

ISLAMIC REPUBLIC OF IRAN NATIONAL REPORT FOR PHOTOGRAMMETRY, REMOTE SENSING AND SPATIAL INFORMATION SCIENCE 2004-2008

A. Eslami Rad^a, M. Sarpoulaki^b

^aDirector Technical Advisor, National Cartographic Centre of Iran (NCC), P.O.Box 13185-1684, Tehran, IRAN - eslamirad@ncc.org.ir

^bDirector Technical Advisor, National Cartographic Centre of Iran (NCC), P.O.Box 13185-1684, Tehran, IRAN - sarpoulaki@ncc.org.ir

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ABSTRACT:

This national report outlines activities and development related to photogrammetry and remote sensing as well as GIS, digital mapping, education and research activities in these fields during the 4 years period (2004 - 2008) within Islamic Republic of Iran. According to this, involvement of various sectors is described including governmental institutions and organizations, private companies and user community. After a brief introduction, situation of different effective sectors which shape the structure of photogrammetry, remote sensing and spatial information science in the country with emphasis on changes and transformations in the report period will be described which includes education and research activities in this field. It follows with a summary about national plans for spatial data production and usage and achieved progresses in this plans during the last four years period. Recent situation of country in terms of available map and spatial data will come in the next part of this report. The next and last part comprises a summary of methods and technology used for data acquisition and processing as well as presentation of spatial data.

1. INTRODUCTION

This national report follows the pattern of the earlier ones and tries to demonstrate the challenges that people working on development of Geomatics in Iran have been faced with and efforts that spatial data producers and users as well as people in research and education area have been made within the last four years. Of course any claim about development of country in the field of Geomatics should be referenced by proper measures about growing demand for cartographic products, situation of Geomatics education and research, movement towards digital and space technology, standardization efforts as well as other issues.

Islamic Republic of Iran, a country with more than 1648000 Km² area and semi mountainous nature is located in the Middle East region. Its economy as one of the developing countries is mostly dependent to oil production and export. The history of planning for development in Iran returns to 1950 years; when the first economic growth winds started to blow. This is exactly the time that the first National Mapping Organization (NMO) in Iran was established: National Cartographic Centre of Iran (NCC). Despite all challenges and difficulties, NCC has always been carrying out the same missions:

- Creation of survey infrastructure and production of base map coverage,
- Production of maps and other spatial information needed for national plans and projects,
- Technical supervision on mapping private sector activities.

One the strong driving forces behind our organization to define its policy and action plan during the last half century could be

considered as changes in governmental vision and structure. In Iran, during the last 15 years, four governmental plans have been launched one after another in order to reform old structures and maintain a basis for:

- Sustainable development of country in all political, economical and social aspects,
- Social equity,
- Popular participation in development.

As a subsequence to this new approach, NCC is moving from an executive mapping organization to a governmental management body which focuses on infrastructure planning in the field of Geomatics for the whole country, playing proper role in disaster management, cooperation in establishment of E-Government idea and following the privatization policies of the government.

2. TRANSFORMATIONS AND DEVELOPMENTS IN IRANIAN SURVEY AND GEOMATICS SYSTEM

This issue is categorized in two major components namely changes in structure of the system and standardization activities which will be explained in the following sections:

2.1 Changes and Transformations in the System Structure

As mentioned above, the main national mapping organization of the country is well known National Cartographic Center of Iran (NCC) which used to be a branch of Management and Planning Organization of Iran (MPO). As a subsequent of decentralization policy of new government, MPO has been

reorganized in 2007 and most of its responsibilities transferred to provincial governor offices. National Cartographic Center of Iran is still connected to the remaining part of this revised organization but its future position is still a place of conflict. However, the new position is not as strong as before since the previous justification for NCC position as provider of spatial information needed for planning and management of country is not valid anymore. In any case, NCC is strongly following its mission as before.

Another affecting factor to Iranian surveying and Geomatics system is the privatization policy of the government. In the last decade, the government decided as a general policy, to decrease gradually the number of employees in the governmental organizations including NCC, which resulted in increase the contracts for mapping projects awarded to private companies. As a result to this policy, one can compare the number of private firms in the field of photogrammetry, remote sensing and all surveying and mapping companies in country during last decade which is shown in the figure 1.

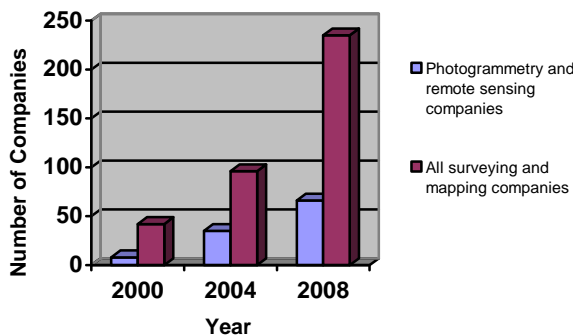


Figure 1. Number of private companies in the field of Surveying and Geomatics

As a logical subsequent of this development in private sector, increasing the influence of scientific and trade societies which are active in the field of Surveying and Geomatics photogrammetry could be expected. There used to be at least three societies who try to develop rights of people work in this field in interaction with the other policy making bodies, namely:

- Iranian Society of Surveyors
- Iranian Society of surveying engineering
- Iranian society of consulting engineers - Surveying Engineering division

A very recent development in this field could be considered as establishment of Iranian Society of surveying and Geomatic Engineering (ISSGE). The web site address of this society is: [Http://www.issge.ir](http://www.issge.ir). The designed perspective for this non governmental organization is so that in long term it could be act as national partner of international societies such as ICA and ISPRS.

The issue of policy making in the field of Geomatics in Iran is traditionally a responsibility of Supreme Council for Surveying which works under direct supervision of deputy of the Iranian President. Members of this council consist of peoples in high management levels from data user community, major data producers and research and education sectors. Unfortunately, in the recent years this council was not active enough but recently by activating the technical commission and working groups of

this council, the brighter and more effective future could be expected.

2.2 Standardization Activities

Standards and specifications required for surveying and mapping activities are developed by the NCC's Standards Committee in the context of the Management and Planning Organization. The scopes of these standards are extended in accordance to scientific advances and requirements. As an example, specifications for development of GIS and Topographic Databases were added when the need arose.

User needs are gathered through communication with the National Council of GIS Users. NCC's Standards Committee conducts the necessary studies to develop required standards based on these user needs.

A list of standards and specifications that have been developed or are under development in the framework of the "Unified Specifications for Surveying and Mapping" are as follows:

- Volume 1: Geodesy and Leveling
- Volume 2: Photogrammetry (General)
- Volume 3: Geospatial Information System (GIS)
- Volume 4: Cartography (General)
- Volume 5: Microgeodesy
- Volume 6: Gridded and Raster Data
- Volume 7: Digital Topographic Mapping at 1:500 Scale
- Volume 8: Digital Topographic Mapping at 1:1000 Scale
- Volume 9: Digital Topographic Mapping at 1:2000 Scale
- Volume 10: Digital Topographic Mapping at 1:5000 and 1:10000 Scales
- Volume 11: Hydrography

In addition to the documents stated above, NCC has also developed standards and specifications for:

- Gravimetry
- Digital Topographic Information at 1:25000 Scale
- Digital Topographic Image Maps at 1:50000 and 1:100000 scale
- Digital Topographic Maps at 1:250000 scale.

The standard for 1:25000 maps consists of 5 volumes, covering the different aspects of data acquisition, topographic databasing and presentation of geospatial information for the NTDB and base maps:

- Content and feature definition
- Coordinate system and projection
- Conceptual model
- Cartographic presentation
- Metadata

Beside to these activities, NCC and Institute of Standards and Industrial Research of Iran (ISIRI) which is Iran national standardization body, have established ISIRI/TC211 Mirror technical committees with responsibility of commenting and voting on ISO/TC211 standard drafts. ISIRI/TC211 consists of experts representing different organizations in Iran which are related to Geomatics and Geospatial Information. Iran is currently an O-Member (Observer) of the ISO/TC211 Technical Committee, but is in the capacity building phase in order to be able to elevate to P-membership in the future.

3. CURRENT SITUATION

3.1 Proposed Strategic Plan and Related Projects

In 2002, the first strategic plan for creating National Spatial Data Infrastructure (NSDI) in Iran has been proposed by NCC to the government. It has been designed to fulfil future national requirements for NSDI in the field of Geomatics. This plan was mainly concentrated in the following issues:

- Training and education;
- Standardization and documentation of technical procedures;
- Research and development;
- Privatization;
- Developing the applications of spatial information;
- Revising the legislations in this area.

According to the goal of this plan, a few national project have been proposed which will be addressed as follows. Note, that some of these projects have already begun and the rest is under consideration:

- Completion and updating the 1:25000 scale base maps, NTDB and geo database;
- Development of national DEM coverage;
- Completion and updating large scale digital maps of cities;
- Production of 1:10000 scale maps of rural areas around cities with more than one million population;
- Development of standards required to fulfil these projects;
- Large scale mapping and development of topographic database for rural areas with population greater than 200 families;
- Development of National Spatial Data Transfer Standard.

This strategic plan and related national projects can guarantee a sustainable development of the country in terms of spatial data production and usage, as well as education and research in Geomatics domain. In any case, many efforts have been made during last decade to change the situation of the country in terms of available map and spatial information. It implies a drastic change in this regard in comparison to ten years ago. The following paragraphs briefly explain the current situation.

3.2 Digital Topographic Maps and National Topographic Database

Fortunately, the current situation of available topographic maps compared to ten years ago, signify a remarkable change, not only in terms of number of map sheets available, but also concerning the restrictions of individual access to geographic information. In order to explain the current situation in terms of topographic maps and database, the following projects has to be addressed:

- 1:25000 scale base map series: This project was started in 1991 using analogue technology and then switched to digital products. By the end of 2007, the number of digital maps produced in this project passed the number of 9300 (covering 93 percent of country). Note that Iran will be covered by about 10000 map sheets in this scale. The remaining parts mostly consists border areas that confront with some security problems for aerial photography. Due to this problem, NCC started to produce map sheets of these border area using 2.5m SPOT5 HRG satellite imageries and SPOT5 HRS DEM. The number of map sheets produced using satellite imageries in this project passed the number 700 at the end of 2007.

In the mean time, updating Phase of these data has been started and more than 1300 map sheets in this scale have been revised during last four years.

- National Topographic Database (NTDB): As a consequence to new digital technology, NCC decided to create National Topographic Database of the country based on above mentioned 1:25000 base maps. The first step was design and standardization of this database followed by applying necessary changes to production line. The NTDB standard was published in 1994 and creation of this database started at the same time. First version of NTDB has been produced in a sheet wise manner and stored in a file-based style. Based on this data, NCC has started execution of it's Geodatabase project containing different data rather than just 1:25000 map sheets. It contains some other data such as Landsat ETM+ imageries or data from other organizations like Geological survey of Iran. In this new project NCC is developing a multi-user seamless database accessible for different organizations based on interoperability concepts.
- Digital Cartographic Maps: Based on 1:25000 scale maps and by using cartographic techniques, digital maps at various scales such as 1:50,000 , 1:100,000 , 1:250,000 are under production.
- 1:2000 scale map series of the cities: In 2001, increasing demand of governmental and private organizations for reliable and updated large scale maps of cities for various purposes motivated the MPO to assign the NCC as responsible organization for this project. This project started with responsibility for producing maps for 630 cities but it exceeded to 1026 cities during past three years. Even though, so far digital maps of about 721 cities have been produced, but still considerable numbers of cities (about 300 cities) are suffering from lack of updated maps and spatial data. In case of allocating proper budget to this project, it is planned that the productions phase of theses data to be finished within 2 years. Obviously, the updating process has been started during the report period.

3.3 Image Maps and Digital Elevation Models

During the last few years, there has been a revolutionary increase in demand for different types of image maps in Iran, thanks to accessibility of high resolution remotely sensed data, proper software systems and very fast computers.

In 2007, more than 130 large and medium scale image mapping project have been performed by NCC and private companies which shows a huge growth rate to the figures of 2004. It is planned to develop the role of private sector in image map production by increasing the users request for these products.

Digital Elevation Model is a key element of every image mapping and remote sensing activity. In response to this demand, in 2001, NCC decided to produce a national DEM from 1:25000 base map series with 10m resolution. At present, more than 90 percent of country is covered by these DEM data with height accuracy of better than 6 meter. At present time, some programs for improving this data in terms of accuracy and resolution are under development.

In order to promote remote sensing activities in Iran, NCC decided to facilitate accessibility of users to geo-referenced and geometrically corrected image data. For this purpose a pilot

project was executed with a full coverage of Landsat ETM⁺ imageries for whole country which goes through a rectification process using 1:25000 base maps and 10m DEM of Iran. This project has ended in 2004 and final products were presented as ortho-rectified 14m PAN and 28.5m multispectral satellite imageries in a block wise manner. Note that the country has been divided to about 132 blocks with dimension of 1.5 degree in longitude and 1 degree in latitude.

The second project with the same perspective started at the same time. This project uses the IRS1C/1D 5.8 m resolution satellite data and the produced map sheets are in the same size of 1:50000 scale map sheets. At the time being, about 2570 orthorectified image map sheets has been produced and presented to users.

4. METHODS AND TECHNOLOGY

4.1 Data Production Policy

Until recent years, the only comprehensive program for map and spatial data production in country was limited to 1:25000 base maps and associated data bases. In this atmosphere, the situation of private sector could not be so good since their customers were a limited number of governmental constructive project owners. Lots of efforts have been made during these years to introduce capabilities of digital maps and geographic information systems to actual and potential users with this idea that the interaction with user community implies that they should determine the usefulness of the data and system. These efforts resulted in establishment National Council of GIS users by NCC to collect their needs and to interact with them. . This council is a major active body to make effective measures in promotion of awareness of GIS users in national level and also to organize and harmonize different activities in design and development of a National GIS. NCC is Chair & secretariat of this council and director of NCC is it's chairperson and GIS manager is acting as secretary. This Council consists of representatives from 22 different ministers and organizations related to GIS. Challenges of this council resulted in increase of formally established GIS departments in different ministries and organizations from 3 in 1998 to 15 in 2006.

Necessary actions are taken based on requirements collected through these users' needs. This council has a regular monthly scheduled meeting and relevant issues are considered and discussed in these meetings. Four different technical committees have been operated under supervision of this council and some of them are still operational. These committees are as follows:

- Committee on Geospatial feature coding
- Committee on Urban GIS
- Committee on policy for underground facility management and mapping
- Committee on policy for Geospatial Information Exchange

These sort of activities with direct support of the government resulted in a rapid development of private sectors and we witness increasing amount of governmental contract with private companies during the recent years. Table 1 shows the number and amount of photogrammetric digital mapping contracts with private companies during the past years:

Year	Number of Contracts	Total Amount in US\$
2000	53	1 100 000
2001	77	1 980 000
2002	105	3 750 000
2003	150	5 330 000
2004	145	5 120 000
2005	230	8 850 000
2006	169	6 100 000
2007	123	5 650 000

Table 1. Number and Amount of photogrammetric Mapping contracts with private companies

It should be mentioned that due to some problems and conflicts with authorities in country about aerial photography, the number of flown projects has decreased in 2006 and 2007. As it is shown in table 1, the number of photogrammetric mapping contract has been decreased during these years.

4.2 Photogrammetric Digital Mapping Systems

Digital map production has been started in Iran since 1995 by upgrading analogue stereo plotters of NCC and the upgrading program was so successful that within less than 5 years, all the photogrammetric systems in the country were upgraded. Nowadays, the number of digital photogrammetric workstations in the country have increasingly grew so that reported sold systems of Iranian ParadyesTM photogrammetric workstation passed the number of 200. Note that just 25 of these systems are installed in NCC.

4.3 Use of Advance Technology

The first GPS photogrammetry system has been used in Iran by NCC within its Jet Falcon 20 aircraft for 1:40000 aerial photography projects in the year 2000. This system accompanying with bundle aerial triangulation method were a great help to NCC to accomplish the task of preparing 1:25000 base map for remote and desert area of country. Due to some problems, it is decided not to use this system for large scale mapping projects.

In 2003 a comprehensive study on Direct Geo-referencing systems using GPS/IMU observation took place in NCC and negotiations with one of system providers were started. According to this, the basic approval for utilizing these systems in large scale photographic projects has been made and as soon as clearing a few technical details, the purchase process will be started.

Recently, after a serious decision for use of digital aerial triangulation system followed by comprehensive study on available systems, one of them which is develop by an Iranian company has been selected and purchased. Note that, traditionally almost entire aerial triangulation process of civil mapping projects in Iran are executed by NCC.

Beside all these efforts, a preliminary study on upgrading imaging systems has been started and it is expected to equip our aerial photography fleet with digital aerial camera and/or new imaging sensors such as LIDAR. Note that the first aerial LIDAR sensor has been purchased and imported to country by private sector and the first VEXCEL UltraCam digital camera was started to work in Iran in 2005.

4.4 Use of Space Technology

With advent of new satellite technology and vast amount of high resolution satellite imageries, in addition to rapid development of remote sensing activities, one can observe a serious impact to photogrammetry discipline. Beside many activities for using these images for mapping purposes in country (some of them were mentioned earlier in this report), recently NCC has started to use 2.5m SPOT HRG imageries for producing and updating 1:25000 digital base maps of Iran.

Another national project in this regard is related to Statistical Centre of Iran (SCI). This organization used high resolution satellite imageries for planning and implementation phase of 2006 national census of Iran. For this purpose, new high resolution IKONOS imageries were purchased for about 500 cities of country. These imageries after passing through a geometric correction process were used for updating old line maps as the basic information for this national census. According to this new approach, in the last national census of Iran, the collected data was transformed to georeferenced statistical information for the first time which can be considered as a revolution in the history of

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