State Authority for Geodetic Works
The Former Yugoslav Republic of Macedonia

THE STUDY FOR ESTABLISHMENT OF STATE BASE MAPS FOR GIS IN THE FORMER YUGOSLAV REPUBLIC OF MACEDONIA

Final Report

(Summary)

December 2006

JAPAN INTERNATIONAL COOPERATION AGENCY

KOKUSAI KOGYO, CO., LTD.

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PREFACE

In response to a request from the Government of Macedonia, the Government of Japan decided to conduct a study on The Study for Establishment of State Base Maps for GIS in the Republic of Macedonia and entrusted to the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr.Akira NISHIMURA of KOKUSAI KOGYO Co., LTD. and consists of KOKUSAI KOGYO Co., LTD. between March, 2004 and December, 2006.

The team held discussions with the officials concerned of the Government of Macedonia and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of Macedonia for their close cooperation extended to the study.

December 2006

Kazuhisa MATSUOKA,
Deputy Vice President
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

Kazuhisa Matsuoka
Deputy Vice President
Japan International Cooperation Agency

It is an honor to submit herewith the report of the Study for Establishment of State Base Maps for GIS in the Republic of Macedonia. This report was prepared, incorporating the suggestions and advices received from the Japan International Cooperation Agency (JICA) and concerned authorities, as well as the agencies affiliated with the Government of Macedonia including the State Authority for Geodetic Works.

During the study, a spatial data infrastructure on a scale level 1:25,000 was established as a part of National Spatial Data Infrastructure for the Macedonia, and printed topographic maps were created on the same scale. In the meantime, techniques relating to this work (GPS survey, digital leveling, digitization of aerial photo film, digital triangulation, digital mapping/editing, GIS, printing data) were transferred to the State Authority for Geodetic Works of the Government of Macedonia. Furthermore, various activities related to the dissemination of geographic information (environmental map exhibition, forum, and press release etc.) were conducted.

In the final chapter of this report, specific recommendations are made based on the results of the study. From the perspective of maintaining and developing the results of the study, I hope that these recommendations will be promptly implemented by the agencies affiliated with the Government of Macedonia.

On behalf of the team, I would like to express my sincere gratitude to JICA, the Ministry of Foreign Affairs, the Ministry of Land, Infrastructure and Transport, and the affiliated agencies, for the valuable advice and cooperation they provided us with during the implementation of this study. I would also like to express my deep appreciation to the agencies affiliated with the Government of Macedonia, including the State Authority for Geodetic Works, for their generous assistance and cooperation during our stay in Macedonia.

December 2006

Akira Nishimura
Team Leader
The Study for Establishment of State Base Maps for GIS in the Republic of Macedonia

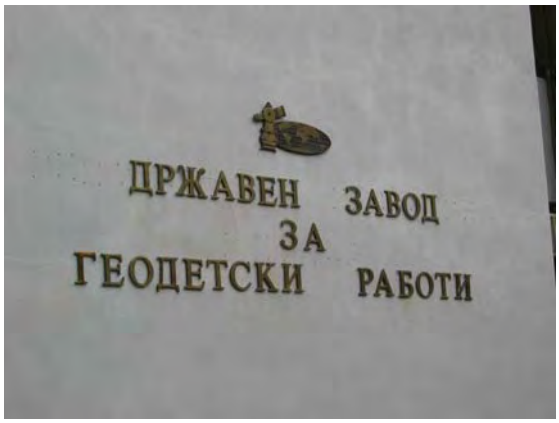
Location Map of the Study for Establishment of State Base

Photograph

Scenery of Skopje

Local Scenery of Macedonia

SAGW Office (Skopje)



Sign of SAGW (Skopje)

First Order Triangulation Point

Observation Tower of Triangulation Point

Photograph

Installing Photo Signal
(Photo Control Point Survey)

Observation
(Photo Control Point Survey)

Levelling (Photo Control Point Survey)

Levelling (Photo Control Point Survey)

Field Identification (Preparation)

Field Identification (Field)

Photograph

Supplementary Field Identification
(Preparation)

Supplementary Field Identification
(Field)

Field Identification for Land use DB
(Field)

Field Identification for Land use DB
(Arrangement of Results)

Technology Transfer (GPS Survey)

Technology Transfer (GPS Analysis)

Photograph

Technology Transfer (Levelling)

Technology Transfer (Levelling)

Technology Transfer (Photogrammetry)

Technology Transfer (Photogrammetry)

Technology Transfer (Photogrammetry)

Technology Transfer (Photogrammetry)

Photograph

Technology Transfer (Field Identification)

Technology Transfer (Field Identification)

Technology Transfer
(Supplementary Field Identification)

Technology Transfer
(Supplementary Field Identification)

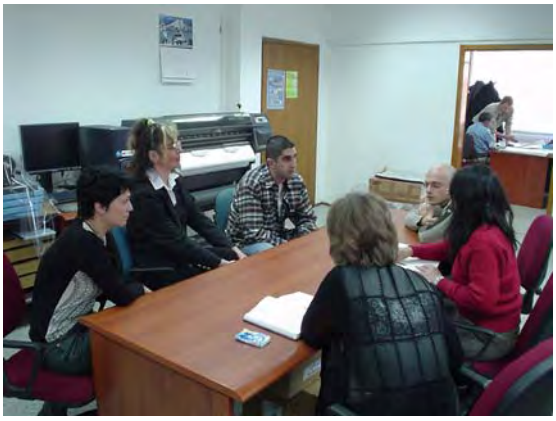
Technology Transfer (GIS)

Technology Transfer (GIS)

Photograph

Technology Transfer (GIS)

Technology Transfer (GIS)



Technology Transfer (Printing Data)

Technology Transfer (Printing Data)

Technology Transfer (Printing Data)

Technology Transfer (Printing Data)

Photograph

Dissemination of Geographic Information
(Environmental Map Contest)

Dissemination of Geographic Information
(Environmental Map Contest)

Dissemination of Geographic Information
(Environmental Map Contest)

Dissemination of Geographic Information
(Environmental Map Contest)

Visit to Neighboring Country (Czech)

Visit to Neighboring Country (Czech)

Photograph

Visit to Neighboring Country (Hungary)

Visit to Neighboring Country (Hungary)

Visit to Neighboring Country (Slovenia)

Visit to Neighboring Country (Slovenia)

Dissemination of Geographic Information (Forum)

Dissemination of Geographic Information (Forum)

Photograph

Dissemination of Geographic Information (Forum)

Dissemination of Geographic Information (Forum)

Dissemination of Geographic Information (Forum)

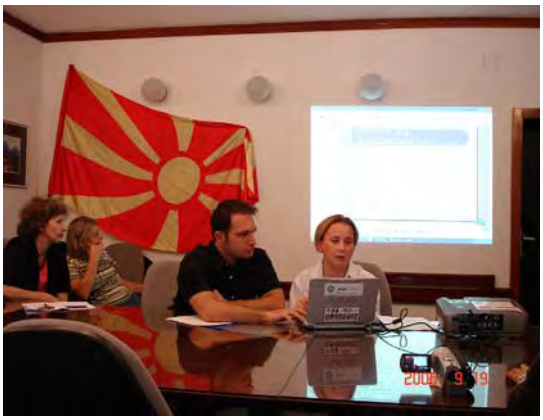
Dissemination of Geographic Information (Forum)

Dissemination of Geographic Information (Forum)

Dissemination of Geographic Information (Forum)

Photograph

Work Shop



Work Shop

Seminar

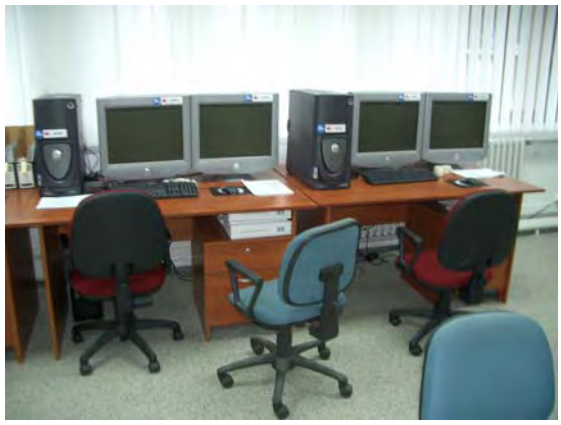
Seminar

Press conference

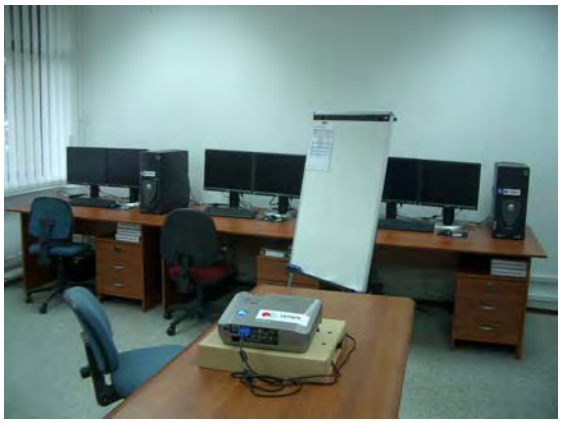
Press conference

Photograph

Equipment for Technology Transfer
(Scanner)



Equipment for Technology Transfer
(Plotter)



Equipment for Technology Transfer
(Compiler)

Equipment for Technology Transfer
(Macintosh)

Equipment for Technology Transfer
(GPS receiver)

Equipment for Technology Transfer
(Electric Level)

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1.1 Overview of the Study

(1) Objectives of the Study

The Study had the following objectives:

- ♦ Production of national basic maps (establishment spatial data infrastructure)
- ♦ Technology transfer
- ♦ Dissemination of geographic information

(2) Overview of the Study

The overview of the Study is described below.

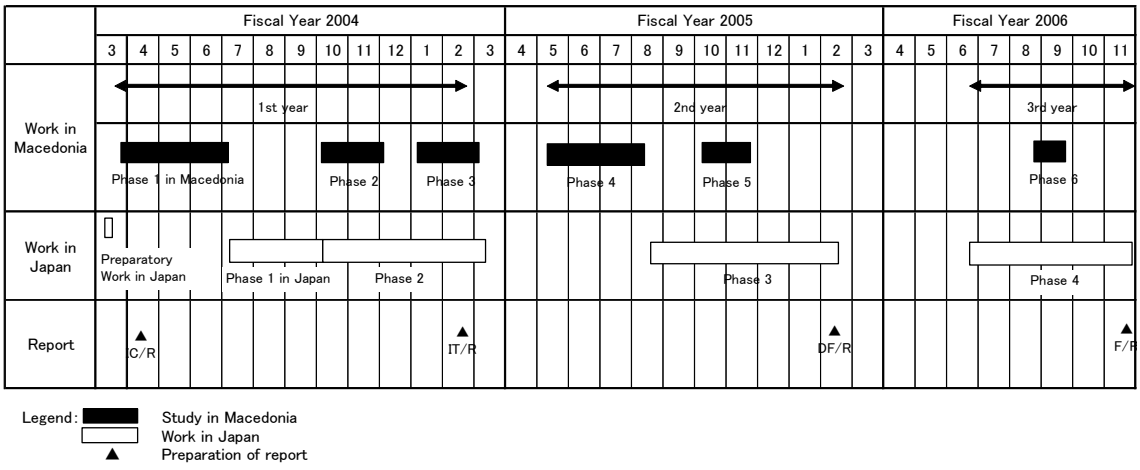
Objective	Overview of the Study			
Creation of National Basic Maps	Study Item	Specifications	Quantity	Remarks
	1. Aerial photography	Scale: 1/40,000 Film type: Black/white	Approx. 25,713km2	Local subcontract
	2. Creation of aerial photo images	1,693dpi	Approx. 25,713km^2	Work in Japan
	3. Photo control point survey	First order control points Photo control points	21 points 28 points	Technical cooperation with SAGW and OJT
	4. Aerial triangulation	Bundle adjustment	1,625 photos	Work in Japan
	5. Field identification (incl. supplementary field identification)	Joint use of aerial photos and output maps	Approx. 14,145km^2	Technical cooperation with SAGW and OJT
	6. Creation of digital topographic maps	105 maps	Approx. 14,145km^2	Work in Japan and OJT
	7. Creation of printed maps of topographic maps	6-color printing	105 maps 500 copies each	Work in Japan
	8. Creation of GIS topographic map database		Approx. 14,145km^2	Work in Japan and OJT
	9. Creation of land use map database	CORINE Level 3	Approx. 3,556km^2	Technical cooperation with SAGW
	10. Creation of Lake Ohrid environmental conservation database		Approx. 3,556km^2	Technical cooperation with SAGW
Technology Transfer	Technology Transfer Items			
	1. Spatial data infrastructure creation technology		Number of trainees	Remarks
		a. Ground survey technology (incl. GPS survey)	19	
		b. Digital photogrammetric technology	7	
		c. Printed map data creation technology	4	
	2. GIS technology			

Objective	Overview of the Study			
		a. Basic technology for GIS software operation	4	
		b. Database constructing technology	4	
		c. Operation of spatial data infrastructure on GIS	4	
		d. GIS applications	4	
Dissemination of Geographic Information	Extension Activity Items			
	1.	General extension activities	Target	Remarks
		a. Interviews	Governmental officials	
		b. General publicity activities	Mass media	Radio/TV/press, twice inserted in newspaper
	2.	Environmental map contest	Number of entries	Remarks
		a. Holding of environmental map contest at Prilap	276	1,109 participants
		b. Participation in environmental map contest in Japan	17	
	3.	Holding of forum	Number of participants	Remarks
		a. New maps in Macedonia	Approx. 200	

(3) Schedule of the Study

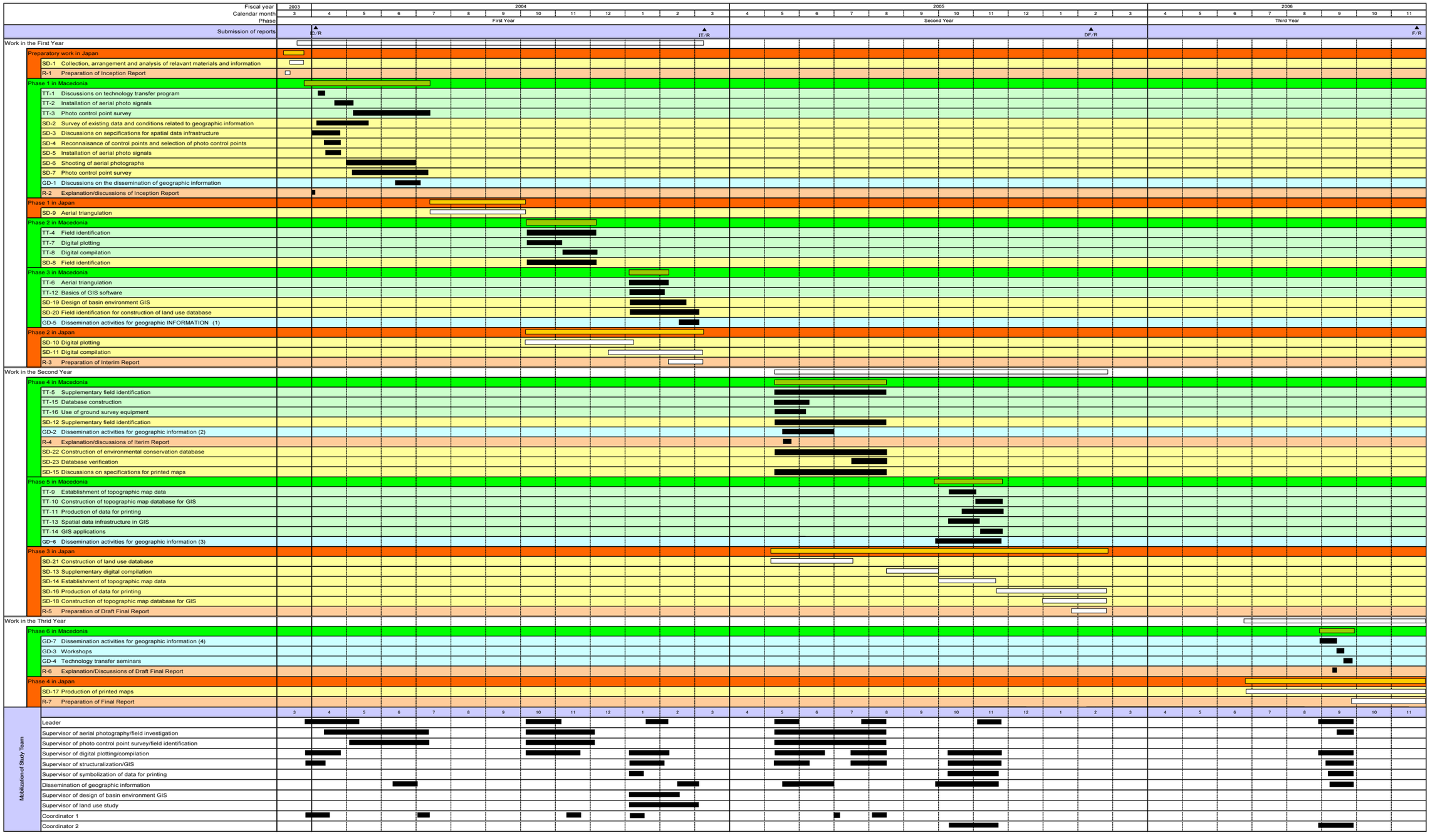
The Study was started in March 2004 and completed in November 2006.

The rough schedule of the Study is shown in the chart below.



The detailed schedule and the flowchart of the overall Study are shown in Table 1-1 and Figure 1-1.

Table 1-1 Work Schedule



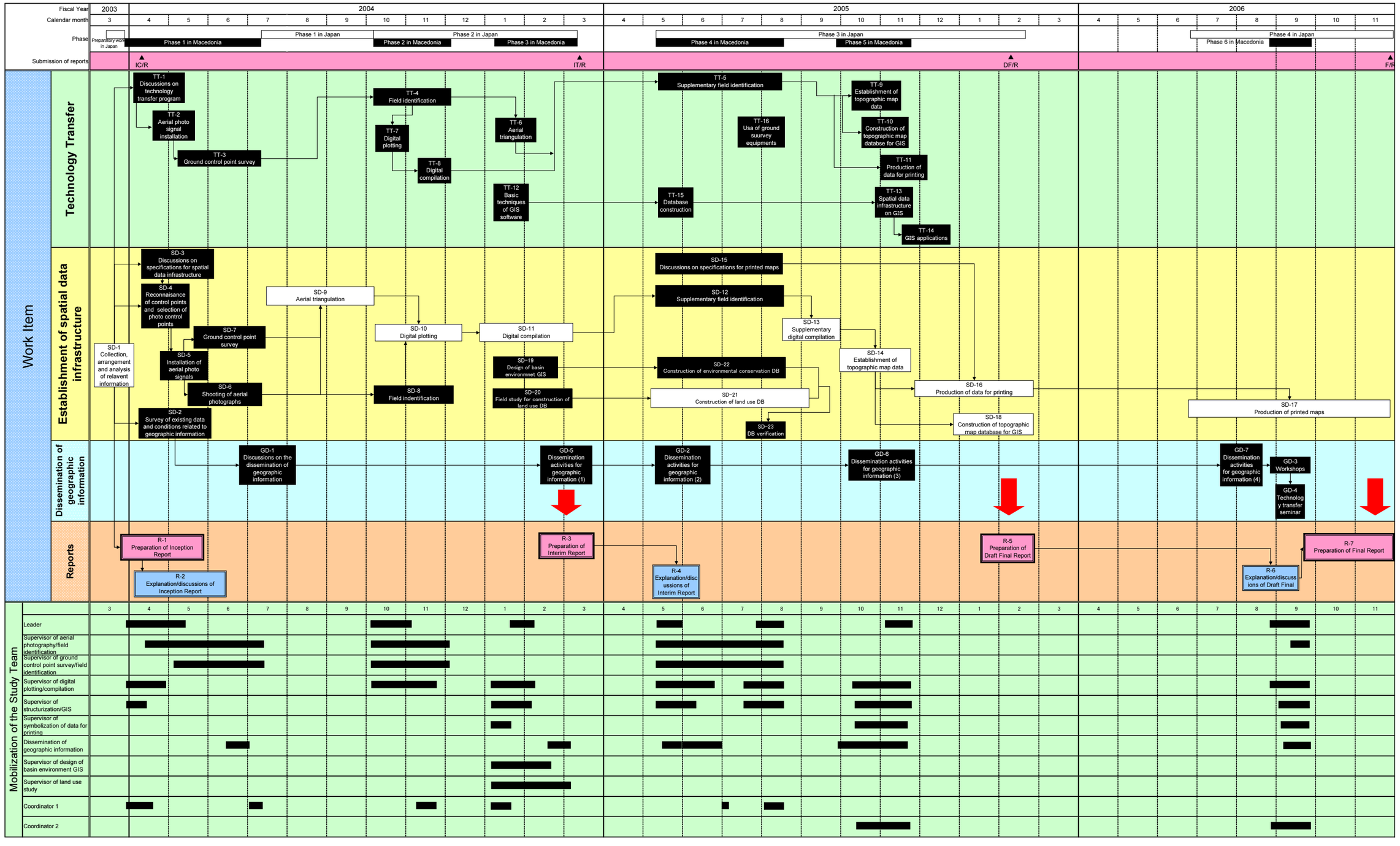


Figure 1-1 Flowchart

(4) Results

The results were as follows during the course of the Study.

Study Reports

- Inception Report
- Interim Report
- Draft Final Report
- Final Report

Products

- Aerial Photography
- Results of photo control point survey
- Results of aerial triangulation
- 1:25,000 topographic map films for printing
- 1:25,000 topographic map (printed maps)
- Digital data file

Chapter 2 Results of the Study

2.1 Objectives of the Study

The Study had the following 3 objectives:

(1) Production of national basic maps (Establishment of spatial data infrastructure)

The establishment of a spatial data infrastructure was intended to produce the following results:

- ♦ Production of digital national basic maps (scale 1/25,000) (including printed maps)
- ♦ Constructing of a GIS database

(2) Technology transfer

The technology transfer was intended to transfer the following technologies to enable the counterparts to create and use similar products independently after completion of the Study.

a. Spatial data infrastructure creation technology

The technology related to spatial data infrastructure creation was transferred through ground surveys (such as the GPS survey) and digital photogrammetry (including creation of printed map data).

The technology transfer included planning, schedule control and quality control methods to create a spatial data infrastructure.

b. GIS technology

GIS technology included the following items:

- ♦ Basic GIS software operation
- ♦ Database constructing
- ♦ Operation of spatial data infrastructure on GIS
- ♦ GIS applications

(3) Dissemination of geographic information

The following activities were conducted in order to disseminate the geographic information to government agencies and civil society:

a. Dissemination of geographic information and publicity activities
b. Improvement of the method of providing geographic information.

2.2 Basic Policies of the Study

Based on the objectives described above, the Study was executed under the following basic policies:

(1) Basic policy for creation of national basic maps (spatial data infrastructure)

Adoption of technical specifications according to the needs of use

Creation of highly versatile spatial data infrastructure

(2) Basic policy for technology transfer

Transfer of digital technology for spatial data infrastructure creation

Transfer of technology for GIS utilization of spatial data infrastructure

(3) Basic policy for dissemination of geographic information

General disclosure of geographic information

Promotion of utilization of geographic information

2.3 Target Areas of the Study

(1) Target areas for the production of national basic maps

The target areas of this Study were as follows:

a. Target area for acquisition of aerial photo image data

The target area for acquisition of aerial photo image data covered approximately 25,713km^2 of the entire national land area. (See Figure 2-1)

b. Area for production of national basic maps (spatial data infrastructure)

Approximately 14,145km^2 of the entire national land area was targeted to create 105 maps (scale 1/25,000). (See Figure 2-2)

7 of the 105 maps were targeted for technology transfer through OJT.

c. Area for building GIS database

Approximately 3,556km^2 of the entire national land area was targeted to build individual databases. (See Figure 2-2)

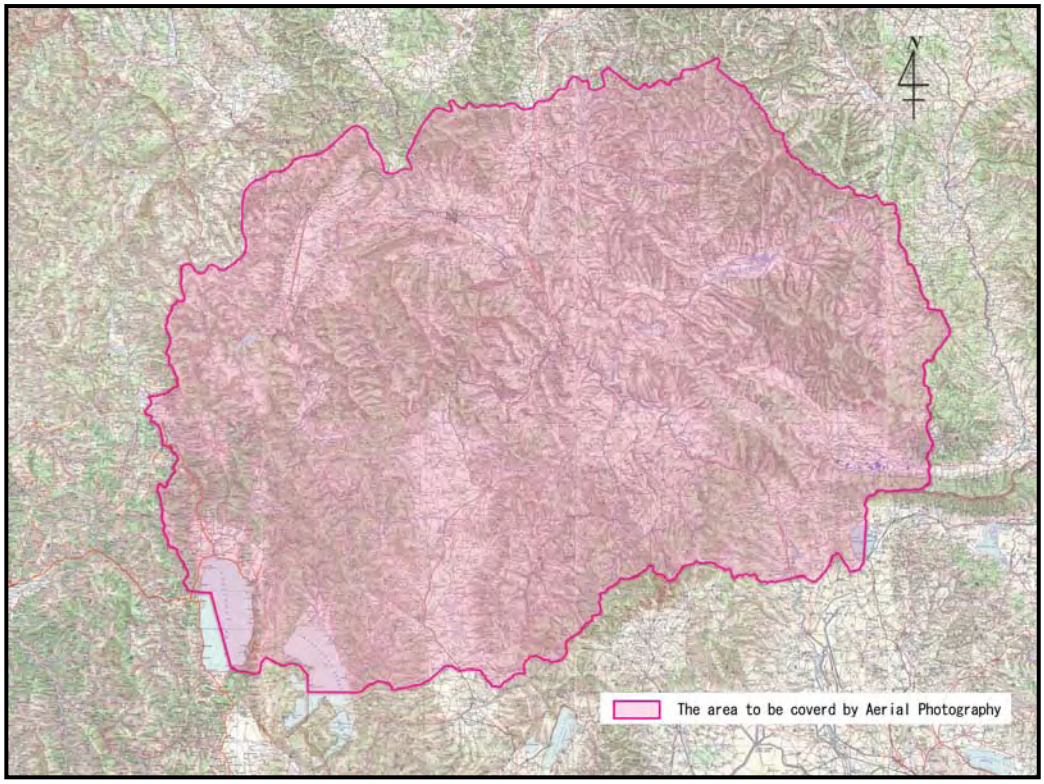


Figure 2-1 Target area for acquisition of aerial photo image data (Target area for aerial photography)

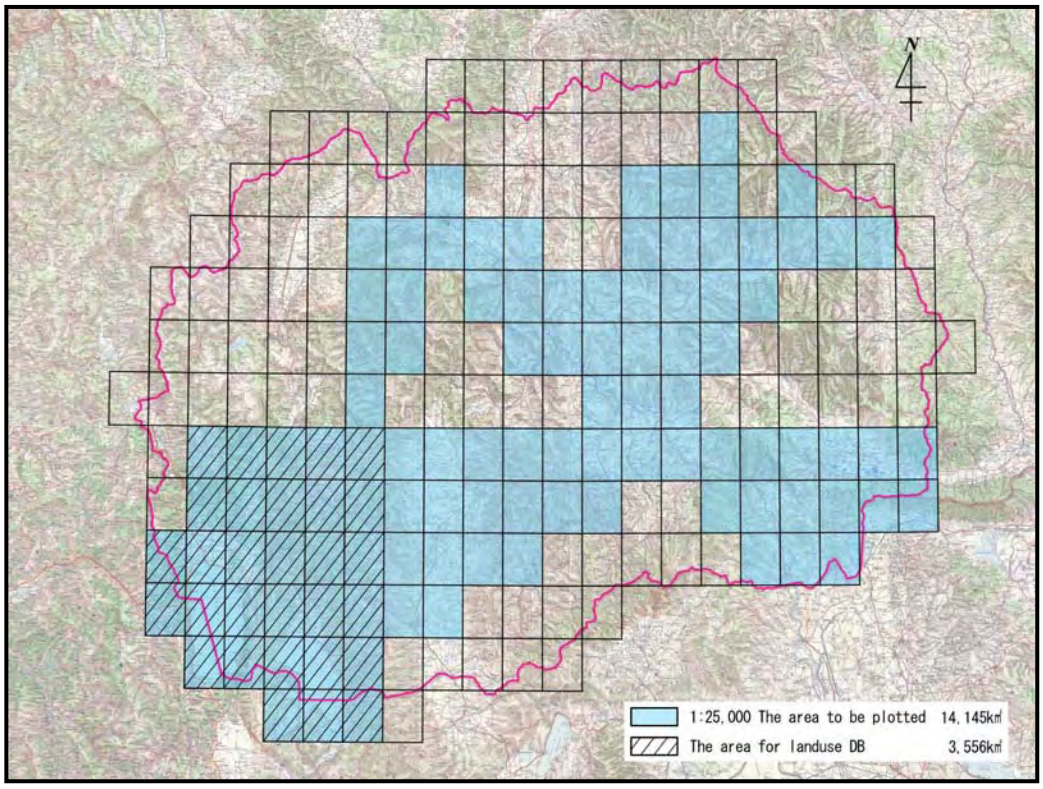


Figure 2-2 Area for production of national basic maps

(2) Target for technology transfer

The technology transfer was targeted at the staff of each department of SAGW.

(3) Target for dissemination of geographic information

The dissemination of geographic information was assumed to be targeted at the following groups:

- ♦ Governmental agencies and the concerned staff thereof
- ♦ International organizations (including donors from other countries)
- ♦ Citizens

2.4 Methodology of the Study

The works in this Study were implemented using the methodology described below.

2.4.1 Methodology of Production of National Basic Map

It was planned to establish the spatial data infrastructure (national basic maps) in digital form for effective use of the maps. For this reason, digital techniques were applied to each work process as far as possible.

a. Aerial photography and digitization of photo images

Aerial photography was conducted on a scale of 1/40,000 in black and white mode out of consideration for the photographing period and the use of the photos for interpretation. In addition, the method of digitizing the photo images by scanning the photographed films was employed.

b. Control point survey

The GPS survey was applied to survey the control points in order to digitalize the survey technology.

c. Building of spatial data infrastructure

Digital photogrammetric technology (digital aerial triangulation, digital plotting and compilation) was employed to build the spatial data infrastructure from the digitized photo images.

d. Creation of GIS database

The specifications of the land use and environmental conservation databases were

defined employing a production method based on the results of the interview survey and information-gathering study. The databases were built using the achievements of the GIS technology transfer as far as possible.

e. Production of printed maps

The reproduction films necessary to create printed maps were produced using the digital data for printed maps.

2.4.2 Methodology of Technology Transfer

The transfer of various technologies in the Study was performed using the following methods:

- ♦ The technology transfers were not centered on theoretical training in lecture form, but emphasis was placed on the transfer of practical technologies based on actual work.
- ♦ The OJT method was used to ensure that the target trainees for technology transfer created actual products by themselves.

2.4.3 Methodology of Dissemination of Geographic Information

The following methods were employed out of consideration for the dissemination of geographic information in Macedonia:

- ♦ The method of examining the state of dissemination of geographic information to target organizations was employed.
- ♦ The method of utilizing the mass media (radio/TV/press) was employed in order to reach ordinary citizens.
- ♦ The method of holding participation-type events for geographic information promotion was employed for primary school children and junior high school pupils who are expected to use geographic information in the future.
- ♦ A study trip was organized to refer the actual situation of institutes dealing with geographic information in neighboring countries.
- ♦ The method of holding events on the subject of “New era of Mapping in Macedonia” was employed, targeted at related organizations and interested parties.

2.5 Details of the Study

2.5.1 Details of National Basic Map production

(1) Specifications of national basic maps (spatial data infrastructure)

1) Exchange of opinions with advisory staff

The opportunity was provided to discuss the methodology and outcome of the Study with the technical advisory group under SAGW.

2) Ground and other surveys

Discussions were held with SAGW on the following specifications related to ground and other surveys:

- ♦ Survey rules
- ♦ Survey specifications (reference ellipsoid, projection method and coordinate conversion parameters)
- ♦ Scope of work (including neat line size)

3) Specifications of spatial data infrastructure

The specifications of the spatial data infrastructure were drafted in accordance with ISO standards for geographic information. Discussions on the draft were held with SAGW and the specification of the spatial data infrastructure was decided.

(2) Photo control point survey

1) Reconnaissance of ground control points and selection of photo control points

The necessary number of photo control points for the horizontal positions and height was calculated based on the specifications. A photo control point survey plan was drawn up based on the calculated results. After that, a survey of existing triangular points, selection of the photo control points, setting of monuments and installation of aerial photographic signals were conducted.

2) GPS photo control point survey

A GPS survey was conducted using 6 GPS receivers in accordance with the following specifications:

- ♦ Observation method: Static method
- ♦ Data acquisition interval: 15 sec.
- ♦ Observation period: 3 hours

3) Determination of height photo control points

The GPS photo control points and the height control points whose position could be defined on the aerial photos were determined by direct leveling.

4) Analytical calculations

After the GPS observation survey, a baseline analysis and net adjustment calculations were conducted to determine the position of the GPS photo control points. The height control points were also calculated and processed to determine the height, based on the observed values during leveling.

(3) Aerial photography

The aerial photography was carried out by a local subcontractor.

1) Selection of local subcontractor

The local subcontractor for aerial photography was selected by bidding. In the end, 2 companies bid. As the result of evaluation of the bid contents, Geodetski Zavod Slovenije (Slovenia) was selected as the subcontractor.

2) Photography

Permits for photography were acquired from Macedonia and neighboring countries and photography commenced on June 21, 2004 and was completed on July 21, 2004.

The details of photography were as follows:

- Photographic scale: 1/40,000
- Photographic films: Black/white films
- Photographed area: Approx. 25,713km^2
- Photography courses: 28 courses

(4) Field identification

A field identification was conducted using the aerial photos enlarged to a scale of 1/25,000.

1) Preparations for field identification

The aerial photos were prepared, enlarged to a scale of 1/25,000. Existing topographic maps (scale 1/25,000 and 1/50,000) were collected. In addition, SAGW was requested to collect the information that was not obtained in the field survey.

The map symbols for the field survey were also prepared in accordance with the specifications of the spatial data infrastructure.

2) Field identification method

The targets of the field identification were defined using the collected information and aerial photos.

The defined targets were surveyed in the field at the same time as the necessary information was collected. Then, the results were indicated on the aerial photos.

3) Implementation of field identification

The field identification of the target area of 14,145km^2 was conducted by 6 teams, consisting of 2 persons per team. In the survey, the necessary information to make a photo interpretation handbook was collected.

(5) Photogrammetry 1

1) Aerial films scanning

For the scanning of the aerial films, the negative films were scanned using a photogrammetric scanner in accordance with the following specifications:

- Resolution: 15μ (1,693dpi)
- Data format: TIFF (uncompressed)
- Data size: Approx. 220MB/photo
- Scanned quantity: 1,625 photos

2) Aerial triangulation

Using the scanned aerial film images and the results of the photo control point surveys, a digital aerial triangulation by bundle adjustment with self-calibration was conducted. The courses and quantity of the conducted works were 28 courses and 1,625 photos respectively.

3) Digital plotting and compilation

Digital plotting and compilation were conducted using the results of the aerial triangulation and field identifications.

Basically, the digital plotting employed TNTmips.

After digital plotting, the data was output and a visual check of the output maps was made in accordance with the specifications. Then, after the visual check, a logic check of the data (consistency of topology and code classification) was performed.

The area for digital plotting and compilation was approximately 14,145km^2 including that for OJT for SAGW.

(6) Supplementary field identification

A supplementary field identification was conducted using the data output maps obtained after digital plotting.

1) Preparation of supplementary field identification

After digital plotting, the data was categorized and output as follows:

- ♦ Terrain and planimetric feature data output maps
- ♦ Annotation data output maps (in Latin and Cyrillic)
- ♦ Road information output maps
- ♦ Output maps for field use
- ♦ Output maps for arrangement

Queries that arose during digital plotting and compilation were indicated on the maps after output.

2) Supplementary field identification method

The queries indicated on the output maps for field use were checked at each site. Then, the specific items for the supplementary field survey were checked at each site. The results of the supplementary field survey were clearly indicated on the output maps.

3) Implementation of the supplementary field identification

The supplementary field identification of an area of approximately 14,145km2 was implemented by 7 teams, consisting of 2 persons per team. During the survey, related information was also collected. One investigator took charge of collection and renewal of the annotation information.

(7) Photogrammetry 2

1) Digital compilation of supplementary field identification data

The digital compilation of supplementary field identification data was carried out using the digital-compiled data and supplementary field identification results.

In the digital compilation of the supplementary field data, similar equipment to that used in the digital compilation was used to enter the corrections, based on the supplementary field identification, annotation corrections and ground control point information as well as the attribute information. After digital compilation of the supplementary data was completed, a visual check and logic check were made to correct any errors. The area covered in this work was approximately 14,145km^2 including the area covered by SAGW OJT.

In this work, difficulties arose in the visual check and discrepancies occurred in the Product Specifications, but these problems were solved by using abbreviated symbols for the visual check and revising the Product Specifications.

(8) Creation of topographic mapping data and GIS topographic map database

Digital compilation of the supplementary field data was conducted using the results of the supplementary field survey. Then, the topographic mapping data and GIS topographic map database were created.

1) Topographic mapping data

The input data for creating the printing data in sheet unit was produced based on the data file in which the supplementary field identification data was digitally compiled. The data file was prepared in accordance with the printing DXF output specifications in the Product Specifications. The additional data for printing, such as neat lines and coordinate grid lines, was also produced.

The area covered by the produced topographic map data was approximately 14,145km^2, equivalent to 105 maps, including the area covered by SAGW OJT.

2) GIS topographic map database

The data file after digital compilation of the supplementary field identification results includes all the necessary items for the spatial data infrastructure. The data file was converted into ArcInfo Coverage format as specified in the Product Specifications to produce the GIS topographic map database in sheet unit. After conversion, the data displayed on the screen was checked using ArcGIS9.

Metadata was produced for each sheet in accordance with the Product Specifications.

The area covered by the constructed GIS topographic map database was approximately 14,145km^2, equivalent to 105 maps, including the area covered by SAGW OJT.

(9) Constructing of GIS database

A basin environment conservation database and land use database were constructed.

1) Constructing of basin environment conservation database

This database was intended for environmental conservation of Lake Ohrid. For this reason, discussions were held with staff concerned with the Lake Ohrid environmental conservation project in order to define the necessary database. Based on the defined database, the specifications of the database items were determined and the related materials

were collected.

The database was constructed using the collected materials, according to the specifications. The database was constructed by SAGW based on the results of the GIS technology transfer. The constructed database covered an area of approximately 3,556km^2.

2) Constructing of land use database

This database was also intended for environmental conservation of Lake Ohrid. As described above, the land use categories were also discussed with the staff concerned with the environmental conservation project.

As a result, “CORINE” which is used as the standard in European countries was applied to the land use categorization, and “Level 3” was adopted in consideration of the scale of the topographic maps.

A field survey was conducted by 2 teams, consisting of 2 persons per team, in accordance with the adopted land use categories. The land use map database was constructed using the results.

(10) Production of printed maps

1) Production of printing data

The data (topographic mapping data) that was obtained by digital compilation of the supplementary field data was output in DXF format. This data was processed by adding the map symbol, line type, line number and tone data, marginal data and index map data corresponding to the specifications of printed maps, in order to create the printing data.

The printing data was produced using Illustrator software operating on Macintosh.

The produced printing data covered an area of approximately 14,145km^2, equivalent to 105 maps, including the area covered by SAGW OJT.

2) Topographic map printing

Using a resolution of 3000dpi, printing data was output onto 6 sheets of positive film, four colours of process and two colours for features for each sheet.

After the output film was examined and revised, an aluminum copy was made and colour proof paper was printed. The colour proofs were examined for print overlaps, colour specifications and ink bleeds, and amended as necessary.

Once the colour proofs had been examined and revised, final printing was carried out and the prescribed number of copies was selected.

The printing products are as follows.

Print Copies 105 sheets 500 copies（double face printing）

Macedonian Edition 400 copies（200 folded copies）

Latin Edition 100 copies（50 folded copies）

2.5.2 Details of Technology Transfer

(1) Photo control point survey

The technology transfer was conducted in 2 stages out of consideration for the timing of the introduction of equipment and materials.

1) Objectives of technology transfer

The technology transfer was aimed at mastery of the GPS survey technology in terms of planning, observation, analysis and schedule control. Operation of the newly introduced equipment (GPS and electronic level) was also included in the technology transfer.

2) Technology transfer through OJT

The technology involved in planning, observation, analysis and schedule control of GPS surveys was transferred through OJT during implementation of the photo control point survey.

Technology transfer using the introduced equipment was made during SAGW's Sveti Naum Project.

3) Technology transfer through lectures

Technology transfer made through lectures included the theory of planning and analysis (baseline analysis and net adjustment) in GPS surveys, coordinate conversion and quality control of products, and the functions and operating procedure of the introduced equipment.

(2) Field identification

1) Objectives of technology transfer

The transfer of the field identification technology had the following objectives:

- ♦ Understanding of planimetric data items for spatial data infrastructure
- ♦ Familiarization with field identification implementation methods using aerial photos
- ♦ Familiarization with field identification arrangement methods using aerial photos

2) Implementation of technology transfer

The technology involved in preparation of the field identification, survey methods in

the field, presentation methods of the survey results and final arrangement methods was transferred during the implementation of the field identification.

(3) Digital photogrammetry

1) Objectives of technology transfer

The technology transfer was aimed at familiarization with the operating methods of the introduced digital photogrammetry system and familiarization with techniques such as scanning, digital aerial triangulation, digital plotting and compilation.

2) Digital photogrammetry system

The manufacturer of the system explained the outline of the system operating procedure at the time of introduction of the system. Subsequently, the counterparts mastered the operating procedure of individual equipment while actually operating the equipment.

3) Scanning

The technology for scanning aerial films was transferred.

4) Digital aerial triangulation

This technology transfer included conventional aerial triangulation and aerial triangulation by automatic processing. Aerial triangulation covering the area where SAGW conducted digital plotting and compilation through OJT was carried out.

5) Digital plotting and compilation

The counterparts were familiarized with basic digital plotting and compilation operations (including creation of planimetric feature tables and DEM creation) and various functions, and they conducted the digital plotting and compilation of the 7 maps planned for OJT.

(4) Supplementary field identification

1) Objectives of technology transfer

- ♦ Familiarization with supplementary field identification methods using the output maps of the compiled data
- ♦ Familiarization with methods of arranging the supplementary field idntification results using the output maps

2) Implementation of technology transfer

The technology involved in preparation of the supplementary field identification, survey methods in the field, presentation methods of the survey results and final arrangement methods was transferred to the counterparts during implementation of the supplementary field identification.

(5) Digital compilation of supplementary field identification data

The practical technology for finishing the digitally compiled data and the technology for producing input data for printed map production were transferred.

1) Objectives of technology transfer

The objective of the technology transfer was mastery of the technology involved in digital compilation of supplementary field identification data by TNTmips, production of input data for printing, construction of database and quality control.

2) Implementation of technology transfer

To attain the above objective, the technology involved in digital compilation of supplementary field identification data by TNTmips, production of input data for printing, construction of a database and quality control was transferred to SAGW using the data for the area of which SAGW was in charge.

(6) Constructing of database

1) Objectives of technology transfer

The objectives of the technology transfer were mastery of basic operation of the TNTmips compilation software, acquisition of basic knowledge of data processing including error cleaning, and mastery of the technology for constructing a database in accordance with the Product Specifications for the spatial data infrastructure.

2) Implementation of technology transfer

The technology transfer was made in 2 stages, for basic technology (basic operation of TNTmips software) and practical technology (database constructing).

(7) Production of printing data

1) Objectives of technology transfer

The objectives of the technology transfer were familiarization with basic operation of Macintosh OS and Illustrator software and basic technology for producing the data for printed maps, including the production of the necessary objects for producing printing data.

2) Macintosh OS and Illustrator

This technology transfer was made with emphasis on familiarization with the operating procedures and functions of Macintosh OS and Illustrator necessary to create the data for printing.

3) Production of printing data

Based on the results of the technology transfer described in 2) above, the counterparts were familiarized with the import of sample data to the Illustrator software and the creation of various objects (line types and patterns). Furthermore the technology involved in the production of data for printed maps of the sample data was transferred to SAGW.

In addition, the data for printed maps was producted through OJT for the 7 maps of which SAGW was in charge.

(8) GIS

1) Objectives of technology transfer

The objectives of the technology transfer were mastery of basic operation of GIS software and acquisition of practical skills and analysis technology. Furthermore, the objectives included familiarization with technologies such as database design and constructing, data analysis and thematic data production to meet various needs for GIS.

2) GIS software

Technology such as basic operation of the ArcGIS software introduced in this Study, and practical skills such as digitization of various types of data, geometric correction, creation of topology, and attachment of attribute data were transferred. In addition, technology for 3D analysis and spatial analysis was also transferred.

3) Lake Ohrid environmental conservation GIS database

The trainees implemented the procedures for constructing the environmental conservation database through OJT, based on their experience in the technology transfer programs described above.

2.5.3 Details of Geographic Information Dissemination

Dissemination of geographic information was implemented through the following activities:

- ♦ Discussions on dissemination of geographic information
- ♦ Geographic information dissemination activities

(1) Discussions on dissemination of geographic information

Opinions on dissemination of geographic information and the work in this Study were exchanged with the governmental agencies of Macedonia, international organizations and aid agencies for effective use of the geographic information.

Investigation of the geographic information (including the printed maps of topographic maps and aerial photos) possessed by SAGW was carried out with SAGW.

(2) Geographic information dissemination activities

1) Publicity activities

The following publicity activities were conducted within the framework of this Study and the publicity activities of SAGW.

a. Publication of Newsletters（English and Macedonian）

Newsletters were published in the form of newsletters about the details of activities and work progress in order to share information and deepen mutual understanding between parties affiliated with the project and local residents. The created newsletters from issue 1 to issue 9, which was the final issue, were released on the SAGW website.

b. Newspaper, Radio and Television Coverage

There were newspaper, radio and television reports on the details of the project work, and details of the geographic information dissemination activities, such as the environmental map contest and forum.

2) Environmental map contest

An environmental map contest was held for primary school children and junior high school pupils with the intention of disseminating geographic information to the younger generation. There were 1,109 participants and 276 entries in the contest.

17 outstanding entries from this contest were entered in the environmental map contest in Japan and won prizes.

3) Visits to neighboring countries

Visits to neighboring countries were made in order to study the actual spread of geographic information in those countries. The director and one employee of SAGW and one member of the Study Team participated in these visits to the Survey Bureaus of neighboring countries such as Hungary, Czech and Slovenia. They investigated the state of creating, updating, selling (selling method, including prices) of geographic information, and the basic policy of promoting geographic information in those countries.

4) Forum

A forum on "The New Era of Mapping in Macedonia" was held for the purpose of disseminating geographic information to the public sector including governmental, educational and utilities agencies, private companies, international organizations and aid organizations in other countries.

The forum took up the following topics:

- History of maps in Macedonia
- Present state of map sales in Macedonia
- Necessary geographic information and services
- Use of new geographic information
- GIS in Macedonia
- State of geographic information in neighboring countries (Czech and Hungary)
- Geographic information-oriented society in Japan
- Improvement of geographic information services of SAGW

5) Technology Transfer Seminar

The study work was carried out for a period of three years and at the end of the period a technology transfer seminar was conducted to disclose a report of the study work carried out by the counterpart while reporting the progress and the results of the entire study work to the affiliated persons.

There were around 70 participants who were directly affiliated with the study work.
A presentation was given at the technology transfer seminar detailing the progress and results of the entire study work by the Study Team and the progress and results of the study work which the counterpart side was involved in. The contents of the seminar were as follows.

- Opening remarks
- Summary of progress and results of The study work
- Report from SAGW of each study work
- Report of training results in Japan
- Report of workshop results
- Award of technology transfer participation certificates and equipment provision
- Message from the Study Team
- Closing remarks

6) Workshop

On the 19th of September a workshop for the participants of each training course was held in the SAGW conference room covering a summary of the technology transfer training. The workshop was titled "Action Plan for Our Next Step" and the aim was to provide a place to discuss opinions regarding cross-technical issues between courses and to formulate an action plan for technical issues upon completion of the project. Twenty participants from the training courses and nine members from the Study Team (including an interpreter) participated in the workshop and a proactive and lively discussion was carried out by the counterpart side.

The following action plans were created to roundup the technical transfer courses which were based on the results of the group discussions of each technical transfer course, the group presentation and the question and answer sessions. The action plans were presented by representatives at the seminar the following day.

- Completion of 1/25,000 base data: a plan was suggested to implement the inter-cooperation of required technical fields
- Promotion of intensive use of orthophotos: a plan was suggested for a system to create various orthophoto products with high needs and for human resource development required for this
- Creation of reduced compilation maps: in conjunction with the completion of the 1/25,000 base data, technical investigation and a concrete schedule was suggested for creating 1/50,000 and 1/100,000 national base maps
- Construction of GPS control network: a plan was suggested for engineer training aimed at construction

As the workshop was held in Macedonian, the Study Team had to act as a facilitator, however the participants could easily join in thus the initiative of the counterpart side was fully drawn out from the discussion. The summaries of the technical transfer courses enabled us to clarify the technical issues upon project completion and define the necessity of cooperation between courses.

7) Press Conference

SAGW sponsored press conference was held upon the commencement of the sale of map products, including the new 1/25,000 topographic maps created by this study, for the media organizations, such as television, radio and newspaper companies, as well as organizations who utilize geographic information, such as UN agencies, to spread the information to the citizens of Macedonia.

In addition to the presentation at the commencement of the sale of the products (January 2007), the conference explained the issue of the major update and improvement of the contents of the newly produced topographic maps in comparison with the existing topographic maps. Furthermore, in addition to improving the contents of maps, the map sales and price system was revised, and the price was cut, the length of time required for the purchase procedures was shortened and it was emphasized that the general public would purchase the maps more easily.

8) Disclosure of Geographical Information

SAGW amended the management and procurement procedures for geographic information, which have been in place since the independence of the state. The disclosure of geographic information, the amendment items related to provision of the service and plan for the expansion of the service are described here.

a. Announcement of Geographic Information Provision

A map catalogue including an index map, purchase prices, sales procedure, Q&A, posters (A2) detailing the provision of new maps and leaflets to be placed at information counters, were created and distributed to inform the public. Newspaper advertisements were also published for the same purpose

b. Type of Disclosed Geographic Information

All of the geographic information (printed maps, digital files, GIS databases etc.) provided by this project is being released to the public. In addition, the old maps, which have been dealt with until now, will continue to be sold until the stock has run out.

c. Sales Price and Purchasing Method

In reference to the data collected by the study trip in 2005 and the map sales prices of neighboring countries, the price of one printed map which was 144 Euro has been lowered to 5.2 Euro. This pricing system has also been adopted for the old maps. In addition, the previous procedure that customers had to obtain the approval of SAGW management after making the purchase application, which took several days, has become unnecessary, and the length of time required for purchasing the information was significantly reduced. However, users must wait for several days for digital geographic information to be burned onto a CD.

d. Copyright

SAGW has given users permission to sell the disclosed geographic information with value-added information. In this case, users will inform SAGW of the intended purpose when purchasing the data, sign a pledge to observe the terms of service, and obtain an authorization number. Users are requested to note the authorization number and the passage that indicates the application of the geographic information data obtained with SAGW approval on the processed map product.

e. Geographic Information Provision Plan

From here on, as part of a development plan, SAGW are examining the construction of a system whereby data can be downloaded from the website, the establishment of a SAGW map sales counter and the sale of geographic information at SAGW local offices and city Kiosks.

2.6 Results and Evaluation of the Study

2.6.1 Results and Evaluation of National Basic Map Production

(1) Specifications of national basic maps (spatial data infrastructure)

1) Results

Discussions were held with SAGW and the technical advisory group to decide the specifications for the ground survey (including reference ellipsoid and projection system) and the scope of work (sheet size and sheet index). The specifications of the spatial data infrastructure were also decided in accordance with ISO geographic information standards.

2) Evaluation

The world geodetic system and EU standards were not adopted for the survey specifications because of the restrictions of the current survey method. One of the remaining issues is to re-calculate the results in the case of changes in the geodetic system in the near future.

At this point in time, the specifications of the spatial data infrastructure are based on world standards. The issue is to maintain conformity with world standards in future.

(2) Photo control point survey

1) Results

The photo control points for 59 horizontal positions including 28 existing points were

determined in 18 sessions of the GPS survey.

The standard deviation of the horizontal positions and height after net adjustment was a maximum of 9.3mm (limit value of 150mm) and 20.3mm (limit value of 300mm) respectively.

A total of 125 height control points including 59 photo control points for horizontal positions was provided basically to determine their height by leveling.

2) Evaluation

The accuracy of the position and height of the photo control points was within the limit values.

(3) Aerial photography

1) Results

As a result of inspection after photography, 1,668 aerial photos on a scale of 1/40,000 for 28 courses were adopted to cover the entire national land area of Macedonia.

2) Evaluation

The photographing period was later than initially estimated, but photographing was completed in one month.

(4) Field identification

1) Results

The field identification was conducted while implementing technology transfer, but it was completed within the specified period.

2) Evaluation

Information for preparation of the photo interpretation handbook, which was undertaken concurrently, was collected.

(5) Photogrammetry

1) Results

The scanning of 1,625 aerial photos was conducted and a total of 360GB of digital data was acquired.

Aerial triangulation was conducted at 59 control points for horizontal positions and 125 height control points and the following results were obtained:

- ♦ Bundle resection residual: 28.874μm (max.)
  4.233μm (standard deviation)

♦ Control point residual:

(Horizontal position)	0.674m (max.)
	0.224m (standard deviation)
(Height)	0.435m (max)
	0.079m (standard deviation)

In the digital plotting and compilation, the errors in the visual check and the logic check were corrected to produce the compiled data.

2) Evaluation

The data obtained in scanning the aerial photos was good enough to be used for subsequent production of the ortho-photo images.

The maximum value and standard deviation of each residual in the aerial triangulation were within the limit values, so good results were achieved.

The output maps of the compiled data were used effectively in the subsequent supplementary field survey.

(6) Supplementary field identification

1) Results

The supplementary field identification was conducted by more teams than initially planned, so all the field work was completed within the planned period.

2) Evaluation

The results of the supplementary field identification contained some disparities, but were as expected by the Study Team.

(7) Establishment of topographic mapping data and GIS database

1) Results

The topographic mapping data was produced in accordance with the printing DXF output specifications in the Product Specifications as finally determined.

The GIS database for the topographic maps passed the logic check to ensure it could be widely used through the metadata.

2) Evaluation

The topographic mapping data served adequately as the raw data for the printing data. The metadata was attached to the GIS database and it is expected that the database will be used as basic data for positional information in various GIS applications.

(8) Constructing of GIS database

1) Results

The basin environmental conservation database was constructed by collecting materials related to the specified data items. However, not all the materials related to the specified data items were obtained. The items that were not obtained were left blank and will be included in the database when they are obtained.

The constructing of the land use database was completed in accordance with "CORINE Level 3" through the field survey.

2) Evaluation

The basin environmental conservation database lacks some data, but both databases can be used as basic data in the Lake Ohrid environmental conservation project.

(9) Production of printed maps

1) Results

The printed map data was completed in both the Macedonian and Latin versions through a visual check and corrections using the printing data output maps. Printing data for index maps was also produced, taking into account the sale of maps to the public.

2) Evaluation

Printing in both Macedonian and Latin to allow for the sale of the maps in Macedonia and other countries is highly evaluated from the viewpoint of dissemination of geographic information. The printed index maps for sale to the public are also highly appraised.

2.6.2 Results and Evaluation of Technology Transfer

(1) Photo control point survey

1) Results

Technologies ranging from GPS survey planning to analysis were transferred to SAGW through lectures and OJT.

Leveling using a digital level included observation exercises without any practical work, but the technology was successfully transferred to SAGW.

2) Evaluation

As for the GPS survey, at the final stage of the technology transfer, the trainees from SAGW were considered able to carry out the work from planning to analysis in an actual project by SAGW without any problem.

They can be expected to gain experience in leveling using a digital level in future.

(2) Field identification

1) Results

The technology transfer was made through OJT in parallel with practical field identification. As seen from the results obtained by the SAGW trainees in the field identification, the objectives of the technology transfer were more or less attained.

2) Evaluation

The SAGW trainees are able to conduct field identifications by themselves for the production of topographic maps, based on the results of the technology transfer and their cadastral survey in the field.

(3) Digital photogrammetry

1) Results

The trainees produced 7 topographic maps through OJT as planned, without any problem. From this, the objectives of technology transfer in this field are considered to have been attained.

2) Evaluation

From the visual check and logic check of the results of OJT, the SAGW trainees are basically capable of creating topographic maps independently using digital photogrammetry.

(4) Supplementary field identification

1) Results

Most of the trainees in the technology transfer had experience in field identifications using aerial photos as described above, and they mastered the supplementary field identification technology without any problem. The supplementary field identification for 7 maps was successfully completed by SAGW.

2) Evaluation

SAGW was able to conduct the supplementary field identification for its 7 maps based on the results of the technology transfer. Future issues include the establishment of uniform survey results and the transfer of the technologies transferred to the SAGW trainees to other engineers.

(5) Digital compilation of supplementary field identification data

1) Results

During the period of the technology transfer, SAGW completed the digital compilation of the supplementary field identification data for one map for the area of which SAGW was in charge, and successfully produced the input data for printing and the database.

2) Evaluation

The data completed during the period of the technology transfer satisfied the specifications in the Product Specifications and the technology has been successfully transferred to SAGW. The data for the remaining 6 maps was subsequently processed by the trainees, and this technology has been reliably transferred to SAGW. In addition, the quality control results of the completed data show that the quality control technology has also been successfully transferred to SAGW.

(6) Constructing of database

1) Results

By and large, the trainees mastered the basic technology (basic operation of TNTmips compilation software) more or less to a similar extent. They also acquired the practical technology (database constructing technology) and completed the database for one map for the area of which SAGW was in charge.

2) Evaluation

A series of technologies for constructing a topographic map database using the photogrammetric method was transferred to SAGW by this technology transfer. SAGW's acquisition of the series of technologies means that they have established a base from which they can expand the spatial data infrastructure independently in future.

(7) Production of data for printed maps

1) Results

The final target of the technology transfer was to produce printed maps from the topographic maps, but in the end, SAGW acquired the technology for producing the data for printed index maps as well as for producing printed maps.

2) Evaluation

The work of producing the data for 7 printed maps in the OJT program took longer than planned, but SAGW acquired the technology satisfactorily. They also produced the data for the printed index maps independently, based on the results of the technology transfer.

(8) GIS

1) Results

SAGW mastered the target GIS technologies faster than the Study Team expected. The resulting spare time was allocated to the higher application technologies of each GIS software program.

2) Evaluation

Higher application technologies for the GIS software than the preset target have been transferred to SAGW. The SAGW trainees also conduct the environmental conservation database more or less independently, based on the results of the technology transfer.

Technology transfer seminars were held based on each of the aforementioned results and assessments. At the seminars the progress and results of the technology transfer work as well as the improvement in technical capability for each field, was reported from SAGW.

2.6.3 Results and Evaluation of Dissemination of Geographic Information

(1) Discussions on dissemination of geographic information

1) Results

The desire for the dissemination of geographic information (such as the need for geographic information, and its distribution and sale) became clear through discussions with the related agencies. Light was also shed on the present state of provision of geographic information (such as types of information, and sale and supply systems) by SAGW.

2) Evaluation

It is important that various kinds of information which will be needed in future development of geographic information dissemination activities were obtained.

(2) Geographic information dissemination activities

1) Results

The actual state of geographic information establishment became publicly known through publicity activities in the press and on the radio and TV. The environmental map contest that was held for primary school pupils won a greater response than expected.

The present state of geographic information obtained from the visits to neighboring countries is expected to have a favorable influence on the policies of SAGW in the near future. In addition, the forum in which many related organizations participated has contributed to higher expectations regarding geographic information.

In order to publicize the results of the study work, affiliated civilians and press (newspaper, television, and radio) were gathered and a press announcement was made. This announcement was covered in newspaper articles and television news broadcast and also appealed to local citizens.

2) Evaluation

As a result of publicity activities, environmental map contest and visit to neighboring countries, SAGW realized that many related agencies have high expectations regarding geographic information, and based on that realization, SAGW announced concrete guidelines and policies for dissemination of geographic information at the forum.

Moreover, the selling price (considerably cheaper than before) of geographic information (topographic maps, aerial photographs, orthophotos etc.) and the purchase method (people can purchase without authorization) was specified through the press announcement, and it had substantial outcomes in the geographic information dissemination activities.

2.7 Conclusion of the Study

This Study was implemented with the following objectives:

- Production of national basic maps (spatial data infrastructure)
- Technology transfer
- Dissemination of geographic information

(1) Production of national basic maps (spatial data infrastructure)

During the period of the Study, the planned number of national basic maps (spatial data infrastructure) was produced through cooperation between SAGW and the Study Team.

This could be said to be the result of daily efforts made by both parties in the Study.

In producing the national basic maps, world standards and a new concept were introduced in deciding the specifications, to the extent permitted by the laws and regulations of Macedonia. For instance, existing laws were applied to the survey standards, but ISO-based world standards were applied to the specifications of the spatial data infrastructure and the map symbols for the printed maps, introducing a new concept with utmost care.

(2) Technology transfer

During the period of the Study, all the technologies targeted for transfer were transferred to SAGW together with some advanced technologies. Review of exercises by the SAGW trainees on holidays and their request for transfer of additional technologies were more than the Study Team expected and were seen as a sign of their desire to improve themselves. The outcome of technology transfer by OJT played a role in the final achievements of the Study.

(3) Dissemination of geographic information

The third objective, dissemination of geographic information, was an unprecedented attempt, but included a diverse range of activities such as publicity, an environmental map contest, visits to neighboring countries and the holding of a forum. As a result, awareness of geographic information was greatly enhanced among related agencies and the general public. This led to many inquiries about geographic information being made to SAGW and the Study Team during the period of the Study, and to SAGW announcing concrete polices for the establishment and dissemination of geographic information at the forum.

(4) Conclusion

In the course of the Study as described above, the Study Team held discussions with SAGW and its technical advisers and implemented the Study based on mutual understanding and cooperation. Owing to this, the Study Team was able to create a base for mutual trust and cooperation in many fields, including this Study.

Following SAGW's announcement at the forum, it is expected that SAGW will establish, update and disseminate geographic information step by step in the future, based on the results of this Study.

2.8 Results

The results were as follows during the course of the Study.

(1) Study Reports

The following reports were produced during the course of the Study.

- ♦ Inception Report 20 sets
- ♦ Interim Report 20 sets
- ♦ Draft Final Report

  Main Report 20 sets

  Summary 20 sets

- Final Report

Main Report	20 sets
Summary	20 sets

(2) Products

The following products were produced during the course of the Study.

- Aerial Photography

Negative film :	1 set
Positive film :	1set
Digital data of aerial photos :	2 sets
Contact prints of aerial photos :	2 sets
Photo index map :	1 set

- Results of photo control point survey : 2 sets
- Results of aerial triangulation : 2 sets
- 1:25,000 topographic maps

1:25,000 topographic map films for printing :	1 set
1:25,000 topographic map (printed maps) :	500 sets

- Digital data file

1:25,000 level topographic map data :	5 sets
1:25,000 level data base for GIS :	5 sets
Land use database :	5 sets
Environmental conservation database :	5 sets

Chapter 3 Present Status and Tasks

3.1 Present Status and Tasks

3.1.1 Establishment of National Base Maps and Spatial Data Infrastructure

(1) Present Status

1) National base maps

Of 205 map sheets of the national base maps covering the entire national land, 105 map sheets (each in 500 copies) was produced when the project of this Study was completed and it is expected that they will be effectively used for various basic programs to be implemented by the national and local governments as the basic information on the national land. SAGW has declared the future 3-year plan of producing the remaining 100 map sheets at the Forum.

The 105 map sheets and the existing national base maps are kept in order in the storeroom, but their conditions are not controlled well because the storeroom is not air-conditioned well. In addition, it takes much time to take out the map sheets to be purchased.

The national base maps produced in this Study were basically specified in accordance with the specifications of the existing national base maps, but some specifications were changed or added.

2) Spatial data infrastructure

The Product Specification for the spatial data infrastructure was intended to cover the items necessary to represent as the national base maps and to enhance the data usability. In addition, the advanced technical elements were also involved in the Product Specification.

The updating of the produced spatial data infrastructure was not made by an advanced, professional photogrammetric technique, but the ortho photo image digitization technique was adequate to meet the required accuracy in updating.

(2) Tasks

1) National base maps

The tasks to be done for the national base maps are as follows:

- To produce the 100 remaining sheets of the national base maps.

- To secure any adequate place of storage for the printed national base maps.
- To realize the systematic management of the printed national base maps.
- To increase the demand for the printed national base maps and to make an accurate demand prediction.
- To conduct the job of ordering the increased prints.
- To improve the specifications of the national base maps.

2) Spatial data infrastructure

The tasks to be done for the spatial data infrastructure are as follows:

- To revise the Product Specification of the spatial data infrastructure.
- To determine the method and intervals of data updating for the spatial data infrastructure.
- To acquire the budget for updating the spatial data infrastructure.

3.1.2 Technical Capabilities (Technology Transfer and Propagation)

(1) Land survey

1) Present status

GPS photo control point survey: As the result of the technology transfer made to SAGW, SAGW will be able to conduct the GPS survey by itself independently.

Digital leveling survey: SAGW possesses the technologies in operation of the equipment, the experimental level survey and the calculations and processing of measured values.

Field identification using aerial photos: SAGW had made similar surveys such as cadastral surveys. This experience was reflected on the technology transfer and contributed to acquisition of the technology to ensure SAGW to make the field identification independently.

Supplementary field identification: SAGW had the experience in the field identification using aerial photos as described above, so that its technology of supplementary field identification has reached the level to ensure it to make the works of preparing, implementing the survey and wrapping up the survey results independently.

2) Tasks

The tasks to be done in the technical capacity related to the land survey are as follows:

GPS photo control point survey: It can be decided that there is no problem at this moment.

Leveling using digital levels: SAGW lacks the experience in actual operations. Their speed of leveling is not sufficient for actual operations.

Field identification using aerial photos: There are differences among the survey results that the surveyors had obtained. It is also a problem to choose what survey items to be taken when the scale level was changed and to maintain the uniformity in understanding the criteria of choice.

Supplementary field identification: There are differences and irregularities among the survey results that the surveyors had obtained.

The common problem in these surveys was the tradition of these technologies.

(2) Digital photogrammetry

1) Present status

As the result of technology transfer, 4 or 5 engineers of SAGW have acquired a series of technologies that they can practice independently ranging from scanning of aerial photos and establishment of spatial data infrastructure (digital aerial triangulation, and digital plotting and compilation) to the basic technique of producing ortho photo images (including DTM construction) and the technique of producing the input data for the printed national base maps.

2) Tasks

The tasks to solve for enhancing the technical capacity for digital photogrammetry are as follows:

- ♦ To apply the digital photogrammetric technologies (ortho photo production and error rejection) to other works.
- ♦ To spread the digital photogrammetric technologies.
- ♦ To use the digital photogrammetric technologies in a systematic way.
- ♦ To make an opportunity for the SAGW staff to get familiar with the IT technology and to ensure them to do so.

(3) GIS

1) Present status

To evaluate the technical capacity for GIS, the model by Duane F. Marble Professor (Ohio State University) was applied in which the GIS technology is categorized into 6 skill levels, which are defined as follows (Source: Rebuilding the Top of the Pyramid: Structuring GIS Education to Effectively Support GIS Development and Geographic Research, December 1997):

- **Level 1: Basic Spatial and Computer Understanding**: Understanding basic cartography, basic spatial analysis, basic computing, and basic geodesy; Using GIS for display and simple output of data.
- **Level 2: Routine Use of Basic GIS Technology**: Using GIS on a routine basis and having no problem in using GIS applications; Creating, managing, and expressing data according to the specifications
- **Level 3: Higher Level Modeling Applications**: Capable of spatial analysis and modeling required for work; understanding basic programming and general theories of database structures
- **Level 4: GIS Application Design and Development**: Capable of more advanced spatial analysis and modeling; Using more than one GIS application and using programming to customize interfaces and develop tools required for work
- **Level 5: GIS System Design**: Familiar with information science in general and having advanced programming and database management skills; Working as a GIS system analyst to establish and implement a new GIS introduction plan
- **Level 6: GIS Research and Software Development**: Capable of advanced research and software development using GIS; Using skills related to GIS, databases, and networks to provide a wide range of solutions

In accordance with this evaluation model, it can be deemed that the technical capacity of the participants in the technology transfer program reached the Level 3 when the technology transfer was completed.

2) Tasks

The tasks of SAGW in the field of GIS based on the present status described above can be summarized as follows:

- The technical level of the staff can be further improved.
- Training and job opportunities need to be provided to improve the technical level of the staff.
- Equipment required for the solution of the above tasks need to be maintained and reserved.

(4) Production of printed maps

1) Present status

a. Present status of equipment

The equipment used for the technology transfer will be granted to SAGW when this

Study is completed. The maintenance and checking of the equipment will be made until the time of grant in an appropriate manner.

b. Present status of technical capabilities

At the time of completion of the technology transfer, the technology transfer three trainees from SAGW were recognized to have the following technical capabilities:

- ♦ Basic operations of the Macintosh
- ♦ Basic operations of Illustrator CS
- ♦ Practical operations of Illustrator CS
- ♦ Producing terrain data for printing
- ♦ Producing marginal information data for printing
- ♦ Data check methods

As described above, SAGW has acquired routine technical capabilities for converting digital compilation data (Illustrator format) into printing data.

2) Tasks

a. Equipment

At present, there is no plan concerning the maintenance and checking of the equipment, the maintenance of software and the replenishment of consumable parts. Therefore, it is a problem how the equipment and materials should be managed in an appropriate manner in the future.

b. Technical capabilities

- ♦ Maintaining the acquired skills
- ♦ Propagating the acquired skills
- ♦ Sophisticating the acquired skills
- ♦ Quality and process control

3.1.3 Dissemination of Geographic Information

(1) Present status of dissemination of geographic information

1) Overview of geographic information

a. Status of development of geographic information

SAGW has established various types of geographic information so far. The produced geographic information includes the topographic maps, aerial photos and the national control points (triangular points and benchmarks).

2) Dissemination of geographic information

The activities of SAGW to spread the geographic information as the controller of the geographic information remain in a low level to the governmental agencies as well as to the private sector.

3) Geographic information education

For the primary and secondary education, educational materials indispensable to learning such as globes and maps are either insufficient or damaged, causing problems in lessons.

4) Publicity and advertisement of geographic information

a. Publicity of geographic information

SAGW is conducting a wide range of activities on geographic information but is not publicizing its activities to the concerned ministries and agencies, local authorities, private sector, or general citizens. The Web site that SAGW has opened is not carrying any information about disclosure or sale of geographic information but is showing the progress of Study under way.

b. Advertisement of geographic information

SAGW has made no active advertising activity for spreading various types of geographic information so far.

(2) Tasks in dissemination of geographic information

1) Tasks in development of geographic information

a. Tasks in development of geographic information

The geographic information (topographic maps) that SAGW had taken in charge of was old and has little updated. Therefore, the existing geographic information had a large discrepancy from the actual conditions and its reliability was lost.

b. Tasks related to establishment of geographic information

SAGW has taken in charge of the cadastral maps, topographic maps and aerial photos, but the register to manage those maps and photos has not been provided.

The information on the conditions of and the method of accessing to the geographic information has not been disclosed to users.

2) Tasks in dissemination of geographic maps

The geographic information possessed by SAGW has not been known well to the local

governments or as the related ministries and agencies. The legal system to disseminate the geographic information to the private sector has not been established yet as well.

3) Problems in geographic information education

SAGW is not providing any free-of-charge supply of educational materials such as topographic maps in the classes nor support to geography education.

4) Tasks with publicity and advertisement of geographic information

a. Tasks in public relations

SAGW does not understand the importance of its publicity activity that should be widely known to the society using the national budget. It has opened the Web site, but it does not recognize the effectiveness of its publicity activity on the Web site as well.

b. Tasks in advertisement

SAGW has made no advertisement of its activities such as, for example, the issue of any pamphlets covering the information including the available geographic information, its prices and the method of providing it, and any report on the details of its activities to the tax payers.

3.1.4 Services

(1) Present status

1) Targets of geographic information services

The geographic information services that SAGW is handling at present are as follows:

- ♦ Topographic maps in various scales (printed maps)
- ♦ Aerial photos
- ♦ Information on national control points (including coordinate values, height information and location information)

2) Services

The following describes the present status of geographic information services.

a. Present status of supply

Various topographic maps are available to general citizens if they pay a price for them. Aerial photographs are virtually not available due to the lack of laboratory equipment. There was no demand for information on national control points, either, because the private surveying business was not legally permitted until October 2005.

b. Service of supplying topographic maps

The service of supplying topographic maps is carried out as follows:

Location of sale: Topographic maps are sold at the SAGW headquarters in Skopje.

Procedure of purchase and payment: A statement of reason and a signature of the SAGW director are required to purchase topographic maps. The price for them must be paid via funds transfer at a post office.

Prices of topographic maps: 144 euros (1: 25,000)

(2) Problems

a. Location of sale

The geographic information is sold at one place within the SAGW headquarters, but there is no section in charge of the sale.

b. Procedure of purchase

The purchase of the geographic information needs a very complicated procedure as described above. The receiving of the purchased information takes several days to about one week.

c. Selling prices of topographic maps

The prices of the topographic maps are extremely high compared with those in the neighboring countries and the income levels of the nation.

d. Years of production of topographic maps

The years of production of various types of topographic maps are dated back to over 30 years before for the newest and not updated. Therefore, there were many secular changes to be added to those topographic maps and the discrepancies from the actual geographic conditions were large.

3.1.5 Cooperation in Organization

(1) Present status

1) Cooperation in land survey

The installation of monuments and aerial signals and the aerial photography were conducted in a smooth way through the mutual discussions and authorizations of the concerned agencies and with the close cooperation between the organizations. On the other hand, the photo control point survey, which was the work that could basically be made independently of other organizations, was made without close cooperation with other

agencies except the delivery of the products.

The Product Specification introducing new concepts and the symbol specifications based on it were prepared after several times of corrections. As a result, the mutual discussions between the field survey and field completion survey groups and the photogrammetry group who were affected by such corrections were made to confirm the corrections. However, the documents of symbol specifications had some differences between the both parties and the corrections were instructed orally.

2) Cooperation between land survey and photogrammetry

Only the delivery of products was made between the group in charge of photo control point survey and that in charge of aerial triangulation. In plotting and compilation, the results of the field identification and the supplementary field identification were delivered as the supplemental materials. In addition, the queries in plotting and compilation were given to the engineers in charge of supplementary field identification.

3) Cooperation between photogrammetry and printing data production

In producing the data for printing, some problems were fund in the processing work. Therefore, a meeting was held between the photogrammetry group and the printing data production group in order to solve the data inconsistency.

4) Sharing of software programs and skills for using them

The use, maintenance and management of the software possesses by the departments of SAGW were made in a vertically divided system, but the software has not strategically been put into the common possession and active use within one organization of SAGW. The software application technologies that SAGW acquired through the technology transfer have the mutually intensive, correlative relations, but the common use of the acquired technical knowledge and know-how were not made by the participants in the technology transfer training. In addition, the technologies related to software that SAGW acquired through the technology transfer can fully be used for GIS skills, but there is no opportunity and system through which the technologies are further transferred mutually between the groups and engineers.

(2) Problems

From the present status as described above, the following problems can be extracted:

1) Cooperation in land survey

♦ The system of work meetings between the groups in charge of installation of

monuments and aerial signals and photo control survey has not been established yet.

- ♦ The Product Specification and the Symbol Specification are not in common possession by the related agencies.
- ♦ The symbol application specifications have some inconsistent points between the related agencies.

2) Cooperation between land survey and photogrammetry

- ♦ The system of work meetings between the groups of land survey and photogrammetry has not been established yet.

3) Cooperation between photogrammetry and printing data production

- ♦ The system of work meetings between the photogrammetry group and the printing data production group has not been established yet.

4) Sharing of software and skills for using them

- ♦ The software and its technologies available in recent years have the universal features, but SAGW has no idea of the common use of them among the related groups and of getting familiar with them.

3.1.6 Cooperation with Other Agencies

(1) Cooperation between SAGW and donors

1) Present status

At present, SAGW are implementing 4 projects simultaneously in cooperation with the respective donors and working to maximize the effects of assistance as a whole avoiding the duplicate assistances.

For these projects, SAGW has assigned the manager and members in charge of each project, and it has adopted the other members than the manager who are deemed to be the most adequate for the project.

2) Problems

While the cooperation between SAGW and donors seems to be smoothly maintained in each of the projects, SAGW lacks a viewpoint for organically connecting the progress and outputs of different projects (input equipment, personnel, and outputs).

(2) Cooperation between SAGW and other governmental organizations

1) Present status

At the beginning of this Study, the questionnaire on the cooperation with the current SAGW and the use of maps was issued to other agencies. All the related agencies that answered the questionnaire replied that they felt it necessary to cooperate with SAGW. They called for the technical guidance to the use of the thematic geographic information, the supply of topographic maps and the updating of topographic maps.

When the existing information was collected from the governmental agencies in this Study made after the questionnaire was made, it was made clear that each related agency constructed the GIS data and the associated maps in a similar approach, that they had no system of making the common use of those and that the owner of any data had a tendency of taking sole possession of it.

2) Problems

In view of the present status described above, the following problems were discovered.

- ♦ The Macedonian government organizations in general are not actively pursuing sharing of information owned by each of them but tend to keep it themselves.
- ♦ SAGW has never actively promoted the disclosure of geographic information, creating a vicious circle in which the dissemination and promotion of use of geographic information is hampered and more than one organization invest their resources on construction of similar data in a duplicated way.

3.2 Tasks

3.2.1 Maintenance of Survey Results

Tangible and intangible results were obtained from the study work. Even after study work is completed, these results must be maintained and effectively utilized.

It is important to realize the tasks set out in section 3.2.2 and carry out the priority project mentioned in chapter 4 for the maintenance and development of the results of The study work.

3.2.2 Production of National Base Maps and Spatial Data Infrastructure

(1) Tasks

1) National base maps

From the problems as described above, the following tasks are considered:

- ♦ It is a future task how the remaining 100 map sheets should be produced for 3 years.
- ♦ The provision of an adequate storage facility (equipped with an air conditioning system) for the national base maps and the application of the systematic operation method to it should be realized in acquiring the budget.
- ♦ The means of enhancing the commercial values of the printed national base maps should be devised (in terms of a folder of printed maps or packing in a vinyl case).
- ♦ An appropriate volume of national base maps (printed maps) should be kept in stock to realize the condition that they are always available.
- ♦ The specifications of the newly produced national base maps should be made available and disclosed widely by issuing a booklet or on a Web site to promote the right use of the new maps.

2) Spatial data infrastructure

- ♦ The Product Specification for the spatial data infrastructure should be disclosed as an official document on the SAGW Web site on Internet.
- ♦ The specifications of the spatial data infrastructure should be revised to reflect the demand from users and meet their needs.
- ♦ The updating cycle should be established in order to respond to the topographic features and the users' requests for updating.
- ♦ The data source for updating should be selected and used to meet various updating requirements.
- ♦ A simple, inexpensive updating method should be adopted in taking into account the updating accuracy requirements.

3.2.3 Technical Capacity

(1) Land survey

1) Tasks

a. GPS photo control point survey

From the general viewpoint of training GPS engineers (who are engaged in the work

of changing the standard geodetic system), it is a task for them to master the theory of GPS survey.

It is also a task to formulate the renewal plan for GPS survey equipment and take a step to acquire the budget for it.

b. Leveling using digital levels

It is one of the tasks of SAGW to make the practical leveling survey using a digital level. It is also a task to speed up the leveling survey with a digital level through the practical experience.

c. Field identification using aerial photographs

It is one of the tasks of SAGW to enhance the understanding of the field identification items and the data acquisition standard and maintain the uniformity of the results of field identification.

d. Supplementary field identification

The task considered for the supplementary field identification technology is the same as the field identification with aerial photos.

The common task for the land survey technologies is to revise the manuals, and to reflect on the existing manuals the know-how that will be obtained in the practical work to be done in the future.

From the viewpoint of increase in the technical potential, it is also a task to propagate the technologies widely to SAGW staff members without limiting to the trainees participated in the technology transfer training.

(2) Digital photogrammetry

1) Tasks

a. Equipment

It is anticipated that the digital data in the spatial data infrastructure to be produced in the future will have an advanced format including attributes and phase structures. The TNTmips software for the compilation system introduced in these circumstances is capable of responding fully to the advanced digital data. SAGW has the task to renew the existing compilation software (Microstation) to a new compilation system (TNTmips) that is compatible with the advanced data format.

b. Technology propagation

5 or 6 participants in the technology transfer training for the digital photogrammetry mastered the contents in general. This technology will be further transferred to other members to increase the human resources.

c. Application of acquired skills to other operations

The technologies (such as ortho photo production) acquired through the technology transfer will be applied to other works (such as cadastral work) to enhance the work efficiency.

d. Acquisition of IT skills such as programming

It is expected that the IT technology in the higher level than the present will be required in the ordinary works in the future. To respond to this tendency, the engineers in the related groups will be improved in their technical capacity for practical programming.

(3) GIS

1) Improvement of technical level

Each related staff member of SAGW should have practical experience to acquire at least one specified technical skill for the maintenance and brush-up of the current technical level and should aim at becoming a GIS specific engineer (such as GIS database manager, GIS network manager, GIS customize engineer, or GIS standardization instructor).

2) Creation of training and job opportunities needed to improve the technical level

As described in the above, it is exceedingly important to learn know-how in actual operations in addition to receiving education and training required for improvement of GIS technical level.

a. Production of meta data

Meta data shall be produced concerning the spatial data infrastructure constructed in this Study and various spatial data already owned by SAGW.

→ Enhancement of geographic information standardization technology

b. Construction of WebGIS

It is a preferred task to configure the WebGIS system to disseminate geographic information so that the users can access to various types of data efficiently. For this purpose, the following is needed:

→ Enhancement of database management capabilities

→ Enhancement of network management capabilities

c. Improvement of cadastral information system

The GIS functionality has been used effectively as the symbol and attributes error checking tool in acquisition, maintenance and updating of the cadastral data so far. By incorporating the most up-to-date functions in this tool, a more efficient and simpler processing cycle will be able to be re-configured. For this purpose, the following is needed:

→ Enhancement of GIS software operation capabilities

→ Enhancement of programming capabilities

3) Maintenance and securing of equipment necessary for conducting the above tasks

The equipment (hardware and software) to be supplied at the completion of this Study has sufficient specifications to conduct the above tasks. Meanwhile, the minimum essential equipment must continue to be maintained.

(4) Production of printed maps

1) Tasks

a. Equipment

The maintenance of the procured equipment is essential to always maintain the hardware and software in the operable conditions.

The minimum quantities of consumable parts should be kept in stock.

For this purpose, it is a necessary task to secure the budget for the maintenance of the equipment and the stock of consumable parts.

b. Technical capabilities

SAGW has the following tasks in technical capabilities for creating printing data.

- ♦ Maintaining the acquired skills
- ♦ Propagating the acquired skills
- ♦ Sophisticating the acquired skills
- ♦ Quality control

3.2.4 Dissemination of Geographic Information

(1) Tasks concerning dissemination of geographic information

1) Tasks concerning establishment of geographic information

a. Tasks concerning establishment

From the viewpoint of the spread of geographic information, it will be one of the future tasks to update and digitize the existing information.

b. Tasks related to establishment

The establishment of geographic information will also require the tasks to arrange the information in a systematic manner, standardize the information and found a clearinghouse.

2) Tasks concerning dissemination of geographic information

It is necessary to establish a committee for effective use of the geographic information owned by the related agencies within the Government for the purpose of the common use and spread of the geographic information.

It is also necessary to revise the legislation so as to provide the private sector for the geographic information and protect the copyright of it.

3) Tasks concerning geographic information education

SAGW should provide the teaching materials for geographic education to the primary and middle education agency and dispatch instructors to the schools. In addition, SAGW should start the joint researches with universities and research institutes.

4) Tasks concerning public relations and advertisements of geographic information

a. Tasks concerning public relations

SAGW should establish a publicity department to make the publicity activities such as operation of the Web site and issue of publicity magazines.

b. Tasks concerning advertisements

SAGW should make the advertising activities such as holding of the events and international conferences to appeal the recognition of SAGW.

3.2.5 Services

(1) Tasks

a. Location of sale

From the viewpoint of service improvement, the selling places should be increased not

only at the SAGW headquarters but also its local offices and private bookstores.

The purchase of geographic information should be enabled by means of the mail-order sale on Internet, or by telephone or mail.

b. Procedure of purchase

The current legislation that restricts the disclosure and purchase of the geographic information should be revised to simplify the current complicated purchase procedure.

c. Selling prices of topographic maps

SAGW should establish the policy of selling the geographic information for the wide range of its use and revise the prices (to lower prices), and should also revise the legislation for the price revision if necessary.

d. Years of production of topographic maps

To increase the values of geographic information as merchandises, SAGW should expand the scope of production and conduct periodical update of its topographic maps in an organized and planned manner.

e. Development of new products

From the viewpoint of service improvement, SAGW should develop a variety of products for geographic information (such as ortho photo maps and aerial photos).

3.2.6 Cooperation in Organization

(1) Tasks

1) Cooperation in land survey

A system for the work meetings for the staff in charge of the installation of monuments and aerial signals should be established, and the daily reports on aerial photography should be systematized.

The technical issues, such as, for example, product specifications and symbol specifications, related to both groups of photogrammetry and land survey should be resolved at work meetings systematized between the groups.

2) Cooperation between land survey and photogrammetry groups

The groups related to photo control point survey, aerial triangulation, plotting and compilation should establish a system to discuss and resolve various problems occurring among those groups.

e-mail should be introduced to build a close communication system between both

groups of land survey and photogrammetry.

3) Cooperation between photogrammetry and printing data production

The groups of photogrammetry and printing data production should mutually understand the technologies and work details of each group, get familiar with the working schemes with lower loads and make smooth data exchange with each other.

4) Sharing of software programs and skills for using them

The software owned by SAGW should be recognized as the property of the entire organization in order to formulate the use plan for common use of it. The software engineers should mutually promote their common access to the technologies and know-how that they have acquired individually. For this purpose, those technologies and know-how should be transferred to other staff members that have not acquired them yet.

3.2.7 Cooperation with Other Agencies

(1) Cooperation between SAGW and donors

SAGW is required to accomplish the following tasks in cooperation with donors:

- SAGW managers in charge of the projects shall meet regularly to share information and exchange opinions on progresses, outputs, tasks, etc.
- Lists of supplied equipment shall be created to update as needed and keep track of the operation and maintenance information and operational status of the equipment.
- Personnel training histories shall be created to record and update as needed the history of personnel participating in technology transfer training and other education provided by donors in order to ensure continuous skill development and effective utilization of human resources.

(2) Cooperation between SAGW and other government organizations

The Macedonian government organizations are not actively pursuing sharing information and therefore the sharing of information including GIS data between SAGW and other government organizations has not progressed.

Under this situation, SAGW is required to accomplish the following tasks.

- SAGW shall take the initiative to form a cross-ministry organization such as an NSDI committee to pursue planning and implementation of development, use, and dissemination of spatial information in Macedonia.

- SAGW shall actively promote disclosure and supply of information prior to the other organizations. The produced data shall be utilized and effort will be made not to overlap the production of data by other organization in the future.
- SAGW will extensively advertise the services that are available using the skills, equipment, and personnel that it owns and establish a system of cooperating with other government organizations while gaining due prices for it.

Chapter 4 Proposals to Counterpart Agencies

4.1 Proposals on Priority Projects

The proposed priority projects are as follows:

Project 1. Complete production of national base map

Project 2. Establishment of Permanent GPS station and Transformation of the Macedonian State Coordinate System to the World Geodetic System

Project 3. Advanced application of orthophotos

Project 4. Support for establishment of middle/long term plans

Project 5. Improvement of the services of selling topographic map

Project 6. Construction of WebGIS

Project 7. Production of reduced scale maps

4.1.1 Priority Projects

(1) Complete production of national base maps (Project 1)

1) The outline of this project is as follows:

- To formulate the detailed plan of the national base map production plan in and after 2006.
- To produce 25 sheets of the national base maps in 2006.
- To produce 35 sheets of the national base maps in 2007.
- To produce 40 sheets of the national base maps in 2008.

2) Requirements for implementation of the Project

The requirements for implementing the Project are considered as follows:

- To formulate the detailed work plan.
- To secure the engineers to be engaged in the Project through technology propagation.
- To estimate and reinforce the necessary equipment as needed.

(2) Establishment of Permanent GPS station and Transformation of the Macedonian State Coordinate System to the World Geodetic System (Project 2)

1) Establishment of permanent GPS station net and disclosure of observation and analysis data

- Setting 17 permanent GPS stations in Macedonia

- Constructing in the capital city a center for analyzing and distributing observation data from permanent GPS stations
- Establishing 24-hour continuous observation, observation data transfer, and an observation data analysis systems
- Establishing a system for disclosing and distributing observation and analysis data
- Acquiring skills for maintaining, managing, and operating permanent GPS station nets, analysis and distribution centers, etc.

The required personnel and equipment are as follows:

- Project leader
- Geodetic survey engineers
- GPS engineers
- Network engineers
- System engineers
- Permanent GPS station units
  GPS receivers, power units including auxiliary power, data transfer units, etc.
- Center equipment
  PC servers, analysis software, database management software, etc.
- Data distribution equipment

2) Transformation of the Macedonian State Coordinate System to the World Geodetic System

The outline of the project is as follows:

- To study the standard geodetic system in the EU countries.
- To examine and decide the change of the standard geodetic system and the coordinate conversion method to respond to the change.
- To implement the project in accordance with the changed standard geodetic system and the coordinate conversion method as examined and decided.
- To evaluate the accuracy of the products after the coordinate conversion.

The required personnel and equipment are as follows:

- Project leader
- Geodetic survey engineers
- Engineers who have experience in the change of the geodetic reference system and the coordinate conversion needed for it
- Various net adjustment programs

(3) Advanced applications of orthophotos (Project 3)

The project overview is as follows:

- ♦ Basic skills for producing digital orthophotos
- ♦ Practical skills for producing digital orthophotos
- ♦ Market research on digital orthophotos
- ♦ Productivity improvement for digital orthophotos

The required personnel and equipment are as follows:

- ♦ Engineers with abundant experience and skills for creating digital orthophotos
- ♦ Digital photogrammetry system (equipment installed with optional software for creating digital orthophotos)

(4) Support for establishment of middle/long-term plans (Project 4)

SAGW must formulate the plans (short-, middle- and long-term) to secure the national budgets and to obtain the assistance by any donor organization or the fund on loan from any financing organization.

The project overview is as follows:

- ♦ Status survey on SAGW
- ♦ Trend survey on geographic information organizations in other countries
- ♦ Technical trend survey in the geographic information field
- ♦ Market research on geographic information in Macedonia
- ♦ Establishment of short and middle/long-term plans

In this Project, the short-, middle- and long-term plans will be formulated, but it is necessary to recruit the specialist who can instruct the planning methodology and give advice in formulating the plans. In addition, the engineers experienced in the geographic information field and in the organization of SAGW and its operation are required.

(5) Improvement of the service of selling topographic maps (Project 5)

The project overview is as follows:

a. Production of topographic maps

The printed topographic maps (in the scale of 1/25,000 or other scales) and other geographic information such as, for example, ortho photos will be produced. The information on the national control points will also be prepared for supply. In addition,

the geographic information on the topographic maps and ortho photos as newly produced in each scale will be updated.

b. Improvement of the sale service

The prices of the current topographic maps (printed maps) will be revised in considering the income level of the nation and the price levels in the neighboring countries while the purchase permit system will be abolished and changed from the collection or payment of charges at post offices to the payment at SAGW's counter. The selling spots will be increased at local offices and the mail-order sale system will also be introduced. In addition, the pamphlets indicating the service details, the index maps and the price list will be prepared for free-of-charge distribution.

(6) Construction of WebGIS (Project 6)

1) General WebGIS building procedure

In building WebGIS, the following procedure will desirably be taken in principle:

a. Forming a working group for WebGIS construction to build a coalition across different departments
b. Establishing prospects for the future and defining the purpose of WebGIS construction
c. Establishing a specific plan (analyzing the present status and establishing a basic plan)
d. Introduction (system introduction, data introduction, and equipment procurement)
e. Operation and management (data update, related laws, security measures)

2) Steps in constructing scalable WebGIS in SAGW

As SAGW has obtained the essential elements (equipment and technical capacity) to construct WebGIS, it is recommended to realize the steps gradually as described below.

Step 1: Sharing geographic information in SAGW using a clearing house

Step 2: Sharing geographic information and GIS tools in SAGW using an intranet

Step 3: supplying and promoting the use of geographic information and GIS tools to organizations other than SAGW, companies, and citizens in general using the Internet

(7) Production of reduced-scale maps (Project 7)

If the topographic maps in the scale of 1/25,000 are completed, the demands for the maps in reduced scales will arise from the governmental agencies and the commercial market. To

respond to these demands, the project of production of maps edited in reduced scales should be planned and implemented based on the 1/25,000-scale topographic maps that have been produced.

1) Targets of reduced-scale map Production project and order of priority

The order of priority in the production project can be as follows:

First priority: Scale of 1:500,000 (Number of sheets: 1)

Second priority: Scale of 1:200,000 (Number of sheets: 8)

Third priority: Scale of 1:50,000 (Number of sheets: 61)

2) General procedure for producing reduced-scale maps

The general procedure for producing reduced-scale maps can be as follows:

- ♦ Determination of the specifications of reduced-scale maps (expressed items and forms and colors of symbols)
- ♦ Selecting required data from the original data
- ♦ Executing scale reduction compilation

The scale reduction compilation process shall be followed by establishment of topographic map data and GIS topographic map databases and production of printed maps in the same way as in the current study project.

The production time and costs (total man-days required) are expected as follows:

Time: 30 days

Cost (total man-days required): 53 man-days

4.1.2 Requirements for Realization of Priority Projects

(1) Present status for implementation of priority projects

For implementing the priority projects, the present status of SAGW has been evaluated in terms of the technical capacity, human resources, organization and finance necessary for the individual priority projects as follows:

	Technical Capacity	Human Resources	Organization	Finance
Project 1	Provided	Provided	Weak	Not sufficient
Project 2	Not provided	Not provided	Insufficient	Insufficient
Project 3	Not sufficient	Not sufficient	Insufficient	No problem
Project 4	Not provided	Insufficient	Provided	No problem

Project 5	Provided	Provided	Provided	Insufficient
Project 6	Provided	Provided	Provided	No problem
Project 7	Insufficient	Insufficient	Insufficient	Insufficient

(2) Requirements for implementation of individual priority projects

a. Complete production of national base maps (Project 1)

According to the public commitments made by SAGW in the forum, the requirements for completion of the project within the time limit are to enhance the organization and to secure budgets for costs for outdoor operations such as field identification.

b. Establishment of Permanent GPS station and Transformation of the Macedonian State Coordinate System to the World Geodetic System (Project 2)

The implementation of this second-priority project requires the assistance of expert engineers who have experience in these operations and can handle the finances needed for them. Of course, there must also be personnel and an organization that can accept such expert engineers and proceed with the project.

The technical assistance of the Japanese organization that has experience and technical capabilities in this field is a strong candidate that satisfies the requirements.

c. Advanced applications of orthophotos (Project 3)

One of the requirements is that SAGW engineers who participated in the technology transfer for digital photogrammetry implemented in the current study project continue to participate in this Study. Additionally, the equipment used for technology transfer need to be used and the costs for maintenance and upgrade of related software need to be met.

d. Support for establishment of middle/long-term plans (Project 4)

There must be experts who can teach and advise on the methodology for establishing plans. Furthermore, experienced persons knowing the skills in the geographic information field and the organization and management of SAGW also need to participate in this project.

e. Improvement of the service of selling topographic maps (Project 5)

For improvement of the service of selling topographic maps according to the public commitment made by SAGW in the forum, it is necessary to develop and update topographic maps, etc., revise the prices (to low cost), abolish the permission-based selling system, simplify the procedure of collecting prices, increase the locations of sale, and advertise the sale of geographic information. For these measures, it is necessary to revise

the Survey Law and provide financial support for the increase of locations of sale, etc.

f. Construction of WebGIS (Project 6)

Requirements for the construction of WebGIS are as follows:

- ♦ Sharing of a common understanding in SAGW on the purpose, targets, and contents of WebGIS
- ♦ Coalition across different departments in SAGW for construction of WebGIS
- ♦ Establishment of prospects for the future and specific plans
- ♦ Guarantee of operation and management (laws, security measures, and data update)

g. Production of reduced-scale maps (Project 7)

It is necessary to acquire skills for selecting data items according to scales of maps and enhance the organization containing personnel who can handle this operation. As for financial matters, the printing costs for reduced-scale maps need to be met.

4.1.3 Project Priorities

Under the current conditions of SAGW (technical capability, economic strength, human resources etc) it is difficult to carry the 7 projects out simultaneously. From the current conditions of SAGW and the degree of social demand the following priorities have resulted for the 7 projects.

1st Priority : Project 1. Complete production of national base map

2nd Priority : Project 2. Establishment of Permanent GPS station and Transformation of the Macedonian State Coordinate System to the World Geodetic System

3rd Priority : Project 3. Advanced application of orthophotos

4th Priority : Project 5. Improvement of the services of selling topographic map

5th Priority : Project 4. Support for establishment of middle/long term plans

6th Priority : Project 7. Production of reduced scale maps

7th Priority : Project 6. Construction of WebGIS

4.2 Future Image of SAGW

4.2.1 Photogrammetry Department

The photogrammetry department of SAGW is only one organization capable of creating spatial data by itself independently and one of a few organizations having the high technical

potential. The future image and plan of SAGW that will be realized in steps will be described below.

Table 4-1 Future of SAGW photogrammetry department

Time	Future image	Future plan
In 3 years	• Full digitalization of photogrammetry skills The photogrammetry operation in the department shall be fully digitalized, enabling the efficient construction of sophisticated spatial data.	• Completion of establishment of spatial data infrastructures Complete establishment of spatial infrastructure data and national base maps.
In 5 years	• Establishment of a spatial data center The production of meta data and construction of a clearing house shall advance to ensure effective utilization of the accumulated spatial data in various fields. The department shall serve as a base for data input to ensure construction of various thematic data.	• Establishment of meta data for various spatial data Internet-based production of meta data, construction of a clearing house, and realization of data delivery • Revision of specifications of spatial data infrastructures The specifications of spatial data infrastructures shall be revised from transitional ones requiring also the production of paper-based maps to ones premised on the use of digital data. • Supply of various thematic data Using the expert knowledge on spatial data construction, various thematic data required by the government and local authorities shall be established.
In 10 years	• Consultation on spatial data Using the expert knowledge on spatial data construction, the requirements of the government and city departments shall be reflected on spatial data. Concerning GIS construction, consultation on supply, input, and update of data can be provided.	• Consultation on GIS construction Consulting operations on system operation and maintenance such as input, supply, and update of thematic data as well as supply of data to government ministries and agencies that aim at GIS construction using spatial data infrastructures.

4.2.2 Services

(1) Supply of geographic information

1) Types of geographic information to be supplied

Along with the reforms of organizations, equipment and consciousness in SAGW and the legislative revision as well as the improved living level of the nation, the following geographic information will be supplied to the users in the future:

♦ Topographic maps (printed maps and digital data)

- ♦ Orthophoto maps (color, output maps, and digital data)
- ♦ Various thematic maps (printed maps and digital data)
- ♦ Aerial photographs (photographic paper and digital data)

For specific experts and companies, SAGW will also provide the following geographic data:

- ♦ Spatial data infrastructures
- ♦ National control point information

2) Supply methods

The above geographic information items will be supplied as actual articles at the SAGW offices, general bookstores, and other sales windows. Additionally, they will be available through correspondence sales using mail, telephone, fax, and the Internet. Digitalized geographic information will even be available via download from the Internet.

3) Prices

The geographic information will be provided under the national budget and the prices of the geographic information that is a national property will be decided on a pricing policy base, but not on a cost base. The prices are expected to be lower than the current prices. The prices of digital type of geographic information, ortho-photo maps, thematic maps, aerial photos and spatial data infrastructure will also be determined to be low prices on the pricing policy base.

(2) SAGW's activities

1) Research and development activity

The technology in the geographic information production field is making rapid progress. SAGW will make the research activities in this field as the only geographic information agency in Macedonia and contribute to publishing the results to the nation and improving the geographic information. SAGW will also plan and develop the tools necessary for producing the geographic information.

2) Educational activities

To promote the spread of geographic information, SAGW will establish the support system in providing the teaching materials to the primary and middle education agencies and dispatching the instructors for geographic information education. SAGW will also cooperate with universities in the lectures and exercises of geographic information production in providing the unique technical education that is a little different from the

academic education.

3) Activity report

SAGW will report to the national government and general citizens who are taxpayers about its activities conducted on national budgets by publishing annual reports and technical newsletter and promote understanding of the social significance of the activities.

4) Publishing activities

SAGW will publish annual reports and technical newsletters as described above as well as easy-to-understand books on how to use geographic information and history of map in Macedonia.

(3) Activities in civil society

SAGW's anniversary of founding will be made the Surveying Day on which an event for citizens is held. This event will include a demonstration for showing citizens how geographic information is created and deepen their understanding on the activities of SAGW.

Also, It is expected that an environmental map contest will be held, in which citizens can participate and orienteering in which the participants' ability for reading topographical maps can be improved.

4.2.3 Organization (Structure and Finance)

(1) Organization (structure)

The group in charge of topographic maps out of the geographic information undertakes various services. In considering the performance of these services, the organizational system consisting of the departments with the following functions is deemed to be one of the future images of SAGW:

1) Planning department

This department will undertake the planning of all the activities to be made by SAGW.

2) Geodetic survey department

This department will determine the standard geodetic system and install, maintain and update the ground control points.

3) Spatial data infrastructure department

a. Field survey division

This division will conduct the photo control point surveys, field identifications and

supplementary field identifications for producing topographic mapping data.

b. Photogrammetry division

This division will make the technical management for aerial photography and conduct a series of works for photogrammetry (including aerial triangulation and digital plotting/compilation). In addition, it will produce the data for printing and build the topographic map database for GIS.

c. GIS division

This division will develop the systems using the topographic map database and build various thematic map databases to meet the needs of users.

d. Quality inspection division

This division will inspect and approve the quality of geographic information.

4) Geographic information dissemination department

This department will undertake the sale and supply of the geographic information (digital/analog topographic maps, ortho photos, aerial photos, control point information, observed and analyzed data at electronic control points, etc.) to a wide range of users. It will also make the publicity and advertising activities to promote the use of geographic information.

5) Research and development department

This department conducts research on cutting-edge technologies in the geographic information field as well as research and development for introduction of these technologies to SAGW.

(2) Finance

In general, it is deemed that the geographic information constitutes a part of the public infrastructure. From this point of view, it is necessary for SAGW to secure the national budget to cover the costs necessary and stabilize the financial base for production, maintenance and updating of the geographic information.

The Government of Macedonia aiming at becoming a member of the EU intends to form a “small government” from the standpoint of financial balance. In this background, it is necessary for SAGW to secure the national budget and the independent source of revenue to cover the required costs.