



Economic and Social Council

Distr.  
LIMITED

E/CONF.87/L.1  
18 March 1994

ENGLISH ONLY

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THIRTEENTH UNITED NATIONS REGIONAL  
CARTOGRAPHIC CONFERENCE FOR  
ASIA AND THE PACIFIC  
Beijing, 9-18 May 1994  
Item 4 of the provisional agenda\*

COUNTRY REPORTS ON THE CURRENT STATUS AND ISSUES OF SURVEYING,  
CHARTING AND MAPPING AT THE NATIONAL LEVEL: NEEDS AND  
REQUIREMENTS VERSUS REALITY IN THE REGION

Qatar's Digital Base Map Database

Paper submitted by Qatar\*\*

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\* E/CONF.87/1.

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## INTRODUCTION

In the Middle East, in the State of Qatar, there has been a most amazing transformation. One which is all the more astonishing because of the rapidity by which it took place. Qatar's traditional manual methods of managing its land, and infrastructure have given way, in less than three years, to an extremely sophisticated, highly automated methodology based on a Digital Base Map Database (DBMD) designed with users in mind.

In 1988 two delegates from Qatar, interested in Geographic Information Systems and digital mapping visited Canada. They liked what they saw, particularly in Ontario. It was apparent, from the Ontario model, that the implementation of an effective digital mapping program and GIS first required an in-depth user needs study to determine the ways in which the digital maps and associated GIS technology could and would be used. Qatar enlisted the help of the Canadian Government in carrying out such a User Needs Study. Thus Canada and Qatar became partners in progress. The study was completed in January 1989. Those were the stepping stones that led to the formation of the National Geographic Information Systems (GIS) Steering Committee, The Centre for GIS, and an on-line, high resolution, Digital Base Map Database (DBMD) that has already become a functional tool in the hands of government agencies and citizens alike.

The National GIS Steering Committee, chaired by the Minister, Ministry of Municipal Affairs and Agriculture, reports directly to a group of five of Qatar's fourteen Cabinet ministers and oversees the operation of The Centre for GIS. The Centre in turn is responsible for providing and maintaining a state-of-the-art, on-line DBMD for all of Qatar's urban areas having populations in excess of 1000. This DBMD was compiled with resolutions suitable for the production of 1:1000 and 1:10,000 scale mapping and is topologically structured so as to accommodate the integration, correlation and analysis of a variety of user themes.

The Centre for GIS also provides expertise and training in the operation and use of GIS to the various government

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ministries and assists them in developing and implementing their GIS applications and systems which are integrated with and depend heavily on the DBMD. Thus far personnel from eight of Qatar's fourteen ministries have received in-depth training on the system. Several of these ministries have already begun to reap the benefits of the DBMD and some of its associated features, including a street network complete with street names, numbers, zones and addresses for all urban areas in both Arabic, the native language, and English. The street network component of the DBMD has, in the form of a PC product called Electronic Place Finder (EPF), found its way into the private homes and businesses of Qatar.

GIS Units are being established in all fourteen of Qatar's ministries. Some are in place now, others are in various stages of implementation. The staff of each GIS Unit are responsible for: developing, enhancing and maintaining those applications peculiar to their ministry; maintaining the hardware and software in the Unit; and data capture. Each ministry's GIS Unit has its own work station(s), plotters and digitizers all of which are connected by a high speed data network to each other and to the DBMD at The Centre for GIS.

In the absence of an effective cadastre, Qatar must for the present rely on accurate large scale topographic base maps for the bulk of its land-related applications. The DBMD from which these maps are generated is but one of the exemplary features of the overall system. A general review of the quality assurance standards that have made this DBMD so reliable and useable will be covered in this paper together with some of the unique features of the database that has made it so popular in Qatar.

#### **THE STATE OF QATAR**

The State of Qatar has a population of approximately 400,000 eighty percent of which reside in the capital City of Doha. Situated mid way on the west coast of the Persian Gulf, Qatar covers 11,437 sq.km. The terrain consists primarily of flat rocky surfaces, arid planes and sand dunes, with some fertile areas. The discovery of vast oil reserves in the 1940's increased the economic growth of the state dramatically and contributed to the significantly high values of urban real estate. While many magnificent walled mansions abound in the urban areas of Qatar, many of the traditions of this independent and sovereign state have not changed. Only recently have street signs been erected and addresses assigned to buildings.

#### **THE CENTRE FOR GIS, STATE OF QATAR**

Armed with a comprehensive User Needs Study, the government of Qatar prioritized its tasks. First and foremost was the creation of a unit to develop digital mapping specifications and standards, acquire the necessary hardware and software, develop

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a digital map monitoring capability, train staff and implement the digital mapping program. This work began in the GIS Division of the Ministry of Industry and Public Works but as the work and products produced by this unit began to have an influence on, and effect the work of a variety of different ministries the government moved the unit out from under the control of any single ministry and established The Centre for GIS, State of Qatar.

Once the DBMD was well underway, The Centre for GIS acquired the necessary hardware and software for eight of Qatar's ministries. It hired and trained the managers, analysts, technologists and technicians that are in the GIS Units of each of those ministries. And it established a high speed data network link between them all and itself.

#### **HARDWARE AND SOFTWARE**

After reviewing several operational GIS facilities and investigating the software capabilities available that would meet the needs identified in its User Needs Study, Qatar selected ESRI's ARC/INFO GIS software and DEC VAX hardware.

#### **TRAINING**

The Centre for GIS also has a fully equipped training centre and provides regular training on GIS, ARC/INFO, VMS and related technology to government personnel.

#### **DATABASE SPECIFICATIONS AND DATA DICTIONARIES**

In addition to being responsible for the DBMD, The Centre for GIS is working hand-in-hand with several of Qatar's ministries to develop database specifications and data dictionaries for each of their respective disciplines. The creation and use of these detailed specifications has introduced order and discipline to the collection, naming, coding and storing of data. Not only have they standardized and streamlined data collection and other procedures and techniques in those ministries where they have been implemented but in addition their use has considerably improved such things as field service and inventory maintenance. To ensure they are not taken lightly the following statement of authority is placed on a single page at the beginning of the database specifications and data dictionaries for each of the government ministries:

#### **Authority**

These specifications are administered under the authority of the National Geographic Information Systems (GIS) Steering Committee. It is the responsibility of this committee to provide national

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standards and specifications for all GIS databases in the State of Qatar that are compatible, and provide for effective sharing/exchange of data where such sharing is warranted. These specifications have been approved by the National GIS Steering Committee prior to distribution.

Any changes to these specifications will be made upon approval by the National GIS Steering Committee in order to ensure that this compatibility for data sharing is never jeopardized. Such requests for changes should be submitted in writing to the GIS Standards and Specifications Secretariat, National GIS Steering Committee, P.O. Box 22088, Doha, Qatar.

#### **QATAR'S DIGITAL BASE MAP DATABASE**

At the present time all of Qatar's GIS applications depend heavily on the Digital Topographic Base Map Database. The lack of a comprehensive cadastre magnifies this need. Thus the implementation of an accurate on-line digital map database at resolutions suitable for the many applications that were identified in the User Needs Study was of prime importance.

The hardcopy map sheets themselves irrespective of scale are rectangular in shape being one metre in width by one half metre in height. They are oriented to and structured on the Qatar National Grid which is a modified Transverse Mercator Grid. The map sheets are indexed by an eleven digit number. The first three digits represent the map scale in thousands, the next four the easting and the last four the northing of the southwest corner of the map sheet expressed in hundreds of metres. Qatar's extensive horizontal and vertical control networks helped to ensure base map accuracy.

Both the 1:1000 and the 1:10,000 digital topographic map files are stored as ARC/INFO coverages and are on-line in a read only mode, around the clock, to all users. Since every agency in the State of Qatar uses ARC/INFO for their GIS applications there are no conversion problems to face; and with the standards set by the National GIS Steering Committee, compatibility abounds. This is one of the major reasons Qatar's progress in the development of its GIS has been unimpeded.

In addition to having 1:1000 and 1:10,000 scale digital maps for all urban areas, Qatar has total coverage at 1:500,000 and 1:50,000. It plans to complete 1:10,000 scale mapping for the entire country in the near future.

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## **DIGITAL BASE MAP DATABASE SPECIFICATIONS & DATA DICTIONARY**

Once organized, The Centre for GIS began almost immediately to develop a specification which would provide a highly accurate, on-line Digital Base Map Database. The database provides adequate resolution for the production of customized 1:1000 and 1:10,000 scale maps. It is structured so that all potential users can integrate their own and other themes to the base map features for the purposes of spatial analysis, report generation and graphic display. In April 1990 Qatar's DBMD Specification and Data Dictionary was published. It contains an Introduction; a Glossary of terms and their definitions; the definition of a map sheet; annotation levels; a data dictionary which contains all map feature descriptions, examples, definitions, and codes including building type codes and a hierarchy of feature coding for lines that are common to more than a single polygon feature; it defines the various map sheet layers or coverages together with a list of the features and codes found in each coverage; and lists a series of quality assurance procedures. Mapping contractors were provided with a copy of the specifications and they agreed to meet it.

### **QUALITY ASSURANCE PROCEDURE**

The Quality Assurance Procedure developed by The Centre for GIS is in fact an elaborate, highly automated examination process for monitoring and enhancing the digital map files supplied by Contractors. This quality assurance procedure ensures the digital map files that are entered into Qatar's DBMD are literally error free, and feature representation is complete as of the date of photography. The fact it is highly automated reduces both operational costs and the chance of human error.

### **ELECTRONIC PLACE FINDER**

Another component of Qatar's DBMD is that street addresses have been incorporated with the streets. While beneficial to a Country where street signs and addresses are part of the way of life, this enhancement would not have the magnitude of impact that it has had on Qatar. In Persian Gulf Countries where street names and addresses have not in general been part of the culture, the impact of having street names and addresses in a Digital Base Map Database can be enormous.

Only recently have street signs been erected in Qatar and sequential home address numbers placed on all buildings. The general population did not grow up with them and so they are not yet used to them, nor yet are those who drive emergency vehicles. Traditionally people found their way about the villages and towns of Qatar, as they have in many Middle Eastern countries, by reference to some locally named land mark such as a road roundabout, a mosque or some well known public building or place. Although they were late in coming and are not widely used, Qatar's street signs contain a wealth of information in

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both Arabic and English. Qatar has been divided into zones based on population. The city streets in the urban areas of Qatar have been given street numbers unique to the zone in which they are located. The zone number is depicted along with the street name and the street number on each of the street signs placed at all street intersections. While these signs were a great improvement, they alone did not significantly change the manner in which the people of Qatar find their way about. For example, each road roundabout in Doha has been given a local name which is familiar to most of the townspeople. They are often used by citizens, when reporting a fire to give its general location to the Fire Department. The problem is road roundabouts are often several kilometres apart. Thus one could frequently observe a fire truck rushing to a road roundabout and then sitting there, or driving around in circles looking for the fire until it was found, or until someone came and guided the firemen to the exact location of the fire. Likewise a citizen could order a pizza from a nearby store and not receive it for hours, if at all, because the driver could not find the home to deliver it to. People wanting to take a taxi to the airport would often drive to the taxi stand and have the taxi driver follow them home, where they would leave their car and then take the taxi to the airport. These are true stories, but things are beginning to change thanks to the DBMD and its ability to identify any address or place in the urban centres of Qatar.

For the convenience of the citizens, businesses, and some government agencies, The Centre For GIS developed a PC program called Electronic Place Finder (EPF) which contains the street network portion of the DBMD complete with addresses and land marks. EPF available to anyone for an nominal fee (US \$ 275), is beginning to find its way into Government agencies, private businesses and homes alike, where it is used for a multitude of purposes. By far the most common use is for finding and displaying the location of an address or place, hence the name Electronic Place Finder or EPF for short. It has already reduced response times for both emergency and delivery services by an order of magnitude.

The street network portion of the DBMD is bilingual, street names and landmarks are in Arabic and English. The addresses at intersections, the names and numbers of all streets and the locations and names of all major buildings and cultural features have all been loaded into the DBMD and hence to EPF. To apply the addresses to individual places a subroutine proportions between the known addresses at street intersections which were derived from field observations.

The EPF operates on an IBM compatible personal computer outfitted with a minimum 10 Megabyte hard drive, VGA or better graphics card and minimum 2 MB of RAM. The more powerful the personal computer, the faster the display. EPF allows users to produce a graphic display of the planimetry of an area in which

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the address they are interested in finding is both highlighted and pinpointed by an arrow on their screen.

The EPF menu provides several options to locate a place, such as address or telephone number etc. The first option is Address, which if chosen opens up a space on the screen in which the address sought can be entered in Arabic or English. Pressing the Enter key causes the underlying city map to instantly give way to a much larger scale map, near the centre of which is the place sought both bolded and pinpointed by an arrow displayed on the screen. The second menu option is Telephone, which if chosen requires the user to type in the telephone number of the place sought. Since telephone numbers are considered classified information in Qatar only those telephone numbers of public buildings, government offices and hotels are pre-loaded in the system. Users however, have the option of adding any telephone numbers they wish to their own copy of EPF and these too may be used as search keys. There are several other options that make EPF a very useful tool for locating places in Qatar.

#### **URISA AWARD 1992**

Qatar's unique approach to implementing GIS nation-wide has attracted attention from around the world (see *article in GIS World - January 1994 issue*). Qatar first got top level management support from the cabinet, then involved every Government Department in developing National specifications and developed implementation strategies that ensures harmony in data collection and integration of all government departments. Qatar's work was displayed at an international GIS conference held in Doha, Qatar in January 1993, and attended by 1,200 delegates from 17 countries.

The Centre for GIS, State of Qatar, won the 1992 "Exemplary Systems in Government Award" from The Urban and Regional Information Systems Association (URISA) whose headquarters are in Washington D.C., U.S.A.

Different government agencies from around the globe have the opportunity to compete for this highly prestigious annual award. The award is presented in recognition for exceptional achievement in the application of computer technology that significantly improves the delivery and quality of government services. Some of the past winners of this award include Sweden's "Land Data System", Canada's "Land Data System", Australia's "Queensland Cadastral Mapping System" and California's "Merced Global Information System". Qatar's "Centre For GIS" now joins this prestigious list of winners.

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