THE STUDY
FOR
ESTABLISHMENT OF DIGITAL TOPOGRAPHIC MAPS IN GEORGIA

Final Report

PASCO CORPORATION

March 2008

CURRENCY EQUIVALENTS

Currency Unit = Georgian Lari (GEL)
US$1.00 = 1.5450 (exchange rate February 18 , 2008)

PREFACE

In response to a request from the Government of Georgia, the Government of Japan decided to conduct a study on The Study for Establishment of Digital Topographic Maps in Georgia and entrusted to the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Hisashi MORI of PASCO Corporation and consists of PASCO Corporation between April, 2005 and February, 2008.

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

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

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

March 2008

Eiji HASHIMOTO,
Deputy Vice President
Japan International Cooperation Agency

Mr. Eiji HASHIMOTO
Vice President for
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

Dear Mr. Hashimoto,

We are greatly honored to submit to you the final report on "The Study for Establishment of Digital Topographic Maps in Georgia" that was implemented based on the contract with your Agency.

This report summarized the progress of the study and results of the works over the three years from fiscal year 2005. Pasco Corporation carried out this study from April,2005 to March, 2008, and the outcomes from the works include aerial photographs on the scale of 1/40,000, topographic maps on the scale of 1/50,000 , the digital topographic data with GIS database and GIS model systems.
In this report, we also elaborate on approaches to effective use of the topographic data in various fields of decision-making and are convinced that it will contribute to the promising socio-economic development of Georgia.

On behalf of the study team in Pasco Corporation, I would like to express my deepest gratitude to the Geology-Cartography and Geodesy Service and the organizations concerned in the Government of Georgia for their close cooperation extended to the Study Team.

Finally, I wish to convey my sincere appreciation to the officials in JICA, Geographical Survey Institute, the Ministry of Land Infrastructure and Transport, the Ministry of Foreign Affairs and the Embassy of Japan in the republic of Azerbaijan for providing us with suggestive advices and appropriate directions that have been given to us during the implementation of the project.

March, 2008

The Study for Establishment of Digital Topographic Maps in Georgia
Leader of the Study Team Hisashi Mori

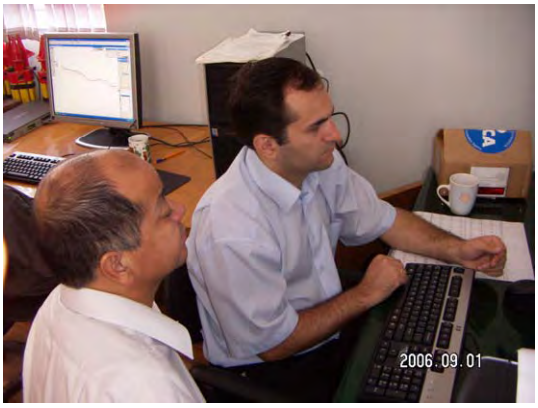
View of Tbilisi city

The Ministry of Environment Protection and Natural Resources of Georgia

Official meeting of the Coordinating Committee

Discussion on the progress report

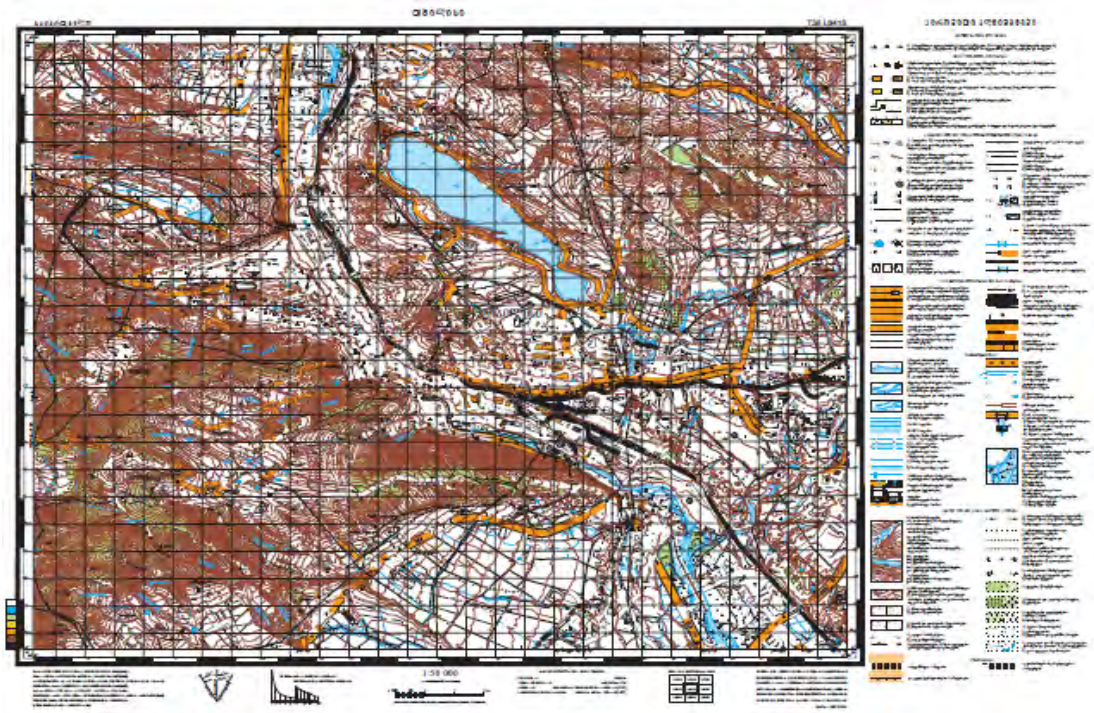




Scenes of On the Job Training by the Study Team during the project

Presentations by the counterpart personnel in the Workshop

Successful Seminar with many fruits



A sample of the new map sheet (Tbilisi)

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List of Abbreviations

CAD	Computer-Aided Design
DEM	Digital Elevation Model
DGC	Department of Geodesy and Cartography
DTM	Digital Terrain Model
EPNR	Environment Protection and Natural Resources
GCGS	Geology-Cartography and Geodesy Services
GCP	Ground Control Point
GIS	Geographic Information System
GPS	Global Positioning System
JICA	Japan International Cooperation Agency
MSL	Mean See level
MST	Multi-sensor Triangulation
NGO	Non-Governmental Organization
OJT	On-the-Job Training
RMS	Root Mean Square
SGC	Service of Geodesy and Cartography
SIA	Spatial Information Agency
TIN	Triangulated Irregular Network
UML	Unified Modeling Language
UNDP	United Nations Development Program
UTM	Universal Transverse Mercator
WGS 84	World Geodetic System 1984

Chapter 1. Introduction

1.1. Background of the Study

1.1.1. Background and progress of the Study

Necessity for the Project

Georgia is currently carrying forward national development and democratization, and the country is in absolute need for foreign assistance in shifting to a market-based economy, developing social infrastructure and environmental protection, supporting refugees, etc. through land reform. More concretely, accurate ascertainment of geographical information which underlies the national land is among top priority issues. However, in the aspect of national basic map, there has been no revision conducted so as to keep the topographic maps up to date since 1980s during the former Soviet era, and the obsolete geographical information has been one of the hindrances to planning and formation of national development programs and smooth implementation of relevant projects.

Therefore, it is a common understanding that immediate construction of national spatial basic data (geographical information) reflecting the most recent situation and digitization of map data for easy use are vital for smooth realization of all sorts of national development plans. Accordingly, the government of Georgia submitted an official request to the government of Japan in January 2004, which has successfully led to the implementation of the Project.

Progress of the Study

This Project started in April, 2005, in response to the request of the Government of Georgia to the Government of Japan. The Study Team finished the aerial photography and ground control point surveys in July 2005. The field verification was carried out in October and November 2006. In the course of the Project implementation in the 1st year, the organizational reforms took place by the Government of Georgia, and accordingly affected all spheres of administration including the field of geodesy and cartography. As a result, the number of staff members of the former Geodesy and Cartography was reduced to six only, and the name of the organization was changed from DGC (Department of Geodesy and Cartography) to SGC (Service of Geodesy and Cartography). This new organization, as the counterpart of this Project, consisted of six (6) persons selected through an examination held by the ministry. They were assigned to take charge of mainly

execution of the national mapping program, cadastral mapping and so on, as well as inviting tenders for mapping works.

The Study Team consulted Japan International Cooperation Agency (JICA), the official agency responsible for the implementation of the technical international cooperation program in Japan, concerning this restructuring, and sought for a countermeasure involving a dispatch of the representative of JICA London office to Georgia to investigate the situation of the SGC in due way. As a result of discussion with the SGC, the Study Team and JICA reached consensus that the implementation of the work through On–the-Job Training (hereinafter referred to as the OJT), which had been expected in January 2006, should be postponed to the next stage, owing to the lack of technically-eligible personnel in the SGC.

Meanwhile, the ministry newly established the Spatial Information Agency (hereinafter referred to as the Agency) in January 2006, to share the works partly to support the SGC in the technical aspect. The ministry and the Agency pledged to address the OJT in cooperation with the SGC, and conducted interviews in February 2006 to choose qualified personnel who took part in the OJT from among nearly 50 candidates. Consequently, 10 eligible staff members enrolled in the Agency.

Restart of the Study and amendments to the volume

The work in the 2nd year (2006) was thus undertaken by the new counterpart body comprising of staff of both the SGC and the Agency after the JICA Project Consultation held from 31st July to 3rd August, 2006.

In this Project Consultation necessary information on the possibility of project implementation was given out by the SGC to judge whether space and human resources for conducting the OJT were duly prepared. The JICA missions for the consultation confirmed all the necessary conditions and approved the restart of the Study.

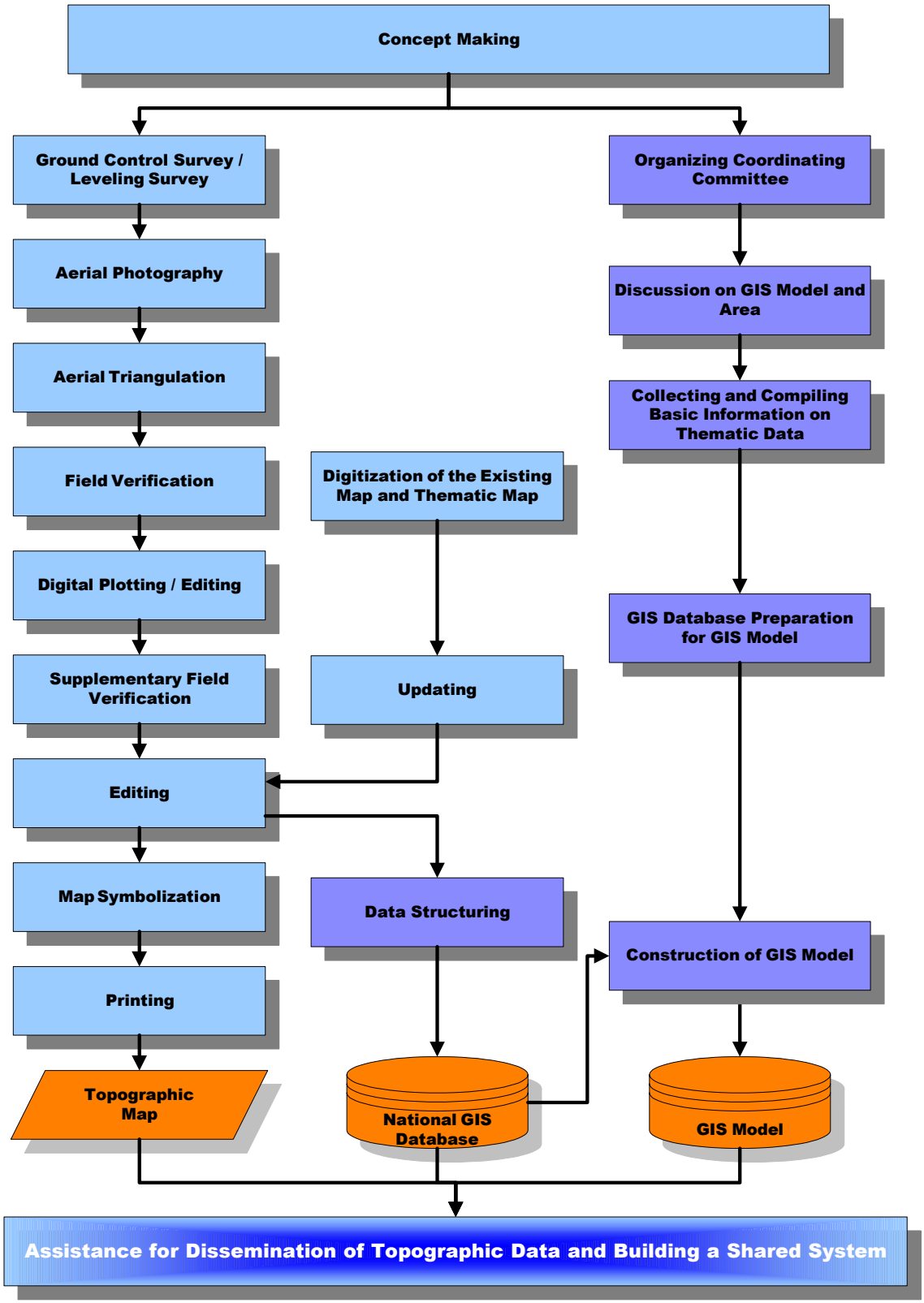
Meantime the SGC was reorganized again by affiliating with the Service of Geology and changed the name as the Geology-Cartography and Geodesy Services (GCGS). The function of the former SGC, however, remains unchanged in terms of implementing the Study and has been taken over in conducting map production and maintaining the related works.

1.1.2. Objectives of the Study

In this study work, the items noted below were carried out for the purpose of providing technical assistance in making available the latest geographic information that would be helpful in formulating mid- and long-term national development planning in Georgia and putting those data to help create GIS model systems, disseminating geographical information, including GIS databases, and building a system for sharing that information and promoting wider use of the digital map data.

- Provision of digital maps (1:50,000)
- Creation of GIS databases in priority fields of national development
- Creation of GIS model systems using the above databases
- Technology transfer relating to these works
- Dissemination of geographic information and assistance in building a shared system

The following is a conceptual diagram showing a work flow and major items of the works.


Concept Making
Ground Control Survey / Leveling Survey
Aerial Photography
Aerial Triangulation
Field Verification
Digital Plotting / Editing
Supplementary Field Verification
Editing
Map Symbolization
Printing
Topographic Map
Digitization of the Existing Map and Thematic Map
Updating
Data Structuring
National GIS Database
Organizing Coordinating Committee
Discussion on GIS Model and Area
Collecting and Compiling Basic Information on Thematic Data
GIS Database Preparation for GIS Model
Construction of GIS Model
GIS Model
Assistance for Dissemination of Topographic Data and Building a Shared System

1.2. Outline of the Study

1.2.1. Area targeted in the Study

At the beginning of this Project the areas to be mapped by the Study included the regions where industries key to state development are located and populations are concentrated, as well as the regions around that area, covering approximately 30,000km^2 of land (out of 69,700Km^2 national territory). The new Study Area is shown in Figure 1.2.1 below.

However, JICA and the Georgian sides agreed that the area of mapping production by OJT would change from 9,000km^2 to approximately 3,000km^2, because the production capacity of the Georgian side had been reduced due to the reorganization of the former DGC.

In accordance with the decrease in OJT area, finally the Study covered an area of approximately 24,000km^2.

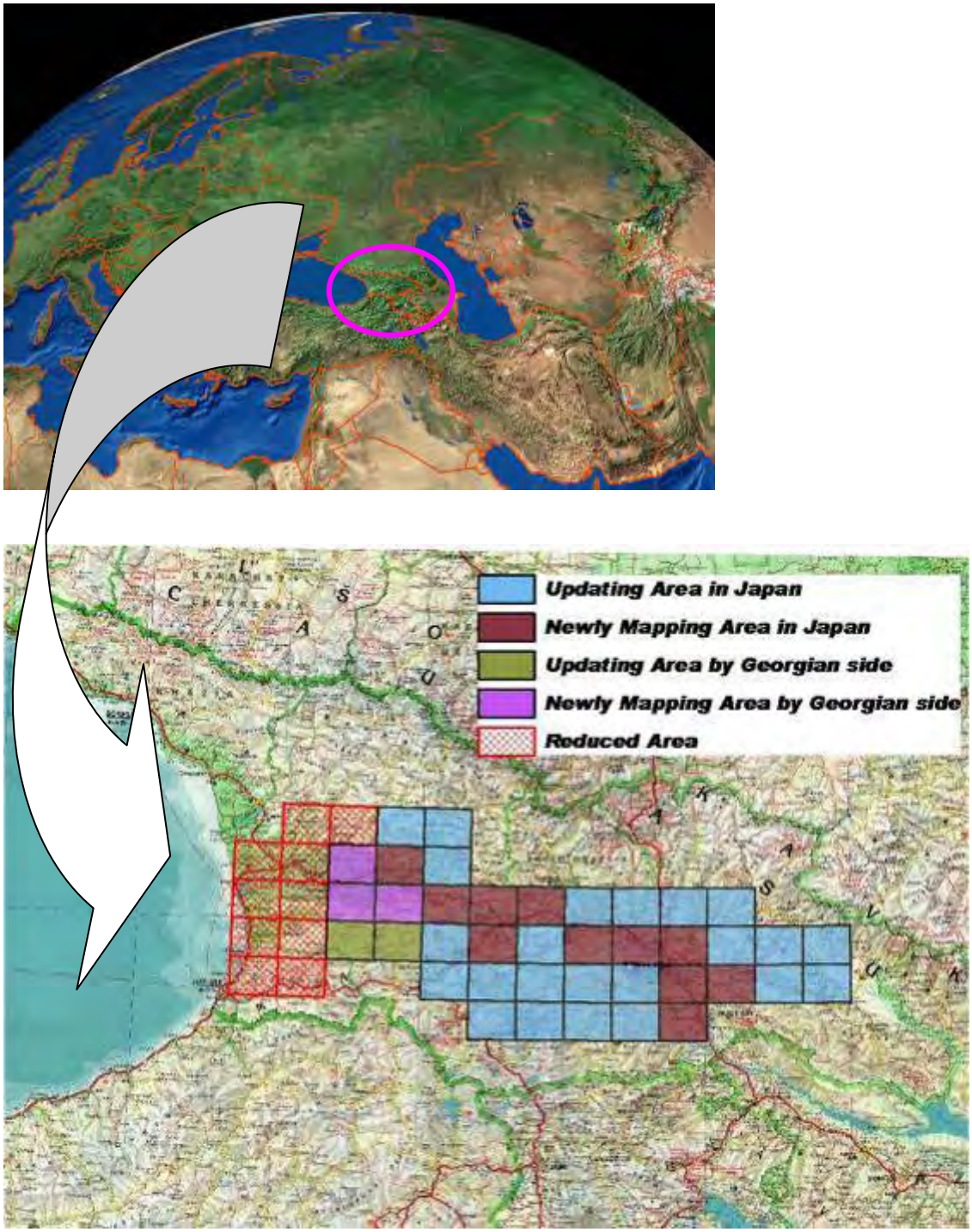


Figure 1.2.1 Revised Study Area and demarcation of responsibility

Table 1.2.1 Revised work volume

Work Item	Portion	Area (km^2)
Newly Mapping	Japan	6,750
	Georgia(OJT)	1,840
Updating	Japan	14,130
	Georgia(OJT)	1,230
Total Area		Approx. 24,000

1.2.2. Progress of the work in each year

(1) The work done in the 1st year

The following table summarizes the details and volume of the work in the 1st year.

Table 1.2.2 Summary of the Study works in the 1st year

Item	Quantity and Area	Description
Discussion about map symbolization	Overall area	Decision on survey standards, symbolization and specifications. Discussion with the counterpart based on Georgia's existing map symbols.
Aerial photography	Targeted Area: 30,000 km^2	Scale: 1:40,000. Panchromatic film (BW). Lateral overlap:60±5%. Adjacent overlap:30±5%.
Creation of Orthophotos	196 scenes covering the area of 30,000 km^2	For 49sheets.
Digital mapping (For updating)	Existing maps for 14,130 km^2 was vectorized in Japan.	Plotting scale : 1:50,000. The vectorization of existing maps and digitization for feature updating were done in 2nd year.
Digital mapping (Newly plotting)	3,500 km^2 of new maps were plotted in Japan.	Producing new topographic maps using the digital plotter for the rest of updating areas.
Field Verification	Area targeted for new maps	Preliminary photo-interpretation. Verification and checking of geographic features.
Creation of GIS databases	Entire area of the mapping	Design of GIS database.

GIS Model Systems	Selection of GIS themes and model areas.	Preparation of basic data and digitalization of thematic maps.

(2) The work done in the 2nd year

The following table summarizes the details and volume of the work in the 2nd year.

Table 1.2.3 Summary of the Study works in the 2nd year

Item	Area Targeted	Description
Digital mapping (Updating)	Feature updating was done for 14,130 km^2 in Japan * The rest of 1,230 km^2 was done by the OJT	Total updated area 15,360km^2. The area for the OJT was decreased due to the reform of the counterpart.
Digital mapping (Newly plotting)	6,750 km^2 of new maps were plotted in Japan. * The rest of 1,840 km^2 was done by the OJT	Producing new topographic maps using the digital plotter for the rest of updating areas.
Map symbolization	Maps covering 10,500 km^2 were symbolized	Symbolizing topographic data using Illustrator.
Creation of GIS database	Area covering 24,000 km^2	Design and creation of GIS data from digital topographic data.
Creation of GIS Model Systems	For 6 model areas	Generation and digitization of basic data including thematic maps collected from each member of the Coordinating Committee.
Field Verification	Area targeted for updating map sheets	Verification and checking of ground features.

(3) The work done in the 3rd year

The following table summarizes the details and volume of the work in the 3rd year.

Table 1.2.4 Summary of the Study works in the 3rd year

Item	Area Targeted	Description
Compilation of digital topographic data	21,000 km^2 was done in Japan. * The rest of 3,000 km^2 was	Editing the digital plotting data.

	done through the OJT	
Map symbolization	Maps covering the rest of 10,500 km^2 were symbolized	Symbolizing topographic data using Illustrator.
Field completion	Area targeted for all map sheets(24,000 km^2)	Confirmation and checking of geographical names and ground features.
Creation of GIS database	Area covering 24,000 km^2	Technical transfer of the creation of GIS database to the counterpart.
Creation of GIS Model Systems	For 6 model areas	Construction of GIS Model Systems and Technical Transfer through the work shop and feedback from the task force members.

1.2.3. Outcomes of the Study through out 3 years

The outcomes of the works as final results are as follows:

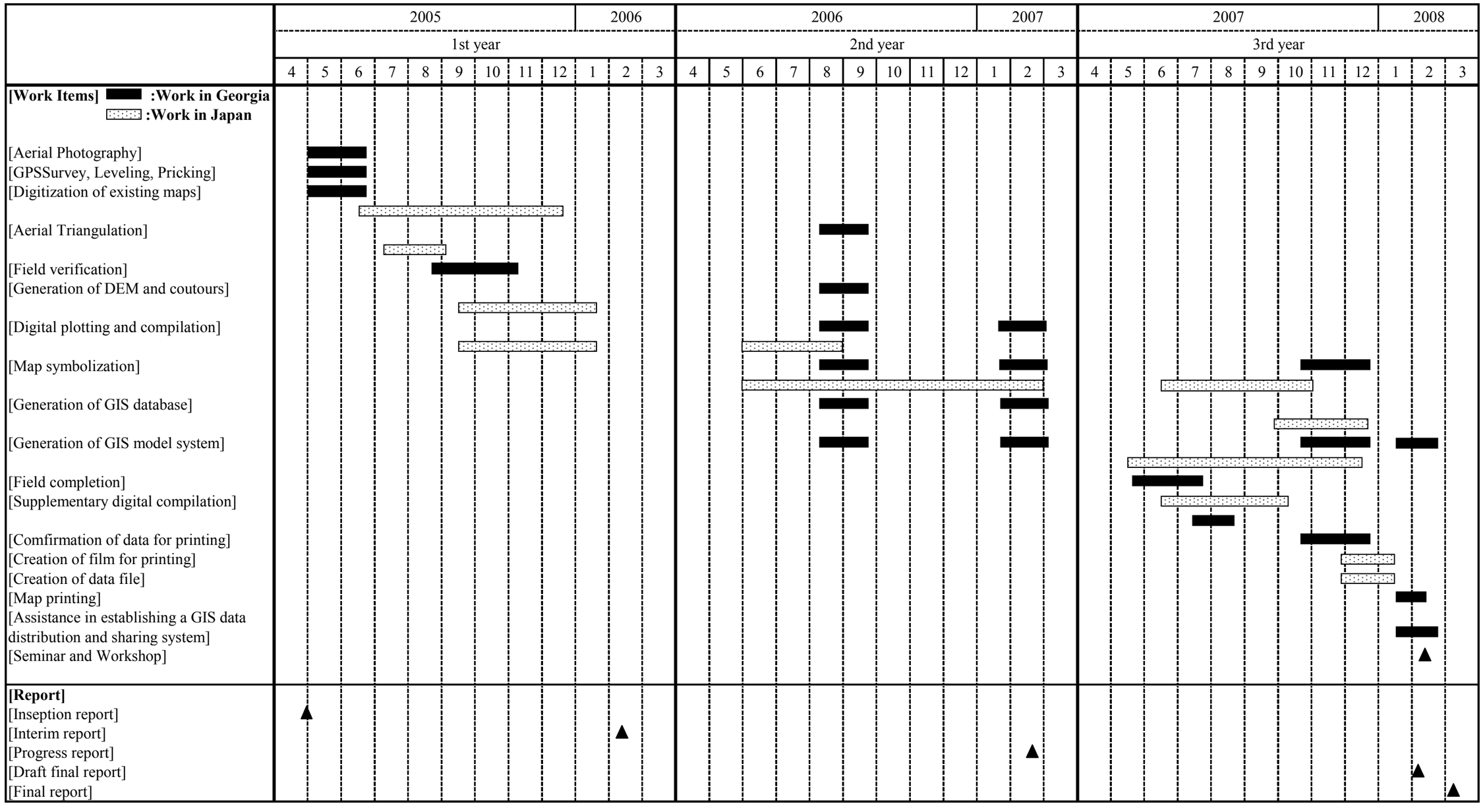
Table 1.2.5 Out comes of the Study from the Study

Item	Quantity	Remarks
Negative films of aerial photographs	1 set	Covering 30,000 km^2
Scanned images of aerial photographs	1 set	
Contact prints of aerial photographs	1 set	Panchromatic films
Flight index sheet of aerial photographs	1 set	
Result of field survey	1 set	Ground Control Points
Result of aerial triangulation	2 blocks	1,441 models
Films for printing maps	1 set	Scale: 1:50,000
Digital data file of topographic maps	5 sets	
Topographic maps	500 copies	Scale: 1:50,000 250 copies in English 250 copies in Georgian
GIS model system	1 set	6 models for Coordinating Committee
Inception report	10 copies of English 10 copies of Russian	
Interim report	10 copies of English	As per request of the

	10 copies of Georgian	counterpart, Report in Georgian was prepared instead of Russian
Progress report	10 copies of English	
	10 copies of Georgian	
Draft final report : Main report	10 copies of English	
	10 copies of Georgian	
: Summary	10 copies of English	
	10 copies of Georgian	
Final report : Main report	10 copies of English	
	10 copies of Georgian	
: Summary	10 copies of English	
	10 copies of Georgian	

1.3. Implementation schedule

The following table shows each process of the Study.



1.4. Members of the Study Team

The members of the Study Team and their dispatch from Japan to Georgia for the Study are as follows;

1.4.1. The 1st year

TITLE	NAME	STUDY PERIOD
Team Leader	Fujio ITO	25 Apr. – 14 May. 2005
		28 Jan. – 10 Feb. 2006
Project Adviser	Hisashi MORI	04 Apr. – 06 Jun. 2005
Supervisor for aerial Photography	Timo JARVINEN	28 Apr. – 26 Jul. 2005
Supervisor for control Survey	Yutaka NAKADA	27 Apr. – 24 Jun. 2005
Supervisor for field verification 1	Sadao MATSUMOTO	27 Aug. – 09 Nov. 2005
Supervisor for field verification 2	Toshinori OTSU	27 Aug. – 09 Nov. 2005
Supervisor for revision of existing map	Akihiro SUGITA	27 Apr. – 24 Jun. 2005
Supervisor for construction GIS model system	Hidetoshi KAKIUCHI	27 Apr. – 15 May 2005
Supervisor for map symbolization	Takashi SHIMONO	27 Apr. – 15 May 2005
Interpreter	Makiko UEHARA	27 Apr. – 24 Jun. 2005
Coordinator	Kensuke KIMURA	27 Apr. – 01 Jun. 2005
		27 Aug. – 18 Sep. 2005

1.4.2. The 2nd year

TITLE	NAME	STUDY PERIOD
Deputy Leader	Hisashi MORI	29 Jul. – 23 Aug. 2006
		22 Jan. – 20 Feb. 2007
Supervisor for digital plotting and compilation	Minori ONAKA	12 Aug. – 25 Sep. 2006
		22 Jan. – 07 Mar. 2007
Supervisor for GIS Database	Awadh Kishor SAH	12 Aug. – 25 Sep. 2006
		22 Jan. – 07 Mar. 2007
Supervisor for construction GIS model system	Akihiro SUGITA	12 Aug. – 25 Sep. 2006
		22 Jan. – 07 Mar. 2007
Supervisor for map symbolization	Toshinori OTSU	12 Aug. – 25 Sep. 2006
		22 Jan. – 07 Mar. 2007
Coordinator	Kensuke KIMURA	12 Aug. – 10 Sep. 2006
		22 Jan. – 20 Feb. 2007

1.4.3. The 3rd year

TITLE	NAME	STUDY PERIOD
Team Leader	Hisashi MORI	20 May – 08 Jun. 2007
		31 Jan. – 29 Feb. 2008
Project adviser	Hisashi MORI	24 Oct. – 20 Nov. 2007
Supervisor for Supplementary Field Verification 1	Sadao MATSUMOTO	20 May – 27 Jul. 2007
Supervisor for Supplementary Field Verification 2	Akihiro SUGITA	20 May – 27 Jul. 2007
Supervisor for GIS Database	Awadh Kishor SAH	16 Jan. – 29 Feb. 2008
Supervisor for construction GIS model system	Akihiro SUGITA	24 Oct. – 23 Dec. 2007
		16 Jan. – 29 Feb. 2008
Supervisor for map symbolization	Toshinori OTSU	24 Oct. – 23 Dec. 2007
		16 Jan. – 29 Feb. 2008
Coordinator	Kensuke KIMURA	20 May – 03 Jun. 2007
		24 Oct. – 21 Nov. 2007
		31 Jan. – 29 Feb. 2008

Position	Name	2005												2006												2007												2008		
		1st Year												2nd Year												3rd Year														
		4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
Leader	Fujio ITO																																				
	Hisashi MORI																																				
Deputy Leader	Hisashi MORI																																				
Project Adviser	Hisashi MORI																																				
Aerial Photography	Timo JARVINEN																																				
GPS Survey	Yutaka NAKADA																																				
Field Verification 1	Sadao MATSUMOTO																																				
Field Verification 2	Toshinori OTSU																																				
	Akihiro SUGITA																																				
Revision of Existing Map	Akihiro SUGITA																																				
Digital Plotting and Compilation	Minori ONAKA																																				
Preparation of GIS Database	Awadh Kishor SAH																																				
Map Symbolization	Takashi SHIMONO																																				
	Toshinori OTSU																																				
Construction GIS Model System	Hidetoshi KAKIUCHI																																				
	Akihiro SUGITA																																				
Interpreter	Makiko UEHARA																																				
Coordinator	Kensuke KIMURA																																				

■ :Work in Georgia　□ :Work in Japan

1.5. Equipments of the Study

The equipments for the digital mapping and GIS were newly introduced into the counterpart office and the systems were used for the OJT.

The systems were constructed a system network, as shown in Figure 1.5.1.

The network system consists of 14 desktop computers, 4 laptop computers, two A0-size color plotter, an A0-size roll-type color scanner, an A3-size laser color printer, digital photogrammetric software, GIS software and map symbolization software.

Table 1.5.1 List of the installed equipments

Item	Model	QTY
Scanner	HP DesignJet 4200	1
Printer	HP Color laserJet 5550n	1
Printer	HP DesignJet 4000ps	2
	HP Officejet 7313	1
Workstation (Desktop Computer)	HP xw8200	2
	HP xw4300	4
	HP dc7600	6
	HP dx2000	2
Laptop Computer	Fujitsu Siemens Celsius H230	2
	HP nx7010	2
GPS	Leica GPS System 1200	4
Digital Level	Leica Digital Level Sprinter100	4
Total Station	Leica TC805	2
SOFTWARE	Arc View 9.1 single use	6
	Arc View 3.3	1
	Arc Info 9.1	1
	Spatial Analyst	1
	3D Analyst	1
	Network Analyst	1
	ERDAS IMAGINE 8.7 Professional	1
	Virtual GIS	1
	Leica LPS DTM	1
	Leica LPS PRO600	1
	Autodesk CAD	2

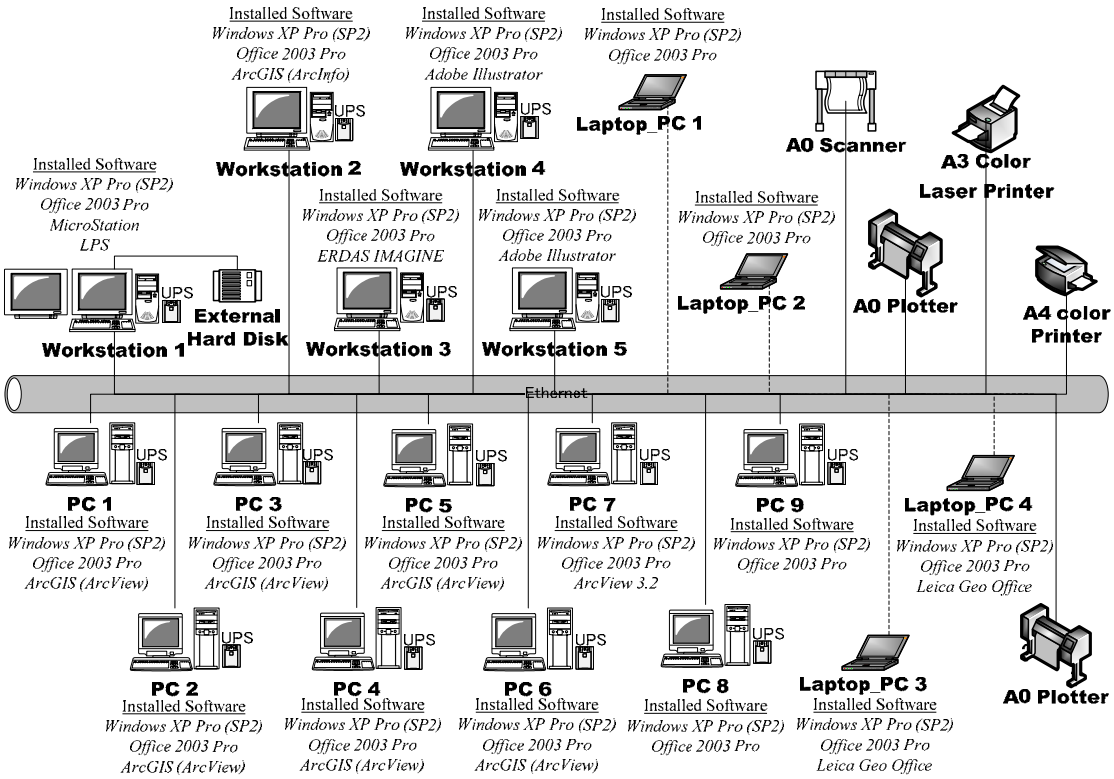
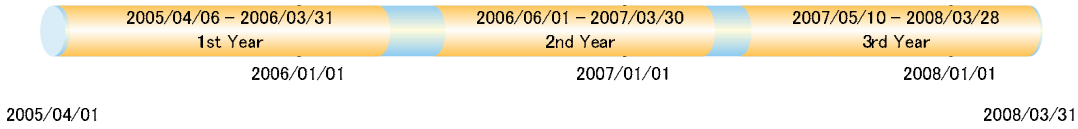


Figure 1.5.1 Aspect of Computer Network

Chapter 2. Summary of the Study Work Over the Past 3 Years



2.1. The works in Georgia (2005)

The work in Georgia for fiscal year 2005 was two-phased: the 1st work took place between April and November 2005 and the second work from January to March, 2006. The following works were carried out.

- Discussion on map symbolization: WGS84 and the UTM (Universal Transverse Mercator) coordinates were chosen as the survey standards by consultation with the counterpart. Further, 154 items were newly adopted as map symbols for the new maps to be created.
- Aerial photography: 1,447 aerial photos of 73 courses were taken with a scale of 1:40,000 over the Study Area of 30,000km^2.
- Control point survey: 33 ground control points were newly set up for GPS observation. Leveling was also carried out in order to obtain data for height correction in aerial triangulation.
- Field verification: Using the orthophotographs mentioned above, identification of geographical features and description items on maps and verification with photo images were conducted for digitization work to be held in Japan.
- Operation of and advice on the coordinating committee: In order to facilitate effective use of geographic information, the Study Team provided support in gathering organizations that use digital topographic data and setting up the coordinating committee. Working groups to promote use and utilization of the data for GIS model systems and task forces, composed of experts, were also established under the coordinating committee and three strategy meetings were held.

2.2. The works in Japan (2005)

The following works were conducted in Japan in parallel with the work in Georgia.

- Aerial triangulation: Digital aerial triangulation was conducted using GCP data and coordinate data of existing benchmarks obtained in Georgia. The results of adjustment calculation were accurate at an appropriate level and they were utilized in the digital mapping of new map.
- Generation of DEM and orthophotographs: Orthophotographs with a scale of 1:20,000 were generated based on the aerial triangulation results and digital images for easy field verification. 196 scenes cover the entire Study Area.
- Acquisition of existing map data (contours, waters, etc.): Existing data on contours, waters and forests were purchased as existing topographic data in the ArcGIS format with approval of the DGC. The data were checked, corrected and used as digital plotting data.
- Vectorization of existing topographic map data: Topographic data of basic map information items, such as roads, vegetation, railways, transmission wire, etc., were digitized based on the existing maps.
- Digital plotting and compilation of new maps: An area of 3,500m^2 of the Study Area was newly digitized with the digital plotter in the work in Japan for the 1st year.
- Training of counterparts: Two counterpart personnel visited Japan between November 14th, 2005 and December 9th, 2005 to participate in the technology transfer sessions on aerial triangulation, vectorization of existing map data, generation of annotation data, and an introduction to GIS. These sessions were held in Pasco Corporation.

2.3. The works in Georgia (2006)

The work in Georgia for the 2nd year was carried out under the reformed new organization that had taken over the basic policy that had been adopted preliminary.

The member of counterpart was grouped into 3 groups on consideration with ability and experience of each staff to achieve a most optimum effect by the technology transfer.

The following is the list of counterpart staff who took part in the OJT works.

Table 2.3.1 The list of the OJT staff assigned to each group

#	Name	Organization	Field
	Sasha Avetisov	GCGS	Supervisor on plotting, symbolization and field verification
1	Zaza Mdzeluri	Agency	Plotting , GIS, Field verification Responsible for IT
2	Otar Demetrashivili	Agency	Plotting, GIS, Field verification
3	Maka Devidze	Agency	Plotting, GIS
4	Bela Chalauri	Agency	Plotting, Symbolization
5	Galina Matchabeli	GCGS	Plotting, Annotation
6	Shalva Rukhadze	GCGS	Symbolization, Annotation, Field verification
7	Irakli Gotsadze	Agency	Symbolization, Field verification
8	Tedo Gorgozde	Agency	Symbolization, Annotation, Field verification
9	Giorgi Peradze	Agency	Symbolization, Field verification
10	Khatuna Alasania	GCGS	Symbolization, Annotation
11	Nino Khidirbegishvili	GCGS	GIS Data creation, symbolization, Task Force meeting organizer
12	Tamar Onashvili	GCGS	GIS thematic map creation
13	Mariam Gigauri	Agency	GIS thematic map creation, database creation
(14)*	David Svanadze	Agency	GIS thematic map creation, database creation
(15)*	Sopio Khorbaladze	Agency	GIS thematic map creation, database creation

Agency: Spatial Information Center

*: They left the agency in midstream.

The following works were carried out in Georgia.

- OJT for aerial triangulation, digital plotting and compilation: Technology on practical work of digital mapping of new maps was transferred using the newly introduced digital photo survey system.
- OJT for updating of the existing maps: Technology on the updating techniques was transferred using the newly introduced digitization and compilation equipment.
- OJT for establishment of GIS database: Technology on the establishment methodology and techniques was transferred using the newly introduced GIS equipment.
- OJT for map symbolization: Technology on the symbolizing techniques was transferred using the newly introduced symbolization equipment.
- OJT for preparation of GIS model systems: Technology on the establishment methodology and techniques was transferred using the newly introduced GIS equipment.

a) Although the former DGC was transformed into new body of organization, a Coordinating Committee that had been established in the 1st year continued to sustain the functions of playing a central role in making the best use of geographic information for facilitating the national-level development programs in each field.

b) A meeting of the Coordinating Committee was held during the 1st work of Georgia where upon the Study Team confirmed the continuity of the members and their activities.

c) Through repeated discussions with the members of individual taskforces under the coordinating committee, the themes and topics that each organization is willing to prioritize were narrowed down and also the GIS model areas best suited to such themes were selected finally in 6 areas.

d) Creation of data for GIS Model System was realized. Considering the data source, basically two types of GIS data were included for the GIS Models;

   A. Those from Topographic Maps so prepared under this Project, such as contour, road, rivers, vegetation, etc.

   B. Those that collected from the related organizations such as soil, forest including its inventory, etc.

- Discussion of progress report was made at the end of the 2nd year's work for the all staff including Agency personnel.

2.4. The works in Japan (2006)

The following works were conducted in Japan in parallel with the work in Georgia.

- Digital plotting and compilation of new maps: An area of 6,750m^2 of the Study Area was newly digitized with the digital plotter.
- Updating of the existing maps: An area of 14,130km^2 of the Study Area was updated with the digital plotter, CAD and GIS software.
- Map symbolization: An area of 10,500km^2 of the Study Area was symbolized with graphic software while the rest of 10,500km^2 was done by Georgian side as the OJT.

2.5. The works in Georgia (2007)

The following works were conducted in Georgia in parallel with the work in Japan.

- The field completion was conducted to verify the geographical features, names and description items that were plotted on the draft maps prepared newly in Japan. The field verifications were made by the staff of the SGC and Agency as OJT under supervision of the Study Team. Four (4) groups were formed to carry out the work.
- OJT on construction and analysis of GIS databases and map symbolization were implemented as a means of technology transfer, targeting the counterpart (SGC), by both preparing GIS database for five map sheets and preparing five digital map data.
- For the purpose of extensive use of topographic data as well as GIS database, a series of meetings with the SGC was held to exchange the opinions about a shared system and centralized administration of geographic data, and to discuss and sort out future visions and recommendations thereof.
- Confirmation of printed maps: The Study Team discussed the point of inspection on the map contents with the SGC, and the SGC went over all the map sheets to verify each of them for necessary corrections prior to the creation of printing films.

2.6. The works in Japan (2007)

The following works were conducted in Japan after the field completion.

- Using the newly-plotted and compiled digital maps incorporated with the corrected information from the field completion, which was done prior to this work component, supplemental editing of final map data was carried out for 34

map sheets, equivalent to the mapping area of 21,000km^2.

- Based on the edited data obtained through the process of supplemental compilation, the structuralization of digital map data to prepare GIS database was carried out in accordance with the specifications discussed in the work in Georgia during the 1st year.
- Development of GIS model systems:
  GIS models were elaborately created in Japan, using 1:50,000 topographic basic data as well as the data collected and prepared as a database by cooperative participation of the parties concerned in Georgia. The models have resulted in covering the following 6 fields.
  1. Urban development
  2. Forest management
  3. Preservation of natural resources
  4. Agricultural Land Use
  5. Development of Tourism
  6. Educational facility information
- Preparation of printing films :
  After the draft maps verified by the SGC in detail and corrected finally on account of authorized proof, printing films for each color plate were created using the Image Setter in Japan.
- The digital data for the 1:50,000 topographic maps created during the third Work in Japan were stored in DVD.

2.7. The works in Georgia (2008)

- Using the printing films created during the fore mentioned work in Japan, 1:50,000 topographic maps were successfully printed by a local subcontractor.
- Seminars and workshops were organized for the purposes of promoting the wider use of GIS databases and digital topographic data and improving the capacity of users in related fields. Not only the parties concerned in this field but also press people were invited so as to leverage such an opportunity to spread the knowledge of the products from the Project.
- The Study Team prepared the draft of final report for achievement throughout the 3 years. The explanation for the contents of the report was given to the counterpart and discussion on the results was also made.