different types of materials and their spatial pattern

2004. SZÁZHALOMBATTA – FÖLDVÁR

Azonosító /
ID. NO.:

STARTING DATE	FINISHING DATE	NÉGYZET SZÁM/GRID NO	SZINT / LEVEL	RECORDER

Wheelbarrow	Total Volume	Ceramic	Bone	Daub	Vitrified clay	Char-coal	Shell	Lithic	Pebbles	Other
ROSTÁLÁS / SCREENING										

FÖLDMINTÁK / SOIL SAMPLES			
SAMPLE	VOLUME	TOTALSTATION NO	MEGJEGYZÉS / COMMENTS
FLOTÁLÓ MINTA / FLOTATION			
EGYÉB / OTHER			

POINT PROVENIENCE	
TOTAL STATION NO:	DESCRIPTION

NARRATIVE DESCRIPTION

Fig. 2. Recording sheet.

both horizontally and vertically. The analysis is then supplemented with and compared to the evidence from the macrofossils (i.e. archaeobotany) coming from the same samples. They can provide insight into the spatial distribution and composition of food processing activities (*Fig. 3*).

Overall the remains suggest that the ceramic remains of the so-called ”piazza” and “midden” come already worn, broken into different sizes and they are not subjected to in-situ abrasion (i.e. wear-tear). It indicates that these levels are made up of material that was brought from somewhere else and dumped here and the finds were protected from further wear. This could be accounted for by two activity types, one is a possible continuous dumping, which buries the material and in a way “protects it”. The other is that these areas were not frequently subjected to such activities as trampling or sweeping, which results in a much more homogeneous find material. In opposition to this is the pottery from the so-called “general fill”, where the overall amount of ceramic sherds is much less and is surprisingly uniform in numbers and weight. It shows much homogenised remains, which could have happened due to consistent trampling, sweeping, and movement across it. This indicates the area to be a yard or a communal activity area. With the only note that the number of bones (mainly fish bones) was extremely high in some areas, which might suppose the closeness of a fish processing area. The bone material, the archaeobotanical remains and the soil-micromorphology, all show very similar differences between the layers.

To sum up, the analysis of the heavy fraction material suggests distinct changes in the composition and the use of the same area during the three levels. The compactness, the large amount of slightly abrated sherds and other finds in the “piazza” layer suggest that the area was deliberately made-up and used for consistent movement and was not a working area. The high number of small bones, special concentrations of lime and food processing, the small size of all the fragments suggest that the so-called “general fill” is actually a place for major activities. It can be suggested that the area was used as a yard or communal working area, through which people moved constantly, and some sweeping might have taken place. In opposition to the idea that the “general fill” is produced in a short time, it is very likely that this level accumulated over some time. The “midden” area seems to be a dumping area, a kind of “back space” removed from the main activity areas around the house. It is very probable that this area was filled up in a short time period.

In conclusion we can state that the analysis of the small finds added new information to our understanding in the different use of space within the tell settlement.

Digital documentation and data processing in the SAX Project

The data system of the project was designed to be a helpful tool for handling enormous amounts of data, produced on a tell site excavation. Up on site data collection is aided by total station. The total station is a positioning and registering device. It consists of an immobile base modem and a portable measuring rod. The base modem stores and processes the data. It communicates with the rod by a radio transmitter responsible for the data transfer (*Fig. 4*). The position is given by laser beam, reflecting from a prism on the top of the rod (*Fig. 5*). There is also a data input panel on the rod. The base modem of the instrument we use in Százhalombatta is equipped with a servo engine so it can follow the measuring rod in a certain angle. The station is set up and calibrated every morning with the help of fixed points placed around the site (2 cm difference is acceptable).

For on site positioning we use the UTM (Universal Transversal Mercator-projection) co-ordinate system (*Fig. 6*). The site is divided to grid units (1x1 m or 2x2 m) which have permanent id numbers for the database programme and changing id numbers for the statistical units (excavation units). Identification numbers are given by the total station to record all objects by a point and polygon as well. A record of the total station consists of a code, a unique number and the X (North) Y (East) Z (elevation) co-ordinates. Each new layer or feature is identified by one of the 3000 number series. The layers and features are divided to excavation units: these are the grid units, with changing id number also from the 3000 series. These are statistical units for registration of samples and finds. All samples get a number from the 500 000 number series. Special finds and stake-holes are identified by the 700 000 series both of them are connected to the excavation units. The code gives the geo-type of the data (points, polygones, subsurface points, inner polygons and 3D objects all start with different numbers) (*Figs. 7–8*). The second part of the code gives the attribute of the record according to a code system worked out before the excavation.

The total station allows us to do basic interpretation. Connections can be given to each record. With this we can code samples and finds to excavation units, and the excavation units to layers or features. The data are imported to the database system every day. This way we can easily correct the mistakes made on site, such as double numbers or coding errors. Records can be fed to the system manually as well. Every excavation unit has a recording sheet

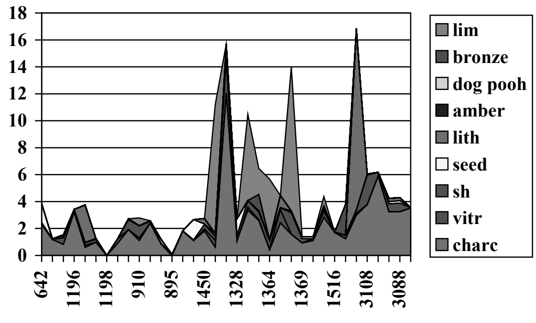

Fig. 3. An interpretative presentation of the small finds results.

Fig. 4. Total station.

Fig. 5. Rod of the total station with the prism and the input panel.

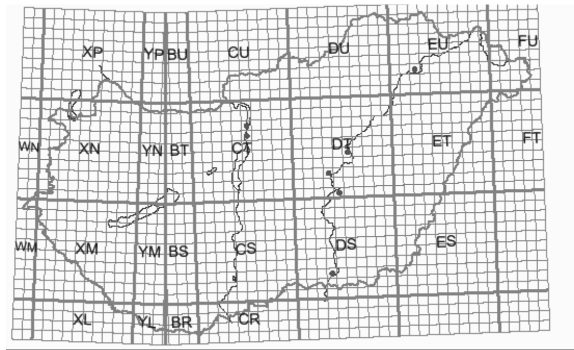

Fig. 6. The UTM co-ordinate system of Hungary.

Fig. 7. Special find with its ID number.

run by the excavator of the area. These sheets are also typed in during the excavation. Sample and find analysis can also be fed in connected to the excavation units in MS Access or Excel file format.

Since 2003, we have been using a powerful database system called INTRASIS for storing and processing digital information. The INTRASIS (Intra-site Information System) is a Swedish software specially developed for archaeological use, with field archaeologists involved in the development. The system is flexible, the attributing system and the identification alternatives (naming the object) can be changed according to the requests of the given excavation (*Fig. 9*).

Each record in the database consists of:
1. Geo-data that give the position of the feature by the point and shape, and by polygon.
2. Attribute data: mostly this contains the archaeological and statistical information (amount of soil, number of ceramic fragments, etc.).
3. Relations of a record: here we can make more accurate interpretations of an object by defining its spatial, contextual, stratigraphical connections. Photos can also be connected to the records.

Fig. 8. Archaeological feature with its ID number.

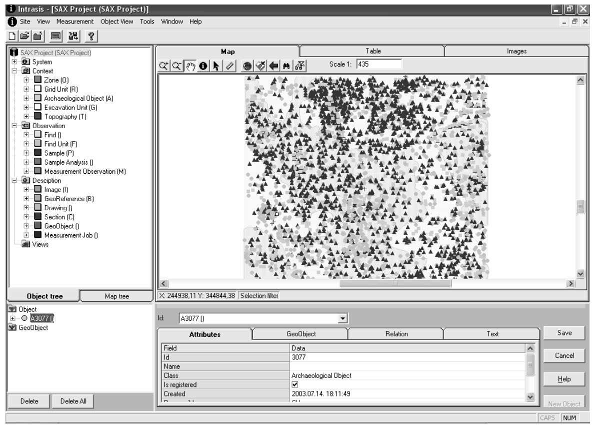

Fig. 9. Intrasis screenshot.

4. Textual information like observations, interpretation etc. can also be fed in directly or through imported MS Office files.

Although INTRASIS is a database programme, it has its own map view that shows you the selected feature but does not allow any spatial data manipulation. Data can be selected by the selection tool, or by pointing on it in the map view. The selected data appears in the selection view where its attributes and relations can be manipulated. You can change the geo-data as well by the vertex edit tool. Changed polygons and moved points will be marked in red (*Fig. 10*).

The data is stored in zip format on the hard disk to save space. Backups are necessary and can be made easily also in zip format. The security rate of INTRASIS is high. To log in, you need an individual password. For changing or deleting data you need to be an administrator. The system notes who, and when made changes and stores it in the history file.

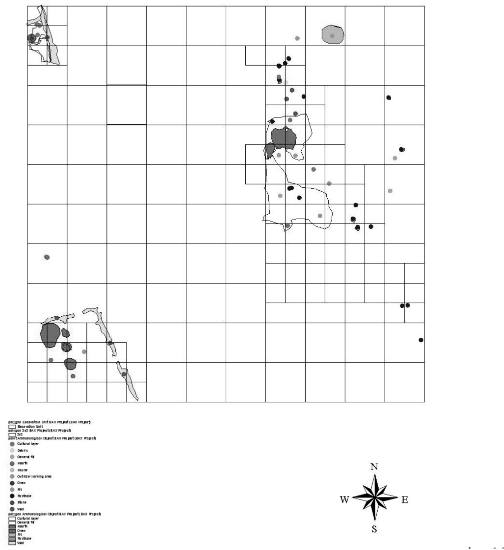

Fig. 10. Presentation of a spreadsheet.

For analysing and presenting the data INTRASIS has a direct connection with Arcwiev GIS. This connection is established automatically during the installation and it appears in your GIS system as an extension. With the INTRASIS GIS data wizard it is easy to do the pre-selection of your data, even before your data is imported to the GIS by choosing an alternative or attribute of the group of data of your selection. After the data is imported to the GIS system, making spreadsheets is easier. The data can also be exported to an MS Excel file and printed out in tables.

This system with small changes has been in use for 6 years in the SAX project and proved that large amounts of complicated data, their interpretation, and presentation can be handled simply in a single database.

Summing up, informatics seem to revolutionise all our ways in thinking of excavation, documentation, and even interpretation. It changes our views both practically and theoretically.

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