Republic of Guinea
Institut Géographique National (IGN)

The Large Scale Topographic Mapping Project for Sustainable Development in Conakry City and its Surrounding Area

Final Report Summary

August 2016

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

PASCO CORPORATION
KOKUSAI KOGYO CO., LTD.

EI
JR
16-111

Currency exchange rate
Currency unit: Guinea franc (GNF)
100 GNF = 1.15 yen (OANDA rate as of 30th June 2016)

Photographs

Previous office of C/P

New office of C/P

Existing benchmark

Output: Topographic map

Output: Simple map

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Abbreviations

Organization Names

ABBREVIATION	NAME IN FRENCH	NAME IN ENGLISH
BGDA	Bureau Guinéen du Droit d'Auteur	Guinea Copyright Office
EDG	Electricité de Guinée	Electricity of Guinea
IGN	Institut Géographique National	National Geographic Institute
IGN France	Institut Géographique National France	National Geographic Institute- France
JICA	Agence Japonaise de la Coopération Internationale	Japan International Cooperation Agency
MCI	Ministère de la Coopération Internationale	Ministry of International Cooperation
MATD	Ministère de l'Administration du Territoire et de la Décentralisation	Ministry of Land Administration and Decentralization
MP	Ministère du Plan	Ministry of Planning
MTP	Ministère des Travaux Publics	Ministry of Public Works
SAF	Service Administratif et Financer	Administrative and Financial Service
SEG	Société des Eaux de Guinée	Guinea water Society
MUHC	Ministère de l'Urbanisme de l'Habitat et de la Construction	Ministry of Land Urban Planning and Construction

Technical Terms and Others

ABBREVIATION	Standard Nomenclature
C/P	Counter Part
CCD	Charge Coupled Device
DEM	Digital Elevation Model
DGNSS	Differential Global Navigation Satellite System
GIS	Geographic Information System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
IMU	Inertial Measurement Unit
JCC	Joint Coordinating Committee
OJT	On-the-Job Training
UCD	UltraCam-D
UTM	Universal Transverse Mercator
WGS	World Geodetic System

Chapter 1 Outline of the Project

1.1 Background to the Project

The Guinean government requested the Japanese government to create large-scale topographic maps over an approximate area of 500km2 including Conakry City and its surrounding area in order to create geospatial information that will serve as the basis for infrastructure development plans aimed at solving some urban problems such as traffic congestion and deterioration of living environments due to a rapid increase in the population of Conakry City.

In response, the Japan International Cooperation Agency (JICA) dispatched a study team for establishing a detailed plan in February 2012, discussed with the National Geographic Institute (Institut Geographique National: IGN) of the Ministry of Public Works and Transport, an implementing organization of the Guinean national government, regarding creation of topographic maps of Conakry City and its surrounding area and technology transfer related to it, and signed a Record of Discussion (R/D) as of February 24th, 2012. This Project was implemented according to the above R/D.

1.2 Objectives of the Project

This Project is aimed at:

- Creating 1/5,000-scale digital topographic maps and orthophotos of an area of ca. 520.79 km^2 including Conakry City and its surrounding area; and
- Transferring the technologies for basic surveying and maintenance/updating of the digital topographic maps.

1.3 Project Implementation Period

This Project is implemented in a period from September 27th, 2012 to August 26th, 2016.

The work in Guinea was initially planned to be implemented in September 2014 but was postponed to April 2016 for the sake of safety due to an outbreak of Ebola hemorrhagic fever in the country. Consequently, the project completion date was changed from the one planned at the start of the project (the project was originally scheduled for completion on October 22nd, 2014 at the project start).

1.4 Counterpart

The counterpart (C/P) organization of this Project is the National Geographic Institute (Institut Geographique National: IGN). IGN is situated in the Ministry of Public Works (Ministère des Travaux Publics: MTP) and is responsible for managing and updating measurement outputs for the

entire land of Guinea. IGN has 36 staff members as of June 2016.

1.5 Establishment of Joint Coordinating Committee

In this Project, a Joint Coordinating Committee (JCC) consisting of members of relevant authorities with usage needs was established to promote utilization of geospatial information. For the member organizations and details of JCC, see Section 4.2, "Joint Coordinating Committee."

1.6 Project Details and Work Schedule

This Project includes creation of topographic maps, technology transfer to C/P personnel, and activities for promoting utilization of geospatial information as shown in Figure 1-1 and Table 1-1.

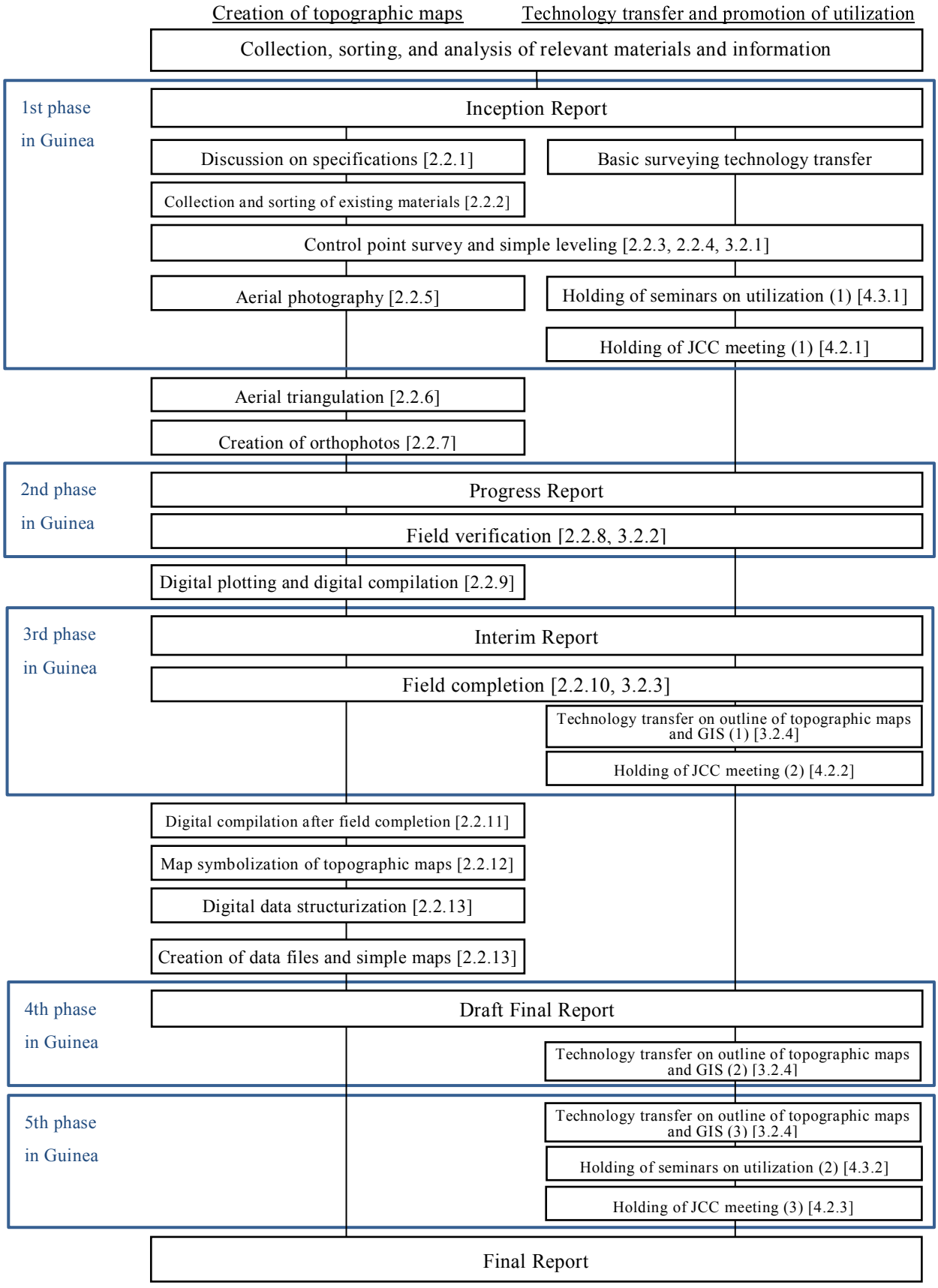
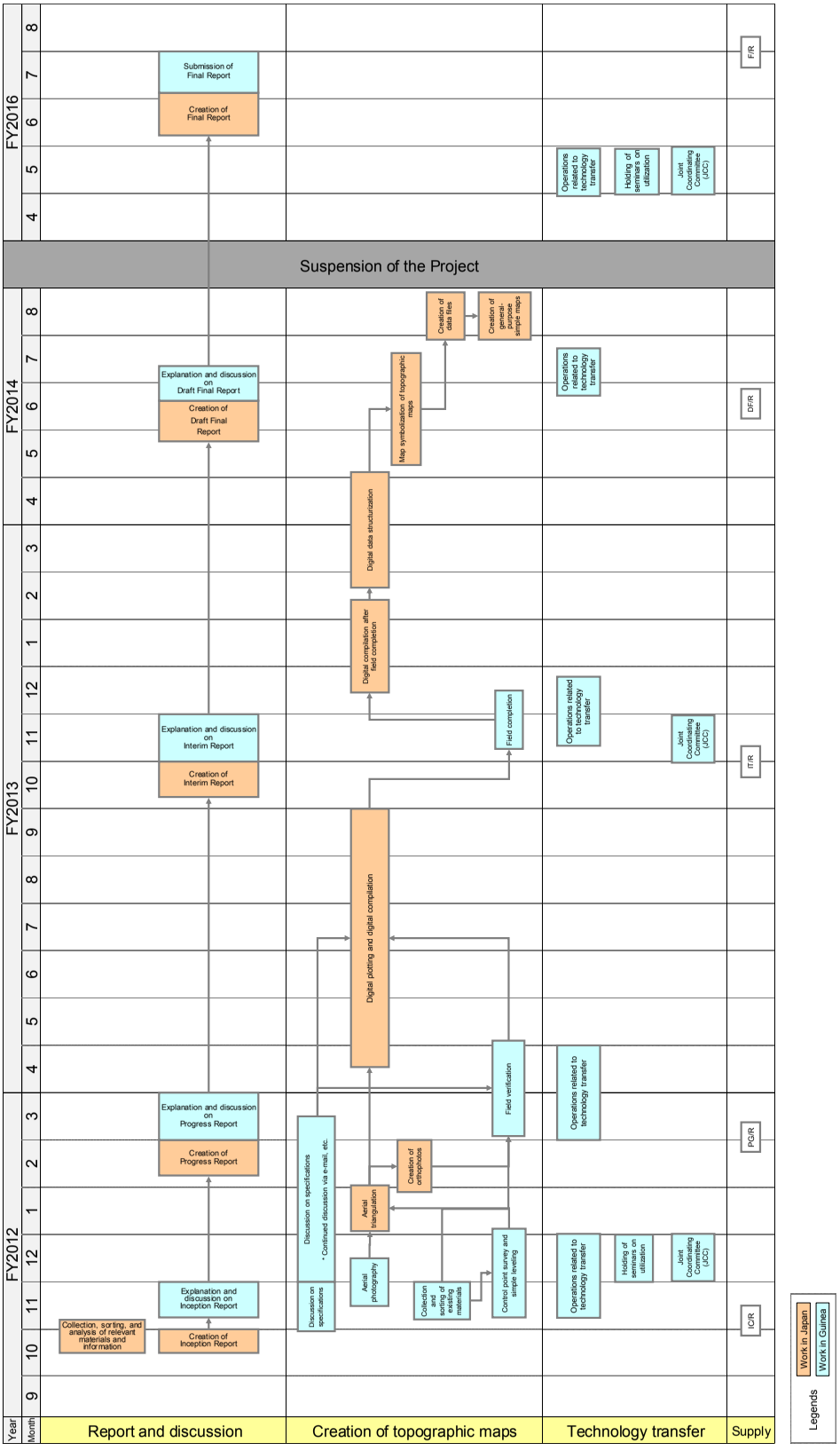


Figure 1-1 Project Details

Table 1-1 Work Schedule



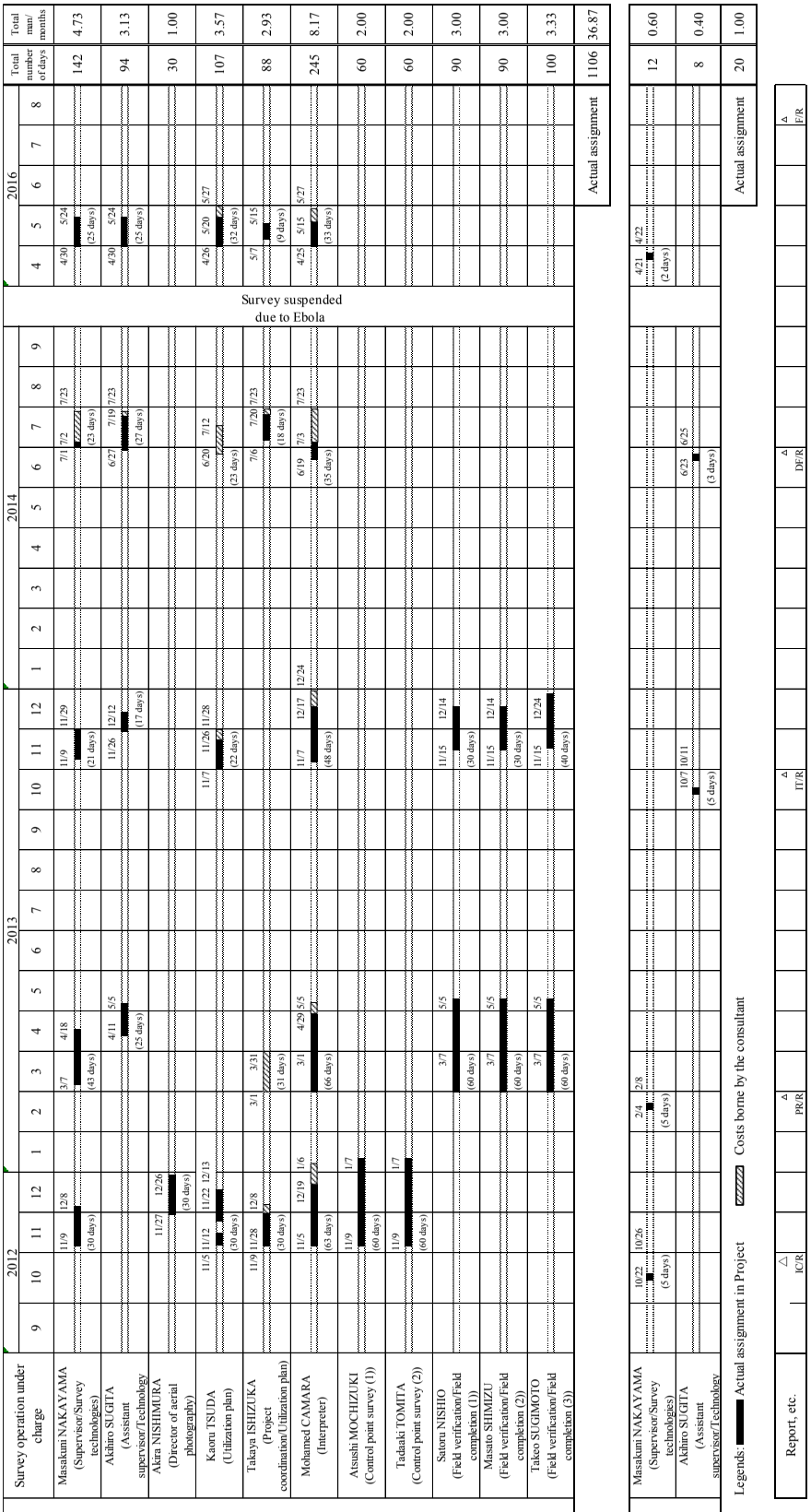
1.7 Project Members and Actual Assignment

The project members who were engaged in this Project are shown in Table 1-2 and their actual assignments are shown in Table 1-3.

Table 1-2 List of Project Members

Name	Survey operation under charge	Agency
Masakuni NAKAYAMA	Supervisor/Survey technologies	PASCO CORPORATION
Akihiro SUGITA	Assistant supervisor/ Technology transfer plan	PASCO CORPORATION
Akira NISHIMURA	Director of aerial photography	KOKUSAI KOGYO CO., LTD.
Kaoru TSUDA	Utilization plan	PASCO CORPORATION
Satoru NISHIO	Field verification/Field completion (1)	KOKUSAI KOGYO CO., LTD.
Masato SHIMIZU	Field verification/Field completion (2)	KOKUSAI KOGYO CO., LTD.
Takeo SUGIMOTO	Field verification/Field completion (3)	PASCO CORPORATION
Atsushi MOCHIZUKI	Control point survey (1)	PASCO CORPORATION
Tadaaki TOMITA	Control point survey (2)	PASCO CORPORATION
Mohamed CAMARA	Interpreter	KOKUSAI KOGYO CO., LTD.
Takaya ISHIZUKA	Project coordination	PASCO CORPORATION

Table 1-3 Actual Assignment of Project Members



1.8 Outputs

1.8.1 Reports

The reports listed in Table 1-4 were submitted in relation to this Project.

Table 1-4 List of the Reports as Outputs

Report		Quantity	Remarks
Inception Report		5 copies in Japanese 15 copies in English 15 copies in French	Including 10 copies in English and 10 copies in French submitted to the Guinea national government.
Progress Report		5 copies in Japanese 15 copies in English 15 copies in French	Including 10 copies in English and 10 copies in French submitted to the Guinea national government.
Interim Report		5 copies in Japanese 15 copies in English 15 copies in French	Including 10 copies in English and 10 copies in French submitted to the Guinea national government.
Draft Final Report			
	Main Report	10 copies in Japanese 15 copies in English 15 copies in French	Including 10 copies in English and 10 copies in French submitted to the Guinea national government.
	Summary	10 copies in Japanese 15 copies in English 15 copies in French	Including 10 copies in English and 10 copies in French submitted to the Guinea national government.
Final Report			
	Main Report	10 copies in Japanese 15 copies in English 15 copies in French	Including 10 copies in English and 10 copies in French submitted to the Guinea national government.
	Summary	10 copies in Japanese 15 copies in English 15 copies in French	Including 10 copies in English and 10 copies in French submitted to the Guinea national government.

1.8.2 Outputs Related to Creation of Topographic Maps

The data, printed materials, and documents listed in Table 1-5 were created as outputs related to creation of topographic maps.

Table 1-5 List of Outputs Related to Creation of Topographic Maps

Item	Quantity	Remarks
Field survey results	1 set	1 set for the Guinea national government
Aerial triangulation results	1 set	1 set for the Guinea national government
Digital data files		
1/5,000 topographic map data	2 sets	1 set for the Guinea national government
1/5,000 GIS* database	2 sets	1 set for the Guinea national government
1/5,000 topographic map data in PDF format "PDF topographic maps"	3 sets	1 set for the Guinea national government
Digital aerial photograph data	1 set	1 set for the Guinea national government
Orthophoto data	2 sets	1 set for the Guinea national government
Booklets		
A3 size "1/5,000 Topographic Map Booklet (A3 Size)"	100 sets	100 sets for the Guinea national government
Original map size "1/5,000 Topographic Map Booklet (Full Size)"	4 sets	4 sets for the Guinea national government
General-purpose simple map "Simple Map of Conakry City"	1,000 sets	1,000 sets for the Guinea national government
Report on quality control "Accuracy Control Report"	1 set	
Work manuals (described in detail later)	1 set	1 set for the Guinea national government

* Geographic Information System

1.8.3 Outputs Related to Technology Transfer

The work manuals listed in Table 1-6 were created as outputs related to technology transfer.

Table 1-6 List of Outputs Related to Technology Transfer

Item	Quantity
Work manual for control point survey and simple leveling	1 set
Work manual for field verification (including the uses of GPS-enabled digital cameras and handy GPS receivers)	1 set
Work manual for field completion	1 set
Work manual for GIS	1 set

1.9 Results of the Project

This Project created 1/5,000-scale digital topographic maps and orthophotos of an area of ca. 520.79 km^2 including Conakry City and its surrounding area. It also transferred to the C/P personnel the technology required to appropriately maintain and update the geospatial information including topographic maps that have been created. Furthermore, activities were carried out to promote utilization of geospatial information, such as development of an environment and wide-ranging advertising for promotion and sale of geospatial information. The Project Team carried out activities according to the basic policies set forth at the project start as shown in Table 1-7.

Before the start of this Project, Guinea had only topographic maps created more than 30 years ago. Therefore, a vicious circle existed: The topographic maps were too old to be used; No budget was allocated because they were not used; The maps were not updated because of lack of budget, equipment, and technology; and the maps became more obsolete. The outputs of this Project will provide an opportunity for generating a virtuous circle. IGN, the C/P in this Project, must recognize the completion of this Project not as a goal but as a start and permanently update geospatial information, maintain and develop technologies that have been transferred, and promote utilization of geospatial information.

Table 1-7 Results of the Project

Basic policies that have been set forth	Results
Creating topographic maps that will serve as the standard for Guinea	The Project Team created topographic maps that will serve as the standard for Guinea in collaboration with the C/P, using the items in the legend of the 1/5,000-scale topographic maps provided in the "Survey International Specifications (for Base Maps)" (Japan International Cooperation Agency, December 2006) to be referenced in geospatial information development projects implemented by JICA and the "Standard Map Symbols and Standard Classification of Measurement of Digital Topographic Map Data in Public Surveys" (published by the Ministry of Land, Infrastructure, Transport and Tourism of Japan) to be referenced in Japan, based on experience and knowledge acquired in similar projects implemented by the Project Team in various countries.
Realizing an environment that facilitates sharing of topographic information for everyone	The Project Team held JCC meetings and gave seminars to inform the relevant authorities of the supply method, selling prices, and examples of utilization for geospatial information created in this Project. Furthermore, the seminars were advertised on TV and in newspapers to inform the Guinean people of this Project and geospatial information. At the seminars on utilization, a simple map of Conakry City was given away free of charge to the participants and a special sale of the "Simple Map of Conakry City" and "1/5,000 Topographic Map Booklet (A3 Size)" was conducted as a means for creating an environment for promotion.

Basic policies that have been set forth	Results
Transferring the basic technologies for ensuring prolonged use of topographic maps	The Project Team transferred basic technologies for creating and updating data using open-source GIS software that can be used by anyone with a focus on allowing the C/P to update on its own the geospatial information created in this Project.
Carrying out the fieldwork in consideration of regional characteristics	The Project Team planned and implemented the fieldwork in a period other than the rainy season to avoid risks. Although the security became unstable due to an election of the National Assembly during the project implementation period, the Project Team shared safety information with the Japanese Embassy in Guinea and the JICA Senegal office and implemented this Project without accident.
Coordinating between JCC members carefully	JCC meetings were held at the beginning, middle, and end of this Project to discuss the objectives and progress of this Project and how to utilize the geospatial information in Guinea from now on and share the ideas of the JCC members.

Chapter 2 Work for Creating Topographic Maps

2.1 Outline of Work

2.1.1 Purposes

This work is aimed at creating 1/5,000-scale digital topographic maps and orthophotos of Conakry City and its surrounding area as the basis for improving the urban infrastructure to address urban problems occurring in this area.

2.1.2 Scope of Creation

As a result of discussion between the Project Team and the C/P, the scope for creating digital topographic maps and orthophotos was determined to be an area of 520.79 km^2 including Conakry City and its surrounding area as shown in Figure 2-1.

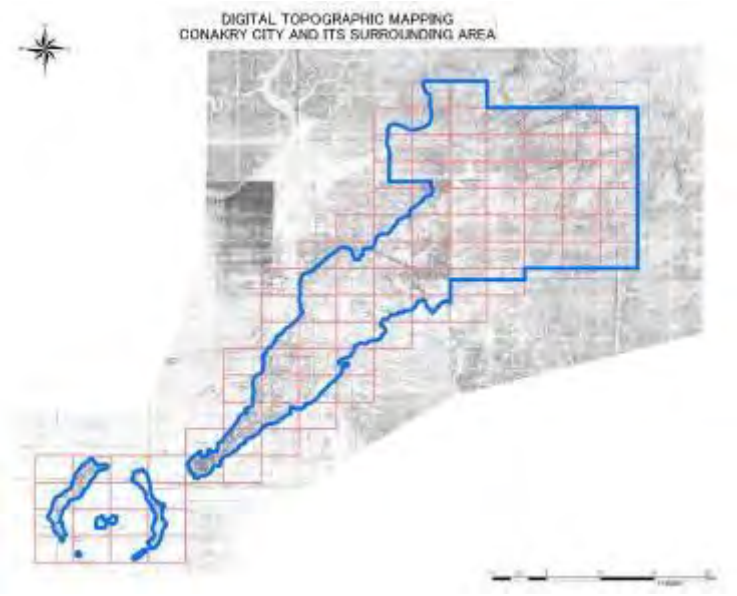


Figure 2-1 Scope for Creating Topographic Maps and Orthophotos (Conakry City and its Surrounding Area)

2.1.3 Work Period

September 27th, 2012 to August 26th, 2016 (Same as the implementation period of this Project)

2.1.4 Workflow

The work progressed according to the workflow shown in Figure 2-2. As part of technology transfer efforts, some C/P personnel participated in the control point survey, simple leveling, field verification, and field completion.

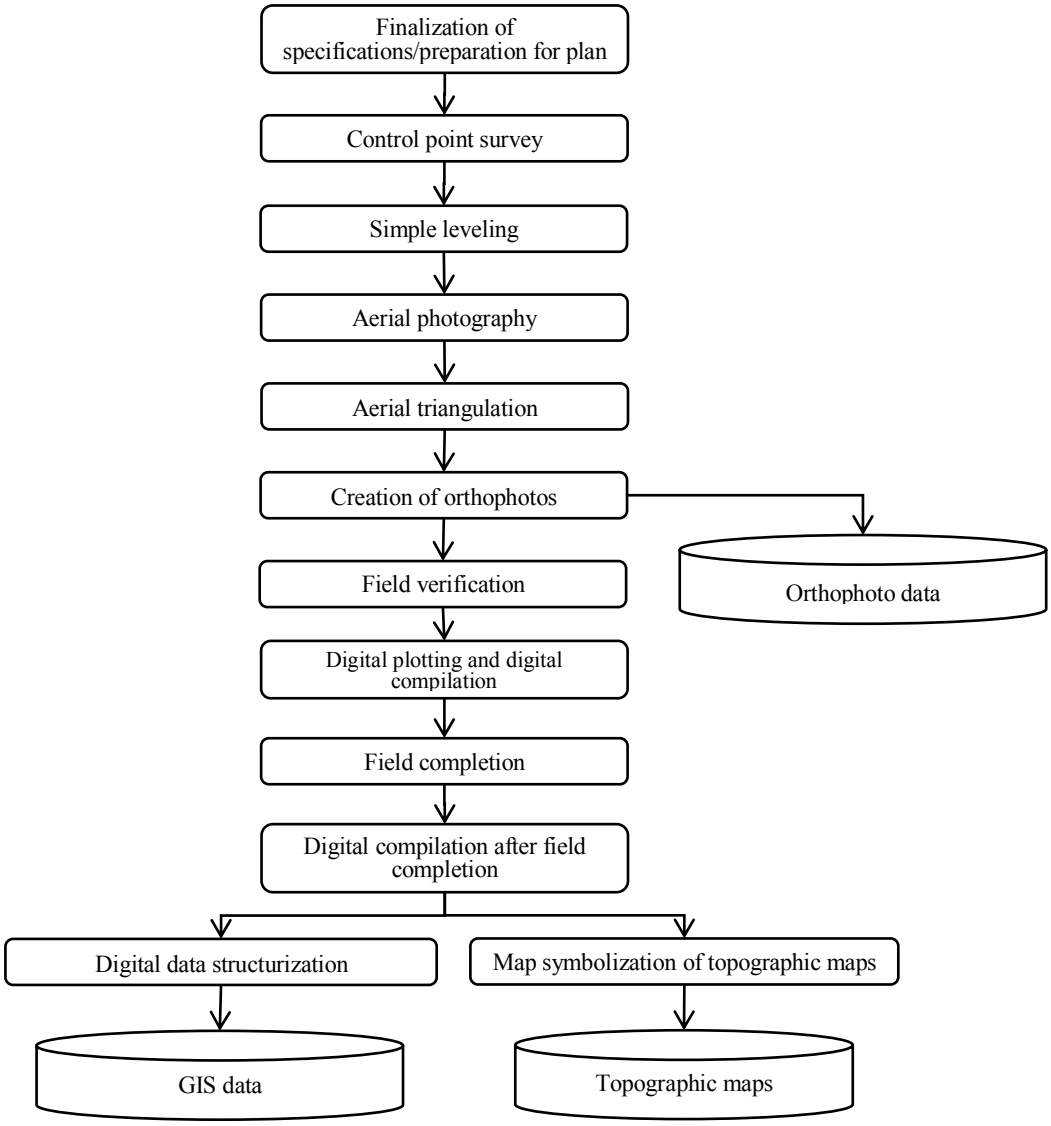


Figure 2-2 Workflow for Creating Topographic Maps

2.1.5 Compliance with Standards

All the works related to creating topographic maps were carried out according to the "Survey International Specifications (for Base Maps)" (Japan International Cooperation Agency, December 2006). The Project Team also checked that the accuracy standard was met using an accuracy control sheet for each work process according to the above specifications before proceeding to the next process.

2.2 Project Details

2.2.1 Discussion on Specifications [Work in Guinea]

The Project Team discussed with the C/P and determined the specifications of orthophotos and topographic maps to be created in this Project as follows.

(1) Survey Standards and Accuracy of Outputs

As a result of discussion between the Project Team and the C/P, the survey standards, accuracy of topographic maps, and accuracy of orthophotos were determined as shown in Table 2-1, Table 2-2, and Table 2-3. Also as a result of discussion with the C/P, the map sheet division was determined as shown in Figure 2-3 and the number of map sheets was 93.

Table 2-1 Survey Standards

Geodetic coordinate system	WGS84
Reference ellipsoid	WGS84 a (semi-major axis) = 6378137.00 m f (oblateness) = 1/298.257223563
Horizontal coordinate system	UTM (Zone 28N) False_Easting (eastward distance): 500,000.0 m False_Northing (northward distance): 0.0 m Central_Meridian: Longitude 15.0 degrees west Scale_Factor: 0.9996 Latitude_Of_Origin: 0 Unit: Meter
Height criteria	Based on the output of (existing) national benchmarks of Guinea

Table 2-2 Accuracy of Topographic Maps

Category		Accuracy (standard deviation)
Horizontal location of a planimetric feature		0.7 mm or less on a map
Elevation	Elevation point	1/3 or less of contour intervals
	Contour line	1/2 or less of contour intervals

Table 2-3 Accuracy of Orthophotos

Category		Accuracy
Map information level		5,000
Horizontal positional accuracy		3.5 m or less
Ground resolution		0.8 m or less
Digital elevation model*	Grid spacing	50 m or less
	Elevation point accuracy	2.5 m or less

*Digital Elevation Model: DEM

Figure 2-3 Map Sheet Division

(2) Map Symbols Regulation

The Project Team prepared the map symbols regulation according to the result of discussion with the C/P using the items in the legend of the 1/5,000-scale topographic maps provided in the "Survey International Specifications (for Base Maps)" (Japan International Cooperation Agency, December 2006) and the "Standard Map Symbols and Standard Classification of Measurement of Digital Topographic Map Data in Public Surveys" published by the Ministry of Land, Infrastructure, Transport and Tourism of Japan and based on the case study on the map projects of equal scales implemented in the African countries (such as Mauritania and Burundi).

2.2.2 Collection and Sorting of Existing Materials [Work in Guinea]

The Project Team collected copies of leveling results of existing benchmarks and topographic maps created in the period between the late 1920's and the 1980's. Furthermore, the Project Team also borrowed from the C/P the simple topographic maps created by the National Geographic Institute (Institut Géographique National France: IGN France) in the 1980's.

2.2.3 Control Point Survey [Work in Guinea]

The control point survey is carried out to establish relationships between points in the photographs and the coordinates on the ground in aerial triangulation or digital plotting operation. The survey refers to installing points (control points) on the ground and observing the points that have been installed to acquire accurate coordinates of them.

In this Project, 24 control points were surveyed. Since this work was also part of technology transfer efforts, two project members accompanied each of the four teams of C/P personnel as required and provided guidance and supervision on the work procedures.

The outputs prepared in this work are aerial marker details registers, control point survey results, a control point network map and an accuracy control sheet.

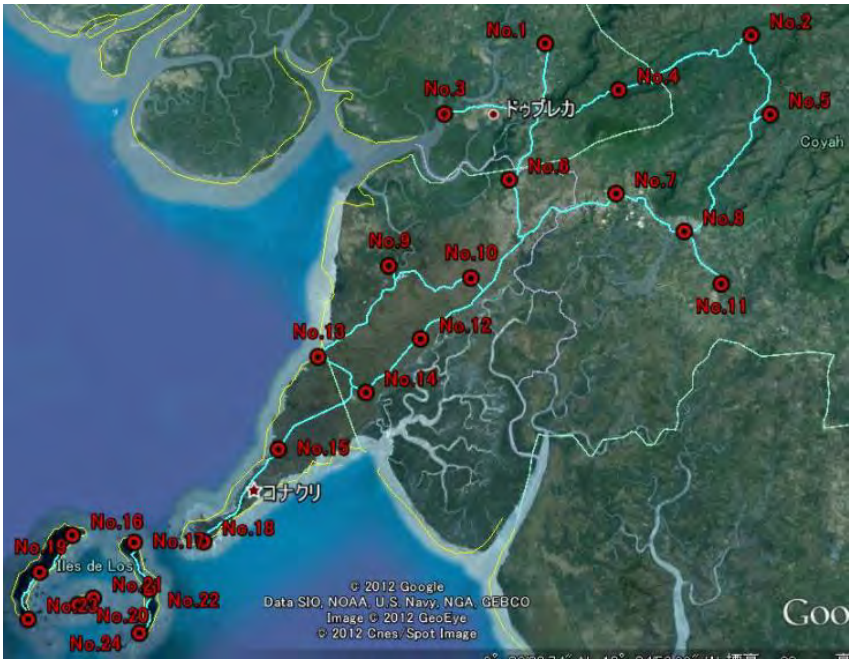


Figure 2-4 Control Point Distribution Map

Photo 2-1 Installation of an Aerial Marker

2.2.4 Simple Leveling [Work in Guinea]

Simple leveling is carried out to acquire the height of an installed control point.

Since this work was also part of technology transfer efforts, four teams of C/P personnel were formed and carried out the work under the supervision of the project members.

Observation records, calculation results and pricking point details registers (of elevation values of BMs including their coordinates observed with handy GPS receivers) were prepared as the outputs of this work.

2.2.5 Aerial Photography [Work in Guinea]

In November 2012, the Project Team implemented the aerial photography based on the specification for the aerial photography shown in Table 2-4 and according to the workflow shown in Figure 2-5. In 22 photography courses, 1069 aerial photographs were taken.

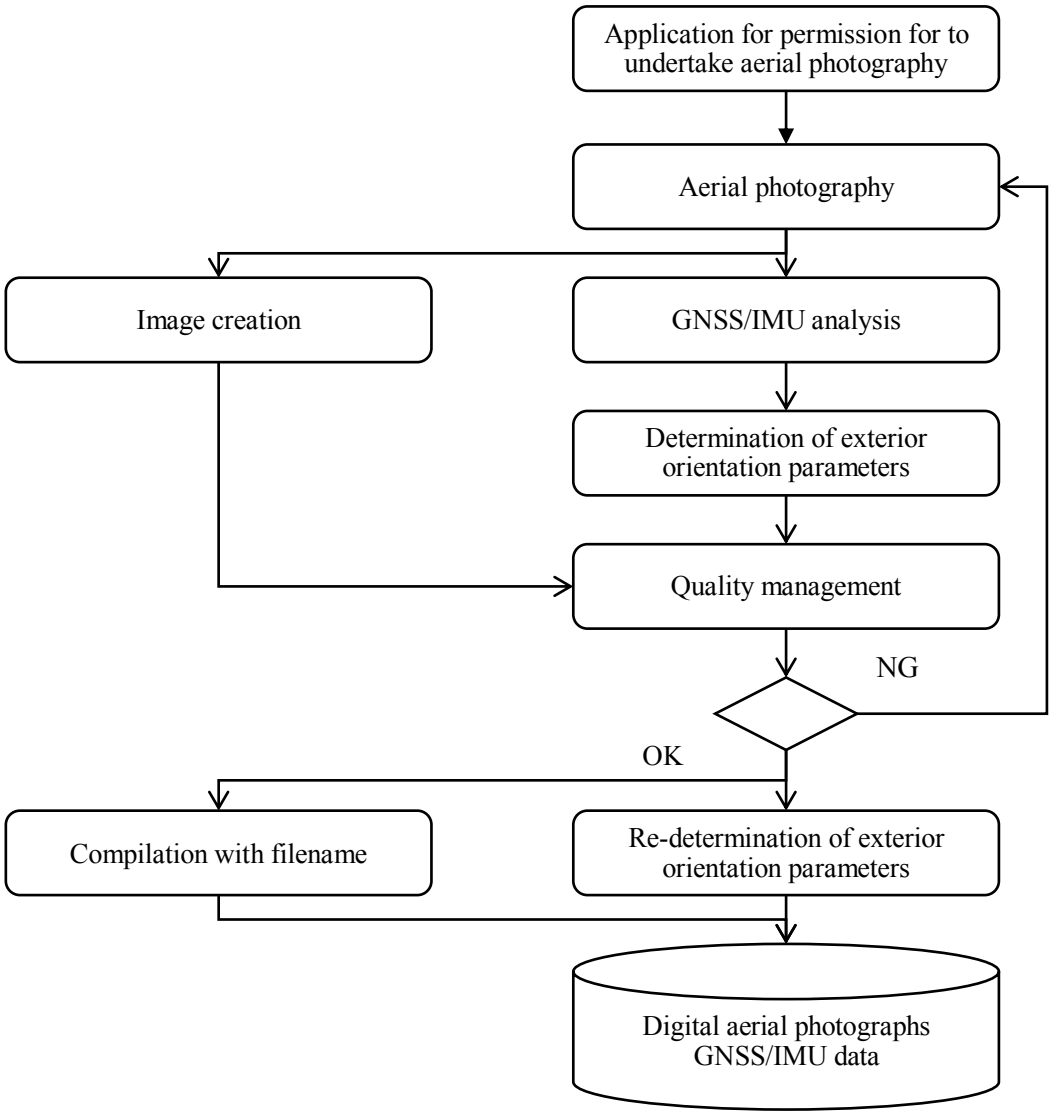


Figure 2-5 Workflow for Aerial Photography Using Digital Cameras

Table 2-4 Aerial Photography Specifications

Photography resolution	20 cm resolution
Photography type	Digital color photography (Tiff)
Aircraft used for photography	Aero Commander 690 with the immatriculation SE-LZU
Camera	UltraCam-D (UCD) of Vexcel
Above ground level	Approx. 2,300 m on the average
Overlap rate	Overlap rate of 60 ± 5% and sidelap rate of 30 ± 5%
Allowable cloud cover	3% or less in five continuous photos
Photographing conditions	The coordinates of a principal point in the photo shall be acquired using DGNSS*1, and the attitude angle shall be acquired using IMU*2.
Image processing	To be processed in Guinea (Creation of images and rush prints)

*1 Differential GNSS (Global Positioning Navigation Satellite System, a technology for improving the accuracy of measurement results of GPS)

*2 Inertial Measurement Unit

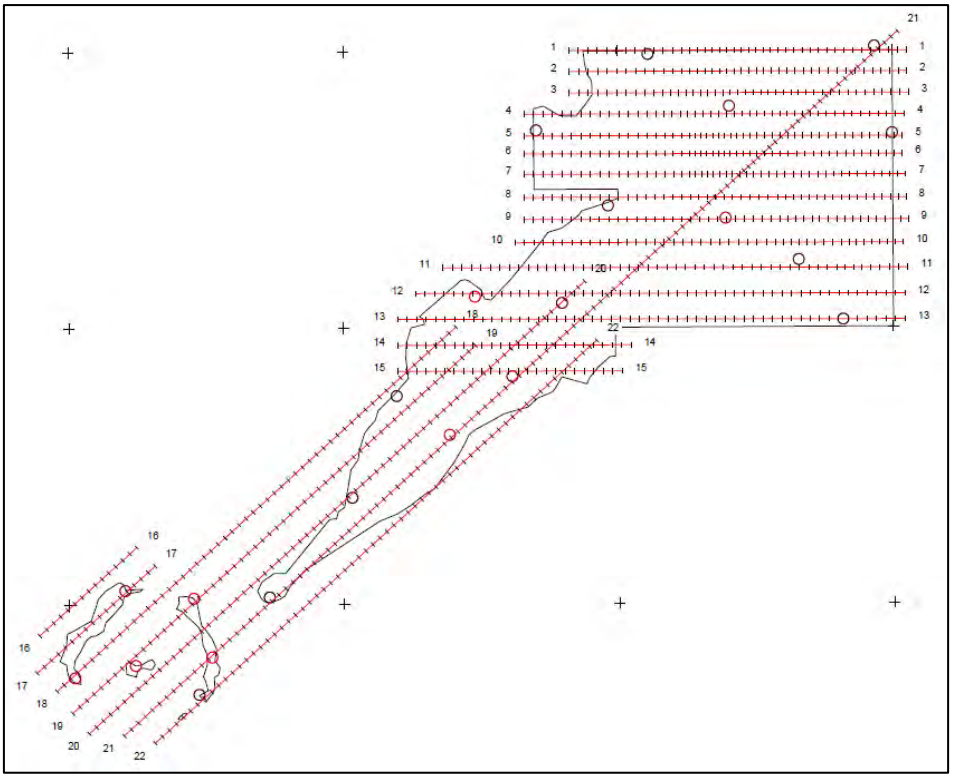


Figure 2-6 Photography Plan Map

Photo 2-2 Aircraft (Left) and Digital Camera (Right) Used for Photography

2.2.6 Aerial Triangulation [Work in Japan]

Aerial triangulation refers to measuring coordinates of pass points[1], tie points[2], control points, etc. on the photographs using a stereo plotter and conducting adjustment calculation by integrating control point survey results and positional information of principal points on the photographs in order to determine the output values of the positional information of principal points on the photographs and the horizontal positions and elevations of pass points, tie points, etc.

The Project Team implemented aerial triangulation based on digital aerial photograph data acquired in the aerial photography and GNSS/IMU data according to the workflow shown in Figure 2-7.

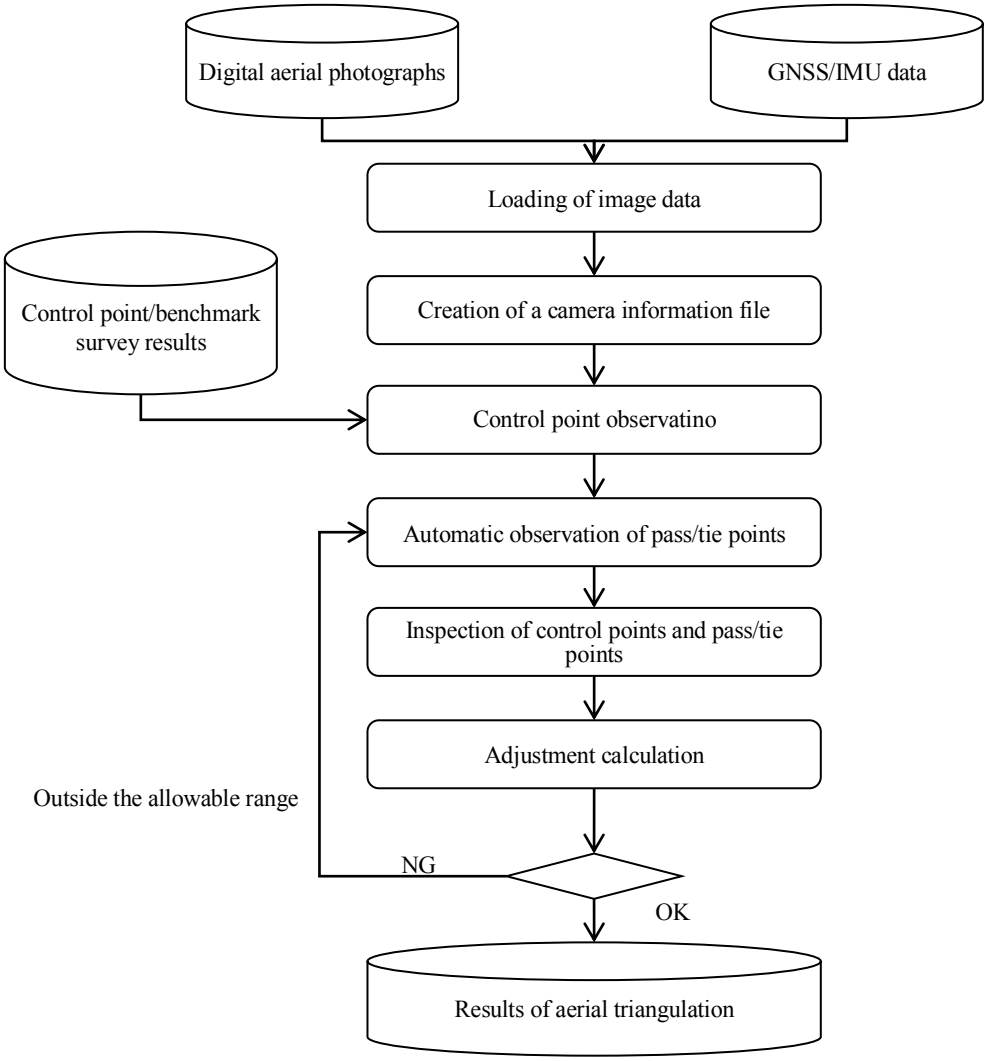


Figure 2-7 Aerial Triangulation Workflow

[1] A point marked at a place where it can be recognized clearly on overlapping adjacent photographs taken on the same flight course in order to image-match those photographs

[2] A point marked at a place where it can be recognized clearly on overlapping adjacent photographs taken on adjacent flight courses in order to image-match those photographs

2.2.7 Creation of Orthophotos [Work in Japan]

An orthophoto is created by acquiring an aerial photograph with central projection and processing it with orthogonal projection to correct distortions using elevation information.

Based on the specifications shown in Table 2-5, the Project Team created orthophotos by creating stereo models from the data of digital aerial photograph images and the aerial triangulation outputs, creating DEMs with 20 m grid spacing, and correcting distortions in the digital aerial photos.

Table 2-5 Specifications of Orthophotos

Format	Geo-Tiff (non-compressed and non-tiled) 24 bit color (8 bits each for the red, green and blue channels)
Ground resolution	20 cm
Map sheet division	4 km x 3 km

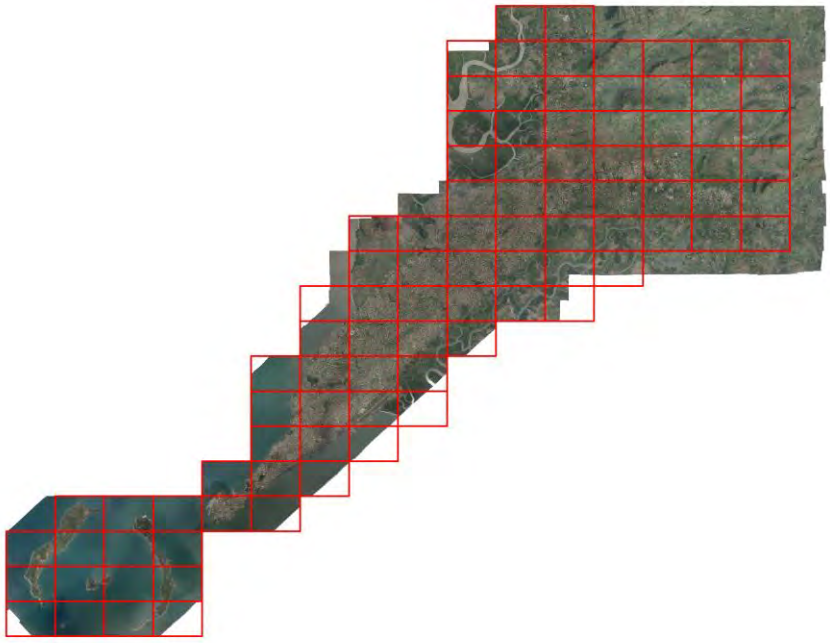


Figure 2-8 Range Covered by Created Orthophotos

2.2.8 Field Verification [Work in Guinea]

Field verification refers to verifying in the field what cannot be verified in the interpretation of aerial photos that have been taken or using the existing topographic maps or relevant materials that have been collected. In this Project, seven teams were formed to conduct field verification on the vegetation, topography and planimetric features according to the workflow shown in Figure 2-9.

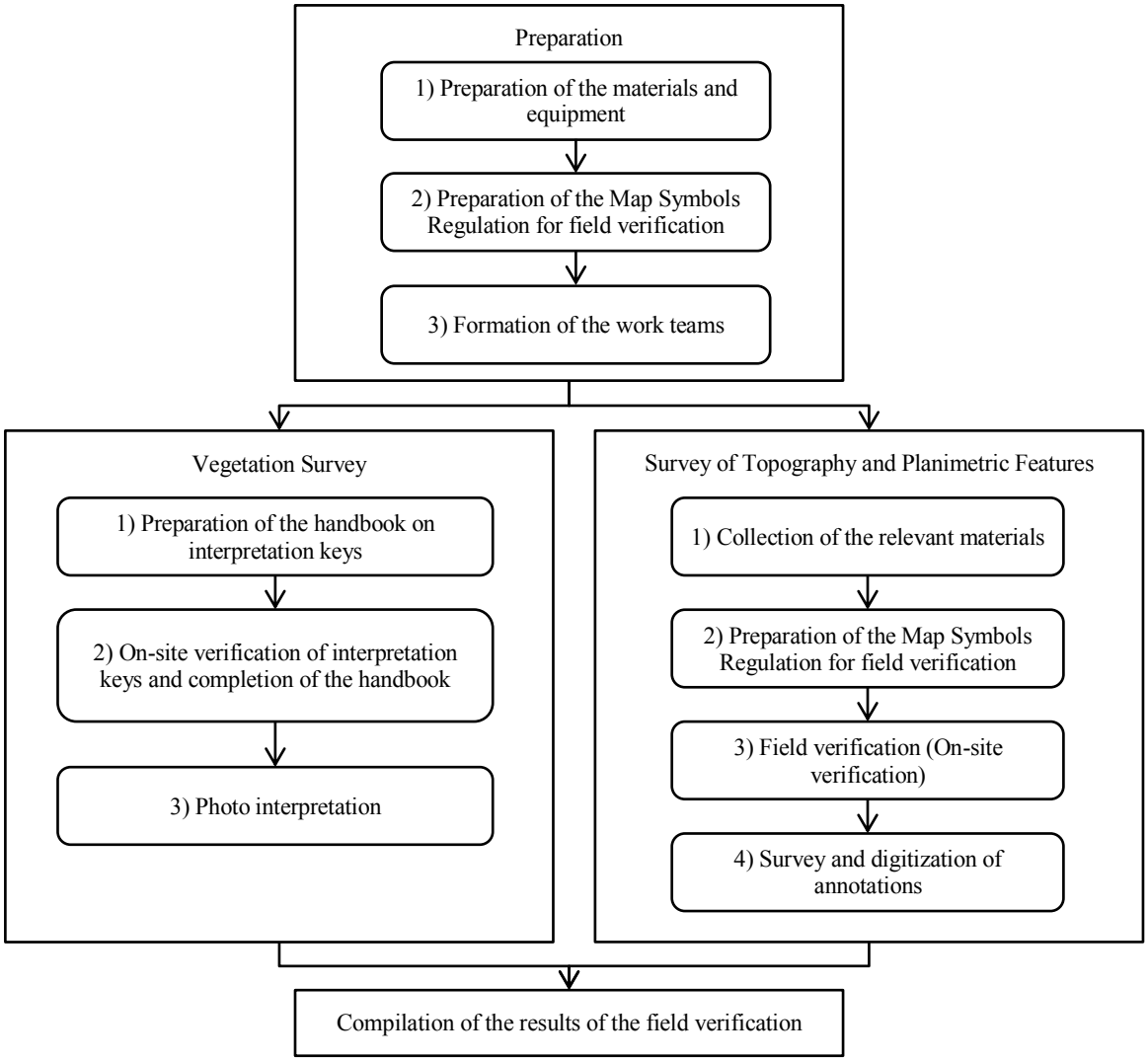


Figure 2-9 Field-verification Workflow

Photo 2-3 Discussion on the Map Symbols for Field Verification

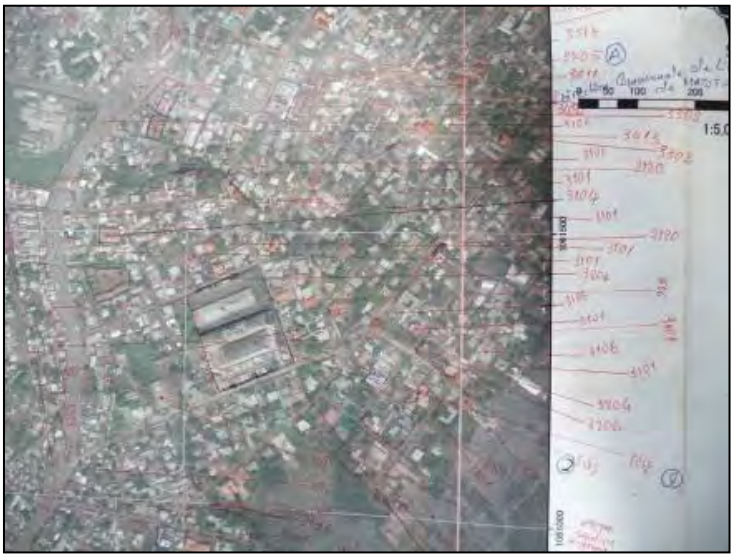


Figure 2-10 Example of a Field Verification Sheet

Table 2-6 Outputs of Field Verification

Item	Quantity
Field verification sheets	69 (one per map sheet)
Photo interpretation sheets	69 (one per map sheet)
Digital data and data sheets	One set
Results of checking data on railway lines (discontinued and operating) and annotations such as names of seas, rivers, mountain ranges, islands, etc. based on the existing 1/50,000-scale topographic maps	One set
Results of checking the names of major roads based on the existing 1/10,000-scale topographic maps	One set
Handbook of interpretation keys	One set

2.2.9 Digital Plotting and Digital Compilation [Work in Japan]

The Project Team implemented the digital plotting and digital compilation work according to the workflow shown in Figure 2-11. CAD software was used for the digital plotting and digital compilation work.

(1) Digital Plotting

Digital plotting refers to creating stereo models from the results acquired in aerial photography and aerial triangulation using a stereo plotter, acquiring coordinates of topography and planimetric features, and creating digital plotting data.

The data were obtained on the shapes and locations of planimetric features as graphic data using the results of the field verification as reference and the digital plotting data (of the 520.79 km^2 area) were created with those data. For each graphic data, the Project Team classified and entered the attribute information such as planimetric features by class (feature type) and data type according to the data measurement items and standards for the plotting set forth in the map symbols regulation.

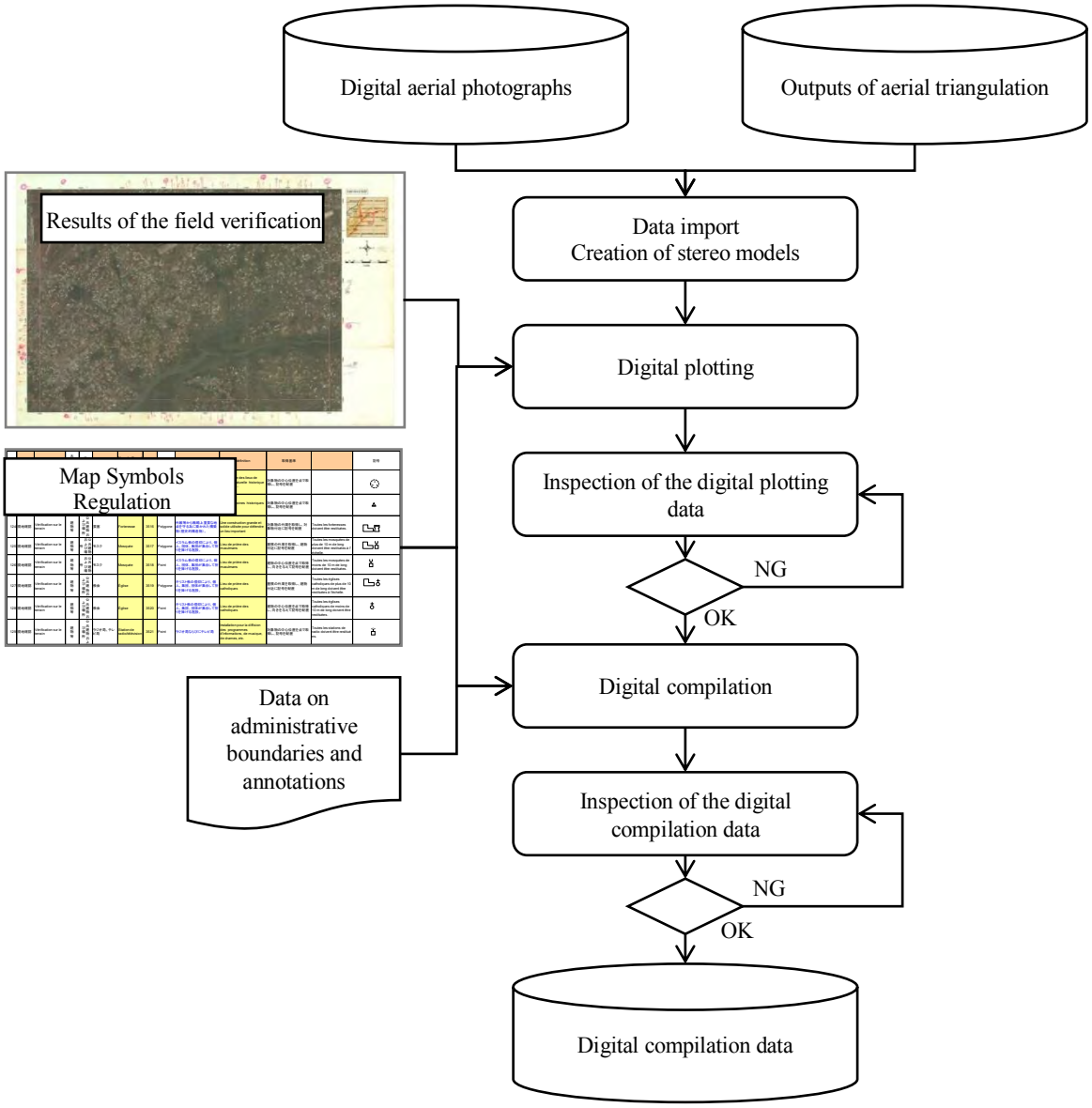


Figure 2-11 Workflow of the Digital Plotting and Digital Compilation

(2) Digital Compilation

Digital compilation refers to creating digital compilation data by connecting the line data, creating polygon (plane) data, and carrying out data cleaning on the digital plotting data, including removal of unnecessary data, in accordance with the results of the field verification, etc. and by adding data on the administrative boundaries and annotations to the digital plotting data. During this process, edge matching of planimetric features on adjacent map sheets is confirmed.

The matters to be clarified or verified (for omissions and errors) in the results of the field verification identified in the digital plotting/compilation were entered in a "matter-to-be-clarified/verified" layer created in the digital compilation data as text data and the data in the layer were used in the field completion as reference material.

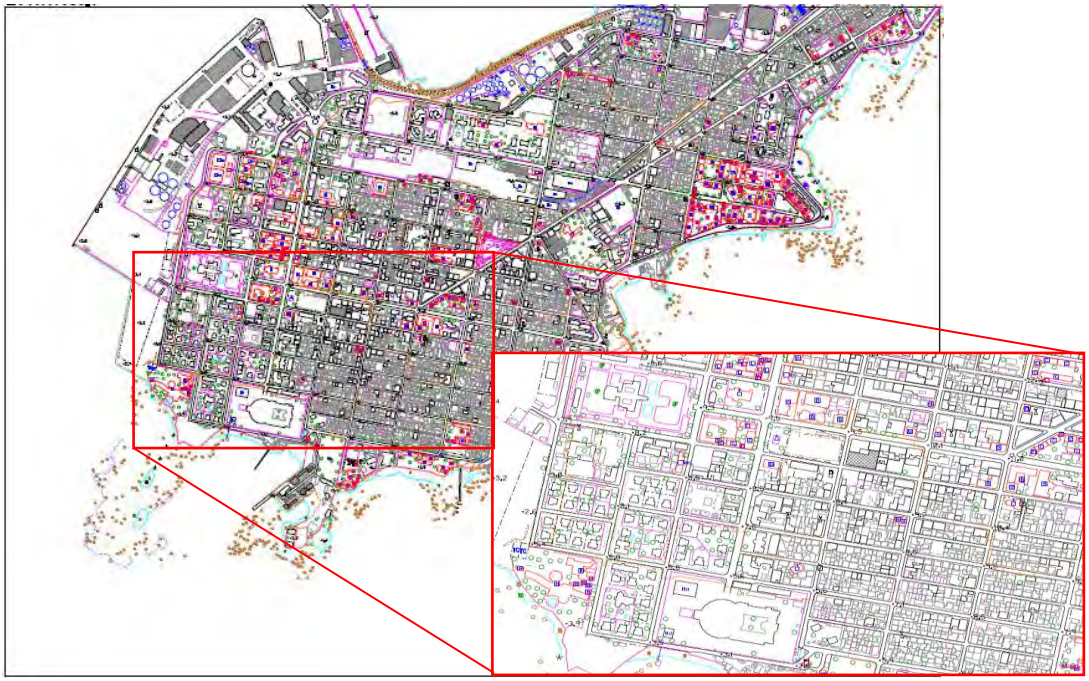


Figure 2-12 Digital Compilation Data (of the central part of Conakry City)

2.2.10 Field Completion [Work in Guinea]

The field completion process refers to reconfirmation in the field with regard to invisible topography and planimetric features under trees out of those shown in the digital compilation data created in the digital compilation process.

In this Project, eight teams were formed to conduct field completion at approx. 1,400 points. The target planimetric features were checked for the positions, ranges, forms, names, and classifications (code numbers) based on the verification list prepared by areas corresponding to map sheets. The verification results were written on the field completion maps with comments while referring to the Map Symbols Regulation.

Photo 2-4 Fieldwork in the Field Completion

Figure 2-13 Maps for Field Completion Work

(Matters to be clarified are indicated with a reference number and a survey classification on a leader line.)

Table 2-7 Outputs of Field Completion

Item	Quantity
Field verification sheet	93 (one per map sheet)
Transmission line survey sheets	36 (one per map sheet)
Administrative boundary data for Kindia Region	One set
Administrative boundary data for Conakry Special Zone	One set
Positional information data for aqueducts	One set

2.2.11 Digital Compilation after Field Completion [Work in Japan]

The Project Team corrected the digital compilation data based on the result of the field completion work.

2.2.12 Map Symbolization of Topographic Maps [Work in Japan]

The map symbolization of topographic maps refers to adding map symbols to each of the codes such as topography and planimetric features in the topographic map data that has undergone the digital compilation after field completion based on the Map Symbols Regulation.

CAD software used for the digital plotting, digital compilation, and digital compilation after field completion was used to conduct symbolization.

Figure 2-14 Map Symbolization

2.2.13 Digital Data Structurization and Creation of Data Files [Work in Japan]

Using the topographic map data created in the digital compilation after field completion, the Project Team conducted the structurization of digital data to create data usable for GIS based on the settings determined in the Discussion on Specifications (number and details of layers to be grouped during CAD data format conversion). Furthermore, the GIS data created in the structurization was converted to create data files in the "Shape-file format," a data format with a structure that is user-friendly and highly versatile.

2.2.14 Preparation of Booklets, etc.

Based on topographic map data created in this work, the Project Team prepared booklets and simple maps listed in Table 1-5.

2.3 Proposal on Creation and Update of Topographic Maps

The collaboration between the Project Team and the C/P created new digital topographic maps and orthophotos for Guinea after about 30 years. Although the project is complete, the C/P must serve as an organization that manages and maintains geospatial information by updating these topographic maps whenever possible and keep them in an excellent condition.

Update of topographic maps needs technologies (personnel), materials and equipment, and budgets and must be conducted on a planned basis. The Project Team proposes to the C/P to establish a plan for updating topographic maps as soon as possible. The major items to be considered in establishing a plan are described below.

- Update cycle

  The update cycle must be determined while keeping the balance between securing of budget and personnel and statuses of changes in the mapping area. For example, the Geographical Survey Institute of Japan updates the basic map information, the fundamental information on planimetric features such as roads and rivers, four times every year (January, April, July, and October). Furthermore, it handles digital topographic maps differently: The geospatial information is updated promptly (whenever required) upon occurrence of a wide-area change in the topography and planimetric features or construction of highways, national roads/bypasses, railways, and large buildings. However, the update procedure requires considerable cost and labor. Considering the status quo of Guinea and the capacity and financial conditions of the C/P, it seems appropriate in Guinea to update geospatial information once every three or four years as a guideline and conduct partial update in relation to significantly changed parts.

- Update targets

  Update targets must be determined in advance because necessary materials and equipment, budget, and personnel differ depending on what is to be updated. An area without a topographic change is expected to be updated relatively easily because only flat-plane planimetric features need

to be updated. If a topographic change such as excavation is involved, however, the elevation information must also be updated. If it is difficult to update all the information every time, different update cycles may be specified for different update targets.

- System of update

  The departments in charge of the work processes for update, such as securing of budgets, update procedure, and notification to users, must be determined in advance to ensure smooth progress of the work processes upon arrival of the due date for update. In particular, securing of budgets is extremely important and requires time, the departments in charge must have a meeting at least one year before the due date for update to check the details of update work and necessary materials and equipment, estimate the budgets, and consult with MTP, the upper organization. Furthermore, the departments in charge of the update process must coordinate the daily duties of the personnel to be engaged in this process to allow sufficient time for the update process during the period for it.

- Update method

  If the update cycle is every several years, the personnel in charge may be transferred in the meantime. Therefore, the update method must be recorded in documents in detail based on the technology transfer contents and work manuals prepared in this project in order to maintain the capacity despite transfer of personnel. The data to be used for the update process can be satellite images and field survey results but must be considered each time according to the scales of the budget and update process.

- Notification to users

  It is desirable to inform in advance the users of two of the above items, the update cycle and the update target, as a “plan for providing geospatial information.” This procedure can both motivate the C/P to periodically update the geospatial information and assure the users that the information currently used by them will be updated appropriately. Consequently, this procedure is expected to further promote the availability and utilization of the geospatial information.

Chapter 3 Technology Transfer

3.1 Outline of Technology Transfer

3.1.1 Purposes

The Project Team transferred the technologies for basic surveying and maintenance/updating of the digital topographic maps in order to allow the C/P itself to maintain and update the digital topographic maps created in this Project. Furthermore, technology transfer for promoting the utilization of them was conducted through discussion with the relevant authorities at JCC (see "4.2 Joint Coordinating Committee (JCC)") and holding of seminars on utilization (see "4.3 Seminars on Utilization").

3.1.2 Creation of Technology Transfer Plan

As a result of discussion between the Project Team and the C/P, the technologies to be transferred and the objectives to be achieved were determined as shown in Table 3-1. Of these technologies, those for the control point survey, leveling, field verification, and field completion were transferred in the actual process for creating topographic maps.

Table 3-1 Technologies to be transferred

Item	Objectives	Forms	Classification
Control point survey and leveling	• To understand the work procedures • To understand the role of each procedure in the entire workflow • To learn how to operate the latest models of measuring equipment • To learn how to analyze and handle data	Lecture and practice	Basic survey technology/The entire workflow related to creation of topographic maps (outline of creating topographic maps)
Aerial photography	• To acquire knowledge of aerial photography • To understand the differences between digital and analog cameras	Lecture	The entire workflow related to creation of topographic maps (outline of creating topographic maps)
Field verification	• To understand the work procedures • To understand the role of each procedure in the entire workflow • To learn how to operate the handy GPS receivers • To acquire the ability to match planimetric features on the ground and those on the photos • To acquire the ability to interpret photographs • To learn how to mark the results of the field verification on the photos	Lecture and practice	Basic survey technology/The entire workflow related to creation of topographic maps (outline of creating topographic maps)

Item	Objectives	Forms	Classification
Field completion	• To understand the work procedures • To understand the role of each procedure in the entire workflow • To learn how to operate the handy GPS receivers • To acquire the ability to match planimetric features on the ground and those on the maps • To learn how to mark the results of the field verification on the maps	Lecture and practice	Basic survey technology/The entire workflow related to creation of topographic maps (outline of creating topographic maps)
Aerial triangulation	• To understand the work procedures • To understand the role of each procedure in the entire workflow • To acquire knowledge of aerial triangulation	Lecture	The entire workflow related to creation of topographic maps (outline of creating topographic maps)
Creation of orthophotos	• To understand the work procedures in the creation of orthophotos • To understand the role of each procedure in the entire workflow	Lecture	The entire workflow related to creation of topographic maps (outline of creating topographic maps)
Digital plotting	• To understand the work procedures • To understand the role of each procedure in the entire workflow • To acquire knowledge of digital plotting	Lecture	The entire workflow related to creation of topographic maps (outline of creating topographic maps)
Digital compilation/digital compilation after field completion	• To understand the work procedures • To understand the role of each procedure in the entire workflow • To acquire knowledge of digital compilation and digital compilation after field completion	Lecture	The entire workflow related to creation of topographic maps (outline of creating topographic maps)
Map symbolization	• To understand the work procedures • To understand the role of each procedure in the entire workflow • To acquire knowledge of map symbolization • To learn how to create output maps	Lecture and practice	The entire workflow related to creation of topographic maps (outline of creating topographic maps)
Digital data structurization	• To understand the work procedures • To understand the role of each procedure in the entire workflow • To acquire knowledge of digital data structurization • To acquire knowledge of GIS • To learn how to handle GIS data • To learn how to operate the software	Lecture and practice	The entire workflow related to creation of topographic maps (outline of creating topographic maps)
Partial revision	• To learn field survey methods • To learn how to operate the handy GPS receivers • To understand the procedures of data revision • To learn how to operate the software	Lecture and practice	Partial revision

3.1.3 Procurement and Preparation of the Materials and Equipment

The materials and equipment listed in Table 3-2 were procured and prepared to be used for technology transfer.

Table 3-2 List of Materials and Equipment Procured and Prepared

Name of Equipment	Q'ty
GNSS receivers for surveying (two frequencies)	3
Tripods for GNSS observation (wooden)	3
GNSS analysis software	1
Digital levels for leveling	3
Tripods for leveling (aluminum)	3
Bar-code leveling staffs	6
Portable handy GPS receivers	3
GPS-enabled digital cameras	3
Total station	1
Mirrors for total stations	2
Plane tables	3
Survey poles (2 m long)	5
Steel measuring tapes for surveys (50 m)	3
Esron tapes for surveys (50 m)	3
Screen for projector	1
Hard disk for data management (1 TB)	3
Desktop PC for data analysis	3
Liquid crystal monitors	3
Laptop PCs for data input and analysis	3
Uninterruptible power supply (UPS)	3
Color laser printer-cum-scanner and consumables	1
Set of consumables for the network LAN cable (5) and hub (1)	1
Small generators (5 kVA)	2
A3-size multi printers (printing, scanning, and copying)	1
Equipment and materials for establishing an Internet environment (USB-connected devices or wiring)	5
A0 Color plotter	1

3.1.4 Participants in Technology Transfer

The C/P personnel amounting to 60 persons (25 persons if overlaps are excluded) participated in the technology transfer.

3.2 Technology Transfer Contents

3.2.1 Control Point Survey and Simple Leveling

(1) Contents

The technologies used in the series of work in control point survey and simple leveling were transferred through lecture and practice. Practice was provided in the actual process for creating topographic maps in the field on an OJT basis in November and December 2012.

Photo 3-1 Technology Transfer for Leveling

(2) Evaluation of Technology Transfer

Before the implementation of this Project, the Project Team estimated that the C/P personnel could use only fundamental-level technologies because they had lacked experience in basic work procedures such as those for using the equipment to be used in this Project. However, the participants, in general, have understood the transferred technologies well, partly because the technology transfer concerned the survey equipment used in the C/P's area of specialty, despite some difference in the level of understanding among the personnel.

All the participants successfully learned the technologies selected as key points for technology transfer as well as how to operate handy GPS receivers and GPS-enabled digital cameras. The Project Team appreciates the fact that the control point survey/simple leveling was completed within the planned work period (of 60 days).

This technology transfer served also as the human resources development based on the recognition of the types of engineers, "leader-type, craftsman-type, and young members." The C/P has a well-balanced composition of these types of personnel. In this organization, therefore, knowledge and technologies learned in the technology transfer are expected to be disseminated and inherited.

3.2.2 Field Verification

(1) Details

The technologies used in the series of work including preparation for survey, field verification, and marking of verification results were transferred through lecture and practice in order of: lecture on the purposes of and activities in field verification; trial verification with all the participants; trial verification in tentative teams; and actual process for creating topographic maps in the field (March to April 2013).

After the start of the field verification, the project members provided the participants with OJT by accompanying different teams every day and providing them with advice on the verification method and work procedures in an effort to brush up their technologies.

(2) Evaluation of Technology Transfer

In the early stage of the field verification, there was inconsistency in the work procedures and photo interpretation (object matching) between different teams, slow progress of the work and cases of interpretation errors and misunderstanding. However, the participants were able to solve these problems in a short period of time because they had experience as survey engineers, which they had acquired in their work, and instruction and advice provided by the accompanying project members.

One participant was unable to attend the technology transfer because of sickness. However, his place was immediately filled by another person. Therefore, the work continued smoothly without a hitch. The Project Team considered that the C/P personnel who participated in the technology transfer in the field verification understood its contents sufficiently. They continued to implement the verification activities without taking extra breaks on hot days. The Project Team highly appreciated such dedication to the work shown by the participants.

3.2.3 Field Completion

(1) Details

The technologies used in the series of work in field completion including preparation, field completion work, and marking of field completion results were transferred through lecture and practice in order of: lecture on the purposes of and activities in field completion; trial verification with all the participants; and actual process for creating topographic maps in the field (November to December 2013). After the start of the field completion, the project members provided the participants with OJT by accompanying different teams every day and providing them with advice on the completion method and work procedures in an effort to brush up their technologies.

(2) Evaluation of Technology Transfer

The implementation of the technology transfer through a lecture and OJT in stages is considered to have led to the improvement of understanding of the field completion among all the participants. Many C/P personnel also participated in the technology transfer in the field verification so that few interpretation errors and erroneous entries were observed.

The technology transfer of field completion is considered to have been completed upon achievement of the objective because the participants conducted the marking activities without problems and had high understanding about the explanation of the accuracy control sheet.

Almost all the participants participated in the entire technology transfer without fail. They continued to implement the completion activities without taking extra breaks on hot days. The Project Team highly appreciated such dedication to the work shown by the participants.

3.2.4 Outline of Creating Topographic Maps, Basics of GIS, and Partial Revision of Topographic Map Data

(1) Details

The technologies related to "outline of creating topographic maps," "basics of GIS," and "partial revision of topographic map data" were transferred in three stages in December 2013, July 2014, and May 2016 through lecture and practice.

Before technology transfer, a questionnaire was sent out to the participants to identify their status quo. The questionnaire included questions on their knowledge and skills such as "professional career, understanding of creation of topographic maps, understanding of survey criteria (such as reference ellipsoid, map projection, and scale) and experience of computers and GIS." The details of the lecture were arranged in view of the result of this questionnaire based on the policies of technology transfer.

(2) Evaluation of Technology Transfer

During the technology transfer conducted indoors, the project members explained and showed actual operations using a projector to all the participants. Throughout the explanation by the project members, all the participants seriously watched the images projected on the screen and took notes without uttering a word. The participants made such serious efforts in the technology transfer that, when they did not understand anything in the explanation, they immediately asked a question to request for further explanation.

Photo 3-2 Manual Prepared by the Project Members and Notes Taken by the C/P Personnel

The practice of GIS operations was proceeded with while checking step-by-step the understanding and acquisition of basic operations as required until, finally, all the participants were observed to achieve the specified objective of this practice.

Although the plane-table survey is a basic technology for creating maps, the Project Team was initially afraid that the C/P personnel might not be interested in it because this survey method is used less often now. However, they were able to realize that, as the work progressed, the shapes of houses, fences, and gates were drawn one after another and began to form the appearance of a map. Therefore, they became better motivated and more interested in the practice as the work progressed. The electrical power conditions in Guinea are not so good. If more digital equipment begins to be used and more electrical power (such as batteries) is needed, there may be circumstances in which the C/P personnel may need to depend on this analog method.

The Project Team highly appreciates the participants' attitude to learn with willingness in this technology transfer. Some of the participants spontaneously reviewed during recess what had been learned and even wanted to extend the practice time beyond the initially planned end. Despite the environment in which there was no electricity, they said that they wanted to continue practicing spontaneously in the future.

As the evaluation of this lecture and practice, the Project Team admires the participants' high motivation and good results of the check test and hopes that they will continue to have the same high motivation in pursuing the acquisition of technology in the future.

3.3 Proposal on Technology Transfer

The Project Team transferred the technologies for basic surveying and creation/revision of the digital topographic maps in order to allow the C/P itself to maintain and update the digital topographic maps created in this Project. Since the objectives specified for each of the technologies to be transferred were achieved as described above, the Project Team considers that the C/P mostly acquired the target capacities.

However, the technologies transferred in this Project are only basic ones. When the C/P actually updates digital topographic maps after completion of this Project, it is expected to encounter various problems and difficulties. Furthermore, any technology or knowledge will be forgotten sooner or later unless the C/P personnel keep daily contact with it and use it continuously. It is one of the Project Team's concerns that they do not have opportunities to immediately use in their work duties many of the technologies that have been transferred in this Project. Furthermore, the C/P must consider not only brushing up the technologies of its personnel who participated in the current technology transfer but also providing training to new personnel to be assigned to this organization.

To address these issues, first the C/P personnel who participated in the current technology transfer must examine and consistently make the efforts required to maintain and improve their technical capabilities. Specifically, for example, they can hold technical study meetings or research paper reading meetings (conducting case study on latest examples in other countries) and carry out activities for sharing new knowledge and experience that they have acquired. Alternatively, all of the C/P personnel can meet, for example, once a year and conduct the same practice as in the technology transfer to prevent forgetting the acquired technologies.

The Project Team confirmed through the technology transfer the C/P has a strong enthusiasm to acquire the technologies. These activities will provide good opportunities to maintain their enthusiasm and brush up the knowledge and skills that they acquired in this Project. It is expected that they will become trainers and the C/P itself will continue to improve its technologies and develop human resources in the future.

The social infrastructures of Guinea are not sufficient by any means. There are difficulties that the C/P cannot overcome by itself, such as unstable supply of electricity that is required to update the digital data that has been created in this Project. However, the project members told the C/P personnel time and time again that it is exceedingly important for the C/P to brush up the acquired technologies by itself to maintain and improve them for the sake of sustainable development in the future. The project members hope that the C/P personnel will remember this point in carrying out the work duties in the future.

Chapter 4 Promotion of Utilization

4.1 Activities for Promotion of Utilization

To promote utilization of geospatial information such as topographic maps, orthophotos, and GIS data created in this Project, it is necessary to make efforts from two aspects: (1) developing various environments for supplying them smoothly and appropriately and (2) improving name recognition among users and eliciting the needs of users. Based on this approach, this Project held JCC meetings and seminars on utilization as shown in Figure 4-1.

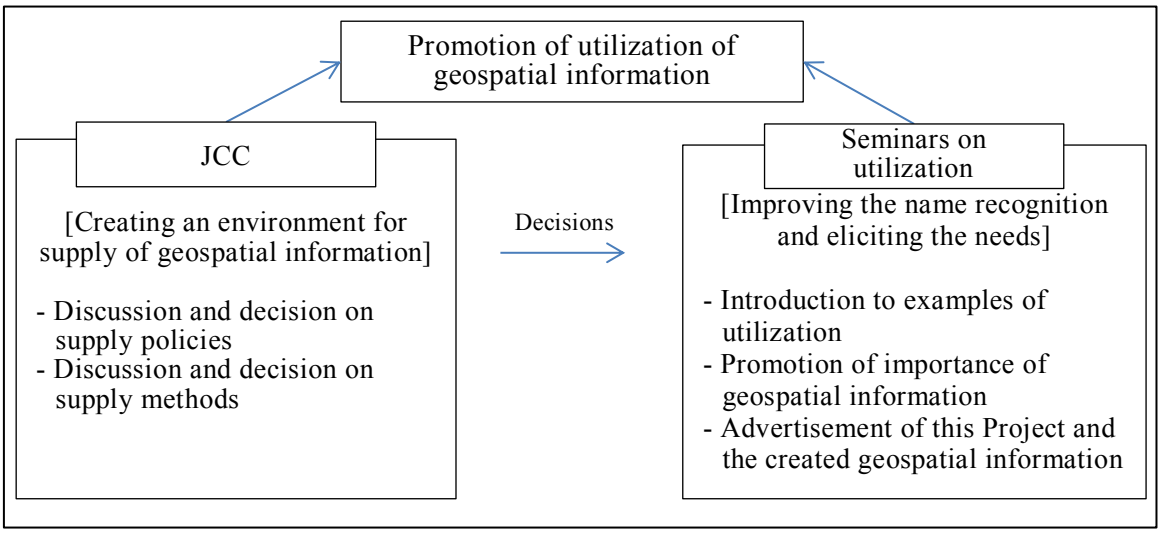


Figure 4-1 Activities for Promotion of Utilization

4.2 Joint Coordinating Committee (JCC)

To develop an environment for supplying geospatial information such as topographic maps created in this Project, the Joint Coordinating Committee (JCC) discussed and decided on specific supply methods and selling prices based on the exchange of opinions on appropriate supply policies and utilization methods for Guinea.

The member organizations of JCC were selected according to the project instruction. However, the Survey Association, initially assumed as a candidate, was excluded because no actual activity was observed. Furthermore, the Ministry of Land Urban Planning and Construction was selected as a member according to a request from the C/P.

Table 4-1 JCC Meeting Participants

Organizations	1st meeting (December 13th, 2012)	2nd meeting (November 21st, 2013)	3rd meeting (May 10th, 2016)
C/P (IGN)	2	1	2
Ministry of Public Works and Transport	1	1	1
Ministry of International Cooperation	1	2	1
Ministry of Land Urban Planning and Construction	1	1	1
Ministry of Planning	1	1	1
Ministry of Land Administration and Decentralization	0	1	1
Conakry City	1	1	1
Dubréka Prefecture	1	2	1
Coyah Prefecture	1	1	1
Japanese Embassy	0	1	1
JICA project member	3	3	3
Total	12	15	14

4.2.1 First JCC Meeting

On December 13th, 2012, the first JCC meeting was held. Since this was the first meeting, brief introduction to this Project was provided and then the members exchanged their opinions extensively on utilization of topographic maps.


Photo 4-1 First JCC Meeting

As a result of opinion exchange, it was found that the geospatial information was not utilized in any of the government agencies and that there was currently more need for printout maps (paper maps) than for digital maps (because of the ease of use) due to shortage of equipment and materials.

4.2.2 Second JCC Meeting

On November 21st, 2013, the second JCC meeting was held. Since this was the second meeting, the progress status of this Project was reported and the members exchanged their opinions on utilization and supply methods of geospatial information.

As a result of opinion exchange, JCC decided to distribute part of the outputs of this Project free of charge to the relevant authorities to increase name recognition of the geospatial information to be created in this Project, examine the measures for preventing illegal copying of the digital geospatial information, set approximately equivalent prices of topographic maps to those in the surrounding countries, and apply for copyright to the geospatial information from the Copyright Office of Guinea (Bureau Guinéen du Droit d'Auteur: BGDA).

4.2.3 Third JCC Meeting

On May 10th, 2016, the third JCC meeting was held. Since this was the last meeting, brief introduction to the outputs of this Project was provided and the JCC members discussed and decided on the supply methods and prices of geospatial information and exchanged their opinions on utilization of geospatial information.


Photo 4-2 Third JCC Meeting

As a result of discussion, the following decisions were made.

Not printing or selling paper-based maps

Since there will be problems in maintenance and management if topographic maps are printed on plotters, the C/P will not start a service to print topographic maps but just supply the outputs of this Project, the Simple Map of Conakry City, the 1/5,000 Topographic Map Booklet (A3

Size), and digital data.

Deciding where to supply

Geospatial information shall be supplied basically at the IGN office. A person who wants to purchase the geospatial information shall send an e-mail or make a phone call directly to the director of IGN to determine the date and time for receiving it. The Simple Map of Conakry City shall be sold also at the bookstores.

Price settings of geospatial information

The prices of geospatial information were set as shown in Table 4-2. The prices of GIS data and orthophotos were set according to the ratios of mapping ranges that were calculated for each map sheet as shown in

Table 4-3.

Table 4-2 Selling Prices of Geospatial Information

Article	Supply media	Scope	Price (GNF)	Place for supply
Simple Map of Conakry City	Printout maps	Central area of Conakry City	75,000 per map	IGN, bookstore, etc.
PDF Topographic Maps	DVD	Project area	50,000 (one set)	IGN
1/5,000 Topographic Map Booklet (A3 Size)	Printout maps		200,000 (one set)	
GIS Data	DVD		30,000 to 100,000 per map sheet	
Orthophotos	DVD			

Table 4-3 Prices of GIS Data and Orthophotos

Mapping ratio	Price per map sheet (GNF)
0.00-10.00% (red)	0
10.01-30.00% (yellow)	30,000
30.01-50.00% (yellow green)	50,000
50.01-70.00% (light blue)	70,000
70.01-100.00% (pink)	100,000

Supply of geospatial information data in operations between government organizations

The geospatial information data shall be supplied to government organizations according to the regulations and customs for operations between the government agencies. Generally, a

government agency (director) shall submit an official request to the Director-General of IGN and then the two parties shall discuss the supply method, shouldering of costs, etc.

Supply methods for GIS data and orthophotos

A person who wants to purchase GIS data and orthophotos is required to submit a purchase application to IGN. On the application, the purchaser must agree to comply with the copyright and usage conditions specified therein for the geospatial information. Furthermore, a purchaser who wants to use the geospatial information for secondary usage must submit an application for such usage. IGN will then issue a secondary-usage license to the purchaser. No application needs to be submitted for other geospatial information than the GIS data and orthophotos.

Finally, the JCC members exchanged their opinions on specific methods for utilizing paper-based topographic maps for population management, waste, security, tax collection, illegal road occupation, establishment of master plans, mitigation of traffic congestion, etc.

4.3 Holding of Seminars on Utilization

4.3.1 First Seminar on Utilization

On December 5th, 2012, the first seminar on utilization was held to notify the significance and contents of this Project. The seminar, attended by 94 participants, was reported on television by a national TV station. It was also reported on the website of the Guinean government (http://www.guinee.gov.gn/cartographie_conakry.php) and in newspapers such as La Republique and L'Observateur.

Photo 4-3 Seminar on Utilization

4.3.2 Second Seminar on Utilization

On May 13th, 2016, the Project Team held the second seminar on utilization to introduce the

geospatial information created in this Project to the relevant authorities of Guinea and international and donor organizations. The seminar was attended by 117 participants from embassies, international donor organizations, universities, local public bodies, Guinean government agencies, public corporations, private companies, media, C/P, JICA, etc.

At the seminar venue, the Simple Map of Conakry City and the 1/5,000 Topographic Map Booklet (A3 Size) were sold at special prices to promote geospatial information. After the seminar, the Project Team supplied DVDs of PDF topographic maps (in all of the mapping range) to the GIZ Guinea Office and the National Directorate of Regional Planning, Ministry of Urban and Regional Planning upon requests from them.


Photo 4-4 Second Seminar on Utilization


Photo 4-5 Selling of Maps at the Seminar Venue

With the cooperation of the Japanese embassy, the Project Team distributed press releases and gave press briefing to the mass media in Guinea to gain wide recognition of the content and outcome of this Project to the Guinean people. Specifically, the national broadcasting company of Guinea (RTG) covered the seminar in a news program on the same day and transmitted video news on the Web.

www.guineesud.com - Nouvelle cartographie pour Conakry - RTG du 14 mai 2016

www.guineesud.com - Nouvelle cartographie pour Conakry - RTG du 14 mai 2016

(https://www.youtube.com/watch?v=7qMjeGBA4Dc&index=6&list=PLrtGSrufH5tAPHQTvw6P7zMuFwmPCOQv8)

Figure 4-2 Video Transmission

4.4 Smooth Supply of Geospatial Information

The following materials were prepared to allow the C/P to provide the geospatial information smoothly.

- Guide to Acquisition of Geospatial Information
- Durable index map
- Receipt
- Sales management sheet
- GIS Data and Orthophoto Purchase Application

4.5 Proposals on Utilization

The Study Team will submit to the C/P and its supervising authorities the proposals listed below for the establishment of the "National Geographic Information Database Available to a Variety of Institutions" based on the problems identified through discussion in the JCC meetings.

(1) Proposals on Supply of Geospatial Information

Proposal 1 - Construction and simplification of a system for supplying geospatial information

IGN does not have a section for customer relations nor a main telephone number or main e-mail address. At present, the mobile telephone number and e-mail address of the Director-General of IGN are used as the contact points for inquiries on the geospatial information. If the Director-General is absent on a business trip or on vacation, however, the customer will not be able to contact IGN. At the earliest possible date, IGN must have a main telephone number and a main e-mail address in order to construct a system in which an inquiry can also be answered by the secretary or Deputy Director-General.

For supply of geospatial information, IGN should avoid supplying paper-based maps as much as possible because expensive consumables such as printers and plotters will be required. Instead, it should supply maps in electronic media (DVD) to simplify the workflow and reduce the costs. We recommend simplifying the selling procedure using a prescribed purchase application or secondary usage license to ensure quick response to customers.

Proposal 2 - Ensuring of transparent sales and inventory control

IGN says that the income earned by selling the geospatial information will be used for maintenance and management. The Project Team proposes that IGN, when selling the geospatial information, should be sure to issue a receipt, enter the sale in the sale management sheet, and record the inventory status in order to enable sharing of the sales and inventory status among the IGN officers.

Proposal 3 - Security measures

Since the current IGN office does not have any lock at the entrance, anyone can go directly to the doorway of any room. All the rooms are locked but no security guard is assigned. Although the electricity supply is gradually becoming more constant, the electric power is down in many of the hours. Since none of the rooms is dust-proof or moisture-proof, they constitute an inappropriate environment for storing computers and hard disks that are susceptible to dust, high temperatures, and humidities. However, this situation cannot be easily improved because of insufficient budgets. The following methods are proposed to store data appropriately even under such circumstances.

(1) Storing original data in a lockable cabinet
(2) Creating backup data from original data
(3) Periodical virus scan
(4) Periodical checkup of hard disks

(2) Proposals on Utilization

Proposal 4 - Fostering of technical advisors for promoting geospatial information

In Guinea, digital geospatial information is utilized only by a limited number of government agencies. IGN must carry out positive promotional activities toward various agencies so that many agencies utilize the geospatial information in their daily operations and projects to make improvements and enhance the efficiency of business activities. Additionally, the Project Team proposes that engineers who can be instructors should be fostered in IGN so that inquiries and consultations from users can be answered.

The instructors must acquire not only GIS-related skills but also instruction skills with which they can plan training programs and stimulate interest of participants in consideration of their circumstances as well as bidirectional communication skills with which they can encourage the participants to receive training spontaneously. If IGN has difficulty in fostering instructors

in-house, it should also consider requesting the international organizations and donors for technology transfer for fostering instructors.

Proposal 5 - Active public relations

IGN and the Ministry of Public Works and Transport, the upper organization of IGN, do not have a media that can be utilized in public relations such as a website or newsletter. The Project Team proposes that IGN should extensively advertise the activities of IGN and use of the geospatial information by positively participating in the events (exhibitions and seminars) hosted by government agencies and international organizations to exhibit topographic maps and conduct free distribution and sale of the Topographic Map PDF and the Simple Map of Conakry City. IGN can minimize the costs by participating in events hosted by public agencies. Furthermore, it can utilize the index map (printed on vinyl cloth with rings for wall hooks) provided by the Project Team.

Proposal 6 - Transition to digital maps

The Project Team proposes that IGN should not only carry out Proposal 5 but also open its own website to construct a system for distributing digital geospatial information. The availability of Topographic Map PDF for browsing and downloading will promote utilization of geospatial information.

Furthermore, IGN should scan and archive the past materials of geospatial information such as the existing topographic maps (scale: 1/50,000), organize the owned information and supply it directly or via the website.