The Egyptian Survey Authority (ESA)

Country Report

For

XIXth Congress of the International Society for Photogrammetry and Remote Sensing (ISPRS)

1. Introduction

The Egyptian Survey Authority (ESA) was established in 1898 as an Egyptian Survey Agency and then changed its status to a General Authority according to Republican decree No.2433 year 1971. The latest State decree No.298 year 1984 was concerned with the reorganization of the Authority.
The Egyptian Survey Authority is the organization responsible for performing various surveying tasks, maps, databases, including basic geographic data to serve the State, its ministries and various departments as well as all citizens. The Egyptian Survey Authority follows the Ministry of Irrigation and Water Resources.

2. ESA's Mission

"As a specialized technical Authority, the General Egyptian Survey Authority produces, maintains and distributes current and accurate geographic data in support of national needs. These data describe the Egyptian landmass, its cultural features and the ownership of the land. They delivered in the form of surveys, digital databases, maps, and related products and services".

The Egyptian Survey Authority, in carrying out its mission performs the following activates:

- Establishment and maintenance of the national, horizontal, vertical and gravity networks; computation of the national geodetic datum and dissemination of data pertaining to these networks.
- Production, maintenance and distribution of the national atlas and small, medium and large-scale topographic maps depicting the Egypt landmass and the cultural features thereon.
- Production, maintenance and distribution of cadastral maps and survey books (dafaatir) describing the ownership of the agricultural land and urban lands within Egypt.
- Maintenance of the national cadaser and its related maps and survey books in support the Real Estate Department, Ministry of Justice, including projects of land expropriation for public benefit.
- Establishment, maintenance and distribution of the annual astronomic almanac and calendar.
- Special tasks concerning Egyptian International boundaries as well as administrative boundaries at different levels.
- Printing of maps and valuable documents such as passports, etc.

In addition, ESA performs the following tasks for the benefit of other parties against paid costs:

- Establishing contour and detailed engineering planning maps of different scales as requested by different government agencies for implementing projects.
- Implementing the different phases of surveying and property research and any necessary work for the land registration decree of Siguel El Ainee and the decrees of agricultural reclamation and Real Estate works.

- All works needed for defining financial, administrative and health boundaries and participation in the related committees.
- Defining the ownership of land and real estate necessary for the public welfare and estimating their value and all compensations related to them.
- Surveying regularly every year the areas cultivated nation wide with the main agricultural.
- Designing and printing technical drawings and stock papers/certificates for others.
- Offering technical experiences and consultations in the field of survey and mapping to different parties, whether they are related to the state or not, and also undertaking the surveying assignments requested by those parties.

3. ESA's Organizational Structure

In performing the tasks of its mandate, ESA works through an organizational structure that includes the jobs for fifteen thousand employees. Figure (1) shows ESA's organizational structure with all its general and central departments.

It is worth mentioning that ESA has started a program aiming towards its modernization including all activities and is following a strategic plan encompassing all its departments. This plan has already been accepted by the Board of Directors and his Excellency the Minister of Irrigation and Water Resources including two hundred strategies divided into seven chapters as follows:

1. Raising the Authority's Stature
2. Responding to Customer Demand
3. Fostering Quality Management
4. Developing and Managing Technology
5. Organization for Excellence
6. Safeguarding the Investment
7. Building Partnership for the public Good

So far the following achievements have been accomplished:

- Studying the reorganization of the Egyptian Survey Authority to cope with the technological progress in the digital era and the needs of users at the present time to facilitate the process of building their specific GIS.

- Also the concept of dealing and organizing the private sector to serve building of the basic infrastructure required for establishing geographic information systems under supervision of ESA has been emphasized.

- The idea of marketing ESA's products of basic geographic information meeting users needs has been taken into consideration on a cost recovery basis.

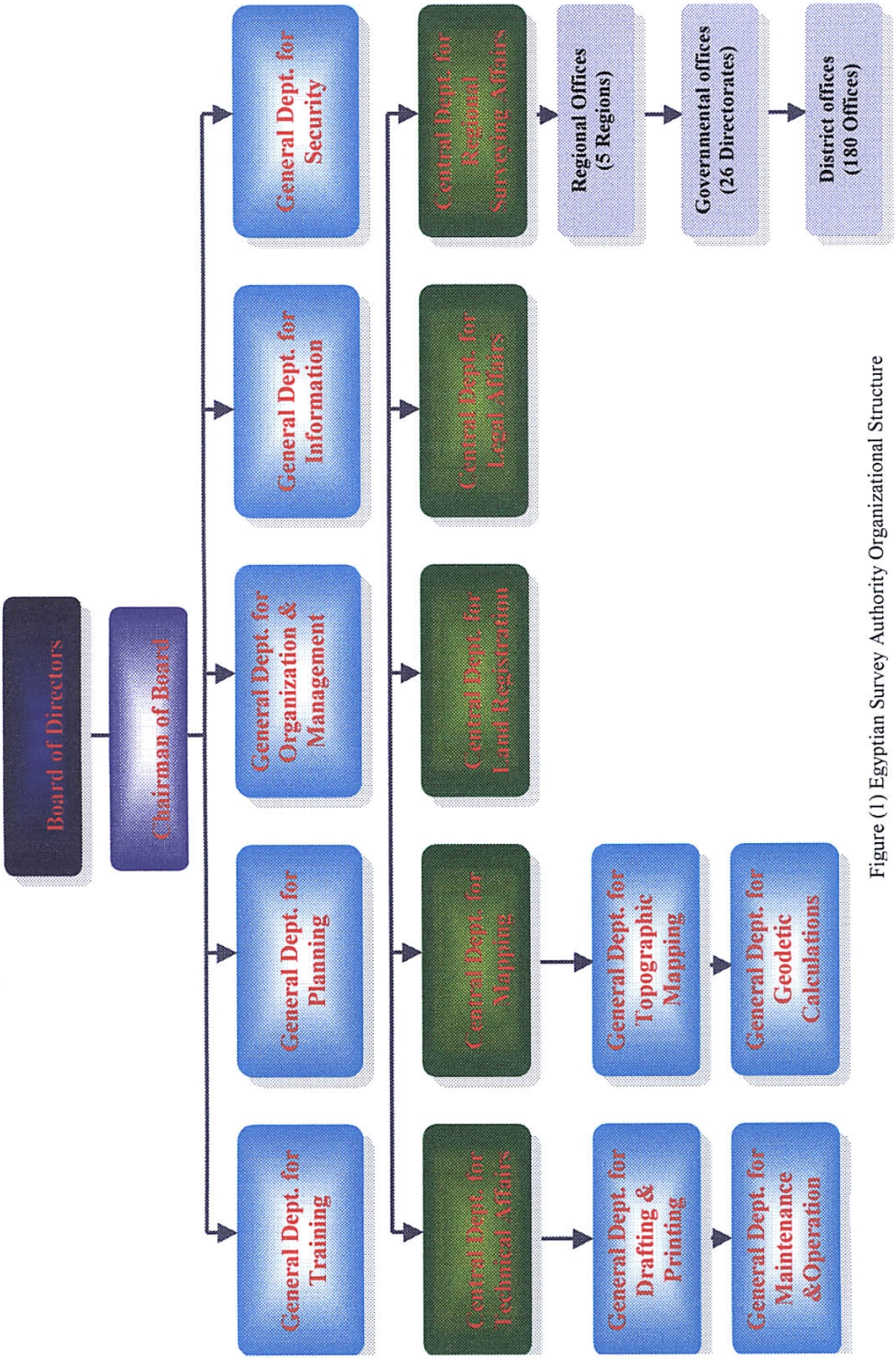


Figure (1) Egyptian Survey Authority Organizational Structure

4. ESA's Activities and Products

4.1 Geodetic Network

Recognizing the important of a solid geodetic network as a backbone for digital mapping and to facilitate the work with GPS & GLONAss receivers. ESA established a modern geodetic network using GPS observations, the primary network consisting 30 points at spacing of 200 km apart with an accuracy of 1/10 million in distances.

The primary network is being densified into first order GPS network consisting of 122 points into the agricultural regions of Egypt with an accuracy of 1/1 million in distances. This densification process is performed according priorities.

The first order network is being further densified into agricultural network of 4 km apart so far seven governorates have been covered and the rest of 26 governorates will be completed according to an approved plan.

4.2 Topographic Mapping:

The ultimate goal of Egypt is the Topographic Mapping Modernization Program to cover all Egypt with medium and small scale of topographic maps. ESA has completed 475 new scales 1:50,000 topographic maps in Eastern Desert, Delta and Nile Valley areas. 400 of those new maps were produced using analogue techniques, while all others were produced using Arc Info GIS. The purpose of the digital production was to demonstrate ESA' s capabilities with those techniques and to show the users of ESA's products the benefits of the GIS. It is hoped that users of ESA's data will eventually install their GIS capability.

All of these analogue and digital scale 1:50,000 maps are used to produce a new series of small 1:250,000 topographic maps (Semi Digital).

In addition to the small-scale topographic maps, Topographic Mapping Modernization Program calls for the production of large-scale topographic base maps and town/ village maps. The maps are produced at scales 1:2,500 and 1:1,000 respectively, and serve as a base to produce and publish cadastral maps. These large-scale maps are produced using digital techniques.

4.3 Cadastral Maps and land Information Systems:

One of the missions of ESA is the preparation, establishment and maintenance of cadastral maps depicting irrigation networks and land subdivision. These maps are used to compute the area of individual's parcels and as graphical indices to the registers, which record information about the legal ownership of each parcel as well as its legal description.
During 1990, ESA began an ambitious plan to prepare and maintain the cadastral maps production in four governorates of Beheira. Sharqiya, Sohag and Asyut, which comprise an area of approximately 12,000 square kilometers within this area. About 1,500 square kilometers in Beheira governorate has been selected as a primary focus for LIS implementation.

The digital files containing the topographic, cultural and cadastral features are maintained in a cartographic database and this database is suitable for distribution to other GOE' s agencies that are in need of such information.

4.4 Cadastral Overlay Production Module:

This module automates the production of information needed to make the cadastral layer for ESA's 1:2,500 scale cadastral map series. The data items maintained within this module are those needed to depict parcel, and administrative boundaries on the scale 1:2,500 map series. These data are collected in the field by using Total Stations equipped with electronic data collectors to permit automated down loading of survey data subsequent processing.

The AutoCAD software was chosen for use in producing the cadastral maps primarily, because of its flexibility and extendibility. Like the data collection system information mentioned above, the cadastral data needed for the production of the cadastral maps will be translated to a DXF file format and then transferred to the map publication system for permanent storage in the cartographic database in Arc Info format.

For purposes of cadastral map publication, this module produced digital files containing the parcel administrative boundary data that, when overlaid on selected planimetric features, enable the publication of 1:2,500 scale cadastral maps. The supplemental planimetric data required for the production of 1:1,000 scale cadastral plats of built up areas are also included.

4.5 Land Records Production Module:

This module automates the production of many forms used by ESA to produce the Title Register. These data items are collected by culling existing records and, when necessary, by interviewing landowners. They are maintained in a Relational Database Management System (RDMS) for easy expansion and modification.

This module produces:

- All reports currently produced by ESA for the Ministry of Justice and Tax office.
- All forms currently in use by ESA for the collection, completion and dissemination of cadastral information.

4.6 The LIS Application Module (LIS-AM):

The purposes of this module are Data Conflation, Exception Processing, Cartographic Presentation, and Spatial Analysis.

Data Conflation: is the cross indexing of the graphic information contained in the cartographic database with data items contained in the Land Record Management System (LRMS) database.

Exception Processing: is the processing of data which failed to conflate during normal processing due to inconstancies in the disparate data sources.

Spatial Analysis and Cartographic Presentation: can be obtained through the interactive query of the database.

The database has reporting capabilities from the LRMS data using the online graphic interface provided by the modules of GIS software.

This module produces:

- Special purpose maps at various scales are generated by LIS-AM on demand to demonstrate land ownership demographic and taxation attributes.
- Special queries & tabular report of the cross-indexed database are produced, taking full advantage of the topological attributes maintained by Arc Info. For example, reports can be generated listing all parcels within a specified search radius of a particular point of interest, or lists may be produced of landowners who hold property at elevations below a specified elevation.

4.7 Orthophoto Mapping System:

Orthophotos (aerial photographs that have been mathematically corrected and rectified to remove distortion) have been used for map planning and engineering for many years. In digital form, they can now be displayed on computer screen as a base map or background for compilation or quality control of new and existing products.

Present scanning technology, computer software and hardware now make it possible for orthophotos to be created with minimal amount of manual interaction. The scanning process consists of the construction of raster data sets at resolutions of up to 12.5 microns (2000 lines per inch).

Moreover, the sophisticated image correction software modules such as automatic digital terrain extraction, interactive digital terrain data editing, and mosaicking allow digital orthophoto generation using tools that were previously unavailable in the conventional processes.

As a component of its modernization efforts, during 1991 ESA installed a digital orthophoto production system. The system consists of the Helava 650 mono Digital Photogrammetric Workstation (DPW), Helava 750 stereo DPW with image processor, and Joyce Loebl 3302 a film writer for the plotting of the completed orthophoto on film.

ESA has completed 1,800 scale 1:10,000 orthophoto maps of the Nile Delta for the performance of a comprehensive crop and soil inventory. These maps cover the Delta, Fayoum, and all of the Upper Egypt. Each of these monochrome maps covers an area of approximately 28 square kilometers and has been overlaid with marginalia, place and feature names, and where available one meter contours. The absolute accuracy of coordinate measurements made on these maps will be 5 meters.

The comprehensive crop and soil inventory have been completed utilizing an interpretation of crop and saline and water logged soil polygons from 1:20,000 scale CIR photography. These data was transferred to the 1:10,000 orthophotos with the help of zoom transfer scopes and stereo viewing devices.

The 1:10,000 scale orthophotos are ideally suited for the production of crop and soil inventory overlays for several reasons:

- Map data transfer at this scale allows for adherence to a timely completion.
- The format of orthophotos, coupled with crop and soil data, creates a product ideally suited for GIS studies and cropping trend analysis.
- At this scale, reasonable area studies can be conducted for water utilization studies and drainage network analysis.
- Preliminary engineering plans and proposed canal/ ditch/ pipe routes can be overlaid to the orthophoto for general planning purposes.
- Right-of-way studies and farmer encroachments on GOE land, are easily identifiable when the orthophoto is overlaid with cadastral map data sets.
- Engineers will find these maps useful for regional planning, and environmental, and archaeological studies.

Future ESA's Mapping Projects, whether site specific or trend-analysis oriented will benefit from the applicability of these map projects. With its orthophoto production system ESA has the capability to create and distribute maps in response to other GOE and private sector needs.

Finally, because the orthophotos were created using digital techniques, the data sets will be archived and retrieved for future mapping requirements and comparison studies. The orthophoto image database will consist of the digital orthophoto images and digital terrain models used to produce the orthophoto maps. The absolute accuracy of the coordinates in this database will be +2 meters. These digital images will be suitable for use in image processing systems.

4.8 Agricultural Statistics Collection:

All aspects of this activity at ESA are being modernized. New 1:20,000 scales Color Infera-Red (CIR) photography has been acquired for two consecutive growing seasons in the Nile Delta. The 1991 winter crop photography covers approximately 18,000 square kilometers, while the 1991 summer crop photography covers more than 23,000 square kilometers. Trained photo interpreters are able to discern features less than one meter in size in this photography.

These transparencies are being interpreted by a staff of 140 newly trained photo interpreters. In addition to cropping and soil condition studies, ministry engineers will find this CIR photography useful for planning, drainage and irrigation network analysis as well as costal, water resource and environmental studies.

The interpreted data – 10 crop types, soil salinity, water logging, irrigation, and drainage facilities, etc are being overlaid on orthophoto. These overlays were digitized into a GIS from which statistical and graphical reports describing the cropping patterns and saline soil conditions are prepared.

All equipment needed for this activity is in place and ESA personnel are busy mastering its use.

5. Specifications, Computerization and Training

5.1 Specifications and procedures:

The introduction of so much modern technology, so quickly, requires more than the simple installation of equipment and the training of personnel. It requires the development of specifications for new and existing products and the documentation of operating procedures for their production. This seemingly endless task continues unabated as each new piece of equipment is put into production.

Provided below is an example of the specifications developed during ESA's modernization and now in use today:

Aerial photography Acquisition and Quality control
Survey Monument Construction and Installation
GPS Observation and Data Reduction Procedures
Leveling Observation and Data Reduction Procedures
Network Adjustments
Aerotriangulation Procedures
1:50,000 &1:250,000 Scale map specification
1:10,000 Orthophoto Specification and Procedures
1:2,500 Digital Map Specification and Procedures
Cadastral Surveying Specification and Procedures
Cadastral Survey Data Reduction Procedures
Cadastral Overlay Specification and Procedures
Digital Cadastral Map Specification and Procedures
Land Record Management System Specification and Procedures
LRMS Data Entry and Utilization Procedures
Existing Cadastral Map Conversion and Procedures
LIS Pilot System Specification and Procedures
Crop & Soil Inventory Specification and Procedures
CIR Inventory Specification and Procedures
Crop & Soil GIS System Specification and Procedures

5.2 Computerization:

"Modernization program can be summed up in single word- computerization"

ESA has added more than 250 IBM. Compatible PCs, 20 Macintosh computers and 30 Unix WS to its equipment inventory, in house computer training.

Training programs have been established and a system support and development staff is being trained to maintain and trouble shoot this modern equipment.

5.3 Training:

The Key to successful technology transfer for a production organization such as ESA, to allow trainees to master the skills, develop work habits and understand its application to the task at hand.

The training program implemented at ESA contains three distinct elements:

* Senior Management Seminar devoted to the management of modern mapping technology, which is conducted by recognized authorities in each discipline. Topics include Electronic surveying, digital photogrammetry, automated cartography , GIS and systems management.
* Middle Management Production Management Training to prepare mid-level managers for the new technology, its pace and Procedures, and to provide the hands-on experience with the technology for which they are responsible.

Some examples for training at this level are as follows:

Middle Management Training Programs

Production Management
Survey Operations
Digital Stereo compilation
Digital cartography
Photo interpretation
Orthophoto production
Land Records Conversion
System Management

* Engineer and Operator Technical Training to provide production orientated programs geared to the introduction of the specific new technology to which the individual trainee will be exposed in his/her job performance. These training programs are too numerous to mention here, however some examples are given below:

Technical Training Programs

GPS Observation and processing
Control leveling
Cadastral Surveying
Aerial Film Quality Control
Aerotriangulation
Analog Stereo compilation
Cartographic Drafting
Basic photo interpretation

* Thanks to grants from USAID, GTZ (Germany) and FINIDA (Finland) that enable Egyptian Survey Authority (ESA) has been implemented this technical modernization plan.

6. Contribution of NARSS in the national paper that will be presented by the Egyptian Survey Authority

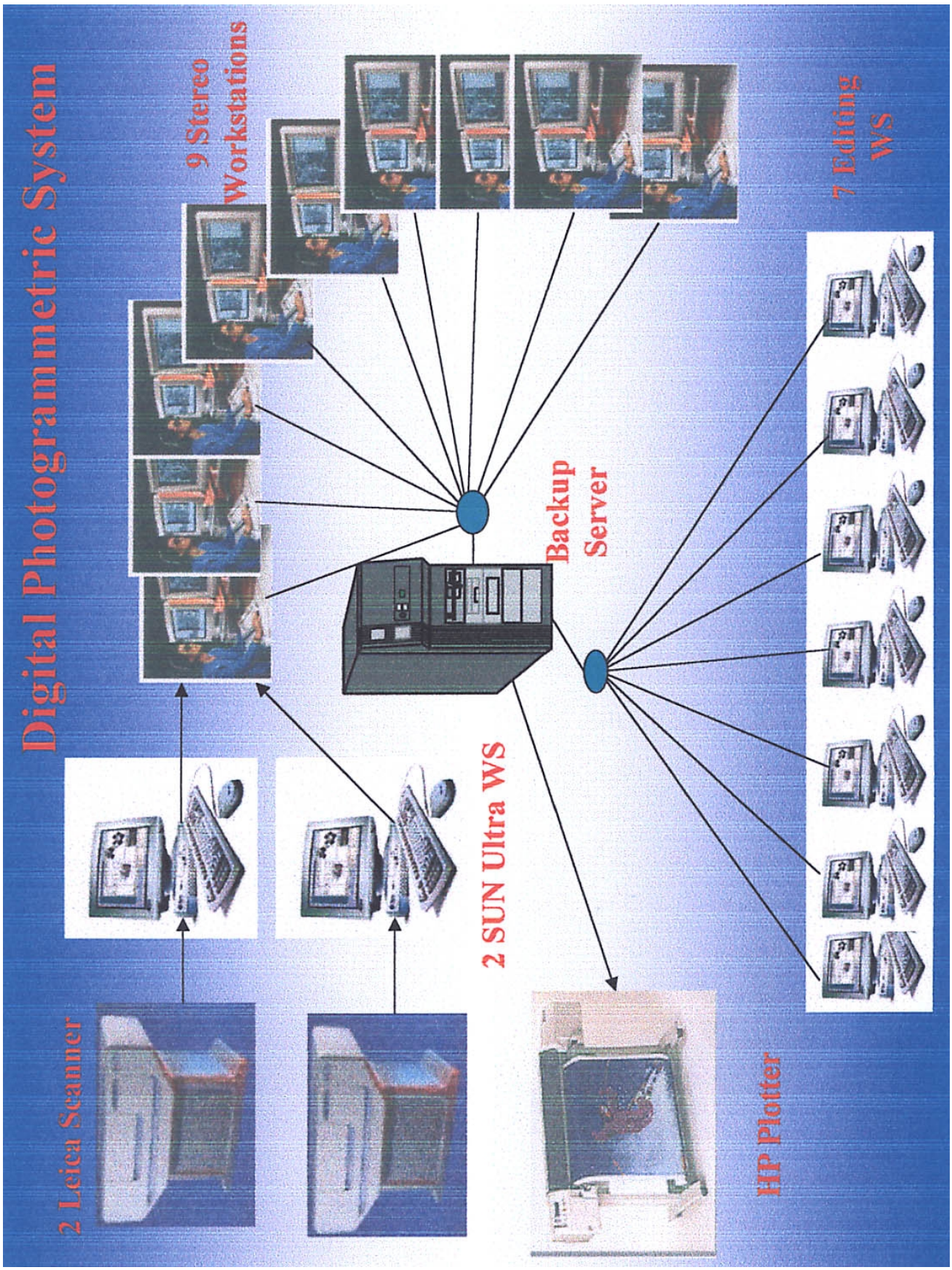
The National Authority of remote sensing and Space Science (NARSS), the governmental body in Egypt entrusted with remote sensing applications and space sciences, is keen to adopt and implement the state-of-the-art relevant technologies as well as upgrading the on-going technologies in order to obtain high precision, expeditious, and relatively low cost products and services. The Authority has a vested interest in transfer of high technology in fields such as imagery processing, satellite surveying, and GIS.

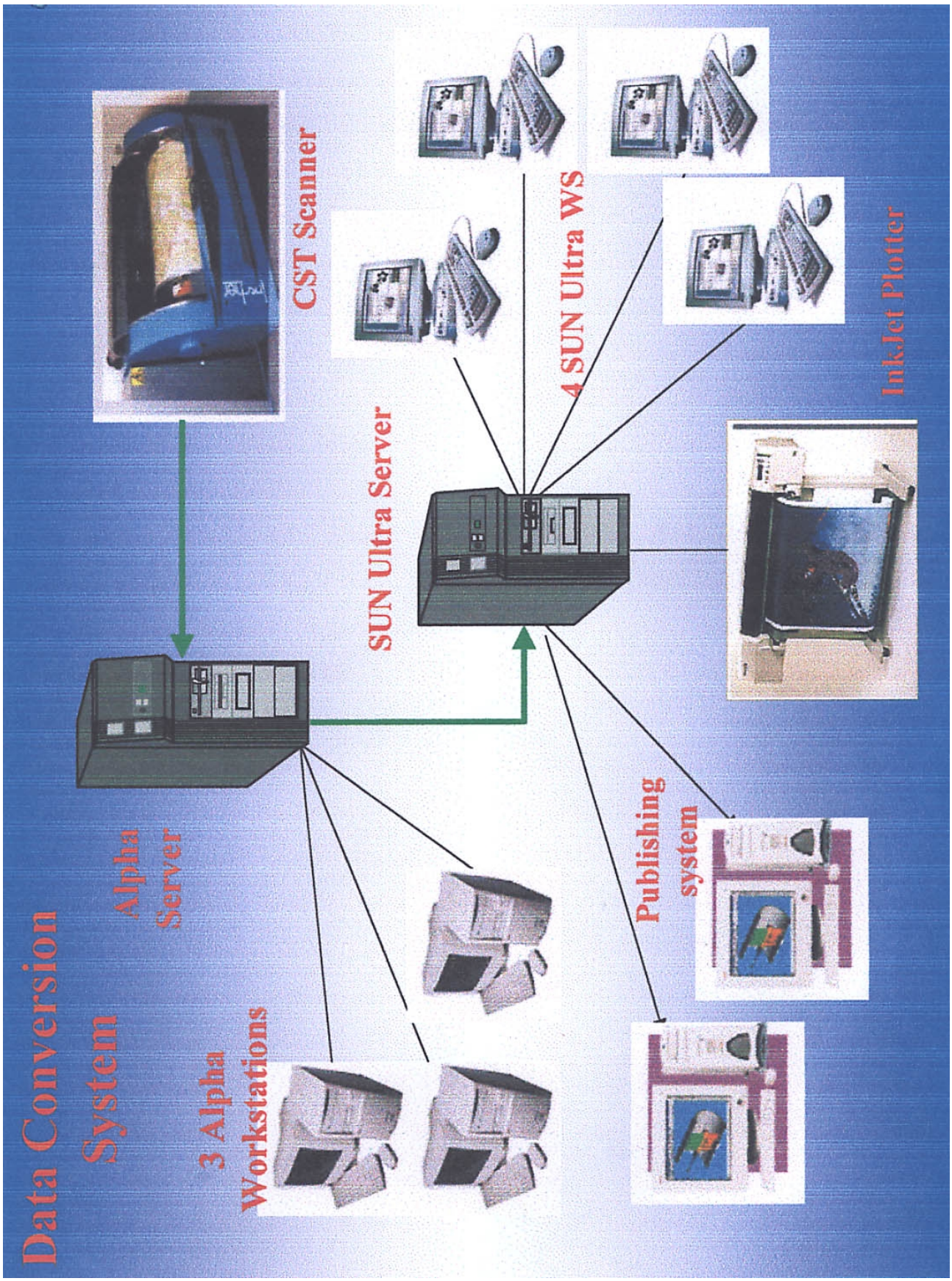
In map production, NARSS is not restricted in use neither by aerial photographs nor satellite images but processes the capability to operate with both. Also NARSS started to receive RADARSAT data and is using them in various applications. And for better flexibility and ability, NARSS owns a super king Air-200 beach craft for aerial photography and is continuously paying attention to up-grade it.

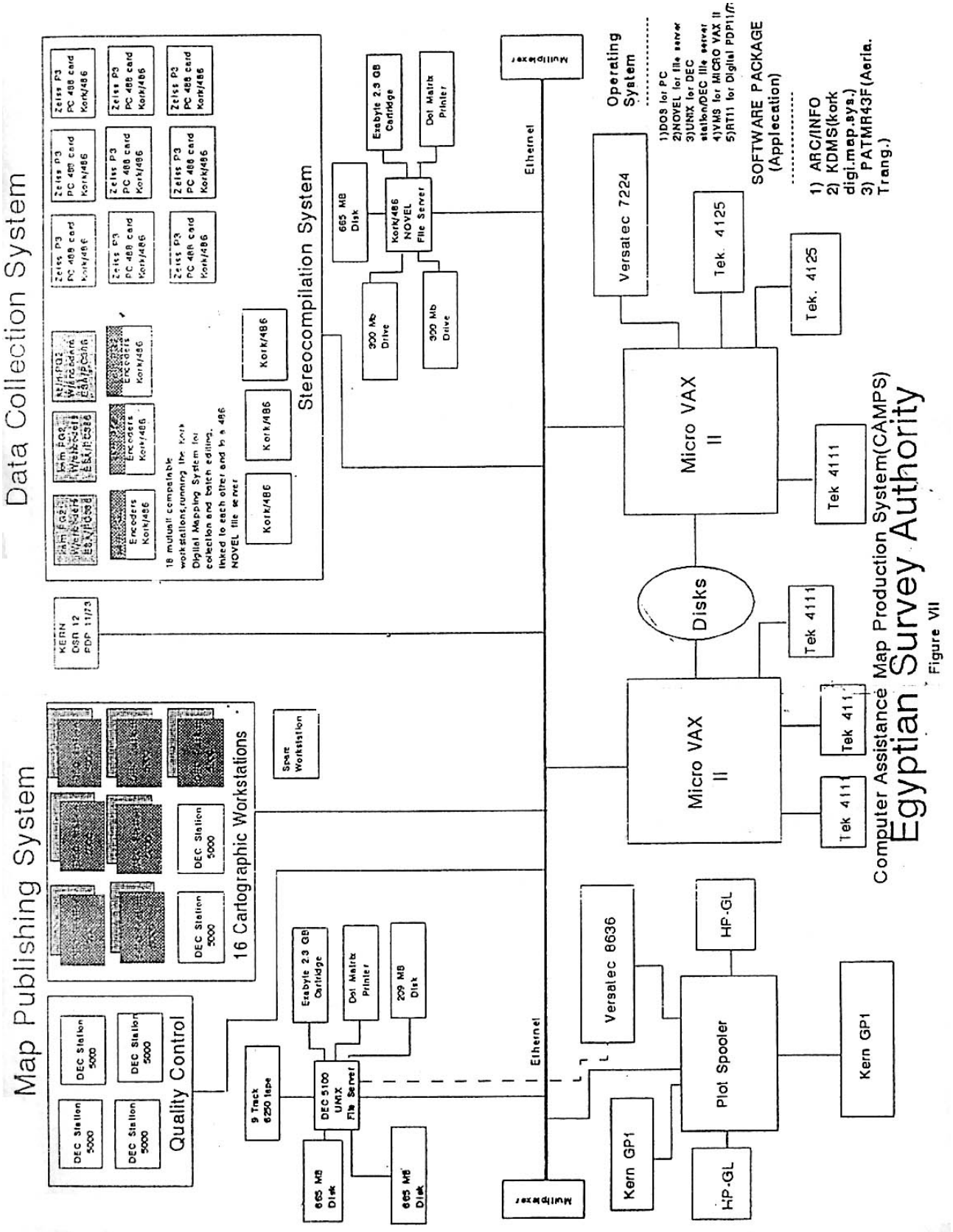
Recently, NARSS has implemented an experimental project using laser technology and employing aviation management System for producing accurate digital elevation models (DEM), in short time and at relatively low cost compared with the classical methods.

On the other hand, to augment its capabilities and because of the expanding users community, NARSS is purchasing a main ground Receiving Station to receive optical and radar satellite data. This will enhance real and semi-real time studies, including monitoring and surveillance. This will be reflected positively on the training and expertise of its staff.

In the field of the peaceful uses of outer space, NARSS is entrusted with design and construction of an Earth Observation satellite aimed principally to desert studies (DESERTSAT), as a part of the Egyptian Space Program adopted by the Research Council for Space Sciences and Technology of the Egyptian Academy of Science and Technology.


Digital Photogrammetric System
9 Stereo Workstations
7 Editing WS
Backup Server
2 SUN Ultra WS
2 Leica Scanner
HP Plotter


Data Conversion System
Alpha Server
3 Alpha Workstations
CST Scanner
SUN Ultra Server
4 SUN Ultra WS
InkJet Plotter
Publishing system


Data Collection System
Stereocompilation System
Map Publishing System
16 Cartographic Workstations
Quality Control
Ethernet
Micro VAX II
Disks
Versatec 7224
Operating System
SOFTWARE PACKAGE (Applecation)
1) ARC/INFO
2) KDMS(kork digi.map.sys.)
3) PATMR43F(Aeria. Trang.)
Computer Assistance Map Production System(CAMPS)
Egyptian Survey Authority
Figure VII