THE MIDDLE EASTERN GEODATABASE FOR ANTIQUITIES (MEGA)

An Open Source GIS-Based Heritage Site Inventory and Management System

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Figure 1. Members of the project team meet with inspectors from the Department of Antiquities in Umm Qeis to learn their specific requirements for the functionality of MEGA-Jordan. (Alison Dalgity, J. Paul Getty Trust/World Monuments Fund)

The emergence of new digital technologies and rapidly spreading Internet access together present possibilities for widely accessible, Web-based national information systems for the inventory and management of heritage sites. The increasing development of open source software tools further provides that such systems may be purpose-built, adaptable, and extensible to the needs of specific situations, and that once developed they can be available to heritage authorities, which are often poorly funded, without associated licensing or upgrade fees.

Working collaboratively with the Jordanian Department of Antiquities (DoA), the Getty Conservation Institute (GCI) and World Monuments Fund (WMF) have developed MEGA-Jordan as a tool to inventory, monitor, and help conserve and manage the thousands of archaeological sites in Jordan. MEGA-Jordan allows DoA officials to address needs such as infrastructure and development control and the development of national and regional research strategies. MEGA-Jordan is Web based, bilingual (Arabic-English), and was developed using state-of-the-art and open source information technologies. It was designed to be modular and easily extensible, allowing it to evolve with the DoA's changing institutional requirements and to be adapted by other countries. The MEGA-Jordan system is available online at www.megajordan.org. Work on an Iraq version of MEGA is slated to begin after the Jordanian system is fully deployed, and will include the system's expansion to contain data for the protection of historic buildings. The GCI and WMF plan to subsequently make the system available for adaptation by other countries.

The understanding of heritage places that is gained through their recording and then embodied in documentary records forms the foundation of heritage decision making. Organized efforts to protect, conserve, and manage heritage places have, through most of their history, recognized the necessity of documentation and recording. This recognition has been identified in numerous international and national heritage charters, conventions, and recommendations, including the *Athens Charter* (1933),[1] the *Venice Charter* (1964),[2] the UNESCO *World Heritage Convention* (1972),[3] and the ICOMOS *Charter for the Protection and Management of the Archaeological Heritage* (1990).[4] The ICOMOS *Principles for the Recording of Monuments, Groups of Buildings, and Sites* (1996)[5] in particular explains in detail the reasons for recording and who should be responsible for recording; suggests essential content for records; and provides guidelines concerning the management, dissemination, and sharing of records. The Australia ICOMOS *Burra Charter* (1999)[6] process follows three primary steps in managing places of cultural significance: (1) understand significance (through heritage place identification and gathering, recording, and assessing information about those places); (2) develop policies; and (3) manage. The first step that the others are based on begins with recording documentary, oral, and physical evidence.

For authorities tasked with managing large numbers of heritage places, whether at national, provincial, citywide, or sitewide scales, the most essential documentation tool is

a heritage inventory. The necessity for inventories is also recognized in numerous international heritage charters, conventions, and recommendations, including the *Athens Charter* (1933), the UNESCO *World Heritage Convention* (1972), the UNESCO *Recommendation Concerning the Protection, at National Level, of the Cultural and Natural Heritage* (1972),[7] the ICOMOS *Charter for the Protection and Management of the Archaeological Heritage* (1990), the ICOMOS *Principles for the Recording of Monuments, Groups of Buildings, and Sites* (1996), and the ICOMOS *Charter on Cultural Routes* (2008).[8] The inventory informs the heritage manager of what must be managed, where it is located and its spatial extent, and what its characteristics are. Inventories can allow for comparison of large numbers of heritage sites to aid in their classification and comparison of significance, integrity, and condition. These assessments can be used as a basis for prioritizing management interventions, whether for protection, conservation, reuse, or presentation. In many places legislation additionally links heritage inventories to statutory protection. Inventories are also particularly necessary for protection of heritage places in events of armed conflict, as recognized in the *Second Protocol to the Hague Convention* (1999), and natural disasters.[9]

Within the last few decades, the emergence of digital information technologies has greatly enhanced the utility of heritage inventories. In 1996, the *ICOMOS Principles for the Recording of Monuments, Groups of Buildings, and Sites* noted that "the effective assembly, management and distribution of recorded information requires, wherever possible, the understanding and the appropriate use of up-to-date information technology." The development and proliferation of geographic information systems (GIS) software in particular has meant that digital inventories may be map based. The use of GIS to analyze heritage inventory data in combination with other spatial data, such as the extent of planned development projects, has proven to be extremely useful for heritage planning and impact assessments. The global and rapidly expanding access to the Internet and ever increasing connection speeds have presented possibilities for widely accessible, Web-based information systems for the inventory and management of heritage sites.

The increasing development of free, open source software tools further provides that such systems may be purpose-built, adaptable, and extensible to the needs of specific situations. Once developed, open source, purpose-built heritage site information systems can be made available to heritage authorities, which are often poorly funded, without associated licensing or upgrade fees for adaptation for their particular circumstances.

This paper presents the collaborative work of the Getty Conservation Institute (GCI) and World Monuments Fund (WMF) to develop and implement an open source, Web-based GIS heritage site inventory and management system for the national heritage authorities of Jordan and Iraq, and has been designed so that it may eventually be made available to and adapted by other heritage authorities internationally. The Middle Eastern Geodatabase for Antiquities (MEGA)–Jordan has been deployed at a nationwide level by the Jordanian Department of Antiquities (DoA) since December 2010. The GCI and WMF are providing for MEGA-Jordan's maintenance for its initial two years of deployment after which time maintenance will be turned over to the DoA. In April 2011, GCI-WMF made a prototype of MEGA-Iraq for archaeological sites available to the Iraq State Board of Antiq-

uities and Heritage (SBAH). Since then the SBAH has been adding data on Iraqi archaeological sites to the system and giving feedback to GCI-WMF to tailor the system to its needs. GCI-WMF are now embarking on the second phase in adapting MEGA for Iraq, which is focused on defining and then developing system functionality for inventorying and managing other heritage types, such as historic buildings and structures, architectural ensembles, and cultural landscapes and routes.

Project Background and Objectives

Following the widespread damage suffered by Iraq's cultural heritage during and in the aftermath of the 2003 war, and in anticipation of reconstruction activities, in October 2003 the GCI and the WMF created the Iraq Cultural Heritage Conservation Initiative and in March 2004 signed a collaborative agreement with the Iraq SBAH, the national authority responsible for Iraq's archaeological and historic heritage.[10] The initiative has aimed to help rebuild the country's professional conservation and heritage management capacity, which had been depleted due to decades of war and isolation.

One component of the GCI-WMF initiative from its start has been the development of a national GIS inventory system to serve as a tool for the SBAH to help protect, manage, and conserve Iraq's archaeological sites and historic buildings. Another component of the GCI-WMF initiative has been increasing the capacities of SBAH personnel in site conservation and management through training. GCI-WMF held several training courses for SBAH personnel in Jordan in 2004 and 2005 with the support of the Jordanian DoA as well as UNESCO. These courses largely focused on laying the groundwork for the SBAH to collect data for the GIS system, such as site condition and significance assessment, as well as a number of forms of documentation and recording including using total stations, GPS devices, laser distance meters, and digital cameras. The training also provided exposure to international heritage charters and conventions and taught a methodology for values-based site planning.

The Iraq GIS system was designed with the intention that it would be based on stand-alone computers in the Baghdad SBAH office. However, two factors led GCI-WMF in late 2006 to step back and reconsider this development approach. First, the worsening security situation in Baghdad meant that if a stand-alone system was installed there and technical problems arose, the GCI-WMF team might be unable to travel to Baghdad to address them. Second, there was a lengthy interruption in communications with the SBAH leadership, particularly after the departure of SBAH chair Dr. Donny George Youkhanna in the summer of 2006. GCI-WMF then decided to pause and assess requirements for a sustainable system in Iraq. This led to the decision, first, to shift development to a Web-based system. This would allow it to operate from a server in any location, to permit remote system maintenance and monitoring of use, to allow regional SBAH offices to independently access and contribute to the central database, and to permit access to parts of the system by international scholars and researchers. As the break in communications with the SBAH continued, GCI-WMF decided to first explore developing the Web-based system for the Jordan DoA, which had similar requirements, in order to permit unimpeded progress in

developing and testing the system and in recognition of the DoA's committed support of the Iraq Initiative.

After the DoA confirmed its interest, it signed an agreement with the GCI and WMF in May 2007 to develop such a system dubbed the Middle Eastern Geodatabase for Antiquities (MEGA)–Jordan.[11] MEGA-Jordan would replace the DoA's existing system called JADIS (Jordan Antiquities Database and Information System), which was initially developed in the early 1990s. The general concept for developing MEGA-Jordan was that it was to be developed for and eventually managed by the DoA, the national authority responsible for cultural heritage in Jordan. GCI-WMF would own the MEGA-Jordan software and grant to the DoA a free, perpetual license to use and modify the software as it wished. The DoA would own all data contained in the system, and would have final say over the character of that data. The DoA would be able to determine its own policies for who could view, contribute to, and edit the system's data, such as archaeological research missions, other Jordanian government agencies, and the general public. Given that the system was to be Web based, it could potentially be accessible internationally to anyone with Web access. GCI-WMF intended to develop MEGA-Jordan so that it would be readily extensible and configurable for Iraq as well as other Arabic-speaking countries in the region. After holding extensive discussions with the DoA, GCI-WMF employed GIS consultants, Farallon Geographics Inc. in San Francisco, to build a system that is designed to address the conservation and management needs that are commonly faced by heritage authorities.

Requirements Gathering, Risk Analysis, and System Design

GCI-WMF began the process of developing MEGA-Jordan by identifying the required content and functionality to respond to the needs of the DoA, as well as the SBAH and other potential users. This need was addressed in two ways. First, GCI-WMF studied international practices in inventorying, assessing, and monitoring heritage places, including reviewing inventory data content and related standards, inventory administrative systems, and inventory information technologies. Systems and methodologies were reviewed in North America,[12] England,[13] the Middle East,[14] Australia,[15] and New Zealand.[16] As part of this review, GCI-WMF consulted international heritage documentation and inventory standards, including the ICOMOS *Principles for the Recording of Monuments, Groups of Buildings, and Sites* (1996), the Council of Europe *Core Data Standard for Archaeological Sites and Monuments* (1998), and the Council of Europe *Guidance on Inventory and Documentation of the Cultural Heritage*.[17]

Second, GCI-WMF engaged in requirements gathering in Jordan, with both the DoA and other stakeholders. Requirements gathering, also known as requirements analysis or requirements elicitation, is a common activity within software engineering and development that has been defined as the process through which one

> gathers, understands, reviews, and articulates the needs of the software project's stakeholders and users. Elicitation involves fact-finding, validating one's understanding of the information gathered, and communicating open issues for resolution. The

objective of this activity is to create a complete list of what the users believe are important requirements.[18]

This effort conducted in May 2007 involved extensive interviews, including with DoA leadership, inspectors, and other staff in the department's Amman central and local offices across the kingdom; national authorities, such as the Ministry of Tourism and Antiquities, the Lands and Survey Department, and the Royal Jordanian Geographic Center; local authorities, including city governments; and various international archaeological institutions based in Jordan. Through this process, a MEGA-Jordan team was established by the DoA consisting of sixteen DoA personnel who provided input during the development.

On the basis of what was learned from the requirements-gathering effort, system use cases—which are descriptions or scenarios of a specific interaction that different types of users may experience with a system—were developed. Also, potential risks to the successful deployment of the system were identified, along with mitigation strategies, and all were documented in an August 2007 report prepared by the project team. The report was shared with the DoA director general for comments and a review of the team's approach.

The fundamental design requirements identified for the MEGA system include the following:

- The system should reflect a primary priority of conservation, protection, and management, with a secondary priority of scholarly research. This reflected the priorities both of GCI-WMF and the DoA. This criterion in particular was fundamental in determining the systems' content and functionality.
- The system should be Web based to provide wide access.
- It should have a bilingual, Arabic-English user interface and be capable of handling data in both languages.
- It must ensure, wherever possible, consistent and valid entry of information.
- The software tools used to build the system must be open source and nonproprietary, providing that (1) there are no associated licensing or upgrade fees given the limited resources of the DoA as well as the SBAH and other heritage authorities; and (2) the software code will be accessible (i.e., not locked) to be more easily maintained, customized, augmented, and adapted by the DoA, the SBAH, and other adopters of the system in the future.
- The system must be easy to use and not require extensive training for the vast majority of people using the system. In particular, general users need not be GIS experts. This requirement was seen both as enabling wider and more frequent use of the system and helping to minimize ongoing staffing costs for the system's implementation. More specialized users, such as those involved in the system's administration and maintenance, require more in-depth training.
- It must have full compatibility with other types of GIS systems (e.g., ESRI's ArcView, Google Earth™, and Quantum GIS) to allow an exchange of data with other

government authorities as well as scholars whose activities either relate to or may impact heritage sites.

- All data must be secure and the system should provide various levels of user access based on user roles—that is, some users will have full access to all functionality within the system, while others may have read-only access to the data.
- The system must track all changes to the data, providing an audit report showing time and date of the change and identification of the person making the change.
- The system must include easy, instant reporting capabilities.
- It must provide the ability to prepare data electronically from the field, including when Web access is not available.
- The system must allow the addition of content and tools to inventory, monitor, and manage historic buildings without requiring its major redevelopment. Although the DoA was not responsible for heritage buildings in Jordan at the time of the system's design, the SBAH in Iraq does have such responsibility and other heritage authorities are responsible for both archaeological sites and historic buildings.

Out of the risk analysis, the report also identified key determinants for MEGA-Jordan's long-term use, which included:

- engagement of DoA leadership in the development process and the need to work closely with DoA staff members who will be the administrators and primary users of the system; securing their buy-in early in the development process is essential because they must ultimately, if deployment is to be sustainable, take ownership of the system;
- identification of a DoA project manager and appropriate staffing for system administration;
- integration of the system with daily activities of the DoA at both national and regional levels, as well as regular coordination of data with other national and local governmental authorities;
- management of the system by the DoA as a program within the department—that is, it requires an ongoing sustained effort rather than being treated as a project of limited duration;
- implementation of standards for data acquisition and system population to ensure data integrity;
- ongoing training of system administration staff, as well as other DoA users, in collecting data and using the system as a management tool;
- identification and ongoing commitment of a budget within the DoA for system maintenance and periodic hardware and software upgrades;
- thorough system documentation;
- engagement of other stakeholder institutions.

Following further discussions with the DoA leadership, the project team prepared a plan for development.

Data Collection Forms and Data Development

Data Collection Forms

Before development of the software could begin, the specific information to be collected on each archaeological site needed to be confirmed. Based on what was learned from the requirements-gathering effort and the results of research into established inventory standards as well as site assessment and monitoring systems, the information to be collected was identified, and it was determined that it should be divided into the following three main categories in order to facilitate its collection and management:

1. Site-level data: this information includes site names; site significance; coordinates of the site boundary (representing a polygon); and, if appropriate, a site buffer zone.
2. Site element-level data: this information includes site element type (e.g., temple, mosque, cistern); cultural periods; and coordinates of the extent of the site element (identified as a point, line, or polygon).
3. Monitoring data: this information, which can be either for a site or a site element, includes overall condition; disturbances (impacts that have already occurred); threats (impending impacts); ownership; potential violations of the Jordanian *Law of Antiquities*; and management recommendations.

Once the specific fields were reviewed and approved by the DoA scientific committee, detailed data collection forms were developed in English and Arabic. Subsequently, valid entries for most fields were identified and given a numeric code, and code cards were created, also in English and Arabic. The use of those forms is supported through the provision of written guidelines explaining each field in the forms and providing guidance on filling out the forms, as well as visual glossaries for site element types that provide concise written definitions as well as exemplary visuals. Those guidelines and glossaries have been prepared in both Arabic and English. Using hard copy forms to collect data in the field, albeit very low-tech, is a practical alternative to the advanced digital options for data collection offered by MEGA-Jordan and other GIS applications and is useful as a backup record in supporting and facilitating the DoA's ongoing data recording, clean up, and entry process.

Data Development

Anticipating the need for complete, authentic data in the system in order to thoroughly test a prototype of it, an effort to collect new data was launched in 2008. (The DoA's existing digital legacy data from JADIS does not contain polygon information for site boundaries; it is limited to point data only.) Using Quantum GIS, a free open source desktop GIS tool, six DoA staff members were trained in the collection and preparation of data that was intended for eventual import into the newly developed system. During this period DoA staff identified the spatial extent of over four hundred sites in the Amman and Irbid


MEGA
Version 5.0.10/09
#2a NEW SITE ELEMENT FIELD CARD (with Boundary)
#٢أ بطاقة ميدان عنصر جديد للموقع (مع الحدود)
Site Identification
تحديد هوية الموقع
Investigator(s) الباحث
Investigator(s)' Institution المؤسسة التابع لها الباحث
Investigation Date التاريخ للبحث
SITE Primary Name الأسم الأساسي للموقع
MEGA Site Number (if not new site) رقم الموقع مجا (إن لم يكن مرقما جديدا)
SITE ELEMENT
عنصر الموقع
Element Code الرمز
ELEMENT Primary Name الأسم الأساسي للعنصر
Other Element Name(s) الأسماء الأخرى للعنصر
Period Code(s) رمز (رموز) الفترة
Topography Code الرمز الطبوغرافي
Sketch of SITE ELEMENT
المخطط عنصر الموقع
Approximate Sketch Scale:
مقياس تقريبي للمخطط:
Elevation (m) الأرتفاع عن سطح البحر
Site Element Coordinates minimum of 3 coordinates)
احداثيات الموقع الحد الأدنى ثلاث احداثيات
Coordinate# #الإحداثيات
Longitude Example: 36.xxxxx E خط الطول مثال:
Latitude Example: 31.xxxxx N خط العرض مثال :
Comments:
تعليقات :
Additional coordinates on attached sheet
اية احداثيات أخرى تدرج على صفحة لاحقة

Figure 2. The MEGA-Jordan card for recording site elements. (J. Paul Getty Trust/World Monuments Fund)

governorates and prepared shapefiles containing polygonal site boundaries for subsequent import into the new system.

System Development, Technology, Functionality, Content, and Uses

Development Process and Technology

Development of MEGA-Jordan began in June 2008 and was completed in June 2010. The application development process began with a design study by the development team to explore the overall layout and user interface for MEGA-Jordan. A primary goal of the user interface design study was to allow GCI-WMF, DoA, and the development team to quickly explore several possible designs and identify the optimal layout. Based on results of the design study, a functional prototype of the MEGA-Jordan application was developed using the field data collected during the data-development phase to test an early working ver-

MEGA

CODE CARD #2 TOPOGRAPHY & MONITORING

Site Element Topography

1001	Alluvial Fan	مصب / رملة	1002	Cliff	جرف
1003	Cutbank	جرف النهر	1004	Dune Field	كثبان رملية
1005	Hilltop	قمة التلة	1006	Plain, Alluvial	سهل غريني
1007	Plain, Non- Alluvial	سهل غير غريني	1008	Plateau	هضبة / سهل واسع
1009	Playa	أرض جافة	1010	Ridge	تلة / سلة
1011	Slope	سطح منحدر	1012	Terrace	مصطبة
1013	Valley Bottom	قعر الوادي	1998	Other Topography (Specify)	الطوبوغرافية الأخرى (حدد)
1999	Unspecified/Unknown Topography				طوبوغرافية غير معروفة / غير محددة

Site Monitoring Codes

THREATS(s): future threats/risks to site					
Threat Group 1 : **Agriculture** & Similar Impacts					
2101	Animal Pen/Shelter	حظيرة حيوانات / مأوى	2102	Deep Plowing	حراثة عميقة
2103	Fruit/Olive Grove	بستان فواكه / زيتون	2104	Grazing	رعي
2105	Irrigation	ري	2106	Land Reclamation	استصلاح الأراضي
2107	Plowing	حراثة	2108	Reforestation	تحريج / زراعة حرجية
2109	Terracing	مدّاميل / مصاطب	2110	Threshing Floor	أرضية لدرس القمح
2198	Other Agricultural Impacts (Specify)				التأثيرات الزراعية الأخرى (حدد)
Threat Group 2 : **Development** & Similar Impacts					
2201	Bulldozing	تجريف بالآليات	2202	Inundation (By Dam)	مغمور بالماء نتيجة بناء سد
2203	Mining	منجم	2204	Quarrying	مستجر/مقلع
2205	Road Work	انشاء طرق	2206	Trenching, Canal	خندق، قناة
2207	Trenching, Pipeline/Sewage/Aqueduct	خندق (مواسير / مجاري) أو شبكة مياه أو نظام قديم	2208	Urbanization	التمدن
2209	Vibrations, Automobile/Truck	الاهتزازات : سيارة / شاحنة	2210	Vibrations, Railroad	الاهتزازات: خط السكة الحديدية
2296	Other Development Impacts (Specify)				التأثيرات العمرانية الأخرى (حدد)
Threat Group 3: **Human** & Similar Impacts					
2301	Air	تلوث هواء	2302	Bedouin Camp	مخيم بدوي
2303	Dumping	مكب / طمم	2304	Looting/Theft	نهب / سرقة
2305	Military Activities	نشاطات عسكرية	2306	Modern Tombs/Cemetery	مدافن حديثة / مقبرة
2307	Reuse of Ancient Masonry	إعادة استعمال مبانٍ قديمة	2308	Reuse of Ancient Structure	إعادة استعمال منشآت قديمة
2309	Vandalism	تخريب	2398	Other Human Impacts (Specify)	التأثيرات البشرية الأخرى (حدد)
Threat Group 4: **Natural** & Similar Impacts & **Deterioration**					
2401	Animal (Non-Domestic) Impact	أثر الحيوانات غير الداجنة (البرية)	2402	Collapse - Wall/Superstructure	انهيارات / انزلاقات
2403	Earthquake	هزات أرضية / زلازل	2404	Erosion, Water	تعرية / مياه
2405	Erosion, Wind	تعرية / رياح	2406	Fire	حريق
2407	Flooding (Not By Dam)	الفيضانات (ليس بواسطة السد)	2408	Land/Rock Slide	انزلاقات أرضية / صخرية
2409	Rising Damp	ارتفاع الرطوبة	2410	Vegetation (Non-Agricultural) Impact	تأثير الغطاء النباتي (غير الزراعي)
2498	Other Natural Impacts & Deterioration (Specify)				التأثيرات الطبيعية الأخرى والتدهور (حدد)
Threat Group 5: **Site Management** & Similar Impacts					
2501	Inappropriate Archaeological Excavation	تنقيب أثري غير مناسب	2502	Inappropriate Conservation/Restoration	حفاظ/ ترميم غير مناسب
2503	Inappropriate Maintenance	صيانة غير مناسبة	2504	Tourism Concessionar Activities	أثر النشاط السياحي
2505	Tourist/Visitor Activities	النشاطات السياحية والزوار/أثر السياحة	2598	Other Site Management Impacts (Specify)	أثر القرارات الإدارية الأخرى (حدد)
Threat Group 6: **Other**					
2998	Other Threats (Specify)	تهديدات أخرى (حدد)	2999	No Threats Observed	لا توجد تهديدات

Figure 3. The MEGA-Jordan monitoring card. (J. Paul Getty Trust/World Monuments Fund)

sion. The functional prototype allowed project team members to confirm that the interface design, functional capabilities, and database structure were viable.

This work also entailed the selection of a set of open source and free software tools to incorporate in the development. The MEGA-Jordan system was developed using open source software tools including PostgreSQL with the PostGIS extension, GeoServer, OpenLayers, and ExtJS.

A major benefit of using open source software is its ability to support well-established standards for encoding geospatial data and accessing data using Web services. In particular, MEGA relies on standards developed by the Open Geospatial Consortium (OGC) for storing and managing geospatial data in relational databases like PostGIS. The application also uses OGC specifications for accessing geospatial data via Web services such as the Web Mapping Service (WMS). MEGA was developed using the MVC (Model View Controller) pattern to enhance the modularity of the application codebase. The application was written in C#, and uses the .NET framework. To promote interoperability, MEGA relies on JavaScript, OpenLayers, and the ExtJS library to render the user interface and map data. The system additionally incorporates Google™ imagery as basemap data, as well as cadastral data obtained from Jordan's Department of Lands and Survey showing land

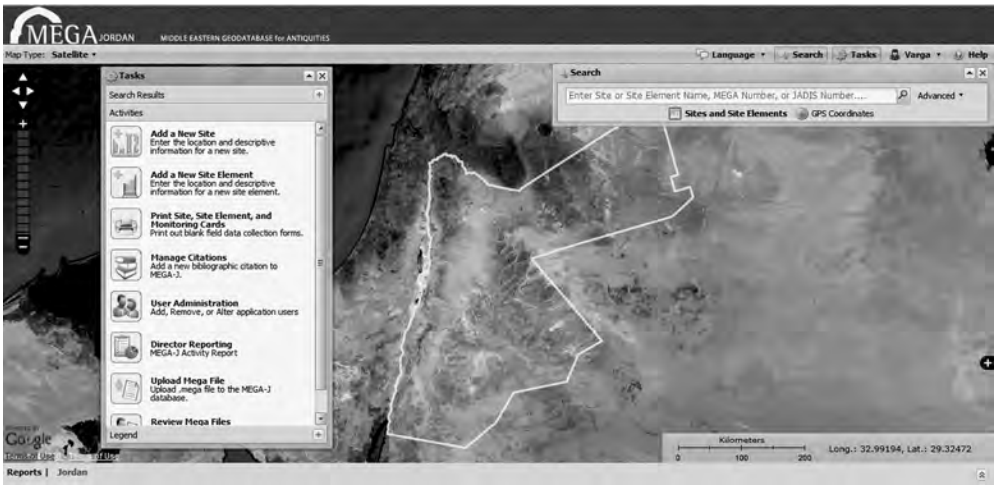

Figure 4. The MEGA-Jordan Web user interface. (2010 Google, Map Data © 2010 Digital Globe)

ownership parcels in selected areas of Jordan. Compliance with the OGC standards ensures that the system is compatible with, for instance, other desktop GIS applications, common Web browsers, and Google™ imagery. It may also utilize other types of basemap data, including georeferenced satellite imagery, aerial photography, topographic maps, or vector map data, if they become available. The MEGA software code is also thoroughly documented so that the DoA, the SBAH, and others who adopt the system in the future may readily maintain, upgrade, and adapt it.

System Functionality

In accordance with the previously stated design criteria, MEGA-Jordan also includes the following functionality:

- Users access the system through a Web-based, Arabic-English user interface. All controlled lists are bilingual, and text data may also be entered and searched in the system in both Arabic and English.[19]
- The system allows the DoA to assign various levels of access to individuals using MEGA-Jordan based on defined roles. Some users may be granted full access to all functionality and the ability to add and edit sites and their attributes, approve new sites, run administrative reports, and import and export data. Other users may only be granted access to search and view the data.
- The system enforces and promotes the standardization of data through (1) data validation rules (e.g., geometries of sites and site elements entered must be located within national boundaries; geometries of sites and site elements must be valid in form according to the OGC standards; for any site or site element entered into the system, it is mandatory to enter certain information, such as geometry indicating

spatial location, site primary name, investigator name, and date of investigation) and (2) the incorporation of controlled vocabularies wherever possible.

- The system provides a custom-made, so-called MEGA File tool, which may be downloaded from the MEGA website and installed on a local user's computer. It allows for compatibility (for both data import and export) with other types of GIS systems such as ESRI's ArcView, Google Earth™, and Quantum GIS, thereby facilitating easy exchange of data with other government authorities as well as scholars. Advanced GIS analysis capabilities contained in other software packages were purposefully not built into MEGA in order to focus MEGA on its core purposes—inventorying, monitoring, and managing heritage sites—and to limit its complexity and the training required for its use. The MEGA File tool is intended to allow data from MEGA-Jordan to be easily exported for analysis within other GIS applications. GCI-WMF have trained DoA staff to use Quantum GIS and to be able to perform specific types of advanced GIS operations that address the DoA's needs. The MEGA File tool enables a user to prepare data electronically from the field, including when Web access is not available.
- The system allows for automatically producing preformatted, printable detailed reports for sites and site elements. The built-in reports generally encompass all data contained in the system for a given site or site element, including a map showing their location and extent. Built-in reports may also be produced showing all of the data contained in the system for a given site or site element monitoring event. Reports can also be exported as .csv files for national, governorate, and subgovernorate administrative levels.

System Content and Uses

The Inventory

The foundation of the data contained in MEGA-Jordan is an inventory of Jordan's archaeological sites, including information describing their location, extent, significance, and other basic characteristics. Archaeological sites are recorded at two levels—the "site" level, which is generally defined as a contiguous area of archaeological remains that requires protection, and the "site element" level, which is defined as a distinct component of a site, such as a temple, a cistern, or a city wall. The system contains a controlled list of site element types. More specifically in this regard, MEGA-Jordan contains the following information:

- The system records boundaries of sites and their elements, as well as site buffer zones. Boundaries may be recorded either through digitizing directly using the MEGA-Jordan Web interface, entering GPS coordinates, or importing boundary geometry from another GIS application.
- For sites, the system allows for recording significance assessment information organized according to a range of heritage values.[20] This information is necessary to determine the relative importance of heritage places and their individual elements,

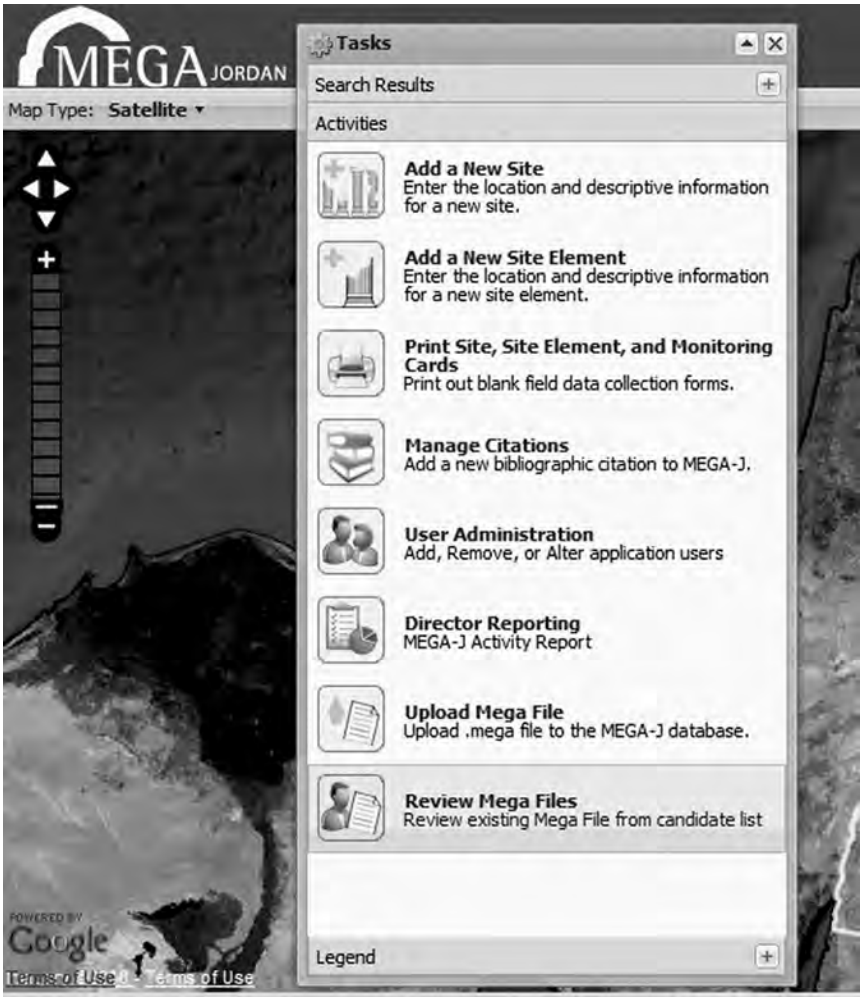

Figure 5. The user interface task bar, which allows for adding sites and site elements, printing monitoring cards, managing bibliographic citations, user administration, producing activity reports, and uploading and reviewing MEGA files. (2010 Google, Map Data © 2010 Digital Globe)

which is in turn essential to establishing priorities for decision making for heritage planning, conservation, and management.

- For site elements, MEGA allows for recording their type and associated cultural periods of use (both based on controlled lists specific to Jordan).
- Bibliographic citations may be attached to each site and site element record. Users may select from an extensive collection of bibliographic records related to the archaeology of Jordan that are already contained within the system, which may be edited or augmented.

Monitoring and Management

Built on top of this inventory is MEGA-Jordan's content and functionality for monitoring, managing, and protecting sites. As mentioned with respect to the MEGA-Jordan

monitoring form, the system provides for recording condition-monitoring events at both the site and site element levels. Multiple monitoring events can be recorded and each is time stamped to indicate conditions at a particular point in time. Recorded monitoring information includes ownership status, disturbances, threats, and overall condition as well as threat ratings, possible violations of the Jordanian *Law of Antiquities*, and management recommendations to address issues of concern. Each of these types of information is recorded using controlled lists, which standardize the data, making it comparable over time. Image and PDF files may be attached to each monitoring record to complement text data—for example, in the form of photographs illustrating site conditions or more in-depth condition assessment reports. Through the DoA's monitoring of sites in the field as part of its MEGA-Jordan data collection activities, a number of significant threats have been identified to date, resulting in notification letters to the DoA director general and follow-up actions to mitigate the threats. At the World Heritage Site of Petra, MEGA-Jordan is now being used as a tool to comprehensively record individual site elements using the GPS coordinates of their locations and to document threats to each recorded site element through a risk-mapping project being carried out by the UNESCO Amman office, in partnership with the University of Leuven's Raymond Lemaire International Centre for Conservation, the Department of Antiquities (DoA), and the Petra Development and Tourism Regional Authority (PDTRA).

Beyond its capabilities for detailed monitoring of sites and site elements, MEGA-Jordan is designed as a tool to assess the potential impact on heritage sites of planned development, such as roadways, pipelines, reservoirs, and the construction of buildings, and proactively prevent damage before such projects are implemented. This function is especially needed in Jordan, which in recent years has experienced rapid urbanization, particularly as a result of the influx of an estimated one million refugees from Iraq following its invasion in 2003. In Iraq the SBAH has indicated that a number of substantial development projects will soon be implemented there as well. MEGA may be used to prevent damage to heritage sites resulting from development as well as to direct development to areas that are not archaeologically sensitive. This may be done either through sharing data with other government agencies involved in development planning, or through the system's polygon search function, which allows users to search for sites within a user-defined polygon, which can correspond to the extent of a planned development project. The DoA has used the system to date in this way, for example, in responding to applications from companies who wish to explore for minerals, including uranium and oil shale, in specific areas of Jordan. The DoA has used MEGA's polygon search function to determine whether these planned projects would adversely impact archaeological sites, and to respond accordingly.

MEGA-Jordan has also been designed to be used as an aid in heritage planning. For instance, it has the potential to be used as a tool for planning at a site level. The previously mentioned risk-mapping project in Petra, which is using MEGA to record threats and disturbances to individual site elements, is using its detailed assessment to lay the groundwork for the development of a proposal of a risk management plan for Petra Archaeological

Figure 6. The MEGA-Jordan Web user interface showing system data for a particular monitoring event, as well as a site's recorded boundary, buffer zone, and recorded site elements. (*Data shown are fictitious and for illustration only.)* (2010 Google, Map Data © 2010 Digital Globe)

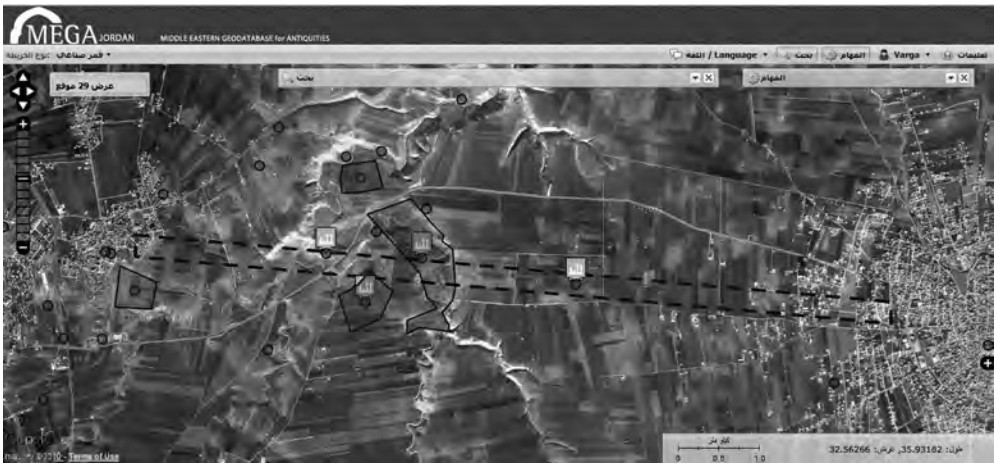

Figure 7. This screenshot depicts a user-defined polygon search (represented by the dashed rectangle) for sites in the area of a simulated construction project. Sites falling within the search polygon, and that would thus be impacted, are highlighted with icons. (2010 Google, Map Data © 2010 Digital Globe)

Park. The project is also using MEGA as a tool to record the boundary of the World Heritage Site.

For detailed planning, the data that it contains on a given site could be exported to another desktop GIS application for use in analysis and drawing up proposed interventions. It also has the potential to be used for heritage planning within urban contexts, indicating the extent and characteristics of archaeological sites within a given city, which can be used to assess potential opportunities for presentation to local residents for educational purposes as well as tourists.

Research

MEGA-Jordan has also been designed to be a tool for both identifying areas of Jordan for new research, and carrying out specific research queries. For the DoA, the system has the potential to be employed as an instrument for formulating national research strategies. MEGA-Jordan allows for the recording of geographic areas within Jordan covered by past archaeological surveys. For each survey, the system also records the institution and investigator who conducted the survey, when the survey was conducted, and all sites recorded through those surveys. By displaying which areas of Jordan have and have not been investigated through surveys, the system can be used to help identify which areas are in need of investigation. This provides the DoA with the possibility to direct scholars applying for research permits to carry out investigations in those locations. The system's survey functionality also can aid in its use for protecting sites from development. If a development project is planned in a given area, persons using the system can know whether that area has already been surveyed in the past to identify sites or whether a new survey should be commissioned to determine whether sites exist in the area that would be impacted.

MEGA's advanced search capabilities also provide for more targeted research, whether for the purposes of site protection, for interpretation and presentation of heritage sites, for tourism planning, or for scholarly purposes. The advanced search function allows users to search the system with essentially any combination of fields as well as at varying geographic scales, whether for an entire nation, a particular governorate, within a user-defined polygon, or within the geographic extent visible in the user interface. For example, a user may search monitoring records to determine recent looting disturbances at a country or regional level to assess patterns of looting activity, and in turn strategically deploy site security personnel. A user may also identify all recorded site element types from a certain cultural period—for example, all Umayyad mosques in Jordan.

Implementation of MEGA-Jordan

Pilot Implementation, Testing, Training, and Nationwide Deployment

To ensure that MEGA-Jordan meets the real-world data entry and reporting needs of DoA staff and other stakeholders, a pilot implementation of MEGA-Jordan was conducted in the summer of 2009 at the DoA's Amman office and at its regional office in Irbid. The primary purpose was to test all technical aspects of the system within the DoA's computing

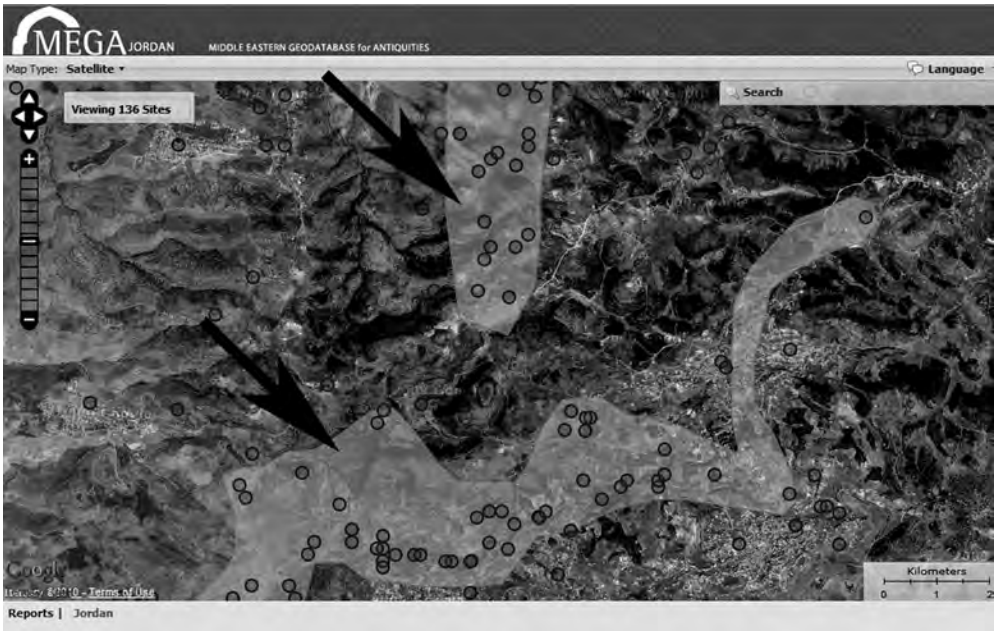

Figure 8. This screenshot shows polygons representing the extent of two archaeological surveys (indicated by arrows) recorded in MEGA-Jordan. The system's information on prior surveys can help identify areas in need of future investigation, particularly in advance of planned development projects. (2010 Google, Map Data © 2010 Digital Globe)

environment. Because MEGA-Jordan is a Web-based system, the pilot implementation provided a realistic test of the DoA's computer network and Internet service. Selected DoA personnel from the two offices were trained in the use of the pilot system. This included providing system administrative training and technology transfer support. Based on this pilot implementation and testing effort, DoA leadership and other personnel identified and requested changes to the system. The DoA and GCI-WMF teams worked with the consultant developer to prioritize the functional capabilities that required improvement based on users' feedback.

After the application was updated to reflect the issues identified, a second pilot-testing phase was undertaken through the same DoA offices to ensure that the system's functionality was acceptable to the DoA. The pilot implementation phase was complete when the design team deemed that all remaining user requested modifications were no longer significant barriers to a full DoA deployment. Testing of the pilot system was conducted over the course of several months.

In anticipation of the system's nationwide deployment, selected DoA staff were trained following a train-the-trainers approach so that they may act as MEGA-Jordan resources for their colleagues. In April 2010, eight DoA trainers came to the GCI for a three-week training program on international heritage standards and guidelines, archaeological site assessment, GPS, and the use of MEGA-Jordan and QuantumGIS. This training also included familiarization with draft guidelines and glossaries prepared for the MEGA-

Figure 9. Department of Antiquities trainers being trained in the use of QuantumGIS for advanced use of MEGA-Jordan. (Michael Aronowitz, ©J. Paul Getty Trust/World Monuments Fund)

Jordan site and monitoring cards. Follow-up training was provided in Jordan to the same group of DoA trainers in July 2010.

In December 2010, the DoA MEGA trainers completed the first round of implementing a plan to initially train new DoA users in all of the department's offices throughout Jordan. Through these efforts an additional fifty DoA personnel from all twelve Jordanian governorates were trained to use the system. This training has been aided through the creation of a number of tutorial videos available on the MEGA-Jordan user interface that demonstrate how to carry out different tasks in the system, such as creating and editing sites and site elements, entering and editing monitoring events, and using the system's searching features. These videos currently appear with English audio instructions, and GCI-WMF plans to create Arabic versions as well.

As of that point in time, the DoA officially began its kingdomwide deployment by regularly entering and editing data in the MEGA-Jordan production system. The production system is the version of MEGA-Jordan deployed to contain official data. The production system is distinguished from a parallel training version of MEGA-Jordan, which is used for training and demonstration purposes and contains some test data.

To help ensure that scholarly archaeological missions working in Jordan contribute data to MEGA, the DoA is also currently revising its guidelines that apply to those missions. The revised guidelines will require that all missions contribute data to MEGA-Jordan in order for the missions to be eligible to apply for a new research permit. This

would effectively prohibit missions from working in Jordan if they do not contribute data produced from their fieldwork to MEGA-Jordan.

In April 2011, under the patronage of Her Royal Highness Princess Sumaya bint El Hassan—who serves as the vice chair of the board of trustees of the Jordan Museum—the GCI, the DoA, and WMF officially commemorated the nationwide implementation of the MEGA-Jordan system. At the same time, the DoA made the MEGA-Jordan system fully viewable on the Internet by the general public at www.megajordan.org.

Status of Data in the System

The system currently contains legacy data imported from the DoA's previous system, JADIS, on over 10,400 sites throughout Jordan. It also contains new data of over four hundred sites that were collected by the DoA during and since the data development phase in 2008. Because much of the legacy data was extracted in the early 1990s from archaeological reports dating to that period and earlier, most site locations were recorded by reading topographic maps rather than through GPS technology. The site locations within the legacy data therefore tend to have limited accuracy and precision. Site locations in the legacy data were also recorded with only one geographic coordinate pair, whether sites were the size of a shard scatter or an ancient city. That data therefore has limited utility in protecting sites from development. One of the first tasks for the DoA in implementing MEGA-Jordan therefore has been to further develop that legacy data and record more accurate, precise site and site element boundaries as polygons that reflect their true archaeological extent.

DoA Roles and Responsibilities

The day-to-day management of MEGA-Jordan is carried out by a newly formed MEGA-Jordan Unit under the DoA's Studies and Publication Directorate. The unit's staff have a number of key responsibilities, including managing user access, preparing regular system reports, coordinating and sharing data and reports with institutions outside the DoA, providing guidelines and assisting academic archaeological missions and other scholars in the submission of data, and generally helping validate and integrate data into the system.

The DoA also created a permanent MEGA-Jordan scientific committee comprised of Jordanian university professors, representatives of international archaeological institutions, and DoA staff members to serve the purposes of providing advice on data standards and guidelines, and providing ongoing input on the need to add or change system content and functionality. The scientific committee also reviewed the pilot system and provided input concerning its content and functionality leading up to the finalization of its design.

Ongoing data collection and input responsibilities are generally distributed throughout the DoA offices in the kingdom's twelve governorates. Each DoA office is headed by an inspector who has responsibilities in tasking out data collection and input to staff under his or her supervision, and reviewing and approving the data that they produce to ensure its quality.

System Monitoring and Maintenance

GCI-WMF have committed to the DoA to provide ongoing system monitoring and maintenance support to MEGA-Jordan for a period of two years following nationwide system deployment. This includes review of system performance, technical issue resolution, and training of a DoA database manager, who will be responsible after the end of the GCI-WMF maintenance period for supporting and maintaining the system servers and managing updates and other technical issues with the system. During the GCI-WMF maintenance period, the system is operating on a server and network, and is backed up on a second server in the United States through services paid for by GCI-WMF. The intent of this period of GCI-WMF monitoring and maintenance is to ensure it is functioning correctly, and to provide DoA system administrators with access to reliable technical experts who can assist them as they become familiar with the day-to-day system monitoring and maintenance tasks during the transition to full DoA system management.

At the end of the GCI-WMF maintenance period, and after the DoA has hired its own database manager, the system will be transferred to servers managed by the DoA, or to a hosting service of the DoA's choice, and the DoA's technology staff will be responsible for its day-to-day management. In the future the DoA will also need technology staff, or the services of a consultant, with programming skills to make periodic updates to the MEGA software, possibly necessitated by information technology changes at the DoA, such as the implementation of updated versions of operating systems and Web browsers. The DoA will also require access to such skills if it wishes to modify or expand the functionality of MEGA-Jordan. As mentioned before, GCI-WMF have provided that the MEGA software code is well documented so that IT specialists may readily maintain, upgrade, and adapt it in the future.

Adapting MEGA for Iraq

Since completion of development of MEGA-Jordan, GCI-WMF have moved forward with adapting MEGA-Jordan for use by the Iraq SBAH. The first phase in this process has been to adapt the existing MEGA-Jordan system for archaeological sites to an Iraqi context. Substantial work required for this step was already completed during the initial efforts to create an Iraq GIS, such as the establishment of Iraqi archaeological periods and site element types. In April 2011, GCI-WMF made available to the SBAH a prototype of the MEGA-Iraq system for archaeological sites. This step was initiated through a meeting between GCI-WMF and the SBAH in Jordan to discuss the system's functionality, how it should be further modified to meet SBAH's needs, and requirements at the SBAH in terms of Internet access, personnel, and training. The DoA also shared with the SBAH its experiences in using the MEGA system in Jordan. Since that time the SBAH has been adding data on Iraqi archaeological sites to the system and has been providing feedback to GCI-WMF for tailoring the system to its needs. GCI-WMF are now beginning work on the second phase in adapting the MEGA system for Iraq, which is focused on defining and then developing system functionality for inventorying and managing other heritage types,

Figure 10. Gathering requirements for inventorying historic buildings with Iraq SBAH personnel in 2005. (Rand Eppich, ©J. Paul Getty Trust/World Monuments Fund)

such as historic buildings and structures, architectural ensembles, and cultural landscapes and routes. Groundwork for this task was also laid during initial work on an Iraq GIS.

GCI-WMF have been looking to international best practices in defining the system's new functionality for these other heritage types.[21] As the SBAH continues to become more familiar with the MEGA-Iraq system through using it with respect to Iraq's archaeological sites, the institution will be in a better position to provide input on adding functionality to the system for other heritage types. In Jordan, the DoA has recently been made responsible for the kingdom's historic buildings, urban heritage, and cultural landscapes.[22] After functionality for heritage types other than archaeology has been developed for MEGA, it also will be added to MEGA-Jordan.

As was the case with Jordan, GCI-WMF plan to hold multiple training activities for SBAH staff on the use of the MEGA-Iraq system and similarly plan to follow a train-the-

trainers approach. GCI-WMF will also continue discussions with the SBAH about ongoing administrative requirements for the MEGA-Iraq system, such as staffing, improved Internet access in SBAH offices throughout Iraq, data quality control including maintaining standards and guidelines for data collection, and approaches to obtaining and reviewing data from archaeological research institutions. GCI-WMF have also committed to the SBAH to provide for maintenance of MEGA-Iraq for two years after the system's nationwide deployment in Iraq, as it has in Jordan.

Wider Dissemination of the MEGA Core System

After fulfillment of their commitments to Jordan and Iraq, GCI-WMF intend to more broadly disseminate the MEGA core system to heritage governmental authorities or to any range of other heritage-related institutions, whether at international, national or other scales. GCI-WMF have received numerous expressions of interest from various parts of the world in obtaining the system. The system was designed and developed to be flexible and extensible so that it may be readily adaptable by other heritage authorities in the future. The current languages of the user interface—English and Arabic—may be substituted with other languages, or more languages may be added. Before the MEGA core system will be ready for broader dissemination, GCI-WMF will first need to develop a licensing arrangement for wider use to ensure that it is employed as it is intended (for conservation, management, and research of cultural heritage), further develop a dissemination strategy, and determine the best means for sharing the system with others. GCI-WMF also plan to prepare and provide written guidance for all those who will adopt the system explaining the requirements and steps for them to configure, install, use, and maintain the system in the future.

Conclusions

Given that the DoA's nationwide implementation of MEGA-Jordan has just begun, it is premature to fully assess the results of the system's implementation in Jordan. However, the authors believe that MEGA's long-term, sustained use in Jordan will require the following:

- that the DoA leadership make its use and support an institutional priority;
- integration of the system's use throughout the DoA's daily activities;
- use of the system, and particularly contribution of data, by scholarly research institutions; and
- advocacy for the system's use and support by parties outside the DoA with an interest in heritage conservation and archaeology, such as by political leaders, nonprofit organizations, and scholarly research institutions.

We believe that MEGA's long-term and sustained use in Iraq will depend on similar requirements, including the establishment of improved Internet access at the SBAH's

offices throughout Iraq. The level of Internet access at SBAH offices, including in Baghdad, is currently quite limited.

Looking more generally at the outcomes of the system's development to date, MEGA is a tool that establishes a national standard for baseline documentation of heritage sites in Jordan, and it is well along the path to doing the same for Iraq. The system enforces and promotes the standardization of data through data validation rules and the incorporation of controlled vocabularies wherever possible. Those documentation standards are enhanced through the provision of written guidelines explaining each field in data collection forms and providing guidance on filling out the forms, as well as visual glossaries of site element types. Those guidelines and glossaries are currently available in both Arabic and English. Given that the documentation standard is embodied in a digital, Web-based system, it lends itself to the widest possible use by the DoA and SBAH (i.e., the system's adopters to date) and outside parties who contribute data to the system, such as archaeological research missions.

The system has been designed to serve a number of purposes that are fundamental to the understanding, appreciation, and management of heritage places. These include (1) heritage place identification, (2) research and analysis, (3) raising awareness and promoting understanding among the public as well as governmental authorities and decision makers, (4) determining needs and priorities for conservation and management, and (5) planning for conservation and management interventions. However, its usefulness for these purposes depends on the system containing data that is both accurate and up-to-date.

Because the system was created using an open source suite of software tools, rather than proprietary software, it is able to support well-established and widely used standards for encoding geospatial data and accessing data using Web services, particularly those developed by the Open Geospatial Consortium (OGC). Compliance with the OGC standards ensures that the system is compatible with, for instance, other desktop GIS applications, common Web browsers, and Google™ imagery. Adherence to such standards also helps provide that if at some point in the future the MEGA system is no longer used in Jordan or Iraq, then the data contained in the system may be readily imported into a different information system. Once GCI-WMF make the system openly available to other adopters beyond the DoA and SBAH, the fact that it has been built using open source software tools also offers the possibility of being adapted and extended to suit the particular circumstances and needs of any other heritage governmental authorities or by any range of other heritage-related institutions, whether at international, national, or other scales. The standard open source software tools with which MEGA has been built are also being continually developed and supported by the steadily growing, international community of open source software developers. The software code is well documented and commented, which will provide the necessary explanatory information for those needing or wishing to modify the code in the future. GCI-WMF also plan to prepare and provide written guidance for all those who will adopt the system that explains the requirements and steps for users to configure, install, operate, and maintain the system in the future.

The development and adoption of open source software applications generally have a number of potential benefits to the heritage field, particularly for institutions with limited resources. Open source software can be purpose-built to the specific needs of the heritage field rather than adding heritage functionality to commercial software. This can in turn allow for limiting system complexity and maximizing ease of use. Most software users typically exploit only a very small percentage of the functionality of commercial software packages and have no choice but to pay for the superfluous bells and whistles. They must also pay for the additional computing-capacity overhead required to run more complex systems (including the higher cost for maintenance) and upgrades encouraged or dictated by commercial software providers. After initial development, open source applications can be made available with no associated licensing or upgrade fees. A GIS system designed to be easy to use can preclude the need to either hire staff with advanced GIS skills or provide extensive training to existing staff. These characteristics can all save substantial costs in the long run. In cases where institutions have limited resources, annual cost savings can equal the salaries of several staff members; and the average salaries of highly trained GIS specialists may be cost prohibitive. However, open source applications should be developed with careful adherence to open source software standards. The adopters of open source software systems will also require access to software programming skills to make periodic updates possibly necessitated by the implementation of updated versions of operating systems and Web browsers, or if they wish to modify or expand functionality. Software code should be well documented so that IT specialists may readily maintain, upgrade, and adapt it in the future.

The authors have noted a number of observations and lessons learned from involvement in the implementation of the MEGA system in Jordan, laying the groundwork for its implementation in Iraq, and studying inventory systems that are being used in other places. First, a heritage inventory should be treated as a living database of information. It needs to be updated and improved on a continual basis and should never be considered to be complete or final, particularly when it relates to heritage on relatively large geographic scales. Heritage authorities should expect to allocate sufficient and ongoing financial, human, and technical resources to support a functioning inventory. The use of a heritage inventory to its full potential requires that the leadership of a heritage authority makes its use and support an institutional priority and may also require advocacy by others. It is recommended that a heritage authority formally recognize its inventory as part of its heritage management process. In some cases this may involve assigning legal protection status to heritage places identified in the inventory. From an administrative standpoint, it is recommended that an inventory be positioned within a discrete, dedicated program of a heritage authority's administrative structure that is focused on identifying, researching, and inventorying heritage places. This program should be well positioned within the authority's overall administrative structure so that it may effectively support the full extent of the authority's heritage management processes. If a heritage authority's financial and human resources are limited, it is recommended to integrate data collection activities within the responsibilities of existing staff rather than creating a new, large, costly bureau-

cracy. Heritage inventories require standards and guidelines to help ensure data quality and consistency. If these measures are put into place, the inventory can serve as a mechanism to establish and enforce core heritage documentation standards for a nation, region, or city. Personnel involved in collecting data should receive ongoing training in the use of standards and guidelines. Once established, standards and guidelines should be continually improved and adherence to them must be enforced. And finally, it is recommended that heritage authorities enter into formal data-sharing agreements with other government agencies whose activities may impact or otherwise relate to heritage sites, as well as authorities who produce and provide cartographic data such as national mapping agencies. Data from these various sources change over time, so data should be shared on an ongoing basis. If properly structured and supported, an inventory system can have an ongoing and vital role as the foundation of heritage decision making, whether at a national, regional, local, or site level.

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19. Users may choose to enter text data into the system in either Arabic or English, or in both languages. The system does not automatically translate text data from one language to another.
20. The heritage value categories contained in MEGA-Jordan are scientific, historical, aesthetic, social, and spiritual. All but the last of these categories are modeled after the *Burra Charter* (1999).
21. A standard of particular importance to identifying content for historic buildings is: Council of Europe, *Core Data Index to Historic Buildings and Monuments of the Architectural Heritage*: *Recommendation R(95)3 of the Committee of Ministers of the Council of Europe to member state on co-ordinating documentation methods and systems related to historic buildings and monuments of the architectural heritage* (Strasbourg: Council of Europe, 1995).
22. Between 2003 and mid-2010, Jordan's Ministry of Tourism and Antiquities was responsible for heritage buildings.