Introspective Sitescaping with GIS

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Abstract

The application of GIS to archaeological research has primarily facilitated landscape analyses up until now. In the process of applying a GIS to facilitate an intrasite analysis it was observed and subsequently proposed that GIS processing concepts applied to landscape analyses can also be mapped *to "sitescape" analyses. Emphasis is placed in either case on the importance of defining questions about the available data, and a set of spatial GIS analyses to answer the questions. A small sub-set of questions and possible analyses are presented for the site of Akrotiri on Thera. The relatively well preserved state of this site offers a number of research options for the spatial organisation of the site. This paper presents preliminary results of a metrical analysis of the site's plans, utilising MapInfo in order to determine what, if any, units of measurement were used for constructing the buildings at the site.*

Key words: sitescape analysis, mapping processes, metrology, Minoan foot

1. Introduction

Archaeological data across a landscape or within a site have a spatial element associated with them. Geographic Information Systems (GIS) facilitate the management and analysis of spatial data. Therefore it was only a matter of time before GIS were applied to the multi-faceted management and analytical requirements of archaeological research. Over the last ten years, GIS have facilitated many projects and applications (Allen et al. 1990, Lock and Stančič 1995). Patterns of GIS use became apparent with an overview of the various applications of GIS to archaeological research, and from this new research directions have been sought.

GIS can be utilised at any level of the archaeological record. The two fundamental levels are those of landscape and intra-site, or as proposed here, "sitescape" archaeology. This paper presents the idea of mapping GIS processing concepts from one level of archaeological research to the other. Some of the underlying concepts of GIS and how these can be mapped to either level of archaeological research will be presented. For instance the buildings can be thought of in terms of the physical surroundings of the artefacts, where the artefacts are "sites" within a "landscape" of buildings.

1.1. The importance of defining which data are to be analysed

For either level of analysis the main question that needs to be asked is, what specific data should be utilised? For landscape analyses the data mainly consist of site locations in relation to the topography and geology of an area. In the case of sitescape analyses, it is usually artefact locations within a site. In most cases this choice of data leads to a distributional analysis, whether of sites across a landscape, or artefacts within various buildings.

The basic issue behind all research is to choose an area to focus on. Projects can range from analysing settlement patterns to the distribution of objects within a room. What issues should an archaeological investigation focus on? A set of questions has to be derived from the available data before an analysis can proceed. Since sites vary by region and period, this results in different questions being asked of the available data. The introduction of GIS to archaeological research makes it even more necessary to constantly re-assess the questions posed on the available remains across a landscape or at a site. For instance how does the distribution of artefacts provide an indication of a culture's behaviour? Colin Renfrew makes a pertinent point that "… very often the form of the question determines the form of the answer." (Renfrew 1984:9). So it is necessary to ensure that GIS are not being used to mould the data to provide for predetermined answers.

Before an analysis can take place, therefore, careful attention should be placed on what questions are asked of the data. Bertrand Russell's remark on the importance of defining questions is very applicable to archaeology. By substituting the word philosophy with archaeology it reads: "In *archaeology* what is important is not so much the answers that are given, but rather the questions that are asked." (Russell 1959:17). This set of questions should guide an investigation towards the provision of information about a culture and eventually lead investigators to understand an aspect of the culture under consideration. Many factors influence the process of working towards a set of questions from the available data. Ultimately a researcher's interests or field of expertise often decides upon what aspect of an archaeological site or sites are to be investigated.

1.2. Case Study: The site of Akrotiri on Thera

In order to better appreciate some of these issues a practical application of a sitescape analysis was made for the site of Akrotiri on the island of Thera. The site of Akrotiri provides a good case study since it offers many avenues for GIS data management and analysis.

Akrotiri can be sitescaped for a variety of analyses such as the density and distribution of artefacts and samples within a building or across the site. Furthermore since many of the buildings are preserved up to the second storey, 3D visualisation is another possibility. There are also a number of potential analyses for the buildings' architectural and dimensional aspects which have not been exhausted.

This paper presents a small sub-set of questions that can be applied to some of the available data. The underlying question is whether a culture can be identified and understood from the spatial organisation of its buildings, down to their sub-division into rooms. The GIS functions of MapInfo were used to digitise and store the site-plans, from which a metrical analysis of the walls of the buildings was performed to determine if standard units of measurement were used at the site.

2. Mapping GIS processes

Since GIS is a tool which facilitates the quantification of the spatial relationships of data, and to some degree through time (Langran 1992), the object of most archaeological analyses is to measure the dimensions, distances, density, and distribution, of sites, buildings, and artefact types. Comparative studies may be made across different regions or periods to determine, for example, how settlement patterns differ from one region to another or from one period to the next. Another example may be analyses between site-types and the various buildings and artefacts found at each site.

It appears that the types of analyses that are commonly undertaken for landscape archaeology can also be applied to sitescape analyses. These remain essentially the same since spatial elements (for example distances) are quantified or measured in each case. So one type of analysis at the landscape level can *map* to a corresponding sitescape analysis. Therefore I propose to define the term "mapping processes" since many of the concepts behind spatial analyses can be *mapped* to either level of landscape or sitescape research. The ability to map processes from one level of archaeological research to another is what allowed GIS to be applied to archaeology in the first place.

2.1. Landscapes versus sitescapes

Both levels of landscape and sitescape archaeological research are basically comprised of two "data units" each. For landscapes, the units are *sites* and *land* where sites are related to the land. For sitescape archaeology, *objects* such as artefacts are related to *site-areas*. These *four* units can be analysed either amongst themselves or in relation to each other. An example is illustrated in figure 1. where artefacts are related to either (P) public or (D) domestic building types, and (S) small (M) medium and (L) large sites are related to an environment. For either level, the spatial relationship between the two units is what links the two levels together. This link allows the underlying GIS management and analytical processing concepts to be interchangeably *mapped* or transferred from one level to the other.

Landscape analyses have primarily focussed on examining the spatial organisation of sites across a geographic area (Gaffney and Stančič 1996). Often geo-morphological elements of the environment are related to the sites and their locations within a landscape. An environmentally deterministic approach has characterised most research projects given the slant of the investigation and the available data (Gaffney et al. 1995). In some cases the less evident and tangible factors of cultural, social and religious elements are considered, although it is difficult to avoid an environmentally deterministic approach given the fact that GIS developed in order to manage and analyse land-use. This deterministic approach occurs since most GIS focus on descriptive data concerning the environment that the sites are located in. Similar issues and concerns also need to be dealt with and addressed when a GIS is used for sitescape analyses. It is possible that building types may be used to influence and subsequently determine ideas about certain types of artefacts that are associated with them, and vice-versa.

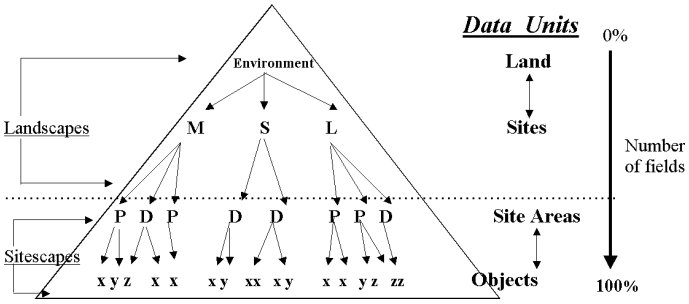

Figure 1: Schematic diagram of archaeological data units in relation to landscapes and sitescapes.

In landscape archaeology, for example, certain site types may correspond to particular environments, where a certain environment-type has a higher percentage of one type of site. On the other hand for sitescape archaeology certain site-areas may have a higher proportion of certain objects. In this case (figure 1) artefacts are related to either public or domestic building types, and small, medium and large sites are related to an environment. The resulting analyses may be influenced by the way the buildings of a site and their related objects are categorised. Correspondingly the way an environment and site-types are categorised can also influence the interpretation of results. As shown in figure 1, proportionally more records are contained as the lower levels of analyses are reached. That is the number of data fields related to each of the units (*land* to *sites* and *site-areas* to *objects*) increases as we move down to sitescape analyses. Hence one of the differences between the two levels of archaeological research is the amount of data fields which are available for analysis and management.

All the capabilities of GIS, especially for sitescapes, have not yet been fully exploited. In the case of sitescapes, up until now most attention has focussed on using a GIS for the analysis of excavation data to investigate artefact distribution across a site or between the various phases and stratigraphy of a site (e.g. Biskowski 1994:115-134). Limited research has been done to investigate all the possible permutations and combinations of the numerous types of analyses that can be made within and between the two levels of archaeological research, and amongst the data units of which they are comprised. For now only a broad overview of some of the capabilities of GIS and how these have been applied to archaeological research so far, follows.

2.2. Mapping GIS processes from landscapes to sitescapes

First of all GIS applications in archaeology can be subdivided into the two broad categories of *managerial* and *analytical* applications. Overall for both levels of landscape and sitescape archaeology there are *four* main types of GIS applications which *map* to either level, see figure 2.

1. *Data management*, where a monuments or sites register *maps* onto an artefact or building register. The storage of site names and locations across a landscape provides a Sites

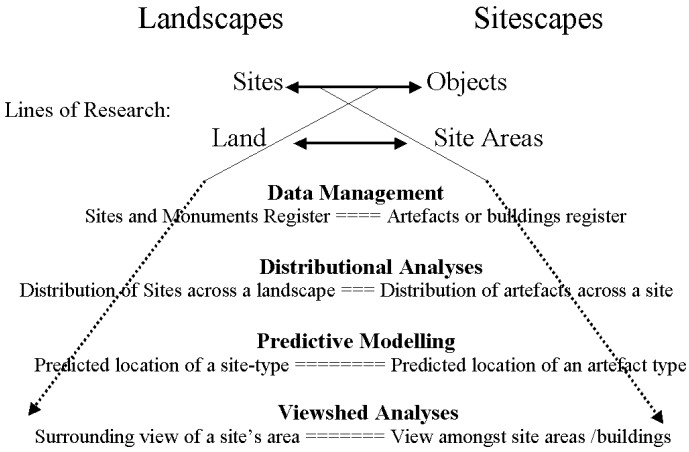

Figure 2: Chart of GIS applications which "map" from landscape to sitescape archaeology.

and Monuments Register. This managerial capability of a GIS can also apply or be *mapped* to an excavation where a GIS can be utilised as a tool which assists in centralising excavated data into one archive. This digital archive can be easily updated and accessed for information about various data that have been excavated at a site. As each monument or site has a specific location and set of attributes within a landscape, so too each artefact or building has a specific location and set of attributes within a site.

2. For a *distributional analysis* the spread of sites across a landscape would *map* to, for example, the distribution of an artefact-type within a sitescape.
3. For *predictive modelling* if the location of a site-type can be predicted in a landscape then these processing concepts can be *mapped* to predict the location of an artefact-type within a site.
4. For a *viewshed analysis* around various sites the process or concepts used would *map* to creating views around a building within one site.

These lines of research correlate to either level, and *mapping* is possible because the underlying data elements are spatial. For instance a set of points can be spatially related to each other and to external features. So in the case of landscapes these points may be considered to be sites relating to each other and to the environment. In a sitescape the location of objects can be related to each other as well as to the buildings or areas of a site. Taking this even further, artefacts scattered within a room can also be managed or analysed along similar lines for "roomscapes".

3. Sitescaping Akrotiri

More archaeological research utilises GIS for landscape than sitescape analyses, to be expected considering that GIS developed in order to manage and analyse land-use over large territories, and subsequently the initial application of GIS to archaeological research was influenced by this. Most of the earliest archaeological studies which used GIS were those investigating sites in relation to their environment, and to other sites (Allen et al. 1990). However the effective management of daily data collected at a site can also be facilitated by the application of a GIS. When it comes to analysing various aspects within one site limited methodologies have developed so far, so, re-thinking what and how a GIS can be applied to a smaller area is important.

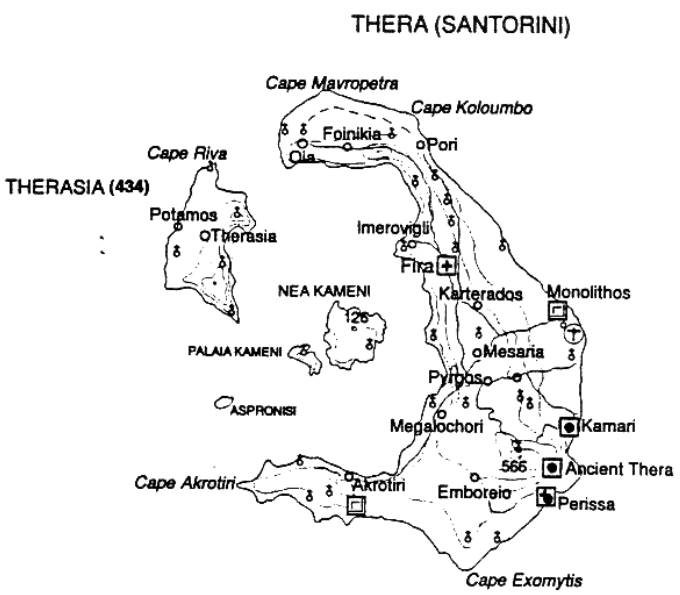

Figure 3: Island of Thera in 1:250,000 scale (Atlas 1999:84).

Therefore, the process of applying a GIS to sitescape analyses was undertaken for the site of Akrotiri to investigate some possibilities, keeping in mind the ability to *map* some of the already developed methodologies or processing concepts from landscape analyses.

3.1. The site of Akrotiri (Thera)

Approximately 3500 years ago the cataclysmic eruption of the volcano on the island of Thera buried the site of Akrotiri under a layer of volcanic ash 30 to 60 m in depth. The volcanic eruption created a geological phenomenon - the largest caldera in the world with cliffs that rise steeply above the level of the sea. On the other hand this destructive event buried the remains of a culture. Akrotiri has been referred to as the Pompeii of the Aegean, because just as at Pompeii the buildings and artefacts have been relatively well preserved (Doumas 1984). Systematic excavations commenced in 1967, by Professor Marinatos, and after his death in 1974 excavation and conservation at the site has continued under Professor Doumas.

Akrotiri, situated on the south coast of the island of Thera, faces Crete which on a clear day is visible on the horizon, see figure 3. Not surprisingly evidence of many elements of Minoan culture are present at the Late Cycladic (LC) site of Akrotiri. Various artefacts, architectural features, wall painting motifs, and local pottery display the close links Akrotiri had with Minoan Crete during the Aegean Bronze Age (Castleden 1990).

It seems that people had enough time to load awaiting boats in the near-by harbour with their most precious possessions since relatively few luxury items and metal objects have been uncovered so far. However what was left behind provides a wealth of information to archaeologists with many of the buildings relatively well preserved, up to two storeys in some cases. The most spectacular discovery was the wall paintings: many of the rooms were decorated with wall paintings depicting various scenes including animals, plants, landscapes, as well as people engaged in various activities, from sea-faring to gathering saffron (figure 4 - from

building Xeste3, room 3a). The variety of themes and subjects which have been depicted offer a unique glimpse into Aegean Bronze Age life and culture at Akrotiri.

Akrotiri had been inhabited since the late Neolithic. The Early Bronze Age or the Early Cycladic period lasted during the fourth to the third millennium BC. A major earthquake ruined many of the Middle Cycladic (MC) or early 17th century BC buildings (Marthari 1984). The LC city of Akrotiri was built on top of the MC phase, and many of the buildings are modifications of the MC buildings. Evidence of rebuilding is apparent throughout the site. In many areas ruined walls were demolished and new walls were built on top of the MC rubble, raising the overall LC level of the site.

The earthquake gave the inhabitants the opportunity to rebuild and refurbish their homes according to their functional requirements. New styles from Minoan Crete influenced the reconstruction. Popular Minoan architectural features such as ashlar masonry, timber reinforcements, stone bases for columns and orthostats were introduced. Palyvou (1984) notes that more ground floor rooms existed prior to their filling-up with debris from the earthquake. Furthermore some of the ground floor rooms became basements since the level of the streets increased when the rubble was spread outside. It also seems that some of the house entrances were also altered to accommodate the changes the debris layer created.

Up until now approximately 10,000 m^2 of the site have been excavated, revealing various building complexes. Only a small fraction (5%) of the estimated 200,000 m^2 area of the site has been revealed to the present moment without there being any indication as to the actual extent of the settlement (Doumas 1984:45). It will take many more years, perhaps generations of archaeologists to uncover all the available data at this site. So far the amount of available data offers numerous possibilities for GIS analyses at the sitescape level alone. So what are some of the possible GIS analyses for the data which have been found to date?

3.2. Some possible sitescape analyses at Akrotiri

GIS functions can facilitate a variety of spatial analyses. There are a number of possible analyses for the wall paintings alone. For instance the location of wall painting themes across the site can be related to the size of a room. Do certain recurring themes appear in larger or smaller rooms? This would mean that the wall paintings would have to be categorised according to the subject matter and then these categories would then be related to the size (in m^2) of the room they are located in.

It would also be of interest to see if there is a pattern regarding which walls, in terms of orientation, the paintings are located on in each room. Were the paintings located on certain walls, and if so were they on those walls to avoid harsh sunlight from damaging them (Doumas, pers. comm.)? Another major project is to investigate the distribution of artefacts and various samples within the buildings around the site. Can the distribution of artefacts be used to determine the functional purpose of each building or room?

A GIS can also allow for the analysis of the buildings at the site. Some questions that can be asked of the buildings focus on aspects of (1) density and distribution of the buildings within the area of the site which has been excavated to date, (2) design of the buildings, and (3) wall orientation. Some possible investigations relating to the buildings are listed below.

3.2.1. Building layout and design

The study of the relatively well preserved buildings offers many challenges. The density, distribution, general orientation and layout of the buildings throughout the site can be analysed. This may result in patterns appearing where certain building-types are grouped in the vicinity of particular areas at the site. Patterns of distribution of certain building-types across the site may reveal functional or social hierarchies within a site. The dimensional aspects of each individual building may reveal how it was designed based on the spatial organisation of the rooms. Are larger rooms to be expected for larger houses? Can the functional purposes of the rooms be determined by the design?

These types of investigations can be easily catered for by digital plans. Digitised site plans facilitate the easy measurement of the rooms, walls, doors, windows and stairways. Each room has been digitised as one entity allowing for the area of the room to be made available. All these dimensions can now be utilised to provide various statistics, such as averages and ranges of the number and size of rooms, doors, windows, and stairways per building.

These digitised dimensions can be sorted and grouped to enable observations to be made for the way buildings were planned and organised into areas and rooms. Certain patterns may be revealed by considering:

- the dimensions and number of doors and windows per room in relation to the size of each room,
- the total number of doors, windows and stairways per building in relation to the size of the whole building complex,
- the number and size of the rooms for each floor of the buildings,
- the number and average size of rooms in a building in relation to the total area of a housing complex,
- the internal area of the buildings as opposed to the external areas.

The list goes on … The quantification of the dimensions of the buildings by using a GIS allows for a more structured approach to studying the buildings in greater detail than was possible by using only analogue site plans.

3.2.2. Wall orientation - environmental considerations?

The application of a GIS to site plans can also facilitate the investigation of the orientation of the walls. For instance how are the longest walls orientated? Was the orientation of the walls based on cultural or practical requirements? In the case of practical requirements major environmental considerations would be the sunlight, shadows and wind factors on the building throughout the day and the seasons. Are the density and general orientation of the buildings the way they are to provide for optimal shade in summer and to reduce wind speed in winter? The position and orientation of the doors and windows on the buildings can also be examined in light of these climatic factors which can be incorporated into a GIS analysis.

Climatic factors can be easily examined by visualizing the seasonal prevailing winds or sun's rays on a digitised map in relation

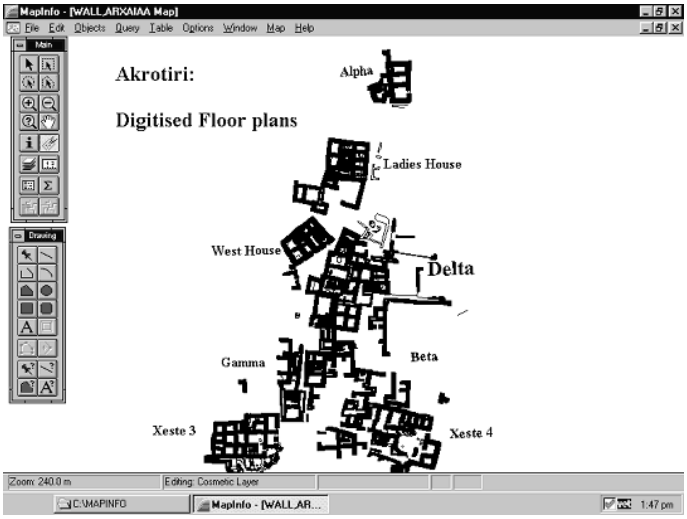

Figure 4: Akrotiri: Digitised ground and first floor plans.

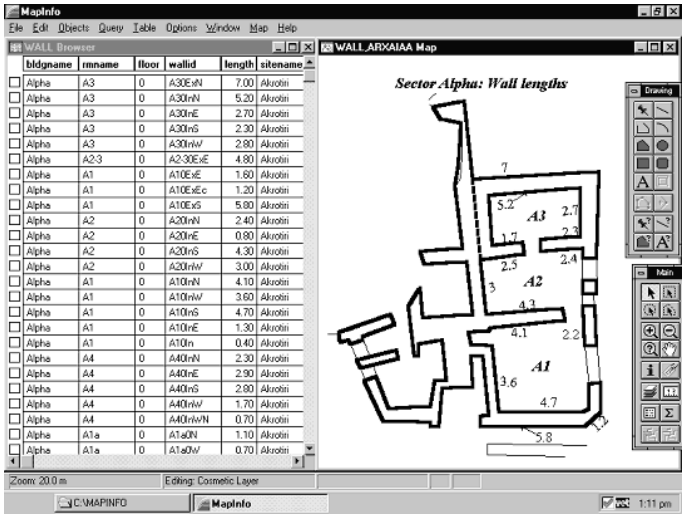

Figure 5: Building Sector Alpha: Digitised plan and "wall" table browser.

to the position of the highlighted doors and windows located on the walls throughout the site. Were the doors and windows orientated in such a way in order to keep the building warm in winter and cool in summer? Do the doors and windows face or avoid the direction of the sun and wind? The orientation of doors and windows can also be considered to determine whether there was some other pattern. Do most doors or windows face the direction of the harbour and coast, or some other feature in the landscape? Or do the doors simply face the streets in between the houses?

This is only a small sample of ideas for sitescape analysis at Akrotiri. For this paper it was decided to undertake a metrical investigation of the buildings at Akrotiri.

4. A metrical analysis using a GIS: Methodology

The aim behind the present analysis is to determine if whole units of measurement were applied to the construction of the buildings at the site. Jones (2000:73) suggests that identifying units of measurement which were utilised at the time may lead to a better understanding of the design of ancient buildings.

The assumption behind this investigation was that people constructed the buildings by using a set of standard units of measurement. On first appearance the layout of the buildings does not suggest that any measurements were used, however, the investigation had not been carried out before. The sheer number of walls had meant that this would have been a very time-consuming task with the possibility of no results, other than to note that no units of measurement were used. Now that the wall lengths are available in a digital format, numerous investigations can be facilitated more conveniently, one of which is a metrical investigation of wall dimensions.

4.1. GIS and Akrotiri

The EPET[1] "Archaeotool" research project has applied the GIS functions of MapInfo in the development of an excavation tool which would essentially archive the daily data collected at Akrotiri.

The present author took part in this project during 1996 and 1997, and subsequently MapInfo was adopted as the tool for this present metrical investigation since the functions it provides are adequate for the current research requirements. Even though MapInfo is a desktop mapping facility, it has many of the GIS functions found in more expensive and less available GIS programs (Johnson 1996:2). MapInfo can be applied to a variety of archaeological research projects which range from the analysis of archaeological sites in relation to the geography of a region, to the analysis of excavation data. These projects can provide further insight into the spatial distribution patterns of archaeological sites across the landscape with possible reasons for their locations, or for patterns of artefact distribution within the various phases and stratigraphy of a site, respectively (Snow 1994:143-148). In the case of Akrotiri the numerous buildings and their associated wall dimensions can now be more readily studied for metrological investigations.

4.2. Data input

The original plans of the site of Akrotiri are in analogue form. The site's architects are currently using AutoCAD to facilitate the updating of plans as new data becomes available. The latest (1997) architectural site plans, supplied by Dr T. Salli, were imported from AutoCAD format and provide a base map from which the walls, rooms, doors, windows, and wall painting locations were digitised by using the on-line digitising facility provided by MapInfo (figure 4).

Separate layers were created for various features such as walls, rooms, doors, and windows. All the dimensions of the walls of the buildings (over 2,300) are stored in the associated MapInfo table named "wall". Because some of the buildings have been preserved up to the second storey, a floor level (0, 1 or 2) field was entered into the wall table in order to analyse each of the walls of the floors separately. Taking a closer look at the building Sector Alpha (figure 5) provides an example of some of the fields contained in the wall table, and depicts details of the wall lengths for some of the walls.

In this case seeking out units of measurement entails metrical studies which can be easily facilitated by a GIS. The process of investigating the digitised plans was to analyse the wall dimensions in the "wall" table for possible units of measurement.

Unit length [cm]	33	27	30	20
Building		% of whole units		
Alpha	0	4	22	38
Beta	1	3	46	50
Gamma	2	5	34	42
Delta	3	3	34	52
Ladies House	3	5	40	44
West House	1	3	36	54
Xeste 3	1	7	40	45

Table 1: Results of the initial metrical analysis: Buildings category, Walls over 90 cm in length.

4.3. Data analysis

Digitised site plans can be used to display and, most importantly, analyse the lengths of walls or other architectural features. Evidence of the use of standard units of measurement is available from some early societies such as Egypt. The process of determining what the length of the measuring unit is when it is not known from written sources, is by dividing the length of the walls by a number of possible units. It is easier to determine units that may have been used to plan buildings at a site if some benchmark from other sites is available. In order to determine a measuring unit used by a society that is being studied some notion of an already known unit of measurement must be sought from related societies.

Since Minoan influence is evident at Akrotiri, it can be assumed that the Minoan foot was used to lay out the walls of the buildings. From previous research, particularly that of Graham (1960:335) who studied wall dimensions at sites on Crete, the Minoan foot ranges from 27.8 to 33.4 cm and averages 30.36 cm in length (Graham 1987:225). However, other units of measurement may also have been used at Akrotiri. So apart from investigating whether the Minoan foot was used, other unit lengths were also used to determine if building standards were utilised.

Graham (1987) assumes that the more regular and uniform a building is, the more likely that a measuring unit was used to construct it. That is, if buildings have accurate right angled corners, it is more likely that units of measurements were used to lay them out. Even if the unit of measurement is not known at a particular site, it is assumed that it will be easier to determine what it was for walls which were built in a regular fashion with neat walls with straight corners.

Unfortunately most of the internal walls at Akrotiri do not have accurate 90° angles, in fact, the corners of most of the internal rooms of the buildings are mainly curved and not squared. Therefore many of the dimensions of the walls are difficult to determine precisely given the fact that many of the internal walls were not constructed with clear-cut corners and did not follow straight lines. To make matters worse some of the early archaeological restoration work at Akrotiri was done before the original state of the walls or features such as doors and windows were accurately recorded. So some of the measurements in the wall table are a reflection of these reconstructed architectural features.

This leads to a certain degree of approximation of the length of the walls on the plans. The schematised architectural building plans were used where the curved corners of many of the rooms have been angled. Furthermore in many cases the walls were distorted by the impact of volcanic debris. Therefore, for the wall table it was decided to initially use a rounded-off figure of the wall lengths for analysis. The length field in the "wall" table was updated by dividing it by a number of possible units and the results were then sorted in search of the most frequently occurring whole unit of measurement that may have been used for constructing the buildings.

Initially all of the wall dimensions of the buildings at Akrotiri were divided by the average Minoan foot of 30.36 cm to see what proportion of the walls may have used this as a whole unit. The ranges of the Minoan foot length were also applied to the wall table. As expected the results were not convincing; taking into consideration the approximation of many of the wall lengths it was decided to base the investigation on units of 30 and 40 cm as well as using the rounded-off units of the extreme ranges of the Minoan foot, that is 27 and 33 cm. These last two units resulted in very few whole units being found. It was noticed that many of the lengths contained half 40 cm units, so it was then decided to group all of the whole and half 40 cm units into a 20 cm unit group.

5. Results and observations

This present paper presents preliminary results of a metrical investigation of the dimensions of the walls of the buildings at Akrotiri. The digitised site plans and associated database provide a central archive of the dimensions of all the buildings excavated at the site to date. The results of this present analysis are limited to some degree by the fact that the total data from the complete area of the site still remains to be uncovered, with only approximately 1/20th of the site revealed so far. Hence the following results, though promising, may be irrelevant when the site is completely excavated!

5.1. Preliminary site results

Tables 1 and 2 present a summary of the results of the metrical investigation for the buildings at Akrotiri. Of all the buildings only the West House can be studied as a completely excavated unit. This is then followed by the Ladies House, Sector Beta, Gamma, Delta and Xeste 3. Only the ground floor of Sector Alpha has been preserved so any observations made relate to that. This is in fact reflected by the results in table 1 below, where a proportionally lower percentage of whole units of measurement are present for Sector Alpha. Table 1 is categorised by building, where the percentage of each of the proposed units of measurement, which is divisible as a whole unit into the length of the wall, is out of the total number of walls over 90 cm in length for each of the selected buildings.

Table 2 is categorised by wall length and the percentage of each of the proposed units of measurement, which is divisible as a whole

Unit length [cm]	33	27	30	20	
Wall length			% of whole units		#of walls
over 20 m	0	0	50	25	4
10 - 20 m	0	0	33	41	17
8 - 10 m	0	12	23	30	26
6 - 8 m	7	0	34	55	44
4 - 6 m	0	4	30	52	186
3 - 4 m	10	0	43	46	231
2 - 3 m	0	10	31	47	359
1 - 2 m	0	0	24	58	400
e.g. The longest wall is 23.4m = 78 x 30 cm units.					

Table 2: Results of the initial metrical analysis: Walls category, Walls over 1m in length.

unit, is out of the total number of walls over 1 m in length for each of the wall length categories.

Therefore, for the over 20 m wall category two of the walls are divisible as whole units of 30 cm and one of the walls is divisible by 20 cm.

This summary of the results in both tables 1 and 2 suggests that 20 and 30 cm units (in approximation) may have been used concurrently when laying out the foundations of the buildings at Akrotiri. The concurrent use of two units of measurement at a site is not unheard of, and occurs elsewhere. Graham (1987) noticed that the use of two or more units of measurement is evident at many ancient sites.

5.2. Conclusions

Since all archaeological data are spatially referenced, GIS can facilitate a multitude of analyses. As new GIS applications in archaeology develop at one level it will be possible to map them to the other level. The spatial aspect of the data allows for the processing concepts behind the two levels of landscape and sitescape archaeological research to be mapped to either level. The ability to map GIS processes from one level to another enables methodologies to be formulated for new research projects. An example of this has been refined for the sitescape analysis of the dimensional aspects of the buildings at Akrotiri. Unfortunately the underlying assumptions and objectives which guide all research means that only a small subset of the numerous possible analyses has to be selected for a project to test the hypothesis at hand. In this case it was data for a metrical analysis. The process of determining whether any standard units of measurement were used in constructing the buildings at one site may *map* to investigations of standard units of distance between sites of one period in a particular area.

Regardless of what data are used, the analytical process requires that the data are entered into a GIS program which will then facilitate the quantification and categorisation of spatial elements. The range of data that can be investigated come from either beyond a site's boundaries, or introspectively from within one site. GIS assists the spatial analysis of the chosen data as well as providing a way of visualising data from a database directly on digital plans. This inspires new analyses to be formulated and allows the process to start all over again. Ultimately new theories are generated which may open up new doors for understanding our past.

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References

ALLEN, K.M.S., GREEN, S.W. and ZUBROW, E.B.W. (eds.), 1990. *Interpreting Space: GIS and Archaeology*, Taylor and Francis, London.

ATLAS 1999. *Archaeological Atlas of the Aegean: From Prehistoric times to Late Antiquity*, Ministry of the Aegean, University of Athens, 84, Map 49.

BISKOWSKI, M., 1993. GIS and the study of grinding tools in the Teotihuacan valley, Mexico. In Johnson, I. (ed.), *Methods in the Mountains: Proceedings of UISPP Comm. IV Meeting*, Mt. Victoria, Australia, Sydney University Archaeological Methods Series 2 1994: 115-134.

CASTLEDEN, R., 1990. *Minoans: Life in Bronze Age Crete*. Routledge, London.

DOUMAS, C.G., 1984. *Thera, Pompeii of the ancient Aegean*. Thames and Hudson, London.

DOUMAS, C.G., 1992. *The Wall-Paintings of Thera*. Thera Foundation, Nomikos, Athens, 152: 116.

GRAHAM, J.W., 1960. The Minoan Unit of Length. In *American Journal of Archaeology* 64: 335-341.

GRAHAM, J.W., 1987. *The Palaces of Crete*. Princeton Uni Press, NJ.

GAFFNEY, V., STANČIČ, Z. and WATSON, H., 1995. The impact of GIS on archaeology: A personal perspective. In Lock, G. and Stančič, Z. (eds.), *Archaeology and Geographical Information Systems: A European Perspective*. Taylor and Francis, London: 211-230.

GAFFNEY, V., STANČIČ, Z., 1996. *GIS Approaches to Regional Analysis: A case study of the Island of Hvar,* Znanstveni Institut Filozofske Fakultete, Ljubljana.

JOHNSON, I., 1996. *Understanding MapInfo - A Structured Guide*. Archaeological Computing Laboratory, University of Sydney.

JONES, M.W., 2000. Doric Measure and Architectural Design 1: The Evidence of the Relief from Salamis. In *American Journal of Archaeology* 104: 73-93.

LANGRAN, G., 1992. *Time in Geographic Information Systems.* Taylor and Francis, London.

LOCK, G. and STANČIČ, Z. (eds.), 1995. *Archaeology and Geographical Information Systems: A European Perspective*. Taylor and Francis, London.

MARTHARI, M., 1984. The destruction of the town at Akrotiri, Thera, at the beginning of LCI: Definition and Chronology. In MacGillivray, J.A. and Barber, R.L.N. (eds.), *The Prehistoric Cyclades: Contributions to a workshop on Cycladic Chronology*. Department of Classical Archaeology, Edinburgh: 119-133.

PALYVOU, C., 1984. The destruction of the town at Akrotiri, Thera, at the beginning of LCI: Rebuilding Activities. In MacGillivray, J.A. and Barber, R.L.N. (eds.), *The Prehistoric Cyclades: Contributions to a workshop on Cycladic Chronology*. Department of Classical Archaeology, Edinburgh: 134-147.

RENFREW, C., 1984. *Approaches to Social Archaeology*. Edinburgh University Press, Edinburgh, 9.

RUSSELLL, B., 1959. *Wisdom of the West*. MacDonald, 17.

SNOW, D.R., 1994. Using MapInfo to map archaeological data. In Johnson, I. (ed.), *Methods in the Mountains: Proc. UISPP Comm. IV Mtg*., Mt. Victoria, Australia, Sydney University Archaeological Methods Series 2: 143-148.

Note

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