

ISLAMIC REPUBLIC OF IRAN NATIONAL REPORT FOR PHOTOGRAMMETRY AND REMOTE SENSING 2000-2004

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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 in these fields during the period 2000-2004. The involvement of various sectors is described including governmental institutions and organizations, private companies and user community.

After a brief introduction, different effective sectors which shape the structure of photogrammetry and remote sensing in the country will be described which includes education and research sector in this field. It follows with a summary about national plans for spatial data production and usage and then the situation of the country in terms of available map and spatial data.

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

Development of Geomatics within the last half century in Iran has faced considerable challenges in different aspects and was not possible without great efforts of spatial data producers and users as well as people in research and education area. The issues such as growing demand for cartographic products, great interest in Geomatics education, revolutionary movement towards digital technology, standardization efforts in this field and popularity of GIS and remote sensing applications can demonstrate development of the country in the field of Geomatics.

In Iran, national organizations, ministerial and municipal offices as well as private companies are active in the field of mapping and geographic information production needed by decision makers and general users. The national organizations concentrate their efforts on small-scale base mapping of the whole country and other governmental surveying offices and private companies are mostly involved on high resolution geographic information production needed for national and provincial projects.

Most research in the fields of photogrammetry, remote sensing, GIS and digital mapping is carrying on in the national organizations, institutions and universities. However a few private companies have also made remarkable research for their commercial products and services.

2. BUILDING BLOCKS OF PHOTOGRAMMETRY AND REMOTE SENSING MARKET IN IRAN

From production point of view, photogrammetry and remote sensing market consists of three major components as follows:

2.1 Spatial Data Producers

As mentioned above, major data producers consist of the following groups:

- National Mapping Organizations: The main national mapping organization of the country is well known National Cartographic Center of Iran (NCC) which works as a branch of Management and Planning Organization of Iran (MPO).

It was established in 1953 and takes the responsibility of coordination among various mapping activities as well as creation a survey infrastructure and production of base map series, production of maps and other spatial information needed for national constructive projects and supervision on private sector activities. Since then, NCC has been responsible for various mapping projects at various scales but the emphasis has been and still is on production of national base maps and databases. Nowadays, beside map and spatial data production activities, almost entire aerial photographic missions and aerial triangulation activities for civil projects are carried on by NCC.

In order to facilitate rapid and accurate access of military section to the geographic information, National Geographic Organization (NGO) was established. This organization is recently equipped with a ground receiving station with ability of receiving imageries from different sensors of Indian IRS-1C/1D satellites.

- Private Sector Companies: In the past few years, the government decided as a general policy, to decrease gradually the number of employees in the governmental organizations including NCC, which culminated 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 and remote sensing which increased with a rate of 4 (from 8 companies in 2000 to 35 companies in 2004). In the same period, the growth rate of all mapping and surveying companies can be observed as 2 (from 42 companies in 2000 to 90 companies in 2004) which can demonstrate the acceptance of photogrammetric methods and products within users and producers community as the best solution for map and spatial data production purposes.

- Ministerial and Municipal Mapping Departments and Offices: Most of these offices and departments are established within ministries and municipalities in order to deal with their need for map and spatial data. Some of them such as surveying office of oil ministry were equipped with photogrammetric equipment and image processing systems but with the recent growth in private sector companies and service providers in this field, many of them are basically changing their tasks to contracting out, technical supervision, data handling and/or providing very specialized products for specific uses. Among these offices, a few of them can be addressed as:

- a. Tehran Geographic Information System Center (TGIS) which was founded by Tehran municipality in 1991 in order to establish a geographic information system for the capital. The base data is 1:2000 map series of the city which produced by private sector with cooperation of NCC in 1996.
- b. Iranian Cadastre Center was established under supervision of the Land Registration Office to centralize cadastral activities nation wide. This center is equipped with advanced analytical stereorestitution instruments, proper software systems and trained personnel for photogrammetric map production. Fortunately, the management board of the center has recently convinced to reduce their mapping activities by using available large scale maps of the other mapping projects and concentrate their efforts on establishment of huge cadastral database of the country.
- c. Iranian Remote Sensing Center (IRSC) was established in 1972 in order to coordinate remote sensing activities in Iran, to promote remote sensing through training specialists, to reproduce and distribute satellite data and related services and to guide related researches in this field. In addition to different image coverage of satellite data which is distributed by this center, its ground receiving station is able to receive different types of data from Indian IRS satellites, NOAA and Terra MODIS sensor.

This center has recently changed to Iranian Space Agency (ISA) and now is responsible for research, design and implementation of space technology, remote sensing as well as development of national and international space technology and communication networks. The aim of ISA is to promote peaceful use of space technology and science and the above atmosphere space to help the development of the country in different aspects. According to ISA new organization and objectives, in field of remote sensing it is mostly concentrated on coordination among

different active sectors in this field, issuing policies and promoting application oriented researches in this field.

2.2 Policy Makers

The main body in the country in charge with issuing policies in this field is the Supreme Council for Mapping 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. The main responsibility of this council is issuing policies in this field, coordination and planning for different sectors, performing evaluation programs to assure the effectiveness of strategic plans and so on.

Beside the above mentioned council and NCC that actually works as secretary of it, technical deputy of Management and Planning Organization of Iran (MPO) is also involved with this task. Among many other responsibilities of MPO, one can consider planning, budgeting and supervision on national and provincial constructional and infrastructural projects as its main objectives. According to this, technical deputy of MPO is in charge with preparation of technical specifications and procedures, planning and supervision and issuing the technical frameworks of projects contract (in terms of financial and legal aspects) in the domain of Iran technical and executive system; a system which includes more than 70 percent of the running projects of the country.

In spite of not very strong influence of scientific and trade societies which are active in the field of surveying, photogrammetry and remote sensing in Iran, but they can not be totally disregarded. There are at least three scientific and trade society who try to develop rights of people work in this field in interaction with the other policy making bodies.

2.3 Research and Education Sector

In order to describe situation of the country in terms of education and training in the field of Geomatics, let's have a quick look at two different sections in the past decade. At the beginning of this decade, only a few bachelor degree surveying students (about 60) were studying in Tehran University and K.N.T Technical University in Tehran and also the surveying college of NCC was in charge with training a few technician degree students in surveying and cartography (Most of them were employed by NCC). Nowadays, there are more than 10 universities and institutions in the country busy for training and educating professional personnel in this field. Talking more accurate, every year about 450 specialists with bachelor degrees in surveying are graduated from universities. In addition, more than 600 technicians in this field should be considered.

All the efforts that were made during these years resulted in a rough estimation of 5000 specialists who are active in the field of Geomatics (non military section). It means about 8 specialists in each 100000 population which is not satisfactory but the trend draw a better situation in the future.

In the mean time, the first master degree courses in geodesy, photogrammetry and remote sensing have been started in Iran during last decade. Nowadays, there are at least 3 universities presenting these courses with about 30 graduated specialists in these fields.

During this decade we witnessed the first PhD degree in photogrammetry which issued by Tehran university. Now there are 5 graduated people in the field of photogrammetry and remote sensing and more than 10 students are working on their research topics. Due to appropriate relations with good standing universities in the world of Geomatics, it can be stated that the qualities of most of these educational programs are compatible with international standards.

As mentioned before most researches in fundamental contexts in the field of photogrammetry and remote sensing is carrying out by universities during MSC and PHD research period. According to the recent development in number of involved universities and their students in this field, a good improvement in research activities can be observed. As a witness to this claim, the number of accepted papers and research reports from Iran by national and international scientific conferences and journals can be mentioned that exceeded from 30 in number during the year 2003.

Within the past four years, fast development in different fields of Geomatics was motivated NCC to increase its cooperation with academic centres in order to promote application driven researches in them. For better accomplishment of this task, NCC established the NCC Research Council which aims to define, guide, support, supervise and assess research projects at NCC. This council specially promotes research activities which improves the accessibility and availability of data for the public. One of the major achievements of NCC in relation with Tehran University is the domestic photogrammetry workstation which now is fully operational within NCC and many private companies. This cooperation resulted in the first R&D private company in Iran who is highly active in developing hardware and software systems in the field of photogrammetry and remote sensing.

Very recently NCC decided to establish the first Geomatics research centre in order to develop its role and presence in the research domain. This centre started its activity in the field of photogrammetry with a research topic about LIDAR with the title of: Comprehensive Evaluation of the Potential of LIDAR for 3D Geospatial Data Collection.

3. CURRENT SITUATION

3.1 Proposed Strategic Plan and Related Projects

In 2002, strategic plan for mapping activities in Iran including photogrammetry and remote sensing has been proposed by NCC to the government. It has been designed to fulfil future national requirements in the field of Geomatics. This plan is 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.

Although, the present structure has the technical and educational ability to meet today's needs, but due to rapid changes in technology and user requirements, a few national projects have been planned which some of them in relation to this report can be addressed as follows (some of them have already begun):

- Completion and updating the 1:25000 scale base maps and NTDB;
- Development of national DEM with 10m resolution;
- 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 Iranian NSDI;
- Development of National Spatial Data Transfer Standard.

This strategic plan and related national projects can guarantee a stable 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 and a comparison to ten years ago shows a dramatic change in this relation. 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 shows a dramatic change not only in terms of number of map sheets, but also regarding 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 have 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 2003, the number of digital maps produced in this project passed the number of 8300. Note that the country will be covered by about 10000 map sheets in this scale. The remaining parts mostly consist of border areas that confront with some security problems for aerial photography.

In the mean time, preparation phase for updating these data has been finalized and proper action will be executed during the year 2004.

- 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. At the time being, all the produced 1:25000 maps have been entered to this database.
- 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 responsibility of this project to NCC. This project started with 630 cities but it exceeded the number of 900 cities during past three years. Although, digital maps of about 220 cities have been produced within this project but still a great number of cities (about 570 cities) are suffering from lack of updated

maps and spatial data. In case of allocating proper budget to this project, it is planned to finish the production phase of these data within 5 years. Obviously the updating process has to be started during this period.

3.3 Image Maps and Digital Elevation Models

In the past, photo maps were produced using conventional aerial photography and analogue photo rectification techniques in a limited number in NCC. 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.

During last year, 20 large and medium scale image mapping projects have been performed by NCC which shows a growth rate of 4 proportional to the year 2002. It is planned to develop the role of private sector in image map production by increasing the users request for these products.

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. The final product of this project will be 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. This product can also be used as background of 1:250000 scale maps of Iran. By now, 40 percent of this project has been finished.

Digital Elevation Model is another key element of every image mapping and remote sensing activity. In response to this need, in 1997, NCC has produced and presented a DEM of entire country with resolution of 25 arc second. The source data for this product was digitized 1:250000 paper maps. Another DEM data with 100m resolution was created in 2000 by Iranian Remote Sensing Center using the same data source.

In 2001, NCC decided to produce a national DEM from 1:25000 base map series with 10m resolution. At present, 60 percent of the country is covered by these DEM data with height accuracy of better than 6 meter.

3.4 Cadastral Activities

In 1995, due to lack of a comprehensive and effective cadastral system, the government decided to execute a cadastral project under supervision of land registration office of Iranian judiciary. The planned cadastral system was based on cadastral maps with scale of 1:500 to 1:1000 for urban areas and 1:1000 to 1:2000 for rural areas. As mentioned before, in order to increase the speed of this project, an agreement has been made to use the 1:2000 digital maps of cities in combination with additional field works for this purpose.

Beside this national project, a number of rural cadastral projects are carrying on every year by private companies according to different contracts. One of the biggest cadastral projects in this group was executed during last two years in response to request of Gilan provincial water authorities in northern Iran. For the first time in the country, a combination of topographic maps,

orthorectified images as base data and extensive field work were used in order to perform a cadastral project. This project covers an area of 1000 km² and costs about 1.4 million US dollars.

4. METHODS AND TECHNOLOGY

4.1 Data Production Policy

Until recent years, the only comprehensive program for map and spatial data production in the 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. Preparation of the above mentioned strategic plan and approval of national mapping projects such as completion and updating large scale digital maps of cities with an estimation of 50 million US dollar cost can be considered as results of these activities.

These medium term plans for mapping with direct support of the government culminated in a rapid development of private sectors and we witness increasing amount of governmental contract with private companies during the recent years. The following table shows the number and amount of photogrammetric digital mapping contracts with private companies during the past four 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	145	5 330 000

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.

In order to show the acceptance of digital photogrammetric systems in the country, the number of scanned aerial photographs can be considered as another measure. The following table shows this figure during the period of 2000 to 2003:

Year	Number of Scanned Photos
2000	8300
2001	12800
2002	21200
2003	33000

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 it is expected to be installed in NCC within a few months. 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 within the next 5 years.

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 the country (some of them were mentioned earlier in this report), recently NCC has finished a project to evaluate the potential of new 2.5m SPOT HRG imageries for updating 1:25000 digital base maps of the country. The final results have shown the capability of these imageries and practical use of them can be started as soon as possible.

5. REFERENCES

- M. Jafari Salim, 2003, National Report on Cartographic Activities in I.R. of Iran, Presented to the International Cartographic Association.
- F. Kianifar, 1996, National Report: Activities in Photogrammetry, Remote Sensing and Spatial Information Sciences in the Islamic Republic of Iran from 1992 till 2000, Presented to the 19th Congress of International Society for Photogrammetry and Remote Sensing.
- Iran Comprehensive Plan for Production of Required Maps and Spatial Information, 2002, Volume 1, National Cartographic Center of Iran
- Web site of National Geographic Organization of Iran, <http://www.ngo-iran.ir>

- Web site of Iranian Remote Sensing Centre, <http://www.iran-irsc.com>