Chapter 2 Results of Study

2.1 Work and period of implementation

2.1.1 Work

(1) Production of national base maps (establishment of spatial data infrastructure)

The work implemented for the production of national base maps is as follows:

SD-1: Collection, arrangement, and analysis of relevant materials and information

SD-2: Survey of existing data and conditions related to geographic information

SD-3: Discussions on specifications for spatial data infrastructure

SD-4: Reconnaissance of control points and selection of photo control points

SD-5: Installation of aerial photo signals

SD-6: Shooting of aerial photographs

SD-7: Photo control point survey

SD-8: Field identification

SD-9: Aerial triangulation

SD-10: Digital plotting

SD-11: Digital compilation

SD-12: Supplementary field identification

SD-13: Supplementary digital compilation

SD-14: Establishment of topographic map data

SD-15: Discussion on specification for printed maps

SD-16: Production of data for printed maps

SD-18: Construction of topographic map database for GIS

SD-19: Design of basin environment GIS

SD-20: Field identification for construction of land use database

SD-21: Construction of land use database

SD-22: Construction of environmental conservation database

SD-23: Database verification

(2) Technology Transfer

The work implemented for technology transfer is as follows:

TT-1: Discussions on technology transfer program

TT-2: Installation of aerial photo signals

TT-3: Photo control point survey

TT-4: Field identification

TT-5: Supplementary field identification

TT-6: Aerial triangulation

TT-7: Digital plotting

TT-8: Digital compilation

TT-9: Establishment of topographic map data

TT-10: Construction of topographic map database for GIS

TT-11: Production of data for printing

TT-12: Basics of GIS software

TT-13: Spatial data infrastructure in GIS

TT-14: GIS applications

TT-15: Database construction

TT-16: Use of ground survey equipment

(3) Dissemination of geographic information

The work implemented for the dissemination of geographic information is as follows:

GD-1: Discussions on the dissemination of geographic information

GD-2: Dissemination activities for geographic information 2

GD-3: Workshop

GD-4: Technology transfer seminar

GD-5: Dissemination activities for geographic information 1

GD-6: Dissemination activities for geographic information 3

GD-7: Dissemination activities for geographic information 4

(4) Preparation of reports

The work implemented for the preparation reports is a follows:

R-1: Preparation of Inception Report

R-2: Explanation/discussions of Inception Report

R-3: Preparation of Interim Report

R-4: Explanation/discussions of Interim Report

R-5: Preparation of Draft Final Report

2.1.2 Period of implementation

The works below were carried out during the following periods:

(1) Preparatory work in Japan

Period: March 14, 2004 - March 28, 2004

Work implemented:

SD-1: Collection, arrangement, and analysis of relevant materials and information

R-1: Preparation of Inception Report

(2) Phase 1 in Macedonia

Period: March 29, 2004 - July 14, 2004

Work implemented:

TT-1: Discussions on technology transfer program

TT-2: Installation of aerial photo signals

TT-3: Photo control point survey

SD-2: Survey of existing data and conditions related to geographic information

SD-3: Discussions on specifications for spatial data infrastructure

SD-4: Reconnaissance of control points and selection of photo control points

SD-5: Installation of aerial photo signals

SD-6: Shooting of aerial photographs

SD-7: Photo control point survey

GD-1: Discussions on the dissemination of geographic information

R-2: Explanation/discussions of the Inception Report

(3) Phase 1 in Japan

Period: July 15, 2004 - November 15, 2004

Work implemented:

SD-9: Aerial Triangulation

(4) Phase 2 in Macedonia

Period: September 25, 2004 - November 23, 2004

Work implemented:

TT-4: Field identification

TT-7: Digital plotting

TT-8: Digital compilation

SD-8: Field identification

(5) Phase 3 in Macedonia

Period: January 5, 2005 - March 8, 2005

Work implemented:

SD-19: Design of basin environment GIS

SD-20: Field identification for construction of land use database

GD-5: Dissemination activities for geographic information 1

TT-6: Aerial triangulation

TT-12: Basics of GIS software

(6) Phase 2 in Japan

Period: September 25, 2004 - February 23, 2005

Work implemented:

SD-10: Digital plotting

SD-11: Digital compilation

R-3: Preparation of Interim Report

(7) Phase 4 in Macedonia

Period: May 11, 2005 - August 13, 2005

Work implemented:

SD-12: Supplementary field identification

SD-15: Discussion on specification for printed maps

SD-22 Construction of environmental conservation database

SD-23: Database verification

GD-2: Dissemination activities for geographic information 2

TT-5: Supplementary field identification

TT-15 Database construction

TT-16: Use of ground survey equipment

R-4: Explanation/discussion on Interim Report

(8) Phase 5 in Macedonia

Period: September 28, 2005 - November 25, 2005

Work implemented:

TT-9: Establishment of topographic map data

TT-10: Construction of topographic map database for GIS

TT-11 Production of data for printing

TT-13: Spatial data infrastructure in GIS

TT-14: GIS applications

GD-6: Dissemination activities for geographic information 3

(9) Phase 3 in Japan

Period: May 10, 2005 - February 9, 2005

Work implemented:

SD-13: Supplementary digital compilation

SD-14: Establishment of topographic map data

SD-16 Production of data for printing

SD-18: Construction of topographic map database for GIS

SD-21: Construction of land use database

R-5: Preparation of Draft Final Report

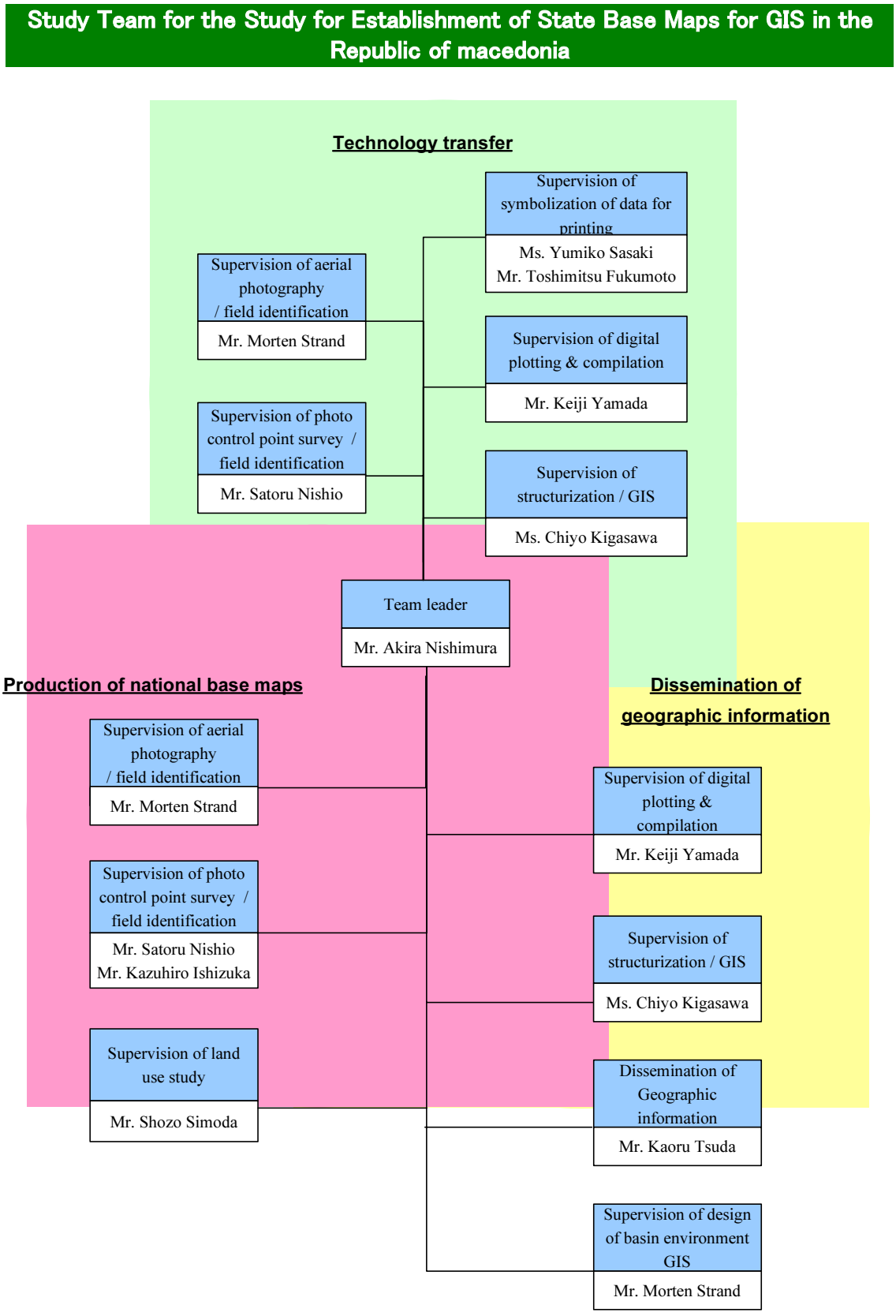
2.1.3 Members of the Study Team

The members of the Study Team responsible for implementation of the works in the Study were as follows:

Assignment	Person in charge	Main responsibilities
Team leader	Mr. Akira Nishimura	• Supervision/management of overall Study • Planning/management of technology transfer program
Supervision of aerial photography / field identification	Mr. Morten Strand	• Local subcontracting of aerial photography, supervision/management of the work • Supervision/management of field identification for the production of national base maps and technology transfer for such work
Supervision of photo control point survey / field identification	Mr. Satoru Nishio / Mr. Kazuhiro Ishizuka	• Supervision/management of photo control point survey for the production of national base maps and technology transfer for such work • Supervision/management of field identification for the production of national base maps and technology transfer for such work
Supervision of digital plotting & compilation	Mr. Keiji Yamada	• Technology transfer for set of techniques for digital photogrammetry (aerial triangulation, digital plotting/ compilation)
Supervision of structurization / GIS	Ms. Chiyo Kigasawa	• Technology transfer for GIS database construction and the application, operation and updating of that data in GIS

Assignment	Person in charge	Main responsibilities
Supervision of symbolization of data for printing	Ms. Yumiko Sasaki/ Mr. Yoshimitsu Fukumoto	• Technology transfer for the compilation of printed map data of spatial data infrastructure (national base map data)
Dissemination of geographic information	Mr. Kaoru Tsuda	• Study/analysis and recommendations for the dissemination of geographic information
Supervision of design of basin environment GIS	Mr. Morten Strand	• Preparation of specifications necessary for construction of databases for environmental GIS, collection of concerned information
Supervision of land use study	Mr. Shozo Shimoda	• Field identification on land use • Field identification for production of topographic map

The organization of the Study Team is as follows:



2.2 Results of the Study

2.2.1 Production of National Base Maps

(1) Specification of national base maps (spatial data infrastructure)

1) Exchange of opinions with advisor staff

SAGW has a group of technical advisors who give advice on work-related issues. Arrangements were made for frequent discussions with members of this group, consisting of Associate Professor Stojanco Vuckov and assistants Mile Varoshlieski and Aleksandar Postolovski from the Faculty of Civil Engineering of Ss. Cyril and Methodius University, regarding the specifications, methods and products of the study. This is because SAGW valued the advice of these experts in deciding on various specifications and in determining whether or not existing results were worth using.

2) Land Survey

Before conducting the land survey in Macedonia, discussions were held between SAGW and the JICA Study Team on the specifications of the survey (survey regulations, survey reference, scope of work, etc.).

In the discussions, specifications for the ground survey were discussed and decided on based on the various materials prepared during the "Collection, arrangement and analysis of relevant materials and information". Other than SAGW, SAGW's expert advisors, including Stojanco Vuckov, also took part in these discussions. As for the survey reference decided on, the details are recorded in the "MEMORANDUM (July 9th 2004)" attached in the Appendix but the main items were as follows:

- Ellipsoid: Bessel (semi-major axis (a)=6377397.155; flattening (1/f)=299.1528128156)
- Projection system: Gauss Kruger
- Point of origin: Intersection of 21 ° east latitude and the equator (Coordinates of point of origin: XO = 0.00 m, YO = 500,000.00 m)
- Scale factor at the central meridian: 0.9999
- Unit: m
- Sheet size: 7'30" x 7'30" (1/25,000)
- Coordinate conversion parameters (From WGS84 ellipsoid, ITRF94 coordinate system to Bessel ellipsoid, geodetic system in Macedonia): (T1, T2, T3) =(-521.7476m, -229.4892m, -590.9207m)
  (R1, R2, R3) =(4.02878", 4.48836", -15.52067")

$d=9.7803\times10^{-6}$

The mapped area and sheet division were as shown in Figure 2-1. The yellow map sheets (82) were done in Japan, the red ones (7) were done by SAGW through OJT, and the blue ones (16) were done in Japan along with the design of the basin environment GIS and construction of the land use database.

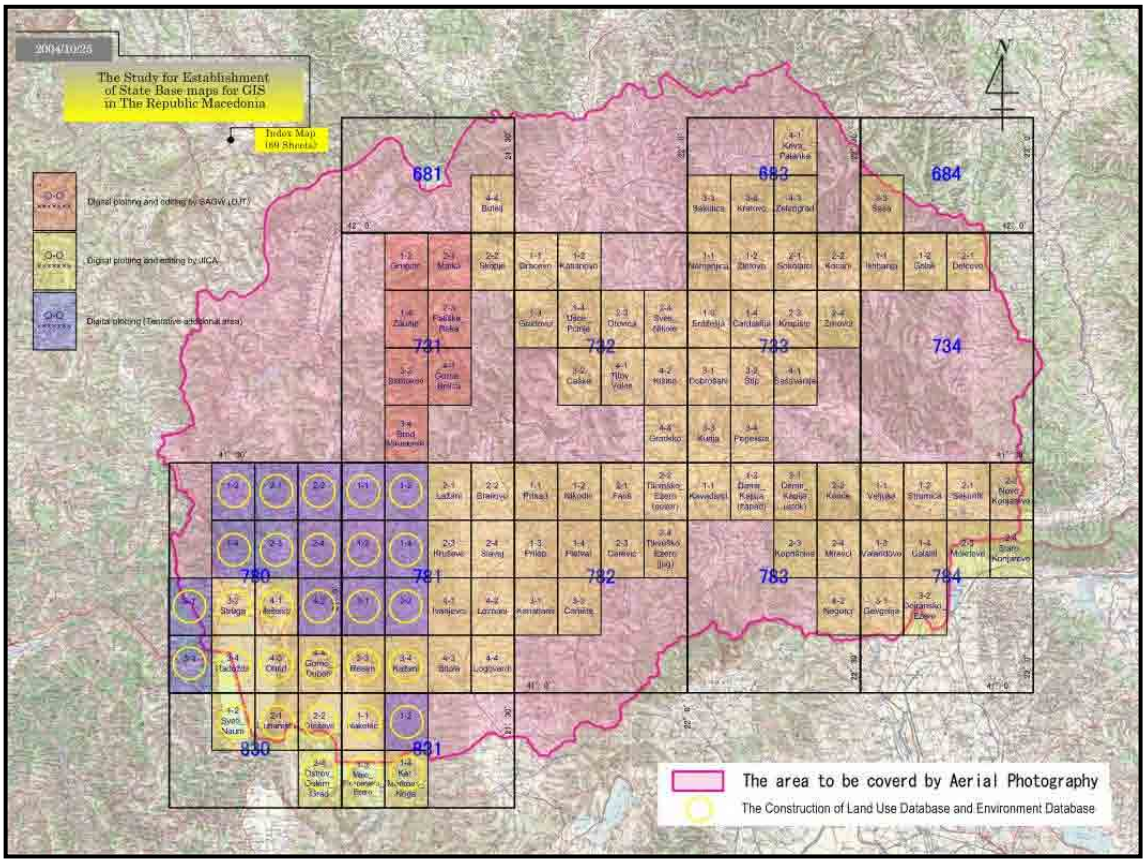


Figure 2-1 Target area of National Base Map

3) Specification of spatial data infrastructure

The specifications of spatial data infrastructure were discussed with SAGW based on the following basic policies (draft) for the design of spatial data infrastructure (SDI), which were decided in advance.

a. Basic policies for the specification design

[Design focusing on data updating (selection of data format)]

Once established, the spatial data infrastructure is expected to play a continuing role as social infrastructure. Therefore, it should meet the following requirements.

- The data specification should allow for expansion or modification in the future.
- The data format should currently be widely distributed and used. It should also allow for meeting international standards such as ISO for the purpose of format conversion processing in the future.
- The data format specification should be made available to the public.

[Design that maximizes the merits of data utilization (design of the product life cycle)]

The spatial data infrastructure established should continue to be used to the fullest extent possible for various purposes. For that reason, an environment that enables users to utilize the latest data sets at any time is needed. In order to realize that environment, the life cycle of data updating should be planned. The following requirements have been set based on this point.

- The data specifications shall basically focus on data use. As for the production of printed map data, a method that meets the requirements for representation/display shall be adopted.
- The data specification shall be described so that the user is able to utilize the data directly, avoiding unnecessary data conversion as much as possible.

[Conformance with international standards (ISO19000 series)]

The data specification shall be in compliance with international standards for the purpose of data conversion and distribution. Moreover, the product specification shall define not only the data specification but also the description method of the specification, the description method of the metadata, etc.

Examples of international standards include the ISO19000 (Geographic Information) series developed by the ISO/TC211 and GML standards developed by the Open GIS Consortium. As the data will be considered as national social infrastructure, the specification shall comply with the ISO19000 series of standards for geographic information.

[Application of method for construction and updating of database in consideration of cost effectiveness]

The method used for the initial establishment of spatial data, mainly through field surveys (i.e. GPS surveys, field identification, etc.) and photogrammetry, is expected to produce detailed and highly accurate results. However, in the data updating phase, it is expected that work will be hampered by the vast cost, time required, and limited human

resources and facilities, and the smooth updating of data by this method will be difficult. Therefore, methods that conform to the product specification and meet the requirements below shall be examined.

- The required positional accuracy and acquired items should be met. Higher accuracy and further detailed items than required are not necessary.
- The method should be simplified as much as possible, efficient and low costing, and should expand production capacity.

b. Technical background

[Design focusing on data updating (selection of data format)]

In order to design the optimum data specification based on the current technical level and technical outlook, it is necessary to design the data format according to the following three phases. Phase 1 is to be implemented in this project.

- Phase 1 (to be implemented in this project):
  In the initial phase of establishing spatial data, Arc/Info's Coverage format, which has become the defacto standard, will be adopted as the data format.
- Phase 2 (future plan):
  In the data update phase, the data format shall be gradually changed to a specification based on a relational database format which is flexible and will facilitate specification expansion and data editing.
- Phase 3 (future plan):
  XML data format, which is in conformance with the ISO19000 series, shall be selected as the final data format of spatial data infrastructure.

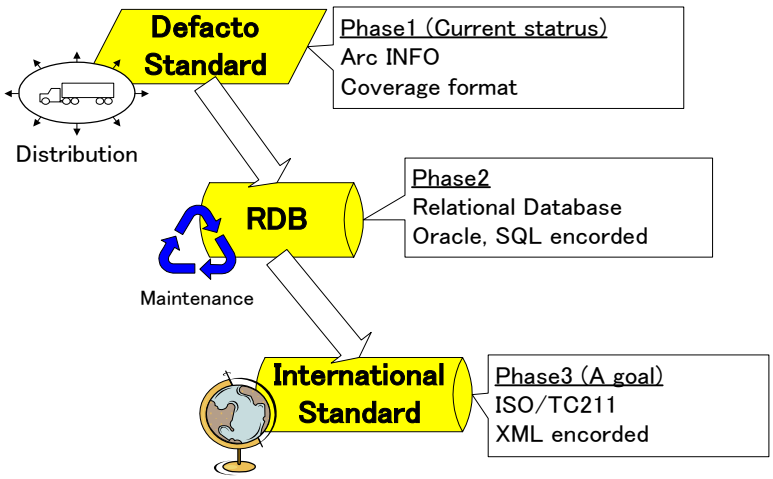


Figure 2-2 Application of optimum data format and future plan

[Design that maximizes the merit of data utilization (design of the product life cycle)]

Spatial data infrastructure shall be constructed as the sole original data source, and the updating life cycle shall be designed. The updating method of secondary GIS databases and printed map data will be designed in the designed life cycle.

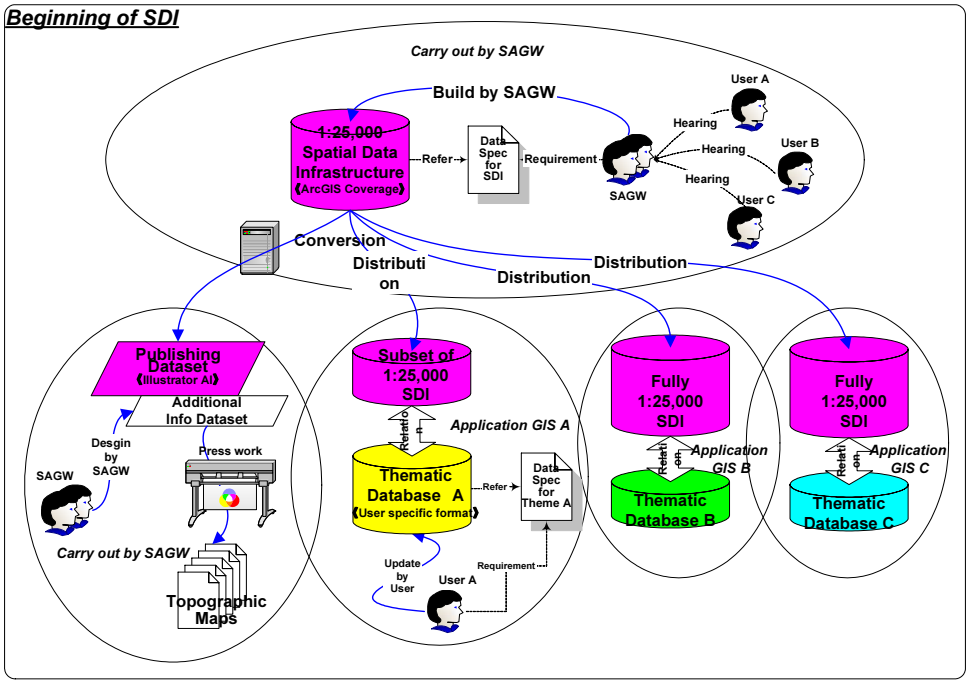


Figure 2-3 Initial establishment of SDI and Application GIS/Scheme for printed map production

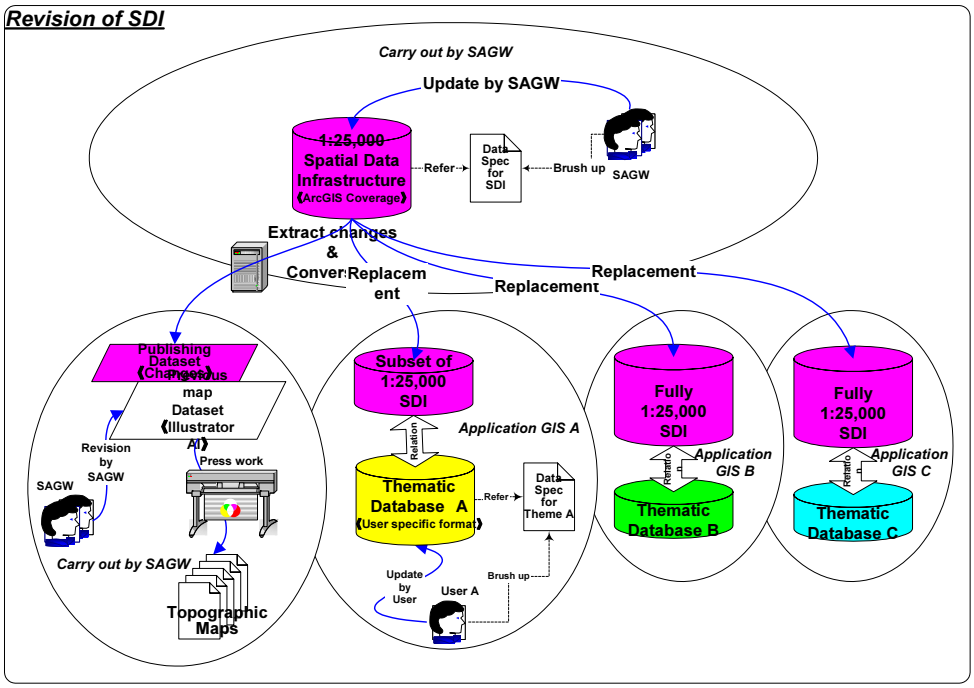


Figure 2-4 Updating of SDI and Application GIS/Concept of updating printed maps

[Conformance with international standards (ISO19000 series)]

The product specification of spatial information is defined in accordance with the ISO19000 series of standards. This definition includes not only the data format but all the items for data conversion, namely the applied schema (acquired items/attributes, etc.), spatial schema (geometric/graphic data model), graphics (symbol representation) and metadata profile.

Although the specification design meets these international standards, existing symbols, lines, etc., that are dependent on specific graphics shall be adopted.

[Application of method for construction and updating of database in consideration of cost effectiveness]

Based on the current technical level, the conceivable methods that meet the requirements of the databases to be established and take into consideration cost-effectiveness are follows:

- Phase of initial establishment of spatial data: Digital photogrammetry, which is a method for establishing highly accurate and detailed data mainly through data acquisition, will be selected. This will enable homogeneity of data sets and the establishment of reliable products.
- Data updating phase: The monoscopic plotting method using DEM (Digital Elevation Model) and orthophotos produced by automatic processing of digital photogrammetry will be adopted. Use of this simple method will realize an improvement in productivity and a flexible production system, in order to increase production capacity.

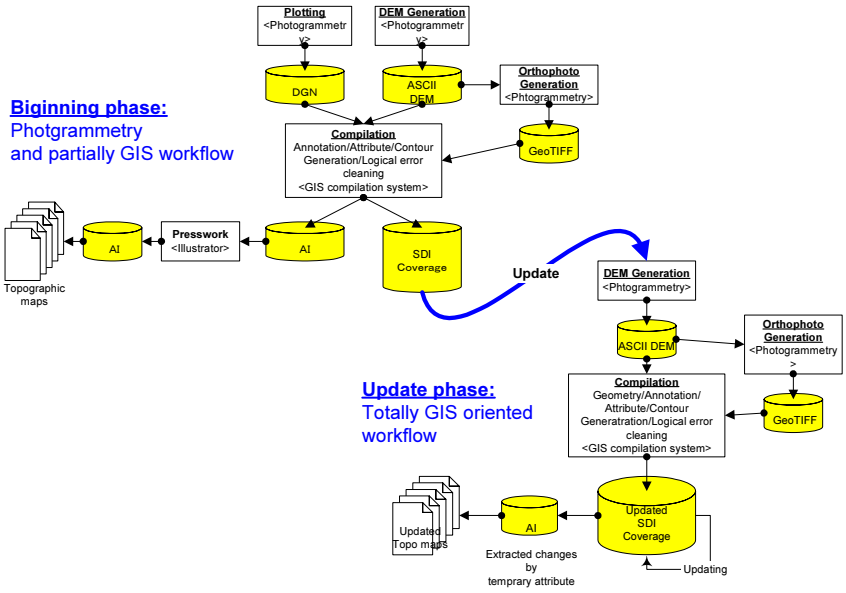


Figure 2-5 Simple technique for meeting 1/25,000 requirements

c. Defined product specification

The product specification (draft) was prepared, holding repeated discussions with SAGW based on the basic policies and their technical background. It was decided that the establishment of data including plotting and compilation was to be carried out based on the product specification. In the discussion, the following points were considered.

- Map symbol representation: In principle, the existing 1/50,000 and 1/25,000 topographic map representation will be followed.
- Setting of items to be acquired: The setting of new items taking into account the use of data in applied fields while covering all acquired items of existing topographic maps will be examined.
- Handling of image data, etc.: As the orthophotos, DEMs, etc., generated in the production process can be useful sources in GIS use, they will be defined as a part of the product.
- Examination of production method: In order to make the most of SAGW's technical experience thus far, the data exchange rules are included in the data format to be used for data input and editing so that it is possible to use Micro station DGN format.

The product specification prepared based on discussions and agreed on by SAGW is attached in the appendix as "1/25,000 Spatial Database Data Specification".

(2) Photo control point survey

The photo control point survey is a ground survey to contribute to subsequent photogrammetric works (such as aerial triangulation, digital plotting, etc). In general, this work was carried out as a joint effort with SAGW, and technology transfer through OJT and lectures was conducted simultaneously with this work.

1) Field reconnaissance of control points and selection of photo control points

a. Quantity of photo control points

The quantity of photo control points necessary for subsequent works was calculated by applying JICA's Overseas Survey Work Regulations (for Basic Mapping). The formulas based on the work regulations used to calculate the quantity were as follows:

Nh (photo control points for horizontal position) = 4+2[(n-6)/6]+2[(c-3)/3]+[(n-6)(c-3)/30]

Nv (photo control points for vertical position)=[n/12]c+[c/2]

n: Average no. of models per flight line

c: No. of flight lines (Round off the calculation results in [ ] to the nearest whole number)

According to the photography flight plan, n=33 and c=28, therefore, Nh=55 points and Nv=98 points.

b. Field reconnaissance of control points/Selection and monumentation of photo control points

Photo of control point

The information on national control points such as existing triangulation points at SAGW was collected, and the field reconnaissance and point selection were carried out based on the photo control point plan prepared during the "Collection, arrangement and analysis of relevant materials and information".

In the field reconnaissance, it was found that the existing 1st order control points (points used in the EUREF-MACEDONIA-1996 campaign) were monumented with pillars or poles and that observations had been carried out in 1996. They were, therefore, well preserved and all the necessary points could be used.

In addition, though they did not have coordinates in the WGS-84 system, the 2nd order control points and control points in cities existed in large numbers and were also monumented with pillars like the 1st order control points. As a result, they were well preserved and could be used in place of the photo control points that were to be newly established.

As a result, 59 points in total were selected, 10 existing 1st order control points as given points and 21 existing 2nd order control points and 28 newly established points as photo control points. This number exceeded the initial plan (Nh=55 points in total, 4 given points and 51 photo control points).

Photo of signal

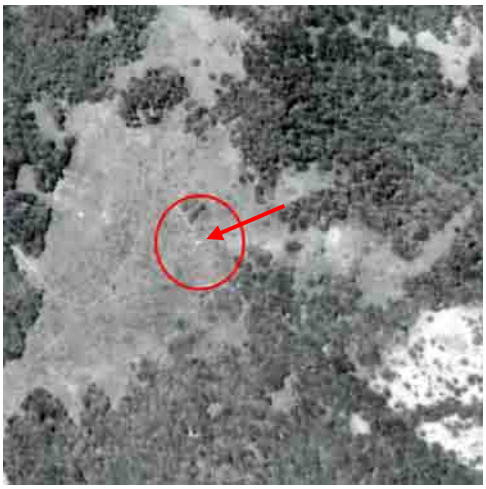
All the newly established points were marked with concrete monuments as shown in the picture, as requested by SAGW. Because SAGW had staff with experienced in

monumenting, this work was carried out as a joint effort.

2) Installation of aerial photo signals

In principle, A-type (Y-shaped), B-type (square-shaped) and C-type (X-shaped) signals are installed at 1st order control points and selected photo control points. However, as digital processing is expected, the points were marked with round signals (refer to the photograph in the previous section), which can be considered as an improved version of the B-type signal. (In general, the stones laid out around the points were painted with a mixture of lime powder and water). This signal type was adopted taking into consideration the theory and practical experience in the digital processing of images. Based on the results of discussions on specifications, it was decided that the size of the signals would be 3m in diameter. The signals were installed at 59 points in total, the ten existing 1st order control points, the 21 existing 2nd order control points and the 28 newly established points, all of which were confirmed in the aerial photos. However, there were many other round objects in nature than expected and the fact that time was spent on identifying them is a matter for future investigation.

The details of these results are summarized in a separate document.



Contact print

3) GPS photo control point survey

The GPS photo control survey was carried out to establish photo control points with horizontal and vertical positions necessary for aerial triangulation. The observation plan for the photo control point survey was determined based on the draft plan prepared in the "collection, arrangement and analysis of information and materials", taking into consideration the results of the "field reconnaissance of control points and selection/monumentation of photo control points".

The observations were carried out by the static method, using six GPS receivers. The data acquisition interval was 15 seconds per data, the observation time was three hours per session, and the total number of sessions was 18. The observation network map is shown in Figure 2-6.

The details of these results are summarized as survey results in a separate document.

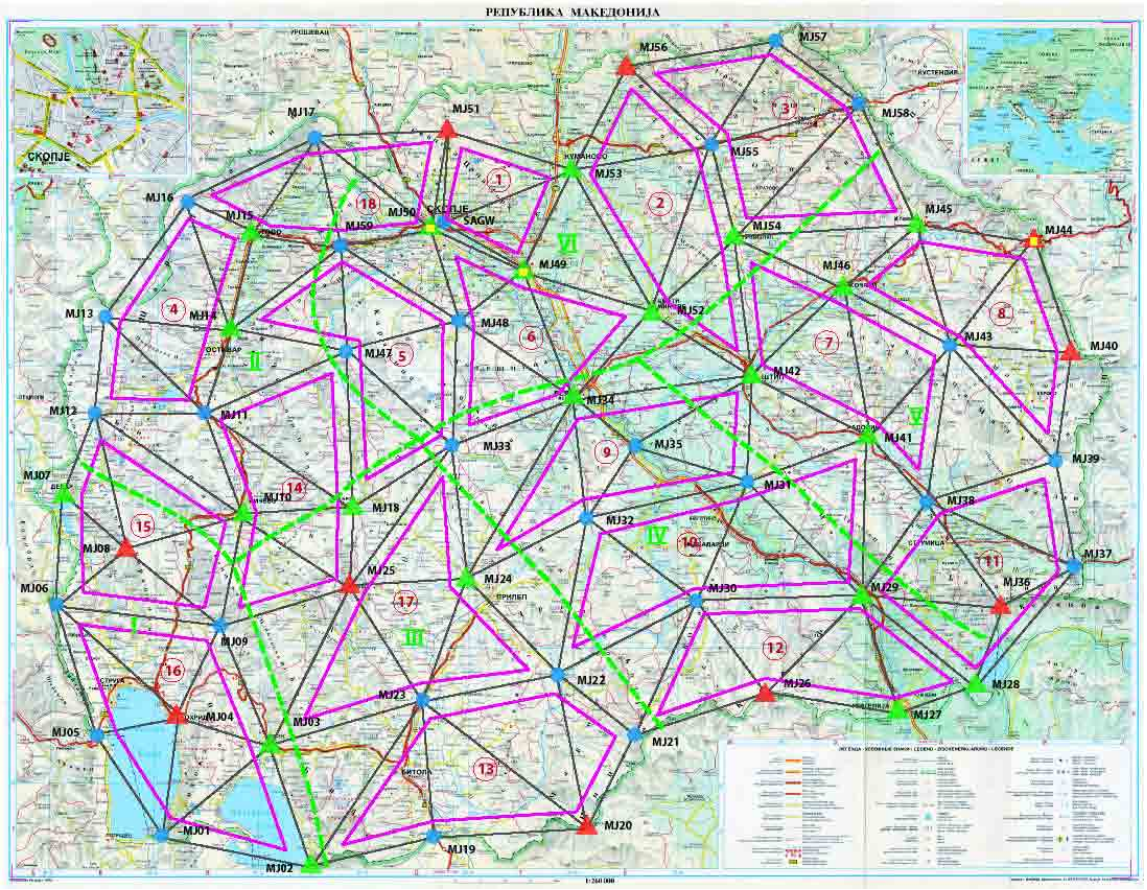


Figure 2-6 GPS observation network map

4) Determination of photo control points for elevations

Points which were identifiable in photographs and could be pricked (road intersections, bridges, intersections of roads and railways, etc.) were selected as photo control points for elevations necessary for aerial triangulation. The elevations of these points were determined by direct leveling from existing bench marks and these points were pricked. The number of pricked photo control points for elevations was 66 points (125 points when combined with the 10 given points and 49 photo control points established by GPS, which exceeds the planned quantity of Nv=98 points).

An effort was made to determine the elevations of photo control points established by GPS by direct leveling whenever possible. As a result, 13 of the 49 photo control points established by GPS had heights determined by direct leveling (The heights of the remaining GPS photo control points were determined by interpolation method of GPS analytical software.

The details of the results are summarized as survey results in a separate document.

5) Analysis computations and arrangement of the results

The coordinates of the GPS photo control points were determined through GPS baseline analysis and net adjustment computations. As a result of the net adjustment computations, the standard deviation of the horizontal and vertical positions of new points was a maximum of 9.3mm (limit: 150mm) and 20.3mm (limit: 300mm) respectively, and it was decided that the coordinates after the net adjustment would be adopted.

The heights of the vertical photo control points were established by direct leveling.

In the case of the GPS photo control point survey, quality control was carried out by inspecting the error of closure of the GPS observation loop, the discrepancy in length of duplicate baselines and the standard deviation of the net adjustment computation results. In the case of leveling, accuracy control was carried out by inspecting the discrepancy in return observations. There were no problems in the results of these quality controls.

The details of the results are summarized as survey results in a separate document.

6) Other matters

- **Presentation of the project at SAGW's national conference**

SAGW held its national conference, including staff from regional offices, in the town of Struga situated on the shores of Lake Ohrid, from June 12-13, 2004. Prof. Dusan Joksic of the University of Belgrade, a leading expert in the field of geodesy in East Europe, was invited to participate in the conference.

The Study Team gave a presentation of the project in the main program, which included a presentation by Prof. Dusan Joksic. This was an excellent opportunity to inform SAGW's entire staff of the objective, results, etc. of the project.

Scene from national meeting of SAGW

(3) Aerial photography

Aerial photography was carried out by a local subcontractor.

1) Preparation and approval of specification

The specification for aerial photography for the local subcontractor was prepared based on JICA's "Overseas Survey Work Regulations (for basic mapping) (Draft)" (March 12, 2004) and approval was obtained from JICA. (March 25, 2004)

2) Selection of local subcontractor

Tender activities were conducted using the specification approved by JICA. The five candidate companies recommended by SAGW were as follows:

- ♦ EVROGEOMATIKA (Serbia)
- ♦ GEOFOTO(Croatia)
- ♦ GEODETSKI ZAVOD SLOVENIJE(Slovenia)
- ♦ EUROSENSE EOOD, BG(Bulgaria)
- ♦ Fin Map-International(Finland)
- ♦ Swede Survey AB(Sweden)

The above five companies were requested to submit a tender based on the specification by April 19, 2004 (April 5, 2004) .

However, the two companies, EVROGEOMATIKA (Serbia) and GEOFOTO (Croatia) were disqualified as they did not meet the submission deadline. Furthermore, EUROSENSE EOOD BG (Bulgaria) and Swede Survey AB (Sweden) issued a request to decline from tendering.

In the end, the tenders submitted by the two companies, GEODETSKI ZAVOD SLOVENIJE (Slovenia) and Fin Map-International (Finland) were evaluated (April 20, 21, 2004).

After considering the capacity to carry out aerial photography, experience and estimate of the two companies, GEODETSKI ZAVOD SLOVENIJE (Slovenia) was selected as the subcontractor. A request to appoint the subcontractor was submitted to JICA, and approval was obtained on April 23, 2004.

3) Photography permits

The aerial photography was to cover the entire territory of Macedonia so there was a chance of the aircraft entering and shooting neighboring countries. It was, therefore, necessary to obtain flight permits and photography permits not only for Macedonia but from all neighboring countries.

Requests for flight and photography permits for within Macedonia and all neighboring countries (Serbia, Bulgaria, Greece, and Albania) were submitted with full cooperation from SAGW and the permits were obtained.

4) Taking of aerial photographs

Photography work commenced from the area for which photography permits were obtained. Photography work started on June 21, 2004 and was completed on July 21 the

same year.

The development of photographs was carried out successively from the areas for which photography work was completed.

5) Results of photography

The development and printing of photographs were carried out in Slovenia. The printing work included the production of black and white contact prints, which were used to inspect the results of the aerial photography. In the inspection, the following items were checked to determine whether they met the specifications.

- Specified coverage
- Overlap and sidelap
- Tilt of aerial photographs
- Cloudiness

After photography work was completed, the aerial photographs to be adopted were inspected. As a result, all the aerial photographs were found to be acceptable and were therefore adopted. The number of aerial photographs adopted was 1663 photographs taken in 28 flight lines. The photo index map is shown in Figure 2-7.

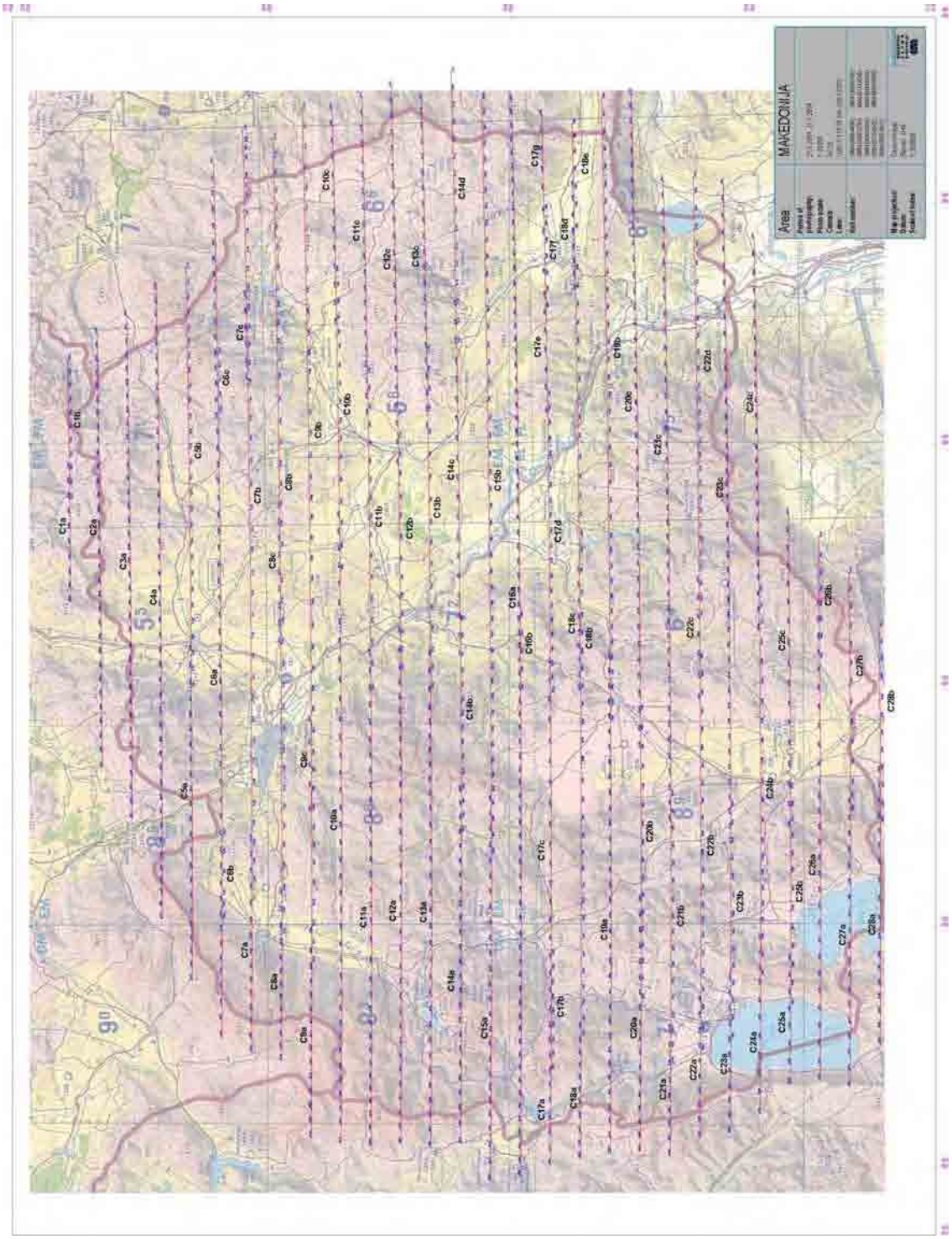


Figure 2-7 Photo index map

(4) Field identification

1) Objective

The aim of field identification is to collect information necessary for aerial photo interpretation and information that cannot be obtained through photo interpretation alone, which are essential for the production of topographic maps.

2) Policy

In order to achieve the objective above, the following implementation policy were set:

- ♦ SAGW has little experience in conducting field identifications using aerial photographs to collect a variety of information necessary for the production of topographic maps. Therefore, the field identification will be conducted in accordance with current conditions.
- ♦ The field identification will be conducted to prepare a photo interpretation handbook that can be used for photo interpretation of vegetation features.
- ♦ As for the target of the field identification, priority will be given to features of spatial data infrastructure that can only be verified in the field.
- ♦ Topographic maps produced during the time of the former Yugoslavia will be used as supplementary material in the collection of information necessary for the production of topographic maps.

3) Preparations

a. Preparation in Japan

The aerial photographs to be used in the field identification were prepared in Japan by enlarging aerial photographs at a photographic scale of 1/40,000 to a scale of 1/25,000, which is equal to that of plotting.

b. Preparation of existing material

In order to use the existing topographic maps effectively and efficiently, the following topographic maps within the mapping area were collected from SAGW:

- ♦ 1/25,000 Topographic Map; produced in the 1970s by the Former Yugoslavia
- ♦ 1/50,000 Topographic Map; produced in the 1980s by the Former Yugoslavia

c. Preparation of map symbols

The symbols for field identification were prepared based on the specification for spatial data infrastructure.

4) Discussions with SAGW

The Study Team held discussions with SAGW on the following matters:

- Organization of survey groups (12 members/group, 6 groups)
- Explanation and discussion of survey schedule
- Explanation of symbols specification for items to be surveyed and instruction of survey method.

Discussion with survey groups

5) Method and implementation of field identification

The items targeted in the field identification were classified into the following groups:

- Items that must be directly identified in the field using aerial photographs and existing topographic maps (buildings such as public facilities, factories, etc, and annotations)
- Items that can be indirectly identified in aerial photographs, using aerial photographs (land use classifications such as vegetation)
- Items that can be identified in existing topographic maps after cross checking aerial photographs and existing topographic maps (natural topography, buildings, etc.)
- Information that cannot be identified in aerial photographs and items that need to be obtained from or verified at concerned agencies(place names; administrative boundaries; control points; facilities that require annotations, power lines, road classification, etc.)

The field identification targeting the above items was conducted under the instruction of the Study Team, in accordance with the following procedure and method.

a. The area to be surveyed by each survey group was made clear by marking the extent of the survey, the neatline of each map sheet, and the line where the photo joins with adjacent photographs in different colors on the aerial photographs for field identification.
b. The topographic and planimetric information on existing topographic maps were crosschecked with the aerial photographs and the sections that needed to be verified in the field were determined.

Field identification

c. The sections that needed to be verified in the field were surveyed at the site and the information obtained was clearly indicated on the aerial photographs with symbols for field identification and annotations.

d. A list of annotations for every group team was prepared.

e. Inspection and arrangement of results was carried out such as joining among each survey group.

f. A list of various annotations of existing topographic maps was prepared.

g. A field survey necessary for preparation of the Aerial Photo Interpretation Handbook was carried out.

6) Acquisition of other information

The Study Team held discussions with SAGW concerning the information necessary for topographic map representation that could not be obtained in the field survey. In the discussions, SAGW was asked to collect and prepare the following information:

- National boundary data (including positional data on piles on national boundaries)
- Administrative boundary data (the latest data after reorganization of administrative divisions of 2004)
- Names, positional data of existing triangulation points (including elevations)
- Names, positional data of existing bench marks (including elevations)
- Administrative names (Names after reorganization of administrative divisions of 2004)
- Annotations on existing 1/25,000 topographic maps (indicated by Latin and Cyrillic alphabet)

In addition, the agencies below were requested, through SAGW, to provide the latest information necessary for the production of topographic maps.

- Electric Power Company of Macedonia (ESM)

  As power cables and their steel towers are difficult to identify in 1/40,000-scale aerial photographs and it is expected that the information on the existing topographic maps are outdated, their latest positional information is needed.
- Bureau of Public Roads

  When representing roads on topographic maps, information on road classification is needed.

7) Results of the field identification

- Aerial photographs specifying the results of the field identification (enlarged

6-fold)

- ♦ List of annotations verified in the field identification
- ♦ List of annotations of existing topographic maps
- ♦ Aerial Photo Interpretation Handbook

(5) Photogrammetry 1

1) Scanning of aerial photographs

a. Method

Digital data was produced by scanning the negative films of the aerial photographs using a photogrammetric scanner. The equipment used and specifications applied were as follows:

- ♦ Equipment used: Vexcel Ultra Scan 5000 MFR
- ♦ Resolution: 15μ(equivalent to 1693dpi)
- ♦ Data format: TIFF/uncompressed
- ♦ Channel: 8bit grey scale
- ♦ Data size: approx. 220MB/frame

In processing the data, attention was paid to the following points:

- ♦ Geometrical accuracy: To carry out geometric calibration of scanner
  To carry out accuracy control of geometric accuracy
  To rescan the images if the error of the photogrammetric inner orientation exceeds the limit
- ♦ Color tone: To carry out radiometric calibration of scanner
  To carry out accuracy control for each image concerning brightness, contrast, and agreement between adjacent images. In particular, to check that there is no hindrance to plotting in shaded and highlighted sections and to rescan problems areas.

b. Volume and results of work implemented

It was confirmed that the geometric accuracy and color tone of the scanned images were generally favorable and that the quality was adequate for digital photogrammetry and the generation of orthophotos. All of the data was stored on two hard disks, one to be used for work and the other for storage. The volume of the data produced was as follows:

- ♦ No. of photographic images: 1625
- ♦ Total data size: 360GB

2) Aerial triangulation

a. Implementation method

Digital aerial triangulation was carried out using the scanned aerial photo image data. The equipment and method used were as follows:

- ♦ Equipment used: digital photogrammetric system, Image Station SSK (Intergraph)
- ♦ Adjustment calculation method: Bundle adjustment with self-calibration that can be used with Image station SSK

In order to take full advantage of the benefits of digital aerial triangulation, automatic processing by image matching was frequently used in this work. Measurement of the photographic coordinates (image) of tie points, etc. was mainly done automatically. In analog aerial triangulation, about three or five tie points are measured manually per picture. However, with digital aerial triangulation, 80 tie points on average were measured per picture. The measurement of control points was done manually as in the past.

As the volume of measurements by automatic measurement is large compared to the manual method, steady results (solutions) in subsequent calculations and analytical processing can be expected.

b. Volume and results of work implemented

The volume of the work implemented was as follows:

- ♦ No. of photographs: 1625
- ♦ No. of control points (horizontal position): 59
- ♦ No. of control points (elevation): 125
- ♦ Total no. of observed points of photographic coordinates: 190885

The various limits of the adjustment calculation results in aerial triangulation in the Study were as follows:

- ♦ Limit for residual error of bundle intersections: 30μm (max.), 15μm (standard deviation)
- ♦ Limit for residual error of control points: 0.04% (2.4m) of altitude (max.), 0.02% (1.2m) (standard deviation)

The results of the adjustment calculations, which are shown below, fully satisfied the accuracy requirements.

- ♦ Residual error of bundle intersections: 28.874μm (max.), 4.233μm (standard deviation)
- ♦ Residual error of control points: (horizontal) 0.674m (max.), 0.224m (standard deviation)
  (vertical) 0.435m (max.), 0.079m (standard deviation)

3) Digital plotting/compilation

a. Implementation method

Digital plotting and digital compilation were carried out in accordance with the product specification defined, using the equipment below.

- ♦ Equipment used

  Plotter: Digital photogrammetric system, Image Station SSK (Intergraph)

  Plotting software: Micro station V8 (Bentley)

  Compilation software: TNT mips 6.9

For the photo interpretation in digital plotting and compilation, reference was made to the field identification photos and photo interpretation key. In addition, sections that could not be interpreted were recorded in data files for investigation in the supplementary field identification.

After digital plotting and compilation, the joining of graphics and attributes between neatlines was checked visually using an output map, and corrected when necessary.

After the visual check, the following logical checks were carried out.

- ♦ Topological consistency check: A logical check for the following items was carried out for the features defined as interrelated graphics

Items	Description
Adjoining	To ensure there are no unjoined elements
Undershoots	To ensure there are no undershoots
Overshoots	To ensure there are no dangles
Overlapping of polygons	To ensure there is no unacceptable overlapping (of houses, etc.)
Consistency of polygon classification	To ensure that each polygon has only one code To ensure there is consistency of classification between neatlines
Self-intersecting lines	To ensure there are no self-intersecting lines
Self-intersecting	To ensure there are no self-intersecting polygons

Items	Description
polygons	
Duplication of data	To ensure there are no duplicate lines

♦ Classification correctness check: A logical check for the following items was carried out for all features

Item	Description
Validity of feature code	To ensure there are no codes other than the ones defined
Validity of data type	To ensure there are no data types other than the ones defined

b. Volume and results of work implemented

The volume of digital plotting and compilation implemented was as follows:

♦ Volume: 105 sheets (1/25,000, seven of which were covered by SAGW)

The work was completed in accordance with the product specification. A part of the data plotted and compiled is shown in the figure.

In the process of digital plotting and compilation, there were some problems to be dealt with in future works. Those problems and measures to deal with them are as follows.

♦ The details in the field identification photos were found to be lacking in uniformity. In particular, in the representation of annotations, there were areas where abbreviated names were used and areas where full names were used. However, this problem can be solved through proper verification of the names in the supplementary field identification.

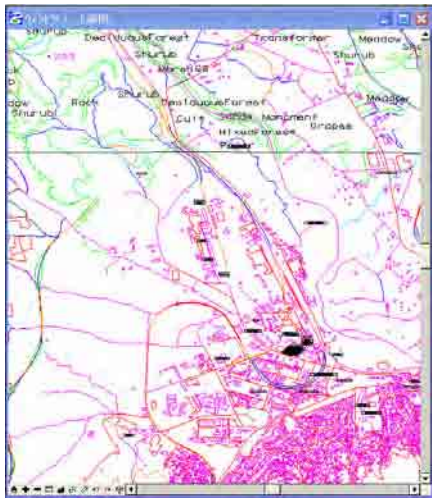


Figure 2-8 Example digitally plotted/compiled data

♦ It was pointed out that the requirements for acquisition of features in the product specification are unclear. There are many newly established features that do not exist in previous topographic maps (for example, “publicTransportSite” to be applied to bus terminals, etc.). Although the application of these features was

considered in the discussions on the preparation of the product specification, in the actual work when various cases were encountered, that application was found to be inadequate. This problem should be dealt with by giving feed back on the matters pointed out in digital plotting and compilation to the product specification, and revising/applying them at the time of the supplementary compilation.

(6) Supplementary field identification

1) Objective

The objective of supplementary field identification was to verify in the field the problems with topographic representation that arose during digital plotting and compilation. Another important goal was to collect administrative boundaries, administrative names, annotations, etc. as well as necessary information for the representation of topographic maps that could not be gathered in the field.

2) Policy

In order to conduct an effective study to achieve the objectives mentioned above under the current circumstances in Macedonia, the following policies for implementation were formulated:

- ♦ To conduct the supplementary field identification, taking into account SAGW's lack of experience in the collecting and arranging of the various information necessary for the production of topographic maps.
- ♦ To conduct the supplementary field identification with an understanding of the difficulty of aerial photo interpretation, i.e. verify in the field the various vegetation items interpreted based on the Photo Interpretation Handbook prepared during the field identification.
- ♦ To effectively use existing topographic maps, produced during the time of the former Yugoslavia, as supplementary material to collect necessary information for the production of topographic maps.

3) Preparations

The maps (symbol size/color output specification, etc.) and materials to be used in the supplementary field identification were prepared based on the experience of the previously implemented field identification, taking into account ease of use of each map/material. The prepared maps/materials are as follows:

(for supplementary field identification)

- ♦ Output sheet of compiled data: 1 copy ea.

(for arrangement of supplementary field identification)

- Polyester-base output map of compiled data (for topographic/planimetric features): 1 copy ea.
- Output sheet of compiled data (for road information): 1 copy ea.

(for inspection of annotations)

- Output map with Latin annotations: 1 copy ea.
- Output map with Cyrillic annotations: 1 copy ea.

(Other relevant materials)

- Aerial photographs indicating the field identification results 1 set.
- Output sheet of orthophotos: 1 copy ea.
- Symbols for supplementary field identification: 1 set
- Photo Interpretation Handbook: 1 set
- List of abbreviations used on the results of supplementary field identification： 1 set
- Manual for supplementary field identification: 1 set

4) Discussions with SAGW

The Study Team conducted discussions with SAGW on the following matters:

- Organization of the survey groups for supplementary field identification (eight teams consisting of 15 members each, one team in charge of preparing annotation list)
- Explanation of survey schedule, etc.
- Explanation of the symbols to be used in the supplementary field identification and the implementation method

5) Collection/Arrangement of map-related data

At the start of the supplementary field identification, SAGW was asked to collect various data relevant to the production of topographic maps and to inspect the contents. After collecting and inspecting the data, SAGW submitted the following materials to the Study Team:

a) Annotation list (in Latin and Cyrillic)

b) Data on administrative names/administrative boundaries

c) Names, coordinates and height data of existing control points and benchmarks

d) Map of main road network

e) Position coordinate data of power lines and pipelines

However, after the field identification, the method for preparing the annotation list was

discussed once more with SAGW and based on the results, the list was prepared. In preparing the list, the annotation data was updated.

U{}e P~inje 175-1-4

Number	Input data	Vl ezni podat oci	Name of feature	Opi s	Code	Remark
1	Katlanovo	Kat l anovo	name from adjoining map	i me na sosednat a kart a	8016	
2	Skopje	Skopje	road direction annotation	soobr a} aen pr avec	3024	
3	Skopje	Skopje	road direction annotation	soobr a} aen pr avec	3024	
4	U{i	U{ i	common name	vi kano mest o	8013	
5	Gradi{te	Gradi { t e	hill	ri d	8014	
6	Vr{nik	Vr{ ni k	peak	vr v	8001	trig.Point
7	Blace	Bl ace	village < 1000	sel o < 1000	8007	
8	Korija	Kor i ja	common name	vi kano mest o	8013	
9	Nerezini	Ner ezi ni	common name	vi kano mest o	8013	
10	Lesov dol	Lesov dol	creek with cliff in mountain	pot ok vo pl ani nski del	5003	
11	P^ INJA	P^ I WA	stream over 5 m	vodot ek nad 5 m	5002	
12	Grot	Gr ot	common name	vi kano mest o	8013	
13	Drenje	Dr ewe	common name	vi kano mest o	8013	
14	Rid	Ri d	hill	r i d	8014	
15	Me~karite	Me~kar i t e	common name	vi kano mest o	8013	
16	Katlanovska Breznica	Kat l anovska Br ezni ca	village < 1000	sel o < 1000	8007	
17	Urva	Ur va	common name	vi kano mest o	8013	
18	Sredni rid	Sr edni r i d	hill	r i d	8014	
19	Raskrsnica	Raskr sni ca	common name	vi kano mest o	8013	
20	Crni vrv	Cr ni vr v	common name	vi kano mest o	8013	
21	Tumkova niva	Tumkova ni va	common name	vi kano mest o	8013	
22	Cuculki	Cucul ki	common name	vi kano mest o	8013	
23	Kamenica	Kameni ca	hill	r i d	8014	
24	Badar	Badar	village < 1000	sel o < 1000	8007	
25	Lojze	L ojze	common name	vi kano mest o	8013	
26	Me~kin rid	Me~ki n r i d	hill	r i d	8014	
27	Preslop	Pr esl op	ridge	sr t	8002	
28	Pavlov krst	Pavl ov kr st	hill	r i d	8014	
29	Str~kovica	St r ~kovi ca	ridge	sr t	8002	
30	Dab	Dab	peak	vr v	8001	trig.Point
31	VARDAR	VARDAR	stream over 5 m	vodot ek nad 5 m	5002	
32	Skopje	Skopje	road direction annotation	soobr a} aen pr avec	3024	
33	Novo Selo	Novo Sel o	village < 1000	sel o < 1000	8007	
34	[kodra	[kodr a	common name	vi kano mest o	8013	
35	Tanasica	Tanasi ca	common name	vi kano mest o	8013	
36	Ramni{te	Ramni { t e	common name	vi kano mest o	8013	
37	Kopa~arica	Kopa~ar i ca	ridge	sr t	8002	
38	Galeva voda	Gal eva voda	spring	i zvor	5101	
39	Vr{nik	Vr{ ni k	peak	vr v	7021	
40	Tursko lojze	Tur sko l ojze	common name	vi kano mest o	8013	
41	Ramni{te	Ramni { t e	common name	vi kano mest o	8013	
42	Ru{to korje	Ru{ t o kor je	common name	vi kano mest o	8013	
43	Mramor	Mr amor	steepSlope	st r mni na	7006	
44	Soli{te	Sol i { t e	common name	vi kano mest o	8013	
45	Letevci	Let evci	village < 1000	sel o < 1000	8007	
46	Vramovica	Vr amovi ca	common name	vi kano mest o	8013	
47	Ajdu~ka ~e{ma	Ajdu~ka ~e{ ma	spring	i zvor	5101	
48	Kitka	Ki t ka	peak	vr v	8001	trig.Point

6) Inspection of digital compilation

Prior to supplementary field identification (field work), the method for inspection and preconsideration of digital compilation was explained to the members of the SAGW survey groups. The map symbols utilized for the output map of the compiled data was also explained.

The preconsideration and inspection work mainly consisted of the following:

- ♦ Verification of uncertainties pointed out by the operator during plotting
- ♦ Comparison check of the field survey results and the digital compilation results (position, etc. of churches, mosques, schools, and so on)
- ♦ Crosscheck with existing topographic maps (particularly areas where secular

change is expected, i.e. the outskirts of cities, river structure, etc.)

- ♦ Comparison with the interpretation key of the Photo Interpretation Handbook (particularly for vegetation classifications)
- ♦ Crosscheck with map of main road network
- ♦ Check of uniformity of plotted representation for each sheet

The uncertainties and items to be checked that were found in the preconsideration and inspection work were marked on the maps for the supplementary field identification as targets of the field survey.

After the preconsideration/inspection work, the method for conducting the supplementary field identification was explained.

7) Implementation of supplementary field identification

The items that needed to be surveyed and or verified in the supplementary field identification were determined in the preconsideration/inspection work mentioned above. Based on those results, the area to be surveyed was divided into seven areas, considering the even distribution of work load among each survey group and ensuring that the indoor work (i.e. arrangement of results) could be done at the branch offices.

As the rate of work differs between map sheets, each group formulated a plan for conducting the supplementary field identification.

The supplementary field identification focused on verifying in the field the items pointed out in the preconsideration/inspection work. Among the target items, particular time was devoted to the following:

- ♦ Verification of streets in urban areas and paths in villages
- ♦ Verification of sections of roads and footpaths hidden by trees
- ♦ Verification of intersections of newly constructed roads, etc. (level crossings, overhead crossings, etc.)
- ♦ Verification of the classification of cultivated land (vineyards and orchards, farmland and paddy fields, etc.)
- ♦ Measurement of the positions of difficult-to-plot power lines by portable GPS
- ♦ Verification river improvement areas (levees, retaining walls, dams, etc.)
- ♦ Verification of irrigation canals

Verification of road and cultivated land

Measurement of power line coordinates by portable GPS

8) Details determined during the supplementary field identification

The following matters were discussed and decided on with SAGW during the period of the supplementary field identification:

a) The power lines to be represented on topographic maps shall be 110kv power lines and above.

b) Border Pillar(7031) and Cross in the Stone(7032) shall not be surveyed in the field

c) Regarding the coordinates list of existing triangulation points, if a point on a building (i.e. church) and a point on the ground are indicated, priority shall be given to the former when indicating the point on a topographic map.

d) In principle, Spring(5101) and Water Tap（5103） shall apply to those that are annotated on the existing topographic maps.

e) Water Works(5112) (purification plants) shall be added to the items targeted in the supplementary field identification.

9) Results of supplementary field identification

As a result of implementation of the supplementary field identification, SAGW and the Study Team obtained the following results:

- Output map indicating the results of topographic and planimetric features of the supplementary field identification concerning (polyester based)
- Output map indicating road classification (paper based)
- Output of corrected annotations (in Latin and Cyrillic)
- Corrected annotation list (in Latin and Cyrillic)
- Output map of power line and pipeline positions

(7) Photogrammetry 2

1) Supplementary digital compilation

a. Implementation method

Supplementary digital compilation was conducted using the compiled data files and results of supplementary field identification. The equipment used was as follows:

- ♦ Digital photogrammetric system: Imagestation SSK (Intergraph)
- ♦ Plotting software: Microstation V8 (Bentley)
- ♦ Compilation software: TNTmips 6.9 (Microimages), ArcGIS 9 (ESRI), NIGMAS (Nihon Computer Graphic), PC-Mapping (Mapcon)

The main work items of supplementary digital compilation were as follows:

Work Item	Description
Revision of output (topographic) sheet for supplementary field identification	Addition of missing data: Missing data pointed out in supplementary field identification was input by plotter. Road classification: All road classification was re-examined based on road classification information obtained through supplementary field identification. Power lines/oil pipelines/gas pipelines: Scanned image of output sheet used in supplementary field identification was digitized and input.
Revision of annotations	The classification and spelling of all annotations were re-examined. In addition, all annotations were input as theme attributes of graphics, according to the product specification.
Addition of information on control points, etc.	Administrative divisions/national park boundaries: The official data managed by SAGW was input. Existing triangulation points/bench marks and ground control points: The official data managed by SAGW was added.
Simplified symbolization	Simplified symbolization was carried out using compilation software according to the symbols defined by the product specification. Through this, the necessary shifting of annotations and point data in topographic map representation was carried out.
Input of attributes	Defined attribute information other than annotations, such as. history, etc., was added as theme attributes of graphics, according to the product specification.
Visual check	The adjoining between map sheets of items/graphics compiled in supplementary field identification, and land use classification was checked using an output sheet of which simplified symbolization had been carried out.
Logical check	Like the check conducted during digital compilation, a check of topological consistency and a check of classification correctness were conducted.

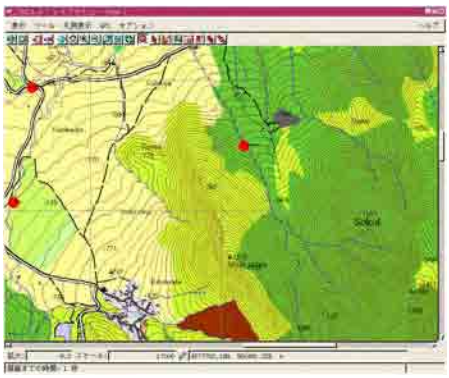
The digital files of which supplementary digital compilation was competed were stored in the respective compilation software data formats which are compatible with the final product format.

b. Results of implementation

The volume of work implemented in supplementary digital compilation was as follows:

Volume: 105 sheets, approx. 14,145km^2
(7 sheets done by SAGW)

An example of compiled data for which simplified symbolization has been carried out is shown below.



The generation of data of all the items of spatial data infrastructure was completed as described above. The problems identified through the work and the measures taken to deal with them were as follows.

- Difficulty of inspection by output map

When conducting the inspection using a symbolized output map, it was difficult to check certain features because symbolization had not been completely carried out in accordance with the specification. For example, since the symbol for cliff (7005) was complex, only the upper and lower lines were shown and, as a result, it was difficult to recognize the polygon shape. This is because in the specification for spatial data infrastructure, the symbols are independent from the data itself as plotting schema, and it was necessary to wait until the stage of printed map data production for complete symbolization. In order to solve this problem, the errors detected in the inspection by output map during the stage of printed map data production were revised by returning to this stage.

- Flaws in product specification

Flaws in the product specification were detected through the supplementary field identification and supplementary digital compilation, and measures to deal with these flaws were examined with the understanding of SAGW. Based on the results, additions and changes were made to the product specifications. A record of the changes was kept with "track changes".

The main flaws and measures taken were as follows:

- ♦ Change of point symbol size: A disparity was found in the size of the symbols described in the existing symbols book in Macedonia and the symbols shown on the topographic maps. Several of the point symbols were too big for topographic map representation. Therefore, these point symbols were made a little smaller in accordance with the existing maps.
- ♦ Improvement of application standards: Some of the standards were unclear. Therefore, these standards were more clearly defined. For example, the standard for acquisition of power lines was limited to those of 110kv or more.
- ♦ Addition of annotated items: Some items could not be classified with the annotations on existing maps. Therefore, annotations were added to some items as theme attributes. For example, there are only two airports in Macedonia so it was decided that it would be better to indicate them by annotation than by symbol.
- ♦ Subdivision of acquired items: After rechecking the output maps with symbols of items which were simplified from the existing maps, it was found that some of the items needed to be subdivided like the existing maps. Therefore, certain items were further divided into subclasses. For example, "streamUnder5m (5001)" was divided into "streamUnder5m (5001)" or "seasonalRiver (5008)".

(8) Establishment of topographic map data

a. Contents of work implemented

Based on the data files compiled in supplementary digital compilation, the input data for the production of data for printing in sheet units was produced. The data files were generated in DXF format in accordance with the product specification on printing. The neatline and coordinate grid line were also generated as additional data for printing. The main specifications of the data are as follows:

- ♦ DXF version: 11/12
- ♦ No. of dimensions: 2
- ♦ Naming rules: As shown in the table below.
- ♦ No. of colors: 256
- ♦ Line width: Excluded
- ♦ Conversion shape: polyline
- ♦ Output elements: All (header, entity, all others)
- ♦ Unit: meter
- ♦ Graphic:
- ♦ Color: black
- ♦ Line width: 0.1mm

Overview of processing of each component

No.	Component Name	Description of Processing
01	XXX_XX_X_extent	・Area Attribute: extent_item ・Polygon Form: each polygon independent ・Polygon Division: When an entire map sheet is within a polygon or a polygon extends over a map sheet, that polygon shall be divided by the neatline. ・Annotation: extent_mName shall be placed in the center(or inside) of each polygon as a label. If an entire map sheet is within a polygon, one shall be placed in the center of each sheet. (The specific position is not important.)
02	XXX_XX_X_admin	・Area Attribute: admin_item ・Polygon Form: each polygon independent ・Polygon Division: When an entire map sheet is within a polygon or a polygon extends over a map sheet, that polygon shall be divided by the neatline. ・Annotation: extent_mName shall be placed in the center(or inside) of each polygon as a label. If an entire map sheet is within a polygon, one shall be placed in the center of each sheet. (The specific position is not important.)

No.	Component Name	Description of Processing
03	XXX_XX_X_landc	・Area Attribute: landc_item ・Polygon Form: each polygon independent ・Polygon Division: When a polygon extends over a map sheet, that polygon shall be divided by the neatline. ・Annotation: landc_mName shall be placed in the center(or inside) of each polygon as a label. If a polygon extends over a map sheet, one shall be placed in the center of each map sheet. (The specific placement is not important.)
04	XXX_XX_X_roadn	・Line attribute: roadn_item
05	XXX_XX_X_roadfpol	・Area Attribute: roadfpol_item ・Polygon Form: each polygon independent ・Polygon Division: When an entire map sheet is within a polygon or a polygon extends over a map sheet, that polygon shall be divided by the neatline.
06	XXX_XX_X_roadflin	・Line Attribute: roadflin_item
07	XXX_XX_X_railwayn	・Line Attribute: railwayn_item
08	XXX_XX_X_railfpol	・Area Attribute: railfpol_item ・Polygon Form: each polygon independent ・Polygon Division: When a polygon extends over a map sheet, that polygon shall be divided by the neatline. ・Annotation: railfpol_mName shall be placed in the center(or inside) of each polygon as a label. If an entire map sheet is within a polygon, one shall be placed in the center of each sheet. (The specific placement is not important.)
09	XXX_XX_X_railflin	・Line Attribute: railflin_item
10	XXX_XX_X_streamn	・Line Attribute: streamn_item ・Annotation: streamn_mName shall be placed above, about midway along the line of each river(from one junction with the annotated river to another junction) on a map sheet as a label. (The specific placement is not important.)
11	XXX_XX_X_waterpnt	・Point Attribute: waterpnt_item ・Annotation: waterpnt_mName shall be placed right next to the point as a label. (The specific placement is not important)
12	XXX_XX_X_waterlin	・Line Attribute: waterlin_item ・Annotation: waterlin_mName shall be placed above the line about midway along the line as a label. (The specific placement is not important.)
13	XXX_XX_X_smallpol	・Area Attribute: smallpol_item ・Polygon Form: each polygon independent ・Polygon Division: If a polygon extends over a map sheet, that polygon shall be divided by the neatline. ・Annotation: smallpol_mName shall be placed in the center(or inside) of each polygon as a label. If an entire map sheet is within a polygon, one shall be placed in the center of each sheet. (The specific placement is not important.)

No.	Component Name	Description of Processing
14	XXX_XX_X_smalllin	・Line Attribute: smalllin_item
15	XXX_XX_X_smallpnt	・Point Attribute: smallpnt_item
16	XXX_XX_X_topolin	・Line Attribute: topolin_item
17	XXX_XX_X_topopnt	・Point Attribute: topopnt_item ・Annotation: topopnt_coordZ shall be placed right next to the point as a label. (The specific placement is not important.)
18	XXX_XX_X_anno	・Point Attribute: anno_item ・Annotation: anno_mName shall be placed right next to the point as a label. (The specific placement is not important.)
19	XXX_XX_X_frame	・Neatline Layer ・Projected coordinate system grid: 1km grid lines, coordinate value at end of each line (Unit: km) ・Longitude/latitude grid: 30”grid lines, coordinate value at end of each line (Unit: xxx° xx’xx”) ※Including overlapping sections of neatlines

* XXX_XX_X indicates the map sheet number.

b. Results of work implemented

The volume of work implemented in the production of topographic map data is as follows:

Volume: 105 sheets, approx. 14,145km^2
(7 sheets done by SAGW)

As a result of the work implemented, some problems arose in the conversion of data between this work and the production of data for printing. The problems and the measures taken are described below.

- Lack of uniformity of display scale

When displaying the DXF data with Adobe Illustrator to be used for printing, it was not at a scale of 1/25,000. This is because the display scale parameter described in the DXF data is automatically set depending on the compilation software. To solve this problem, the neatline and grid line components were output in both DXF and Adobe Illustrator format, and the display scale was set based on the Illustrator format data.

- Excess/lack of river annotations

River annotations are stored redundantly as theme attributes in the line elements of rivers. As a result, the number of annotations necessary for a river on a printed map has to be selected from all the line elements of the river. With long rivers or rivers with many

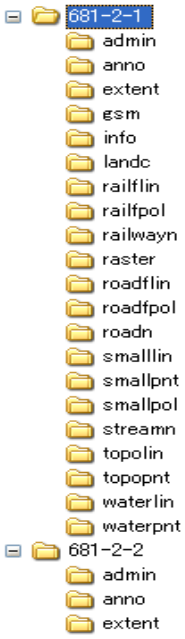
branches, the selection of annotations is difficult resulting in an excess or lack of annotations. In order to avoid a lack of annotations, a step was added to confirm the number of necessary annotations on an output sheet prior to the selection of annotations.

(9) Establishment of GIS topographic maps database

a. Implementation method

The data files compiled in the supplementary digital compilation include all the necessary items for spatial data infrastructure. This data set was converted to ArcInfo Coverage format, which is specified in the product specification, and stored. Each map sheet is composed of 21 individual folders. After the conversion process, the data was displayed on screen using ArcGIS and checked.

Moreover, metadata was also produced for each map sheet in accordance with the product specification. Metadata files in XML format were prepared as a sample, and the necessary sections were revised. In editing the metadata, the plain text data and the data structure were checked using XMLEditPro v2.2 (David Levinson).



b. Volume and results of work implemented

Volume: Coverage data set, 105 sheets
Metadata, 105 sheets

All the ArcInfo Coverage data files generated using several types of compilation software could be correctly loaded, displayed and edited in ArcGIS. No problems occurred in this conversion work.

After editing the text format of the metadata, a check of the structure and a logical check were conducted with XML editor. Therefore, the proper file structure was created.

(10) Production of printed maps

1) Production of data for printing

a. Implementation method

Data not needed for printed maps, attribute information, etc. was removed from the established topographic map data to produce the data for printing, which consisted of 18 individual DXF data files divided with respect to each item per sheet.

The work for producing data for printing was carried out using a Macintosh G5 computer and Adobe Illustrator CS software. First, the 18 individual files were copied and

pasted to combine them into a single file. Then, based on the symbol specification for spatial data infrastructure, the generation/editing of line width, color, symbol, pattern, annotation, etc. for each item was carried out. Furthermore, the hierarchal relationship of the layers was revised in accordance with the visual representation as a topographic map.

As for the annotations, two versions were created; one in Macedonian and one in Latin. Based on the above, the data for printing topographic maps was produced.

To produce the marginal data for printing, the marginal data produced in DXF format was edited by Illustrator CS.

The data for printing in map sheet units was completed by overlapping the data produced for printing and the marginal data, and inputting information such as the sheet number, title, etc. for each sheet.

The completed data for printing was output by plotter, and the patterns of the topographic map, etc. were visually inspected. At the same time, the data was inspected to make sure it was of the color and density required for printing.

Any necessary revisions found in the inspections were corrected immediately until the data for printing was complete.

The index map to be printed on the backside was produced by first adjusting the scale to the sheet size based on the index map converted to Illustrator ai format and then editing it according to the existing sample.

b. Volume and results of work implemented

The volume of work implemented in the production of data for printing was as follows:

Data for printing (topographic map):	105 sheets in Macedonian
	105 sheets in Latin (However, topographic map data other than annotations was shared)
Index map data:	1 sheet

Results

The data for printing and index map data produced are the finished data for printing maps, and there were no problems with the data or topographic map content.

2) Topographic Map Printing

a. Implementation method

The geographic data used for printing was output on positive film by a film output device called a setter. Of the output film, four colors were created for data processes and two colors for features thus there were six sheets in total. A resolution of 3000dpi is usually

used for topographic maps therefore this was the resolution at which the film was output.

Map data was output by a plotter and set on the output film one by one, and then examined to confirm the correctness of the color specifications and data assignment (overprint), and whether or not there were unreadable characters or symbols. When there were defects in the data, the data was amended, the positive film was output again and re-examined.

When the examination was finished, an aluminum copy (typesetting) was created for color proofing using the positive film and color proof paper was printed. A final examination was carried out of the color proofs mainly for print overlaps, smudges, ink bleed and the correctness of the color specifications of the map data. When there were flaws in the map data, the data was amended, positive film was output and re-examined.

Final printing (offset litho) was carried out upon completion of the examination and amendment, and more copies were printed than the actual volume. Quality assessment was conducted after printing and only the approved printed maps were used.

As the paper used for printing was larger than that of the actual product, it was trimmed to the prescribed size.

The required numbers of copies of the trimmed print were folded, the quantity was confirmed and the goods to be delivered were completed.

b. Volume and results of work implemented

Volume

Print Copies	105 sheets	500 copies（double face printing）
	Macedonian Edition	400 copies（200 folded copies）
	Latin Edition	100 copies（50 folded copies）

Outcome

There were no issues with the contents of the topographic maps printed by the specified color tone.

(11) Construction of environmental conservation database for Lake Ohrid

1) Objective of the design of the environmental conservation GIS for Lake Ohrid (hereinafter referred to as environmental conservation GIS)

The aim of the design of the environmental environment GIS was as follows:

- ♦ To specify the GIS database needed for the Lake Ohrid Conservation Project
- ♦ To design a GIS database for environmental conservation
- ♦ To collect information based on the design of the GIS database
- ♦ To determine land use items based on the design of the GIS database

2) Specification of GIS database

In order to specify the GIS database necessary for conservation of the Lake Ohrid area, a meeting was held with the Lake Ohrid Conservation Project (LOCP). In the meeting, it was found that LOCP knew the kind of data needed for environmental conservation and where it could be obtained, but did not have a concrete plan for a GIS database.

The Study Team had prepared a list of information necessary for lake basin conservation from past experience and based on that list, the data items that could be used in a GIS database were examined and discussed with LOCP.

As a result of the examination and discussions, it was concluded that the following data consisting of 67 detailed items in total would be useful.

- ♦ Base map and land use
- ♦ Watershed specific data
- ♦ Natural resources
- ♦ Environmental contamination
- ♦ Thematic data

3) GIS database design

The GIS database was designed based on the data items specified as being useful for conservation of basin environments. As there was a great variety of data items, they were divided into the classes and sub-classes of data sets based on the database theme for easy access.

4) Collection of information

As mentioned previously, LOCP did not have the above data but they did provide information on where it could be obtained. Based on this information, discussions were held with the agencies below.

- ♦ Ministry of Environmental and Physical Planning

- Ministry of Agriculture Forest and Water
- Hydro Metrological Institute
- State Department of Statistic
- Enterprise of Physical Planning
- Sector for Urban planning Environment in Ohrid
- Ministry of Economy

In the discussions with the various agencies, a brief explanation of the Study was given along with a detailed description of the aim of constructing the environmental conservation GIS database. As for the procedure for obtaining the data, the various agencies suggested that SAGW submit an official request and that negotiations be held based on that request. However, this procedure for obtaining the data was more difficult than expected and as a result, not all of the 67 detailed items specified as useful in "2) Specification of GIS database" could be collected.

5) Determination of land use items

As mentioned previously, the LOCP did not have a concrete plan for individual GIS databases. Therefore, for the land use items, the "CORINE (Coordination of information on the environment)" standards, which have been adopted by the European Environmental Agency, were to be applied.

The CORINE standards are divided into several levels. Based on the scale (1/25,000) of the topographic map, which will form the main part of the database, and the required level of detail of the information, it was decided that Level 3 of the CORINE standard would be adopted.

6) Construction of environmental conservation GIS database for Lake Ohrid

The collected data items specified as necessary for the environmental conservation GIS database for Lake Ohrid were arranged, and the environmental conservation database

was constructed according to the GIS database design, based on the determined specifications. The database construction work was conducted by the participants of the 2nd and 3rd technology transfer training through on-the-job training.

The items that could be used for the environmental GIS database were extracted from the spatial data infrastructure (GIS topographic map database) and converted, to avoid duplication in establishing the database.

A member of the Study Team checked these items and made revisions as deemed appropriate.

(12) Construction of land use database

1) Field identification for land use map

a. Objective of field identification

The objective of the field identification was to collect information necessary for the production of land use maps (30 sheets) in accordance with the given specifications, and to record the results on aerial photographs.

b. Basic policies of field identification

In order to achieve the objective above, the basic policies of the study were decided as follows:

- ♦ Conduct the field identification in accordance with the land use classification adopted for the design of the basin environment GIS
- ♦ Make effective use of the understanding of the specifications for spatial data infrastructure
- ♦ Make effective use of the experience of the field identification for the topographic map.
- ♦ Apply photo interpretation on uninhabited areas in consideration of season and weather condition

c. Preparations for field identification

- Preparations in Japan

A total of 92 aerial photographs for the field survey were prepared in Japan by enlarging the 1/40,000 scale photos to the same scale as that of plotting (1/25,000).

d. Discussions with SAGW

The Study Team discussed the following matters with SAGW:

- ♦ Organization of the survey group

- ♦ Survey schedule
- ♦ Implementation method of the survey

e. Implementation of field survey for land use

- Survey area

The survey area was the Lake Ohrid region, which is situated in the southwestern part of Macedonia. It extended from 20°30′ to 21°15′ east longitude and 40°45′ to 41°30′ north latitude, covering an area of approximately 3,556 km by 30 sheets.

- Survey group

Four local engineers familiar with the geography of the survey area were selected from SAGW.

- Survey period

The survey period was from January 8, 2005 to March 6, 2005.

- Indoor work

The neatline of each of map sheet was marked on the aerial photographs which were enlarged (from 1/40,000 contact prints) to nearly the same scale (1/25,000) as that of plotting. After the neatlines of all the map sheets were marked on the photographs, the photographs were joined.

- Field work

The study area was divided into two areas (west side and east side), separated by the BIGIA mountains, which extend northwest to southwest. The field identification for the production of the land use map was carried out, staying in Ohrid on the west side and in Prilep on the east side.

The survey began on the items (approx. 40 items) required for the land use map defined by the specifications. Considering the season and weather conditions, the survey was conducted in the inhabited area while comparing the actual sites with the aerial photos and the results were recorded on the aerial photos. In the event that a team member was not able to determine the land use, the details were verified with residents living in the neighboring area. Data related to land use maps was also collected. (For example, remains of mudslides caused by flooding and deserted villages were recorded on the photos.)

- Indoor interpretation work

Due to the season and weather conditions, photo interpretation was very useful in the survey of land use in the uninhabited mountain region. The Aerial Photo Interpretation Handbook prepared in the field identification for topographic maps was used in this interpretation work. The photo interpretation was carried out, relating the adopted classification items of CORINE Level 3 to the definitions of the classification items of the Aerial Photo Interpretation Handbook. The results obtained in the field work were also used for photo interpretation.

f. Results of field survey

Through implementation of the field survey, the Study Team and SAGW obtained the following results:

- ♦ Aerial photographs indicating the field survey results (enlarged 1.6-fold)
- ♦ Data considered to be related to land use (site photos, etc.)

2) Construction of land use database

a. Objective of construction of land use database

The GIS database was to be constructed from the information that was collected in the field survey and indicated on the photographs.

b. Basic policies for construction of land use database

To achieve the above objective, the following basic policies were set:

- ♦ The data shall be established in accordance with the land use classification adopted in the environmental conservation GIS design.
- ♦ The results of the establishment of spatial data infrastructure (aerial triangulation, DEM) shall be used.
- ♦ The data shall be established in the format that is most user-friendly to general database users

♦ A simple database including only the minimum required information shall be established, assuming secondary editing by the user.

c. Implementation of work

To achieve the above objective, the work was implemented based on the basic policies as described below.

- Production of orthophoto mosaic image

Using the results of the establishment of spatial data infrastructure (aerial triangulation, DEM), a color orthophoto mosaic image was produced from the aerial photographs indicating the results of the field survey for land use mentioned above.

- Construction of land use database

Land use classification was obtained as closed figure (polygon) data with the produced orthophoto mosaic image as the base map. The data structure and attributes were checked to make sure there was no problem as a GIS database. As for the data format, the most widely used data format, ESRI ArcView Shape files, was adopted.

- Production of land use maps

The land use map was produced based on the land use database. For the color coding of land use classification, the color scheme in accordance with Level 3 of the CORINE (Coordination of information on the environment) standards, which are prescribed by the European Environmental Agency, were adopted. The other marginal information was discussed on decided on with SAGW.

2.2.2 Technology Transfer

(1) Photo control point survey

1) Technology transfer program

In the implementation of the technology transfer for photo control point survey, the following items were discussed with SAGW.

a. Schedule

The technology transfer for photo control point surveys was to be implemented during the period of the photo control point survey. Technology transfer was also to be conducted after that equipment to be provided was introduced.

b. Techniques transferred

The techniques covered in the technology transfer were as follows:

GPS survey techniques (planning, observations, analysis, and flow control)

c. Participants

As a result of discussions, it was decided that there would be 12 participants in the technology transfer.

d. Method

As the photo control point survey was to be carried out in parallel, the main method of the technology transfer was to be on-the-job-training (OJT) and actual implementation of work by SAGW.

2) Implementation of technology transfer (at time of photo control point survey of the study)

a. Objective

The objective of the technology transfer for photo control point survey was set as follows:

- ♦ To acquire various GPS survey techniques, such as planning, observations, analysis and flow control.

b. Implementation

As mentioned in “1) Technology transfer program”, the technology transfer was carried out mainly through OJT from April 19, 2004 to July 9, 2004.

- **Technology transfer through OTJ**

The participants of the technology transfer from SAGW had acquired the techniques for operating GPS receivers in the EUREF -1996 - Campaign, and had worked together with engineers of various nationalities. As a result, their technical level for operating GPS receivers was high.

Based on this fact, in OJT emphasis was placed on the transfer of GPS survey techniques such as planning and preparation, observations, analysis, and flow control.

Regarding the planning and preparation for the GPS survey, the preparation of supplies such as the external battery (car battery) necessary for long observations, arrangement of a transport vehicle and accommodations, requesting cooperation from SAGW's local offices, collection of information on local weather, etc. were explained in detailed and carried out through OJT.

The transfer of techniques for analysis of observation data was done not through OJT in the field, but by a method described later on.

The technology transfer for flow control was conducted in consideration of the following features of the work.

- ♦ Conducting of field work in the northwestern region where security is poor
- ♦ Conducting of observations in mountainous areas with remaining snow cover
- ♦ Need to minimize movement of survey team between observations
- ♦ Need to minimize the number of observation sessions

- **Technology transfer through lecture-style training**

Technology transfer through lecture-style training was done through actual lectures and workshops.

In the lectures, GPS survey planning, the theory of analysis (baseline analysis, net adjustment), coordinate conversion of the results, and quality control were explained.

Scene from workshop

Technology transfer for baseline analysis, net adjustment, matters requiring a logical explanation, and technical advice based on diverse experience that could no be fully

covered in OJT and lectures was done through workshops. The workshops were held at SAGW on June 29-30, 2004.

The various materials used in the above technology transfers are attached separately as a manual.

c. Evaluation of technology transfer

As mention in "b. Implementation", the participants in the technology transfer had an abundance of experience in the operation of GPS receivers. Therefore, as a result of this technology transfer, they were able to reinforce and refine this skill.

The technology transfer for the planning and preparation of a GPS survey was done, with some difficulty, through OJT during the joint work with SAGW. As a result, the participants were able to acquire the basic techniques. However, because there is a need for flexibility to change the initial plans and preparations according to local information received, the participants are expected to gain further practical experience.

As with the planning and preparation of a GPS survey, the technology transfer for flow control was conducted during the joint work with SAGW. Flow control, taking into consideration the features of the work, was done together with the Study Team. It is judged that this experience will be of some contribution in the flow control of future works.

Of the techniques transferred through lectures and workshops, the transfer of "theory" (baseline analysis, net adjustment) did not achieve adequate results due to the difficulty of the subject and the limited time. The transfer of these items is an issue that needs to be addressed in the future. On the other hand, the technology transfer for observation planning, baseline analysis, net adjustment and coordinate conversion using software, and flow control, which are closely linked to actual work, was evaluated as being successful because adequate GPS survey results were obtained. Verification of the techniques obtained, building on practical experience, and the dissemination of these techniques are future tasks for SAGW.

3) Implementation of technology transfer after introduction of equipment to be provided (GPS, digital level)

The GPS receivers (8 units) and digital levels (2 units) to be provided were introduced in September 2004 and May 2005.

The technology transfer for using this equipment was conducted at the end of July 2005.

a. Objective

The objectives of the technology transfer were set as follows:

- ♦ To understand the function and acquire the skills to use the GPS receivers introduced
- ♦ For participants to carry out the planning, observations and analysis of an actual GPS survey of SAGW
- ♦ To understand the function and acquire the skills to use the digital levels introduced and to carry out trial observations and analysis

b. Implementation

This technology transfer was conducted from July 20, 2005 to August 12, 2005.

- To understand the function and acquire the skills to use GPS receivers

The technology transfer concerning the function and use of GPS receivers was conducted mainly through lectures using actual GPS receivers.

- GPS survey planning, observations and analysis

The participants planned the GPS survey of the Sveti Naum project near Lake Ohrid, which was actual work of SAGW. The participants also carried out observations and analysis according to this plan.

- To understand the function and acquire the skills to use digital level/To carry out trial observations and analysis

This technology transfer concerning the function and use (including adjustment) of a digital level was conducted mainly through lectures using an actual digital level. Afterwards, a trial leveling was planned and observations and analysis were conducted according to the plan.

c. Evaluation of technology transfer

- GPS survey

The SAGW trainees are evaluated as being able to make practical use of the results of the technology transfer for GPS survey implemented in 2004, and have acquired the capability to adequately use the newly introduced GPS receivers in actual work.

In addition, the GPS survey of the Sviet Naum project near Lake Ohrid was generally conducted according to schedule, and the analysis results met the required accuracy.

Based on the above results, the trainees are considered to have acquired the capability for conducting GPS surveys.

- Digital leveling

The SAGW trainees are considered to have gained an understanding and acquired the skills to use a digital level through the technology transfer using actual equipment. They have also acquired the technique for adjusting the digital level, although more experience in needed.

As for the trial observations and analysis by digital level, although it was the first experience for the trainees, the expected observation and analysis results were obtained and the trainees are considered to have mastered these techniques. However, they are still not able to conduct observations at an adequate speed and are expected to improve on this based on future experience.

(2) Field identification

1) Technology transfer program

In the implementation of technology transfer for field identification, the following items were discussed with SAGW.

a. Schedule

The technology transfer for field identification was to be conducted during the actual field identification.

b. Techniques transferred

The technology transfer targeted the techniques necessary for implementing field identification using aerial photos.

c. Participants of the technology transfer

Based on discussions with SAGW, 12 persons participated in the technology transfer.

d. Method

As the technology transfer was to be conducted in parallel with the field identification, it was to be done mainly through on-the-job training (OJT).

2) Implementation of technology transfer

a. Objective

The aim of the technology transfer for field identification was as follows:

- ♦ To understand the data items of the newly defined spatial data infrastructure
- ♦ To acquire techniques for conducting field identification using aerial photos based on the above mentioned specifications
- ♦ To acquire the method for arranging the results of the field identification using

aerial photos

b. Implementation

As mentioned in "1) Technology transfer program", the technology transfer was to be implemented mainly through OJT, from October 6, 2004 to November 18, 2004.

At the start of the technology transfer, the following items were explained and discussed through lecture style training.

- Specifications of symbols for field identification
- Schedule of the field identification
- Method of interpretation of aerial photos

Following the explanation and discussions, the various techniques were transferred in the form of OJT in parallel with the schedule for field identification.

Marking of survey extent on aerial photographs

Method of surveying items in the field

The techniques transferred through OTJ were as follows:

- Marking of survey extent on the aerial photos in the preparatory works (including marking of line where photo adjoins with adjacent photos)
- Method of field identification
- Method of indicating the results of the field identification on the aerial photos
- Method of final arrangement of the results of the field identification

c. Evaluation of the results of technology transfer

Almost all of the 12 surveyors who participated in this technology transfer were mid-ranking engineers with a great deal of experience in cadastral and boundary surveys. As a result, they gained a good understanding of the techniques for field identification using aerial photos, which was the target of this technology transfer, and it is thought that the initial objectives were achieved.

Based on the result of the technology transfer and the practical experience that

accompanied it, SAGW is very likely to be able to conduct the field identification for the seven sheets on their own.

In the future, it is hoped that the understanding of various items of the map symbols regulations by those who participated in the technology transfer will be enhanced, and that the application of map symbols regulations among the engineers in charge will be standardized with the aim of standardizing the interpretation results that are adopted.

Moreover, it is also expected that the techniques transferred will be disseminated from those who participated in the technology transfer to other engineers, and that the technical potential of SAGW will be enhanced.

(3) Digital photogrammetry

Technology transfer was conducted for digital photogrammetry to establish 1/25,000 spatial data infrastructure in accordance with the product specification.

1) Technology transfer program

In the implementation of technology transfer for digital photogrammetry, the following items were discussed and decided on with SAGW.

a. Schedule

The technology transfer for digital photogrammetry was to be carried out during the assignment period of the team member in charge.

b. Techniques transferred

The techniques covered in the technology transfer were as follows:

- ♦ Method for operating digital photogrammetric system (digital plotter, digital compiler)
- ♦ Aerial triangulation
- ♦ Digital plotting/compilation

c. Participants

Discussions were held with SAGW concerning the selection of participants for the technology transfer. Considering the need for the technology transfer for photogrammetry to be effective so that SAGW can carry out the work independently immediately after the training, the participants selected included five persons with experience in photogrammetry and editing of digital data.

d. Method

It was decided that the technology transfer was to be implemented through lecture style training and practical training using data, etc. produced in the work in Japan. OJT was also to be adopted targeting the digital plotting and compilation of the area to be covered by SAGW.

2) Implementation of technology transfer

a. Objective

The ultimate goal of the technology transfer was to ensure that SAGW is able to establish spatial data infrastructure at a scale of 1/25,000 on its own. In addition, the goals to be achieved by the end of each period of technology transfer were also set.

b. Schedule/implemented items

The period, goal, and items implemented in the 1st technology transfer were as follows:

Period of 1st technology transfer: October 11 to November 19, 2004 (30 days)

The goal here was for the participants to acquire the techniques for operating all the equipment concerned with photogrammetry procured in the Study and to be able to carry out digital aerial triangulation on its own.

[Items implemented and contents]

- Operation of photogrammetric scanner
  The participants acquired the techniques for scanning rolls of negative film and cut positive films of aerial photographs
- Basic operation of digital photogrammetric system
  The participants gained an understanding of supplementary functions such as the processing flow of the digital photogrammetric system, project creation, data input/output, etc.
- Aerial triangulation by manual measurement
  The participants acquired the method of conventional aerial triangulation using a digital photogrammetric system.
- Aerial triangulation by automatic measurement
  The participants acquired the aerial triangulation method, which frequently applies automatic processing using image matching.
- Basic operation of plotting
  The participants acquired the basic operation of plotting functions by stereoscopic

viewing of image data.

- Compilation of feature table

  The participants acquired the technique for creation and compilation of feature tables, in accordance with the data specifications used for plotting.

- DEM generation by manual measurement

  The participants acquired the technique for measurement of elevation data by manual measurement.

- DEM generation by automatic measurement

  The participants gained an understanding of the functions for automatic generation of elevation data using image matching.

- Orthophoto generation

  The participants gained an understanding of the functions for generation of orthophoto images using image data and elevation data.

The period, goal and items implemented in the 2nd technology transfer are as follows:
Period of 2nd technology transfer: January 12 to February 8, 2005 (20 days)

The goal here was to gain proper understanding of the product specification and acquire techniques for plotting spatial data infrastructure based on that specification.

[Items implemented]

- Preparatory work for digital plotting

  The participants gained an understanding of the collection of necessary data and building of the software work environment.

- Input and editing of items related to land use

  The participants acquired the method for plotting features related to land use and for inputting and editing topologically structured surface data.

- Input and editing of road network, railway network, and water system network

  The participants acquired the technique for plotting road, railway and water system networks and for the inputting and editing topologically structured data.

- Input and editing of items for representing topography

  The participants acquired the method for plotting and compiling items necessary for topographic representation, such as contour lines. As for contour lines, the method for using the function for automatic DEM generation in was also acquired.

- Plotting of landmark objects, etc.

  The participants acquired the technique for proper classification and plotting of

small objects, etc.

- ♦ Input and editing of annotations

  The participants acquired the technique for inputting and editing information such as annotations to be stored as attributes.

c. Results and evaluation of the implementation of technology transfer

- **Results of implementation**

As the participants of the technology transfer had experience in photogrammetry and digital data editing, the technology transfer for digital photogrammetry covered more advanced and specialized techniques, while excluding the basic ones. Also, two of the five participants of the 1st technology transfer were replaced in the 2nd.

In order to ensure a close link with the other technology transfer training courses (GIS course, printing course) in the actual work in the future, an observer was selected as a key man to participate in all the courses.

- **Evaluation**

The degree to which the expected goals of the technology transfer were achieved was evaluated at the end of each period of technology transfer.

[Aerial triangulation]

It is judged that the participants have reached a level where they can carry out digital aerial triangulation of the entire photographed area on their own.

After the completion of the 1st technology transfer, SAGW carried out aerial triangulation until the end of 2004. After evaluating the results of that work at the start of the 2nd technology transfer, it was found that the results met the accuracy requirements and that the volume and procedure of the measurements were also correct. Therefore, it was confirmed that the participants had achieved a very high technical level.

[Digital plotting/compilation]

Based on the degree of understanding of the participants during the technology transfer, it is judged that they have reached a level where they can generally carry out digital plotting on their own.

(4) Supplementary field identification

1) Technology transfer program

In the implementation of the technology transfer for supplementary field identification, the following items were discussed with SAGW.

a. Schedule

The technology transfer for supplementary field identification was to be conducted by OJT during the period of the actual supplementary field identification.

b. Techniques transferred

The technology transfer covered techniques for the planning, preparation and implementation of supplementary field identification using the topographic maps output after digital plotting and compilation.

c. Participants

The participants of the technology transfer included 15 surveyors from SAGW.

As the supplementary field identification was to be done in conjunction with the previously conducted field identification, the participants were to have experience with field surveys to the extent possible.

d. Method

As the technology transfer was to be done in parallel with the actual supplementary field identification, it was conducted mainly through OJT.

2) Implementation of technology transfer

a. Objective

The objective of the technology transfer for supplementary field identification was as follows:

- ♦ To understand the survey items based on spatial data infrastructure
- ♦ To acquire the method for conducting supplementary field identification using output maps of data compiled based on the specification mentioned above
- ♦ To acquire the method for arranging the results of the supplementary field identification using the output maps

b. Implementation

The technology transfer for supplementary field identification was conducted from May 13 to August 10, 2005.

In the initial stage of the technology transfer, the transfer of techniques for preparation was conducted by explaining any questions or uncertainties the participants had regarding the output maps of the compiled data.

In addition, detailed questions and items to be checked in the supplementary field identification were explained in discussions, and technical advice was given.

The contents of the explanations and discussion made during the technology transfer were as follows:

- The procedure of supplementary field identification
- The symbol specification to be used in the supplementary field identification
- The method of reading the output maps for the supplementary field identification
- The method for setting up and using portable GPS

Following these explanations and discussions, the technology transfer was conducted in the form of OJT in parallel with the schedule of the actual supplementary field identification.

The content of the technology transfer conducted by OJT was as follows:

- Method for preparing for supplementary field identification
- Method for conducting supplementary field identification
- Method for arranging the results of supplementary field identification on the output maps
- Method for adjoining the results of supplementary field identification between adjacent maps

c. Results and evaluation

The 15 surveyors that participated in the technology transfer were mid-level surveyors with a great deal of experience with SAGW cadastral surveys, boundary surveys, etc. In particular, ten of the participants, who had participated in the previous field identification using aerial photos and had a high level of understanding of the procedure for the supplementary field identification, are thought to have achieved the initial objective.

In addition, the SAGW trainees completed the supplementary field identification for the seven sheets they were responsible for without any problems, showing that they achieved the initial objective.

A future challenge for SAGW is to increase its understanding of the various rules for symbols application, as well as to devise a survey method on its own and standardize the method and results based on a survey manual, etc., in order to ensure uniformity and consistency in surveying work.

Meanwhile, it is expected that the technical potential of SAGW in this field will improve by transferring the skills acquired in this technology transfer training to other engineers.

(5) Supplementary digital compilation

The technology transfer was conducted for supplementary digital compilation of compiled data to complete the products, and for the production of input data for the production of printed maps.

1) Technology transfer program

The Study Team submitted a plan for the technology transfer program to SAGW. Based on this plan and the results of discussions, the following matters were decided on.

a. Schedule

The technology transfer concerning practical skills for supplementary digital compilation of topographic map data was implemented from October 17 to November 23, 2005.

b. Participants

Based on discussions, it was decided that the participants were to be the same as those in the training already conducted in the basic techniques and practical techniques for topographic map data compilation.

Participants: 5 persons (from the Photogrammetric Section)

Observer: 1 person (responsible for coordination with other technology transfer course)

c. Techniques transferred

The technology transfer covered the following techniques:

- ♦ Supplementary digital compilation using TNTmips compilation software
- ♦ Production of input data for printed maps using TNTmips compilation software
- ♦ Production of products in accordance with the product specifications

d. Method

The technology transfer was conducted through hands-on training using the manuals prepared.

2) Implementation of technology transfer

a. Objective

- ♦ To acquire techniques for supplementary digital compilation using TNTmips
- ♦ To acquire techniques for the production of input data for printed maps
- ♦ To acquire techniques for database (final product) construction and for quality control

b. Implementation

The technology transfer course was implemented according the schedule below.

5th Phase: Carry out editing of 7 map sheet (2)
Advanced Techniques for TNTmips (2)
Planning for Future Work

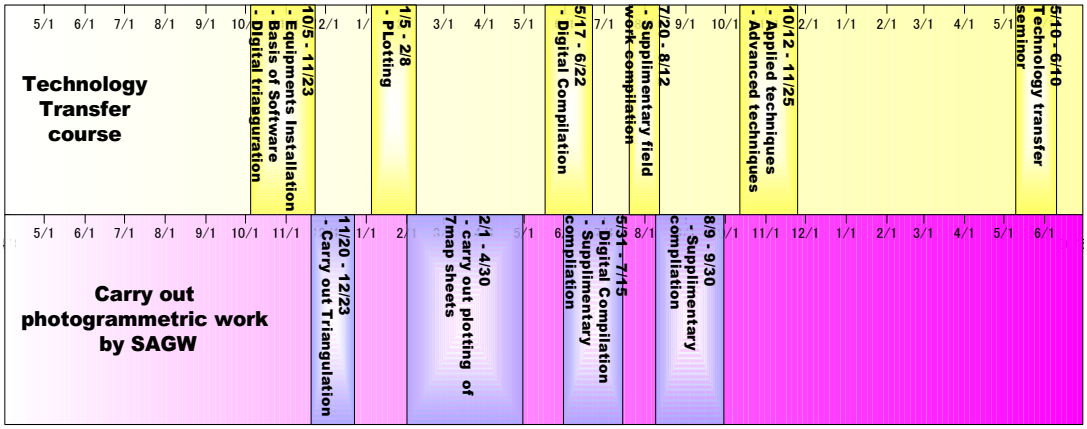
Date		Category	Contents	Objective	Remarks
13-Oct-05	Thu				
14-Oct-05	Fri				
15-Oct-05	Sat	"			
16-Oct-05	Sun				
17-Oct-05	Mon		Meeting, Preparation	Meeting, Check progress of work	For 7 map sheets
18-Oct-05	Tue			Preparation	-
19-Oct-05	Wed	Practical	Supplementary Editing	Remaining Part of Components	Adopt "731-2-1" for training
20-Oct-05	Thu	"	"	"	"
21-Oct-05	Fri	"	"	"	"
22-Oct-05	Sat	"			
23-Oct-05	Sun				
24-Oct-05	Mon	Practical	Supplementary Editing	"	"
25-Oct-05	Tue	"	"	"	"
26-Oct-05	Wed	"	Export DXF for Publishing	All components of the map sheet	Adopt "731-2-1" for training
27-Oct-05	Thu	"	"	"	"
28-Oct-05	Fri	"	"	"	"
29-Oct-05	Sat				
30-Oct-05	Sun				
31-Oct-05	Mon	Practical	Export to Coverage	All components of the map sheet	Adopt "731-2-1" for training
1-Nov-05	Tue	"	"	"	"
2-Nov-05	Wed	"	Ortho Photo Generation	For New 3 Map Sheets	-
3-Nov-05	Thu	"	"	"	-
4-Nov-05	Fri	"	"	"	-
5-Nov-05	Sat	"	"		
6-Nov-05	Sun				
7-Nov-05	Mon	Advanced	TNTmips	Surface Modeling	-
8-Nov-05	Tue	"	"	"	-
9-Nov-05	Wed	"	"	Mosaic images	-
10-Nov-05	Thu	"	"	"	-
11-Nov-05	Fri	"	"	3D Animation	-
12-Nov-05	Sat				
13-Nov-05	Sun				
14-Nov-05	Mon	Advanced	TNTmips	Object Type Conversion	-
15-Nov-05	Tue	"	"	Analysis for Raster	-
16-Nov-05	Wed	Miscs	Mapping Forum	All trainees will attend	Held at Alexander Palace.
17-Nov-05	Thu	Advanced	TNTmips	Analysis for Vector	-
18-Nov-05	Fri	"	"	Auto-Vectorization	-
19-Nov-05	Sat				
20-Nov-05	Sun				
21-Nov-05	Mon	Review	For All Category	-	-
22-Nov-05	Tue	"	"	-	-
23-Nov-05	Wed	Planning	Planning for Future Work	-	-

c. Evaluation

Of the seven map sheets produced by SAGW, the participants were generally able to complete the entire process for sheets, and are generally thought to have acquired the capacity to carry out this work. Based on this, the series of techniques for the production of topographic maps from the scanning of film after aerial photography to the production of spatial data infrastructure and input data for printed maps has been transferred.

Moreover, the transfer of practical techniques was conducted effectively by coordinating the map production work to be carried out by SAGW with the course schedule.

The coordination of technology transfer course and topographic map production works is shown in the table below.



(6) Database construction

Technology transfer was conducted for database construction to produce the final product from the plotted and compiled data in accordance with the product specifications.

1) Technology transfer program

The Study Team submitted the plan for the technology transfer program for data editing (database construction), which followed the basic and practical courses in digital photogrammetry, to SAGW. Based on that plan and the results of discussions, the following matters were decided on.

a. Schedule

The technology transfer was conducted during the following two periods:

May 17 to June 22, 2005: Basic techniques for editing topographic map data

July 21 to August 12, 2005: Practical techniques for editing of topographic map data

b. Participants

Based on discussions, it was decided that the participants were to be those who had participated in the training implemented for basic and practical techniques of digital photogrammetry. However, two of the five participants in the previous training were to be participants in the technology transfer for GIS. Therefore, two new participants were selected.

The result was as follows:

Participants: 5 persons (from Photogrammetric Section)

Observer: 1 person (responsible for coordination with other technology transfer course)

c. Techniques transferred

The techniques transferred were as follows:

- Basic operation of TNTmips compilation software
- Practical operation of TNTmips compilation software

d. Method

The technology transfer was conducted through hands-on training using the manuals prepared.

2) Implementation of technology transfer

a. Objective

- To acquire techniques for the basic operation of TNTmips compilation software and basic knowledge of GIS data editing, i.e. error cleaning
- To acquire techniques for editing data in accordance with the product specification for spatial data infrastructure, using TNTmips compilation software

b. Implementation

The technology transfer course was conducted according to the schedule below:

3rd Phase: Understanding procedure of plotting
Carry out plotting of 7 map sheets

Date		Category	Contents	Objective	Remarks
16-May-05	Mon	n/a	n/a	n/a	n/a
17-May-05	Tue	Review	ISOP	Producing orthophotos from color large scale photography.	Using photos taken by SAGW recently
18-May-05	Wed				
19-May-05	Thu	Review	Q/C for 7mapsheets	Printing out, Logical data structure check, Manual data error check	Fix problems, in case there are.
20-May-05	Fri				
21-May-05	Sat				
22-May-05	Sun				

3rd Phase: Understanding procedure of plotting
Carry out plotting of 7 map sheets

Date		Category	Contents	Objective	Remarks
23-May-05	Mon	Basics	TNTmips	Update programs, Open and close, Localize language, RVC file structure, Display 2-D data, Display 3-D data, Configure coordinate reference system, Object types, Import external data, Geo-reference image, Maintenance RVC objects,	Master displaying techniques
24-May-05	Tue				
25-May-05	Wed				
26-May-05	Thu				
27-May-05	Fri				
28-May-05	Sat				
29-May-05	Sun				
30-May-05	Mon	Basics	TNTmips	Digitize Vector data, Digitize Cad data, Change graphics, Attribute data, Overshoot, Undershoot, SML<Spatial Manipulation Language>, Contouring, Export data	Master manipulating techniques
31-May-05	Tue				
1-Jun-05	Wed				
2-Jun-05	Thu				
3-Jun-05	Fri				
4-Jun-05	Sat				
5-Jun-05	Sun				
6-Jun-05	Mon	Practical	Compilation	Compilation for 7 map sheets	Each map sheet for 1 person
7-Jun-05	Tue				
8-Jun-05	Wed				
9-Jun-05	Thu				
10-Jun-05	Fri				
11-Jun-05	Sat				
12-Jun-05	Sun				
13-Jun-05	Mon	Advanced	By-products	Create layout, plotting, Surface Modeling, Mosaic images,	Producing by-products
14-Jun-05	Tue				
15-Jun-05	Wed				
16-Jun-05	Thu				
17-Jun-05	Fri				
18-Jun-05	Sat				
19-Jun-05	Sun				
20-Jun-05	Mon	Review	TNTmips	Reviewing overall technical topics	After course, trainee will complete compilation for 7 map sheets.
21-Jun-05	Tue				
22-Jun-05	Wed				

4th Phase: Carry out editing of 7 map sheets
Advanced Techniques for TNTmips

Date		Category	Contents	Objective	Remarks
20-Jul-05	Wed	-	-	-	-
21-Jul-05	Thu	Practical	Meeting, Preparation	Meeting, Patch TNTmips, Printing out for supplementary field survey	For 7 map sheets
22-Jul-05	Fri	"		Printing out for supplementary field survey	Ditto
23-Jul-05	Sat				
24-Jul-05	Sun				
25-Jul-05	Mon	Practical	TNTmips	Landc	Adopt "731-2-1" for training
26-Jul-05	Tue	"		Landc	Ditto
27-Jul-05	Wed	"		Landc	Ditto
28-Jul-05	Thu	"		Roadn	Ditto

4th Phase: Carry out editing of 7 map sheets
Advanced Techniques for TNTmips

Date		Category	Contents	Objective	Remarks
29-Jul-05	Fri	"		roadn, railwayn, streamn	Ditto
30-Jul-05	Sat				
31-Jul-05	Sun				
1-Aug-05	Mon	-	-	-	Day off
2-Aug-05	Tue				
3-Aug-05	Wed	Practical	TNTmips	roadfpol, roadflin, railfpol, railflin, waterpnt, waterlin	Ditto
4-Aug-05	Thu	"		Smallpol	Ditto
5-Aug-05	Fri	"		smalllin, smallpnt	Ditto
6-Aug-05	Sat				
7-Aug-05	Sun				
8-Aug-05	Mon	Practical		topolin, topopnt	Ditto
9-Aug-05	Tue	"		anno, admin, extent	Ditto
10-Aug-05	Wed	"		Gsm	Ditto
11-Aug-05	Thu	Advanced	By-products	Mosaic images, Surface Fitting, 3D animation	Producing by-products
12-Aug-05	Fri	"	"	Object type conversion, Various analysis, Auto-vectorization	Ditto

c. Evaluation

After the basic course for editing techniques was completed, the level of understanding, practical ability and technical problems of each participant were evaluated through questions and answers. As a result, it was found that although the level of understanding varied among participants to some degree, each of them acquired the techniques for basic operation for all items.

The participants were evaluated again after completion of the practical course for editing techniques. The participants were nearly able to complete the data editing for the seven map sheets produced by SAGW and they are generally thought to have the capacity to carry out this work.

(7) GIS

1) Technology transfer program

In the implementation of the technology transfer for GIS, the following items were discussed and decided on with SAGW.

a. Schedule

The technology transfer was to be carried out during the period of assignment of the Study Team member in charge.

b. Techniques transferred

The techniques covered in the technology transfer were as follows:

- ♦ GIS database construction
- ♦ GIS data analysis
- ♦ GIS data encoding
- ♦ Various GIS applications

c. Participants

Based on discussions, the participants of the technology transfer were to be three staff from SAGW. However, in response to a request by the SAGW side, an engineer from the digital publishing section participated as an observer in the 2nd to 4th technology transfer, making the total number of participants four.

d. Method

The technology transfer was conducted through a combination of lecture-style training using handouts and practical training using actual data. Moreover, in the 2nd to 4th technology transfers, on-the-job training was conducted with the aim of firmly establishing the techniques through the construction of an environmental conservation GIS database for Lake Ohrid.

2) Implementation of the technology transfer

a. Basic policies of the technology transfer training

The technology transfer training for GIS was implemented during working periods, based on the following policies:

- ♦ To acquire GIS techniques through actual work
- ♦ To cover the broad scope of GIS techniques
- ♦ To aim for GIS use that can be sustained by SAGW

b. Objective

Based on the above policies, the technology transfer was conducted to achieve the following objectives:

- ♦ To construct a GIS database for the environmental conservation of Lake Ohrid
- ♦ To acquire basic operation techniques, practical skills and analytical techniques of GIS
- ♦ To meet the various GIS needs, such as database design, data analysis, production of thematic maps, etc.

c. Schedule/Implemented items and content

A total of four technology transfer trainings were conducted from January 2005 to November 2005. The schedule, implemented items and content of the trainings are as follows.

1st Training: January 12 - February 2, 2005 (22 days)

- Basic concept of GIS

  Participants gained an understanding of the construction and functions of GIS and the data types dealt with on GIS through explanations in lecture-style training using handouts.

- Basic operation of GIS, editing/revision of GIS data (basic course)

  Participants got an overview of the basic operation of GIS (data display, format conversion, search, edit, 3D analysis, and raster analysis) through practical training using actual GIS software (ArcInfo Desktop) provided.

2nd Training: May 16 – June 9, 2005 (24 days)

- Digitization of existing maps

  The participants acquired the techniques for scanning, georeferencing, and digitizing existing maps.

- Editing/Revision of GIS data (practical course)

  The participants acquired the techniques for checking and revising graphical errors of digitized GIS data (point, line, and polygon data), as well as for attaching attribute data to GIS data.

- GIS database design

  The participants learned the procedure, the necessary skills and the techniques for utilizing the tools for designing a GIS database.

3rd Training: July 20 – August 12, 2005 (24 days)

- Acquisition/Editing of 3D data

  The participants acquired the techniques for constructing DEMs by extracting contours from the spatial data infrastructure.

- Catchment area analysis

  The participants acquired the technique for carrying out catchment area analysis using DEMs to obtain river basin boundaries, catchment area boundaries, channels and catchment points.

- Overlay analysis

  The participants acquired various analysis techniques (extraction, overlay, neighboring analysis, statistical analysis) for GIS vector data.

- Model builder analysis

  The participants acquired the technique for using model builder (function for building a model joining multiple analysis functions), which is one of the interfaces for conducting spatial analysis in ArcInfo Desktop.

4th Training: October 17 - November 23, 2005 (37 days)

- Custom symbolization

  The participants acquired the techniques for creating the necessary symbols to realize the symbol representation to be used in topographic maps in an ArcInfo Desktop environment.

- Custom annotations

  The participants acquired the techniques for creating the necessary annotations to realize the annotation representation on topographic maps in an ArcInfo Desktop environment.

- Creation of relationship classes

  The participants acquired the techniques for creating and using a relationship class (class that defines the relationship between two feature classes and an attribute table in a GIS database).

- Building of geometric networks

  The participants acquired the techniques for building and using geometric networks (geodatabase models that manage the connectivity and flow of points and lines).

- Introduction to ArcIMS

  The participants gained an understanding of the basic concept of ArcIMS (an application server to provide GIS data, maps and metadata on the Web).

- Introduction to ArcSDE

  The participants gained an understanding of the basic concept of ArcSDE (an integrated GIS application for storing/managing and serving spatial data in a DBMS).

d. Results

Four SAGW engineers, including one observer, were assigned to the technology transfer for GIS. Three were from the Photogrammetry, Survey, and Cadastre Sections and were familiar with CAD software (i.e. Microstation, AutoCAD, etc.) and one was familiar with DTP software (i.e. AdobeIllustrator, Photoshop, etc.). They all had an understanding

of basic computer operation and the concept of GIS and spatial data and the technology transfer went smoothly. However, as it was the first time for them to operate GIS software, the 1st technology transfer provided general training on basic display, search, edit and analysis functions of ArcInfo Desktop in order to give an overview of the basic operations. In the 2nd and 3rd technology transfers, the participants learned the techniques for constructing GIS data from existing data through OJT, with the goal of constructing an environmental conservation GIS database for Lake Ohrid. Using the skills they acquired, the participants actually constructed the environmental conservation GIS database, which after being inspected by a JICA Study Team member was adopted as the final product. The 4th technology transfer aimed at acquiring skills for symbols, annotations and marginal information, focusing on how to develop the GIS database created to represent a map. The necessary software for the construction of Internet GIS (ArcIMS、ArcSDE), which may be used as a tool for sharing map information in the future, was also explained.

e. Evaluation

In the end, a total of four SAGW staff, including one observer, took part in the technology transfer. Among GIS software, ArcGIS is very user-friendly and all the participants were able to master the basic operations without difficulty. They were also able to acquire practical skills through the construction of the environmental conservation GIS database for Lake Ohrid. The participants were found to have mastered the processes from needs analysis of data users to database design, database construction, data analysis and map representation, and have reached a level where they can carry out this work on their own. Moreover, each of the participants came up with ideas for using the GIS applications included in the training for SAGW work in the future.

(8) Production of data for printing

1) Technology transfer program

In the implementation of the technology transfer for the production of data for printing,

the following items were discussed and decided on with SAGW.

a. Schedule

The technology transfer for the production of data for printing was to be conducted in mid-January and mid-October, 2005.

b. Techniques transferred

The techniques covered in the technology transfer were as follows:

- Macintosh OS
- Basic operation of Illustrator Software
- Creation of objects necessary for the production of data for printing (line type, line width, pattern, color)
- Production of data for printing using actual data (DFX data)

c. Participants

In the selection of participants, those who have knowledge of maps were to be selected if possible, but special conditions concerning personal technical experience was not required.

Discussions were held based on the above conditions. As a result, the participants of the technology transfer were as follows:

Participants: 4 persons (experienced in the operation of Microstation)

Observer: 1 person

d. Method

The technology transfer was implemented through lectures using the manuals that came with the various hardware and software and original manuals prepared by the Study Team, and through practical training using actual data.

2) Implementation of the technology transfer

a. Objective

The objectives of the technology transfer were set as follows.

- To master the operation of Macintosh OS
- To master the basic operation of Illustrator Software
- To master the technique for creating necessary objects for the production of data for printing
- To master basic techniques for the production of data for printing

♦ Production of data for printing using actual data

b. Implementation

The technology transfer was implemented during the following period.

Period: January 12 (Wed) - January 20 (Thu), 2005 (1st)

October 17 (Mon) - November 21 (Mon), 2005 (2nd)

The equipment used in the technology transfer and the arrangement of equipment was as follows:

Equipment used: Macintosh G5, 2 units

Software used: Adobe Illustrator CS

Two and three persons were assigned to each computer.

- **Implementation**

[Basic operation of software and creation of objects]

After a brief description of Macintosh OS, the basic operation of Illustrator functions and the functions used when producing topographic data for printing were explained. After that, all the participants carried out the actual operation of those functions in accordance with the manual.

Next, the participants carried out operations such as the creation of various line types, the creation of patterns and coloring for the objects thought to be necessary in the actual production of topographic data for printing

Operations such as to move layers and to move objects between layers were also carried out.

[Basic operation for the production of data for printing]

The Study Team, who had converted existing databases for Illustrator use, produced actual topographic data for printing using the sample data they had.

The sample data file was converted by ArcInfo and Microstation and divided into eight files including lines, polygons, annotations, symbols, etc., with each file consisting of a single layer.

For the technology transfer, first the technique for layer division, with respect to each item, of the files forming a single layer was transferred. Then, the technique for changing the color, line width and line type of the items divided in each layer, according to the specifications was transferred.

Finally, the eight individual files were combined into one, and the techniques for adjusting the hierarchal relationship of the layers and creating ticks and color according to

the specifications were transferred. As a result of this technology transfer, the participants completed the sample topographic data for printing.

[Acquisition of practical skills and applications for Illustrator software]

The objective of the 2nd technology transfer was for the participants to complete the data for printing using actual data. The basic operation of Illustrator learned in the 1st technology transfer was reviewed, and the techniques for creating the registered colors (six), marks, patterns, etc. used in a topographic map, in accordance with the symbols specification was transferred. By registering the created marks, etc. as a library, they could be recalled at any time and the input DFX data could be converted all at once by item. For its application, the technique for creating brush patterns (line patterns), which can be converted from DXF data (i.e. administrative boundaries, railways, and cliffs input as line data) was transferred. Furthermore, the techniques which essential for editing topographic maps, such as the movement of layers, the movement of objects between layers, clipping mask (clipping of topographic map), etc. were also transferred. Lectures were also given on the requirements (overprint, etc.) for outputting the final topographic map data for printing (output of film).

[Completion of topographic map data for printing with actual data]

The transfer of techniques for editing topographic map (sheet no. 731-2-1) data for 1/25,000 printed maps was carried out through OJT according to the following procedure:

c. Input of DXF data (13 files in total)

After enlarging so that the “Frame file” mesh (grid) was at a scale of 1/25,000, the enlargement rate of the other 12 files was set and they were combined into one file based on the “Frame file” neatline.

d. Verification of files and arrangement of layers

When converting a vegetation polygon into DXF format, “donut” processing is ineffective. Therefore, an additional layer was created and adjusted so that it could be properly displayed. As all the annotation groups of the “annotation file” are included in the same layer, the layer was divided by item based on the point attached to the annotation. Additional layers were also created and adjusted for items that need processing for elevation (bridges, etc.).

e. Change of specification according to symbols

The specification was changed for each item according to the symbols. The marks,

line patterns, etc. in the library created in the first half of the technology transfer were effectively used.

f. Correction

The topographic map data produced was printed out, visually inspected and revised as needed. Errors with the administrative boundary, and so on, which occurred during DXF conversion, were notified to the Photogrammetric Section and corrected.

g. Evaluation of the technology transfer

All of the participants had experience with the operation of Microstation and did not have reluctance to hardware and software. One of the participants was a graphics engineer who had worked with Adobe Photoshop and had used Illustrator's old version in the past.

In addition to the above, based on the results of the practical training, the participants have acquired the techniques for operation of Macintosh OS and Illustrator Software. Also, judging from the quality of the sample data produced by the participants during the technology transfer, they have acquired the basic techniques necessary for the production of data for printing (including the technique for the creation of objects). Although only one completed map sheet was produced, the participants did the work on their own from the input of actual data (DXF data) to the verification, editing, and revision of the data. Therefore, the participants are thought to have attained a level of understanding and skill where they can generally produce topographic map data for printing on their own. Furthermore, the participants showed a willingness to improve their skills such as holding discussions with the Photogrammetric Section (the provider of DXF data) on their own initiative to improve coordination and work flow efficiency, and producing map sheets of color specifications different from the completed products for consideration.

2.2.3 Dissemination of Geographic Information

The following works related to the dissemination of geographic information were implemented.

- ♦ Discussions on the dissemination of geographic information
- ♦ Activities for the dissemination of geographic information

(1) Discussions on the dissemination of geographic information

In order to have the general public, donor governments, etc. effectively use geographic information, the dissemination of geographic information and the exchange of opinions were carried individually for the following concerned organizations:

International organizations, donor governments:
World Bank, United Nations Development Program (UNDP), United Nations Food and Agriculture Organization (FAO), German Agency for Technical Cooperation (GTZ), Embassy of Switzerland in Macedonia, Swedish International Development Cooperation Agency (SIDA)

Macedonian Government: Ministry of Education and Science, Ministry of Environment and Physical Planning, primary school teachers

In the exchange of opinions, the Study Team distributed newsletters, a Project Brief, and copies of newspaper articles as handouts, and explained the project briefing and the aim and method of the dissemination of geographic information, after which a question and answer session was held. The questions asked included “Is SAGW going to make the new geographic information available to the public?” and “By when is SAGW going to map the area not covered by the JICA Study Team?”

Discussions were also held with SAGW on the distribution of geographic information and a survey was conducted on the types of maps possessed by SAGW, the quantity of stock, the sales method, use conditions, the extraction of problems, etc. As a result of the survey, it was found that there was very little distribution of maps due to the fact that SAGW did not have a sales section for map information, there was only one place to obtain such information, and the maps were outdated and expensive.

(2) Activities for the dissemination of geographic information

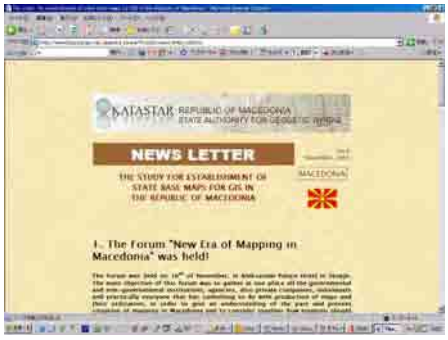
Based on the results of the discussions above, the following dissemination activities for geographic information were planned and implemented.

1) Publicity activities

Publicity work on the Study and the activities of SAGW were carried out through the following media, as part of the activities for the dissemination of information.

a. Publication of newsletter (in English and Macedonian)

Information transmission was carried out in the form of newsletters about the details of activities and work progress in order to share information and to deepen the shared understanding between parties affiliated with the project and local residents, and. The newsletters were created in English and Macedonian and both versions were released on the SAGW website.



Newsletter No.8 (in Macedonian)

An outline of the newsletters is as follows:

No. 1: Overview of the Study, introduction of the Study Team and C/T

No. 2: Taking of aerial photographs, donor conference hosted by the C/P, completion of GPS survey

No. 3: Set up of equipment for technology transfer at SAGW office, start of technology transfer training

No. 4: Organization of environmental map contest, expansion of mapping area, launching of environmental GIS for Lake Ohrid basin area

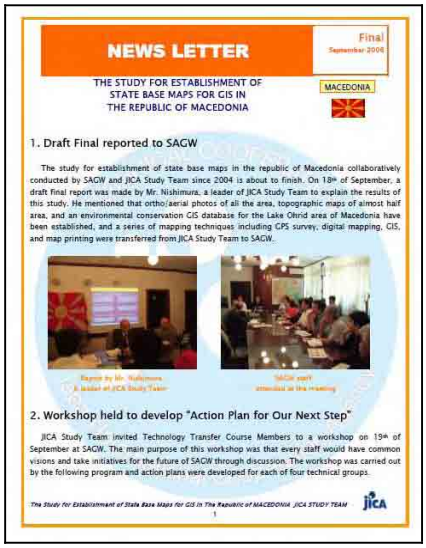
No. 5: Holding of environmental map contest and deciding on winning maps

No. 6: Implementation of training for SAGW staff in Japan, start of work in the 2nd year, arrival of new equipment to SAGW

No. 7: Visit to neighboring countries, participation of SAGW staff in global mapping

No. 8: Organization of forum on “A New Mapping Era in Macedonia”

In issue 9 of the newsletter which was the final issue, the result of the draft final report meeting carried out for SAGW, details of workshop and seminar held for discussion and presentation of the issue in technological field and future action plan, as well as a press conference held for the media were reported.



NEWS LETTER

Final
September 2004

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

MACEDONIA

1. Draft Final reported to SAGW

The study for establishment of state base maps in the republic of Macedonia collaboratively conducted by SAGW and JICA Study Team since 2004 is about to finish. On 18th of September, a draft final report was made by Mr. Nishimura, a leader of JICA Study Team to explain the results of this study. He mentioned that ortho/aerial photos of all the area, topographic maps of almost half area, and an environmental conservation GIS database for the Lake Ohrid area of Macedonia have been established, and a series of mapping techniques including GPS survey, digital mapping, GIS, and map printing were transferred from JICA Study Team to SAGW.

2. Workshop held to develop "Action Plan for Our Next Step"

JICA Study Team invited Technology Transfer Course Members to a workshop on 19th of September at SAGW. The main purpose of this workshop was that every staff would have common visions and take initiatives for the future of SAGW through discussion. The workshop was carried out by the following program and action plans were developed for each of four technical groups.

The Study for Establishment of State Base Maps for GIS in The Republic of MACEDONIA JICA STUDY TEAM

JICA

Newsletter Final (in English)

b. Reporting in newspapers (Utrinski Vesnik, Dnevnik: two national papers)

The activities of the Study were reported in newspapers targeting the entire country of Macedonia.

An outline of the articles published is as follows:

April 2004: JICA Study Team commences project for production of topographic maps in Macedonia.

June 2004: JICA Study Team takes aerial photographs and conducts GPS survey covering entire country.

Словенците не снимаат од воздух

June article

Македонија ќе добие дигитални топографски карти

November article

November 2004: JICA Study Team plans to organize environmental map contest in Prilep.

November 2005: Current situation and problems concerning topographic maps in Macedonia, smooth progress for JICA project

c. Radio broadcast (Macedonian Radio)

In April 2004, the state-run Radio Skopje conducted an interview regarding the commencement of the JICA mapping project, the background and schedule of the project, and the importance of topographic maps.

d. Television broadcast (Macedonian Television & Television Prilep)

The commencement of the JICA mapping project, its objectives and a brief description of the project was broadcast on Skopje TV news in April 2004.

In November, publicity activities on the mapping project being conducted by JICA at primary schools in Prilep, and an overview of the environmental map contest to be organized in Prilep were also reported on.

In addition, in November 2005, an announcement of the opening of the forum and its contents was aired on the TV news. A video on topographic maps made by the comedy group K-15 and shown at the forum also ran several times on national and local TV stations.

e. Distribution of leaflet about the study

Leaflets (1500 copies) describing, with pictures, why JICA conducts mapping projects in developing countries and how maps are produced were distributed to primary schools in Prilep.

Leaflet

2) Environmental map contest

Although primary schools in Macedonia teach geography, the class often covers all countries throughout the world, and the students hardly ever learn about the area where they live and its surroundings. Therefore, an environmental map contest was organized so that the students could learn about map production while studying the environment around them.

a. Preliminary arrangements for organizing environmental map contest

Prior to organizing the environmental map contest, discussions were held with the Bureau for Development of Education under the Ministry of Education and Science, SAGW, and geography teachers from primary schools. As it was the first time such an event was to be held in Macedonia, it was decided that the place of the contest should be narrowed down to an area where access and communication was easy. As a result, Prilep City, where a branch office of SAGW is located, was selected.

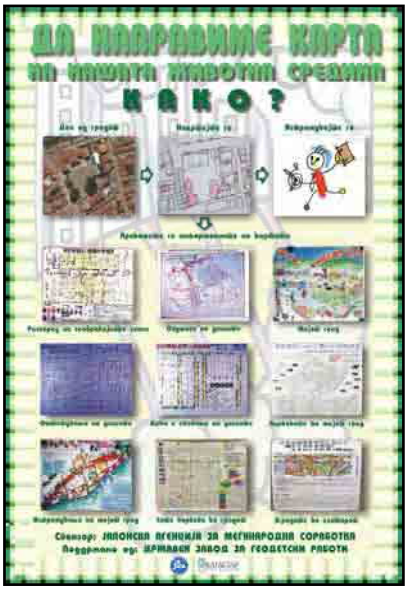
b. Explanation of environmental map contest and JICA project

Discussions were held with the geography teachers (14) and principals of seven primary schools in Prilep and the bureau chief of the Ministry of Education and Science on the details of the contest (objective, schedule, target participants, rules, judging criteria, awards, etc.).

Meeting with primary school teachers from Prilep

c. Distribution of posters on the environmental map contest

In order to publicize the contest, the posters shown below were distributed to all schools in Prilep, the Ministry of Education and Science and its local office in Prilep, SAGW's branch office, and so on. A manual on how to make a map and a pamphlet introducing an example of a map contest in Japan were also handed out.



Posters distributed

d. Details of the environmental map contest

The details of the environmental map contest were as follows.

Objective:	To take a look at the environment around you and learn new skills such as information gathering and map making though the map making process.
Eligible participants:	The contest was open to 5th to 8th grade students (from the age of 11 to 14) from seven schools in Prilep
Mapping area:	Within the City of Prilep
Rules:	Make a map of the environment around you. The precision (accuracy) of the map is not important. The map should be A0 size. Any color is acceptable. Group entry is also allowed. For those interested, materials needed for making the maps (drawing paper, color pens, crayons, etc.) were supplied.
Judges:	JICA Study Team, SAGW, Ministry of Education and Science, Television Prilep
Judging criteria:	The maps entered were judged based on the items represented on the map, how the environment was dealt with, and how the matters observed and investigated by the student were expressed. The best maps were selected based on cleverness of idea and perspective, meticulous observational research, clear results, and excellent map representation.

Exhibition of maps, awarding ceremony:

An awarding ceremony and an exhibition of the maps entered in the contest was held on February 18.

e. Eligible participants and actual participants in the environmental map contest

The total number of students in the seven primary schools targeted in the environmental map contest, the number of eligible participants and the actual number of those who participated were as follows.

Name of school	Date founded	Total no. of students	No. of eligible participants 5th grade - 8th grade students	No. of actual participants
Goce Delcev	1974	971	522	225
Kire Gavriloski-Jane	1960	908	486	170
Rampo Levkata	1965	787	434	200
Dobre Jovanoski	1954	1245	590	60
Blaze Koneski	1986	1018	532	186
Koco Racin	1954	1040	552	160
Kliment Ohridski	1963	800	509	108
Total		6769	3625	1109

A presentation was given to introduce an example of an environmental map exhibition held in Japan targeting students (11 - 14 year olds) of target schools from around 50 classes (40 students/class) and to explain the JICA mapping project and the details of the environmental map contest.

Explanation of environmental map contest to primary and middle school students

Of the students eligible to participate in the contest, materials (400 sets of drawing paper, color pens, crayons, etc.) needed for making the environmental maps were supplied

to those interested.

f. Holding of the environmental maps contest

The contest was held based on the preliminary arrangements and contest rules mentioned above.

As a result of the preliminary explanation, 276 maps were entered in the contest. The maps were reviewed by the pre-selected panel of judges and the winning maps were selected based strictly on the specified criteria.

On February 18 (Fri), 2005, an awarding ceremony was held at the culture center in Prilep, attended by the winners and their parents (approx. 80), the geography teachers (14), concerned persons from the Ministry of Education and Science (10), SAGW staff (10), Television Prilep, and the JICA Study Team. After the ceremony, the students who won the top award from each grade gave a presentation of their map and explained why they chose the subject of their map, the problems they ran into in their research and to make an appeal for action on issues that concern them.

At the venue of the awarding ceremony, an exhibition of the best maps was also held.

3) Visit to neighboring countries

a. Background

At present, SAGW buys topographic maps (printed maps) of various scales from Belgrade for sale to the general public. Although SAGW is officially providing geographic information, the cost of maps is high (144 Euros/sheet), the map information is outdated and does not represent the current situation, and the process of obtaining maps is complicated. As a result, the users are limited to a small number of government agencies. Moreover, SAGW has not been conducting dissemination activities for geographic information or publicity campaigns for information disclosure.

Under such circumstances, SAGW realized the need to examine methods for gaining public understanding of its activities as well as for policy and implementation methods for the establishment and dissemination of geographic information.

b. Objective

Based on the above background, SAGW, as an agency that provides geographic information and aims to join the European Union (EU), visited neighboring countries that are already EU member states in order to gain an understanding of how those countries establish and disseminate geographic information.

c. Selection of countries to be visited

In view of current conditions in Macedonia and SAGW, countries that met the following conditions were to be visited:

- Has an agency like SAGW that establishes and disseminates geographic information
- Former socialist country
- EU member state
- Geographic information not under control of the Defense Ministry
- Geographic information is freely distributed

Candidate countries included Albania, Greece, Austria, Montenegro, Bulgaria, Romania, Hungary, the Czech Republic, Croatia, Slovenia, etc., and the three countries that met the above conditions were Hungary, the Czech Republic and Slovenia. These three countries were also selected since they were the most recent members of the EU (joined in 2004) and because, having agencies like SAGW that establish and disseminate geographic information, they could serve as a standard for SAGW, which aspires to be an EU member.

d. Itinerary and organization visited

Based on the schedules of the host-agencies in the three countries and that of the visiting SAGW staff, the schedule and organizations visited were as follows:

- Slovenia (Ljubljana)

  Date: June 6 - June 8, 2005

  Organization visited:

  Slovenia Survey & Mapping Authority (government agency)

  Geodetski Zavod Slovenije (private surveying company)

- Hungary (Budapest))

  Date: June 26 - June 28, 2005)

  Organization visited:

  Institute of Geodesy, Cartography and Remote Sensing (government research organization)

  Department of Lands and Mapping (government agency)

- The Czech Republic (Prague)

  Date: June 28 – June 30, 2005

  Organization visited:

  Czech Office for Surveying, Mapping and Cadastre (Government agency)

e. Members of visiting party

The visiting party consisted of the following SAGW staff, and the JICA Study Team member in charge of the dissemination of geographic information.

- Ms. Bisera Jakimovska: Director of SAGW
- Mr. Saso Dimeski: Head of Sector for Geodesy

f. Content of visit

During the visits, surveys were conducted focusing on the following items:

- Current situation of establishment and updating of geographic information
- Management of analogue geographic information
- Management of digital geographic information
- Disclosure of geographic information
- Publicity activities

g. Results of visit

The results of the visits are as follows:

- Current situation of establishment and updating of geographic information.

  All three countries have established geographic information at various scales, and the updating of information is carried out every year. In each country, the updating is done by dividing the national land into three to five areas and taking aerial photographs of the respective areas. In addition, GPS-based control stations have been installed in each country, and they have been joined to the international GPS network. With these GPS-based control stations, high-accuracy positional information is provided in real time. This information is also provided to private users, etc. at cost.

- Management of analogue geographic information

  In all three countries, printed maps are neatly stored in cabinets at the map sales offices of the national mapping agencies. Historically valuable maps and equipment are also on display in the lobby and kept in the archives office. In the case of Slovenia, businesses are granted permission for reproduction, and charged according to the volume of sales.

- Management of digital geographic information

  All three countries promote the release of digital geographic information. However, all digital data possessed is not made available to the public. In each

country, when purchasing digital data, the buyer is required to sign a written agreement not to reproduce the data.

♦ Disclosure of geographic information

In all three countries, a map sales office (map sales center) is set up at the head office of the respective national mapping agencies. In Hungary and the Czech Republic, map information can also be purchased at local branch offices while in Slovenia, sales of cartographic data is commissioned to private facilities.

These map sales offices provide sample maps and index maps and customers can search for geographic information by computer. Anyone can buy geographic information just by filling out a form. All three countries offer a service for the sale and delivery (fee charged in the Czech Republic) of printed maps and digital geographic information (on CD) via the Internet. However, the digital data cannot be provided immediately, as it needs to be copied to CD.

Map sales office in Hungary ((left above)
Map sales office in the Czech Republic (left below)
Map sales office in Slovenia (below)

♦ Publicity activities

The national mapping agencies in Hungary and the Czech Republic organize a symposium on geographic information each year. They also publish a journal of surveying technology containing various articles and research papers.

In Hungary and Slovenia, an annual report on the mapping agency's activities is also issued.

The mapping agency in the Czech Republic publishes a sales catalog for geographic information and also sells antique maps.

In all three countries, the mapping agencies have their own Website through which they describe their activities and provide the latest geographic information to the general public.

In Slovenia, because private surveying companies are expanding, specialty shops selling maps are found in sightseeing areas. Tourist maps are also provided for free at hotels, etc.

4) Forum

a. Background

In the 1990s, there were dramatic changes in the field of geographic information in developed countries. Examples include the emergence of in-car navigation systems, mobile phones that offer a variety of functions including the capability to determine where the user is, man-made satellite geodetic systems that instantly identify areas struck by disasters such as earthquakes, online map search systems that are easy and free to use, and so on. These technologies have been realized using geographic information, which is becoming a more essential part of society than ever before.

In countries in Europe, geographic information, the foundation of the information society, is being established at a considerable speed.

On the other hand, the establishment and dissemination of geographic information in Macedonia is unfortunately at a low level compared with other European countries. Therefore, a forum was organized to make SAGW and concerned persons aware of these current problems and to stimulate the establishment and dissemination of geographic information in Macedonia.

b. Date and venue of forum

The date and venue of the forum were as follows:

- Date/Time: November 16, 2005, 9:30 - 15:30
- Venue: Hotel Alexander Palace (in Skopje)

c. Participants

The target participants of the forum were Macedonian government officials, Macedonian private businesses, SAGW staff, international organizations including donors, and Japanese government officials. As a result, there were approximately 180 participants. The breakdown is as follows:

- ♦ International institutions including donors: approx. 30 persons
  World Bank, United Nations Development Programme (UNDP), North Atlantic Treaty Organization (NATO), Food and Agriculture Organization (FAO), German International Cooperation Agency (GTZ), Swedish International Development Cooperation Agency (SIDA), etc.
- ♦ Macedonian government officials: approx. 40
  Ministry of Environment and Physical Planning; Ministry of Agriculture, Forestry and Water Supply; Ministry of Defense; Ministry of Education and Science; Ministry of Economy; Ministry of Foreign Affairs, etc.
- ♦ Educational institutions in Macedonia, private business: approx. 60 persons
  Prilep high school students, military academy students, GIS companies, cell phone companies, the media, etc.
- ♦ SAGW staff: approx. 40 persons
  The Director, the C/P, other staff
- ♦ Japanese government officials: approx. 10 persons
  JICA staff, Infrastructure Development Institute, JICA Study Team

d. Contents

At the forum, presentations were given by persons concerned with geographic information and an "exhibition corner" displaying various maps was set up. Handouts were also prepared for the visitors. The details are as follows. (The forum program is attached at the end of the report.)

- ♦ Presentations
  - ■ Opening remarks
    Opening greetings and an explanation of the purpose and objectives of the forum were made by the Minister of Environment and Physical Planning of Macedonia and the Resident Representative of JICA Austria Office.
  - ■ Problems concerning sales of geographic information in Macedonia
    Problems were pointed out, i.e. there is only one place where maps are sold, the cost of maps is high, maps are outdated, it takes long time to obtain maps, etc.
  - ■ Current situation of geographic information in Macedonia
    The current situation in Macedonia was presented i.e. low recognition of geographic information, lack of teaching materials at educational institutions, etc.

■ Current situation of geographic information in neighboring countries

The management, sales method, etc. of geographic information in the Czech Republic and Hungary were presented.

■ Use of geographic information in Japanese society

Examples of the use of geographic information combined with recent developments in IT were presented (i.e. car navigation systems, etc.)

■ Environmental map contest

Environmental maps made by Prilep high school students were shown and awards were presented to the winners.

■ Introduction of projects by aid organizations of other countries

JICA, World Bank, and SIDA projects currently being implemented by SAGW were introduced.

■ Promise by Director of SAGW

The Director of SAGW pledged the following concerning the current problems with the sales of geographic information in Macedonia.

* The data produced in the JICA project will be available for general sale from October 1, 2006.
* A topographic map (1/25,000) covering the entire country will be produced by December 31, 2008.
* By October 1, 2006, the sale price of geographic information will be as follows:

Topographic map (printed map)	3-8 Euros
Topographic map (digital data)	10-15 Euros
Orthoimage	15-20 Euros
Aerial photo image	3-8 Euros

* A statement indicating the reason for purchase and the Director's signature will no longer be required on the application when buying geographic information and it will be possible to pay directly rather than at the post office.
* A map sales office will be set up at the SAGW head office. It will also be possible to buy maps at book stores, kiosks, etc.
* It will be possible to order geographic information online.


Scene from forum

♦ Exhibition Corner

An "Exhibition Corner" displaying the items below was set up at the forum. Staff explained the exhibited items and answered visitors' questions.

- Poster introducing the JICA project: approx. five panels
- Various maps of Macedonia (topographic map, urban planning map, cadastral map, etc.): approx. 10 maps
- Various maps of Japan (topographic map, map created by Tadataka Ino, picture map of Kyoto, water supply map, sewage map, cadastral map, etc.): approx 15 maps
- Maps entered in the Environmental Map Contest: approx. 5 maps


Scene from "Exhibition Corner"

♦ Handouts

The following items were distributed to the participants:

- Program (1 copy in either English of Macedonian)
- Printout of powerpoint presentations (1 copy in either English or Macedonian)

- SAGW pamphlet
- Diary
- Writing material
- Orthophoto of central Skopje (A3 size)
- Carrier bag
- Stickers with the project name
- Jacket with the SAGW and JICA logos (for presenters only)
- DVD of the K-15 skit
- Data (powerpoint data, JICA project newsletter, orthoimage data of Skopje, aerial photo data of principle cities in Macedonia, etc.)

5) Technology Transfer Seminar

a. Background

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.

b. Date, Time and Location

The date and location are as follows.

- Time and Date: 9:00-14:30 on 20th September 2006
- Location: Hotel Alexander Palace (Skopje)

c. Participants

As mentioned in「a. background」, the participants were those directly affiliated with the study work. Thus, there were around 70 participants comprising of the following members:

- Staff from SAGW headquarters (including the Director): about 40 people
- Staff from SAGW district offices: about 10 people
- People from Macedonian Government and municipalities: 3 people
- Donors providing support to SAGW: 2 people
- People affiliated with the Japanese Consulate General in Skopje: 2 people
- Japanese side: 10 people

  JICA employees, Infrastructure Development Institute, and JICA Study Team

d. Contents

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 in which the counterpart side was involved. In addition, materials including a seminar program were prepared for distributing to the participants.

- ♦ Presentation
  - ■ Opening remarks

    The current honorary Japanese Consul General for Macedonia gave an opening greeting at the seminar which included a summary of the study work.
  - ■ Summary of progress and results of the study work

    The leader of JICA Study Team gave a summary of the progress and results of the study work.
  - ■ Report from SAGW of each study work

    SAGW staff gave a report of the contents and results of the GPS, photogrammetry, printed map data creation study work (technology transfer, technical cooperation) that they were involved in.
  - ■ Training in Japan

    SAGW staff who underwent training in Japan reported the progress and results of the training course.
  - ■ Workshop

    The results of the workshop carried out on the 19th of September were reported by SAGW staff.
  - ■ Award of technical transfer participation certificate and equipment provision

    The equipment and materials used in the study work were provided to the agency director of SAGW by JICA staff. In addition, technical transfer participation certificates were awarded to representatives of the participants by the leader of the Study Team.
  - ■ Message from the Study Team member
  - ■ Closing remarks

    The former and current directors gave acknowledgment to the completion of the study work and finished with a closing remark.


Technology Transfer Seminar

- Distributed Materials
  - Program (English and Macedonian)
  - Study work pamphlet (English and Macedonian)
  - Sample printed topographic map (Skopje 1/25,000: limited edition)
  - SAGW pamphlet (procurement method and new price list for geographic information such as topographic maps: Macedonian version)
  - Advertising leaflet
  - Writing utensils etc.
  - Bags

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.

a. Selecting Topics for Discussion

The participants of the training courses selected the topics for discussion. The Study Team offered the seven priority projects presented in the Draft Final Report as topic options. The topics selected for group discussion in each group, as shown below, are a result of the opinions stated from the different points of view of each course from the seven priority projects and several topics which arose from discussions.

- ♦ GIS Course: Completion of 1/25,000 base data
- ♦ Photogrammetry Course: Promotion of intensive use of orthophotos
- ♦ Printing Course: Creation of reduced compilation maps
- ♦ Field Survey Course: Construction of GPS control network

b. Group Discussion

The technical issues for the realization of the selected topics of each course were analyzed and the action plan was examined. A PowerPoint presentation was prepared detailing the results.

c. Group Presentation and Formulation of Entire Action Plan

The representatives of each group gave a presentation of the results of the discussions, then there was a question and answer sessions based on the presentations. The following action plans were created to roundup the technical transfer courses which were based on the results of 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

d. Outcome

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.

Topic Selection

Group Presentation

Report at the Seminar

7) Press Conference

a. Aim

A 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.

b. Date, Time and Location

The date and location are as follows.

- Time and Date: 11:00-12:30 on 22nd September 2006
- Location: Hotel Alexander Palace (Skopje)

c. Contents

- Presentation

The presentation was given by SAGW employee, Saso Dimeski who is the Macedonian director for the study. 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. The specific points for improvement that arose included, making the legends more detailed, the possibility of choosing from both English and Macedonian (Crylic characters), double face printing, the necessary location of the map numbers can be confirmed by glancing at the index map published on the reverse side, maps being not only paper-based, and the possibility of providing every type of digital data (aerial photographs, orthophotos and GIS database).

Furthermore, in addition to improving the contents of maps, it was emphasized that the general public would purchase the maps more easily because of the revised price system that lead to the price down and shortened length of time required for the purchase procedures for the dissemination of geographic information in Macedonia.

♦ Distributed Materials

A "map catalogue" listing the necessary procedures for procuring maps, a product list, price list and inquiry details were distributed to the sixty or more attendees of the conference as well as a free special edition 1/25,000 topographic map (analogue and digital) focusing on Skopje city. The conference was reported to the residents of Macedonia by a television broadcast that same day.

SAGW staff holding the Press Conference

Media and Map Users Attending the Press Conference

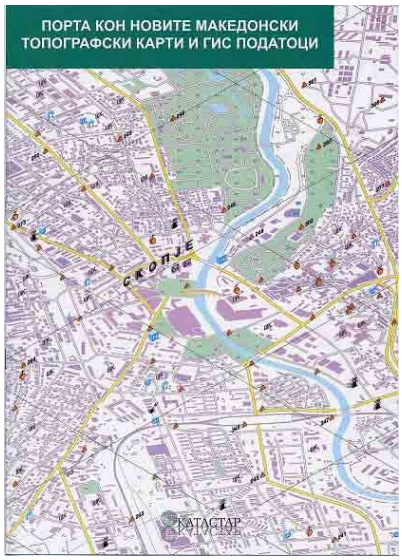
8) Disclosure of Geographical Information

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

♦ Map Catalogue

A map catalogue including an index map, purchase prices, purchase procedure and Q&A, was prepared so that people wishing to purchase maps can easily search for their required maps.



Map Catalogue

♦ Posters and Fliers

Posters (A2) and fliers (A5) were created and left at the office information counter to inform residents of the provision of new maps. Newspaper advertisements were also published for the same purpose.

Map Used for Posters and Fliers

♦ Free Telephone Consultation

A free consultation service was launched for handling general questions relating to the SAGW service and complaints.

Information about the Free Telephone Service Handling Questions and Complaints

♦ Display of New Topographic Maps

The new topographic maps of Skopje that were created in the study are displayed in the lobbies of the university and government establishments and new maps are being introduced.

b. Types of Disclosed Geographic Information

All of the geographic information (printed maps, digital files, GIS databases etc.) provided by this study 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 (the types of geographic information are shown in the sales price list in c).

c. Sales Price

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 and a sales price list is illustrated below.

	Product Name		Price (ДNR)
1	A map in paper format (1:25,000)		320
2	A map in raster format (1:25,000) on CD		1,200
3	A map in vector format (1:25,000) on CD	All	20,000
		Administrative Boundary	3,200
		Land use	3,200
		Road	3,200
		Railway	3,200
		Water	3,200
		Small Object	3,200
		Topography	3,200
		Annotation	3,200
4	Ortho Photography (1:25,000, Black/White, Georeferenced) on CD		1,000
5	Aerial Photography (1:25,000) on CD		400
6	Digital Terrain Model (every 20m grid, 1:25,000) on CD		4,000
7	Ohrid Basin Environmental Conservation GIS Database in Paper format		320
8	Ohrid Basin Environmental Conservation GIS Database in Vector format on CD		1,200
9	Ohrid Basin Environmental Conservation GIS Database in Raster format on CD		20,000

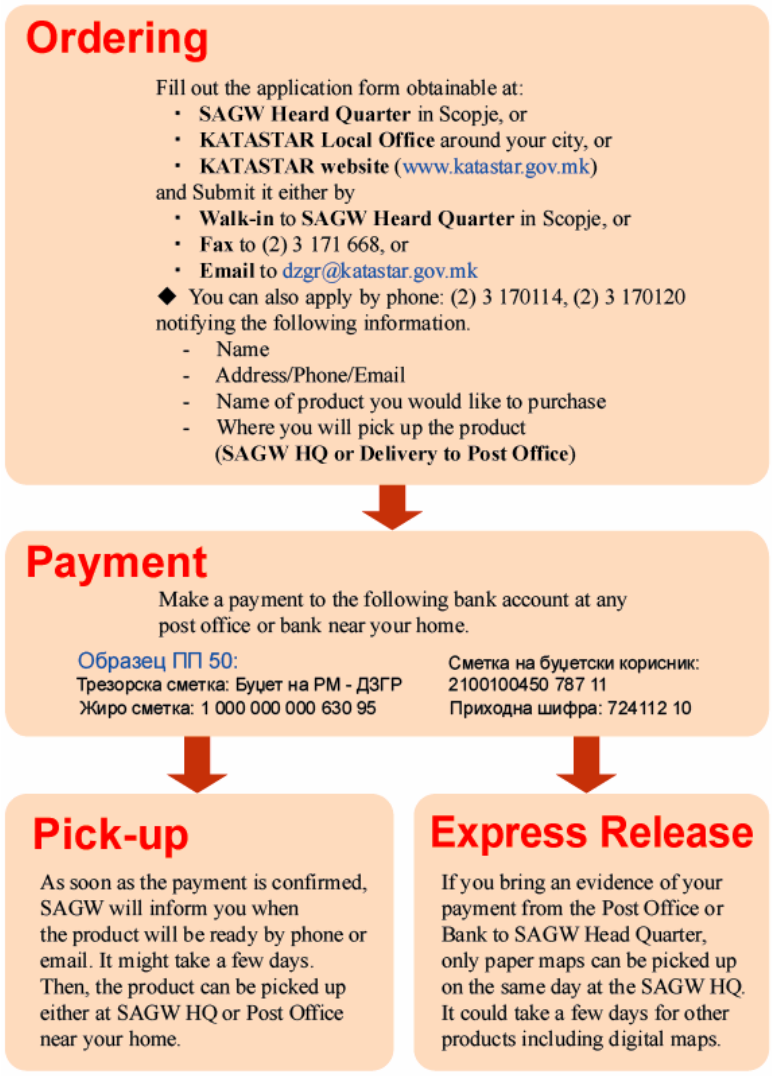
*The prices don't include a tax. (January, 2007)

Product and Price List

d. Purchasing Method

♦ Printed Maps

The complex purchase procedures for geographic information, which require some waiting time, were simplified and the length of time required for purchasing the information was significantly reduced. One of the reasons for the time reduction is that under the previous purchase procedure for geographic information customers had to obtain the approval of SAGW management after making the purchase application and this took several days, and this has become unnecessary. In addition, until now users had to visit and purchase information directly from SAGW headquarters, however since October 2006, purchase applications can be made by email or fax, and if the fee is transferred via the post office or a bank then the ordered maps can be received from a nearby post office. In short, until now customers had to go to SAGW headquarters on three occasions, firstly to make the application, then to submit proof of remittance and finally to collect it. However, as it is now possible to send maps by post, customers can obtain maps without going to SAGW headquarters



Map Purchasing Flow

♦ Digital Map Information

Unlike the provision of printed maps, users who order digital geographic information have to wait for several days as the data is burned onto a CD. As soon as the preparation has been completed, SAGW guides the user by phone or email. The procedures and acceptance of digital geographic information are carried out at the SAGW headquarters workstation.

e. 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. There will be no new fees, such as royalties or copyright usage fees, when using the geographic information for a second time.

Оваа карта е репродуцирана од топографската карта во размер 1:25 000 со одобрение од директорот на Државниот завод за геодетски работи (број на одобрение: xx-xxxx/x, од јан. 200X). Содржината на оваа карта е изготвена врз основа на податоците добиени во јули 2004 година. Копирањето и/или печатењето на оваа карта за комерцијални цели, без дозвола од ДЗГР е забрането.

Obligatory Passage Stated on Map Products

f. Geographic Information Plan

♦ Geographic Information Provision Plan

As mentioned previously, in October 2006 SAGW revised the pricing system and method of providing geographic information. The full operation of providing digital maps began when JICA delivered the printed maps. Furthermore, the existing printed maps are being sold at the new price.

Although the convenience of the system has improved by things such as application by telephone and email and delivery of printed maps by mail, the information provision base is located in the same place in the SAGW headquarters in Skopje. SAGW plan to develop the following items in order to further improve the service for distant users and users who cannot go to the SAGW headquarters.

♦ Website

A geographic information provision service will be established on the SAGW website（http://www.katastar.gov.mk/）, the application method will be posted and index maps and application forms will be downloadable. The following steps to make data downloadable from the web, as planned, are currently being carried out in the SAGW headquarters.

♦ SAGW Sales Window

A cadastral development study is currently being carried out by aid from the World Bank. However, one of the components involves renovation of the SAGW headquarters facility. The renovation is scheduled to remodel the warehouse which stores the maps and to establish a new inquiry counter at the entrance of the

building. The plan is to create a facility where index maps and catalogues are placed at the reception and people who wish to purchase data can be easily lead to the purchasing office.

♦ Provision at Local Offices

The local offices are informing residents and organizations of the provision of the new maps by distributing posters, leaflets and map catalogues. In the future, local offices will be able to supply printed maps covering the local area to direct users. Payment will be made via post offices or banks.

♦ Provision at KIOSKs etc.

We plan to provide topographic maps covering the capital Skopje, and the cities of Ohrid and Bitola, from city kiosks, bookshops and petrol stations.

City Kiosk

2.3 Results of the Study

The results produced in the Study were as follows:

(1) Reports

a. Inception Report	20 copies
b. Interim Report	20 copies
c. Draft Final report	
Main report	20 copies
Summary	20 copies
d. Final report	
Main Report	20 copies
Summary	20 copies

(2) Products

a. Aerial photography

- ♦ Negative film 1 set
- ♦ Diapositive film 1 set
- ♦ Contact prints of aerial photographs 2 sets
- ♦ Photo index map 1 set
- ♦ Digital data of aerial photographs 2 sets

b. Results of photo control point survey 2 sets

c. Results of aerial triangulation 2 sets

d. 1/25,000 topographic map

- ♦ 1/25,000 topographic map(film for printing) 1 set
- ♦ 1/25,000 topographic map(printed maps) 500 sets
- ♦ 25,000 level topographic data 5 sets
- ♦ 25,000 level topographic database for GIS 5 sets

e. Databases

- ♦ Land use database 5 sets
- ♦ Environmental conservation database 5 sets

Chapter 3 Present status and Tasks

3.1 Present status and Problems

In this Study, SAGW obtained certain results through partial production of national base maps and technology transfer required for this process. From the process and results, the present status and problems concerning the products such as national base maps, technical capabilities, available services, and cooperation within SAGW and with external organizations were discovered.

3.1.1 Production of National Base Maps and Establishment of Spatial Data Infrastructure

The present status and problems in national base maps and spatial data infrastructure discovered from the process and results of this Study are as follows:

(1) Present status

1) National base maps

As for national base maps, 500 copies of printed maps per sheet were produced. Films for printing were produced simultaneously for the sake of future reprinting.

a. Unproduced range

Upon the completion of this Study, 105 sheets out of 205 sheets of national base maps have been produced. The produced 105 sheets mostly cover the major city areas and the trunk roads connecting these cities and therefore can be utilized as national land information for various basic plans of the national and local governments.

SAGW declared in a forum a production plan for the remaining 100 sheets in the coming three years (25 sheets in 2006, 35 sheets in 2007, and 40 sheets in 2008).

b. Storage and management of national base maps

The existing national base maps are stored in good order in a warehouse but without air conditioning facilities. The numbers of each of the maps are not controlled. As for purchasing, it takes some time to retrieve a corresponding map.

c. Quantity of inventory

The quantity of new national base maps in stock is 500 copies each for 105 sheets. On the other hand, the quantity of the existing topographic maps in stock is not accurately known because there is not sufficient control.

d. Specification of national base maps

National base maps produced in this Study basically use the same representation methods as the existing national base maps. The specifications of the size of sheet and basic representation items are the same as before. On the other hand, some specifications are changed or newly added. For example, some graphic symbols are added or unified. Annotations, which used to be in Serbian, are in Macedonian in a unified way.

2) Spatial data infrastructure

A spatial data infrastructure was established for the same range as national base maps according to the "1/25,000 Spatial Database Data Specification."

a. Product specification

The adopted product specification for the spatial data infrastructure was determined through discussions between SAGW and the Study Team. The specification is intended to completely cover the represented items and improve the usability of data. Additionally, some advanced technical elements such as object-oriented programming and data modeling based on UML (Universal Modeling Language) are incorporated into the specifications.

The technical background of these specifications was the improvement in quality of specifications such as improvement of ambiguous definitions of acquired items in existing maps (such as road types) and elimination of data formats that are low in use.

b. Data update methods

The data update of the produced national base maps (with a scale of 1/25,000) can be expected from our experience to mostly concern linear objects such as roads and large houses scarcely accompanied by plane-based revisions. Therefore, the most appropriate update method is not photogrammetry, an advanced and specialized method, but digitization of orthophotos that meets the required accuracy and can easily be mass-produced. Due to technology transfer, SAGW has already acquired most of the technical capabilities required for data update.

(2) Problems

1) National base maps

National base maps were produced according to the specifications defined in this Study but there are the following problems:

a. Unproduced range

Agricultural projects and water supplying projects require the use of maps for an

entire catchment basin, not the use of individual maps. In such an application that requires plane-based use, the production of the remaining 100 sheets is also important.

b. Storage and management of national base maps

The current printed copies of national base maps are not stored in a good, properly air-conditioned environment but in an inappropriate one for maintaining the quality of printed maps. Furthermore, the printed maps are simply organized on shelves and not properly managed to enable immediate retrieval of necessary maps.

c. Quantity of inventory

The quantity of new national base maps in stock is 500 copies each. However, a potential demand is expected for the urban areas so that additional printing will be required sooner or later. At the time of additional printing, an order specification needs to be created. However, SAGW lacks expertise related to printing operation, in particular, knowledge required for ordering and knowledge related to estimate of workload.

On the other hand, SAGW may carry surplus inventory as long as more than 10 years for the mountainous and rural areas from which little demand can be expected. From the viewpoint of newness of information, these inventories are not desirable.

d. Specification of national base maps

The specification of a changed national base map must be provided to users. However, how this can be accomplished has not been considered yet.

2) Spatial data infrastructure

The specifications of a spatial data infrastructure have been defined but several problems can be expected in the future operations.

a. Product specification

The product specification meets data items and use conditions required of the product at the time of establishment. From now, it will be necessary to examine the revision of the product specification in consideration of users' opinions and new technical requirements in order to increase the utility values.

b. Data update methods

To update data, it is necessary to shoot new aerial photographs or purchase high-resolution satellite images, both of which require budgets. Data update must be planned for each unit of sheet, at 3-year to 5-year intervals in urban areas and normally at

about 10-year intervals in mountainous and rural areas.

3.1.2 Technical Capabilities (Technology Transfer and Propagation)

(1) Land survey

In the Study, technology transfer was conducted concerning GPS photo control points survey, leveling using digital levels, field identification using aerial photographs, and supplementary field identification.

1) Present status

At the time of completion of technology transfer for Study, the present status of SAGW engineers can be evaluated as follows:

a. GPS photo control points survey

We evaluate that, due to technology transfer that was conducted in two phases, the technical capabilities of SAGW have reached the levels described below.

Planning of GPS survey: The SAGW engineers made a plan of GPS survey in the second phase of technology transfer that met the required accuracy and work period, then they have reached a level sufficient for implementation of actual operation.

Observation in GPS survey: The SAGW engineers, being able to manipulate the GPS receivers that have been introduced, have acquired technical capabilities that allow them to carry out necessary observation operation.

Analysis of GPS observation: The SAGW engineers have reached a level sufficient to make analysis and adjustment computation using the analysis software that has been introduced.

Evaluation of analysis results: The SAGW engineers have reached a level sufficient to evaluate analysis results and decide whether GPS survey has been properly conducted.

In sum, SAGW can conduct GPS survey on its own.

b. Leveling using digital levels

Despite the short-term technology transfer, SAGW has acquired skills for use of equipment, experimental leveling, and computation process for observed values.

c. Field identification using aerial photographs

SAGW has been conducting similar survey in cadastral survey, albeit with different survey items. Therefore, the tasks in technology transfer were to understand of target items, understanding of criteria for selecting target items, and interpretation of photographs.

We evaluate that SAGW has acquired skills for conducting this survey on its own.

d. Supplementary field identification

It was the first time for the SAGW staff to conduct this survey, using the output maps of data after digital data compilation. Having experienced field identification using aerial photographs described in the above section, however SAGW has acquired supplementary field identification techniques with a level sufficient to conduct the entire process including preparation, implementation, and result arrangement on its own.

2) Problems

At the time of completion of technology transfer for Study, SAGW has the following problems in its technical capabilities related to land survey:

a. GPS photo control points survey

We conclude that, at present, there is no problem in actual-operation GPS survey conducted by SAGW because the result can be sufficiently utilized as the actual output.

b. Leveling using digital levels

Having received technology transfer in a short period of time, SAGW lacks the experience in actual operations. Their speed of leveling is not sufficient for actual operations.

c. Field identification using aerial photographs

Although SAGW can conduct 1/25,000-scale field identification at a level sufficient for actual operations, the outputs varied among different surveyors. This needs improvement from the viewpoint of producing topographic maps with uniform quality. There is also problem in how to maintain the uniformity of surveyors' understanding of survey items and criteria for selection when the scale level is changed.

d. Supplementary field identification

In the same way as for the field identification described in the previous item, the survey results had variations and uneven levels between surveyors, which need improvement.

In addition to the specific problems described in the above for skills a through d, there is also a common problem to them, which is the propagation of these skills.

(2) Digital photogrammetry

1) Present status

The technology transfer of production skills for digital photogrammetry was conducted in this Study. As a result, four or five SAGW engineers were able to mostly reach a technical level for carrying out on their own a series of skills including aerial photograph scanning, spatial data infrastructure establishment (digital aerial triangulation and digital plotting and compilation), basic skills for orthophoto production (including DTM production), and input data production for printed national base maps. As far as the establishment of spatial data infrastructures and national base maps is concerned, these engineers are expected to be able to fulfill the requirements for the time being in terms of technical capabilities and capacities.

2) Problems

On the other hand, we should point out the necessity for the entire SAGW organization to further utilize digital photogrammetry and data compilation skills.

a. Application of the acquired skills to other operations

Some of the skills acquired in this Study can be applied to other operations. For example, it is effective to lend the orthophoto production and data error removal skills to the cadastral operation. SAGW needs to examine in this way whether the acquired digital photogrammetry skills can be applied to other operations. For the sake of actual application, SAGW needs to train about 10 digital photograpmmetry engineers, twice as many as the current number, who are well-informed about the cutting-edge technologies.

b. Problems in data compilation in general

Although technical capabilities depend on individual engineers, the worth of an organization exists in how it can systematize the technical capabilities. The current operation system for photogrammetry is dependent to some extent on individuals' skills to carry out data processing.

c. Acquisition of IT skills such as programming

IT skills such as programming are becoming essential also in the field of digital photogrammetry. Against such a background, some of the engineers in the photogrammetry unit have mastered simple programming such as Visual Basic and are using it to improve the efficiency of operations. On the other hand, engineers who were not given opportunities to learn such skills find it difficult in terms of time and costs to obtain these learning opportunities for themselves. SAGW must consider how it can provide opportunities for learning basic information processing skills in order to raise the

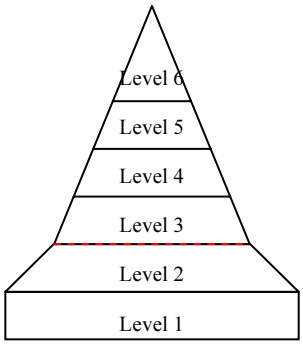
level of technical capabilities of front-line engineers who are involved in production.

(3) GIS

1) Present status

Before reporting the technical capabilities of SAGW staff who have completed technology transfer related to GIS, this section first defines in general terms what are GIS engineers and what kind of technical capabilities are expected of them. There are many discussions on this point both in the U.S. and Japan, advanced countries in GIS. This is because GIS is a new technological field, because the technological renovations in GIS is advancing fast in synchronization with development of IT technologies in general and, above all, because the engineers and necessary technical capabilities of GIS, applied in a wide range of fields, cannot be defined unconditionally.

Modeled after one of the GIS certification systems in the U.S. the GIS technical certification system in Japan started and gradually developed since 2005. This GIS technical certification system, conducted in port folio format (based on carrier management and documentary examination systems and continued education), certifies examinees who gain a certain number of accumulated points for 5 years and gives emphasis to work experiences. The very fact that this certification system evaluates experience and education in various fields based on continued education, as described earlier, results from the diversity in technological fields related to GIS and promptness of innovations.



Under these circumstances, Professor Duane F. Marble (Ohio State University) proposed a model of six GIS skill levels that suits the current state of affairs. Professor Marble's model of GIS skills levels is represented in a hierarchical structure shown in the figure on the right (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

The following is an evaluation, based on the above model, of the current technical levels of the SAGW staff who participated in the GIS technology transfer of this Study.

In the GIS technology transfer, GIS skills necessary for actual operations were transferred through the construction of GIS database for environmental conservation in Lake Ohrid. Application skills were also transferred in a bid to enable sustainable use and utilization of GIS by SAGW. During the construction of GIS database for environmental conservation, necessary data was extracted and imported from a spatial data infrastructure established in this Study, in a bid to transfer skills for utilization of a spatial data infrastructure to the construction of other databases.

At the time of completion of these technology transfers, the technical level of the participants can be evaluated as being about to reach Level 3 of the above model. The SAGW staff who participated in technology transfer consisted of engineers in the photogrammetry, geodesy, cadastral survey, and DTP departments, all of whom had sufficiently acquired, before the start of technology transfer, basic skills required to handle spatial information classified into Level 1. The major difference between Levels 1 and 2 is that persons in the latter category use GIS on a routine basis as part of their regular operation and, by doing so, have acquired the skills for a series of procedure necessary for the work. In this sense, the participants in technology transfer, by working to construct GIS database for environmental conservation in Lake Ohrid, have acquired skills for constructing, managing, and expressing data according to the specifications, and they have, a competency for meeting Technical Level 2.

In Professor Marble's classification of GIS technical levels, persons who wish to climb from Level 2 to 3 need to make great efforts. The major difference between Levels 2 and 3 is that the persons in the latter category have skills for not only conducting work

according to the available specifications and procedures but also conducting analysis and modeling using combinations of different tools and methods. Concerning this point, the technology transfer participants executed catchment area analysis, overlay analysis, and three-dimensional representation when they constructed a GIS database for environmental conservation. Consequently, the technology transfer participants have sufficiently acquired skills for combining or selecting the existing tools and procedures as required and therefore have a high competency. Another difference of Level 3 from 2 is that the persons need to have basic knowledge of programming and databases. Since programming skills were not included in the technology transfer items, sufficient learning and practice of them are to be covered in the future. Since the knowledge on databases was covered in the technology transfer as practices on database design and introductory lectures on ArcIMS/ArcSDE, the technology transfer participants have understood the general theories of databases.

2) Problems

The problems 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 problems need to be maintained and reserved.

(4) Production of printed maps

The "production of printed maps" in the current Study included technology transfer for producing printing data and production of data.

1) Present status

a. Present status of equipment

In the technology transfer, the following equipment was used:

- PC: Macintosh G5, 2 units
- Scanner: A3 flat scanner, 1 unit
- Software: Adobe Illustrator CS, Adobe Photoshop, 2 sets each

The above equipment was handed over to SAGW when the Study project is completed. Up to the time of handover, the servicing and maintenance of the equipment was properly conducted.

b. Present status of technical capabilities

At the time of completion of the technology transfer, the three technology transfer 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 (creating symbols and patterns, manipulating line width, moving objects, and registering to library)
- ♦ 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) Problems

At the time of completion of the Study, SAGW successfully completed printing data for 7 sheets that it produced in its own charge. Now that the Study was completed, however, the following problems are expected in the future.

a. Equipment

At the time of completion of the Study, all the equipment is running without problems. The maintenance of this equipment is required in order to ensure proper operation of the equipment in the future. At present, there is no plan whatsoever for servicing of the equipment, maintenance of the software, and supply of consumable parts, which is a problem in appropriate management of the equipment in the future.

Additionally, no consideration is yet given to what to do if an enhancement of the production capacity (increase of the number of equipment) is required, this is another problem.

b. Technical capabilities

The production of printing data for seven sheets by SAGW took a long time but contained no technical problem. However, the current technical capabilities of SAGW have the following potential problems:

- ♦ Maintaining the acquired skills

  The acquired skills for producing printing data consists of some individual skills. For proper maintenance of these skills, an organized course of action (e.g., periodical training and actual operations as appropriate intervals) is indispensable

but, at present, there is no such plan.

- ♦ Propagating the acquired skills

  At present, three technology transfer trainees have skills for producing printing data. In view of enhancement in production capacity and change of generations of engineers, propagation of the acquired skills to other staff members is indispensable. However, there is no plan for propagating the skills.

- ♦ Sophisticating the acquired skills

  The skills transferred in the technology transfer are only routine ones for completing an assignment without fail and not skills devised in consideration of applications and productivity.

- ♦ Quality and process control

  In the Study, the quality control on printing data was conducted through visual inspection of plotter output maps and recheck against the content of map symbol specifications. The process control was conducted by the person in charge of technology transfer on their behalf.

If there is no printing office in Macedonia, the inspection of printing data on film outputs will be difficult, causing a problem in quality control. The process control on production of printing data is likely to be made light of because there is no department dedicated to it.

3.1.3 Dissemination of Geographic Information

In the Study, the Study Team and SAGW conducted a wide range of public relations and advertisements as well as promotion and survey in order to improve the recognition and understanding of SAGW and geographic information on the part of the Macedonian people, companies, etc.

(1) Present status of dissemination of geographic information

1) Overview of geographic information

a. Status of establishment of geographic information

SAGW has been establishing various geographic information from the past to the present. The geographic information that has been established includes the following topographic maps, aerial photographs, and national control points (triangulation points and bench marks).

- ♦ Topographic maps: Printed maps with scales of 1/5,000, 1/10,000, 1/25,000, 1/50,000, 1/100,000, 1/200,000, 1/300,000, 1/500,000, and 1/1,000,000.

- ♦ Aerial photographs: Color and monochrome aerial photographs with various scales.
- ♦ National reference points: Coordinate values, heights, sketches, etc.

2) Dissemination of geographic information

SAGW, having jurisdiction over geographic information, is conducting dissemination activities only at a low level.

a. Dissemination in government organizations

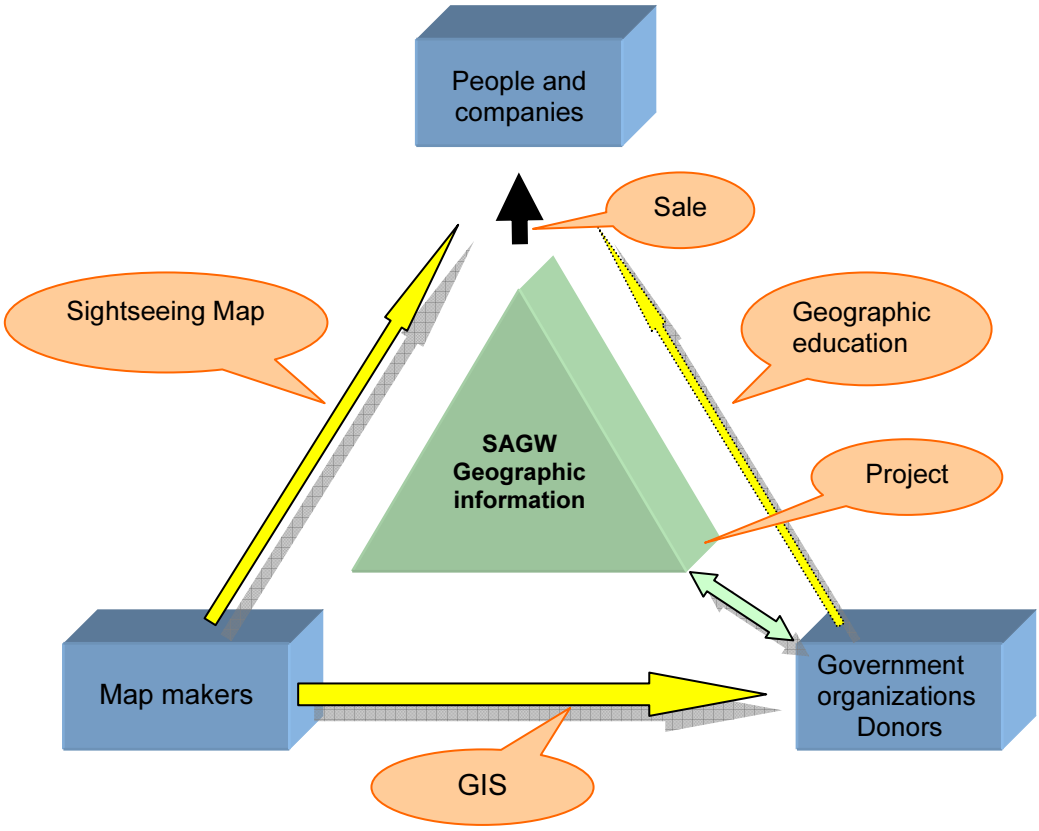
Geographic information is scarcely in use at the government ministries and agencies and local authorities partly due to the sluggish dissemination activities by SAGW.

b. Dissemination in private sector

In Macedonia, road maps and sightseeing maps are made and sold by private companies. However, these maps are not based on topographic maps supplied by SAGW but are made by these companies on their own. Since surveying is monopolized by SAGW, there is neither private surveying agent nor demand for information such as national control points.

Due to these circumstances, geographic information such as topographic maps and national control points is scarcely in use in the private sector in any way.

The following shows the distribution status of geographic information in Macedonia. The thicker the arrow shows the stronger the relationship between the two organizations connected by it.



3) Geographic information education

The primary and secondary education incorporates geographic information (geography) education in their social studies and geography subjects. However, educational materials indispensable to learning such as globes and maps are either insufficient or damaged, causing problems in lessons. Students are not being given any lesson using maps of their home town or any lesson for improving the skill of reading maps.

4) Public relations and advertisements for geographic information

a. Public relations for 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. Thus, SAGW is not publishing any periodicals or technical journals, either. SAGW is not disclosing its annual action plan or report to the outside. 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 studies under way. This site is updated at irregular intervals.

b. Advertisements for geographic information

As described earlier, SAGW supplies various geographic information. However, almost no advertisements are made about this supply of information. For example, SAGW has not issued any index map or price list to be used for sale of topographic maps. No pamphlet for advertisement of SAGW is issued, either.

(2) Problems in dissemination of geographic information

1) Problems in establishment of geographic information

The establishment and credibility of geographic information are exceedingly important elements in promoting dissemination such as the use of geographic information.

a. Problems in establishment of geographic information

Most of the geographic information (topographic maps) owned by SAGW was established in the 1950s to 1970s. This geographic information was scarcely updated after establishment, resulting in disparities between the contained information and the current state of affairs in many cases and damaging its credibility.

b. Problems related to establishment of geographic information

The archives section of SAGW has cadastral maps, geographic maps, and aerial photographs since 1900 stored in good order. However, no ledger has been made to manage the archives and it is unknown how each of the geographic information is currently stored.

Additionally, the establishment status (type, target area, and date of update) and acquisition method (procedure, price, and place of acquisition) of geographic information are not disclosed, either.

2) Problems in dissemination of geographic information

The geographic information owned by SAGW is scarcely appreciated by the government ministries and agencies and local authorities. This is because of insufficient public relations to the concerned organizations and obsolescence of geographic information.

The dissemination (supply) of geographic information to the private sector does not have a legal framework yet. No method of supply has been established, either.

3) Problems in geographic information education

As described for the present status, there are not sufficient educational materials such as topographic maps in the classes of geometry. Concerning this matter, SAGW is not

providing any free-of-charge supply of educational materials nor support to geography education. This means non-cooperation to geography education, which will contribute even partly to the dissemination of geographic information.

4) Problems in public relations and advertisements of geographic information

a. Problems in public relations

SAGW does not understand the importance of allowing the society in general to recognize its activities conducted on the national budget. One example of this lack of understanding is that the organization is not making positive efforts to disclose the information on the establishment status of geographic information and the annual activities. A Web site of SAGW is available but contains only fragmentary and obsolete information. This is because SAGW does not recognize the effectiveness of public relations on the Web site.

b. Problems in advertisements

SAGW, owning various geographic information produced on a national budget, is obliged to pursue effective use of this information. At present, however, it has not published even a pamphlet that contains information such as available geographic information, prices, and supply methods. It has not reported its activities to taxpayers, either.

3.1.4 Services

SAGW, as a national organization, conducts operations related to the establishment of geographic information on a national budget. This includes geographic information service for the concerned government ministries and agencies, local authorities, private sector, and general citizens.

(1) Present status

SAGW conducts activities in the establishment of geographic information such as topographic maps and the cadastral field related to land registration. In the cadastral field, the organization provides service to the public and private sectors in relation to land registration, etc.

On the other hand, geographic information such as topographic maps was handled as state secrets and placed under the control of military authorities in the days of the Federal Republic of Yugoslavia. Consequently, it was difficult for people other than specific government officials to obtain and use the information without restraint. After Macedonia separated itself from the Federal Republic of Yugoslavia, geographic information was placed under the jurisdiction of

SAGW.

1) Targets of geographic information services

At present, SAGW handles geographic information services on the following targets:

- ♦ Topographic maps (printed maps) with various scales
- ♦ Aerial photographs
- ♦ Information about national control points (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 the public including general citizens if they carry out a predetermined procedure and pay a price for them. However, the annual sales quantity is minimal. Aerial photographs are not virtually 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, the only service actually supplied, is implemented 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: As listed below.

Scale of topographic maps	Unit price (euro)
1/5,000	100
1/10,000	48
1/25,000	144
1/50,000	144
1/100,000	144
1/200,000	144
1/300,000	105
1/500,000	105
1/1,000,000	105

(2) Problems

In view of the present status described above, there are the following problems in the geographic information service:

a. Location of sale

As described previously, there is only one location of sale, the SAGW headquarters. Furthermore, SAGW has no department in charge of sale nor window for users such as a sales counter. In the headquarters building, there is no direction board for the facility and visitors do not know where geographic information is sold.

b. Procedure of purchase

A statement of reason and a signature of the SAGW director are required to purchase topographic maps. Additionally, the price for them must be paid at a post office, requiring a complex procedure. Users cannot receive their purchases on the spot but need to wait for a few days to about one week, from application to delivery.

c. Selling prices of topographic maps

The topographic maps managed by SAGW have the selling prices listed in the above. Since the topographic maps are abnormally expensive in comparison with the starting salary of university-educated government personnel in Macedonia, which is 255 euros, they cannot normally be purchased in view of the income level of citizens. The selling prices are also abnormally higher than those of topographic maps in neighboring countries.

d. Years of production of topographic maps

The topographic maps were produced in the 1940s to 1970s, with even the newest one more than 30 years old. Therefore, all the topographic maps are subject to significant secular changes and no structures such as new roads are added or corrected, resulting in disparities with the current state of affairs.

3.1.5 Cooperation in Organization

As the SAGW operations makes possible through cooperation of more than one department, the cooperation in the organization is an exceedingly important element. This Study was implemented mainly through cooperative work with engineers in the geodesy and photogrammetry departments. Through this cooperative work, the present status of cooperation among organizations that took charge of their respective assignments was discovered.

(1) Present status

During the establishment of national base maps and the construction of spatial data infrastructures, the engineers who took charge of their respective assignments cooperated with each other as follows:

1) Cooperation in land survey

Land survey completed setting of monuments and aerial photo signals, control points survey, field identification, and supplementary field identification were completed.

a. Setting of monuments and aerial photo signals

We consulted about the forms and sizes of aerial photo signals to be set with the persons in charge of the downstream process of photogrammetry and set them in the planned setting positions. Monuments were installed after obtaining permissions via the SAGW staff.

Aerial photographs were taken based on the discussions between the aerial photo signals setting group and the photographing crew.

The discussions for this operation were smoothly conducted.

b. Photo control points survey

Photo control point survey can be conducted basically independently from other organizations. However, the outputs, which are to be used in the downstream process, must be in a format agreed upon with the persons in charge of the downstream process. Since there were certain criteria for the format, the outputs were smoothly delivered to them.

c. Field identification and supplementary field identification

The field identification and supplementary field identification in this Study was conducted based on the newly determined product specification for spatial data infrastructures. Specifically, the map representation specifications in the product specification were used.

Since the product specification produced mainly by the photogrammetry department involved introduction of new concepts, the product specification and the map representation specification had to be corrected several times. Consequently, discussions were held between the photogrammetry department and the persons in charge of field identification and supplementary field identification who were influenced every time a correction was a made. Still, the map representation specification as a documents contained differences between the two parties and, therefore, instructions for corrections were given to them by word of mouth.

2) Cooperation between land survey and photogrammetry

The photogrammetry department mainly conducted such operations as aerial triangulation and plotting and compilation, which were conducted based on the results of photo control points survey, field identification, etc.

a. Aerial triangulation

Although aerial triangulation was conducted based on the results of photo control point survey, the outputs were delivered from one party to the other.

b. Plotting and compilation

For this operation, too, the results of field identification and supplementary field identification were delivered as attachments from one party to the other. The questions raised in plotting and compilation were delivered as reference to the engineers of supplementary field identification.

3) Cooperation between photogrammetry and printing data production

The data produced by the photogrammetry department based on the product specification was remade into printing data.

a. Printing data production

The photogrammetry department produced data based on the product specification, converted it to the Illustrator file format, and delivered it to the printing data production department. However, the printing data production department found problems during the processing operation. The two departments held a meeting to eliminate inconsistencies of data in order to solve the problem.

4) Sharing of software programs and skills for using them

The geodetic department (Sector for Referent Networks and Special Geodetic Works) and the cadastral information system department (Sector for Cadastral Information System) independently use, maintain, and manage the GIS software (ArcInfo) owned by each of the departments. The software is used, maintained, and managed by the two departments in an uncooperative way and not strategically shared or utilized by SAGW as one organization.

Technology transfer was conducted concerning editing of topographical map data using TNTmips (GIS software) and construction of thematic databases using ArcGIS (GIS software) independently. Although these two software programs and the skills for using

them have a strong correlation, the participants of the two technology transfer do not share the acquired skills and know-how.

Although the skills for the two software programs acquired through technology transfer can be used as GIS skills assumed to be necessary in the cadastral information system department (Sector for Cadastral Information System), there is no system or opportunity to transfer skills to each other between different departments or engineers.

(2) Problems

In view of the present status described above, there are the following possible problems:

1) Cooperation in land survey

a. Setting of monuments and aerial photo signals and photo control point survey

Setting of monuments and aerial photo signals and photo control point survey were smoothly conducted in a cooperative way due to the past experiences of the departments concerned. However, there is no guarantee that the operation will be conducted smoothly in the future. Therefore, it is a problem that there is no system for providing opportunities to have discussions, etc. between the cooperating departments.

b. Field identification and supplementary field identification

When the product specification or the map representation specification is revised, the information of revision is known only to people involved in the product specification or map representation specification and not shared with people involved in operations to which they are actually applied. Furthermore, there is no system to ensure the sharing of information, either.

It is also a problem that the application rules for map symbols have not been sufficiently discussed between the two parties nor put into writing.

2) Cooperation between land survey and photogrammetry

a. Aerial triangulation

Problems often occur between the results of photo control point survey and aerial triangulation. At present, SAGW has no system to deal with these problems, failing to ensure smooth solutions for them.

b. Plotting and compilation

There are only insufficient means for the engineers in the two departments to properly

recognize questions arising in plotting and compilation or results of field identification and supplementary field identification, resulting in insufficient quality control of these operations.

3) Cooperation between photogrammetry and printing data production

a. Printing data production

In this Study, the two departments discussed with each other and solved problems after they arose. To ensure smooth operations, however, it is necessary to have discussions and experiments before problems occur. The engineers in the two departments are not positive enough to do so.

4) Sharing of software and skills for using them

The recent software including GIS and skills for using them are aimed at versatility. The introduction of software and acquisition of skills for using them, therefore, must be strategically considered for their scope of application. The current two departments using software, however, do not have such a way of thinking but think only of the application of software in each of the departments. Furthermore, the higher-level departments that have control over the two departments do not have such a way of thinking, either, resulting in the lack of propagation of skills or sharing of software.

3.1.6 Cooperation with Other Organizations

SAGW cooperates with donors (national governments and international organizations) and other government organizations in Macedonia. The cooperative relationships discovered in this Study are described below.

(1) Cooperation between SAGW and donors

1) Present status

In Macedonia with a high education level and a high human resources potential, the only concern was the political situations and security matters. With these situations stabilized in the recent years, however, Macedonia is beginning to establish various cooperative relationships with donors and international organizations in the world as a good target country for assistance. At present, SAGW is simultaneously carrying out the following four projects in cooperation with international organizations and donors in order to maximize the effects of assistance on the whole while avoiding overlapping of assistance in each of them.

Cooperating organization	Project name	Period
Japan International Cooperation Agency (JICA)	THE STUDY FOR ESTABLISHMENT OF STATE BASE MAPS FOR GIS IN THE REPUBLIC OF MACEDONIA	2004-2006
Swedish International Development Agency (SIDA)	TECHNICAL ASSISTANCE TO SUPPORT CAPACITY BUILDING AT SAGW IN MACEDONIA	2005-2008
World Bank (WB)	THE REAL ESTATE CADASTRE AND REGISTRATION PROJECT	2005–2011
Dutch government	THE REAL ESTATE CADASTRE AND REGISTRATION PROJECT - Pilot Project Kumanovo	2005-2006

For cooperation with these donors, SAGW assigned a responsible official and members to each of the projects to carry out operations. Members other than a responsible official are not limited to the staff of the department to which the official belongs but persons in other departments who seem to be the most appropriate for the work are assigned. This fact was observed also in our experience in cooperation with SAGW in this Study.

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 government organizations

1) Present status

At the beginning of this Study, we gave questionnaire on the current cooperation with SAGW and uses of maps as well as the related organizations briefing on the project. The following describes the summary of the result.

		Agency of Educational Development	Faculty of Engineering, Ss. Cyril and Methodius University	Faculty of Agriculture, Ss. Cyril and Methodius University	Ministry of Defence	Ministry of Environment and Physical Planning	Utility Corporation of Space and Urban Planning
Q1	Do you use geographic information?	No	Yes	Yes	Yes	Yes	Yes
Q2	Do you cooperate with	No	Yes	Rarely	Yes	No	Yes

	SAGW?						
Q3	Do you consider it necessary to cooperate with SAGW?	Yes	Yes	Yes	Yes	Yes	Yes

All the related organizations that answered the questionnaire, including organizations already cooperating with SAGA, admitted that they felt the necessity to cooperate with SAGW in response to Question 3. Specifically, the following answers were given. In sum, it was discovered that technical guidance on the thematic use of geographic information, supply of topographic maps, and update of topographic maps were in demand.

- probably can cooperate in the field of mapping and also creation of school location network
- already involved in the same projects such as development of remote control and management system for dynamic objects
- for cooperation in the establishment of the land management system
- a need of maps - plans in printed and digital format
- sharing information, both cadastral and topographic
- a need for updated spatial data
- a need for topographic maps in all scales, color printed maps

Afterwards, conventional information gathering was conducted on the government organizations during the construction of GIS database for environmental conservation in Lake Ohrid. At this time, it was discovered that various organizations constructed GIS data and maps related to environmental conservation in similar approaches but that there is no system to share the acquired data and that the owners of the data tended to keep it to themselves.

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 to 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 invests their resources on production of similar data in a duplicated way.

3.2 Tasks

3.2.1 Maintenance of Survey Results

Man Tangible (printed topographic maps, all kinds of databases etc) and intangible (various transferred technology etc) 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.

Many of the tasks mentioned in 3.2.2 are closely related to the results of the study work. The realization of the tasks based on the results of the study work will provide a stable background for the maintenance and development of these results. Based on this stable background, the implementation of the priority project mentioned in chapter 4 will specifically maintain the results of the study work and concurrently lead to a contribution in its development (effectiveness and utilization).

3.2.2 Establishment of National Base Maps and Spatial Data Infrastructure

The following tasks can be expected for smooth establishment and maintenance/update of national base maps and spatial data infrastructures.

(1) Tasks

1) National base maps

In view of the problems described above, the following tasks can be expected.

a. Unproduced range

The unproduced range constitutes 100 sheets. Concerning this present status, SAGW declared in a forum that the establishment of geographic information for these 100 sheets will be completed in the coming three years. In view of this fact, SAGW has a task of establishing geographic information for the 100 sheets in the unproduced range in three years.

b. Storage and management of national base maps

It is also important to properly store the produced national base maps and promptly supply them on demand. It is necessary to consider appropriate storage facilities (complete with air-conditioning equipment) and management methods (for systematic management). There is also a task of securing budget required for this operation.

Printed national base maps to be stored and managed should be considered also as

merchandises. As one of the means for improving the commercial values of them, in terms of a folder of printed maps or packaging in a vinyl case should be considered.

c. Quantity of inventory

The production of national base maps means, for general users, that such maps are permanently in stock and available to them. In view of this point, SAGW has a task of having expert knowledge about printing and being able to conduct additional printing smoothly. Furthermore, accurate demand forecast is also important in properly maintaining the inventory level.

d. Specification of national base maps

A different specification than the one for conventional national base maps have been adopted. To ensure proper use of the new national base maps, it is necessary to disclose the specification to the general public. SAGW has a task of publishing a booklet that explains how to use and read the national base maps and supply of the same information on the Web, etc.

2) Spatial data infrastructure

a. Product specification

A product specification should be disclosed for the sake of effective use of data. The product specification for spatial data infrastructures should be disclosed as public documentation as, for example, supplementary provisions to the Survey Law. It would be ideal to disclose it in a geographic information clearing house but it is more realistic, at present, to disclose it on the Web site of SAGW.

The product specification for spatial data infrastructures pursues at present both utilization of data and printed topographic maps. On the other hand, the worth of a product is always backed by users. Consequently, the more the users' demands are met, the more the product will be used. In view of this point, the product specification should be aimed at reflecting and meeting more user demands.

b. Data update methods

When spatial data infrastructures are used on GIS, etc. the newness of data is more important than when they are used on paper maps. In view of such a background, there are the following tasks:

- Setting of update cycles

  Generally, topographic maps are updated at 3-year to 5-year intervals in urban areas. If data is used on GIS, etc., however, it is ideal to update the data more

often in urban areas. Note also that the data users do not necessarily want all the elements to be up to date. While user's update demands should be gradually complied with in the product specification, appropriate update cycles should be set for each of the acquired items.

- ♦ Use of various data sources

  Update using aerial photographs and high-resolution satellite images are an operation with exceedingly large budgets. These techniques are indispensable for updating all the data items and SAGW has a task of securing budgets for them. On the other hand, update of each of the acquired items described above requires effective use of data sources such as existing data and field identification including other simple survey methods in view of costs, instead of using aerial photographs and high-resolution satellite images.

- ♦ Consideration of low-cost and simple update methods

  The selection of an update method has a great influence on the costs. Since update using strict photogrammetry requires high costs, a simple data update method with relaxed update items and required accuracies should be considered. If the scope is limited to 1/25,000 spatial data infrastructure, digitization of orthophoto images can be completed at half the update costs (by excluding aerial photography) and work period while meeting the accuracy requirements.

3.2.3 Technical Capabilities

(1) Land survey

1) Tasks

In view of the present status and problems in land survey skills described in Section 3.1.2, SAGW has the following tasks:

a. GPS photo control point survey

SAGW has no problem or task in conducting GPS survey using the existing equipment. From the viewpoint of comprehensive training of GPS engineers (for making changes in a geodetic reference system), however, it has a task of mastering theories of GPS survey.

Since GPS survey equipment is advancing rapidly, SAGW has tasks in this field of establishing update plans for equipment and securing budgets required for this purpose.

b. Leveling using digital levels

An actual operation of leveling using digital levels has not been conducted yet. SAGW has a task of promptly conducting this as an actual operation. Through the

experience in conducting the actual operation, SAGW engineers also have a task of accelerating the leveling using digital levels.

c. Field identification using aerial photographs

The representations of topographic maps to be created must be uniform between the maps. In this sense, SAGW has tasks of deepening the understanding of survey items and acquisition criteria and maintaining the uniformity in field identification results. To produce topographic maps with changed scales, SAGW also has tasks of understanding the survey items, interpreting the selection criteria in an unified way, and homogenizing the results of aerial photograph interpretation.

d. Supplementary field identification

The technical tasks for supplementary field identification are the same as those for field identification using aerial photographs.

In addition to the specific problems described in the above for technical fields a through d, there is also a common problem to them, which is the revision of manuals. When SAGW completes the tasks in the actual operation to be implemented in the future, the know-how that they will acquire should be reflected in the existing manual.

Another task for SAGW from the viewpoint of maximizing the technical potential is to propagate the acquired skills generally to the SAGW staff, instead of limiting them to the technology transfer trainees. That is, when a skill is used for an actual operation, a person(s) inexperienced in the skill must be added to the staff so that the skill can be propagated on an on-the-job basis.

(2) Digital photogrammetry

Through technology transfer of digital photogrammetry, high-level skills for establishing spatial data infrastructures and national base maps were transferred. In the future, SAGW is expected to accomplish the following tasks:

1) Tasks

a. Equipment

Spatial data infrastructures were established in this Study. This establishment was made using the latest hardware and software. This equipment can be used in the future establishment of spatial data infrastructures. On the other hand, the digital data to be established is expected to be in advanced formats including attributes and phase structures.

TNTmips software in the introduced compilation system has functionality as a CAD system and, being able to readily meet the future sophistication of digital data, is expected

to replace Microstation, which SAGW mainly uses as the current compilation software. In view of this point, the update of compilation systems is an important task.

Note that it is technically possible to use the digital photogrammetry system in combination with analytic plotting equipment. Therefore, we hope that the engineers learn the skills for using on the analytical plotter the aerial triangulation outputs obtained on the digital photogrammetry system.

b. Technology propagation

Through technology transfer of digital photogrammetry, five or six participants mostly mastered the skills. The number of participants was not sufficient in view of the total number of equipment. At least about 10 engineers in this field are required to operate the two digital photogrammetry systems and three compilation systems in a two-shift operation. To secure that many engineers, it is necessary to conduct technology propagation of the concerned skills. If this is done, the skill level of engineers can be upgraded from CAD-based compilation of graphics to compilation of GIS data with advanced structures.

c. Application of acquired skills to other operations

The use of orthophotos in the cadastral operation has a potential of drastically improving the efficiency of this operation. We hope that the specifications and work procedures of orthophotos will be standardized in accordance with the cadastral operation.

d. Acquisition of IT skills such as programming

It is expected that, as the specifications of digital data products get more sophisticated, IT skills higher than at present will be required more often in the regular operations. For example, designing of specifications for databases and conversion of data into a required format will be required.

To raise the level of practical programming skills of engineers in the concerned departments, SAGW should actively plan and supply on-the-job training type of operations such as program coding.

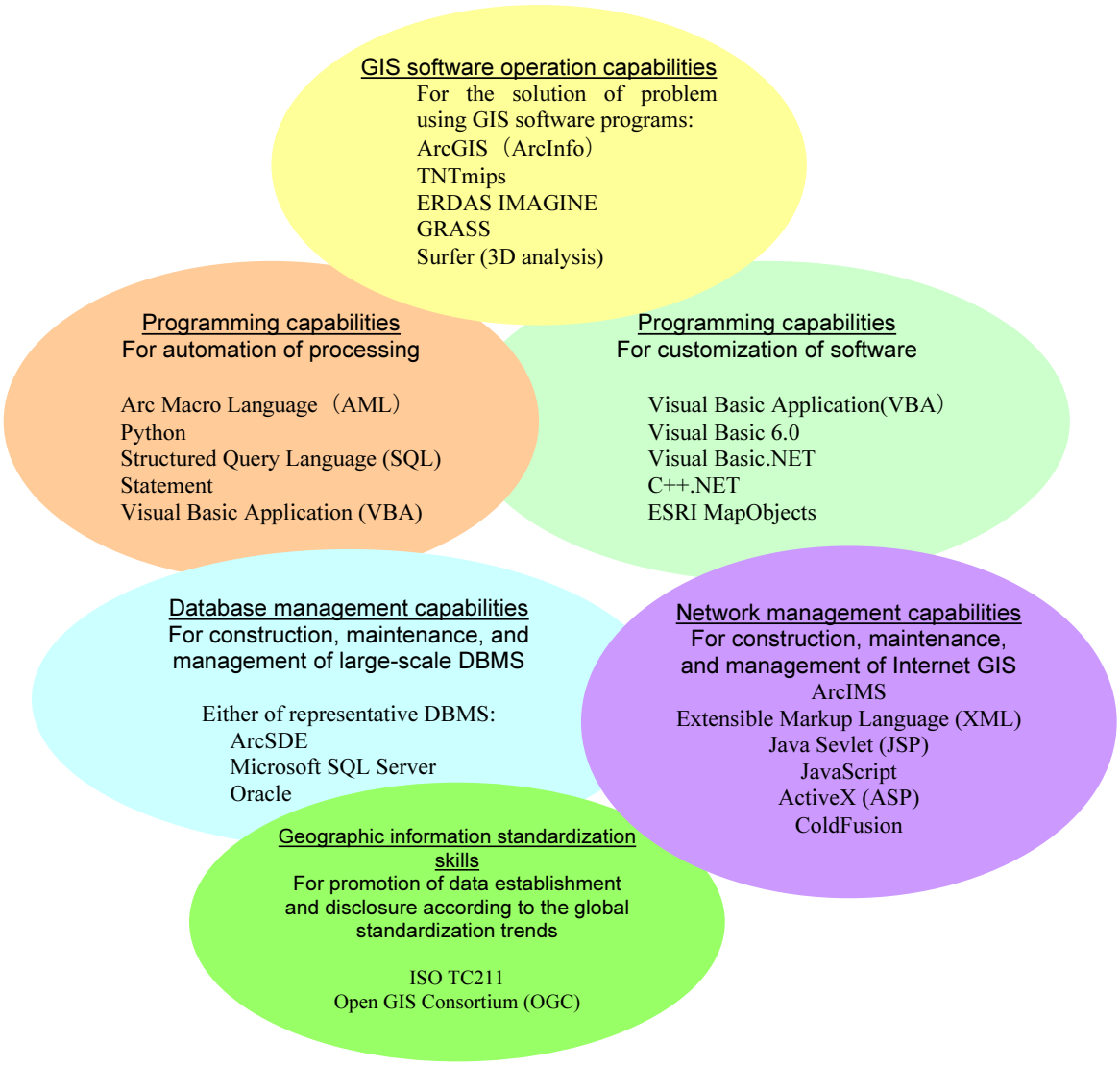
(3) GIS

Concerning the problems derived from the present status summarized in Section 3.1.2, SAGW is required to complete the following tasks:

1) Improvement of the technical level

The GIS technical level of training participants was evaluated as being about to reach Level 3 of the Professor Marble's model of 6 levels. To maintain and brush up their level,

SAGW need to focus on the following technical items. A person who has more than one specialized knowledge and its work experiences in the specialized field of GIS will be able to serve as a very powerful GIS engineer. A person who has one specialized skill among them can be a specialized GIS engineer (GIS database manager, GIS network manager, GIS customization manager, 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. The following describes job opportunities that contribute to the actual operations of SAGW and the improvement of GIS skills, as well as technical capabilities expected to be improved.

a. Production of metadata

Meta data shall be produced concerning the spatial data infrastructure constructed in

this Study and various spatial data already owned by SAGW. In the future, constructing a clearing house can improve the openness of spatial data.

→ Enhancement of geographic information standardization technology

b. Construction of WebGIS

Since SAGW is required to actively pursue the supply of geographic information, it can greatly contribute to the dissemination of geographic information by constructing a system that delivers geographic information via the Internet. This is considered to be a high-priority task so that various data, the outcome of this Study, can be efficiently delivered to the users.

→ Enhancement of database management capabilities

→ Enhancement of network management capabilities

c. Improvement of cadastral information system

SAGW has already established a processing cycle for acquisition, maintenance, and update of cadastral data. In this cycle, the GIS functions are used as tools for graphic and attribute error check. However, cutting-edge functions are not taken advantage of because old-version GIS software is currently in use. Cutting-edge functions shall be installed to reconstruct a more efficient and simple processing cycle.

→ 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. However, it takes time to conduct the tasks in phases. Meanwhile, the minimum essential equipment must continue to be maintained. If there emerges simpler and lower-priced equipment with equivalent specifications in terms of technical and financial aspects, SAGW shall respond flexibly to the situation and secure such equipment as required.

(4) Production of printed maps

Some problems were pointed out in "Present status and Problems" for printing data production skills. SAGW has a task of solving these problems based on the current situation.

1) Tasks

a. Equipment

The provided equipment need to be maintained and constantly kept in an operable

status. Maintenance and upgrading is indispensable for software equipment.

A minimum stock of consumable supplies should be secured.

It is a basic task for SAGW to secure budgets in its annual budget plan for the items described above, i.e., the maintenance of equipment, maintenance and upgrading of software, and securing of a stock of consumable supplies, in order to maintain and develop the technical capabilities for producing printing data.

It is also an important task for SAGW to secure budgets for replacement of hardware equipment in consideration of useful life.

Furthermore, SAGW also need to conduct a task of increasing budgets to obtain additional equipment and securing its installation space at a given point in time in view of enhancing the production capacity.

b. Technical capabilities

In view of the aforementioned problems in technical capabilities for producing printing data, SAGW has the following tasks:

- Maintaining the acquired skills

  The acquired skills will soon be lost unless they are continuously used. To prevent this problem, SAGW has a task of planning periodical training and actual operations that require these skills.

- Propagating the acquired skills

  Only three technological transfer trainees have acquired the skills for producing printing data. In view of retirement of trainees, change of generations of engineers, and enhancement in production capacity, SAGW has an important task of planning and implementing propagation of these skills to other engineers of SAGW.

- Sophisticating the acquired skills

  In technology transfer, routine skills for producing printing data were transferred. From the viewpoint of cost reduction and enhancement in production capacity, SAGW has a task of carrying out autonomous technical examination and development activities in order to improve the current skills into rational and sophisticated ones.

- Quality control

  SAGW has quality control-related tasks such as dispatch of an inspector to inspect printing data on film outputs if a topographic map cannot be printed in Macedonia. SAGW also has process control-related tasks such as appointment of special managers.

3.2.4 Dissemination of Geographic Information

As described in section 3.1.3, SAGW has several problems in dissemination of geographic information.

(1) Tasks concerning dissemination of geographic information

1) Tasks concerning establishment of geographic information

SAGW has tasks concerning the establishment of geographic information itself on which the dissemination of geographic information is premised.

a. Tasks concerning establishment

From the viewpoint of dissemination of geographic information, SAGW has tasks of establishing the following items:

- ♦ Update of established geographic information (e.g., update of old topographic maps)
- ♦ Establishment of geographic information not yet established (e.g., establishment of large-scale maps and orthophoto maps)
- ♦ Establishment of digital data from analog data (e.g., establishment of digital topographic maps and orthophoto maps)

b. Tasks related to establishment

SAGW has the following tasks related to establishment:

- ♦ Systematically organizing geographic information currently organized on shelves, etc.
- ♦ Digitalizing and organizing geographic information (including production of meta data)
- ♦ Standardizing digital geographic information
- ♦ Constructing a clearing house to disclose the details of digital information

2) Tasks concerning dissemination of geographic information

A council for effective use of geographic information among the concerned government ministries and agencies shall be established, being aimed at effective use of geographic information in the government. SAGW shall take the initiative in this council in an effort to share and disseminate geographic information.

Furthermore, the legal system shall be revised to allow SAGW to supply geographic information to the private sector. At the same time, legal changes shall be made to ensure the protection of copyrights.

3) Tasks concerning geographic information education

SAGW, having abundant geographic information, has a task of providing the primary and secondary education institutions with full support for geography education. Possible specific actions include supply of educational materials and dispatch of instructors to lessons on reading maps, etc.

Regarding universities and research organizations, SAGW has a task of delivering lectures on surveying and conducting joint research.

4) Tasks concerning public relations and advertisements of geographic information

a. Tasks concerning public relations

SAGW shall establish a public relations department, which shall play a major role in conducting public relations activities. Possible specific activities shall include the following:

- ♦ Operating a Web site with abundant contents
- ♦ Introducing SAGW and issuing PR periodicals covering activity plans and reports
- ♦ Conducting a survey on demands for SAGW and geographic information

b. Tasks concerning advertisements

SAGW shall conduct advertisement activities to improve public recognition of the organization. Possible specific activities shall include the following:

- ♦ Holding various public events (map contests, tours in SAGW offices, etc.)
- ♦ Publishing books related to geographic information
- ♦ Publishing technical information journals
- ♦ Hosting international conferences
- ♦ Lending equipment to public organizations

3.2.5 Services

Concerning geographic information services, SAGW has problems described in Section 3.1.4. As the only geographic information organization in Macedonia, SAGW has to deal with these problems to improve the geographic information services.

(1) Tasks

As described in Section 3.1.4, SAGW has problems in geographic information services. SAGW has a task of solving these problems.

a. Location of sale

To improve the services, SAGW should expand the locations of sale to its local branch offices, general bookstores, etc. in addition to the SAGW headquarters. Furthermore, direction boards or other means should be provided to guide purchasers to the window of sale at the current and additional locations of sale.

Currently, those who want to purchase geographic information must visit the location of sale. However, it is high time that a system of correspondence sale such as online shopping, teleshopping, and mail-order should be established. This is also a task that SAGW must accomplish.

b. Procedure of purchase

The current complex procedure of purchase is due to restriction of the legal system. The legal system concerning the disclosure and purchase of geographic information should be amended to allow anyone to purchase it easily without permissions. It is also important to establish a system under which fees can be paid and purchases can be received on the spot.

c. Selling prices of topographic maps

As is obvious in the prices of topographic maps, the selling prices of geographic information are far apart from the income level of Macedonia. SAGW shall establish sales policies and revise the prices (to low cost) so that geographic information will be widely used. If required, the legal system shall be amended accordingly.

d. Years of production of topographic maps

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

e. Development of new products

At present, the merchandises available from SAGW are limited to printed topographic maps. From the viewpoint of improvement of services, however, SAGW should develop a wide range of geographic information merchandises. Possible merchandises are, for example, orthophoto maps and aerial photographs. It should be considered that these merchandises need not be limited to conventional concepts but can be made of new materials.

"For Your Information"

In a forum held on November 16, 2005, SAGW made public commitments about the following decisions:

- ♦ The following data produced in the JICA Study shall be sold to the public starting October 1, 2006:
  - ・ Printed maps and digital data of topographic maps
  - ・ Aerial photograph data for the entire national land
  - ・ Orthophoto image data covering 55% of the national land
  - ・ GIS data for environmental protection of Lake Ohrid
- ♦ Topographic maps (1/25,000) covering the entire national land shall be produced by December 31, 2008.
- ♦ Starting October 1, 2006, the merchandises shall be sold at the following prices:
  - ・ Topographic maps (printed maps) 3 to 8 euros
  - ・ Topographic maps (digital data) 10 to 15 euros
  - ・ Orthophoto images 15 to 20 euros
  - ・ Aerial photo images 3 to 8 euros
- ♦ A statement of reason for purchase and a signature of the SAGW director, currently required for application, shall be abolished. Payment of prices for them at a post office shall be discontinued.
- ♦ Customers shall be able to purchase geographic information at locations of sale within 10 minutes.
- ♦ A map store shall be opened in the SAGW headquarters. Maps shall be available also at bookstores and/or kiosks.
- ♦ Online orders shall be received on a Web site.

3.2.6 Cooperation in Organization

The tasks for enhancing the cooperation in the SAGW organization for improved efficiency and sophistication can be considered as follows:

(1) Tasks

1) Cooperation in land survey

a. Setting of monuments and aerial photo signals and photo control points survey

Whereas the operations for setting of monuments and aerial photo signals and photo control point survey are conducted through daily cooperation between the persons in charge, SAGW has a task of setting up the place of cooperation as a system. As for aerial

photography currently outsourced, the results should be communicated as daily reports. SAGW also has a task of establishing such institutionalized daily reports.

b. Field identification and supplementary field identification

Technical tasks related to both the photogrammetry and land survey departments, e.g., establishment of a product specification and a map representation specification can be accomplished only through systematic, close cooperation between the two parties. In view of this point, personal efforts of persons in charge should not be counted on but the results should be attained through institutionalized cooperation between the organizations. In this sense, SAGW has a task of establishing this system.

2) Cooperation between land survey and photogrammetry

a. Aerial triangulation and plotting and compilation

The departments involved in photo control point survey, aerial triangulation, plotting and compilation have a task of enhancing their cooperation such as establishing a system for discussing and solving problems arising in the procedures of delivering outputs and the cooperation among the departments.

b. Communications

Since field engineers often work entirely out of their offices, it is highly likely that they cannot be easily got in touch with when necessary. In this case, e-mail can be used to attain necessary communications. At present, however, SAGW does not basically permit its staff to use the Internet for work. It can be easily guessed that, as the software and system to be used become more and more sophisticated in the future, search for information and download of data from the Internet as well as communications via e-mail will be increasingly more necessary. It is high time that SAGW considers how it should grant access rights to e-mail and the Internet to all the staff as far as their work is concerned.

3) Cooperation between photogrammetry and printing data production

a. Printing data production

The photogrammetry and printing data production departments should be ready for troubleshooting about data at all times. For this purpose, both the departments have a task of understanding the structures of databases and the contents of printing data and identifying the items necessary for conversion of printing data.

In the future, both the departments also have a task of deepening the operation experiences to learn operation methods with less workload and ensure smooth exchange of

data.

4) Sharing of software programs and skills for using them

SAGW owns GIS software programs acquired through supply from donors or purchase on its own budget. SAGW needs to identify these programs as the assets of the entire organization, establish the policies for utilizing them, and make a utilization plan for the entire organization instead of individual departments that currently use them to ensure effective management. The engineers who use each of the programs need to hold study meetings and workshops to share the acquired skills and know-how with each other. Furthermore, these engineer need to take the lead in transferring the shared skills to other staff who do not have the skills and know-how in order to promote the utilization of the programs in other fields.

3.2.7 Cooperation with Other Organizations

(1) Cooperation between SAGW and donors

As described in Section 3.1.6, the cooperation between SAGW and donors seems to be smoothly maintained in each of the projects, In the future, it is important for SAGW to organically connect the progress and outputs of different projects (input equipment, personnel, and outputs). In the current conditions where four projects are simultaneously implemented, it is indispensable for SAGW to have such a viewpoint as a unified organization in order to strategically use and persistently develop the supplied equipment, transferred skills, and created outputs.

For this purpose, SAGW is required to accomplish the following tasks:

- In addition to periodical meetings of regular operations, the 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 prepared 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.
- If it is difficult for personnel to conduct the above activities in addition to the regular operations, some neutral personnel dedicated to the project coordination shall be assigned in SAGW.

(2) Cooperation between SAGW and other government organizations

As described in section 3.1.6, the Macedonian government organizations in general are not actively pursuing sharing of information and therefore the sharing of information including GIS data between SAGW and other government organizations has not progressed. To stop this vicious circle created in 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 establishment, use, and dissemination of spatial information in Macedonia.
- SAGW shall lead the other government organizations to actively promote disclosure and supply of information. The data already established at this point in time is utilized and effort will be made to eliminate any overlapping of establishment by other organizations 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)

SAGW announced in a forum a plan for complete production of national base maps. In view of this fact, this plan was given the first priority among the priority projects.

1) Project overview

The overview of the project is as follows:

- ♦ The details of the national base map production plan in and after 2006 shall be established.
- ♦ In 2006, 25 sheets of national base maps shall be produced.
- ♦ In 2007, 35 sheets of national base maps shall be produced.
- ♦ In 2008, 40 sheets of national base maps shall be produced.

2) Project details

For the sake of production of national base maps (with a scale of 1/25,000) for the whole territory of Macedonia, it is necessary to complete maps for 100 sheets that were left unproduced in the current Study.

The details based on the project overview are as follows:

a. Establishment of a detailed plan for the national base map production plan

The remaining 100 sheets of national base maps shall be produced on the annual

budget of SAGW. Therefore, the detailed plan shall be established according to the fiscal years of Macedonia.

A detailed plan consistent with the decisions declared in the forum shall be established in consideration of the existing equipment and human resources of each process.

The annual budget for the production of national base maps shall be secured according to the detailed plan thus established.

b. Implementation of the detailed plan in each year

National base maps shall be produced according to the detailed plan established as described in the above item.

3) Requirements for implementation of the project

a. Establishment of a detailed project implementation plan

A detailed project implementation plan will form a basis of instructions for the project implementation departments and can be used for necessary information disclosure to external organizations. A detailed plan, in fact, will be a powerful tool in persuading those concerned in order to secure budgets. Therefore, a specific and rational plan shall be established.

A schedule to be contained in the project implementation plan to indicate specific processes shall be in a format that defines a critical path of the project in the same way as a PERT chart. This arrangement is important because the cause of a delay in the project, if any, can be detected in an early stage and the smooth progress of the project plan can be ensured.

b. Securing of project engineers through technology propagation

Due to what SAGW declared in the forum, the project implementation plan has already been established as three years. According to the contents of this declaration, a necessary number of engineers must be assigned to each process. Since, at present, only those who completed a technology transfer course can be engaged in each of the applicable operations, there are not a sufficient number of engineers to form flexible project implementation system such as reinforcement of a Study Team or work in alternate shifts. This problem shall be considered in the prior technology propagation and project implementation plan in order to increase the human resources in a planned manner.

c. Estimation and reinforcement of necessary equipment

If the need for reinforcement of equipment can be estimated in the same way as for human resources, a necessary budget for equipment shall be secured and the timing of

introduction shall be clearly defined.

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

At the onset of a geographic information society, there is a growing demand for positional information service in the society including both the public and private sectors. For the Macedonian government aiming at joining the EU, the geodetic reference system to be used as the basis for displaying positions is now required to be changed to comply with the EU standard.

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

a. Project overview

The project overview is as follows:

- ♦ Setting 17 permanent GPS stations in Macedonia
- ♦ Constructing in the capital city a center for analyzing and distributing observation data from electronic control points
- ♦ 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 electronic control nets, analysis and distribution centers, etc.

b. Establishment of permanent GPS stations

At present, there are 25 first order control points in Macedonia. Based on the allocation of these first order control points and the positions of SAGW branch offices, 17 permanent GPS stations shall be established.

c. Construction of analysis and distribution centers

In the capital complete with electric and telecommunications infrastructures, a center for analyzing observation data and distributing both observation and analysis data shall be constructed. At the same time, each of the permanent GPS stations shall be equipped with a 24-hour continuous observation, data transfer, analysis, and distribution system.

d. Acquiring maintenance, management, and operation skills

Skills required to maintain and operate a permanent GPS station system shall be acquired through technology transfer.

e. Personnel and equipment required for the project

The required personnel is as follows:

- Project leader
- Geodetic survey engineers
- GPS engineers
- Network engineers
- System engineers

The required main equipment is as follows:

- 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 and conversion of coordinates

a. Project overview

The project overview is as follows:

- Studying the geodetic reference system of EU member nations
- Examining and determining the change of the geodetic reference system and the coordinate conversion method needed for the change
- Proceeding with the project according to the examined and determined change and coordinate conversion method
- Evaluating the accuracy of the result after conversion of coordinates.

b. Studying the EU-standard geodetic reference system, etc.

The EU-standard geodetic reference system, etc. shall be studied concerning the following items:

- Elements of the reference ellipsoid (Name and specifications of the reference ellipsoid)
- Elements of the coordinate system (Name and epoch of the coordinate system)
- Permanent GPS station net of EU nations (Positions and states of observation, analysis, and distribution of observation and analysis data)

c. Examining and determining the change of the geodetic reference system and the

coordinate conversion method

The method of changing the geodetic reference system to comply with the EU standard shall be examined and determined while effectively utilizing the 17 electronic control points installed as described in Section 1).

The method of converting the coordinates under the first order control points and converting the coordinates of digital topographic maps and cadastral survey outputs after the change the geodetic reference system shall also be examined and determined.

d. Changing the geodetic reference system and converting coordinates

According to the method examined and determined as described in Item c., the geodetic reference system shall be changed, coordinates shall be converted starting from first order control points, and the geographic information (one with positional information) under the management of SAGW shall be converted to the one based on the EU standard.

e. Personnel and equipment required for the project

The required personnel is 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

Required main equipment:

- Various net adjustment programs

(3) Advanced applications of orthophotos (Project 3)

In the current Study, the skills for producing orthophotos were transferred as part of the technology transfer of digital photogrammetry. Since this technology transfer was focused on the skills for producing digital national base maps, the technology transfer participants have not really acquired working-level skills for producing orthophotos.

In Macedonia, on the other hand, orthophotos are more and more demanded by the government organizations and local authorities to establish urban plans and by the private sector to produce products based on geographic information

a. Project overview

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

b. Basic skills for producing digital orthophotos

What was learned in the technology transfer for producing digital orthophotos in the current Study shall be reviewed using the introduced study operation equipment. Through this review, the participants shall relearn the uses of study operation equipment and various commands required to produce digital orthophotos and prepare a standardized regulation of digital orthophoto.

c. Practical skills for producing digital orthophotos

The participants shall acquire practical skills for producing digital orthophotos based on the basic skills learned and the standardized regulation as described in Item b. These skills shall include constructing routine DEMs and the construction method of DEMs is considered the terrains of target regions for orthophoto production and the quality control of outputs and process control shall be conducted.

d. Market research on digital orthophotos

There are many uses for digital orthophotos. The participants shall understand these uses and understand the specifications (such as resolution, scale, and output formats) of orthophotos required by each of the uses. Additionally, the demand scale and the required speed of supply for each of the uses shall be studied.

e. Productivity improvement for digital orthophotos

The result of market research shall be used to identify the demand scale and required speed of supply. In view of this result, the participants shall examine the measures for improving the productivity; reconstruct the production methods, quality control, and process control in an effort to establish a more practical digital orthophoto production system (including technical skills, the standardized regulation and the quality control).

f. Personnel and main equipment required for the project

The required personnel is as follows:

- ♦ Engineers with abundant experience for producing digital orthophotos

The required equipment is as follows:

- ♦ Digital photogrammetry system (equipment installed with optional software for producing digital orthophotos)

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

SAGW has never formulated any middle/long-term plans before. Despite such a state, SAGW as government organization of Macedonia must secure a national budget for its operation every year. To secure a national budget, SAGW needs to propose its social missions and how it is going to deal with them. To obtain assistance from donor organizations of other countries and borrow funds from financial institutions, SAGW must formulate and propose rational and consistent plans (short and middle/long-terms).

a. Project overview

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
- ♦ Formulation of short and middle/long-term plans

b. Status survey on SAGW

It is necessary to survey and identify the present status of SAGW, an implementing agency for various plans. There are the following survey items:

- ♦ Laws related to geographic information and SAGW
- ♦ Functions of SAGW organization and departments (including the current state of organizational management)
- ♦ Makeup of personnel and human resources of SAGW (number, ages, academic backgrounds, and job experiences)
- ♦ Equipment owned by SAGW (types, quantities, and dates of installation)
- ♦ Geographic information managed by SAGW (types, quantities, storage methods, and supply methods)
- ♦ Budgets and executed budgets of SAGW (past budgets amounts and execution results)
- ♦ Operation results of SAGW

The above survey shall be conducted via questionnaires, interviews, hearings, literature and documentary search, etc.

c. Trend survey on geographic information organizations in other countries

The survey shall be conducted on the geographic information organizations in other advanced countries with similar political and economical systems and history concerning

the survey items of the status survey described in Item as well as the following items:

- Basic policies of geographic information organizations in other countries
- Short and middle/long-term plans of geographic information organizations in other countries and how they are formulated

d. Technical trend survey in the geographic information field

Technologies in various fields are applied to development, maintenance, management, and operation of geographic information. The present status and future direction of these technologies shall be studied. Technical trend survey shall be conducted on the following objects:

- Hardware (land survey equipment, photogrammetry equipment, scanners, personal computers, servers, and communication and network equipment)
- Software (analysis software in land survey field, software in photogrammetry field, GIS software, database management software, and communications and network software)
- Standardization skills for geographic information

e. Market research on geographic information in Macedonia

In Macedonia, road maps and sightseeing maps made by private companies are commercially available to the general public. This fact indicates there is a market, albeit a small one, for geographic information in the private sector. The following market research shall be conducted in view of future dissemination of geographic information to the general public.

- Actual condition survey on private companies related to geographic information in Macedonia (number, businesses and scales, types of geographic information being used, etc.)
- Survey on use states, etc. of geographic information by the government organizations, local authorities, utilities (railroads, electric power, communications, water and sewerage, etc.)
- Survey on types, formats, supply methods, etc. of geographic information required by the public and private sectors

f. Formulation of short and middle/long-term plans

Based on the results of surveys described in Items b to e, SAGW shall establish basic policies and formulate short, middle, and long-term plans according to the policies.

The plans shall be formulated considering the following points:

- ♦ Defining the goals of SAGW based on the established basic policies
- ♦ Formulating short, middle, and long-term plans in consideration of urgency, demand, feasibility, etc. of the goals based on the survey results
- ♦ Defining the deadlines and outputs of the plans to facilitate the evaluation of achievement of the plans
- ♦ The sooner the plan, the more specific the contents should be.

g. Personnel required for the project

Since short and middle/long-term plans shall be formulated in the end, experts who can teach methods and give advice on formulating plans are needed. Furthermore, experienced persons knowing the skills in the geographic information field and the organization and management of SAGW are also needed.

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

SAGW provides a service of selling topographic maps, a type of geographic information. The service of selling topographic maps can be classified into items concerning topographic maps to be sold and items concerning sale methods. There are many tasks to be done about the current sale service. In the priority project, some of the tasks shall be accomplished.

1) Project overview

The project overview is as follows:

a. Production of topographic maps

b. Improvement of the sale service

2) Production of topographic maps

Topographic maps to be sold shall be produced and updated in turn as shown below. The establishment of digital data shall also be targeted.

a. Production of topographic maps with a scale of 1/25,000

In the current Study, topographic maps for half of the entire land of Macedonia have been produced. As SAGW declared in the forum, topographic maps for the remaining half shall be produced as planned in order to complete the production on the whole land.

b. Production of topographic maps with different scales

Reduced-scale topographic maps described later shall be produced in turn.

c. Establishment of other geographic information

Recently, geographic information other than printed topographic maps, e.g., orthophotos, are also growing in demand. Geographic information shall be established based on the result of market research.

As the surveying operation is opened up to the private sector, information on national control points shall be prepared for supply.

d. Update of geographic information

The plan for updating geographic information such as newly produced topographic maps, orthophotos, etc. with various scales shall be established. Thus, geographic information shall be updated in a periodic and planned manner.

The production and update of topographic maps require large costs. Therefore, it is important to establish a steady and reliable plan and implement it step by step.

3) Improvement of the sale service

Improvement of the sale service has influence on many fields. The items declared by SAGW in the forum shall be given a higher priority in the improvement.

a. Revision of selling prices

As SAGW declared in the forum, the current prices of topographic maps (printed maps) shall be revised in consideration of the income levels of the citizens and the price levels of the neighboring countries.

b. Procedure of purchase

The system of purchase permission, currently required, shall be abolished to enable the supply of topographical maps to anyone who wants to purchase them. Additionally, the payment of prices shall be accepted at the counter of SAGW instead of at a post office.

c. Location of sale

At present, there is only one location of sale, the SAGW headquarters. There shall be more locations of sale at local branch offices, etc. Furthermore, a system of correspondence sale shall be introduced.

d. Other

Pamphlets, index maps, and price lists that show the production state of topographic maps for convenience of purchasers shall be prepared and distributed free of charge. Furthermore, booklets containing information on sale of topographic maps shall be

published.

As the surveying operation is opened up to the private sector, there shall be a scheme to provide information on national control points without permission in the same way as for other geographic information such as topographic maps.

(6) Construction of WebGIS (Project 6)

As SAGW declared in the forum, promoting disclosure and utilization of geographic information is an essential task, for which some positive efforts are expected. WebGIS allows users to view and use GIS data on an ordinary Web browser without requiring them to install GIS software on their PCs. Therefore, it is effective to construct a WebGIS system in order to disclose information to the general public without limiting users.

1) General procedure for WebGIS construction

Before WebGIS construction, it is important for SAGW, both user and supplier of information, to share a common understanding in the organization on why, to whom, what, and how to supply geographic information in addition to technicalities such as system and database designs. For this purpose, we recommend taking the following procedure:

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. Formulating a specific plan (analyzing the present status and formulating a basic plan)
d. Introduction (system introduction, data introduction, and equipment procurement)
e. Operation and management (data update, related laws, security measures)

The above procedure must be applied to each of the steps of the Scalable WebGIS construction described below. SAGW must proceed with each step after examining it in the organization.

2) Steps in construction of scalable WebGIS by SAGW

Through the current Study, SAGW has already acquired many of the elements essential to the construction of WebGIS. These elements are hardware (server and client computers), software (GIS software, application servers, database servers, RDBMS, etc.) and data (spatial data infrastructures, environmental protection GIS databases, aerial photographs, orthophotos, analysis results, etc.). Through technology transfer, the

participants have acquired skills concerning construction, maintenance, and update of data. Against such a background, we propose that SAGW perform the following steps one by one in order to introduce WebGIS. The items required to complete Step 1 are described in detail later.

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

3) Items in detail required for completing Step 1

Step 1 shall consist of establishment of an SAGW clearing house to prepare an environment in which the SAGW staff can search beyond the borders of departments, understand in detail, and commonly use the geographic information maintained and managed by SAGW.

a. Contents

Meta data for the following existing and new geographic information owned by SAGW shall be prepared to ensure sharing of information in the headquarters and local branch offices of SAGW.

- ♦ Cadastral survey data
- ♦ Cadastral graphic data
- ♦ Cadastral attribute data
- ♦ Spatial data infrastructures (1/25,000 topographic map database)
- ♦ GIS database for environmental conservation of Lake Ohrid
- ♦ Existing topographic map data (1/50,000, 1/200,000, and 1/500,000)
- ♦ Aerial photograph data
- ♦ Orthophoto data

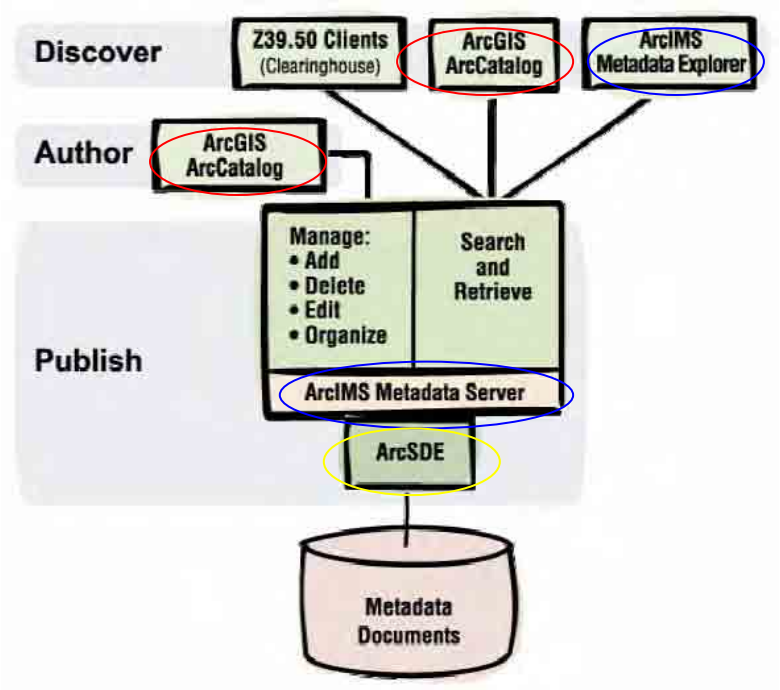
b. Tools and procedures

The actual tools required to establish meta data and publish it at a clearing house are listed below. SAGW, provided with all of these tools as supplied equipment in the current Study, is in an environment to start establishing meta data.

- ♦ ArcGIS: Establishes meta data using ArcCatalog and publishes it in a meta data

service. ArcCatalog has the FGDC and ISO standardization functions.

- ArcIMS: Provides a mechanism for hosting a meta data service. This mechanism allows clients to publish or search information in this service.
- ArcSDE: Meta data established using ArcCatalog shall be transferred via ArcIMS meta data service and ArcSDE to an RDBMS for storage. Every time a client publishes meta data to a service, a new record is created in the database table.
- Metadata Explorer: A Web application included in ArcIMS. This allows the users to search and view information in the meta data service using a Web browser.



"Metadata and GIS", ESRI White Paper 2002

c. Required personnel and costs

The skills concerning meta data specifications and maintenance and publishing of meta data have been acquired in the training period in Japan. The trainees, making the most of the acquired skills, shall first establish data and make system settings required to share geographic information in SAGW. The costs required in this process are only the personnel costs of the staff involved in it. No new hardware or software need to be procured.

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

According to SAGW's declaration in the forum and the implementation of the priority project "Complete production of national base maps", national base maps with a scale of 1/25,000 shall be produced for the entire land of Macedonia.

On the other hand, SAGW already produced topographic maps with scales of 1/50,000, 1/200,000, and 1/500,000 although they are outdated. As soon as the production of topographic maps with a scale of 1/25,000 is completed, these small-scale maps will grow in demand from the government organizations and private market. To meet the demand, SAGW should plan and implement a project for producing reduced-scale maps based on the 1/25,000-scale maps. Note that the production of reduced-scale maps shall include the construction of a GIS topographic map database at each level.

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

Reduced-scale maps shall be produced at the above scales of maps currently stored and sold at SAGW.

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)

This order of priority was determined because there is a high demand for a topographic map that can cover the whole land of Macedonia and because maps with scales close to those of the existing ones can be substituted by them.

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.

3) Production of reduced-scale maps with a scale of 1/500,000

During the production of a reduced-scale map, a reduced-scale GIS topographic map database shall be constructed at the same time as producing a printed map. The application of automatic processing shall be considered in production.

a. Production procedure

The production procedure shall be as follows:

a-1: Determination of the specifications (expressed items and forms and colors of symbols) for a scale of 1/500,000

a-2: Selection of data from the original data according to the specification and automatic processing

a-3: Scale reduction compilation

a-4: Establishment of topographic map data and GIS topographic map database with a scale of 1/500,000

a-5: Production of printing data and printing of maps

b. Description of steps in detail

"a-1: Determination of the specifications (expressed items and forms and colors of symbols) for a scale of 1/500,000"

Items that need to be expressed on a topographic map at this level (selection and integration) shall be determined for each data item and type. The forms, line types, and colors of symbols for the selected expressed items shall be determined.

"a-2: Selection of data from the original data according to the specification and automatic processing"

According to the determined specifications, required data shall be selected from the original data and, through automatic processing, shall be integrated (added up) into necessary data.

"a-3: Scale reduction compilation"

On the data selected and subjected to automatic processing, annotations shall be repositioned and manual scale reduction compilation shall be conducted on areas where automatic processing was not good enough. Additionally, compilation shall be conducted so that appropriate topographic and planimetric features and annotations for a topographic map with a smaller scale of 1/500,000 can be obtained.

"a-4: Establishment of topographic map data and GIS topographic map database with a scale of 1/500,000"

From the scale reduction compilation data, topographic map data and GIS topographic map database shall be established.

"a-5: Production of printing data and printing of maps"

Based on the topographic map data, printing data shall be produced and printed maps shall be produced.

c. Production time and costs

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

"a-1: Determination of the specifications (expressed items and forms and colors of symbols) for a scale of 1/500,000"

Time: 5 days

Cost (total man-days required): 3 persons x 5 days = 15 man-days

"a-2: Selection of data from the original data according to the specification and automatic processing"

Time: 10 days

Cost (total man-days required): 2 persons x 10 days = 20 man-days

"a-3: Scale reduction compilation"

Time: 7 days

Cost (total man-days required): 1 person x 7 days = 7 man-days

"a-4: Establishment of topographic map data and GIS topographic map database with a scale of 1/500,000"

Time: 3 days

Cost (total man-days required): 2 persons x 3 days = 6 man-days

"a-5: Production of printing data and printing of maps" (The time and cost for printing are excluded.)

Time: 5 days

Cost (total man-days required): 1 person x 5 days = 5 man-days

4.1.2 Requirements for Implementation of Priority Projects

To implement these projects, SAGW must provide for prerequisites and necessary environments.

(1) Present status concerning implementation of priority projects

Concerning the implementation of priority projects, the present status of SAGW in terms of the technical capabilities, personnel, organization, and finance is evaluated 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 continue to participate in this project. The other one is that an engineer who has abundant experience for producing digital orthophotos shall be requested the donor to send SAGW.) 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 formulation of middle/long-term plans (Project 4)

SAGW has never formulated any middle/long-term plans before. In the current organization, however, there is a department of staff who can formulate plans. In view of this fact, there must be experts who can teach and advise on the methodology for formulating 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 produce 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)

The construction of WebGIS requires appropriate technical capabilities, equipment, and personnel and an organization that can carry out the operation are required. In the current Study, required technical capabilities have been transferred and required equipment has been supplied. The remaining requirements 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)

In the current Study, SAGW acquired skills for preparing specifications but lacks experience in selecting data items during scale reduction compilation. 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.

(3) Duties of SAGW

SAGW should recognize the order of priority and requirements of individual priority projects and accurately meet the requirements by classifying them into those which can be implemented through efforts within the SAGW organization, through negotiation with the central government, and through requests for assistance to a third country.

4.1.3 Project Priorities

The contents and realization of the 7 priority projects have been set out. These 7 projects have their own high priorities. However, under the current conditions of SAGW (technical capability, economic strength, human resources etc) it is difficult to carry them 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

SAGW is the only geographic information organization in Macedonia after it became independent. Among the geographic information departments, the cadastral department has been conducting good operations since before the independence and, at present, is actively executing the task of computerization of operations.

On the other hand, the basic survey and topographic map production departments started operations after the independence. Since their history is still short, however, future images of them based on middle/long plans are required.

4.2.1 Photogrammetry Department

The photogrammetry department of SAGW is the only or one of very few highly potential organizations that can construct spatial data on its own. This department is required to have capabilities for maintaining and managing spatial data infrastructures as national infrastructures. It is also hoped that this department will provide various government organizations with a gateway function for spatial data procurement and consultation on spatial data construction. The following table shows the future images and future plans that should be realized in time to come.

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 establishment 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 establishment 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 data to government ministries and agencies that aim at GIS construction using spatial data infrastructures.

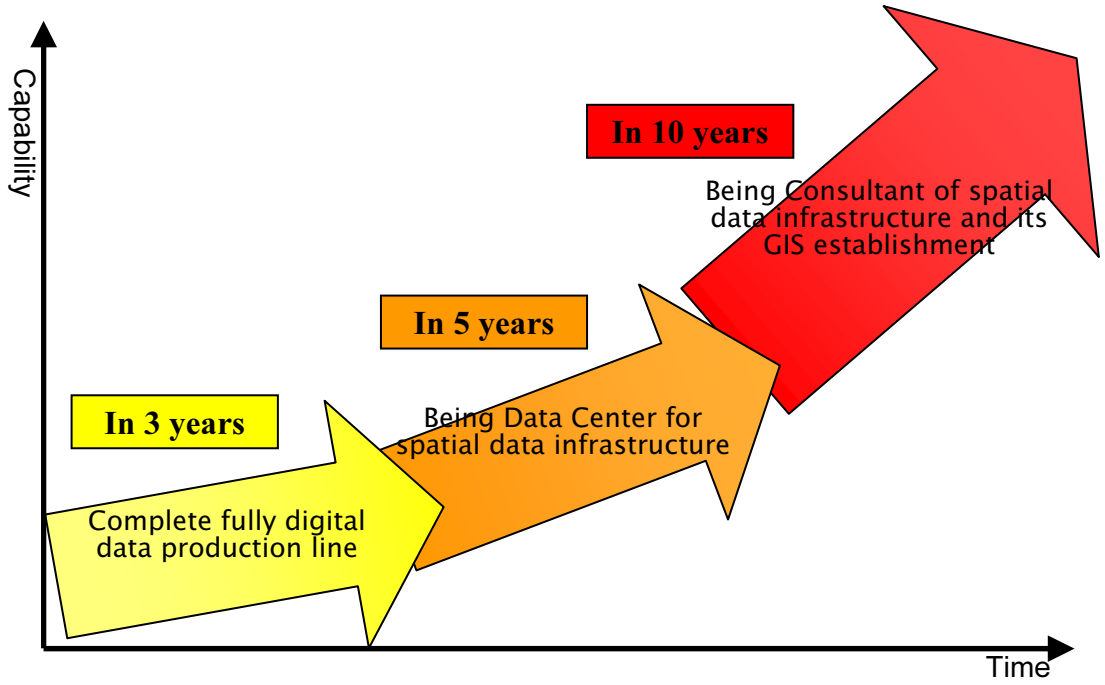


Figure 4-1 Schematic diagram of future image of SAGW

4.2.2 Services

If the tasks described in Section 3.2.5, "Services" are accomplished, SAGW can stand at the starting point for realizing the future image of SAGW services.

(1) Supply of geographic information

The future image of the SAGW services can be seen in the present status of geographic information organizations in the neighboring countries.

1) Types of geographic information to be supplied

Geographic information to be supplied to the general public is expected to become diverse according to the advance in reform of SAGW organization, equipment, and awareness, revision of law systems, and improvement of living standards of citizens. Based on this assumption, SAGW will provide the following geographic information items:

- ♦ 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. 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. For the convenience in supply, SAGW will provide free of charge catalogs, index maps, and booklets covering the supply information such as prices.

3) Prices

Geographic information established in principle on national budgets and being properties of Macedonian citizens will be priced not on cost basis but political basis to ensure wide use among the general public. The prices are expected to be considerably lower than those at present. The geographic information items not currently on sale such as digitalized geographic information, orthophoto maps, thematic maps, aerial photographs, and spatial data infrastructures shall also be priced low based on the price policy described above.

(2) SAGW activities

As part of the services, SAGW is expected to perform a wide range of activities.

1) Research and development activities

The skills in the field of geographic information development are advancing rapidly. SAGW, the only geographic information organization in Macedonia, will conduct research activities in this field to inform the result to the general citizens and contribute to the establishment of geographic information. It will also develop tools for establishing geographic information in a planned manner.

2) Educational activities

To promote dissemination of geographic information, SAGW will establish a support system for the primary and secondary education institutions through supply of educational materials and dispatch of instructors for geographic information education. SAGW will also deliver lectures on actual operations of establishing geographic information and provide assistance in technical education somewhat different from ordinary study at universities.

3) Activity report

SAGW will report to the national government and general citizens who are taxpayers about its activities conducted on national budgets to promote understanding of the social significance of the activities. The activities will be reported in annual reports and periodical journals published by SAGW. Technical research and development will be reported in technical newsletters in a timely manner.

4) Publishing activities

SAGW will publish easy-to-understand books on how to use geographic information as well as annual reports and technical newsletters as described above. Other possible books to be published include those on history of maps and textbooks of surveying, i.e., books in all fields related to geographic information.

(3) Activities in civil society

In Macedonia and many other countries, general citizens are not familiar with the present status of establishing geographic information, etc. Opportunities of exchanges between citizens and those involved in geographic information will contribute to building a rosy future for geographic information.

1) Events

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 established and having them participate directly in the demonstration, thus giving them a sense of unity with SAGW and deepening their understanding on the activities of SAGW.

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

4.2.3 Organization (Structure and Finance)

SAGW is the only geographic information organization in Macedonia and has duties of supplying and disseminating geographic information such as topographic maps to the general public. To smoothly implement these duties, it is necessary to establish an appropriate organizational structure and financial base.

Hereafter, the future image of departments in charge of topographic maps, etc. are described, putting aside the current organizational structure and financial status.

(1) Organization (structure)

The department in charge of topographic maps, etc. included in geographic information is considered to have the following duties:

- ♦ Planning of middle/long-term activities on geographic information
- ♦ Planning and setting of a geodetic reference system that forms the basis of geographic information
- ♦ Establishment, maintenance, and update of control points (triangulation points and bench marks), geographic maps (digital and analog), and orthophotos
- ♦ Supply of control point outputs, topographic maps, orthophotos, and aerial photographs
- ♦ Dissemination of geographic information
- ♦ Standardization of geographic information
- ♦ Hosting of a liaison conference of ministries related to GIS (NSDI Committee)

Based on the assumption of the duties listed above, an organizational structure consisting of the departments with the following functions will be one of the possible future images.

1) Planning department

This department will plan all the activities of SAGW including the cadastral department. This department will plan the establishment of topographic maps, standardization of geographic information, activities of NSDI, etc.

2) Geodetic survey department

This department will set up the geodetic reference system and conduct establishment, maintenance, and update of control points. It will also handle maintenance and operation of electronic control points and coordinate conversion required for changes in the geodetic reference system.

3) Spatial data infrastructure department

This department will handle what is generally called geographic information.

a. Field survey division

This division will handle photo control point survey, field identification, and supplementary field identification for production of topographic map data.

b. Photogrammetry division

This division will conduct technical control on aerial photography and digitalize aerial

photographs. It will also conduct a series of operations (aerial triangulation and digital plotting and compilation) in photogrammetry. Further, it will construct a GIS topographic map database as well as produce printing data.

c. GIS division

This division will develop a system that uses a topographic map database constructed by the photogrammetry division and construct a database of various thematic maps according to the demands for them.

d. Quality control division

This division will inspect and approve the quality of geographic information produced by the spatial data infrastructure department.

4) Geographic information dissemination department

This department will sell and supply to the general public the geographic information (digital and analog topographic maps, orthophotos, aerial photographs, control point information, observation and analysis data on electronic control points) owned by SAGW. It will also conduct public relations and advertisement activities for dissemination of geographic information.

5) Research and development department

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

(2) Finance

Geographic information is generally considered to constitute part of the public infrastructure. If so, the financial base for establishing, maintaining, and updating this public infrastructure should depend on the national finance. Based on this viewpoint, SAGW needs to prepare appropriate plans for establishing, maintaining, and updating geographic information according to the demands of the society and secure national budgets to cover the necessary costs and stabilize the financial base. Of course, these operations of SAGW must be well recognized by the society.

The Macedonian government aiming at joining the EU is aiming at a "small government" from the standpoint of budget balancing. This makes it difficult for SAGW to meet all the necessary costs only with national budgets.

Against such a background, it is high time for SAGW to seek independent revenue sources

in addition to national budgets. In the future, it will need to meet the necessary costs with national budgets and independent revenue sources. SAGW should secure these independent revenue sources by selling geographic information established, maintained, and updated by itself and undertaking construction of custom GIS databases according to orders received from customers.