A proposed National Archaeological Database for Oman (NADO)

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Abstract: *The 1980 National Heritage Protection Law (NHPL) in Oman specifies that the recording of archaeological resources should be part of preserving the country's national heritage. NHPL also calls for the establishment of a continuously updated inventory. By 1998, the Ministry of National Heritage and Culture had constructed its first two electronic databases, which are presently active. However, given the present needs, the current databases no longer suffice. In light of fast-paced technological advances and the effect on the sciences, archaeological resources in Oman require a new archaeological database. Furthermore, the possibility of defaults in its present and future management cannot be dismissed. This paper proposes the establishment of a national archaeological database for Oman (NADO) designed to serve Oman's national archaeological resources. The core concepts and structure of NADO would be adapted from a number of well-developed archaeological records and the standardised database would have the advantage of flexibility, retrievability, consistency, and updatability. Its data model would be flexible to control the processes of recording, distinguishing, and presenting the different types of recorded data. The proposed database would include information on aspects of site condition and conservation, and contain information to help with management such as survival, condition, hazards, land use, accessibility, site significance, and restoration. Furthermore, NADO could possibly be integrated into prospective databases.*

Introduction

Archaeological records are the central source for information in preserving, managing, studying, and interpreting various aspects of historic environments. The use of highly structured databases is fundamental to easing the processes of recording, managing, synthesising, and searching the different types of data related to archaeological resources (Niccolucci et al. 2001: 108). Thus, many countries have devoted 'ever increasing amounts of money and human effort' to the computerisation of their archaeological records and making them accessible through new technologies (Larsen 1992: 3).

In Oman, the earliest indication of the government's awareness of the importance and necessity of creating archaeological records to define and quantify archaeological resources dates back to the early 1980s (Al-Belushi 2008: 164; 2011; in press). The NHPL (Royal Decree 6/1980) clearly dictated the importance of documenting Omani archaeological resources and required governmental organisations concerned with the preservation and conservation of Omani archaeological resources to maintain a public record (Articles III, V, VIII, XXXII, and XLIII of the NHPL).

At present, the Ministry of Heritage and Culture (MHC) has two archaeological databases (Al-Belushi 2011: 10-14). The first is the Omani Archaeological Sites Information System (OASIS), which is designed to record archaeological sites. The second is the

Department of Antiquities Numbers project (DAN) which records and manages the archaeological objects collection stored at the Department of Antiquity. Both databases were a welcome outcome of a cooperative project between the MHC and the French Embassy in Oman between the years of 1998 and 2001 (Al-Belushi 2011). However, their current provision is not equal to what is now required. In addition to the problems associated with the legal and administrative frameworks, there are a number of technical reasons for their limited role, including the lack of data standards (such as those related to recording and terminology), the degree of flexibility of the structures of both databases, and the ways through which the two databases have been populated (Al-Belushi 2011).

The National Archaeological Database of Oman (NADO)

Based on the above mentioned facts regarding the current situation of the archaeological records in Oman, there is a clear and urgent need for a comprehensive strategy to record the various components of Oman's archaeological resources. This can be achieved by enhancing the current databases and/or by creating new databases with up-to-date recording techniques that can integrate the existing records. Therefore, the researcher sought to contribute to this aspect by proposing a flexible, retrievable, and consistent database at the national scale for the archaeological resources of Oman. The proposed database is called the National Archaeological Database of Oman (NADO) and is designed and stored using Microsoft Access which offers data management flexibility and the ability to create hierarchical structures and relational databases.

Parts of the core concepts and structure of NADO were adapted mainly from a cultural landscape characterisation project carried out by the Department of Ancient History and Archaeology at the University of Birmingham for the military base of Fort Hood, Texas, USA (BUFAU 2001; Barrett et al. 2007); and from what has been published about the Sites and Monuments Records (SMRs) of England (ACAO 1978, 1993; Burrow 1984; Fraser 1984, 1986, 1993; Chadburn 1989; Lang 1992, 1995; RCHME 1993, 1998; Fernie and Gilman 2000); and from some other well-developed archaeological records (Guillot 1992; Hansen 1992; Jaskanis 1992; Mikkelsen and Larsen 1992; Murray 1992; Nielsen et al. 2001; Roorda and Wiemer 1992). Concepts relating to the measurement of the condition of resources were acquired from the Monuments at Risk Survey of England 1995 (MARS) (Darvill and Fulton 1998).

The structure of NADO

The structure of NADO has been designed to provide a distinction between different types of data which will be divided based on their nature into three interrelated and interlinked groups: event, site, and source. Based on this data distinction, three types of tables were constructed: an event, a site, and a source data table. The detailed structure of each of these tables will be described later.

Event-Site-Source recording model

As with most developed and newly established archaeological records, the aim of categorising NADO data in such a way is to develop a data recording model resembling the process of archaeology in its dynamic characteristics, 'in which investigation leads to discovery, the collection of new information, interpretation and synthesis leading to new understanding' of the historic environment (Austin et al. 2000: C.2). The aim of using this 'event-site-source' logical data model is to provide NADO with flexibility

in controlling the processes of recording and distinguishing the different types of data.

The archaeological process is of a dynamic nature. It starts with an event, which is a single incidence of information collection related to a particular component of the historic environment at a particular point in time and space using single or multiple types of investigation techniques, including major excavations, field surveys, chance finds, fieldwalks, etc. (Austin et al. 2000: C.3; BUFAU 2001: 1; Barrett et al. 2007: 51-69). Every event is constrained by a number of factors such as the availability of financial and human resources which affect its final output (e.g. finds, maps, plans, reports). Carrying out new activity on the same site at a later period may produce new findings; hence, a new site event will be added to the record. The reason behind the allocation of a separate record for every single event is the static nature of events, as they are never repeatable or overwritten (Austin et al. 2000: C.3). The advantage of recording every single event in NADO is that it will provide both researchers and archaeological resource managers, who are planning to conduct new research or a new management activity on a site, with a complete record of previous work on that site. Thus, any duplication in their efforts would be avoided and current and future research and management activities would be controlled effectively.

After the collection of archaeological data and finds by various activities of site events, the next step in the archaeological process is the interpretation and understanding of the past historic environment in order to identify its past uses. Every site is identified according to the results of the interpretation of the site event data and is therefore subject to change whenever a new event produces a new interpretation about the past use of that site. This means that a site has to be preceded by an event and that it is also dynamic in nature (BUFAU 2001: 2; Barrett et al. 2007: 51-69). The interpretation process, which leads to the identification of the past uses of a site, usually starts by consulting and studying the available archaeological data and finds collected during previous events. Therefore, keeping a record of that data and those finds (i.e. the information sources) is also an important part of the process of understanding and recording archaeological resources (Austin et al. 2000: C.4).

Site data table

This table is designed to include detailed facts and descriptions about every type of site and monument legally covered by the NHPL. Before going any further into describing the detailed structure of this table (Fig. 1), it is important to discuss the level and extent of information upon which the records will be created. The need for consistency in recording different details of the historic environment's components and the need to improve the presentation and retrieval of the recorded data have both led to NADO being structured hierarchically. The concepts behind adopting a hierarchical structure lie in the fact that archaeological data is of an inherently complex nature and that the processes of recognising and recording the different phases of activity on a site are not as simple as they might appear. The need to decide the level of 'splitting' or 'lumping together' the site data is an important issue facing the curators of archaeological records, as the boundaries between different types of archaeological sites and monuments are not always clear and need to be understood before any interpretation can be made (BUFAU 2001: 2; Barrett et al. 2007: 51-69).

The hierarchical structure of NADO categorises site data into site, feature, and object types. This structure needs to be flexible

as objects could be elements of features or sites, or sites on their own right. This means that the hierarchical concept adopted here works on the basis of the presence or absence of other information within the site and how the site components relate to one another. If, for example, a site consists of a settlement, then it will be recorded with settlement as the site type, each one of its houses as features, and, if there are any objects in any of the houses they will be recorded as objects. However, if a site consists of a stray find only (e.g. a pottery sherd) then it will be recorded as a site type because of the absence of any other associated data related to this object. However, these levels of hierarchy may be discarded if this pottery sherd appears in a future study to be part of a pottery kiln and consequently it will no longer be considered a site type on its own right, but as an associated object. It is important to note that the boundaries that separate the site, feature, and object types from each other are sometimes unclear, which means that a good understanding of the archaeological record before making any interpretations is an important element in the construction of archaeological databases. The previous example shows the importance of recording the events and sources and linking them with the site data, as they always help researchers understand the concepts behind the hierarchical categorisation of every set of associated data.

The physical structure of the site data table has been designed to include information about different levels of sites and monuments including site types, features, and objects, in addition to other information about their location and chronology. The table also includes information about the current conditions of the sites and monuments and their related management and conservation data. Condition, conservation, and management information such as survival, hazards, land use, accessibility, site significance, and restoration can be grouped together and moved into separate tables in the future, depending on the quantity of information to be gathered. Below is a brief explanation of a number of aspects in the site data table that need more clarification.

As NADO has been planned as a central record into which information from all current inventories, paper files, maps, photographs, etc. will be migrated and integrated, it is essential to use a numbering system to facilitate the linking of any cross-referencing between NADO and other records. This was solved by allocating a unique reference number, or 'record number', for every NADO record, and by adding another field called 'other identifiers' to identify and link the record with its original source if it was migrated from another database or card index. This cross-referencing will help NADO's users retrieve information.

As NADO is structured hierarchically, in addition to the record number and the other identifiers, every record will also be assigned a site, feature, or object number. Feature numbers will be subdivisions of the site number, whereas the object numbers will be subdivisions of the feature or site number. This will ensure that all the records are related and linked to the relevant site within the database. The function of those three numbers is not to count the records but to ensure that all the records are hierarchically related and linked to the relevant site within the database.

Sometimes a single site or a single feature may comprise many features or many objects of identical form and function. Where such a case occurs, 'feature quantifier' and 'object quantifier' fields will be used to express the quantities of those sites and features by using one of the following expressions: I = individual; S = small (>1–10); L = large (>10), and U =

unknown. These quantifiers will allow the recording of any number of features or objects of exact identical detail in a single record without the need to allocate each of them a separate record. If, for example, a site consists of a cemetery with hundreds of identical graves, then all the graves will be recorded in a single feature record with the expression (L) in the feature quantifier field. The quantifier's concept will save the database a considerable amount of space and will ease the processes of information retrieval and association.

All records will have a Site Broad Category field. This will allow every record, whether it is a site, feature, or object, to be grouped under one of the following categories: Structures, Earthworks, Burials, Art, Cave, Artefacts, or Ecofacts. The purpose of this broad categorisation, which is based conceptually on Darvill and Fulton (1998), is to develop a wider picture of the major components of the resource and to ease the search and retrieval processes.

Many sites or monuments are complex and have been investigated more than once. This sometimes results in producing several interpretations for a single site. Fields of site data in the table describing site, feature, and object types have been designed to store information only about interpretations produced by the latest event activities. However, the past interpretations of the site and current interpretations that are of low measure of certainty can be recorded and discussed in the free format text in the Record Description field.

Recording the chronological periods of sites and monuments has always been one of the main problems facing archaeological databases everywhere. Many sites and monuments are of more than one chronological period. NADO has been designed to reflect this issue by assigning a primary period for each record and by recording the other periods encompassed as present or absent within the same entry.

Event data table

This table has been designed to hold data regarding the different activities, or events, which have been undertaken at fixed moments in time in order to collect primary information about defined geographical areas (Fig. 1). It also includes information regarding the activities carried out to interpret this collected primary information and to manage or interpret the sites and monuments. Sometimes these activities do not produce any archaeological results and thus are described as 'negative events' (Austin et al. 2000: C.21). Moreover, non-archaeological activities that may result in useful archaeological information should also be recorded in this table.

All events are unique and therefore each one should have a separate record with a unique number to differentiate it from the other events. This number links the event data table with the site data table as the latter has a field to link each site, feature, or object record to its relevant event records.

As all events happen at a fixed moment in time, it is important to record the date range during which every event took place. This will help researchers as well as conservationists understand the history of activities undertaken on the site. It should be taken into consideration that unlike the cases with modern events, it is difficult in sometimes to identify the exact date and person who carried out the event if it was done a very long time ago. Many archaeological records recommend creating records of negative events as the 'information about the methods and techniques used and the circumstances in which these events occurred is valuable to archaeologists planning subsequent events on the same or adjacent sites' (Austin et al. 2000: C.21).

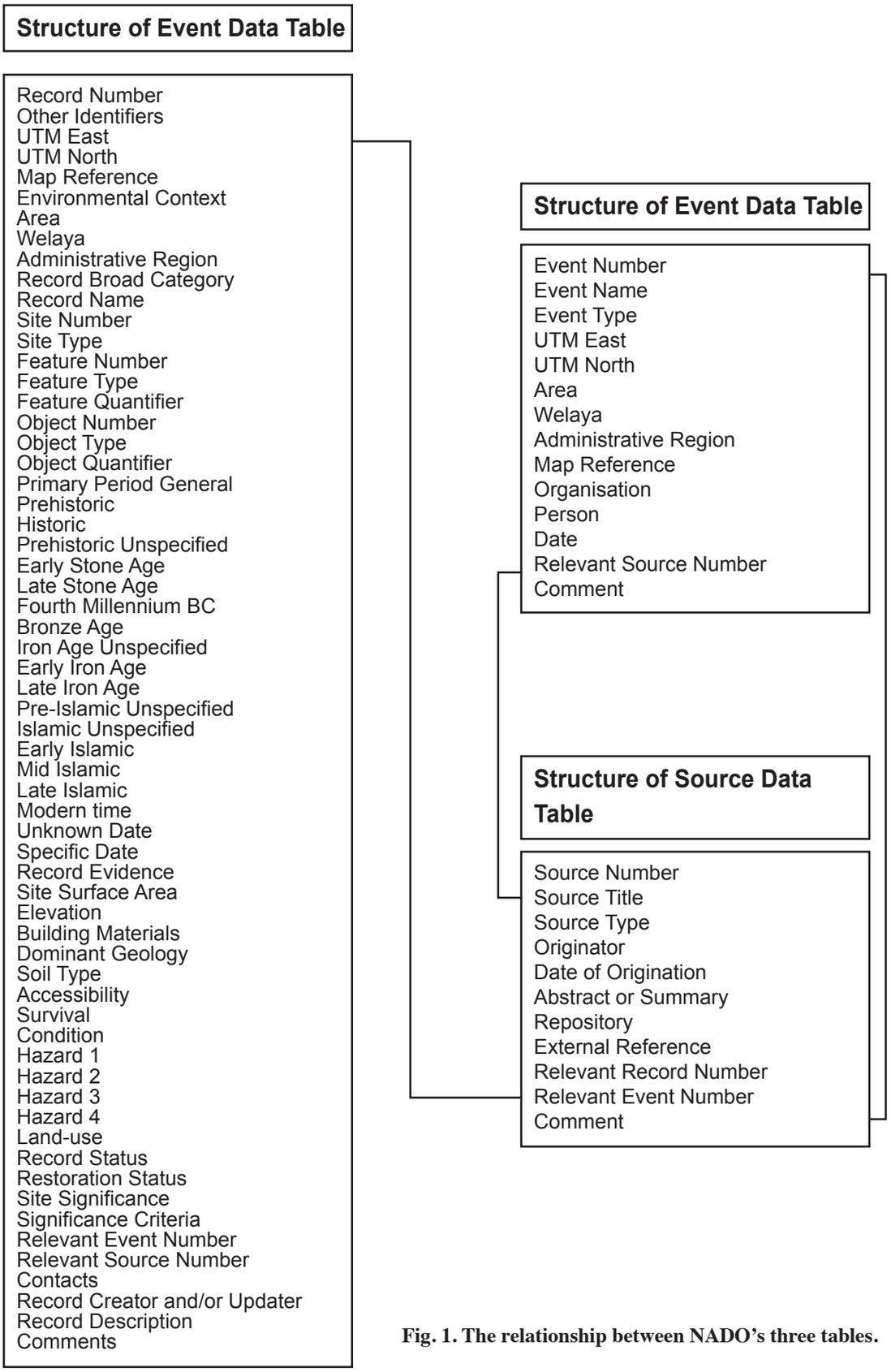

Fig. 1. The relationship between NADO's three tables.

Source data table

This table is designed to hold information about the sources that provide primary and secondary data about the sites, features, and objects in a locality (Fig. 1). This table will allow NADO users to find and retrieve the location of the relevant documents upon which the site record was based.

Every source has a separate record with a unique computer-generated number. To facilitate linking the source data table with both the site and event data tables, two other numbers — the relevant site number and the relevant event number —will be used. Every record in this table has a separate field to provide an abstract or summary of the source. This will provide the researcher the opportunity to see at a glance the main content of the source without going to the repository that holds the original copy.

Pertinence of NADO

The two main reasons for designing NADO are the current absence of quantitative and qualitative information about the nature, size, distribution patterns, and condition of Oman's archaeological resources, and the continuous destruction of those resources, which is occurring as a result of Oman's increasing rates of physical development, land exploitation, and other modernisation processes.

The principal aim of NADO is to fill this information gap by constructing a national body of information regarding the historic environment of Oman. The other anticipated aims can be summarised as follows:

- To be a central body of information regarding the types and nature of the different components of the historic environment.
- To serve as a complete and up-to-date information source for various research, planning, education, and economic purposes.
- To maintain an index of the types of archaeological activities, such as excavations and other management and conservation practices, that have been undertaken over the years in order to know what types of monuments and periods have received more attention. The availability of such information will help in deciding management and research priorities for the sites and monuments.
- To maintain, curate, and index an archaeological archive of different types of materials resulting from various archaeological activities, such as bibliographic materials, plans, photos, etc.
- To provide the national planning authorities with information and advice in matters related to the utilisation of the historic environment, and to help those organisations in monitoring and controlling the implications of their policies.

Breadth and depth of coverage

NADO is designed to encompass all information related to the historic environment. In addition to the basic information about the various archaeological and historical types of sites, features, and objects, NADO will also include information about the activities carried out to collect and interpret this information. Information about other conservation and management activities will also be included.

Since it is proposed to be a national-scale record, NADO is designed to cover all Omani archaeological sites more than 60 years old (Royal Decree 6/1980; Al-Belushi, in press). This concurs with the date set out by the NHPL. For sites and monuments less than 60 years old, the recording process should be more selective and should be based on certain criteria. The

chronological periods that are included in the proposed design of NADO can be changed in the future, according to the expansion of the scope of the record and depending on the nature of new discoveries from each period. For instance, if future archaeological activities were to reveal a large number of new records related to the Iron Age that do not fully fit with the current chronological periods of the site data table, then these periods could be re-divided to accommodate the new data.

The depth of coverage for NADO will depend upon the type and level of recording to be used. The hierarchical structure of the site data table is designed to allow curators to use a high level of recording with regard to the different categories of sites, features, and objects, and to provide extensive description and analysis of primary and secondary sources, in addition to describing the condition and any management information available about the records. Moreover, the other two tables will also allow curators to record a detailed description of the events and sources related to the recorded sites. Despite the fact that the structure of NADO will provide the ability to use such a high level of recording, it would be better at this early stage of its creation to place more emphasis on the breadth rather than depth of coverage. For instance, it is better at this stage to keep the level of the descriptive text of each record to an essential minimum that fulfils and meets the national requirements.

After the first implementation of NADO, digital information in the existing databases should be transferred after an update and standardisation. If it is difficult to adapt this information to NADO, the proposal is to leave them without changing their data or the format in which they are held and to provide a hyperlink to them in NADO. NADO should also encompass all the relevant content of the archaeological databases to be constructed in the future. This can be achieved by harmonising the different databases with NADO, and by adopting data standards and guidelines for their physical structures and the methods that will be used to compile and classify their information.

Information sources

The three main types of information which NADO will depend on are documentary and digital sources of information, information resulting from fieldwork activities, and management activities data. It should be noted here that NADO has been conceived as a starting point, as is the case with most archaeological resource systems elsewhere. This type of guideline system guides the user to the original sources of information but does not replace the information. It is anticipated that information will be collected and supplied by a wide range of organisations and individuals. Information extracted from the documentary and digital sources can be used as the first step to populate the main fields of the three tables of NADO. This will help to create the base upon which NADO curators will build in the next stages of database implementation.

NADO must have a clear information collection policy. This policy will help to identify the sources of information currently available to NADO and those that are not available, and to identify the financial support needed to update them. As the number of sources increases continuously, this policy should be revised and updated constantly. There is also a need to establish a library attached to NADO to include all sources of information relating to recording Oman's archaeological resources. The existing library of the Department of Antiquity at the MHC could be used as a nucleus for a larger well-developed library.

The MHC should obligate all individuals and organisations undertaking any new activities

related to the historic environment such as excavations, surveys, or landscape planning projects to provide NADO with detailed information about their activities as well as copies of their products.

Data standards

It is important that NADO should develop data standards regarding its structure and content. Using data standards will ensure consistency in recording archaeological resources and help curators of NADO to check the technical and academic validity and reliability of the data. It will also facilitate the linking and integration of NADO with other databases in the future. The curators in charge of adding information to the database would be able to achieve standardisation through the creation of clearly written guidelines and well-established systems of vocabulary control, such as thesauri or glossaries of terms. These data standards would then be enhanced regularly based on practical experience and through the utilisation and adaptation of well-developed data standards that are being used in the other parts of the world. Examples of such data standards are the thesauri designed by the archaeological organisations in England: National Monuments Record Thesaurus (EH 1999); MDA Archaeological Objects Thesaurus (EH and RCHME 1997); Thesaurus of Monuments Types: Standard for Use in Archaeological and Architectural Records (RCHME and EH 1995); Thesaurus of Archaeological Site Types (RCHME 1992), and MIDAS: A Manual and Data Standard for Monument Inventories (RCHME 1998).

Using Geographical Information Systems (GIS)

Using geographical information systems (GIS) in NADO will be one of its greatest challenges in the future. During the early stages of designing NADO, it was realised that both its structure and content should be designed in such a way that fulfils the prerequisites needed to operate a standard GIS application. It is recommended that NADO develop standards that can help in facilitating its integration with GIS applications. A number of GIS data standards can be used as guides to this process such as GIS Guide to Good Practice designed and published by Arts and Humanities Data Service (AHDS) in England. This is an example of the standards that provide guidance for individuals and organisations involved in the creation, maintenance, use, and long-term preservation of GIS-based digital resources (Gillings and Wise 1998).

To ensure that the implementation of such an application within NADO can be achieved without any major obstacles, this study believes that GIS and other cartographic systems that are used by archaeological organisations in Oman should be harmonised with other groups, especially environmental conservation groups, in order to ease the link to and transfer of information between records. The study also believes that NADO's core data standards should be enhanced regularly and harmonised with other new databases to ensure their compatibility with GIS programmes and facilitate their data linkage and exchange. It is also recommended that NADO develop standards to help in facilitating its integration with GIS applications.

Requirements for the curation of NADO

According to the NHPL, the MHC is the national body that should take responsibility for the curation of the national archaeological databases. This can be accomplished using various methods, including the allocation of sufficient funding to operate and maintain NADO, the support and update of NADO with appropriate system of recording, and the

employment and training of qualified curators.

Accessibility and expected users of NADO

The main expected users of NADO will be organisations and individuals engaged in conserving,researching,promoting,developing, and utilising Oman's historic environment. Establishing a cooperative relationship between those users and NADO is essential in that both parties should feed and support each other in terms of information supply and other types of assistance and consultation. It is recommended that NADO be accessible and have information-service policies to regulate the access to its information and other services. NADO should also establish different forms of supervised and unsupervised access channels to facilitate accessibility for users. Accessibility can deliver information and enhance public interest and awareness of the historic environment and its conservation.

The way forward

If the MHC is to use NADO, it should transfer OASIS and DAN after standardising and updating them. Difficulties encountered in adapting the existing databases can possibly be bridged by a hyperlink to NADO. It is also recommended that NADO encompasses all the relevant content of future archaeological databases. This can be achieved by harmonising the different databases with NADO and by adopting data standards and guidelines for their physical structures and data collection methods. Finally, it is hoped that the MHC will adopt and advance this database for management and research purposes.

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ملخص: يشير قانون حماية التراث القومي العماني الصادر في عام ١٩٨٠م إلى أن تسجيل المكونات المختلفة للموارد الأثرية يجب أن يشكل جزءا محوريا من عملية حفظ التراث الأثري الوطني للبلاد. كما ينادي القانون بضرورة إنشاء سجل وطني للآثار يتم تحديثه بشكل مستمر. وفي عام ١٩٩٨م قامت وزارة التراث القومي والثقافة ببناء أول قاعدتي بيانات إلكترونية للمواقع والقطع الأثرية. ومع ذلك، فإن هاتين القاعدتين لم تعودا قادرتين على الإيفاء بالاحتياجات المستجدة في قطاع إدارة الآثار في البلاد. وفي ضوء التطورات التقنية المتسارعة في مجال توثيق التراث الأثري، فإن الحاجة أصبحت ماسة لقاعدة بيانات جديدة للآثار قادرة على تحقيق الأهداف المختلفة لإدارة الآثار. تقترح هذه الورقة إنشاء قاعدة بيانات وطنية لآثار عمان تحمل اسم (NADO). ولبناء قاعدة البيانات المقترحة فقد تمت الاستفادة من المبادئ الأساسية التي بنيت عليها قواعد بيانات أخرى متطورة، خصوصا في الجوانب المتعلقة بالمعايير الموحدة في عملية التوثيق، والمرونة، والقدرة على استرجاع المعلومات، والاتساق، وقابلية الإضافة والتطوير المستقبليين. وقد صمم نموذج جمع البيانات بحيث يكون مرنا وذلك للتحكم في عملية التوثيق، ولتسهيل فرز مختلف أنواع المعلومات وعرضها. كما صممت قاعدة البيانات المقترحة بحيث تكون قادرة على احتواء معلومات حول حالة المواقع الأثرية التي يتم توثيقها، وأهميتها، والمخاطر التي تتعرض لها، وإجراءات الصون والترميم التي تحظى بها، إضافة إلى معلومات حول إمكانية الوصول إليها. وأخيرا، فإن قاعدة البيانات المقترحة صممت بحيث لا تتعارض وإمكانية دمجها مع قواعد بيانات أخرى في المستقبل.

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