The Capacity Development Project for Digital Topographic Mapping in the Federal Democratic Republic of Ethiopia

Final Report

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Appendix

Appendix-1

- Minutes of Meeting on the Inception Report 1
- Minutes of Meeting on the Progress Report 1
- Minutes of Meeting on the Inception Report 2
- Minutes of Meeting on the Interim Report
- Minutes of Meeting on the Progress Report 2
- Minutes of Meeting on the Draft Final Report

Appendix-2

- Minutes of Meeting on the Joint Coordinating Committee

Appendix-3

- Quality Control Report

Abbreviations

AT	Aerial Triangulation
CAD	Computer Aided Design
CODIST	Committee on Development Information, Science and Technology
DTM	Digital Terrain Model
DEM	Digital Elevation Model
EEPC	Ethiopian Electric Power Corporation
EKI	Ethiopia KAIZEN Institute
EMA	Ethiopian Mapping Agency
ENSDI	Ethiopian National Spatial Data Infrastructure
GIS	Geographical Information System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GSDI	Geospatial Data Infrastructure
GTP	Growth and Transformation Plan
GUI	Graphic User Interface
INSA	Information Network Security Agency
JCC	Joint Coordinating Committee
NSDI	National Spatial Data Infrastructure
M/M	Minutes of Meeting
OJT	On the Job Training
OSS	Open Source Software
PCM	Project Cycle Management
PDM	Project Design Matrix
RCMRD	Regional Centre for Mapping of Resources for Development
TS	Total Station
UNCE-GGIM	UN Committee of Experts on Global Geospatial Information Management
UNECA	United Nations Economic Commission for Africa
USAID	United States Agency for International Development

Chapter 1 Outline of Project

1-1. Background and History of Project

The Growth and Transformation Plan (GTP), a five-year development plan, was launched in Ethiopia in 2010, with a particular focus on agriculture, regional development, industry and infrastructure. Accurate and reliable topographic maps are indispensable for efficient and effective implementation of the projects in each sector and provision of topographic maps to meet demand from related agencies is required.

The Ethiopian Mapping Agency (EMA) in the Ministry of Finance and Economic Development, the organization responsible for creating national maps of Ethiopia, has been engaged in medium-scale topographic mapping of the entire country since the 1970s and has created topographic maps covering 85% of the country. However, 90% of the created maps have been created based on analog technology. Also, when the topographic maps were created, there were no written and organized work specifications or accuracy control standards nor was the quality of the topographic maps controlled, so no accurate and reliable digital topographic maps that reflect the latest data such as are needed by the related agencies have been created or are available.

Against the background described above, due to the heightened need for creation and upgrading of digital topographic maps, technical assistance was requested for (1) the establishment of work specifications for digital topographic mapping, (2) technology transfer in mapping, and (3) promotion of the utilization of digital topographic map data.

In response to this request, JICA dispatched a Detailed Planning Study Team in May 2013 and held discussions with EMA, the implementing organization of the Government of Ethiopia, on topographic mapping of the area around Mojo and Adama in the State of Oromia and the related technology transfer. The Record of Discussions (R/D) was signed on July 29, 2013. Cooperation will be provided for the Project based on the above-mentioned R/D.

1-2. Project Purpose, Objectives and Priority Items

(1) Project Purpose

The overall goal of the Project and the project purpose are as described below.

Overall Goal

To create an accurate and reliable national spatial database to promote sustainable development of the economic and social infrastructure

Project Purpose

(1) To develop 1/10,000 and 1/25,000 digital topographic map data of an area of approximately 1,140km^2 around Mojo and Adama in the Regional State of Oromia

(2) To build the capacity of EMA itself to develop digital topographic maps through technology transfer, to attain a technical level at which it can perform digital topographic mapping independently based on an appropriate organizational framework, and to enable EMA to implement and manage topographic mapping projects

(2) Project Objectives

The objectives of the Project are as follows.

- To create topographic maps on a scale of 1/10,000 and topographic maps on a scale of 1/25,000 by generalization of an area of approximately 1,140km^2 around Mojo and Adama in the State of Oromia
- To enable EMA to appropriately implement and manage topographic mapping projects

(3) Project Priority Items

Based on the background and purpose of the Project, the Study Team will implement the Project with priority given to the following items.

- To create "accurate and reliable" digital topographic map data based on "uniform standards"
- To strengthen "EMA's organizational structure" based on "improvement of the technical level of EMA staff" to enable EMA to implement and manage topographic mapping projects independently
- To provide assistance for formulation of an organizational structure that enables EMA to implement and manage utilization of geospatial information independently

1-3. Status of EMA at the Beginning of the Project

(1) Structure of EMA

The present status of EMA is as shown below.

The main departments of EMA related to technical aspects of the Project are the Mapping Directorate, Survey Directorate, GIS & Remote Sensing Directorate, IT Directorate and Quality & Standards Directorate. The Planning and Business Development Directorate is mainly engaged in providing support for the entire EMA organization.

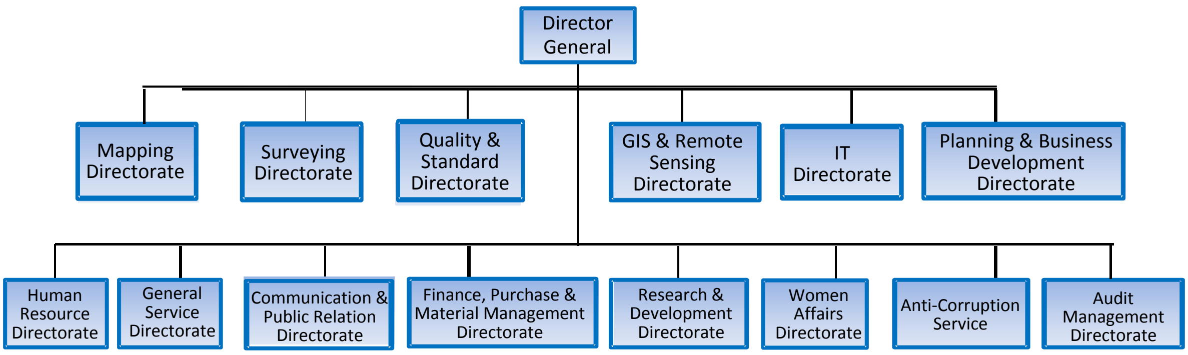


Figure 1 EMA Organization Chart

(2) Status of EMA at the Beginning of the Project

The present status of EMA was summarized to clarify the problems in "achieving a technical level where digital topographic mapping can be performed independently by EMA" and "enabling EMA to implement and manage topographic mapping projects" as stated in the project purpose.

As a result, the means of attaining the goals to be implemented in the Project with the aim of resolving the issues of EMA were decided as follows.

Table 1 Status of EMA and Goals of Each Subject at the Beginning of the Project

Item			Present Status	Goal and Means of Achievement
Equipment	Ground survey equipment	Transit EDM /Total station with accessories	EMA has a lot of equipment, but maintenance is a problem due to the lack of managers.	Attainment of reliable, high-accuracy outputs by provision of the latest GNSS receivers and analysis software for use in photo control point survey
		GPS Receiver with accessories	EMA has 4 Ashtechs and 4 Leicas (including analysis software), but they are outdated and accuracy is low.	
		Level with accessories	EMA has a lot of analog and digital equipment.	
	Photogrammetric equipment		EMA has 3 LPS, but functions and maintenance contents are limited.	Provision of digital photogrammetric system to enable implementation of processes involved in topographic mapping
	Plotting, editing, symbolization and structuralizing equipment		EMA has ArcInfo and CAD, but adequate environment is required.	Provision of the latest equipment and add-ons to enable plotting, editing, symbolization and structuration of topographic data, and provision of the hardware to run the software and improve office environment
	Website		EMA has a website, but web distribution contents and environment maintenance are required.	Creation of a website to enable distribution of topographic maps over the internet
	A0 printing equipment		EMA has analog offset equipment. EMA has 2 HP plotters, but for selling new digital topographic maps, quality and speed are required.	Provision of A0 plotter to enable distribution of high quality topographic maps
Technology	Common		Executives have a fair level of skill, but improvement of workers' level is required.	Creation of manuals and diffusion of technology for improvement of skills at worker level
	Aerial photography planning		EMA has attained a certain level, but work management and accuracy control are required.	Technology transfer in theory and software operation aiming at aerial photography planning using software
	Installation of aerial signals		Operating experience corresponding to the conditions of photo-scale and installation location is required.	Technology transfer in installation of aerial signals according to work specifications to enable work to be performed appropriately under different conditions
	Photo control point selection, survey, data management		EMA has a certain level of observation technology, but skill in photo control point surveys is required. Data management is required for efficient management of acquired data.	Technology transfer focused on photo control point survey by enabling the staff to do planning and accuracy control by themselves
	Aerial triangulation (DEM creation and editing, orthophoto creation)		EMA has a certain level of skill, but work management and accuracy control are required.	Technology transfer to improve work efficiency by raising process management and accuracy control knowledge and skill
	Field identification		Improvement in understanding of work management and quality control from a leadership position and review and organization of the field identification manual are required.	The target is to implement the supplementary field verification with leadership of EMA engineers throughout the whole process as much as possible. Quality and process control will be implemented by progress management and document checking at the time.
	Digital plotting Digital editing		Work experience in digital stereo environment is inadequate. Experience in data creation using latest CAD software is required.	Technology transfer classified by stages: theory/basic skills acquisition period, practice period, process control/efficiency improvement period, and pilot period, to achieve level that takes into account process/quality control and

Item		Present Status	Goal and Means of Achievement
			work efficiency
	Supplementary field verification	Work quality was inadequate due to the lack of practical experience in working independently.	As work involves arranging for vehicles and accommodation, etc. and expense burden is high, technology transfer in the form of OJT will be implemented focused on work efficiency to improve cost effectiveness when EMA does own work.
	Symbolization	The level of digital technology is low at the initial stage. There is a lack of skills at worker level.	Technology transfer to enable understanding of map symbol rules and creation of symbols and symbolization based on map symbol rules Technology transfer in pilot area
	GIS structuration	Experience in data creation using latest GIS software is required.	Technology transfer to enable structuration of topographic map data and creation of GIS model samples that will serve as utilization tools Technology transfer in pilot area
Management & Operation	Promotion of utilization	Lack of management structure with related agencies inside and outside Ethiopia for utilization of topographic maps. Little need for analog topographic maps and not much of a track record in their sale.	Establishment of JCC and holding of regular meetings, collaboration with projects in Ethiopia and abroad, advertising activities and seminars Study of needs for utilization of topographic maps by considering collaboration with related events as well as strengthening of delivery and sales management systems
		Skill in management of web distribution is required.	Technology transfer in website operation for the improvement of operation skills
	Process control	Need for establishment of management system for costs and schedule	Assistance for formulation of organizational structure for work optimization
	Quality control	EMA has materials containing quality control standards, but needs to increase universal use Need for improvement of quality control process	Consideration of work specifications in discussions Inclusion of quality control in each technology transfer item
	Topographic map management	Analog topographic maps are managed and sold by inventory control, but experience in digital distribution is required.	Assistance for formulation of organizational structure to heighten needs by promotion of utilization and improve distribution system based on needs
Establishment of work specifications		Digital aerial photography standards, 1/10,000 scale standards, 1/25,000 scale standards and topographic map sheet reference system standards have been established, but classification and definition of topography and features are inadequate	Establishment of work specifications based on existing materials for development of highly versatile data and smooth project operation and management
Financial aspect		Trend is toward growth, but percentage accounted for by personnel expenses is considerably high. Significant allocation to policy expenses and equipment purchase/replacement costs is considered difficult.	Assistance for improvement of environment by provision of equipment Assistance for cost and schedule management system, and reduction of burden by improved work efficiency through technology transfer in each field

1-4. Project Target

(1) Target Area for Creation of Topographic Map Data

The target area for creating topographic map data in this Project is the range shown in the map below. It is an area of approximately 1,140km^2 (the country covers an area of approximately 1,130,000km^2) around Mojo and Adama in the State of Oromia.

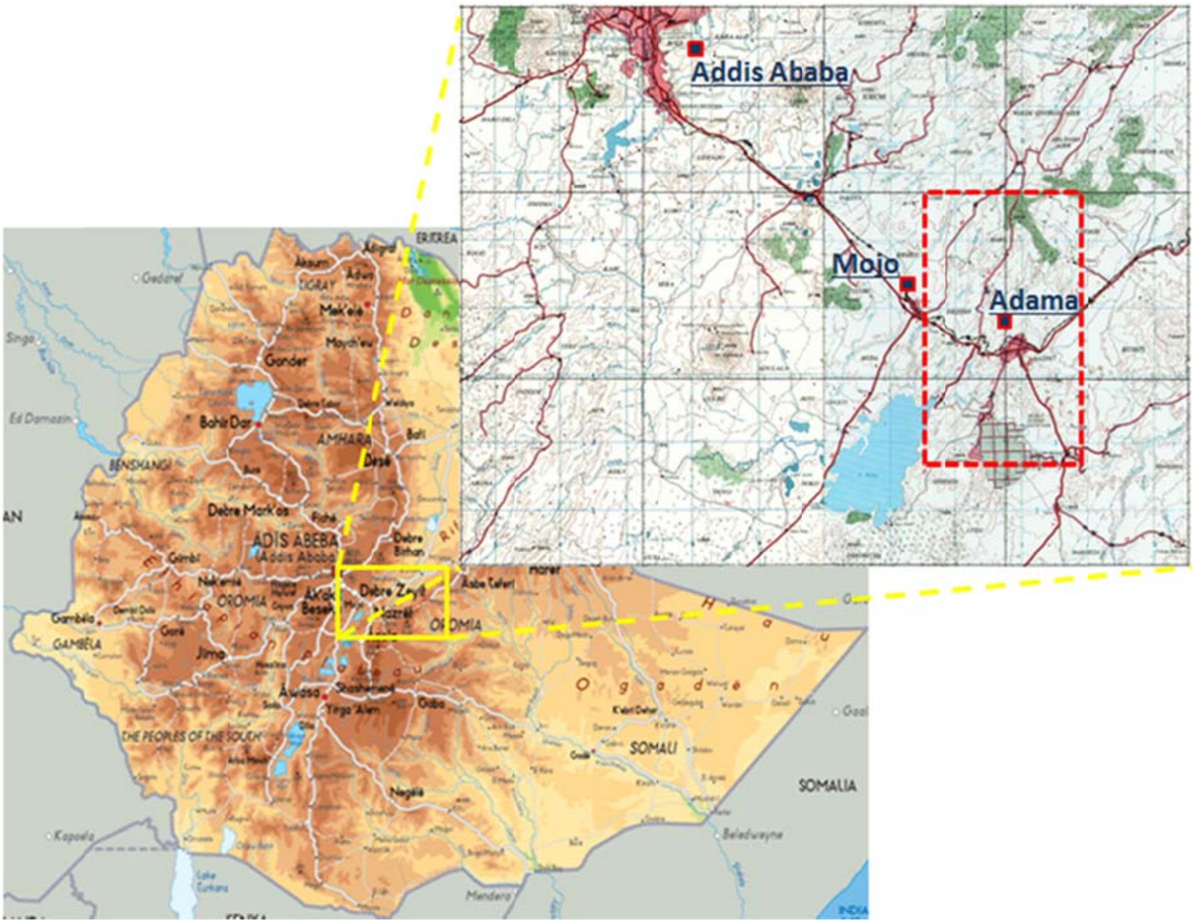


Figure 2 Target Area for Topographic Map Data Creation

(2) Process of Target Area Selection

There has been a plan in the Government of Ethiopia to construct a new highway and railway connecting Addis Ababa (the capital of Ethiopia) and the country of Djibouti.

This project area has been selected from the following conditions: The city of Adama and Mojo is existing belong the construction area; a large scale plantation area along the way has been confirmed; regarding to the 5-year GTP, high potentials of agriculture, rural development and infrastructure development can be found.

(3) Target of Technology Transfer

The figure below shows a simplified general workflow from creation to utilization of geospatial information. In view of the present status and problems of EMA described above, all the work except aerial photography is included in the technology transfer in this Project, taking into account the workflow of the entire project for topographic mapping.

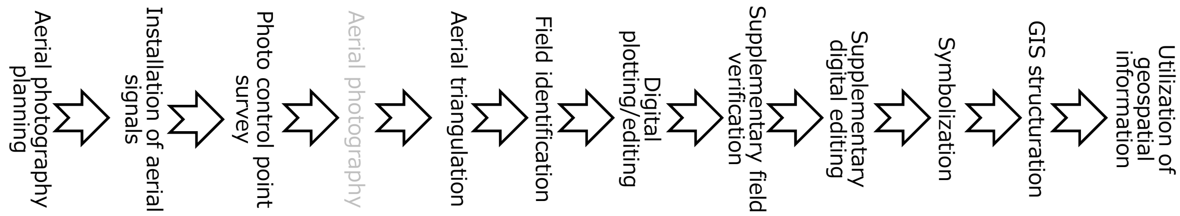


Figure 3 General Workflow Related to Geospatial Information

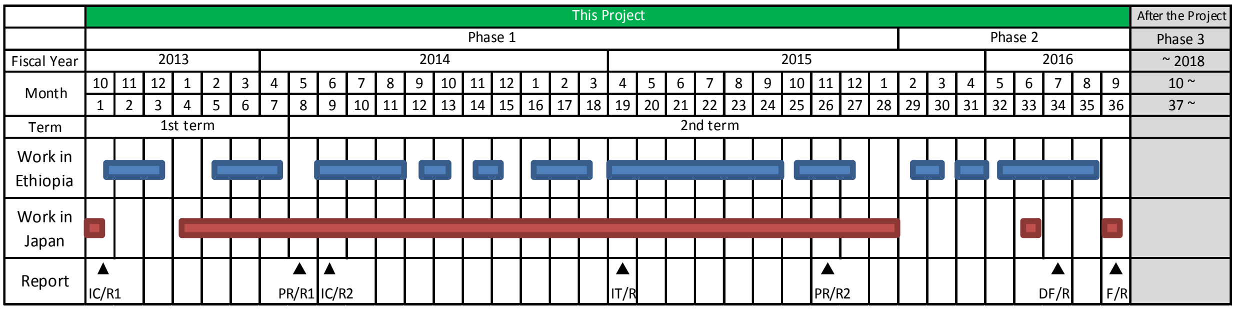
1-5. Entire Schedule, Contents, Technology Transfer and Outputs of Project

The entire process, outline and amount of each work together with the outputs of the Project are shown below.

(1) Entire Schedule

The entire cooperation period is approximately five years from October 2013 to 2018, divided into three phases. The first term of the Project ends in May 2014 during Phase 1 and the second term starts in the following June.

Table 2 Entire Schedule



(2) Contents of Project Implementation

Table 3 Contents of Work to be Implemented

<table>
<tr><th>Term</th><th>Implementation item</th><th>Qty.</th><th>Remarks</th></tr>
<tr><td rowspan="6">1st</td><td>Creation of work specifications</td><td>1 set</td><td>Work specifications, map symbol rules, quality/accuracy control manual, specifications of digital topographic map data</td></tr>
<tr><td>Verification, preparation of images, etc.</td><td>1 set</td><td>Aerial triangulation, verification of orthophoto accuracy</td></tr>
<tr><td>Field identification</td><td>1,140km²</td><td>1/10,000 54 map sheets</td></tr>
<tr><td>Website creation</td><td>1 set</td><td>Existing website survey</td></tr>
<tr><td>Assistance for implementation of organizational capacity building</td><td>1 set</td><td>EMA organization management survey</td></tr>
<tr><td>Promotion of utilization</td><td>1 each</td><td>Opening seminar, 1st JCC meeting</td></tr>
<tr><td rowspan="9">2nd</td><td>Digital plotting/editing</td><td>1,140km²</td><td>1/10,000 54 map sheets</td></tr>
<tr><td>Generalization</td><td>1,140km²</td><td>1/25,000 6 map sheets</td></tr>
<tr><td>Symbolization (1/10,000)</td><td>1,140km²</td><td>54 map sheets</td></tr>
<tr><td>Symbolization (1/25,000)</td><td>1,140km²</td><td>6 map sheets</td></tr>
<tr><td>Digital data structuration (1/10,000)</td><td>1,140km²</td><td>54 map sheets</td></tr>
<tr><td>Digital data structuration (1/25,000)</td><td>1,140km²</td><td>6 map sheets</td></tr>
<tr><td>Creation of data files</td><td>60 files</td><td>1/10,000 (54 map sheets), 1/25,000 (6 map sheets)</td></tr>
<tr><td>Website creation</td><td>1 set</td><td></td></tr>
<tr><td>Assistance for formulation of organizational structure & utilization of geospatial information</td><td>1 set</td><td></td></tr>
</table>

(3) Technology Transfer

Table 4 Technology Transfer Items and Quantities

Phase 1

<table>
<tr><th>Item</th><th>Work Content</th><th>Outline of Technology Transfer</th><th>Implemented Quantity</th></tr>
<tr><td rowspan="4">Aerial photography planning/Installation of aerial signals</td><td>Creation of photography plan</td><td>Formulation of photography plans according to photo-scale</td><td>5 practice areas</td></tr>
<tr><td>Field reconnaissance point selection</td><td rowspan="2">Field reconnaissance to select installation points for aerial signals and installation of aerial signals</td><td rowspan="2">16 practice points</td></tr>
<tr><td>Installation of aerial signals</td></tr>
<tr><td>Accuracy control</td><td>Accuracy control of photography plan and aerial signals</td><td>1 set</td></tr>
<tr><td rowspan="4">Photo control point survey</td><td>GPS survey</td><td rowspan="2">Calculation of coordinate values by measuring installed aerial signals using GNSS equipment and analysis of results</td><td rowspan="2">16 practice points</td></tr>
<tr><td>GPS analysis</td></tr>
<tr><td>Leveling</td><td>Theoretical accuracy training</td><td>1 set</td></tr>
<tr><td>Accuracy control</td><td>Accuracy control of photo control point survey</td><td>1 set</td></tr>
<tr><td rowspan="3">Aerial triangulation orthophotos/DTM</td><td>Aerial triangulation by aerial photo images</td><td>Understanding of theory of aerial triangulation and implementation of actual observation and adjustment calculation</td><td>2 blocks on scale of around 5 photo control points</td></tr>
<tr><td>DTM creation/editing</td><td rowspan="2">Understanding of theory of DTM creation and ortho-creation and implementation of DTM creation and editing and orthoimage creation</td><td rowspan="2">Two 1/10,000 sheets</td></tr>
<tr><td>Creation of orthoimages</td></tr>
</table>

Item	Work Content	Outline of Technology Transfer	Implemented Quantity
Field identification/Supplementary field verification	Pre-interpretation	Understanding of map symbols, acquisition items and acquisition standards Pre-interpretation of target items of field identification	OJT for EMA technical staff (8 teams/16 persons) over 1,140km^2
	Field identification	Field identification and gathering of required feature information	
	Supplementary field verification	Supplementary field verification at doubtful points by plotting and editing processes, and identification and verification in the field	
	Compilation of results	Compilation of identification and supplementary verification results and creation of materials	
Digital plotting	Digital plotting using aerial photo images	Understanding of map symbols, acquisition items and acquisition standards Acquisition of position information of features by digital plotter Decipherment of feature type by digital plotter	15 1/10,000 map sheets
	Accuracy control	Accuracy control of plotting results	1 set
Digital editing/ Supplementary digital editing/Generalization	Digital editing	Understanding of operation of CAD software Addition of field identification and supplementary field verification results to plotting data and correction Understanding of data error detection and correction techniques	Two 1/10,000 map sheets
	Supplementary digital editing		
	Generalization	Generalization according to procedures	One 1/25,000 map sheet
	Accuracy control	Accuracy control of editing results	1 set
Symbolization	Allocation of symbols to topographic map data	Understanding of theory of mapping and map symbols Symbolization according to procedures	Two 1/10,000 map sheets One 1/25,000 map sheet
GIS structuration/ Website creation	Creation of GIS database	Understanding of conversion technique from CAD to GIS format and implementation of data conversion Understanding of GIS software operation Creation of number of GIS models	Two 1/10,000 map sheets One 1/25,000 map sheet
	Website operation and maintenance	Understanding of skills required for website operation and maintenance	To be negotiated with EMA
Promotion of utilization	Grasping of need for use of topographic maps	Establishment and running of JCC and liaison with related agencies	JCC: 5 times Individual interview: as appropriate
Technology transfer to enable EMA to implement topographic map creation projects by itself	Accuracy control by process Creation of accuracy control table	Implementation independently by EMA of process control, quality control and manual creation for each process	1 set per technology transfer

Phase 2

Item	Work Content	Outline of Technology Transfer	Implemented Quantity
Creation of project management manual	Creation of manual	Creation of manual from project planning to implementation and evaluation	1 set
	Updating of manual	Update of manual by EMA itself as required	
Process control	Basics of process control	Understanding of importance of process control and creation of appropriate project process sheet	1 set
	Process control	Process control based on created process sheet	
Quality control	Basics of quality control	Understanding of importance of quality control, quality standards, content and approach to quality control	1 set
	Process control	Quality control in each process	
	Product management	Quality control of products	
Strengthening of topographic map management system	Formulation of management plan	Establishment of manager, management method and operational procedures for management of map sheets and data	1 set
	Topographic map management	Topographic map management by EMA itself according to management plan	
Strengthening of topographic map sales structure	Formulation of sales plan	Establishment of prices of topographic maps, sales manager, sales outlet and terms of use	1 set
	Sale of topographic maps	Sale of topographic maps by EMA itself according to sales plan	
Website creation	Operation of website	Understanding of website operating procedures Understanding of public data update method Website operation by EMA itself	1 set
Promotion of utilization	Holding of seminars	Planning and holding of seminars on initiative of EMA	1 set

(4) Products

Table 5 Outputs etc.

Item			Quantity	Remarks
Study report	Inception Report 1		Japanese 5 copies English 15 copies	First term 10 English copies to EMA 5 Japanese copies and 5 English copies to JICA
	Progress Report 1		Japanese 5 copies English 15 copies	First term 10 English copies to EMA 5 Japanese copies and 5 English copies to JICA
	Inception Report 2		Japanese 5 copies English 15 copies	Second term 10 English copies to EMA 5 Japanese copies and 5 English copies to JICA
	Interim Report		Japanese 5 copies English 15 copies	Second term 10 English copies to EMA 5 Japanese copies and 5 English copies to JICA
	Progress Report 2		Japanese 5 copies English 15 copies	Second term 10 English copies to EMA 5 Japanese copies and 5 English copies to JICA
	Draft Final Report			Second term
		Main Report	English 15 copies	10 English copies to EMA 5 Japanese (Summary) copies and 5 English copies to JICA
		Summary	English 15 copies	
		Summary in Japanese	Japanese 5 copies	
	Final Report			Second term
		Main Report	Japanese 5 copies English 15 copies	10 English copies to EMA 5 Japanese copies and 5 English copies to JICA
		Summary	Japanese 10 copies English 15 copies	10 English copies to EMA 10 Japanese (Summary) copies and 5 English copies to JICA
		Quality Control Report		
Outputs	Field Survey Results		1 set	1 set to EMA
	Digital Data Files			
		1/10,000 and 1/25,000 topographic map data	2 sets	1 set to EMA, 1 set to JICA
		1/10,000 and 1/25,000 GIS base data	2 sets	1 set to EMA, 1 set to JICA
		1/10,000 and 1/25,000 topographic map data, PDF format	3 sets	1 set to EMA, 2 sets to JICA
		Orthophotos	2 sets	1 set to EMA, 1 set to JICA
		Final Report	1 set	
	Quality Control Report		2 sets	1 set to EMA, 1 set to JICA
	Booklet			
		A3 size	33 sets	33 sets to related agencies
		Original size	6 sets	5 sets to EMA, 1 set to JICA
	Work Manual		1 set	1 set to EMA
	Others			
		Acquisition inventory (survey equipment, etc.)	1 set	
Work report			1 set	Monthly (Submitted to JICA by 10th of following month)
Collected materials				List sorted by category is attached
PR materials			200 digital copies in English	150 copies to EMA, 50 copies to JICA
Digital files			1 CD-R	About 20 digital images (in JPEG format) and record table
Others		M/M, etc.		
		Documents for/from the Government of Ethiopia		

Chapter 2 Evaluation and Recommendation of the Study

2-1. Verification of the Achievement

(1) Input

The contents of the input from the Japanese side to the project, *i.e.* the dispatch of experts, training in Japan and provision of equipment (including that for topographic mapping), were appropriate and the input was utilized effectively in the project.

(2) Output

1) A work manual on digital topographic mapping has been created.
2) Digital topographic maps (of an area of 1,140km^2 at the scales of 1/10,000 and 1/25,000) have been created in Japan.
3) EMA has become able to plan, implement and manage digital topographic mapping and conduct trouble-shooting in it independently.
4) The digital topographic maps created in the project have been made available to the public and a system required for the provision of the maps to users has been established.
5) Technologies for digital topographic mapping have been accumulated and an organizational structure and a responsibility-sharing system required for implementing mapping projects systematically have been established in EMA.

Almost all the outputs have been achieved. It has been decided that the outputs of this project shall be made available to the public on the Geoportal of EMA free of charge.

The engineers who participated in the technology transfer in this project have become able to create 1/10,000 and 1/25,000 topographic maps at a steady pace. The technologies for the work scheduling and schedule management have been transferred to them in the project. Therefore, they are expected to be able to implement projects similar to this one in future in accordance with a pre-determined work schedule. In addition, because the training on the quality control in each stage in the mapping was provided to the staff members in the Quality and Standard Directorate of EMA as part of the technology transfer, systems responsible for both schedule management and quality control are considered to have been established.

(3) Progress in the Achievement of the Project Purposes

< Project Purpose >

1) To develop 1/10,000 and 1/25,000 digital topographic map data of an area of approximately 1,140km^2 around Mojo and Adama in the Regional State of Oromia
2) To build the capacity of EMA itself to develop digital topographic maps through technology

transfer, to attain a technical level at which it can perform digital topographic mapping independently based on an appropriate organizational framework, and to enable EMA to implement and manage topographic mapping projects

During the project period, 54 sheets of 1/10,000 digital topographic maps (of an area of 1,140km^2) were created and six sheets of 1/25,000 digital topographic maps (of the same area) were created with the generalization of these 1/10,000 topographic maps.

The engineers who participated in the technology transfer have improved their technical capacity to the level at which they can at least create quality-controlled 1/10,000 and 1/25,000 topographic maps by themselves. They have become able to implement and manage topographic mapping projects of EMA through the experience in preparing the "Work Manual," "Product Specifications" and "Accuracy Control Manual" and compiling them into the "Project Management Manual."

Table 6　Outcome of the Technology Transfer in Relation to the Project Purposes

Item	Outcome
Aerial photography planning/Installation of aerial signals	Became able to formulate photography plans in according to the photography scale by using the software developed in this study.
	Became able to perform point selection according to the photography conditions and at clear locations on the aerial photograph. Became able to install aerial signals based on the work specifications.
Photo control point survey	Became able to use procured equipment (GPS receiver, analysis software) in practical work.
Aerial triangulation/ Orthophotos/DTM	Understood the theories of aerial triangulation and DTM. Understood the operation of digital photogrammetry system.
Field identification/ Supplementary field verification	Understood the operation of the equipment used. Understood the theory of field identification and became able to collect information which is difficult from photo interpretation.
Digital plotting	Understood map specifications, acquisition standards and acquisition procedures. Understood 3D interpretation. Reached the level capable of plotting on a scale of 1/10,000 and 1/25,000 by themselves and application to other scales may be expected.
Digital editing/ Supplementary digital editing/Generalization	Understood the operation of CAD software. Understood the methods of detecting and correcting errors in data and creating polygons.
Symbolization	Understood the theory of mapping. Understood map symbols and 1/10,000 and 1/25,000 map symbolization.
GIS structuration	Understood the conversion technique from CAD to GIS format. Understood the operation of GIS software.
Website creation	Understood the website operation technology.

Table 7 Outcome of the Assistance for the Formulation of Organizational Structures for the Achievement of the Project Purposes

Target	Item	Outcome
Accurate and reliable map creation by EMA	Creation of work specifications	Work specifications were created.
	Acquisition of Basic Technology	All the operators who participated in the technology transfer acquired basic skills.
Accurate and reliable map creation by EMA Development of data creation/update structure	Creation of wide use manuals	Wide use manuals were created and utilized also in the technology transfer.
	Implementation of pilot area operations	Operators who participated in the technology transfer reached the level capable of implementing the operations by themselves.
	Efficient work implementation	Joint operations across the directorates within EMA ("Planning and Business Development Directorate", "Surveying Directorate", "Mapping Directorate", "GIS & Remote Sensing Directorate", "IT Directorate", "Quality & Standards Directorate") were carried out through the technology transfers and creation of "Adama Tourist Map", which clarified the roles and schemes of each directorate.
	Implementation of process control	Performance of different levels of operators was understood through the technology transfer, which laid the foundation for independent process planning by EMA.
	Implementation of quality control	EMA became able to perform quality control in accordance with the quality control manual and accuracy control table by themselves based on an understanding of quality control method.
	Development of sustainable management and operation structure of topographic map creation work	Utilization of the servers and viewers procured in this study laid the foundation for independent and sustainable management of topographic maps by EMA.
Development of easy to use environment for digital topographic maps	Information exchange and coordination with related organizations centered on EMA	Through the seminar and JCC, importance of national geographic information management was shared and the roles of stakeholders and each party were clarified.
		Direction of the analysis and utilization of the outputs of this study were shared, while the needs of potential users were grasped.
		International presence of EMA and the geographical information managed by EMA was enhanced as the presentation by EMA at an international conference was supported by the Study Team.
		At the meeting with "Djibouti City GIS Committee", relationship for sharing information on GIS promotion was established.
	Specific proposals for utilization	With respect to the creation of "Adama Tourist Map" utilizing the output of this study, the Study Team supported EMA and obtained an outcome during the study period.
	Development, management and operation of provision method	This study led to the creation of data that can be uploaded to and downloaded from the existing Geoportal and laid the foundation for independent and sustainable sale of topographic maps by EMA.

2-2. Result of the Evaluation

(1) Relevance

The project is considered to be highly relevant because of the reasons mentioned below.

The project was formulated in accordance with the "Country Assistance Policy" for Ethiopia, which stipulated the direction of Japan's assistance to Ethiopia.

Meanwhile, "agriculture development" and "infrastructure" development, which were expected to be the main areas of utilization of the outputs of this project, continued to be priority areas in the "Second Growth and Transformation Plan (2015/16 – 2019/20)" (draft as of September 2015). In addition, geospatial information is essential for the improvement of the "tax administration" and "land administration," which are mentioned in the draft plan as issues to be addressed. For these reasons, this project is considered to be consistent with the policy of the Government of Ethiopia.

As the Government of Ethiopia announced that the Information Security Agency (INSA) should develop National Spatial Data Infrastructure during the project period, EMA and INSA will have to coordinate in the creation and management of geospatial data.

(2) Effectiveness

This project is considered to have been highly effective for the following reason.

As mentioned in "2-1 Verification of Achievement, (3) Progress in the Achievement of the Project Purposes" above, the project purposes have been achieved with the achievement of the project outputs.

(3) Efficiency

This project is considered to have been highly efficient for the following reasons.

The quantity, quality and timing of the inputs in this project were appropriate. The project has managed to produce more outputs than planned in the assistance to the establishment of an organizational structure for the topographic mapping in the scales other than 1/10,000 or 1/25,000, the assistance in the creation of tourism maps of the project area as a way to utilize the topographic maps created in this project and the preparation of a recommendation on a viewer for the management and browsing of the data owned by EMA.

(4) Impact

No negative impact of this project has been observed so far. The three positive impacts mentioned below have emerged.

1) The equipment for the photo control point survey that has already been provided to EMA in response to a strong request of EMA is being utilized in the work of EMA.
2) EMA received an order for work including aerial triangulation, creation and editing of DEMs and orthophoto creation during this project period. EMA is implementing the work using the technologies learned and equipment provided in this study.
3) EMA began its own project of creating 1/10,000 topographic maps of the area around the study area of this project in order to increase the area coverage of 1/10,000 topographic maps while this project was in progress.

(5) Sustainability

With regard to the sustainability of the technical capacity, EMA is fully utilizing the technologies and equipment provided in this project in a project for photogrammetry and topographic mapping ordered by the Government of Ethiopia during the project period. In addition, EMA is expected to continue utilizing the technologies and equipment in the similar projects.

Greater impact on the organizational sustainability of this project is expected from disseminating the outputs transferred to EMA in this project within EMA, particularly for the training of inexperienced young staff members.

Free provision of the outputs of this project on the Geoportal is expected to lead to continuous utilization of the topographic map data, which is expected to contribute to the sustenance of the data utilization system.

2-3. Conclusion

The results of the evaluation of the implementing processes of this project and the evaluation of the project on the five DAC criteria suggest that the project purposes were achieved within the project period.

2-4. Recommendation

Recommendations on the requirements for sustaining and extending the project outcome after the completion of the project for the achievement of the overall goal, “to create an accurate and reliable national spatial database to promote sustainable development of the economic and social infrastructure” are described in the following.

(1) Requirements for the sustenance and extension of the project outcome

It is considered necessary to provide the support as described in the following table in order for EMA to continuously create, update and manage geographical information data for accurate and reliable national spatial database and for such database to be utilized for “sustainable development of the economic and social infrastructure”.

Table 8 Technical Support Required by EMA in the Future

Item	Theme	Contribution to overall goal
Strengthening of photogrammetry technology	• Development of structure suitable for large-scale operations (aerial triangulation, DEM creation and editing, orthoimage creation)	Establishment of this scheme will facilitate the creation of highly accurate and high-resolution ortho images that can be utilized for cadaster and city planning.
Strengthening of topographic map creation technology	• Extension of technology to inexperienced engineers within EMA (digital plotting, digital editing, symbolization)	By improving the EMA's productivity in the creation of topographic maps, establishment of a structure enabling the creation of geographical information of the necessary regions and at the necessary level of accuracy at an adequate cost and within an appropriate time period can be expected.
Strengthening of GIS technology of EMA and user organizations	• Development of GIS engineers capable of training users (GIS data creation and analysis, application to practical work)	Improvement of the technology for utilization of national spatial database of users and stakeholders involved in the economic and social infrastructure can be expected.
Strengthening of leveling technology	• Technology transfer in determining elevation for utilization of continuously operating reference stations (Support to planning of leveling)	Accuracy and reliability of the national spatial database in the aspect of "height" will be enhanced.
Establishment of structure for the management and operation of geospatial information	• Formulation of topographic map update plans • Strengthening of the data sharing system/promotion of data sharing • Elimination of the duplication in aerial photography, survey and topographic mapping • Training and permanent employment of human resources	Provision of the latest and easy-to-use digital data is made possible by equipping EMA with operating capacity and organizational structure required for the efficient and sustainable creation of geospatial data and by enabling the information sharing between EMA and other survey/planning organizations.

(2) Recommendations for Phase 3

In view of the results of this study, it was decided that specific initiatives should be strengthened in Phase 3 with respect to the following items.

1) Strengthening of photogrammetry technology

EMA has been receiving a growing number of requests for the creation of large-scale high-accuracy geospatial information from relevant agencies and it is considered that this work will continue to exist for a certain period to come. Accordingly, it is necessary to set up a production system to handle such requests. However, EMA does not have adequate skilled manpower and technology for large-scale high-accuracy photogrammetry.

As such, technology transfer should be implemented for the purpose of improving the creation technology and establishing the production system. Necessary equipment should be procured at the same time.

Major contents of the technology transfer are as follows.

Table 9 Support Assumed to be Necessary for the Strengthening of Photogrammetry Technology

Item	Matters requiring focus	Contents	Input (proposed)
Aerial triangulation	Work planning, progress control	Accurate planning based on adequate inspection of 4,000 to 5,000 images and understanding of the degree of difficulty in performing the work	<Japanese side> Expert (1 person) DEM editing software (2 sets) <Ethiopian side> Engineers (4 – 8 persons)
	Improvement of work efficiency	Improvement of efficiency in designing “description of control point” and photo control point observation Automatic setting of tie point observation parameters in accordance with the topography and image quality Establishment of adjustment calculation method by combining different software	
	Quality control	Improvement of efficiency in error detection and correction by combining different software Strengthening of troubleshooting capability	
DEM creation and editing	Work planning, progress control	Clarification of work method to avoid over specifications and standardization of quality among operators	
	Improvement of work efficiency	Division of work area in accordance with the processing capabilities of PC and software as well as topography	
	Quality control	Effective combination of editing tools Division of work taking advantage of the characteristics of different DEM editing software	
Orthophoto creation	Work planning, progress control	Development of a system to avoid work bottlenecks	
	Improvement of work efficiency	Understanding of appropriate mosaic line acquisition method Removal of cloud and haze	
	Quality control	Development of the line and feedback system from ortho inspection to DEM modification	

Table 10 Schedule for the Strengthening of Photogrammetry Technology (Draft)

Item		1st term				2nd term			
Aerial triangulation	Work planning, progress control	○							
	Improvement of work efficiency		○	○	○	○			
	Quality control						○	○	○
DEM creation and editing	Work planning, progress control	○							
	Improvement of work efficiency		○	○	○	○			
	Quality control						○	○	○
Orthophoto creation	Work planning, progress control	○							
	Improvement of work efficiency		○	○	○	○			
	Quality control						○	○	○

2) Strengthening of topographic map creation technology

The staff who attended the technology transfer by the Study Team should act as the instructors for technology transfer to the EMA staff to achieve the widespread use of the technology. Support should be provided for the implementation of this technology transfer. Specific details are as follows.

Table 11 Support Assumed to be Necessary for the Strengthening of Map Creation Technology

Item	Matters requiring focus	Contents	Input (proposed)
Digital plotting	Training of beginner-class engineers by skilled engineers of EMA	Development of digital plotting operators through practice in the areas with existing aerial photographs of which 1/10,000 maps have not been created	<Japanese side> Expert (1 person) <Ethiopian side> EMA instructors (5 – 7 persons) Engineers (10 – 15 persons)
	Acquisition of plotting technology for different scales	Plotting of Addis Ababa 1/5,000 topographic map data	
Digital editing	Training of beginner-class engineers by skilled engineers of EMA	Development of digital editing operators through practice in the areas with existing aerial photographs of which 1/10,000 maps have not been created	
	Acquisition of editing technology for different scales	Editing of Addis Ababa 1/5,000 topographic map data	
	Acquisition of generalization technology for different scales	Generalization from 1/10,000 to 1/25,000 and to 1/50,000	
Symbolization	Training of beginner-class engineers by skilled engineers of EMA	Development of symbolization operators through practice in the areas with existing aerial photographs of which 1/10,000 maps have not been created	
	Acquisition of symbolization technology for different scales	Symbolization of Addis Ababa 1/5,000 topographic map data Creation of 1/5,000 and 1/50,000 symbol catalogs	
	Conversion of symbols to other formats	Conversion from MicroStation (dgn) to ArcGIS (emf)	

Table 12 Schedule for the Strengthening of Map Creation Technology (Draft)

Item		1st term				2nd term			
Digital plotting	Training of beginner-class engineers by skilled engineers of EMA	○	○	○	○	○	○		
	Acquisition of plotting technology for different scales	○	○	○		○	○	○	
Digital editing	Training of beginner-class engineers by skilled engineers of EMA	○	○	○	○	○	○		
	Acquisition of editing technology for different scales	○	○	○		○	○	○	
	Acquisition of generalization technology for different scales		○	○	○		○	○	○
Symbolization	Training of beginner-class engineers by skilled engineers of EMA	○	○	○	○	○	○		
	Acquisition of symbolization technology for different scales	○	○	○		○	○	○	
	Conversion of symbols to other formats		○	○	○		○	○	○

3) Strengthening of GIS technology of EMA and user organizations

Utilization of GIS is essential in promoting the use of topographic map data in different governmental organizations. However, engineers and technological level in this field are inadequate. As such, as the first step, technology transfer to the EMA engineers should be implemented. As the second step, the staff who received the training should carry out technology transfer to other organizations.

Table 13 Support Assumed to be Necessary for the Strengthening of GIS Technology

Item	Matters requiring focus	Content	Input (proposed)
GIS technology	Development of EMA instructors	• Creation of instructor development plan • Creation of training curriculum and text • Practical training, practice	<Japanese side> Expert (1 person) <Ethiopian side> EMA instructors (5 persons) User organization engineers (about 10 persons)
	Expansion of GIS users	• Introduction and promotion of the use of GIS to other organizations and technical training • Holding of GIS seminar • Consulting with users (needs survey, joint operation)	

Table 14 Schedule for the Strengthening of GIS Technology (Draft)

Item		1st term				2nd term			
GIS technology	Development of EMA instructors	○	○	○	○	○			○
	Expansion of GIS users		○	○	○	○	○	○	○

4) Strengthening of leveling technology

Currently, elevation data (benchmarks) in Ethiopia are significantly insufficient for the area of the country (approximately 1.13 million km^2). The placement of benchmarks is skewed and the benchmarks are not evenly distributed. As such, sufficient accuracy cannot be ensured in aerial photography because of the lack of control points for elevation necessary for aerial triangulation. Also, it is impossible to assign elevation to continuously operating reference stations (CORS). Therefore, technology transfer in leveling should first be implemented. At the same time, necessary equipment should be procured.

Table 15 Support Assumed to be Necessary for the Strengthening of Leveling Technology (Draft)

Item	Matters requiring focus	Contents	Input (proposed)
Leveling	Leveling theory and observation technology	Development of managerial-level human resources with respect to the purpose and theory of "leveling", specifications and management method of equipment and installation and observation methods	<Japanese side> Expert (1 person) Zero order Leveling equipment (2 sets) Car hire (4WD: 3 vehicles) Local workers (2 teams of 4 workers) <Ethiopian side> Managers (2 persons) Engineers (5 – 10 persons)
	Leveling planning	Laying the foundation for planning to cater for large-scale operations	
	Quality control	Implementation of error summation practice using spreadsheet software and accuracy control practice in accordance with the "accuracy control and accuracy control table creation manual"	
	Observation practice	Implementation of practice in the leveling between the existing benchmarks and the zero-order control points in the suburbs of Addis Ababa	

Table 16 Schedule for the Strengthening of Leveling Technology

Item		1st term				2nd term			
Leveling	Leveling theory and observation technology	○	○						
	Leveling planning			○	○				
	Quality control					○	○		
	Observation practice							○	○

5) Strengthening of geospatial information management and operation

Recommendation for the establishment of structure for development of geospatial information in Ethiopia

Table 17 Support Assumed to be Necessary for the Strengthening of Geospatial Information Management and Operation

Item	Matters requiring focus	Contents	Input (proposed)
Strengthening of geospatial information management and operation	Formulation of a topographic map update plan	Decision on a policy on the formulation of a medium- to long-term plan on topographic mapping to be required in Ethiopia in future (a work schedule, personnel assignment planning and budget planning for them appropriate for the productivity of EMA to be included in the medium- to long-term plan) Example: Topographic mapping of areas in which national projects (for the construction of dams, airports, roads and railways) are to be implemented	<Japanese side> Experts (2 persons) <Ethiopian side> EMA managers (10 persons)
	Strengthening of the data sharing system/ promotion of data sharing	Assistance in drafting a geospatial information policy	
		EMASDI (discussion on and documentation of the categorization of the data owned by EMA and disclosure/non-disclosure of data and the rules on data disclosure)	
		Assistance in the web and Geoportal operation	
		Development of a scheme in which an organization that has conducted a survey shares the survey results with EMA	
		A study on a scheme for a regular information sharing for data sharing, update and distribution among the major organizations (submission of survey plans and results and update and distribution of geospatial information)	
	Elimination of the duplication in aerial photography, survey and topographic mapping	Recommendations on the creation of a survey plan form and a scheme in which surveying organizations share their survey plans with EMA	
		Presentation of the actual outputs of aerial photography, surveys and topographic mapping	
	Training and permanent employment of human resources	Creation of a guideline on the career path for the staff members	
		A study on the introduction of a qualification system (making reference to the qualification systems in neighboring countries)	
		Strengthening of the training center of EMA	

Table 18 Schedule for the Strengthening of National Geospatial Information Management and Operation

Item		1st term				2nd term			
Strengthening of national geospatial information management and operation	Formulation of topographic map updating plan	○	○	○	○	○	○	○	○
	Formulation of geographical information operation rules	○	○	○	○	○	○	○	○

Chapter 3 Works in the First Term

[1] Collection, Sorting and Analysis of Related Information and Materials《Work in Japan》

The Terms of Reference, Detailed Planning Study Report and materials collected in Ethiopia have been sorted and analyzed.

[2] Preparation of Inception Report 1《Work in Japan》

The policies for implementation of the Project, work schedule, implementation system and technology transfer plan have been compiled to prepare Inception Report 1. The contents are shown below:

- Survey target area
- Setting of survey work amount and issues, items and quantities of the products of the Project
- Basic policy of works
- Technology transfer plan
- Work schedule
- Table of man-months required for the survey

[3] Explanation and Discussion of Inception Report 1《Work in Ethiopia》

Explanation

The Inception Report was explained to EMA directorates at a management meeting. During the explanation, emphasis was placed on the schedule, the relevant departments for each work item, strengthening of the organization, etc.

Discussion

The work policy and content of the surveys, etc. described in Inception Report 1 were explained to EMA. The survey implementation system based on the implementation policy was discussed with EMA, and minutes of the meeting were prepared and agreed by both parties.

[4] Discussions on Specifications《Work in Ethiopia》

Discussions Regarding Surveying Standards

Regarding the surveying standards, the Study Team proposed the following standards taking into consideration facilitation of data sharing with domestic and foreign organizations, aid agencies, etc., and after discussion with EMA, the standards were agreed by the two parties.

Table 19 Surveying Standards

Item	Standard
Reference ellipsoid	Clarke 1880 mod a=6378249.1453 f=1/293.4663
Projection method	UTM (Universal Transverse Mercator) Zone 37
Coordinate system	Adindan
Central meridian line	Longitude east 39°
Correction factor	0.9996 (on central meridian line)
Origin of coordinates	Intersection of central meridian line and equator E=500,000.000m N=0.000m
Annotation	The following annotation will be displayed in the data files. This digital map was prepared jointly by the Japan International Cooperation Agency (JICA) under the Japanese Government Technical Cooperation Program and the Ethiopian Mapping Agency (EMA) of the Government of the Federal Democratic Republic of Ethiopia.

Discussion Regarding Topographic Map Symbol Regulations (1/10,000, 1/25,000 Topographic Maps)

In the first term survey, the Study Team held discussions mainly with the EMA Quality and Standard Directorate while referring to the relevant regulations of EMA, and prepared draft topographic map symbol regulations (map scale level 10,000 and 25,000). The following table shows the procedures for the discussions.

Table 20 Procedures for Discussions on Preparation of Topographic Map Symbol Regulations

Topic	STEP	Content
Map scale level 10,000	1	The concept of feature class and data class for the topography and features to be represented and the concept of the elements that the topography and features to be represented must have in the map symbol rules were explained.
	2	From the initial topography and features of the first feature class and the first data class of the prepared draft of rules, the appropriateness of representation on map scale level 10,000 was discussed, and a selection was made. Also, the names and the definitions of the topography and features adopted were discussed and agreed. At this step, the names and definitions of all the topography and features to be represented on the basic topographic maps were determined.
	3	The standard values in terms of representing the adopted topography and features (in terms of data construction) (standard values of spatial size of topography and features to be represented, importance in terms of representation) and methods of acquisition of topography and features (method of acquisition of the information that topography or features actually exist, method of acquisition of topography and features as digital data) were discussed and determined.
	4	The symbols and data types for representing the adopted topography and features on topographic maps were discussed and determined. In the discussions on symbols, the shape, size, color, etc., were considered, and for the data types the characteristics of the symbols were considered.
	5	For some topography and features the previous step was returned to and the matter was discussed again, and a first draft of the map symbol rules for map scale level 10,000 was prepared.
Map scale level 25,000	1	It was discussed whether or not the topography and features to be represented on the topographic maps at map scale level 10,000 should be represented on the topographic maps at map scale level 25,000. It was decided to adapt some features from 1:10,000 to 1:25,000 map.
	2	The acquisition standard and acquisition method for the topography and features which it was decided should be represented on topographic maps at map scale level 25,000 were determined with reference to the acquisition standard and acquisition method for the topographic maps at map scale level 10,000.
	3	The symbols and data types for representing the adopted topography and features on topographic maps were discussed and determined, with reference to the topographic maps at map scale level 10,000.
Symbols	February – March 2014	Actual size symbols were produced based on the above discussion results, and based on their output drawings the symbol shape, size, and color were discussed again. As a result, items for amendment were identified, and a second draft of symbols for topography and features was determined.
Change in the future class and data class of map symbol rules	March 2014	When the initial feature classes and data classes were prepared (configured) as digital data, it was found that there were some inconsistencies in terms of the preparation system, therefore changes were discussed. Several changes to the classification names and additions were made, and a second draft of map symbol rules was produced. No increase or decrease in the topography and features to be represented was caused by these changes in the map symbol rules at both scales.

As a result of the process described above, as of April 2014 the second draft has been produced for the map symbol rules at both map scale level 10,000 and map scale level 25,000. The following is a summary of the two sets of map symbol rules.

Table 21 Topographic Map Symbol Rules Developed

Map Scale Level	Specification		
	Feature Class	Data Class	Number of Topography and Features
10,000	9	66	224 (including 47 annotations)
25,000	9	66	182 (including 44 annotations)

Figure 4 Discussions on the Specifications
(Left: For map symbols, Right: For marginal information)

Discussion on the Marginal Information of Topographic Maps

The Study Team determined the marginal information of topographic maps after holding a discussion with EMA. The table below shows the details of the discussion.

Table 22 Discussion on the Marginal Information of Topographic Maps

Period	Contents of the Discussion
June 2014	A discussion focused on the issues mentioned below concerning the marginal information of 1/10,000 topographic maps was held. The following are the major modifications decided in the discussion. ・Change in the size of the letters indicating the coordinate values at the corner ・Geographic coordinates to be displayed ・Change in the format of the map sheet name ・Change in the format of the bar scale (the same format as on the printed 1/50,000 topographic maps) ・Deletion of the administrative boundary maps
November 2014	A proposal for modification of the marginal information of 1/10,000 topographic maps based on the discussion in June was submitted. The marginal information of 1/25,000 topographic maps was prepared taking into consideration the proposal. A discussion was held on the proposal and the marginal information and the information was modified in the discussion. The following are the major modifications made in the discussion. ・Change in the line type of the grid lines ・Change in the display format of the grid coordinate values ・Change in the format of the bar scale ・Addition of the surveying record ・Addition of the surveying standards
Output	A sample topographic map containing the marginal information decided in the discussion

[5] Collection and Sorting of Existing Materials《Work in Ethiopia》

Existing data that will serve as basic information or that can be utilized in the Project, such as topographic maps and future plans, etc. owned by related Ethiopian agencies or EMA were obtained through individual interviews with EMA staff related to the various works in this Project and EMA management meetings, seminars and JCCs, and the data were organized.

Table 23 Lists of Existing Materials Collected

Document Name	Received From	Details	Remarks
Existing topographic maps	EMA	1/50,000 1/250,000	
Control points, benchmark results	EMA	Table of results	
Administrative boundary data	EMA	Zone, Wereda	
Existing work specifications Existing topographic map symbols	EMA	1/10,000 1/25,000 1/50,000 Orthophoto map	
Existing website survey results	EMA	Documents concerning website	
Highway road data	Chinese Communications Construction Company	Road planning data	
Data on transmission power lines, high voltage lines	Ethiopian Electric Power Corporation	Data on transmission power line network, high voltage line network	
Telephone lines	Communication Company	1/50,000	
Topographic classification drawings	EMA	Topographic classification	
KAIZEN manual	Ethiopia KAIZEN Institute	KAIZEN documents	Ver. Amharic

[6] Preparation of Work Specifications on Digital Topographic Mapping《Work in Ethiopia》

The Study Team held a discussion on the preparation of the work specifications with EMA. The table below shows the details of the discussion. The team described the outcome of the discussion in the work specifications.

Table 24 Discussion on the Work Specifications

Item	Contents of the Survey and Discussion
Preparation method	Existing work specifications of EMA Work specifications required by EMA and the contents to be included Procedures for the preparation of work specifications
Quality control	Quality control in the topographic mapping practiced by EMA Presentation of the quality control methods used in actual mapping known to the Study Team Explanation of actual use of the quality control methods presented above Explanation of the concept and implementation of the quality evaluation provided in the ISO geographic information standards
Accuracy control at each process	Practical method for accuracy control of the outputs of plotting and editing Explanation of the accuracy control table and preparation of the accuracy control table (draft) for 1/10,000 topographic maps
Product specifications	Explanation of the outline of the concept, composition and contents of the product specifications Explanation of the quality evaluation (including the concepts of the five data quality elements and 15 data quality sub-elements) Explanation of the procedures for quality evaluation in accordance with the map symbol regulations for 1/10,000 digital topographic maps and a trial partial data quality evaluation using the product specifications

[7] Verification and Preparation of Images and Other Information 《Works in Ethiopia/ Japan》

Verification was made whether the aerial photographs owned by EMA (taken in May 2011) and the outputs of the aerial triangulation (conducted in May 2011) were accurate enough to satisfy the required specifications of the Project by inputting them in a digital photogrammetric system in Japan. Although some problems were found regarding a ground control point, it was concluded that the outputs of the aerial triangulation were accurate enough for their use in the subsequent processes including plotting. The pilot trace of the existing aerial photographs owned by EMA is as shown below.

Table 25 Pilot Trace

Contents	Details
Camera	UCX-SX-230
Focal Length	100.5mm
Image size (flight direction)	67.824mm
Image size (wing direction)	103.89633mm
CCD datum size	7.2μm
Pixel size (flight direction)	9,420 pixel
Pixel size (wing direction)	14,430 pixel

Results and Method of Inspection of Aerial Photographic Images

An index map and coverage were created from the exterior orientation elements of the aerial photographic images. Using these, it was confirmed that the available aerial photographic images covered the entire plotting area and satisfied the required conditions of a forward overlap of 60% between adjacent photographs and a side overlap of 30% between adjacent images. It was also confirmed there was no problem in the image quality caused by clouds, etc. by visual inspection of each of the projected images.

Results and Method of Inspection of the Aerial Triangulation Outputs

Observation was made of the numerical data of the control points on the stereo models recreated with the outputs of the aerial triangulation and it was verified that they were below the limits set in the Overseas Survey Operation Specifications. The team also conducted inspection of the data between models and between courses.

Table 26 Results of the Inspection of the Aerial Triangulation Outputs

<table>
<tr><th colspan="2">Item</th><th colspan="2">Result</th></tr>
<tr><td rowspan="3">Inspection method</td><td rowspan="2">Permissible limit of error
(Map Scale Level 10,000)</td><td>Horizontal position</td><td>Less than 3.00m (mean square error)</td></tr>
<tr><td>Elevation</td><td>Less than 1.50m (mean square error)</td></tr>
<tr><td>Method</td><td colspan="2">The inspection was carried out independently for Blocks 4 and 5 in which the plotting area was located.
Inspection was conducted by first recreating the stereo models with the available outputs of the aerial triangulation and then by calculating residuals between the coordinates of the ground verification points measured on the ground and those measured with a plotter to confirm the least square error for all the verification points.</td></tr>
<tr><td rowspan="3">Inspection results</td><td>Block 4</td><td colspan="2">Eight photo control points, F126-16 to 23, are located in this block.
It was confirmed that the mean square errors of 1.616m and 1.462m obtained for the horizontal position and elevation, respectively, were below their respective permissible limits at Map Scale Level 10,000.</td></tr>
<tr><td>Block 5</td><td colspan="2">Five photo control points, F126-11, 21, 23, 25 and 27, are located in this block.
The team obtained the mean square errors of horizontal position and elevation of 21.959m and 0.362m, respectively. The large figure for the horizontal position revealed a considerable error in the measurement of the horizontal position. From closer examination it was suspected that a significant error in the measurement of position F126-27 was the cause of this abnormal figure. Verification conducted without F126-27 produced mean square errors of horizontal position and elevation of 0.996m and 0.362m, respectively, which were well below their respective permissible limits.</td></tr>
<tr><td>Supplementary verification of the outputs of Block 5</td><td colspan="2">In order to verify the hypothesis that “only the output of the control point survey of F126-27 is abnormal and all the other outputs of the control points and the outputs of the aerial triangulation are correct”, stereo models of the area near F126-27 were selected and measurement was made of the points shared between different models.
In the supplementary verification, points Nos. 101 to 108, Nos. 109 to 112 and Nos. 129 to 136 were used in the inter-model verification in the direction from the northeastern edge to the southeastern edge, from the southeastern edge to the center and from the southeastern edge to the southwestern edge, respectively, of the plotting area. In addition, the same inspection was conducted of points Nos. 113 to 128 near the plotting area of this Project for further verification. Since the mean square errors of the horizontal position and elevation obtained in this inspection were 0.432m and 0.706m, respectively, which were below their respective permissible limits, it was concluded that the models in the area excluding the control point P126-27 satisfied the required accuracy.</td></tr>
</table>

[8] Field Identification and Supplementary Field Verification《Work in Ethiopia》

1) Field Identification

The actual work was conducted by 18 engineers from the EMA organization under the instruction of members of the Study Team as a part of the technology transfer (in the form of OJT), with field identification maps sampled from the orthophotos owned by EMA.

- Field identification of topography and features and changes in them over the years
  (February 24, 2014 – March 28, 2014)

- Collection of reference materials relevant to topographic maps
  (February 24, 2014 – April 11, 2014)
- Study on annotations including names of topographic features and facilities
  (February 24, 2014 – April 11, 2014)

Purposes and Study Area

The purposes of the field identification were to verify features/buildings, changes in the features over the years, annotations, etc., which are difficult to interpret on photographs in the subsequent plotting stage, in the field and to collect document-based data such as power transmission lines and administrative boundaries.

An area of approx. 1,155km^2 was set as the target area of this identification work, consisting of the Project target area (approx. 1,140km^2 around Mojo and Adama in the Regional State of Oromia) and an additional area required to cover the entire town of Mojo.

Workflow

Each workflow contained in the field identification is described as below.

Table 27 Method of the Field Identification

Work items	Actual work
Preparation of Field Identification Map Sheets	The team created an orthophoto image on a scale equivalent to 1/10,000 of each map sheet area in the plotting area and one for the additional area around Mojo mentioned above, using the aerial photographs and orthophotos owned by EMA, and prepared field identification map sheets using the orthoimages.
Preparation of Map Symbol Rules for the Field Identification	Prior to the field identification, map symbol rules for the field identification were prepared based on the (draft) map symbol rules prepared in the Discussion on Specifications with EMA. The preparation was conducted in Japan, by the engineers in charge of the field identification who verified the identification items and unidentified locations.
Composition of the Field Identification Teams	Ten field identification teams, each with two members, were formed from a total of 20 engineers (two from the Study Team and 18 from EMA). As the entire area had to be studied within a limited Project period, the study area was divided into ten small areas, each including urban and suburban areas, and each team conducted the field identification in one of those small areas.
Explanation of the Outline of the Work	Guidance was given on the details and method of the field identification to the engineers who were to participate in the work using the Field Identification Manual. The details of the map symbol rules prepared in the Discussion on Specifications were clarified and the items to be identified in the field identification and those to be identified with reference materials were specified.
Pre-interpretation	Prior to the field identification, pre-interpretation was carried out using the existing topographic maps in the office. Each team identified the locations and data on mountains, rivers, roads, railway lines and names of places in its study area in advance using the existing 1/50,000 topographic maps.
Trial work	Acquisition of outputs of a standardized quality requires implementation of the identification work by all the engineers based on the same understanding. Therefore, trial work was conducted in two different environments, urban and semi-urban areas, for standardization of the understanding of the identification work.

Work items	Actual work
Identification of Topography and Features	Topography and features, the targets of the identification, were identified in the field. All the topography and features excluding those which the operators could interpret in the photo-interpretation and plotting, as classified in the map symbol rules, were identified in the field.
	Digital cameras with GPS and/or handheld GPS devices were used for verification of unidentified locations and positioning in the field identification.
	Findings in the identification were recorded on the field identification maps at any time with the description of the corresponding feature codes specified in the map symbol rules on the sheets.
	The field identification teams held weekly meetings to monitor the progress of the work, verify unidentified locations and exchange information between the teams for work process control and quality control.
Study on annotations	The study of annotations was conducted for identification of names of buildings which could serve as landmarks. The topography and annotations of place names shown on the existing topographic maps were also reconfirmed in the field identification. The position of the annotation data obtained in the field identification and from the existing topographic maps and other reference materials were clearly marked on the field identification maps and the annotation data were sorted on the Annotation Table forms used by EMA. The annotation data sorted on the forms in the local language were translated into English and the data in English were digitized with the use of PCs. The digitized annotation data were inspected again by all the members of the field identification team for errors and omissions in data entry.
Compilation of the Outputs of the Field Work	After the completion of the field identification, office work was conducted in order to organize the annotation list and inspect the data for consistencies between different map extents and omissions in the identification. Since inconsistencies in the matching and omissions in the identification had been detected at several locations, the team conducted supplementary identification to complete the field identification.
Outputs of the Field Identification	In order to reduce the complication in handling of outputs, the field identification outputs were compiled in the identification maps and annotation data. These data and the other relevant reference materials were digitized for convenience of use in the subsequent stages.

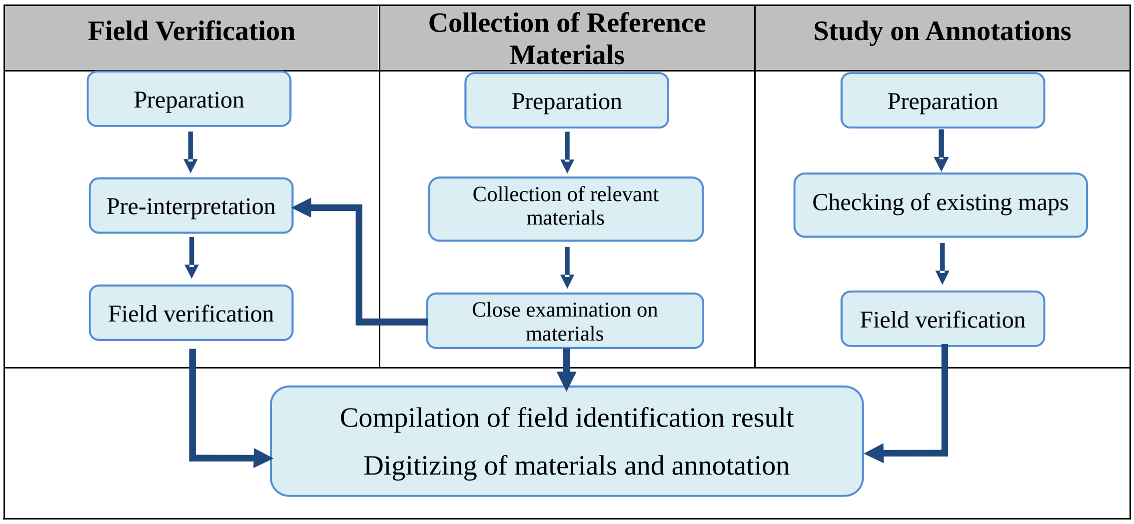


Figure 5 Workflow of the Field Identification

Participants and Grouping in the Field Identification

The field identification was conducted in cooperation of two engineers of the Study Team and 18 engineers of the C/P organization listed below.

Table 28 Personnel List

Mr. Satoru Nishio, Study Team member	Mr. Takeo Sugimoto, Study Team member	
Mr. Israel Gebremeskel	Mr. Tesemma Hunduma	Mr. Abera Tadesse
Mr. Henok Berhanu	Mr. Bekele Robi	Mr. Bereket Terefe
Mr. Alemseged Yesuneh	Mr. Wudneh Belachew	Mr. Fufa Gela
Mr. Daniel Ahmed	Mr. Aklilu Assefa	Mr. Samson Warkaye
Mr. Gizachew Nigussie	Mr. Abdissa Daba	Mr. Natnael Solomon
Mr. Belete Tafesse	Mr. Samuel Abera	Mr. Eskinder Tekabe

Collection of Relevant Reference Materials

Relevant materials and data on administrative boundaries, topography and annotations of place names, telephone lines, power transmission lines, and high voltage transmission lines, which were difficult to identify by photo interpretation, as well as construction sites of the planned highway and railway line and wind power generation facilities, were collected.

2) Supplementary Field Verification

An overview of the supplementary field verification in 1,155km^2 including the area around Adama City and the entire urban area of Mojo City is given below.

Purposes

The supplementary field verification was aimed at re-verifying, adding and correcting the locations, details and codes of all the topography, features and annotations represented on the editing manuscripts with a focus on the unidentified topography, features, etc. including ambiguous features at 1,138 locations. Field verification was also conducted in areas where changes over the years in topography and features were observed. The work procedures used in the supplementary field verification were as follows:

- To prepare supplementary field verification sheets from the topographic map data created in the digital editing
- To bring the printed supplementary field verification sheets and handheld GPS receivers to the field and verify the locations where data ambiguity and questionable annotations were detected in the digital plotting and digital editing
- To compile what was verified in the field on the printed topographic maps for data correction in the subsequent supplementary digital editing

Work Schedule

The table below shows the work schedule of the supplementary field verification.

Table 29 Work Schedule of the Supplementary Field Verification

Period	Activity
Jan. 28 – Mar. 13, 2015	Supplementary field verification (including verification of secular changes over the years)
Jan. 28 – Mar. 6, 2015	Field verification of power transmission lines and telephone lines
Mar. 9 – Mar. 20, 2015	Collection of relevant materials which were not collected in the field identification

Participants and Grouping in the Supplementary Field Verification

The Study Team members and the C/Ps worked together in the supplementary field verification in ten groups. The table below shows the participants and the group composition.

Table 30 Personnel List

Mr. Satoru Nishio, Study Team member	Mr. Takeo Sugimoto, Study Team member	
Mr. Tesemma Hunduma	Mr. Israel Gebremeskel	Mr. Abera Tadesse
Mr. Bekele Robi	Mr. Bereket Terefe	Mr. Zena Lingerih
Mr. Wudneh Belachew	Mr. Fufa Gela	Mr. Daniel Ahmed
Mr. Aklilu Assefa	Mr. Bemnet Ayalew	Mr. Gizachew Nigussie
Mr. Abdissa Daba	Mr. Natnael Solomon	Mr. Belete Tafesse
Mr. Samuel Abera	Mr. Eskinder Tekabe	Mr. Henok Berhanu

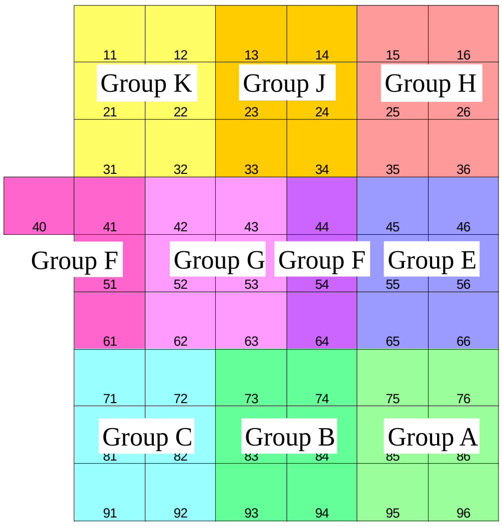


Figure 6 Work Division Diagram

Work Contents

1) Explanation of the Work Procedures

Immediately before implementing the supplementary field verification, the Study Team members explained the work procedures to all the EMA engineers who participated in this work using the Supplementary Field Verification Work Manual (draft) to ensure that they understood the work contents. After arriving in Adama City, they conducted a trial survey in the field to deepen their understanding of the work contents.

Figure 7 Explanation Meeting and Trial Survey

2) Supplementary Field Verification

The procedures mentioned below were used in the supplementary field verification.

- Instruction by the Operators for the Supplementary Field Verification

  The operators in the digital plotting and editing provided instructions for the supplementary field verification in accordance with the description in the figure below. The instructions identified the locations where they had found ambiguities in the results of the field identification and where they had been unable to verify the topography and features because of obstruction of the view in the plotting and editing. While the details to be verified differed depending on the contents of the instructions, they included locations, ranges, shapes, names and code numbers of the topography, features and annotations.

- All the Topography, Features and Annotations

  Instructions for the supplementary field verification given by the operators were followed in the supplementary field verification. In addition, the locations, details and codes of all the topography, features and annotations were re-verified, added and corrected in the field in this project. The correct code numbers and comments on the added and corrected topography and features verified in the field were described on the supplementary field verification sheets as stipulated in the map symbol regulations.

- Field Verification of Power Transmission and Telephone Lines

  EEPC (Ethiopian Electric Power Corporation) confirmed that high (mainly 132kV), medium (33kV) and low (15kV) voltage power transmission lines were used in Ethiopia. (See Figure 8)

Figure 8 Low-Voltage Power Transmission Network (Mojo City urban area) obtained from EEPC

- The accurate locations of the low-voltage power transmission lines were verified in the field using the CAD data of the low-voltage power transmission network maps (of the urban areas of Mojo and Adama Cities) obtained from EEPC. Although the number of lines had increased significantly since the maps were created, all the lines were verified.

  As most of the steel towers and lines of the high- and medium-voltage power transmission networks were identifiable in the photo-interpretation, those structures were verified only at the locations where there was data ambiguity and where they had been installed after the photographs were taken in the supplementary field verification.

  The major telephone lines along the trunk roads were verified in the field using the information on the 1/50,000 topographic maps.
- Collection of Relevant Reference Materials

  In principle, the Study Team asked EMA to send requests to the various related agencies for position information which was impossible or difficult to obtain in the photo-interpretation, including the administrative boundaries, and materials shown in the table below were obtained.

Table 31 List of Collected Reference Materials

Information	Source/form
Zonal, Wereda boundary and name	EMA/GIS data
Area name	EMA/Existing map (1/50,000)
Telephone line	EMA/Existing map (1/50,000)
Express road	Chinese Communications Construction Company (CCCC)/CAD data
Power line	Ethiopian Electric Power Corporation (EEPC)/CAD data for Index map
Forest, Mountain, Plain, Ridge, Hill, Crater name	EMA/Existing map (1/50,000)
Lake, Pond, Wide and Perennial river, Seasonal river, Disappear river, Ditch, Canal, Dam name	EMA/Existing map (1/50,000)
Control point, CORS Station, Benchmarks /Name, Value	EMA/Digital data

Outputs of the Supplementary Field Verification

In principle, the results of the supplementary field verification were to be compiled in the field. However, one day a week was set aside to compile them. The EMA engineers compiled the data which were difficult for them to interpret in collaboration with the Japanese engineers. The results of the supplementary field verification were put together and compiled on the supplementary field verification sheets.

The annotations to be added and corrected were made into Microsoft Excel file data at EMA after the supplementary field verification to eliminate erroneous entry of annotations. All the participants in the supplementary field verification participated in the compilation of the supplementary field verification results. The operators had given instructions to conduct the supplementary field verification at 1,138 locations. It was confirmed that all 1,138 locations had been surveyed in the supplementary field verification. The entire scheduled supplementary field verification work was completed within the scheduled period. The results of the supplementary field verification will be used in the supplementary digital editing to be conducted in Japan.

The tangible outputs of the supplementary field verification are as follows

• Supplementary field verification sheets	56 sheets (1/10,000 supplementary field verification sheets, one per map sheet)
• Power transmission line survey sheets	One set (1/10,000 supplementary field verification sheets, digital coordinate data)
• Telephone line survey sheets	One set (1/50,000 topographic maps, digital coordinate data)
• Annotation data in Microsoft Excel files	One set (digital data)
• Control point data	One set (digital data)

[9] Website Creation《Work in Ethiopia / Japan》

A system in which the existing data and newly created data will be disclosed to allow anyone to easily access the geospatial information will be built by the use of the Web Mapping System that will be newly developed in this Project.

Reports of study in the 1st term

The following is a summary of the existing website survey results, explanation of the web system required for this Project (software, hardware), and details of the technology transfer.

Table 32 Existing Website Survey Results

Item	Result
Operation	Operation has been outsourced to Peer 1 Network Enterprises Limited of UK, but at present the contract has been cancelled.
Server hardware and software owned by EMA	Dell PowerEdge Server R710 2 No, RAM (4GB), HDD capacity 14.4TB, Windows Server 2008, CPU (3.0MHz), maximum number of PCs that can be connected (200) Dell PowerEdge Server R310 1 No, RAM (4GB), HDD capacity 9.6 TB、OS is Windows Server 2003, CPU (3.0MHz) Dell PowerEdge T610, HDD capacity 0.5TB, RAM (8GB), CPU (3.0MHz), Windows Server 2008 Dell PowerEdge 2800, HDD capacity 1.0TB, RAM (4GB), CPU (3.0MHz), Windows Server 2003
Server management staff	Managing department: Information Communication Directorate Database Administration: 5 persons System Administration: 6 persons Technical Instrument Maintenance: 5 persons At present 3 teams are responsible for daily server operation, but there is no software for operating and managing large scale data on the server side, therefore they have not accumulated experience in management and operation of GIS data.
Web communication speed	Only 2MBPS (theoretical value) both up and down, which makes operation of the website difficult.

Item	Result
Website	From June 2013 EMA has commissioned the national Information Network Security Agency (INSA) to produce the website, and the final report was submitted at the end of October. The site is composed of 2 parts, the internet part and an intranet part. The hardware and software from which the system is composed are not disclosed, but Oracle's MySQL Database Server is scheduled to be used, and the development language is Java. Regarding the GIS function, small size (1 page maximum 13MB) map images can be released, but they do not have the function to release and download large size raster data such as orthoimages, satellite images, map images, etc., or vector data such as points, lines, polygons, and annotations. Some existing data contained military information, so INSA issued instructions to suspend the EMA's website. Regarding to this issue, EMA is now planning to request INSA to reopen the website under condition by excluding the military data.

[10] Assistance for Formation of Organizational Capacity Building/Utilization of Geospatial Information《Work in Ethiopia》

The following issues became clear from the interviews at EMA during the first dispatch survey in November 2013. As a result of their evaluation, activities (draft) were extracted as per the figure below.

Table 33 Issues for EMA Identified in the First Dispatch Survey

Current Issue	Factor		Expectations
Effectively usable digital topographic maps are not prepared	Quality and applications are not defined	Preparation method is not unified	Preparation of map symbol regulations and specifications
		Quality control method is undefined	Technology transfer of quality control method
	Map creation and updating system have not been developed	Work management method (process/cost management) is undefined	Technology transfer of work management method
		Lack of manuals and turnover make it harder to exchange and spread technology	Technology transfer and preparation of manuals for the creation of topographic maps
			Discuss with Planning and Business Development Directorate to improve work environment
	Environment for easily using digital topographic maps is not developed	Mechanism to distribute digital topographic maps has not been developed	Discussion in JCC (held twice)
		The preparation of hardware for distribution has not been developed	Technology transfer of web server procurement and operation

The capacity building of the EMA organization was determined to be through the preparation of "Map Symbols" and "Specifications" and by technology transfer in digital topographic mapping work and manipulation of equipment, and capacity building in work management to be enforced by technology transfer with open source software.

Other issues identified consist of improvement of staff retention and development of a topographic map provision system easily accessible for many users.

These issues were addressed in the second term (see Chapter 4 [11]).

[11] Promotion of Utilization《Work in Ethiopia》

Implementation of First Seminar

A seminar was held on Thursday, November 21, 2013 and was attended by 54 persons from 20 organizations. The content of the seminar was as follows, and the Study Team gave presentations on "Outline of the Project", "Examples of Utilization", "System and Issues Concerning Utilization", etc., and EMA gave a presentation regarding the "Present Status of EMA".

The following table shows the seminar content, the effects and the issues identified through the seminar.

Table 34 Contents of the First Seminar

Objective	Explanation of Project outline and technical cooperation by JICA in the field of geographical information for smooth project implementation and effective utilization of the results from a better coordination with other organizations
Content	Outline of the Project (introduction of Study Team members, introduction of EMA, outline of the work, training in Japan, outputs, technology transfer, etc.) Present Status and Issues regarding Geographical Information in Ethiopia Present Status of EMA Introduction of Technical Cooperation on Geographical Information by JICA in Africa Examples of Use of Geographical Information Cooperation Items Requested for this Project (document collection, interview surveys, request for participation in JCC, etc.)
Method of Presentation	Extensive use of technical terminology was avoided, and images and graphics were used, so that the presentations could be understood by persons who were not geographical information specialists. The presentation on "Present Status and Issues regarding Geographical Information in Ethiopia" was presented by EMA staff.
Q&A	1. EMA's response to the issue of turnover of human resources: This is a common issue within other governmental organizations, due to the wage differential between agencies and ministries. The Government of Ethiopia is now on the move to solve this problem. EMA is trying to prevent turnovers by sending staff to university training as an incentive. 2. Possibilities and structure for internet distribution of soft copies: This Project is target to upload and provide data view function. Distribution and the system for this will be discussed with EMA for the final results. 3. Standard of open source GIS software and results of the Project: We have received few questions about open source GIS. The Study Team has explained the strong points and weak points by comparing with general GIS software. Also, there was question about the accuracy of the results; the Study Team has answered this by explaining the data formats and quality standards.
Effects	Information about the Project outline, objectives and outputs was shared with at least ten Ethiopian government agencies and regional agencies. From comments by the participating agencies, it was clear that there have been major changes over time in many areas due to urban expansion, infrastructure development, etc. accompanying development of the country, and the importance of updating the topographic maps was shared anew. The interest of donor organizations (projects related to land management) in Europe and the US was obtained. It was found that many agencies have knowledge of GIS data and software. It was found that there are many domestic agencies with common concerns and common interest in strengthening the EMA organizational structure including turnover measures.

<table>
<tr><td rowspan="2">For the future</td><td>Establishing JCC</td><td>To grasp user's needs related to geospatial information and distribution method
Discuss and decide the rules and system for internet distribution.</td></tr>
<tr><td>Points for the final seminar</td><td>Define information (discrimination, range, quality, spatial definition, time definition and distribution method) and reference method, so that many users will be able to easily understand and use the results.
Add activities for improvement of the human resource turnover issue as a key aspect in the formulation of the EMA organization structure.</td></tr>
</table>

Results of First JCC

As a result of the first Joint Coordinating Committee meeting held on March 3rd, 2014 which was attended by 14 persons from four organizations, the following information was obtained. Also, during the discussions an "Activity Plan (Draft)" for this Project was prepared and agreed by those involved.

Table 35 Results of JCC Discussions and Collected Information

<table>
<tr><th>Item</th><th>Details</th></tr>
<tr><td>Main topics</td><td>Outline explanation of the Project, confirmation of the constituent members, distribution of data, activity plan, utilization</td></tr>
<tr><td>Permanent organizations</td><td>< At present (apart from EMA, Embassy of Japan in Ethiopia, JICA Ethiopia Office) >
Ministry of Urban Development & Construction
Ministry of Agriculture
Ethiopian Road Authority
Oromia Urban Development Office
< Planned to be added >
Ministry of Finance and Economy
Ministry of Transport
Information Network Security Agency
Geological Survey of Ethiopia</td></tr>
<tr><td>Present status of sharing of map information data</td><td>Information is provided through the existing website and workshops, etc., but analog maps are only sold through the EMA sales office.
There is no experience of distribution of digital data.
EMA owns the copyright to most of geographic information within Ethiopia.</td></tr>
<tr><td>Issues regarding sharing of map information data</td><td>It is necessary to prepare a distribution policy for the digital data produced in this Project, and specific schemes for the methods, setting of the cost, etc. Also, it is necessary to have specific measures for utilization of the digital map data produced.
Disclosure of the data possessed by each organization is entrusted to the judgment of each organization.</td></tr>
<tr><td>Directionality for utilization</td><td>The aim is for "Easy to Use" data that can be simply obtained by users.</td></tr>
<tr><td>Agenda for the next JCC</td><td>Anticipating future utilization not limited to the Project area but in the whole of Ethiopia, selection of the participants is discussed with EMA.
To improve the participants' understanding of the Project outputs and works for the Study, sample data is created and shared with them in the next JCC meeting.
The aim is to develop a utilization system through a tie-up with the Ethiopia KAIZEN Institute (EKI)</td></tr>
</table>

[12] Preparation of Progress Report 1《Work in Japan》

Progress Report 1 was prepared, describing the results of the study conducted after the submission of the Inception Report and the progress in technology transfer and in topographic mapping.

Chapter 4 Work and Implementation Plan for the Second Term

[1] Preparation and Discussion of Inception Report 2《Work in Japan/Ethiopia》

Based on the results of study in the first term, the policies for implementation of the Project in the second term, the work schedule, implementation system and technology transfer plan were summarized to prepare Inception Report 2 and the contents of the Report were discussed with EMA. The results of the discussions were recorded as the minutes of discussion, which were agreed upon by both parties.

[2] Digital Plotting/Editing and Generalization《Work in Japan/Ethiopia》

Digital plotting / Digital editing

In accordance with the decisions reached in the discussions on specifications, digital plotting was completed using the data obtained from aerial triangulation and the results of the field identification. The digital editing work was also completed based on the decisions reached in the discussions on specifications. Data requiring supplementation (missing field identification results, data difficult to interpret in the aerial photographs, etc.) was noted on 56 supplementary field verification sheets as target items in the supplementary field verification and used in the supplementary field verification survey.

The digital plotting and digital editing of 1/10,000 topographic maps in Japan were entirely completed.

Figure 9 Digital Plotting and Its Output (Left: Digital plotting, Right: Outputs)

Digital supplementary editing / Generalization

Any error data will be corrected or removed, and the data will be polygonized, and data such as administrative boundaries and annotations will be added to create the topographic map data. The created topographic map data will undergo generalization to create the 1/25,000 topographic mapping data. This work will be executed with the use of CAD software.

Supplementary digital plotting of 1/10,000 topographic maps and generalization to 1/25,000 mapping data have been 100% completed.

[3] Symbolization of Topographic Maps《Work in Japan/Ethiopia》

The digitally edited data will undergo symbolization for 1/10,000 and 1/25,000 topographic maps in accordance with the map symbols as agreed upon through the discussions on specifications. To avoid complicated work, the symbolization will use the CAD software used for digital plotting/editing. In this case, consideration will be given to ensuring that the symbolized data is easy to see as a line map and can also be used as a printed output map. 100% of the symbolization work in Japan was completed.

[4] Digital Data Structuration《Work in Japan/Ethiopia》

The digitally edited data will be structured into data with phase relations in a format which is usable on GIS software. This work will be executed in accordance with the specifications agreed upon with EMA and other related agencies. The file division will not be in units of map sheets, but determined taking into consideration convenience of use. 100% of the digital data structuration work in Japan was completed.

[5] Creation of Data Files《Work in Japan/Ethiopia》

The digital data and GIS data of the created topographic maps will be recorded in appropriate recording media in accordance with the specifications as discussed and agreed upon with EMA.

[6] Preparation of Interim Report《Work in Japan》

The results of the study and the progress of technology transfer and topographic mapping carried out after Inception Report 2 has been compiled to prepare the Interim Report.

[7] Explanation and Discussion of Interim Report《Work in Ethiopia》

The prepared Interim Report was submitted to EMA and the contents were explained and discussed with EMA. The results of the discussions were recorded as the minutes of discussion, which were agreed upon by both parties.

[8] Website Creation《Work in Japan/Ethiopia》

Procedure for website creation

As a result of discussions on website creation with EMA, it was decided to maximize the existing materials and equipment and create the website according the following procedure.

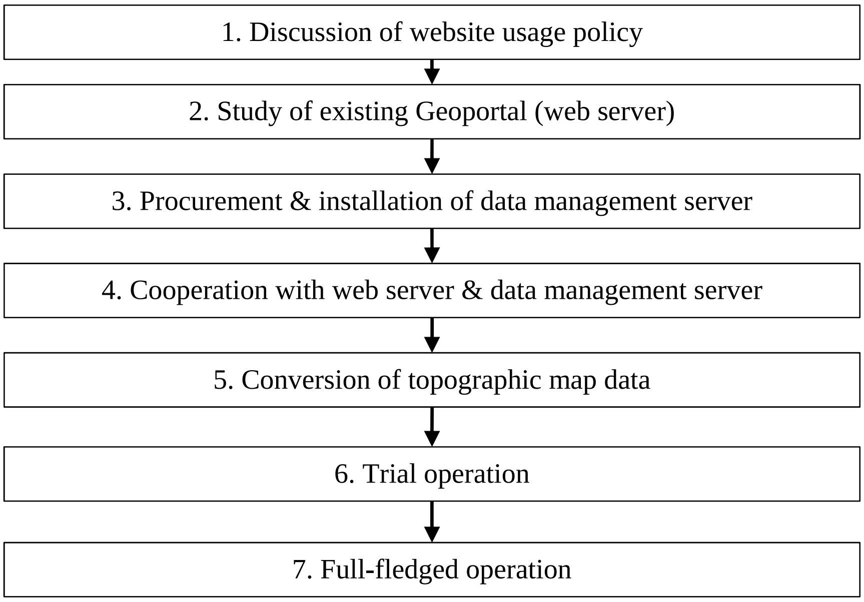


Figure 10 Procedure for Website Creation

The website-related work content to date is as shown below.

Table 36 Current Work Related to Website Creation

Period	Work Content	Result
June 2014	Discussions with EMA on management of website (installation of existing server, connection environment, role of server) Check of existing server capacity	As EMA had a Geoportal procured from RCMRD in July 2014, as a result of discussions, it was decided to provide web services in cooperation with EMA's existing server (RCMRD). The existing Geoportal has a function for uploading shape files and geotif.
November 2014	Procurement and installation of server for data management (database), installation of software	The necessary SQL Server 2012 and ArcGIS Server 10.2.2 software was installed in the server, and connection and cooperation with ArcGIS Server and ArcGIS Desktop was performed. Storing of sample data in the SQL database was completed.
August 2015	Connection and cooperation with data management server and web server, provision of sample data, display test of sample data on web	Updating of the necessary software to the latest version was completed. Data was stored in the data management server. Sample data was provided and stored in EMA's web server and the web display test was completed.
July 2016	Uploading and disclosure of topographic map data created in this Project on the web	The outputs of this survey in the PDF data format were uploaded to the Geoportal of EMA and an environment in which they could be downloaded free of charge was established.

*RCMRD = Regional Centre for Mapping of Resources for Development

Image of Cooperation with Server Procured by RCMRD and Work Process

Besides the server provided in this Project, EMA procured a web server from RCMRD and installed it as the new web server. As a result, the initial plan was altered. The server provided in this study is functioning mainly in an intranet environment, sharing the roles of configuring linkable settings with the RCMRD server as the back-end server and providing web services with the IIS8 as the front-end web server.

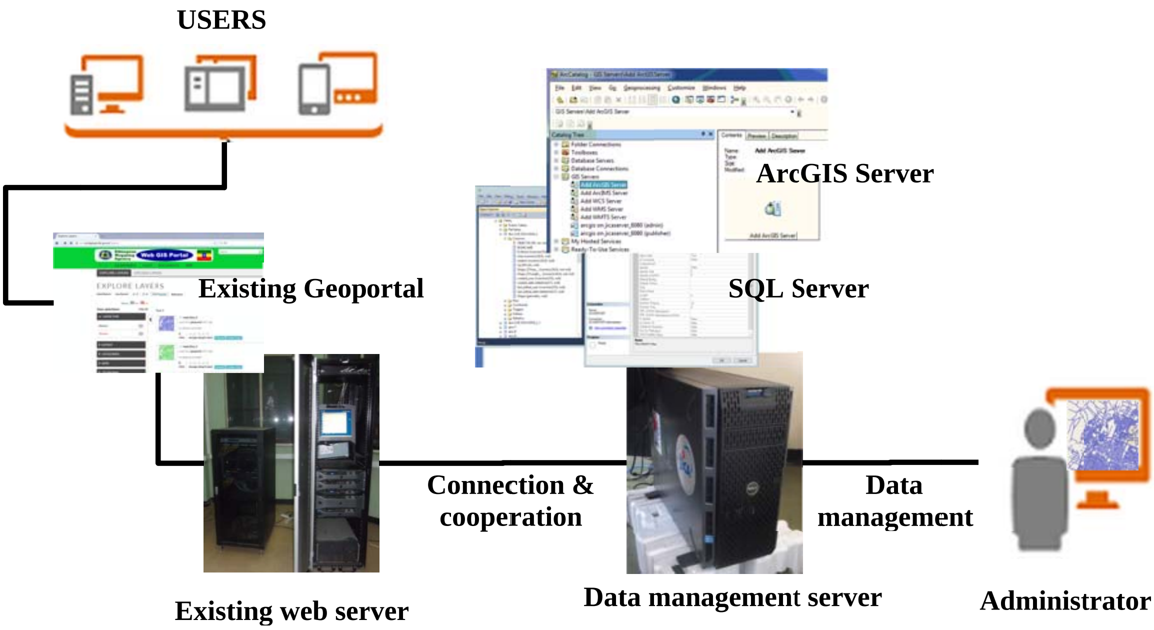


Figure 11 Conceptual Diagram of Web Environment

Types of Data and Storage Method

There are two types of data and data formats provided in this Project, File Geodatabase and SQL Server Geodatabase. Plotted/edited CAD data is converted to the two data formats by the Python tool and stored. The procured server has already been installed and is ready to be connected to EMA's network.

[9] Preparation of Progress Report 2 《Work in Japan》

The results of the study and technology transfer and the progress of topographic mapping conducted after preparation of the Interim Report has been compiled to prepare Progress Report 2.

[10] Explanation and Discussion of Progress Report 2 《Work in Ethiopia》

The prepared Progress Report 2 has been submitted to EMA and the contents was explained and discussed with EMA. The results of the discussions were compiled as the minutes of discussion, which was agreed upon by both parties.

[11] Assistance for Implementation of Organizational Capacity Building/Utilization of Geospatial Information 《Work in Ethiopia》

In the second term, assistance for implementation of organizational capacity building and utilization of geospatial information was decided to be continually enforced using the PCM (Project Cycle Management) method as shown below.

Based on the issues that became clear from the interviews at EMA in the first term, it was decided that the Study Team would continuously hold consultations with EMA on creating an action plan to clarify the terms, targets and activities for organizational capacity building and would implement such activities in accordance with the plan.

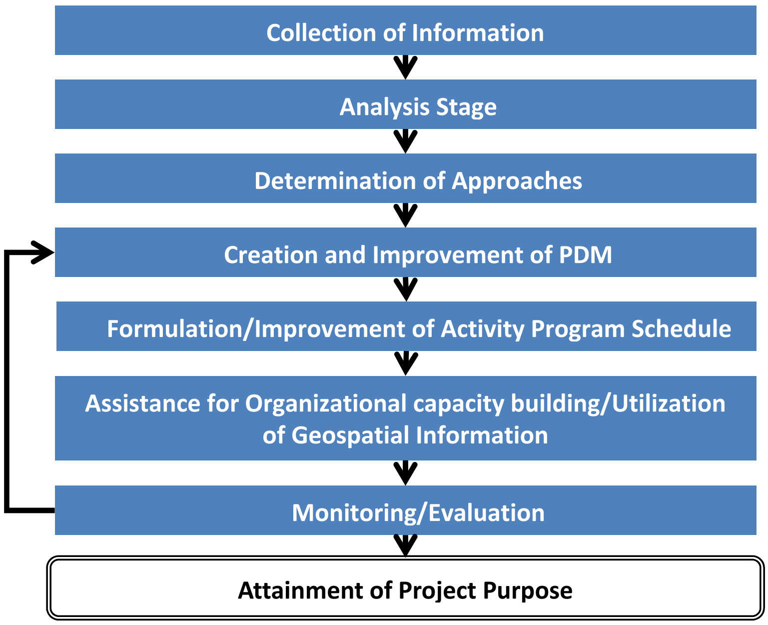


Figure 12　Formulation of Operation Plan and Flow of Implementation/Evaluation

Table 37　Example of Road Map (Operation Plan)

Target	Activities/output	Schedule		
		Phase 1		Phase 2
		2013-2014	2015	2016
	Gather/analyze information			
	Create action plans			
Accurate and reliable map creation by EMA	Creation of work specifications			
	Acquiring basic skills			
	Creation of wide use manual			
	Individual work in pilot area			
	Efficient work flow			
Development of data creation/update structure	Process management/Quality control			
	Management/operation structure for continuous mapping work			
Development of easy to use environment for digital topographic maps	Organize and exchange information with related organizations centered around EMA			
	JCC meeting	◆ ◆	◆	◆ ◆
	Development and management of data distribution			
	Monitoring / evaluation			

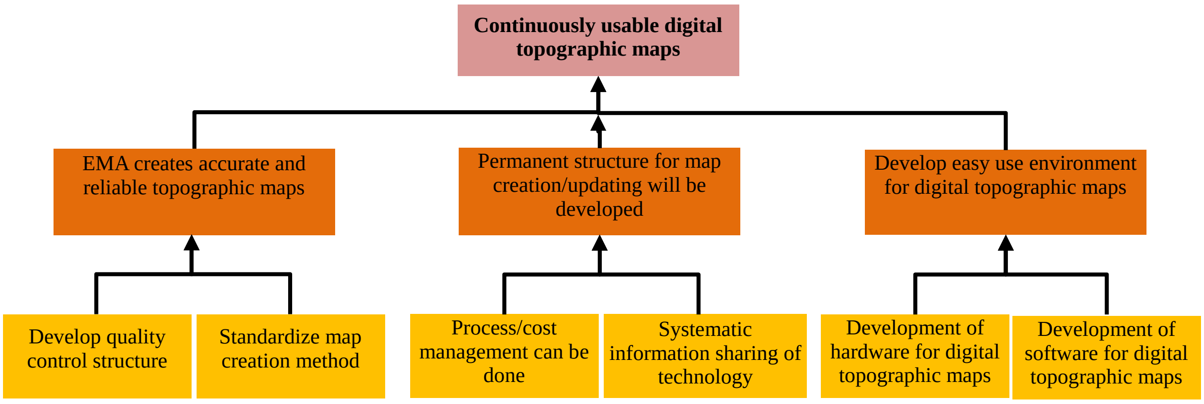


Figure 13　EMA's Evaluation Results and Assumed Activities (draft)

Table 38　Activities for Organizational Capacity Building in EMA

Period		Activity	Outcome	Issue
Develop quality control structure	November 2014 – August 2016	Establishment of a network between the departments responsible for mapping and quality control in the technology transfer Transfer of technologies for quality control in the technology transfer in each process (The C/Ps inspected and corrected the data plotted by the C/Ps in the technology transfer in digital plotting.)	The C/Ps was able to understand the quality appropriate at the scale of 1/10,000, in particular.	None in particular
Standardize map creation methods	June 2014 – November August 2016	Discussion and development of topographic map symbols and work specifications	Discussions are being held in EMA on strategies for data updating in future based on the developed map symbols and specifications	None in particular
Process and cost management can be carried out	April 2016 – August 2016	Creation of work schedules with spreadsheet software	The C/Ps became able to formulate work schedules according to the capability of the operators.	Work implementation based on the work schedule and improved reliability
Systematic sharing and transfer of technologies	July 2014 – August 2016	Creation of manuals in the technology transfer	The C/Ps are quick to remember the work that they did previously and are able to maintain the equipment unassisted.	Unassisted revision of the manuals by the C/Ps and transfer of technologies to unexperienced operators

Development of hardware for the distribution of digital topographic map data	November 2014 – August 2016	Installation of a data server	The preparations for storing the geospatial data to be created in this Project have been completed.	Establishment of policies for data transmission outside EMA and data sharing within EMA
Development of software for the distribution of digital topographic map data	September 2015 – August 2016	Creation of "Adama Tourist Map" utilizing the results of this study and relevant consultation Holding of a ceremony inviting relevant people	The C/Ps acquired know-how on application development and sustainable operation of developed applications.	Sustainable operation and expansion of "tourist map creation" to other major areas
	February 2016 – August 2016	Development of "viewer (proposed)" for the management of geospatial information owned by EMA	Visualization of geospatial information owned by EMA to users can be attempted.	Operation on existing Geoportal

Consultation for utilization of Adama Tourist Map

Utilizing the results of this study, EMA started to create a tourist map of Adama District on their own around April 2015. The Study Team provided technical support with respect to the design and operation of the map. Also, in July 2015, on the sustainable operation of the tourist map was discussed by JICA tourism project experts of national parks in Ethiopia at the request of the Study Team.

As a result, the first version was created in April 2016.

Figure 14 Tourist Map Utilization (Support by Japanese Experts)

Meeting with the Djibouti City GIS Committee

A meeting attended by EMA, Djibouti City GIS Committee, JICA Ethiopia Office and the Study Team was held at EMA for two days on December 19 and 20, 2015.

EMA shared information on the development, updating and distribution of geographical information with the Djibouti City GIS Committee, which shared information on the issues of organization to promote the utilization of GIS with EMA. As a result of the meeting, it was decided to continue the sharing of information and study the system for technical supplementation among the parties.

Figure 15 Meeting with the Djibouti City GIS Committee
(Left: Meeting participants, Right: Presentation by EMA)

Results of the Training Course in Japan

A training course has been implemented from September 28 to October 11, 2014 (Including moving days), to EMA managers. Details of the course are as follows:

Trainees:	Mr. Sultan Mohamed (Director General) Mr. Ayele Teka (Mapping Director) Mr. Karlos Latebo (Quality Control Director) Mr. Girma Giorgis (Survey Director)
Target:	To acquire knowledge of NSDI, national geodetic frame work, surveying and digital mapping activities
Items to accomplish:	1. The theoretical method for the establishment and utilization of NSDI 2. The establishment method of national geodetic frame work 3. The understanding of organization structure, activities, technical guidance, general duties of national surveying and mapping organization 4. Overviewing government / private surveying mapping agencies 5. Overviewing digital mapping work of the ongoing project

Table 39 Contents of the Training

Date	Place	Content	Result
Tue., Sep 30	Briefing		
	Courtesy call to JICA		
Wed., Oct 1	PASCO Corporation	Lecture on private company survey work and its task, and introducing latest technologies	
	KOKUSAI KOGYO Co., Ltd.	Lecture on work and quality control in private companies	
Thu., Oct 2	Japan Association of Surveyors	Introduction on map and survey instruments quality authorization system for quality assurance	Understanding the quality control method for maps and instruments
	Japan Map Center	Introduction of map distribution and diffusion method, and management	Understanding the method to manage, distribute and spread maps in Japan for utilization
Fri., Oct 3	Kinki Regional Survey Dept., Geospatial Information Authority of Japan	Introducing mapping work method and management method in local public offices	Acquiring mapping work flow knowledge implemented by local public offices as a national surveying authority
Sat., Oct 4	Kansai Engineering Center, KOKUSAI KOGYO Co., Ltd.	Overviewing local public survey work by private company	Understanding public mapping method implemented by private company, for outsourcing
Mon., Oct 6	Geospatial Information Authority of Japan	Overviewing Japan's NSDI situation and CORS implementation status	To acquire mentioned information for the utilization in Ethiopia
Tue., Oct 7	Japan Aerospace Exploration Agency	Introducing satellites and its image for usage in mapping work	Learning the features of satellite and its image for mapping usage
	Topcon Corporation	Introducing the latest survey instruments and the survey method	Acquiring the latest technology and the efficient method to utilize them from the manufacture itself
Wed., Oct 8	Infrastructure Development Institute of Japan	Introduction of international mapping and GIS related work by Japanese government	Understanding Japanese Government's implementation on topographic mapping and GIS related works
	DMS Corporation	Overviewing the latest digital topographic mapping site	To realize the gap between Japan and Ethiopia's digital mapping environment
Thu., Oct 9	Reporting to JICA		

During the training course, the trainees were able to grasp the NSDI and CORS implementation status and the utilization method in Japan. Therefore this acquired knowledge will be highly useful for formulating NSDI in Ethiopia. Also the expectation in the formulation of national geodetic frame work in Ethiopia is realizable with regarding the Japanese national geodetic frame work as a model.

[12] Promotion of Utilization《Work in Ethiopia》

Coordination with and Assistance to Related Agencies

Unless the visibility of geospatial information is enhanced by voluntary disclosure and proposals for its utilization are produced, the new information to be created will be kept within EMA and utilized by limited users. For the effective utilization of the project outputs, it was decided to enhance the efforts for holding JCC, participating in international conferences and coordinating with events concerning geospatial information.

Table 40 Coordination with Related Agencies

Term		Content
2nd JCC	July 2014	Outline explanation of the Project and confirmation of the constituent members Distribution of data and utilization
3rd JCC	June 2015	Discussion on data utilization management Discussion on data policy, Decide utilization theme
4th JCC	November 2015	Data process and analysis, Utilization samples from Project outputs
5th JCC	July 2016	Introduction of final outputs, Future issues and proposal of the next step
Final seminar	July 2016	Introduction of project implementation outline, outputs and details of the implementation of technology transfer ,Future issues and proposals
RCMRD Conference	November 2014	Introduction of the work of EMA and the JICA project
UN-GGIMC Conference	April 2016	Introduction of the work of EMA and the JICA project

Results of the Second JCC Meeting

The second Joint Coordinating Committee meeting was held on July 15, 2014 and was attended by 20 persons from five organizations. The committee was informed that a system will be created for storing the outputs of the Project in the server provided in this Study and disclosing them in a timely manner.

Table 41 Outcomes of the Discussion and Information Collected in the Second JCC Meeting

Item	Content
Main subjects	The Project was outlined, the constituent members were confirmed, the status of website creation and data distribution, activity plans and utilization (cases of agriculture development using GIS and elevation data, infrastructure development, urban development, cases of data utilization in Japan) were described, and the selection of appropriate pilot areas was discussed.
Permanent member organizations	< At present (apart from EMA, Embassy of Japan in Ethiopia, JICA Ethiopia Office) > Ministry of Urban Development & Construction, Ministry of Agriculture Ethiopian Road Authority, Oromia Urban Development Office Ministry of Finance and Economy, Ministry of Transport, Geological Survey of Ethiopia < Plan to be added > Information Network Security Agency
Current status of the sharing of map information data	The will to begin discussion of the rules on the distribution of digital data was seen when the presentation of the website to be created in this project was made. However, the only activity for data distribution at present is the sale of analog maps at EMA. Thus, there is no facility for digital data distribution.
Issues to be addressed for the sharing of map information data	It is necessary to create a practical plan including the policy, method and fee setting for distribution of the digital data to be created in this Project. It is also necessary to propose a practical plan for utilization of the digital map data to be created. Each organization which owns map information data is to make a decision on the disclosure of the data that it owns.
General policy for data utilization	To aim at creating "easy-to-use" data that are readily available to users
Matters to be discussed in the next meeting	The permanent member organizations shall discuss how to extend the cases of data utilization in this project to the entire country. As the number of organizations participating in JCC is small, efforts shall be made to make them understand the importance of the discussions at the JCC in order to facilitate the holding of JCC meetings, and to urge the members to participate in the meetings on a regular basis.

Results of the Third JCC Meeting

The third Joint Coordinating Committee meeting was held on June 9, 2015 and was attended by 23 persons from nine organizations.

Table 42 Outcomes of the Discussion and Information Collected in the Third JCC Meeting

Item	Content
Main subjects	The Project outline and progress report, utilization (Adama sightseeing map using the Project data), status of website creation and data distribution were explained and discussed.
Permanent member organizations	< At present (apart from EMA, Embassy of Japan in Ethiopia, JICA Ethiopia Office) > Ministry of Urban Development & Construction Ministry of Agriculture Ethiopian Road Authority Oromia Urban Development Office Ministry of Finance and Economy Ministry of Transport Geological Survey of Ethiopia
Current status of the sharing of map information data	From the fact that INSA has requested EMA to extract military facility image for security reasons and a new server was provided by RCMRD, efforts to create regulations pertaining digital data distribution policy are gradually observed.
Issues to be addressed for the sharing of map information data	As it was found that INSA is responsible for NSDI framework, project based on further discussion the approach will be adopted of enabling approval of disclosure of the data created in the Project. However, this will be confined solely to the outputs of the Project and INSA will be in charge of policies for the whole of Ethiopia.
General policy for data utilization	The aim is to make available to the public the outputs of the Project and create easy-to-get easy-to-use data. The aim is to promote utilization of the technology by diffusing the skills acquired in the technology transfer to other organizations.
Matters to be discussed in the next meeting	It is necessary to speed up the NSDI framework policy for data sharing, so that every stakeholder understands the digital data distribution policy and understanding of disclosure of the output data. As the meeting will be held at the end of Phase 1, a report will be given on the results of the technology transfer and the tasks that EMA can perform independently. As the sample output data will be ready, trial operation on the website will be carried out and the report reviewed.

Results of the Fourth JCC Meeting

The fourth Joint Coordinating Committee meeting was held on December 3, 2015 and was attended by 27 persons from nine organizations.

Table 43 Outcomes of the Discussion and Information Collected in the Fourth JCC Meeting

Item	Content
Main subjects	Progress report of the project Proposal of utilization examples of the outputs of this study Development status of geospatial information owned by EMA and future plans Actual situation of EMA
Permanent member organizations	< At present (apart from EMA, Embassy of Japan in Ethiopia, JICA Ethiopia Office) > Ministry of Urban Development & Construction Ministry of Agriculture, National planning Commission Ethiopian Road Authority, Oromia Urban Development Office Ministry of Transport, Geological Survey of Ethiopia
Outcome of technology transfer in this study	Technology transfer is necessary not only to the target participants but also to all the staff of EMA and other governmental agencies.
Utilization example of the outputs of this study	Creation of tourist map by EMA on their own
Current status and direction of the development of geospatial information by EMA	The outputs of this project will be released free of charge on the web portal.
Matters to be discussed in the next meeting	Specific proposals for utilization

Figure 16 The Fourth JCC Meeting (Left: Participants, Right: Presentation of the results of technology transfer by EMA)

Interview to potential user organizations

In addition to collecting information at the JCC meetings, individual interviews were held with potential users to collect information on the specific details of their work, demonstrate concrete explanations and analysis examples concerning the outputs of this study and discuss specific methods of utilization after the completion of this study. At the interview to the Waterworks Design & Supervision Enterprise implemented on April 11, 2016, the Enterprise commented that 1/10,000 digital topographic maps are very useful to the feasibility design of irrigation facilities and plantations and EMA provided information about the areas where 1/10,000 topographic mapping data have been created. Also, a discussion was held on the scheme to utilize the data while sharing information with EMA when a new plan is formulated about irrigation facilities and plantations in such areas.

Figure 17　Scenes at the Interviews

Holding of the Fifth JCC Meeting

The Fifth Joint Coordinating Committee is scheduled to be held on July 26, 2016. Questions on the conditions for the disclosure of the outputs of this study and a future plan of EMA for the creation of small-scale topographic maps from the large-scale ones were raised in the discussion at the JCC meeting.

Table 44　Contents of the Discussion and Information to be collected at the Fifth JCC Meeting

Item	Content
Main subjects	Report of the project outputs Introduction of the outputs of this study and proposal of utilization examples of the study outputs (Adama Tourist Map, etc.) Outcome of technology transfer and future geographical information development plan of EMA Future issues and proposals
Participated organizations	National Planning Commission Ethiopian Road Authority Oromia Rural Land Administration Bureau Geological Survey of Ethiopia Ethiopian Mapping Agency Japan International Cooperation Agency JICA Study Team
Current status of mapping information data sharing	Data sharing in the intranet environment in EMA A method to share the outputs of this study on the Geoportal of EMA A method to share the geospatial information owned by EMA using the Geoportal of EMA
Issues of mapping information data sharing	Recommendation on the digital copy distribution Recommendation on the operation of the organizations concerning geospatial data
Direction of utilization	The Director General of EMA announced that the outputs of this study should be available to the public free of charge.
Other	Introduction of Phase 3 (follow-up phase)

Figure 18 Scenes at the Fifth JCC

Final Seminar

A seminar was held on July 28, 2016. It was intended to be an opportunity to make the outputs of the project known to and fully utilized by not only Ethiopian organizations interested in geospatial data but also international organizations and donors. Eighty-six people from 31 organizations participated in the seminar. Interest of many participants was on geospatial information to be disclosed by EMA, cooperation among the organizations creating and using geospatial information and the policy of EMA for the creation of geospatial information in future.

The results of the seminar were reported on TV and radio programs, the Internet and newspapers by the collaborating members of the press.

Table 45 Contents of the Final Seminar (tentative)

Objective	Outputs of the Project and Recommendations
Time	July 28, 2016
Contents	Final report (Outline of the achievement of the Project and recommendations, outcome of the technology transfer and the methods for distribution of the outputs) Reports on the subject-specific training course held in Japan by the course participants Activities of the JCC and their outputs Outline and utilization of the newly created website (for web-mapping) Examples of definitions, quality and utilization of digital topographic maps Recommendations for development of geospatial information in future Capacity building activities for EMA organization and their effects
Method of presentation	Presentations on the technologies and experience acquired by EMA engineers in the Project will be made by those engineers who have acquired them. Demonstration of the web-mapping site will be shown to map users who are interested in data distribution to introduce them to the newly configured web-mapping system. Differences between the new work specifications to be prepared in the Project for digital topographic mapping and existing EMA work specifications will be presented in an easy-to-understand way using a comparison between the two.
Documents distributed	Project outline, pamphlet, Adama tourist map
Location	Hotel conference hall in Addis Ababa

Table 46 Participants of the Final Seminar

	Organization	No.		Organization	No.
1	Adama City Culture and Tourism Bureau	2	17	Land Administration to Nature Development	1
2	Adama City Land Management Office	1	18	Ministry of Agriculture	1
3	Addis Ababa Mass Media Agency	1	19	Ministry of Communication Information Technology	2
4	Africa Post	1	20	Ministry of Culture and Tourism	2
5	Central Statistic Agency	2	21	Ministry of Forest, Environment and Climate Change	2
6	Ethiopian Mapping Agency	30	22	Ministry of Science and Technology	1
7	Ethiopia Broadcasting Corporation	1	23	Ministry of Urban Development and Housing	4
8	Ethiopia Herald	1	24	Ministry of water Irrigation and Energy	1
9	Ethiopian News Agency	5	25	National Planning Commission	3
10	Federal Urban Land and Land Related Property Registration and Information Agency	2	26	Office of Government Communication	1
11	Geological Survey of Ethiopia	2	27	Oromedia Media Organization	2
12	House of Peoples Representative	2	28	Oromia Regional Government Bureau of Rural Land and Environment	2
13	Integrated Urban Land Information Management Agency	1	29	Oromia TV	1
14	Embassy of Japan	1	30	Oromia Urban Development Bureau	1
15	JICA Ethiopia Office	4	31	Sheger FM 102.1 radio	1
16	JICA Study Team	5		TOTAL	86

Table 47 Question and Answer in the Final Seminar

	Question	Answer (EMA / JICA Study Team)
1	What was the reason for the selection of the project area?	EMA had aerial photographs of the area taken in 2010. Rapid infrastructure and agriculture development had been seen in the area.
2	In what way have the local governments and the ministries and agencies concerned been involved in this project?	EMA has made efforts to share information with the ministries and agencies concerned and local governments by, for example, inviting them to attend the JCC meetings, which have been held five times.
3	We need the GIS data of EMA for the ongoing project for the development of our open data portal. I understand that the outputs of this project will be available in the PDF format. Could EMA provide the data set in the GIS/CAD format?	INSA and the ministries and agencies concerned are developing NSDI for data sharing. EMA prefers to upload metadata to the open data portal until NSDI has been established.
4	We have an ongoing project for socio-economic data processing. Is it possible to link the data of EMA with the results of this project?	It will be possible to share data among ministries and agencies once a cooperative system has been established.
5	Why was the creation of 1/25,000 maps with the generalization of 1/10,000 maps included in the project?	Maps at various scales are created for various uses. As the scale of the base maps in Ethiopia is 1/50,000, EMA had technical capacity to create topographic maps at this scale. Therefore, the creation of 1/25,000 and 1/10,000 topographic maps was selected as the next technical target.
6	What has been achieved with the technology transfer?	The answer to the question was given by Mr. Ayele in his presentation.
7	Why were the topographic maps created in Japan?	Engineers of EMA will become able to create high-quality topographic maps through technology transfer from Japanese experts and imitating “Japanese-quality mapping.” EMA will have become able to create high-quality maps by the completion of the technology transfer at the end of August.

	Question	Answer (EMA / JICA Study Team)
8	What was the reason for setting the scale of the topographic maps to be created at 1/10,000?	The reason has been explained in the answer to a previous question. Although EMA prioritizes creation of ordinary topography maps, it is creating 1/2,000 cadastral maps for the Ministry of Agriculture. Creation of larger-scale topographic maps requires more labor and time.
9	Most Ethiopians are not able to interpret or read topographic maps. Is there a plan to improve the interest of the general public in the maps?	We understand that not only the ordinary Ethiopians but also public workers do not have sufficient knowledge of topographic maps. In order to improve this situation, EMA has been taking measures 1) to promote the use of maps by the general public through radio programs, 2) to promote the map education at school and 3) to promote utilization of maps by policy makers in the planning, monitoring and evaluation of projects.
10	What was a challenge/problem encountered in this project?	It was difficult to create the latest map data because of the rapid development (of expressways, etc.) in the mapping area since the aerial photography was conducted. However, this problem was solved with the procurement of the latest satellite imagery by JICA.
11	Which area shall be the priority project area in the next phase?	The priority order for the area selection shall be determined by the need for the mapping of the areas concerned.
12	There seems to be a gap between supply by the providers and demand of users. Does EMA have any plan to narrow this gap?	EMA will promote supply of high-quality maps at low prices, which has been made possible by the technology transfer in this project.
13	Does EMA has a plan for an actual project or research and development for the independent topographic mapping?	EMA has acquired the capacity required for creating topographic maps independently in the technology transfer in this project. The knowledge acquired by EMA in this project will be disseminated widely.

Figure 19 Scenes at the Final Seminar

Tie-up with International Conferences and Events Related to Geospatial Information

Cooperation with international conferences in which a number of delegates from various countries were expected to gather was examined to widely disseminate information on the outputs of the Project. Consideration was also given to presenting such information positively to donors and conferences related to geospatial information.

As the events related to geospatial information described below were held in the city of Addis Ababa, participation in such events that offer the chance of presenting the outputs of the Project was discussed with EMA. The effects and costs of such participation (participation fees and cost of exhibition space) were examined and sorted, and the results of the examination were reported to JICA.

- Africa GIS2013 and GSDI 14 (Global Spatial Data Infrastructure Association)

  These events were held at UNECA headquarters in November 2013, and some EMA staff participated in the exhibition.

- Participation in the Regional Centre for Mapping of Resources for Development (RCMRD) Conference

  The RCMRD Conference was held in Addis Ababa from November 10 to 18, 2014. The objectives of the conference were presentation of the annual activity report for the year 2013 to 2014, review of the overall activities carried out between 2011 and 2014 and discussion of the strategic plan of RCMRD between 2015 and 2018. A total of 52 people from 17 member countries, including UNECA, advisors, observers and the secretariat of the conference, participated in the conference.

  *RCMRD: RCMRD was established in 1975 for the development of geospatial information for sustainable development in Africa. It has 20 member countries. It is headquartered in Nairobi, Kenya.

Figure 20 Scenes at the RCMRD Conference (Left: Conference, Right: EMA booth)

- Participation in the Fourth High Level Forum on United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM)

  Chaired by the Director General of EMA, this Forum was held in Addis Ababa from April 18 to

22, 2016. It is a global forum to facilitate joint and collective dialogues concerning the management of geospatial information with all the related governmental organizations, non-governmental organizations and private sector and was attended by about 300 persons from 57 countries around the world.

The Study Team attended the forum with the EMA staff to introduce the study in part of the EMA booth and exhibit the viewer of geospatial information owned by EMA, which was developed in this study.

Figure 21　Scenes at the UN-GGIM Booth

(Left: Explanation to President, Right: Explanation of the work of EMA)

Sharing Information with Ethiopia KAIZEN Institute (EKI)

On November 9, 2013 a hearing and an explanation of the outline of this Project were held at Ethiopia KAIZEN Institute, and it was confirmed that, from the second term on, information sharing and work cooperation would be requested when implementing work to support the EMA organization system.

*As it was later reported by the Institute that it did not intend to implement technology transfer to public organizations during the period of this study at that point, this should be handled as an issue requiring follow-up.

Ethiopia KAIZEN Institute: An organization established by the Government of Ethiopia as a result of the Study on Quality and Productivity Improvement (KAIZEN) conducted by JICA from 2009 to 2011 to promote kaizen all over the country

[13]　Preparation and Discussion of Draft Final Report《Work in Japan/Ethiopia》

The works that have been done so far will be compiled as the Draft Final Report, which will be submitted to EMA for discussion of its contents. The results of the discussions will be recorded as the minutes of discussion, which will be submitted to EMA for agreement. In the Draft Final Report, the following items will be stated:

- Challenges in technology transfer and organizational system
- Potential for utilization of developed topographic maps
- Achievement level of the Project and remaining challenges after the end of the Project

- Technical sustainability after the end of the Project

[14] Preparation of Final Report 《Work in Japan》

The Final Report will be prepared by making additions and corrections based on the comments made by EMA on the Draft Final Report and submitted to JICA.

Individual work manuals for creation of various types of data, operation and maintenance procedures, structured data, system operation and other necessary items will be prepared and attached to the Final Report. For the work processes and results of the quality control work, a separate report will be prepared.

[15] Work Related to Technology Transfer 《Work in Ethiopia》

In this Project, the transfer of topographic mapping technology in which emphasis was placed on EMA's capacity for independent development was conducted. The details are described in the next section.

Chapter 5 Technology Transfer

5-1. Content of Technology Transfer

The technology transfer for creation of topographic mapping data will be implemented with emphasis placed on EMA's independent development as detailed below.

Table 48 Overall Schedule of Technology Transfer

	Phase 1								Phase 2			Target Work
	2014				2015				2016			
Month	Jan – Mar	Apr – Jun	Jul – Sep	Oct – Dec	Jan – Mar	Apr – Jun	Jul – Sep	Oct – Dec	Jan – Mar	Apr – Jun	Jul – Sep	
OJT	■						■					Photo control point survey Field identification/Supplementary field verification
(Stage 1) Acquisition of Basic Technology			■	■								Aerial triangulation Digital plotting, digital editing, symbolization GIS structuration
(Stage 2) Independent Work Execution						■	■					Aerial triangulation Digital plotting, digital editing, symbolization GIS structuration (including process control and quality control)
Implementation of Pilot Work										■	■	
Utilization										■	■	Website creation

Phase 1 (Stage 1: Acquisition of Basic Technology; Stage 2: Independent Work Execution

As the EMA staff members lack sufficient experience in digital topographic mapping, the technology transfer will be conducted by dividing Phase 1 into "Stage 1: Acquisition of Basic Technology" and "Stage 2: Independent Work Execution".

In Stage 1, the "technical level", "experience in target work", and "experience in operation of related equipment" of EMA staff will be studied to grasp the technical capability of each staff member of EMA. The Technology Transfer Plan is drawn up based on that concept.

In Stage 2, a training area for technology transfer will be set up within the scope of the Project to conduct technology transfer that allows EMA to reach the technical level for conducting pilot work independently. The EMA staff members will review the technology transferred in Stage 1 through the work at the individual level of the trainees in the training area, and process control and quality control technologies will also be transferred.

The results of the work in the training area will be quantitatively evaluated by work item to examine the priority items to strengthen the capabilities of the trainees for the work in the pilot area in Phase 2.

Table 49 Concept of Technology Transfer Plan (Phase 1)

Item	Phase 1 (Stage 1: Basic Technology)		
	Goal	Means of Attaining Goal	Evaluation Method
Aerial photography planning/Installation of aerial signals	Capable of drawing up plans to meet the photographic scale using software	Lectures and exercises using software	Evaluation of whether each item of the work specifications is satisfied
	Capable of doing photo control point selection work Capable of installing aerial signals in accordance with the work specifications	Lectures and field work	Evaluation of selected photo control points Test of work specifications
Photo control point selection and survey	Capable of operating digital equipment	Field work and exercises using analytical software	Evaluation of GNSS analysis and results of leveling Evaluation of results of 3D net adjustment analysis
Aerial triangulation orthophotos/DTM	Understanding of theories of aerial triangulation and DTM Understanding of operation of digital photogrammetric system	Lectures and exercises using digital photogrammetric system	Position/ condition of tie-point observation Evaluation of speed and accuracy of photo control point observation Evaluation of results of adjustment calculations
Field identification/ Supplementary field verification	Understanding of operation of equipment used Understanding of theory of field identification work	Field identification (OJT)	Evaluation of sorted results of field identification
Digital plotting	Understanding of map specifications, acquisition criteria and procedures Understanding of basis of 3D interpretation	Exercises in stereo plotting using CAD	Evaluation of stereoscopy Evaluation of plotting results of $20km^2$ (Data and printed maps)
Digital editing/ Supplementary digital editing/Generalization	Understanding of CAD operation Understanding of data error detection and correction, and polygon creation techniques	Exercises using CAD	Evaluation of results of editing of $20km^2$ (Data)
Symbolization	Understanding of mapping theory Understanding of map symbols	Creation of marginal information Exercises using CAD	Evaluation of created symbols (points, lines, polygons)
GIS structuration/ Website creation	Understanding of CAD to GIS format conversion method Understanding of GIS software operation	Exercises using GIS and CAD	Evaluation of results of created exercise data

<table>
<tr><th rowspan="2">Item</th><th colspan="3">Phase 1 (Stage 2: Independent Work Execution)</th></tr>
<tr><th>Goal</th><th>Means of Attaining Goal</th><th>Evaluation Method</th></tr>
<tr><td>Aerial photography planning/Installation of aerial signals</td><td>EMA can independently draw up aerial photography plans including photo control point distribution.</td><td>Execution of exercises</td><td>Evaluation of input values and outputs using photography planning tools</td></tr>
<tr><td>Photo control point survey</td><td>EMA can independently carry out photo control point surveys.</td><td>Testing</td><td>Evaluation of GNSS observation work around EMA and analysis practice, and evaluation by comprehension test based on correct/incorrect answers</td></tr>
<tr><td>Aerial triangulation orthophotos/DTM</td><td>EMA can independently perform aerial triangulation, create and compile DTMs and create orthophotos.</td><td>Testing</td><td>Evaluation of practice results for 40 models on three flight courses</td></tr>
<tr><td>Field identification/Supplementary field verification</td><td>EMA can independently execute the supplementary field verification work.</td><td>OJT</td><td>Evaluation of sorted results of supplementary field verification</td></tr>
<tr><td>Digital plotting</td><td rowspan="4">The works in the training area are completed</td><td rowspan="4">Execution of works in training area</td><td>Evaluation of results of plotting practice in approx. 15 map sheet areas</td></tr>
<tr><td>Digital editing/ Supplementary digital editing</td><td>Evaluation of results of practice in approx. 4 map sheet areas</td></tr>
<tr><td>Generalization</td><td>Evaluation of results of practice in approx. one map sheet area</td></tr>
<tr><td>Symbolization</td><td>Evaluation of results of practice in approx. 2 - 4 map sheet areas</td></tr>
<tr><td rowspan="2">GIS structuration/ Website creation</td><td>The works in the training area are completed.
Capable of creating several GIS models</td><td>Execution of works in training area</td><td>Evaluation of structuration data</td></tr>
<tr><td>Understanding of website operation</td><td>Lectures</td><td>Execution of simple test on related operations</td></tr>
<tr><td>Promotion of utilization</td><td>Able to set up and run JCC
Able to coordinate with related agencies and organizations</td><td>Joint work by EMA and Study Team</td><td>Evaluation by goal attainment level at initial stage of the Project</td></tr>
<tr><td>Technology transfer to enable EMA to implement topographic map creation projects by itself</td><td colspan="3">Execution of technology transfer in “Process Control”, “Quality Control” and “Creation of Manuals” in the mentioned processes as described above</td></tr>
</table>

Phase 2 (Execution of Pilot Works and Utilization of Results)

In Phase 2, EMA will formulate a work schedule for the pilot area for which they will independently develop topographic maps, and will develop the topographic maps while implementing progress control and quality control under the work schedule. The pilot area will be an area with high utilization potential and within the range in which EMA can work independently and will finally be determined through discussions with EMA.

The strengthening of the EMA system including management and sale of topographic maps and tie-ups with other organizations will also be included in the technology transfer plan. The concept of the technology transfer plan in Phase 2 is shown below.

Table 50 Concept of Technology Transfer Plan (Phase 2)

Item	Phase 2		
	Goal	**Means of Attaining Goal**	**Evaluation Method**
Creation of project management manual	Understanding of the Project Management Manual	Creation of the “Project Management Manual” jointly by EMA and the Study Team	Evaluation of the “Project Management Manual”
Process Control	EMA can independently conduct process control and grasp the progress of works.	Formulation and updating of process sheet	Evaluation of process sheet
Quality Control	Understanding of quality control procedures	Execution of quality control under the work specifications	Evaluation of level of understanding of the work specifications
	EMA can independently conduct quality control.	Preparation of accuracy control report	Evaluation of accuracy control report
Strengthening of topographic map production system	A system to allow EMA to independently implement sustainable topographic map management is established.	Strengthening of the system under the activity schedule	Evaluation of “technical aspect” and “organizational aspect” in accordance with PCM
Strengthening of topographic map sales process	A system to allow EMA to independently carry out sustainable sales of topographic maps is established.	Strengthening of the system under the activity schedule	Evaluation of “organizational aspect” in accordance with PCM
Website creation	Understanding of website operation technology	Technology transfer in website operation	Evaluation of website system maintenance capacity
Promotion of utilization	EMA can independently set up and coordinate JCC. EMA can independently coordinate with related agencies. EMA can hold seminars.	Joint work by EMA and the Study Team	Evaluation by goal-attainment level for the goals set after the end of Phase 1

5-2. Necessary Equipment for Technology Transfer

The following equipment required for the technology transfer has all been procured and installed and verification of operation has been completed.

Table 51 Equipment and Materials for Technology Transfer

1st Term		
Equipment	**Qty.**	**Target Work**
GNSS Survey Equipment Set	4	Photo control point survey
Laptop and software for GNSS analysis	1	Photo control point survey
Digital Camera	8	Field identification/Supplementary field verification
Handheld GPS receiver	8	Field identification/Supplementary field verification
Color Laser Printer	1	All
Aerial Triangulation/Plotting Integrated Software	1	Aerial triangulation, Digital plotting
Plotting/Editing Linking Software	1	Digital plotting
Plotting/Editing CAD Software	2	Digital plotting/editing/Compilation, Symbolization
Map Editing Software	1	Aerial triangulation, Digital plotting
Workstation	1	All
USB Hardware Key	1	Aerial triangulation, Digital plotting
Stereoscopic Display	1	Aerial triangulation, Digital plotting
Photogrammetry Mouse	1	Aerial triangulation, Digital plotting
Desktop Computer for Editing/Structuration	1	Digital plotting/editing/Compilation, Symbolization
Editing Monitor	2	Digital plotting/editing/Compilation, Symbolization
Uninterruptible Power Supply (UPS)	3	All
Anti-virus Software	2	All
Office 2010	2	All
2nd Term		
Equipment	**Qty.**	**Target Work**
Project Management Software for Photogrammetry	2	Aerial triangulation, Digital plotting
Stereoscopy Software	2	Aerial triangulation, Digital plotting
Plotting/Editing Linking Software (Cooperation with stereo environment and CAD)	2	Aerial triangulation, Digital plotting
Plotting/Editing Software (DEM Creation)	1	Aerial triangulation
Plotting/Editing Software (DEM Editing)	1	Aerial triangulation
Plotting/Editing CAD Software	3	Digital plotting/editing/Compilation, Symbolization
Map Editing Software	1	Digital editing/Generalization
GIS Structuration Software	1	GIS structuration/Website creation
GIS Utilization Software	1	GIS structuration/Website creation
Workstation	2	Aerial triangulation, Digital plotting
USB Hardware Key	2	Aerial triangulation, Digital plotting
Stereoscopic Display	2	Aerial triangulation, Digital plotting
Photogrammetry Mouse	2	Aerial triangulation, Digital plotting
Desktop Computer for Editing/Structuration	2	Digital editing/Compilation, Symbolization
Editing Monitor	4	Digital editing/Compilation, Symbolization
Data Server (HDD capacity: 4TB or equivalent)	2	Website creation
Map Output Printer	1	All
Uninterruptible Power Supply (UPS)	7	All
LAN Cable	10	All
Switch Hub	2	All
Anti-virus Software	4	All
Office 2010	4	All
Website Creation Hardware	1	Website creation
Website Creation Software	1	Website creation

5-3. Outputs of Each Technology Transfer

(1) Technology Transfer in Field Identification

The technology transfer was implemented in the form of OJT in the series of work for “field identification” in the Work in Ethiopia between February and April 2014.

Table 52 Impact and Problems of the Technology Transfer

Item	Contents	Impact and Problems	Countermeasure
Understanding of the purposes and contents of the work	Role of field identification in the entire process, purposes and methods of the work, understanding of the items to be identified (map symbols)	The team members were able to provide practical technical explanations and practices relevant to the actual work to the trainees and the trainees were able to fully understand the purposes and contents of the work and practiced it.	The quality of the work output shows that the level of understanding of the trainees of the work is so high that they can implement the work without problems.
Process control	Implementation of the work in conformity with the work schedule	The trainees were able to carry out the work aware of the deadline and work load and prioritizing the work contents. It is necessary for them to improve their understanding of “work management” as staff in a “leadership position.”	The goal of the supplementary field verification will be for the EMA engineers to take as much initiative as possible in the entire process from planning, through preparation, field work and verification to data sorting. Each team is to execute the work while implementing quality and process control utilizing the progress confirmation sheets and check sheets.
Quality control	Implementation of the work in conformity with quality standards	The trainees were able to pay attention to the work quality in the data sorting and checking. It is necessary for them to improve their understanding of “quality control” as staff in a “leadership position.”	
Level of self-learning in EMA	Understanding of the work and revision of the manuals	A new method different from the methods which had been used in EMA was presented. The trainees were able to review the work anew and digest it by revising the manual. EMA’s immediate action in planning individual topographic mapping work using the new method shows us the positive effects of the experience of technology transfer.	The implementation of supplementary field verification is to be used as an opportunity to use the experience mentioned on the left to transfer the work to independent implementation by EMA engineers.

Field Identification Work

The trainees improved their understanding of the work methods as they practiced the method for the pre-interpretation of the existing topographic maps and actual identification methods in the field in the trial work.

Figure 22 Technology Transfer on the Field Identification
(Left: Indoor work, Right: Trial work)

The trainees began actual work in full scale in teams. A meeting was held every week to identify problems of each team and provide guidance on the problems. The weekly meetings enabled standardization of the understanding (quality) of the work.

Graphic display of the progress of the work of each team made it possible for all the trainees to carry out the work in conformity with the work schedule. In addition, the Study Team members accompanied each team in the field in order to identify location-specific problems and to confirm work methods actually used by trainees, who could not have been done in the meetings, and to provide advice on understanding of the current state, solution of problems and work methods.

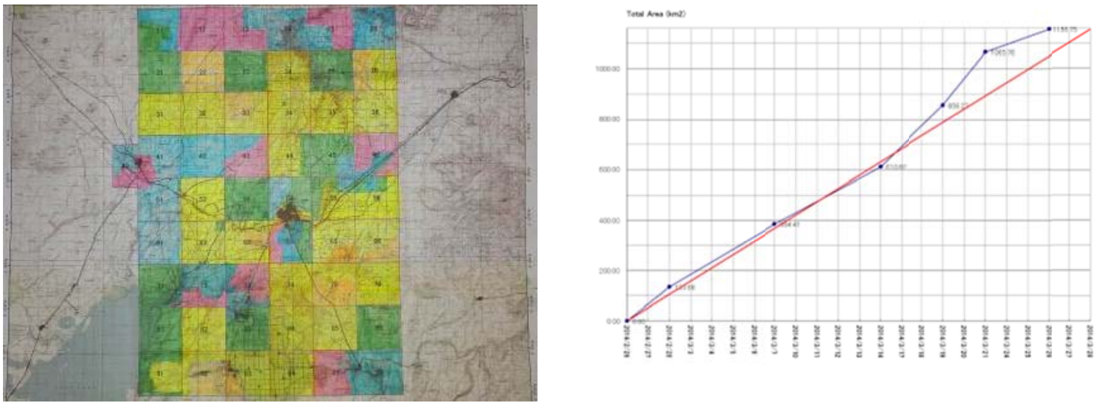


Figure 23 Technology Transfer on Process Control
(Left: Work progress map, Right: Work progress curve)

Evaluation of Technology Transfer

- The trainees were able to recognize and solve the questions and problems concerning the work in the meetings and implement the work smoothly.
- The engineers who carried out the work with the Study Team members had improved their technical capacity to a level at which they could perform the work independently thanks to the direct guidance from the team members.

- The trainees were able to collect required reference materials from the relevant organizations in accordance with the map symbol rules.
- The trainees observed the work schedule and were able to complete the work within the specified period.
- The trainees were able to ensure data quality by conducting data sorting and inspection after the completion of the field work.
- The trainees were able to revise the manual with full understanding of the purposes and details of the work and experience acquired in the actual work.

Output of the Technology Transfer

- Technology Transfer Manual “Field Identification Manual” One set
- Technology Transfer Manual “Handheld GPS and Digital Camera Manual” One set

(2) Technology Transfer in Supplementary Field Verification

Supplementary field verification is the final field verification before the creation of topographic maps. It consists of field verification of the questions raised and ambiguities identified by the plotting operators, field verification of the plotted topographic maps and field surveys of other relevant information.

As 16 of the 18 participants in the work in Ethiopia between February and April 2014 were engineers involved in the field identification, the objective of the technology transfer was for them to use the experience gained in the field identification effectively to implement the supplementary field verification as independently as possible.

Table 53 Details of the Technology Transfer in Supplementary Field Verification

Item	Objective	Form
General explanation	Understanding of the work	Lecture
Trial work	Understanding of the work, map interpretation, compilation of the survey results, operation of the equipment	Practice
Supplementary field verification in the field	Interpretation of maps, compilation of the survey results, operation and maintenance of the equipment	Practice, meeting
Data compilation in the office 1 (on inspection and accuracy control of the survey results)	Compilation and management of the survey results	Lecture, practice
Data compilation in the office 2 (compilation of the survey results and data entry)	Compilation of the survey results, operation of the equipment	Lecture, practice
Revision of the work manual	Manual	Working group


Figure 24 Technology Transfer in Supplementary Field Verification
(Left: Field work, Right: Compilation of the results)

Evaluation of Technology Transfer

The participants were able to understand the work procedures and implement the supplementary field verification smoothly by implementing daily time management, responding to questions and exchanging information in the OJT. Their technical level has reached a level at which they can utilize equipment such as handheld GPS receivers for acquisition of new information without problems. They still need to accumulate experience in activities concerning data quality, such as inspection and compilation of data, intensively to improve the quality of the actual work.

Table 54 Criteria for Evaluation of the Technology Transfer in Supplementary Field Verification

Item	Criteria
Capacity to understand and answer questions	The participants are able to understand the contents of the instructions for supplementary field verification (questions and requests given by plotting operators) and provide appropriate responses to the instructions on the basis of the results of the field verification.
Capacity to verify features in the field	The participants are able to verify the locations, types and required information of the subjects of supplementary field verification in the field.
Capacity to understand the work	The participants are able to implement the supplementary field verification with an understanding of its purposes and methods.
Data compilation	The participants are able to describe the verification results correctly, sort and inspect the collected data and digitize them.
Time management	The participants are able to prepare a plan for the supplementary field verification in order to implement and complete it within a limited time period.

Each team (of two members) was given a test on field work in the final evaluation of the technology transfer in supplementary field verification. The test was marked based on the criteria mentioned in the table below for quantitative evaluation.

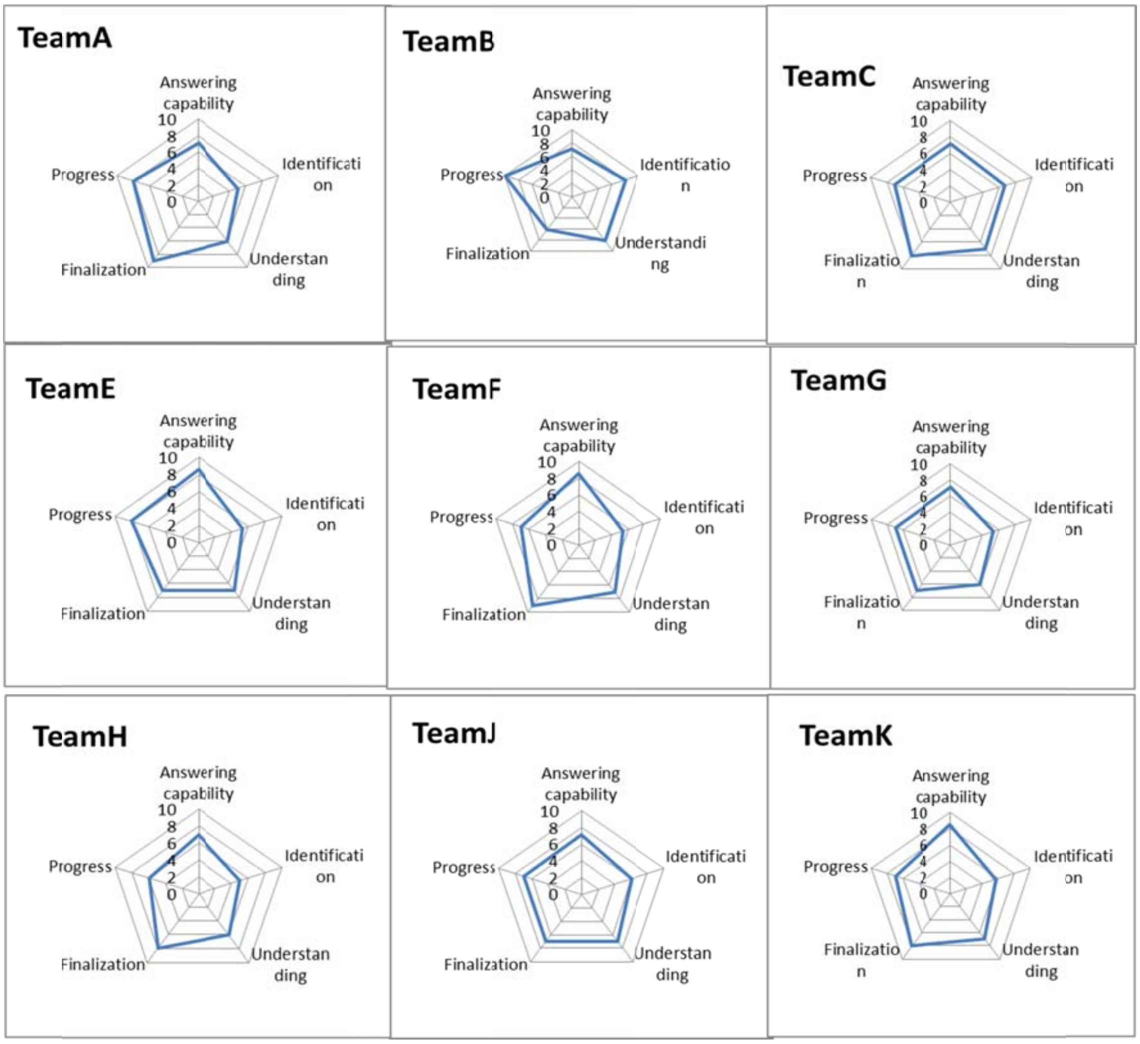


Figure 25　Evaluation of the Technology Transfer

Outputs

Technology Transfer Manual, "Supplementary Field Verification Manual"　　One set

(3) Technology Transfer in the Installation of Aerial Signals and Photo Control Point Survey

The photo control point survey consists of installation of photo control points on the ground and observation of these points to locate aerial photographs and satellite images with accurate coordinate values. An aerial signal is a marker installed at the location of a control point in the photo control point survey before the aerial photography is conducted.

The technologies for the installation of aerial signals and photo control point survey were transferred to a total of 12 EMA engineers of the Geodetic Survey Team in March 2015.

Table 55 Details of the Technology Transfer in Installation of Aerial Signals and Photo Control Point Survey

Item	Outline	Form
Outline (of the photo control point survey, installation of aerial signals and pricking), specifications	Understanding of the work, specifications	Lecture
Introduction to GNSS surveying outline and the equipment used	Understanding of the work, specifications, operation of the equipment	Lecture, practice
Practical work in GNSS surveying (planning and observation)	Specifications, planning, operation of the equipment	Lecture, practice
Practical work in GNSS surveying (analysis and calculation)	Specifications, operation of the equipment, accuracy control	Lecture, practice
Accuracy control	Specifications, accuracy control	Lecture, practice
Installation of aerial signals	Specifications, planning, operation of the equipment	Practice

Table 56 Evaluation of the Technology Transfer in Installation of Aerial Signals and Photo Control Point Survey

Content	Evaluation method and result
Lecture using the Photo Control Point Survey Manual and draft work specifications (hereinafter, work specifications) on the roles of the photo control point survey, installation of aerial signals and pricking in topographic mapping and the methods provided and the accuracy required in the work specifications	• The participants were able to improve their understanding of the methods, inspection and accuracy control provided in the specifications that they had not practiced in their ordinary work.
Lecture on the theories of GNSS surveying at introductory level, types of GNSS surveys, methods used in different types of surveys and method to determine locations on the ground using satellites	• The participants improved their understanding of the differences in accuracy of different observation methods. • They improved their understanding of the necessity to determine distances from satellites which were investigated at the stage of analysis and calculation after the observation. • They were able to understand that the basic composition of the new equipment was the same as that of the equipment that they had been using at EMA and they understood the new functions of the new equipment by actually operating it
Lecture and practice in the planning of an actual GNSS survey (reconnaissance, point selection and observation planning) and observation in the survey to follow up the lectures mentioned above	• The participants were able to recognize the differences between the method described in the work specifications and the plan actually adopted and understand the “advantages and disadvantages” of the two. • They were able to understand the necessity to develop an observation plan taking into consideration inspection and evaluation. • They were able to develop a work schedule and personnel assignment schedule with limited personnel and equipment. • They were able to respond to the problems that occurred in observation (including poor reception of satellite signals and erroneous settings) under the leadership of their leader and complete the observation.
The participants practiced input of GNSS observation data in the PC for calculation and analysis and calculation using the customized	• The participants were able to perform the inspection and evaluation required in observation planning and understood their importance.

software. Their level of understanding of basic matters was sufficient because of their experience in ordinary work. However, as they had not performed inspection and evaluation in the calculation process, the focus of the practice was put on inspection and evaluation.	• The young engineers, in particular, were able to understand the flow and procedures for analysis and calculation by repeated self-training. • The participants were able to understand that the quality of the observation planning affects the quality of the inspection and evaluation and the final results of the analysis and calculation process.
Lecture on various inspection methods and accuracy control in the planning, observation and calculation processes using the work specifications and (draft) Accuracy Control Manual	• The participants were able to understand that implementation of planning, observation, inspection and calculation in compliance with the work specifications ensured the quality of the results and kept the accuracy of the results within the set limits.
The participants practiced installation of aerial signals in the field. They created actual aerial signals with the sizes and forms in compliance with the work specifications and installed them on existing control points.	• The participants understood the need to change the sizes of the aerial signals depending on the scales of the topographic maps to be created.

Table 57 Results of the Written Examination on the Installation of Aerial Signals and Photo Control Point Survey

ID	Initial Score	Final Score
Full marks	**100**	**100**
1	100	100
2	95	100
3	100	100
4	80	100
5	95	100
6	100	100
7	85	100
8	90	100
9	90	100
10	55	100
11	65	100
12	65	100

Evaluation of Technology Transfer

The participants were able to perform basic works in the photo control point survey, GNSS survey and installation of aerial signals as they had performed them already in their work. However, they had not performed inspection, evaluation and accuracy control in either of these processes in their work. They understood that poor inspection and evaluation results required re-observation (implementation of new field observation at locations where the quality of the observation results was poor). They were also able to improve their understanding of the process of preparing an observation plan taking into consideration inspection and evaluation, performing inspection and evaluation at various stages and making a final decision on the observation using the final results which had passed such inspection and evaluation, instead of simply evaluating the observation only by the final calculation results.

The Study Team considers that the participants will have to apply the accuracy control learned in this technology transfer in their ordinary work on a daily basis to ensure the quality of the work.

Output of the Technology Transfer

Technology transfer manual, "Photo Control Point Survey Manual," and set of attached documents

(4) Technology Transfer in Aerial Triangulation/Aerial Photography Planning

1st Term

Prior to the implementation of the technology transfer (in aerial photography planning, aerial triangulation, creation of orthophotos and creation and editing of DTMs) in the second term, the Study Team surveyed the current status concerning the above-described technology transfer items. The Study Team also implemented part of the technology transfer concerned in the first term.

Table 58 Impact and Problems of the Technology Transfer in Aerial Triangulation/Aerial Photography Planning

Item	Contents	Impact and Problems	Countermeasures
Aerial triangulation	Explanation of the principles was partly implemented in the form of lectures	Technology transfer in the second term will be implemented smoothly by explaining the principles and examining the level of knowledge of EMA staff at the same time	Improve the understanding of the principles of aerial photogrammetry of the trainees by practice in practical work using the system to be introduced and train them to be able to implement the work independently by having them master operation of the system at the same time
Aerial photography planning	Explanation of the principles was partly implemented in the form of lectures	Technology transfer in the second term will be implemented smoothly by explaining the principles to EMA staff and examining the level of their knowledge at the same time	

2nd Term

The table below shows the schedule of the technology transfer in aerial triangulation, aerial photography planning and creation of digital orthophotos /DTM.

Table 59 Schedule of the Technology Transfer in Aerial Triangulation/Aerial Photography Planning

Period (2014)		Content (lecture and practice)	Outcome
(2nd technology transfer) July to August 2014	Week 1	Geometric principles of photogrammetry	The participants were able to diagram the geometric relationship when an aerial photograph is taken between the lens, camera and object (ground surface) and to understand the relationships between the focal length, elevation above the ground, image sensor, resolution at ground level, map sheet size, photo scale and photographed area, etc.
	Week 2	Coordinate systems for analytical photogrammetry	The participants were able to diagram the geometric relationship between a pair of stereo images (left and right) and define multiple coordinate systems (photograph, model and ground coordinate systems) linking a monaural photograph, pair of stereo images and the object of photography (ground surface)
	Week 3	Procedures for aerial triangulation	The participants were able to perform aerial triangulation of the area covered by the forty models on three flight courses near Adama City selected as the sample data for the practice on a trial basis and to understand the procedures for aerial triangulation.
	Week 4	Analysis procedures using the LPS System	The participants were able to understand the procedures for creation of DTMs and orthophotos using the outputs of aerial triangulation.
	Week 5	Theories relevant to quality control	Regarding the outputs of aerial triangulation, the participants were able to acquire the knowledge at introductory level of the "least-square method," a method to estimate the true values from data containing errors.
	EMA's own training course (sharing of the contents of the technology transfer within EMA and training in data exchange between the existing photogrammetry software and the photogrammetry software procured in this Project)		
(3rd technology transfer) July to August 2015	Week 1	Aerial triangulation practice and quality control	The participants were able to perform aerial triangulation of the area covered by the 40 models on three flight courses near Adama. They were also able to evaluate the outputs based on the Quality Control Manual and create an Accuracy Control Table.
	Week 2	DEM creation and DEM editing	DEM could be automatically created based on the results of aerial triangulation. The participants were able to create and edit DEM after attending a theoretical lecture on trends in automatically generated DEM errors and corrections and practicing DEM editing.
	Week 3	Orthophoto creation	The participants were able to create orthophotos after creating orthophotos using the results of aerial triangulation and edited DEM.
	Week 4	Orthophoto quality control ORIMA software operation	The participants could evaluate the created orthoimages based on the Quality Control Manual and create an Accuracy Control Table for the corrected final results.
	Week 5	Evaluation of technology transfer	The level of understanding of the EMA trainees and the operations and quality were evaluated and the results compiled.

Table 60 Personnel of the Technology Transfer in Aerial Triangulation and Aerial Photography Planning

Affiliation	Name	2nd (2014)	3rd (2015)
Photogrammetry Division, Mapping Directorate	Ms. Aster Tiruneh	○	○
	Ms. Senait Seyoum	○	○
	Ms. Yewbdar Fikre Silassie	○	○
	Ms. Beza Haile	○	○
	Ms. Tsedale Mehari	○	○
	Mr. Ahmed Muhammed	○	
Orthophotography Division, Mapping Directorate	Mr. Abnet Solomon	○	○
	Ms. Asebech Negatu Aychelet	○	○
Quality & Standard Directorate	Ms. Beltech Zewde		○

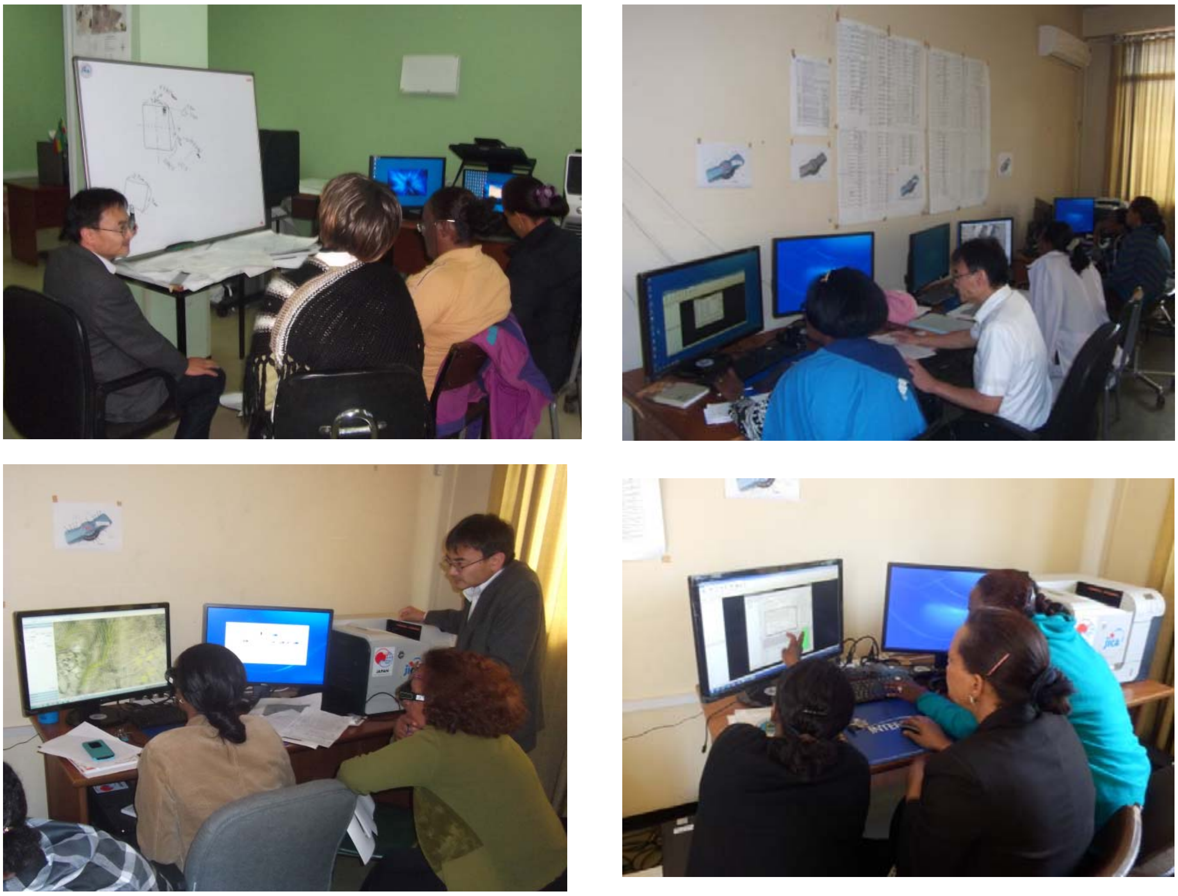


Figure 26 Technology Transfer in Aerial Triangulation

(Top left: Lecture on theories, Top right: Practice in basic operation, Bottom left: DEM correction, Bottom right: Accuracy control)

Evaluation of Technology Transfer

Through the lectures and practice, the trainees understood the basic theory and could perform basic software operations at the same level (speed, accuracy) to a certain extent. They could also perform applied operations such as aerial triangulation of satellite images as well as aerial photographs, exchange of outputs with other software and correction of the quality control results.

Table 61 Evaluation of the Technology Transfer in Aerial Triangulation/Aerial Photography Planning

Item		Objective	Evaluation method and result
Understanding of theory	Aerial photography planning	The participants are able to prepare a plan appropriate for the photo scale using the software.	The participants were given the task of drawing a photography plan map with given specifications (including photo scale and ratios of overlapping and side-lapping) in the lecture. They were able to improve their understanding by correction of errors in the elevation above the ground, etc.
	Aerial triangulation	The participants are able to understand the theories of aerial triangulation.	After an explanation of the pattern of rotational transformation of coordinates was provided in the lecture, the participants were given the task of finding another pattern of transformation. They reached the correct answer while discussing the task among them.
	Creation of orthophotos and DTMs	The participants are able to understand the theories for the creation of DTMs and orthophotos	The participants were given the task of creating orthophotos and DTMs in the practice with given sample data after instruction in the procedures used in the LPS System. Supplementary theoretical explanation was given on the products of the task (both correct and incorrect) to improve their understanding.
	Application	The participants are able to use data between different types of software.	In EMA's own training, the participants were given the task of manipulating data between the photogrammetry software used by EMA and the photogrammetry software procured in this Project after which they were able to perform the task themselves, so there will be no third technology transfer for this item.
Performance	Aerial triangulation	Improvement of processing skills	In the second technology transfer, processing of 40 models on three flight courses took 35 hours by a fast operator, but in the third technology transfer processing by even the slowest operator took only 20 hours.
	Creation of orthophotos and DTMs	Improvement of understanding and practical skills in orthophotos and DTM processing	In the second technology transfer, creation of orthophotos/DTMs of 10 aerial photos on two flight courses required three days, but in the third technology transfer, the participants were able to create orthophotos/DTMs of 40 aerial photos on three flight courses in two days.
Quality	Aerial triangulation	Adjustment of position of tie-point observation	In the second technology transfer, as the participants did not understand the ideal position of tie-point observation and inappropriate observation locations adversely affected the calculation results, a second placement of all the tie-points was unavoidable. In the third technology transfer, the participants built on their experience in the second technology transfer and succeeded in doing the calculations with the first tie-point placements.
	Creation of orthophotos	Improvement of quality control capability	The participants were able to do the work based on the quality control manual. They were able to carry out efficient checks taking into consideration DTMs and seam lines and create an appropriate accuracy control table.

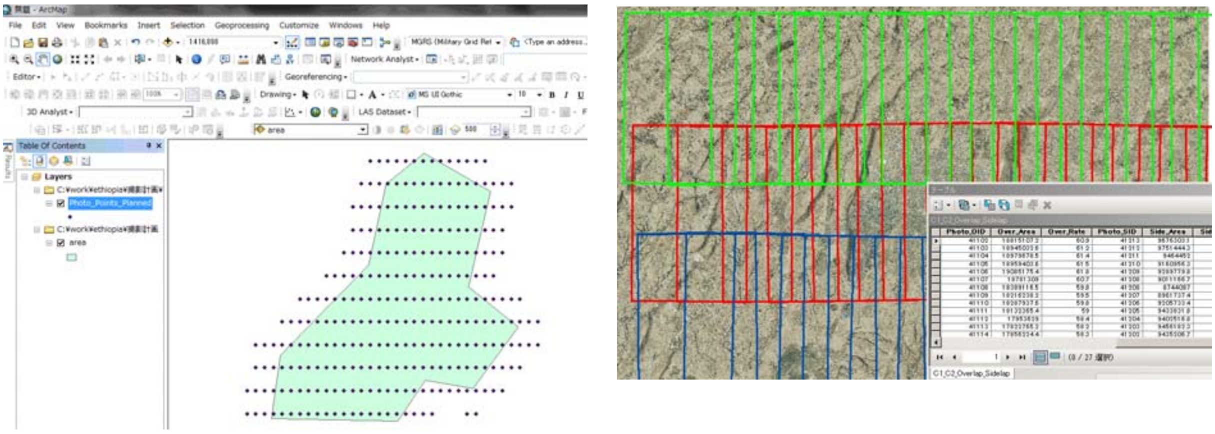


Figure 27 Examples of Quality Control Tools

(Left: Photography plan; Right: Photography output check tool)

Figure 28 Examples of Errors in Ortho Images (Left: DTM; Right: Orthophoto)

(5) Technology Transfer in Digital Plotting

The table below shows the schedule of the technology transfer in digital plotting.

Table 62 Schedule of the Technology Transfer in Digital Plotting

Period		Content	Outcome
(1st) July to August 2014	Week 1	Installation of the equipment Introduction to the technology transfer Questionnaire and interview surveys Basic operation of the CAD software (MicroStation) Practice in symbol creation for digital plotting	PowerPoint presentation on the outline of digital plotting Questionnaire Manual for Basic Operation of the CAD Software (MicroStation) (draft)
	Week 2	Practice in symbol creation for digital plotting	Manual for Symbol Creation for Digital Plotting
	Week 3	Practice in configuration of the stereo viewing software (PRO600)	PRO600 Configuration Manual
	Week 4	Practice in 3D digital plotting Evaluation of the technology transfer	
(2nd) September to November 2014	Week 1 Week 2	Installation of the equipment	Software Installation Manual
	Week 3	Review of the outcome of the technology transfer in the first term (symbol creation for digital plotting and basic operation of the CAD software)	Manual for Basic Operation of the CAD Software (MicroStation)
	Week 4	Understanding of the map symbols of 1/10,000 maps Lecture on how to capture features at a scale of 1/10,000 Practice in capturing planimetric features	Digital Plotting Work Manual
	Week 5	Practice in capturing spot elevations and contours	
	Week 6 Week 7	Practice using the data of the training area	Digital plotting data of two map sheet areas
	Week 8	Evaluation of the technology transfer	
(3rd) April to May 2015	Week 1	Theory of contour mapping suitable for 1/10,000 maps	Contour check maps of two map sheet areas
	Week 2	Correction of contours at a scale of 1/10,000	Contour correction data of two map sheet areas
	Week 3	Planimetry suitable for 1/10,000 maps and correction of planimetric features	Planimetric feature check sheets of two map sheet areas
	Week 4 Week 5	Practice in digital plotting at a scale of 1/10,000	Start of practice in digital plotting with the southern and eastern areas of the plotting area as the training area
EMA's Independent Practice Period (June – July 2015)			
(4th) July to September 2015	Week 1 Week 2 Week 3	Practice in digital plotting at a scale of 1/10,000	Work in Ethiopia and digital plot sheets of the adjoining southern and eastern areas consisting of 16 map sheet areas
	Week 4	Digital plotting quality control and data correction at a scale of 1/10,000 Digital plotting and joining at a scale of 1/10,000	Check sheet of one map sheet area
	Week 5	Digital plotting quality control and data correction at a scale of 1/10,000 Discussion of specifications for other map scales	Check sheets of two map sheet areas
	Week 6	Practice in correcting changes over time using satellite images Application to other map scales	Correction of changes over time of one map sheet area 1/5,000 topographic map symbols (draft)
	Week 7	Outline of process control	Samples of process control tools

	Week 8	Evaluation of the technology transfer	
(5th) January to February 2016	Week 1	Practice in digital plotting at a scale of 1/10,000 (quality control)	Digital plotting work for evaluation (one map sheet per operator)
	Week 2		
	Week 3		
	Week 4	Evaluation of digital plotting at a scale of 1/10,000	Work speed and quality were evaluated for two operators.
	Week 5	Lecture on specifications of digital plotting at a scale of 1/5,000 (Addis Ababa)	
	Week 6	Practice in digital plotting at a scale of 1/5,000 (Addis Ababa)	
(6th) March to April 2016	Week 1	Practice in digital plotting at a scale of 1/10,000 (quality control)	Digital plotting work for evaluation (one map sheet per operator)
	Week 2		
	Week 3		
	Week 4	Evaluation of digital plotting at a scale of 1/10,000	Work speed and quality were evaluated for three operators.
	Week 5	Practice in digital plotting at a scale of 1/5,000 (Addis Ababa)	
	Week 6	Evaluation of the technology transfer	

Table 63 Personnel of the Technology Transfer in Digital Plotting

Affiliation	Name	1st	2nd	3rd	4th	5th	6th
Photogrammetry Division, Mapping Directorate	Ms. Asebech Negatu Aychelet	○	○				
	Ms. Senait Seyoum	○	○	○	○	○	○
	Ms. Yewbdar Fikre Silassie	○	○	○	○	○	○
	Ms. Beza Haile	○	○	○	○	○	○
	Ms. Tsedale Mehari	○	○	○	○	○	○
	Mr. Ahmed Hamid Muhammed	○	○				
	Ms. Fantu Teklegeorgis			○	○	○	○
Cartography Division, Mapping Directorate	Ms. Woinshet Abegaz	○					

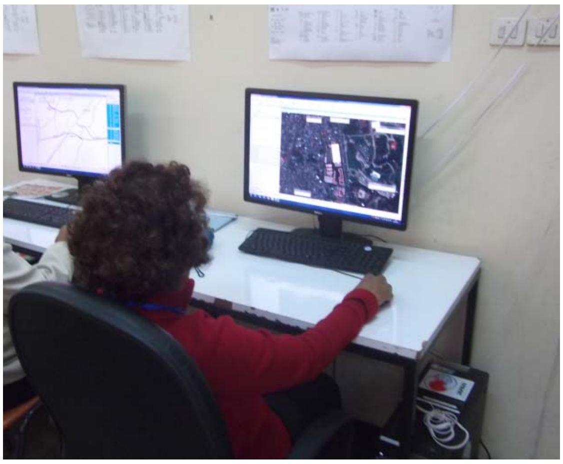
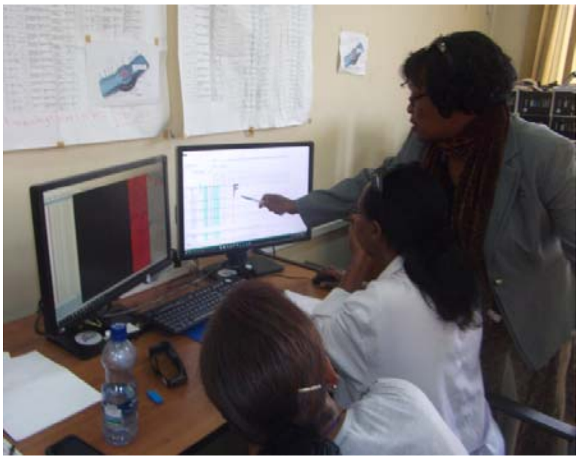



Figure 29 Technology Transfer in Digital Plotting

(Left: Digital plotting at 1/5,000 (Addis Ababa), Right: Practice in process control)

Evaluation of Technology Transfer

An average of five operators participated in the technology transfer from May 2015 to April 2016. Three of them had experience in analog plotting and two had almost no experience.

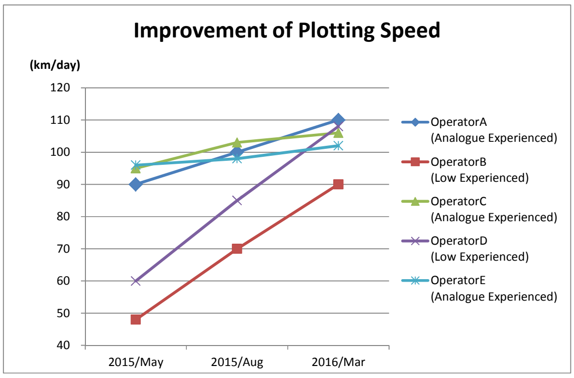
As a result of training, the participants mostly understood necessary software operation and the work speed of all the five participants improved by the end of the training. With respect to quality, a reducing trend of errors was observed for the work of all the five participants (see tables below). In particular, it is considered that in addition to the elimination of obvious mistakes, such as “unconnected roads, rivers and contour lines” and “inconsistency between contour lines and rivers”, reduction of inappropriate excessive acquisitions at a scale of 1/10,000 (both in terms of shape and size) led to the improvement of speed as well as quality.

As the subsequent training in digital editing helped the participants understand the content of errors that turn out to be logic errors in digital editing and which inhibit the creation of polygons, they became able to perform data acquisition in digital plotting based on the awareness of digital editing.

Also, in the latter half of this training, practice in digital plotting at 1/5,000 for Addis Ababa was started based on the newly procured satellite images. This enabled them to work while comparing the specifications and acquisition standards with those of the scale of 1/10,000 and promote the understanding of the difference in scales.

The final evaluation confirmed that digital plotting at 1/10,000 can be carried out at an average speed of 103km/day. Since the average total length of features generated on 1/10,000 map sheets is about 1,100km, the work can be completed in slightly more than 10 days, considering the time required for inputting symbols, etc.

As the average work speed of each operator was understood, practice in process control using bundled software (Microsoft Excel) was also implemented to enable progress control prior to the work.



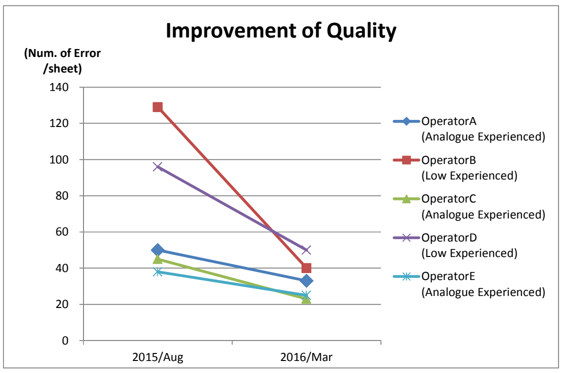


Figure 30 Evaluation of Result of Technology Transfer in Digital Plotting
(Left: Trend of speed, Right: Trend of the number of errors)

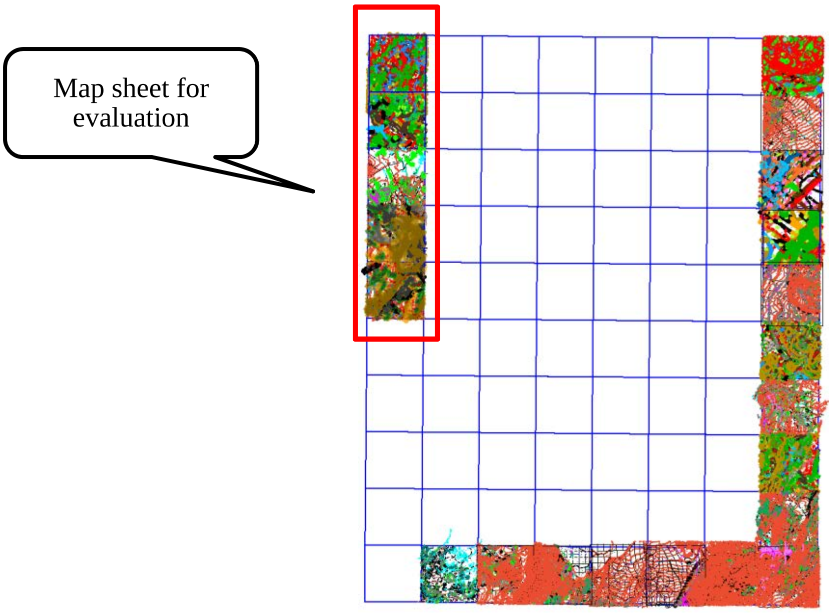


Figure 31 Training Area

Table 64 Evaluation and Issues of the Technology Transfer in Digital Plotting

Item	Objective	Content	Evaluation method and result	Issues for the next term
Understanding of the purpose and details of the work	To understand the specifications for 1/10,000 topographic maps	Training in the creation of the map symbols described in the specifications with CAD software	The participants became able to create symbols at a scale of 1/10,000 without any problems.	Self-training from large scale to small scale
	To understand the criteria for capturing features for 1/10,000 scale digital plotting	Provision of lecture Practice using the training area consisting of two map sheet areas	Introduction of the inspection of printed map sheets enabled the participants to understand excessive acquisitions inappropriate for the scale of 1/10,000.	Nothing in particular
	To understand the procedures for capturing features for 1/10,000 scale digital plotting	Provision of lecture Practice using the training area consisting of 16 map sheet areas	The participants were able to reduce excessive acquisitions inappropriate for the scale of 1/10,000.	Extension of technology to untrained operators
	To understand the basics of 3D interpretation	Practice using the training area consisting of 16 map sheet areas	Implementation of matching in the digital editing training with feedback enabled the operators to work based on the awareness of standardization.	Continuation of training for standardization to achieve higher work efficiency
Performance	Japanese Operator level	Aggregation of the training area consisting of 16 map sheet areas	Although the work speed at this point is about a half of the speed of Japanese operators, it is considered adequate in view of the balance with quality.	Continuation of training to increase the speed and overall improvement
Quality	To implement quality control themselves	Results of inspection of map sheet areas for quality control	Critical errors have almost been eliminated and excessive acquisitions also decreased. The participants became able to perform data acquisition in consideration of the efficiency in subsequent digital editing.	Overall improvement to the level of the operator with fewest errors

(6) Technology Transfer in Digital Editing

The table below shows the schedule of the technology transfer in digital Editing.

Table 65 Schedule of the Technology Transfer in Digital Editing

Period		Content	Outcome
(1st technology transfer) November to December 2014	Week 1	General explanation of digital editing and understanding of the basic operation and functions of the CAD software	Understanding of the details of digital editing Acquisition of how to operate the software
	Week 2	Understanding of the map symbols and map editing functions	Understanding of the rules on data creation in compliance with map symbol regulations implemented separately Mastering of the basic and advanced commands of the editing functions
	Week 3	Practical lesson on data cleaning and creation of polygons (using sample data) Acquisition of how to edit contours	Acquisition of how to display data by category and detect and correct errors Acquisition of how to edit contours, inspect contour data for errors and correct errors
	Week 4	Review by individual participants Practice in editing using actually plotted data	Improvement of the level of understanding of software operation and editing work through repeated practice
(2nd technology transfer) August to October 2015	Week 1	Correction of contours and review of data cleaning process	Review of work content of technology transfer in first year of Project
	Week 2	Confirmation of entire digital editing workflow Mastery of digital editing preparations	Understanding of entire digital editing workflow Understanding of meaning of application of common data settings for digital editing and mastery of procedures
	Week 3	Mastery of annotation input settings and work procedures Mastery of administrative boundary input work	Mastery of annotation input and administrative boundary input work procedures
	Week 4	Practice in digital editing processes using training area data	Understanding of flow of series of work using actual plotting data
	Week 5	Mastery of data check procedures for each data layer Mastery of error data correction procedures	Mastery of data check procedures Mastery of error correction procedures Feedback to quality control of digital plotting work based on understanding of error content
	Week 6	Training in recovery work by themselves	Improvement of operation and understanding of work by repeated practice
(3rd technology transfer) November to December 2016	Week 1	Review of the work schedule and procedures	
	Week 2	Practice in digital editing	Map data for evaluation (4 sheets)
	Week 3		
	Week 4		
	Week 5	Evaluation of the practice in digital editing	Evaluation of the speed and quality of the work of four operators
(4th technology transfer) May to June 2016	Week 1	Practice in digital editing	Map data for evaluation (4 sheets)
	Week 2		
	Week 3	Accuracy control in digital editing	Explanation and practice of the method to evaluate quality of the edited data
	Week 4	Evaluation of the practice in digital editing	Evaluation of the speed and quality of the work of four operators
	Week 5	Lecture on and practice in generalization	Thinning of contours Thinning of plotting single points

(5th technology transfer) August 2016	Week 1	Lecture and review on generalization	List of processing methods by layer
	Week 2	Practice in generalization	Understanding of the generalization methods
	Week 3		
	Week 4	Practice in generalization and evaluation of the practice	Improvement of the understanding of generalization work

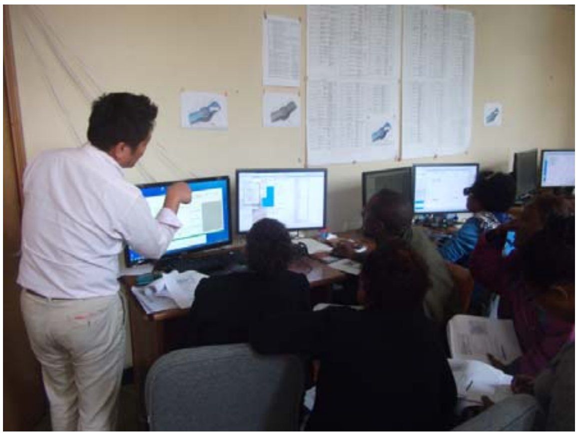


Figure 32 Technology Transfer in Digital Editing

(Left: Error extraction practice; Right: Annotation input practice)

Table 66 Personnel of the Technology Transfer in Digital Editing

Affiliation	Name	1st	2nd	3rd	4th	5th
Cartography Division, Mapping Directorate	Mr. Kasaye Hailu	○				
	Mr. Sime Ayano	○	○	○	○	○
	Ms. Woinshet Abegaz	○				
	Ms. Aynalem Abebe	○	○	○	○	○
	Ms. Almaz Gudisa	○				
	Ms. Fasika Demissie	○	○	○	○	○
Photogrammetry Division, Mapping Directorate	Mr. Abnet Solomon	○				
	Ms. Senait Seyoum	○	○	○	○	○
	Ms. Yewbdar Fikre Silassie	○				
	Ms. Tsedale Mehari	○	○	○	○	○
	Ms. Asebech Negatu Aychelet		○	○	○	○
	Ms. Beza Haile		○	○	○	○
	Ms. Fantu Teklegeorgis		○	○	○	○
Quality & Standard Directorate	Ms. Balainesh Begashaw		○	○	○	○
	Ms. Astawes Tilahun		○	○	○	○

Evaluation of the Technology Transfer and Tasks to be Performed

Approx. 10 operators participated in each of the five technology transfer sessions conducted between November 2014 and August 2016. After implementation of the first technology transfer, the participants understood basic CAD software operations and the data cleaning workflow. Through the second technology transfer, they understood data editing of each layer and the data cleaning procedures as well as understanding the entire digital editing workflow. In the third and fourth technology transfer, the participants understood the procedures used in the entire digital editing process and improved the work speed and accuracy with repeated practice. In the latter half of the fourth technology transfer and in the fifth technology transfer, the participants learned the generalization procedures.

None of the participants of the technology transfer had experience in using the editing software (MicroStation). However, as the participants used the same software they had used in the technology transfer in digital plotting and symbolization implemented concurrently, their technical capacity in operating the software improved significantly. The evaluation of the technology transfer revealed the improvement in the work speed of all the four evaluated participants. The quality of their work was also improved as the evaluation revealed a reduction in the numbers of errors. The repeated practice is believed to have been the cause of such improvement. Although the levels of understanding differed among the participants, they acquired general understanding of the setting of thresholds of the data cleaning tool, which had been a problem for them, and each of them became able to set a threshold appropriate for the data contents.

The focus of the technology transfer in generalization was on the understanding of the map specifications. The participants prepared a generalization manual while each of them considered how to edit each type of features in the generalization. They managed to conduct the generalization independently by following this manual.

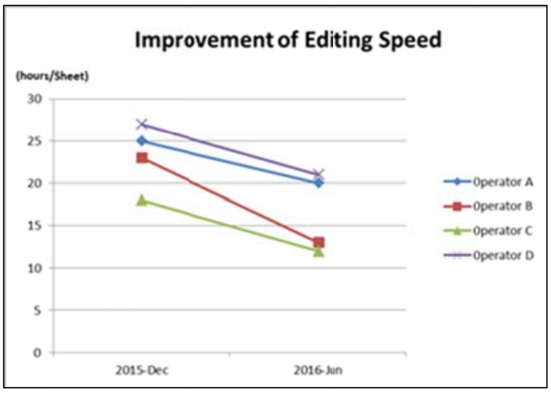


Figure 33 Evaluation of Result of Technology Transfer in Digital Editing (Left: Trend of speed, Right: Trend of the number of errors)

Table 67 Evaluation and Issues of the Technology Transfer in Digital Editing

Item	Objective	Content	Evaluation method and result	Issues for the next term
Understanding of the purposes and contents of the work	Understanding of theory and standards for editing 1/10,000 topographic maps	Lecture	The results of qualitative evaluation of the level of understanding showed that the trainees who attended the technology transfer in digital plotting had a good understanding of the elements targeted for editing. The trainees from the Mapping Directorate who participated had a good understanding of the quality required for the final outputs. Significant progress was achieved based on the results of the lecture and information sharing by both parties.	N/A
	Understanding of acquisition procedures for digital editing at a scale of 1/10,000	Lecture Practice using sample data of one map sheet area	The results of qualitative evaluation of the level of understanding showed that the trainees who attended the technology transfer in digital plotting had a good understanding of software editing operations. In addition, the technology was appropriately communicated to the participants from the Mapping Directorate.	
	Understanding of theory and procedures for polygon creation	Lecture Practice using sample data of one map sheet area	The results of qualitative evaluation of the level of understanding showed that it was the first time for all the trainees, therefore, in the early stage of the technology transfer, the Japanese experts explained the theory and procedures and the participants tried to learn them by imitating what the experts did. In the later stages, their initiatives began to emerge in the practice. For example, they gained a better understanding of the thresholds by processing data with different thresholds set by themselves.	
	Independent execution of digital editing at a scale of 1/10,000	Practice in the training area consisting of two map sheet areas	The results of qualitative evaluation of the content of editing work and data being edited showed that several of the trainees had a good understanding of the theory of editing and the work procedures. The other trainees performed digital editing themselves while checking the work procedures with trainees with a higher level of understanding. When a problem arises, increasingly the trainees discuss it and solve it themselves. Major progress was made towards performing the work independently.	N/A
	Understanding of theory and standards of reduction (from 1/10,000 to 1/25,000 scale)	Lecture Practice using sample data of one map sheet area	The participants conducted a comparative study of the map specifications for the two types of topographic maps and completed the compilation of the generalization manual based on the results of the study independently. The result of qualitative evaluation revealed that they had understood the theory of the generalization and become able to implement it independently.	Further improvement in the work speed with repeated practice and actual work experience
	Quality control	Lecture Practice with data of two map sheet areas in the training area	The participants have understood the theory and procedures of the quality control and become able to control the quality of edited data mutually.	Improvement of awareness to the quality through the implementation of quality control and further improvement in the quality of the work itself

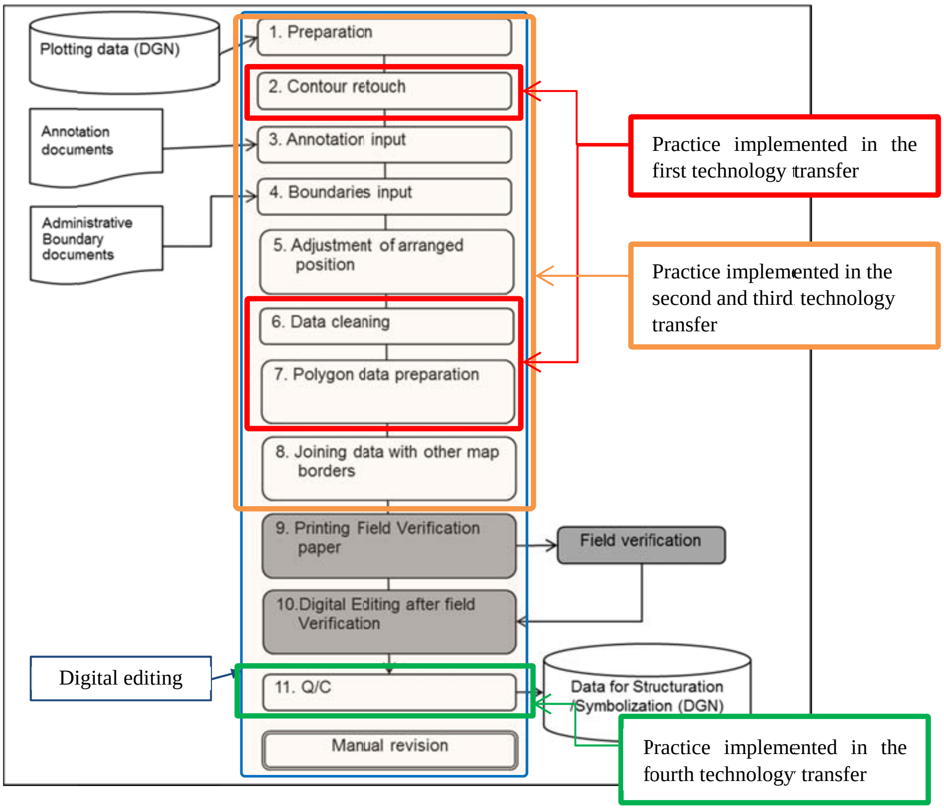


Figure 34 Digital Editing Workflow and Scope of Practice in Technology Transfer

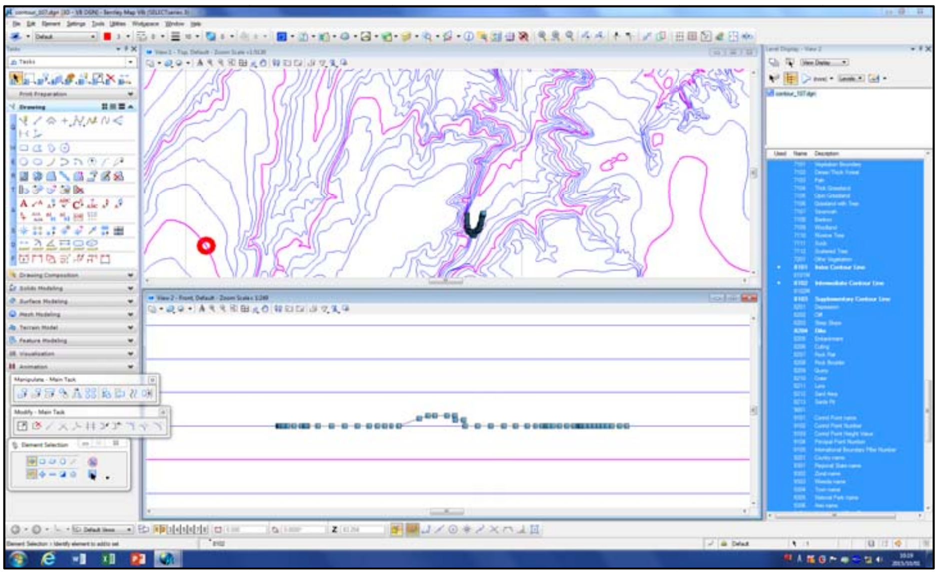


Figure 35 Example of Error in Digital Editing Technology Transfer

(7) Technology Transfer in Symbolization

The table below shows the schedule of the technology transfer in symbolization.

Practice data prepared by the Study Team were used in the training in the first technology transfer because the processing of data of the pilot area in the preceding stage had not been completed yet.

Because the digital editing of data of a map sheet area in the pilot area had been completed, the data of the map sheet concerned were used in the training in the second technology transfer.

Because the digital editing of data of multiple 1/10,000 map sheet areas had been completed, these edited data were used in the training in the third technology transfer. The 1/25,000 map data prepared by the Study Team for the practice were also used in the training.

Table 68 Schedule of the Technology Transfer in Symbolization

Period		Content	Outcome
(1st technology transfer) July to September 2015	Week 1	Investigation of the engineers' level and formulation of the technology transfer plan	Grasp of experience and technical level of C/Ps
	Week 2	◯ Team 1 Understanding of theory of symbolization Understanding of how to create map symbols Understanding of how to operate symbolization software	Understanding of theory of symbolization Mastery of how to create map symbols Mastery of how to operate symbolization software
	Week 3	◯ Team 1 Understanding of theory and procedures of transfer Understanding of how to adjust annotations Understanding of how to adjust the positional relation between features according to the priority level of the features	Understanding of theory and procedures of transfer Mastery of how to adjust annotations Mastery of how to adjust the positional relation between features
	Week 4	◯ Team 1 Understanding of the theory and procedures of hidden line removal Understanding of how to remove hidden contours Understanding of how to remove duplicated hidden feature lines	Understanding of the theory and procedures of hidden line removal Mastery of how to remove hidden contours Mastery of how to remove duplicated hidden feature lines
	Week 5	◯ Team 2 Understanding of the theory of symbolization Understanding of how to create map symbols Understanding of how to operate symbolization software	Understanding of the theory of symbolization Mastery of how to create map symbols Mastery of how to operate symbolization software
	Week 6	◯ Team 2 Understanding of theory and procedures of transfer Understanding of how to adjust annotations Understanding of how to adjust the positional relation between features according to the priority level of the features	Understanding of theory and procedures of transfer Mastery of how to adjust annotations Mastery of how to adjust the positional relation between features
	Week 7	◯ Team 2 Understanding of the theory and procedures of hidden line removal Understanding of how to remove hidden contours Understanding of how to remove duplicated hidden feature lines	Understanding of the theory and procedures of hidden line removal Mastery of how to remove hidden contours Mastery of how to remove duplicated hidden feature lines
	Week 8	Evaluation of technology transfer	Results of questionnaire on level of understanding

Period		Content	Outcome
(2nd technology transfer) November to December 2015	Week 1	◯ Team 1 Refresher training on the training items in the previous training using the data of the pilot area	Reminding forgotten training items in the previous training by practicing the training items in the previous training again
	Week 2	◯ Team 1 Understanding of how to create polygon data Understanding of the order of display of map symbols Understanding of how to make a polygon transparent	Mastery of how to create polygon data Understanding of the order of display of layers Mastery of how to make a polygon transparent
	Week 3	◯ Team 1 Understanding of how to create marginal information Understanding of how to create a map sheet to be printed ◯ Team 2 Refresher training on the training items in the previous training using the data of the pilot area	Mastery of how to create marginal information Mastery of how to create a map to be printed Reminding forgotten training items in the previous training by practicing the training items in the previous training again
	Week 4	◯ Team 2 Understanding of how to create polygon data Understanding of the order of display of map symbols Understanding of how to make a polygon transparent	Mastery of how to create polygon data Understanding of the order of display of layers Mastery of how to make a polygon transparent
	Week 5	◯ Team 2 Understanding of how to create marginal information Understanding of how to create a map sheet to be printed	Mastery of how to create marginal information Mastery of how to create a map to be printed
	Week 6	◯ Teams 1 and 2 Understanding of the quality control method Understanding of how to complete the accuracy control table	Mastery of the quality control method Mastery of how to complete the accuracy control table
(3rd technology transfer) May to July 2016	Week 1	Inspection of the data of the training area created by the counterparts	Symbolized map sheets of the training area (3 sheets)
	Week 2	Correction of the data of the training area	Symbolized map sheets of the training area (3 sheets)
	Week 3	Correction of the data of the training area	Symbolized map sheets of the training area (3 sheets)
	Week 4	Evaluation of the outputs of the symbolization	Results of the evaluation of the speed and quality of the work of the three teams
	Week 5	Transfer of the technologies for the symbolization of 1/25,000 maps	Understanding of the theory of and procedures for the symbolization of 1/25,000 maps
	Week 6	Transfer of the technologies for the symbolization of 1/25,000 maps	Mastery of how to symbolize 1/25,000 topographic maps

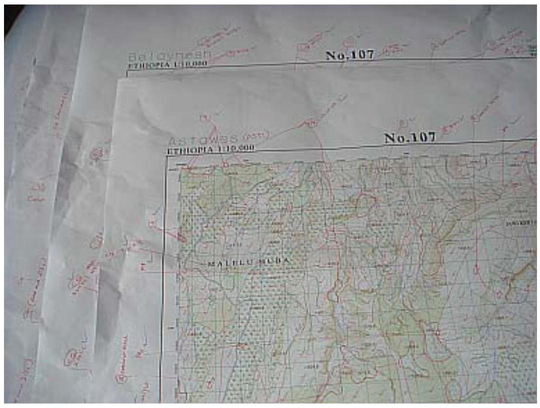
In the first technology transfer, three participants from the Cartography Division, Mapping Directorate, formed Team 1 and two participants each from the Photogrammetry Division and the Quality and Standard Directorate formed Team 2.

In the second technology transfer, two participants each from the Cartography Division, Mapping Directorate, and the Photogrammetry Division formed Team 1 and one participant from the Photogrammetry Division and two participants from Quality and Standard Directorate formed Team 2.

In the third technology transfer, three participants from the Cartography Division, Mapping Directorate, two participants from the Photogrammetry Division and two participants from the Quality and Standard Directorate formed Teams 1, 2 and 3, respectively.

Table 69　Personnel of the Technology Transfer in Symbolization

Affiliation	Name	1st	2nd	3rd
Photogrammetry Division, Mapping Directorate	Ms. Senait Seyoum	○	○	○
	Ms. Tsedale Mehari	○	○	○
	Ms. Asebech Negatu Aychelet	○	○	○
Cartography Division, Mapping Directorate	Mr. Sime Ayano	○	○	○
	Mr. Aynalem Abebe	○	○	○
	Ms. Fasika Demissie	○		○
Quality & Standard Directorate	Ms. Balainesh Begashaw	○	○	○
	Ms. Astawes Tilahun	○	○	○



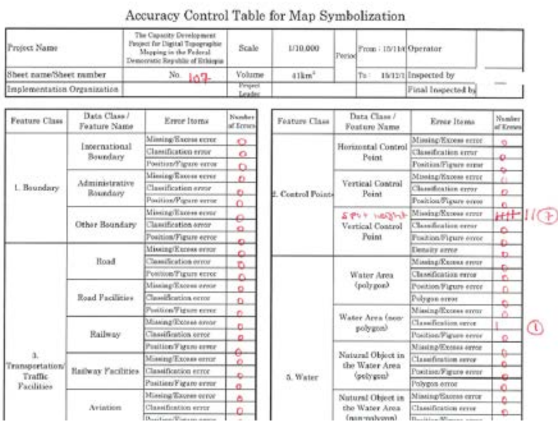


Figure 36　Technology Transfer in Symbolization

(Top left: Practice in quality control, Top right: Created inspection map, Bottom left: Practice of completing accuracy control tables, Bottom right: Part of a completed accuracy control table)

Evaluation of the Technology Transfer and Tasks to be Performed

The results of the questionnaire inquiries and quizzes conducted several times during the technology transfer have confirmed that most of the counterparts have understood “the theory of symbolization,” “how to create map symbols,” “the theory and method of the transfer processing,” "the theory and method of processing hidden lines," "the theory on the order of display of map symbols," "how to create marginal information," "how to create map sheets to be printed" and "the quality control method."

The results of the inspection of the output of the initial training, the three map sheets of the training area symbolized by the counterparts independently and the three map sheets of the training area symbolized by the counterparts at the time of the measurement of the work efficiency were compared for the evaluation of the quality of the outputs. The number of errors identified on a map sheet, which was approximately 40 per sheet in the initial training (implemented between August and December 2015), was reduced to less than 20 and less than 15 at the time of the independent symbolization (between January and May 2016) and the evaluation of the work efficiency (in May and June 2016), respectively. This observation shows that the repeated practice reduced the numbers of errors. The difference in the number of errors between the teams does not relate to the difference in their capacities because the difference was mainly derived from the difference in the difficulty in symbolizing map sheets. (The difficulty increases as the number of features on a map sheet increases.) Because map sheets displayed on a computer screen and printed on paper look a little different, the inspection was conducted with the maps printed on paper as final outputs. Since no serious problem is expected to emerge from the existence of 15 errors per map sheet, the counterparts are considered to have conducted the quality evaluation appropriately.

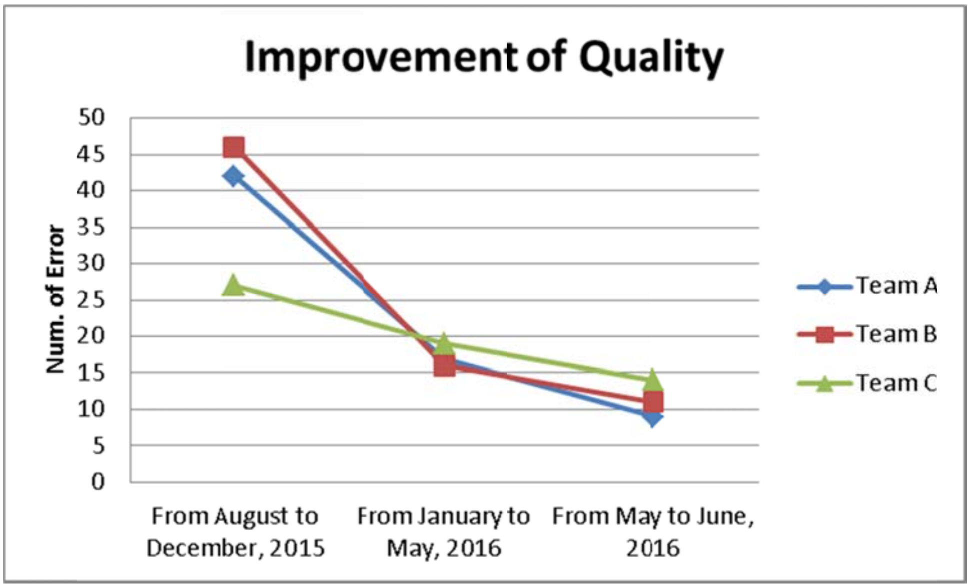


Figure 37 Trend of the Number of Errors

The numbers of hours required for the symbolization in the initial training and the symbolization of three map sheets conducted for the evaluation of the work efficiency were compared.

The result of the comparison detailed in the table below shows that the work efficiency of every team improved by more than two-fold compared with the initial stage. Even the least efficient team symbolized an area of $2km^2$ in an hour. At this pace, an entire map sheet can be symbolized in two to three days, which is considered to be sufficiently efficient.

The difference in the efficiency among the teams was derived from the difference in the difficulty in the symbolization. As Team A symbolized a map of an area mainly consisting of farmland, its work efficiency was high. Meanwhile, Team B required a longer time than Team A for the symbolization, because the map that the team symbolized mainly consisted of urban areas with large numbers of features.

The current work efficiency of the counterparts is at a satisfactory level for their current technical skills. Because they are using the manual prepared by the Study Team in the practice, further improvement of the work efficiency will require the improvement of the symbolization procedures by themselves. It is hoped that the counterparts will make their own efforts to improve the efficiency of the symbolization by improving the symbolization procedures.

Table 70 Evaluation and Issues of the Technology Transfer in Symbolization

Item	Objective	Contents	Evaluation method and result	Issues for the next term
Understanding of the purposes and contents of the work	Understanding of the theory and standards of 1/10,000 map symbolization	Lecture	• As a result of qualitative evaluation, the trainees were judged to understand the basic theory of symbolization. • Five of the trainees answered all ten questions in the test in the qualitative evaluation correctly and the remaining three trainees got nine answers right.	N/A
	Understanding of procedures for creating 1/10,000 map symbols	Lecture Practice with a number of sample symbols	• As a result of qualitative evaluation, the trainees were judged to understand the basic method of creating map symbols. • From the fact that they were able to complete the training practice within the assigned time, they were judged to understand the procedures.	N/A
	Understanding of theory of transfer and hidden line removal of 1/10,000 topographic maps	Lecture Creation of symbolization data using sample data	• As a result of qualitative evaluation, the trainees were judged to understand the basic methods of transferring, removing hidden lines and creating map symbols. • From the fact that they were able to complete the training practice within the assigned time, they were judged to understand the procedures.	N/A

Item	Objective	Contents	Evaluation method and result	Issues for the next term
	Understanding of display order of map symbols	Lecture Practice using data of (a map sheet area in) the pilot area	The trainees are considered to have understood the procedures because they managed to complete the practice in the training in a given time period. It has been concluded that they have understood the importance of the display order because they proposed a way to improve the order presented by the experts in the training.	Dissemination of the technologies to operators who have not taken the training
	Understanding of procedures for creation of marginal information	Lecture Creation of marginal information using data of (a map sheet area in) the pilot area	The trainees are considered to have understood the procedures because they managed to complete the practice in the training in a given time period. It has been concluded that they have understood the procedures to create marginal information because they gained a better understanding of the procedures by repeating the practice of the procedures by themselves.	Dissemination of the technologies to operators who have not taken the training
	Understanding of procedures for creation of printed map data	Lecture Creation of a map sheet to be printed using data of (a map sheet area in) the pilot area	It has been concluded from the result of the qualitative evaluation that the trainees have understood how to create a map sheet to be printed. The trainees are considered to have understood the procedures because they managed to complete the practice in the training in a given time period.	Dissemination of the technologies to operators who have not taken the training
	Understanding of quality control methods	Lecture Quality control using data of (a map sheet area in) the pilot area	It has been concluded from the result of the qualitative evaluation that the trainees have understood the quality control method. The trainees inspected the outputs independently, compared the inspection results and studied the difference in the results. Because they managed to correct errors identified in the inspection and compile the results of the correction in an accuracy control table, they are considered to have understood these procedures.	Quality control of the work conducted independently by EMA with the data of the pilot area
	Understanding of the theory of the creation of 1/25,000 maps and the map symbols for these maps	Lecture	The procedures to create 1/25,000 topographic maps are almost the same as those to create 1/10,000 maps. Therefore, the trainees managed to understand the procedures to create 1/25,000 maps only by providing supplementary explanation on the differences in the two procedures.	1/25,000 topographic mapping of the pilot area to be implemented independently by EMA
	Symbolization of 1/25,000 maps following predetermined procedures	Practice of the symbolization of a combined map created from the generalized data of the three map sheet areas in the training area	The trainees managed to practice the symbolization of 1/25,000 maps only with the provision of the explanation on the differences in the symbolization procedures for 1/10,000 and 1/25,000 maps and complete the symbolization in a given time period.	Symbolization of maps of the pilot area to be implemented independently by EMA
Performance	Two-fold improvement in the efficiency of the symbolization with the data of	Compilation of the data of three map sheet areas in the training area	Comparison of the time required for the trainees to perform the symbolization confirmed that they were able to symbolize maps approx. three times more efficiently than they could have at	Further improvement of the efficiency with EMA's own initiative

Item	Objective	Contents	Evaluation method and result	Issues for the next term
	the training area compared with the efficiency of the work at the time of the lecture		the time of the lecture.	
Quality	Capacity to implement quality control of the outputs of the control area independently	Evaluation of the six map sheets of the training area	The counterparts managed to inspect map sheets and complete an accuracy control table by themselves. However, errors created in the preceding process were detected.	Strengthening of the quality control in each stage of the project coordination between stages

(8) Technology Transfer in GIS Structuration and Website Creation

A survey conducted in the first term revealed the need for technology transfer in the items listed below for realization of creation, structuration and distribution on the website of GIS data (raster and vector data).

Table 71 Technology Transfer Items Related to GIS Structuration and Website Creation

Item	Contents
GIS Structuration	Detailed design of the database
	Creation of schema of feature classes
	Storage and structuration of vector data
	Inspection of vector data for logical errors
	Correction of the errors in vector data
	Automatic creation of mesh data of map sheet areas in all the scales
	Optimization of the vector data display
	Automatic vector data segmentation and integration by mesh of map sheet area
	Data conversion between databases
	Coordinate conversion of GIS data
	Spatial analysis and spatial selection of vector data
	Creation, extraction, statistics and inspection for errors of attribute data
	Utilization of the SQL language for database
	Automatic image segmentation and integration by mesh of map sheet area
	Automatic mapping
Website creation	Utilization of the SQL language for database
	Design of database structure for storage of images
	Optimization of image display
	Coordinated operation of ArcGIS Catalog, ArcGIS Server and SQL Server databases

It had been decided that technologies for website development such as programming and customization would not be transferred and that only technologies for website operation would be transferred in the technology transfer for website creation.

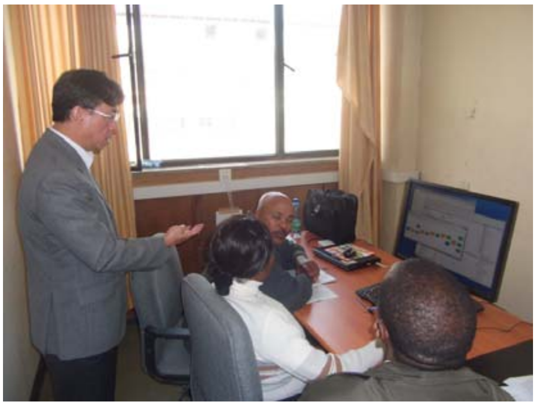
Table 72 Personnel of the Technology Transfer in GIS Structuration and Website Creation

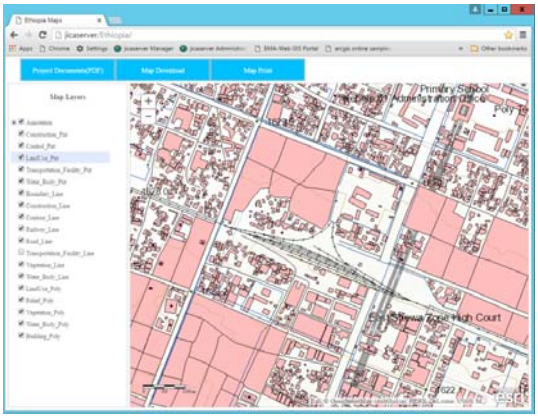
Target	Affiliation	Name	1st	2nd	3rd	4th
GIS Structuration	Photogrammetry Division, Mapping Directorate	Ms. Aster Tiruneh			○	○
		Mr. Abnet Solomon	○	○	○	
	Cartography Division, Mapping Directorate	Mr. Kasaye Haliu	○	○		
		Mr. Sime Ayano			○	○
	GIS & Remote Sensing Directorate	Mr. Israel Gebremeskel	○	○		○
		Mr. Tegene Wedajench			○	○
		Mr. Elyas			○	
Website creation	IT Directorate	Mr. Eyasu Beraharu	○	○	○	○
		Mr. Mukerem Berdi			○	○
		Ms. Hellen Tesfaye	○	○	○	○

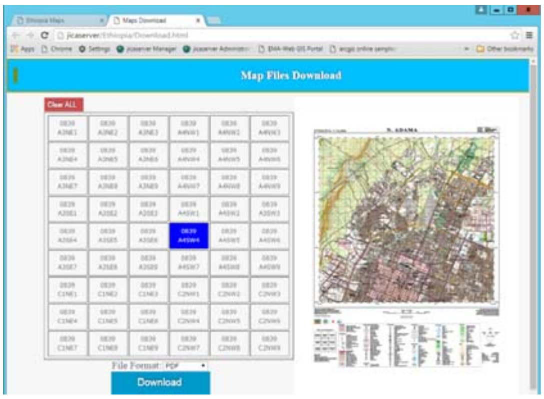
Table 73 Schedule of the Technology Transfer in GIS Structuration and Website Creation

Period		Content	Outcome
(1st technology transfer) June to July 2014	Week 1	Automatic creation of mesh data by map sheet area at all mapping scales	Acquisition of technologies for automatic processing of mesh data by map sheet area at each standard mapping scale in Ethiopia
	Week 2	Automatic vector data segmentation and integration by mesh in map sheet area	Acquisition of technologies for segmentation and integration of the image data created above
	Week 3	Detailed database design Creation of schema of feature classes	Acquisition of knowledge of design, creation and management of databases in different data formats
	Week 4	Data conversion between databases	Acquisition of knowledge for data conversion between databases in different data formats with a customized tool and improvement of the efficiency of routine work
(2nd technology transfer) November to December 2014	Week 1	Storage and structuration of vector data Inspection of vector data for logical errors	Acquisition of skill in use of tools for the creation, analysis and inspection of errors in vector data
	Week 2	Correction of erroneous vector data Optimization of vector data display Spatial analysis and spatial selection of vector data	Acquisition of skill in use of tools for the creation, analysis and inspection of errors in vector data
	Week 3	Creation, extraction, statistics and inspection of errors in attribute data Automatic mapping	Acquisition of skill in creation, processing and inspection of attribute data associated with vector data Acquisition of knowledge of automatic processing and creation of a large quantity of maps
	Week 4	Coordinated operation of ArcGIS Catalog, ArcGIS Server and SQL Server databases	Use of the web server (SQL Server) for data management
(3rd technology transfer) July to September 2015	Week 1	Discussion of web management with IT Directorate	Confirmation of technology content related to web management
	Week 2	How to convert sample CAD data to geodatabase and how to use tools	Acquisition of skill in conversion to geodatabase using ArcGIS and Python tools
	Week 3	Error check of GIS data and error output	Acquisition of skill in identification and output of errors in GIS data by topology rules
	Week 4	Definition, discussion and structuration method of GIS data structuration	Approval of definition of GIS data structuration and acquisition of skill in sample data structuration
	Week 5	How to store structured GIS data in SQL database	Acquisition of skill in storage of structured data in SQL database
	Week 6	How to provide and display GIS data on the web server	Acquisition of skill in provision and display of data on web server

(4th technology transfer) July to September 2016	Week 1	Discussion on the GIS data and web management with EMA and confirmation of the status of the networks and server operation	It was decided to disclose PDF files with Index on the Geoportal of EMA. It was confirmed that the EMA server was operating normally.
	Week 2	Conversion of 1/10,000 and 1/25,000 CAD data to Geodatabase data and inspection of GIS data for error detection	The participants were able to convert data format using the tool developed by the Study Team during this study, understood the details of the errors detected during the conversion and rectified the errors.
	Week 3	Discussion on the method to provide GIS data to the web server and supply of PDF map data to the web server	
	Week 4	Preparation for the JCC meeting and the Final Seminar	
	Week 5	Conversion of 1/10,000 and 1/25,000 CAD data to Geodatabase data and inspection of GIS data for error detection	
	Week 6	Storage of the structured GIS data in a SQL database, management of the SQL database	The participants were able to store all the data created in this study in the SQL database correctly and manage the data.
	Week 7	Provision of GIS data and PDF map data to the server and configuration and display of the data	The participants were able to upload all the data created in this study and share the data in EMA.
	Week 8	Provision of PDF map data to EMA Geoportal and configuration and display of the data	The participants were able to download all the PDF data created in this study on the Geoportal of EMA.







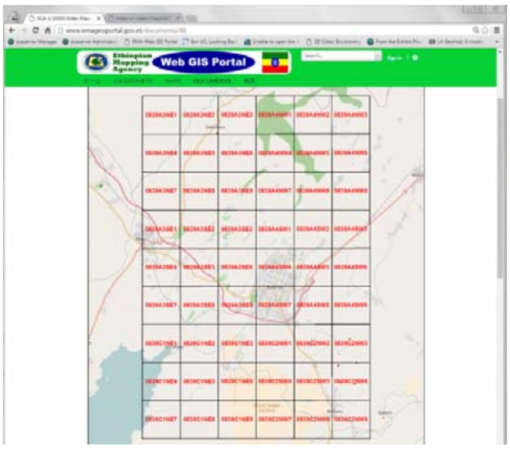


Figure 38 Technology Transfer in Structuration and WebGIS

(Top left: Technology transfer; Top right: Structured data; Bottom left: Data stored in the server; Bottom right: Data on the Geoportal)

Evaluation of the Technology Transfer and Tasks to be Performed

An ArcGIS Python Script tool developed by the Study Team was used in the technology transfer in GIS structuration. The use of this tool made it possible to detect errors occurred in the structuration by examining log files as the rules on data input, output and definition written in the Python Script code were included in the tool and the tool had a function to record output results in a log file automatically.

The participants practiced in the conversion of the data format from dgn to Geodatabase and the examination of detected errors using sample data (in the dgn format) that had been digitally compiled after field completion.

Then they also practiced the storage of error-corrected final data in a SQL database.

The participants have fully understood the contents of the technology transfer and become able to perform the GIS structuration independently as the tool developed for the technology transfer has significantly simplified and automated the data conversion process for the GIS structuration including the error detection in the structuration.

In the technology transfer on WebGIS, the participants took a lecture on the rules for data storage in the existing Geoportal site of EMA and the website on the intranet of EMA established in this study and practiced the data storage in accordance with the rules and the display of the stored data on the Web.

A website on the intranet of EMA was designed with ArcGIS for Server and JavaScript in Japan and established by installing the design on the server.

It has become possible to share the final data stored on the existing Geoportal and the website on the intranet of EMA and display and download GIS data both within and outside EMA.

Because the IT engineers of EMA had the knowledge and technical capacity to store data in the Geoportal, they have fully understood the contents of the technology transfer concerning the data format developed in this study and become able to use the transferred technologies independently.

The table below shows the results of the evaluation of the technology transfer in GIS structuration and website creation.

Table 74 Evaluation of the Technology Transfer in GIS Structuration and Website Creation

Item	Objective	Contents	Evaluation method and result	Issues for the next term
Understanding of the purposes and contents of the work	Understanding of the GIS data structure	Storage, creation, editing and updating of databases	The participants were able to record the processes of data manipulation, analyze the outputs of data creation and create data consistent with the GIS data structure.	N/A
	Data conversion (from CAD format to SHAPE format	Use of ArcGIS conversion tool Use of customized ModelBuilder tool	The participants were able to convert data from the CAD format to the Shape format after repeatedly practicing conversion with sample data and the customized ModelBuilder tool. Improvement in work efficiency by the use of automatic conversion was observed	N/A
	Operation of GIS software	Assistance in advanced operation and tool creation	The participants were able to record the progress of a series of complicated works and perform automatic execution of the works using customized tools created with ModelBuilder.	N/A
	Operation of the server	Creation and management of server users	The participants were able to use the server tools to create and manage server users and create, edit and delete data.	N/A
	Conversion from sample dgn data to GIS data	Conversion of dgn data to geodatabase by ArcGIS and Python tools	The participants were able to perform conversion after practicing conversion of sample dgn data to the geodatabase using ArcGIS and Python tools.	N/A
	Detection of errors in GIS data	Output of GIS data error identification by topology rules	The participants were able to identify and output errors in GIS data after repeatedly practicing with sample data and the ArcGIS tools. Improvement in work efficiency by the use of customized tools was observed.	N/A
	Approval of definition of GIS data structuration	Approval of geodatabase, Feature Dataset, Feature Class, and Field definitions	The participants explained and discussed the definitions of geodatabase, Feature Dataset, Feature Class and Field. The definition of GIS data structuration was understood and approved after practicing using the structuration tool.	N/A
	Storage in SQL database	Storage of structured GIS data in SQL database	The participants were able to store the structured GIS data in the SQL database after practicing storing sample data in the SQL database using the ArcGIS tools.	N/A
	Establishment of a website in the intranet of EMA	Sharing, display and downloading of structured GIS data on a website in the intranet of EMA	The participants were able to share, display and download data after practicing the operation and management of a website using a website on the intranet of EMA.	Sustainable operation and management of the intranet website
	Display and downloading of the latest data on the website	Method to upload the final map data to the existing Geoportal site of EMA and management of the data on the site	The participants were able to upload and manage the final map data after practicing the uploading of multiple sets of the final map data to the web server.	N/A

5-4. Level of Achievement and Total Evaluation of Technology Transfer

The study team has comprehensively evaluated the achievement level from the initial target in each technology transfer item.

Table 75 Achievement Level of the Technology Transfer

Technology	Goals		Points by Achievers / Attendance (%)				Score (point)/100	
			0~24	25~49	50~74	75~100	by goal	SUM
Field Identification / Field Verification	1	Comprehension of "Theory" and "Specification"	0	3	6	9	9	82
	2	Able to operate equipment properly	1	4	7	10	10	
	3	Work implementation in correct procedure	2	5	8	11	11	
	4	Work implementation with stable quality and speed	3	6	9	12	9	
	5	Basic work implementation with "Quality Control"	4	7	10	13	10	
	6	Basic work implementation with "Work Management"	5	8	11	14	11	
	7	Independent implementation on similar work	6	9	12	15	12	
	8	Independent work implementation of similar work with stable quality and speed	7	10	13	16	10	
Installation of Aerial Signals/ Photo Control Point Survey	1	Comprehension of "Theory" and "Specification"	0	3	6	9	9	94
	2	Able to operate equipment properly	1	4	7	10	10	
	3	Work implementation in correct procedure	2	5	8	11	11	
	4	Work implementation with stable quality and speed	3	6	9	12	12	
	5	Basic work implementation with "Quality Control"	4	7	10	13	13	
	6	Basic work implementation with "Work Management"	5	8	11	14	14	
	7	Independent implementation on similar work	6	9	12	15	12	
	8	Independent work implementation of similar work with stable quality and speed	7	10	13	16	13	
Aerial Triangulation/ Aerial Photography Planning	1	Comprehension of "Theory" and "Specification"	0	3	6	9	9	85
	2	Able to operate equipment properly	1	4	7	10	10	
	3	Work implementation in correct procedure	2	5	8	11	11	
	4	Work implementation with stable quality and speed	3	6	9	12	9	
	5	Basic work implementation with "Quality Control"	4	7	10	13	13	
	6	Basic work implementation with "Work Management"	5	8	11	14	11	
	7	Independent implementation on similar work	6	9	12	15	12	
	8	Independent work implementation of similar work with stable quality and speed	7	10	13	16	10	
Digital Plotting	1	Comprehension of "Theory" and "Specification"	0	3	6	9	9	79
	2	Able to operate equipment properly	1	4	7	10	10	
	3	Work implementation in correct procedure	2	5	8	11	11	
	4	Work implementation with stable quality and speed	3	6	9	12	9	
	5	Basic work implementation with "Quality Control"	4	7	10	13	10	
	6	Basic work implementation with "Work Management"	5	8	11	14	8	
	7	Independent implementation on similar work	6	9	12	15	12	
	8	Independent work implementation of similar work with stable quality and speed	7	10	13	16	10	

Technology		Goals	Points by Achievers / Attendance (%)				Score (point)/100	
			0~ 24	25~ 49	50~ 74	75~ 100	by goal	SUM
Digital Editing /Digital Compilation	1	Comprehension of “Theory” and “Specification”	0	3	6	9	9	82
	2	Able to operate equipment properly	1	4	7	10	10	
	3	Work implementation in correct procedure	2	5	8	11	11	
	4	Work implementation with stable quality and speed	3	6	9	12	12	
	5	Basic work implementation with “Quality Control”	4	7	10	13	10	
	6	Basic work implementation with “Work Management”	5	8	11	14	8	
	7	Independent implementation on similar work	6	9	12	15	12	
	8	Independent work implementation of similar work with stable quality and speed	7	10	13	16	10	
Map Symbolization	1	Comprehension of “Theory” and “Specification”	0	3	6	9	9	79
	2	Able to operate equipment properly	1	4	7	10	10	
	3	Work implementation in correct procedure	2	5	8	11	11	
	4	Work implementation with stable quality and speed	3	6	9	12	12	
	5	Basic work implementation with “Quality Control”	4	7	10	13	10	
	6	Basic work implementation with “Work Management”	5	8	11	14	8	
	7	Independent implementation on similar work	6	9	12	15	9	
	8	Independent work implementation of similar work with stable quality and speed	7	10	13	16	10	
GIS Structuration / Website Creation	1	Comprehension of “Theory” and “Specification”	0	3	6	9	9	85
	2	Able to operate equipment properly	1	4	7	10	10	
	3	Work implementation in correct procedure	2	5	8	11	11	
	4	Work implementation with stable quality and speed	3	6	9	12	9	
	5	Basic work implementation with “Quality Control”	4	7	10	13	10	
	6	Basic work implementation with “Work Management”	5	8	11	14	11	
	7	Independent implementation on similar work	6	9	12	15	12	
	8	Independent work implementation of similar work with stable quality and speed	7	10	13	16	13	

Chapter 6 Project Implementation System

6-1. Work Assignments of Study Team Members

The members of the Study Team and the work items assigned to them are shown below.

Table 76 Work Assignments of Study Team Members

Name	Assignment	Work Items
Akira Suzuki	Team Leader/ Planning of Digital Topographic Map Development Project	2nd Term [1] Preparation and discussion of Inception Report 2
		2nd Term [6] Preparation of Interim Report
		2nd Term [7] Explanation and discussion of Interim Report
		2nd Term [9] Preparation of Progress Report 2
		2nd Term [10] Explanation and discussion of Progress Report 2
		2nd Term [13] Preparation and discussion of Draft Final Report
		2nd Term [14] Preparation of Final Report
Akira Ota	Deputy Team Leader/ Assistance for Formulation of Organizational Structure/ Utilization of Geospatial Information	2nd Term [1] Preparation and discussion of Inception Report 2
		2nd Term [6] Preparation of Interim Report
		2nd Term [9] Preparation of Progress Report 2
		2nd Term [11] Assistance for formulation of organizational structure/ utilization of geospatial information
		2nd Term [12] Promotion of Utilization
		2nd Term [14] Preparation of Final Report
		2nd Term [15] Work related to technology transfer
Akira Nishimura	Preparation of Work Specifications	2nd Term [15] Work related to technology transfer
Yoichi Oyama	Digital Aerial Photography Planning/ Aerial Triangulation /Orthophotos (DTM)	2nd Term [15] Work related to technology transfer
Satoru Nishio	Installation of Aerial Signals/ Field Identification/ Supplementary Field Verification	2nd Term [15] Work related to technology transfer
Takeo Sugimoto	Photo Control Point Survey/ Analytical Calculations/ Field Identification/ Supplementary Field Verification	2nd Term [15] Work related to technology transfer
Akira Ota	Digital Plotting	2nd Term [2] Digital plotting/digital editing
		2nd Term [5] Creation of data files
		2nd Term [15] Work related to technology transfer
Ryusuke Nakatani	Digital Editing/ Generalization	2nd Term [2] Digital plotting/digital editing
		2nd Term [5] Creation of data files
		2nd Term [10] Explanation and discussion of Progress Report 2
		2nd Term [13] Preparation and discussion of Draft Final Report
		2nd Term [15] Work related to technology transfer
Wentao Che	GIS Structuration/ Website Creation	2nd Term [4] Digital data structuration
		2nd Term [8] Website creation
		2nd Term [13] Preparation and discussion of Draft Final Report
		2nd Term [15] Work related to technology transfer
Kohei Isobe	Symbolization	2nd Term [3] Symbolization of topographic maps
		2nd Term [10] Explanation and discussion of Progress Report 2
		2nd Term [15] Work related to technology transfer
James Kazumori Watson	Work Coordination / Assistance for Utilization of Geospatial Information	2nd Term [1] Preparation and discussion of Inception Report 2
		2nd Term [11] Assistance for formulation of organizational structure/ utilization of geospatial information
		2nd Term [12] Promotion of utilization
		2nd Term [13] Preparation and discussion of Draft Final Report
		2nd Term [14] Preparation of Final Report

6-2. Project Implementation System

The system of the Study Team to implement this Project is shown below.

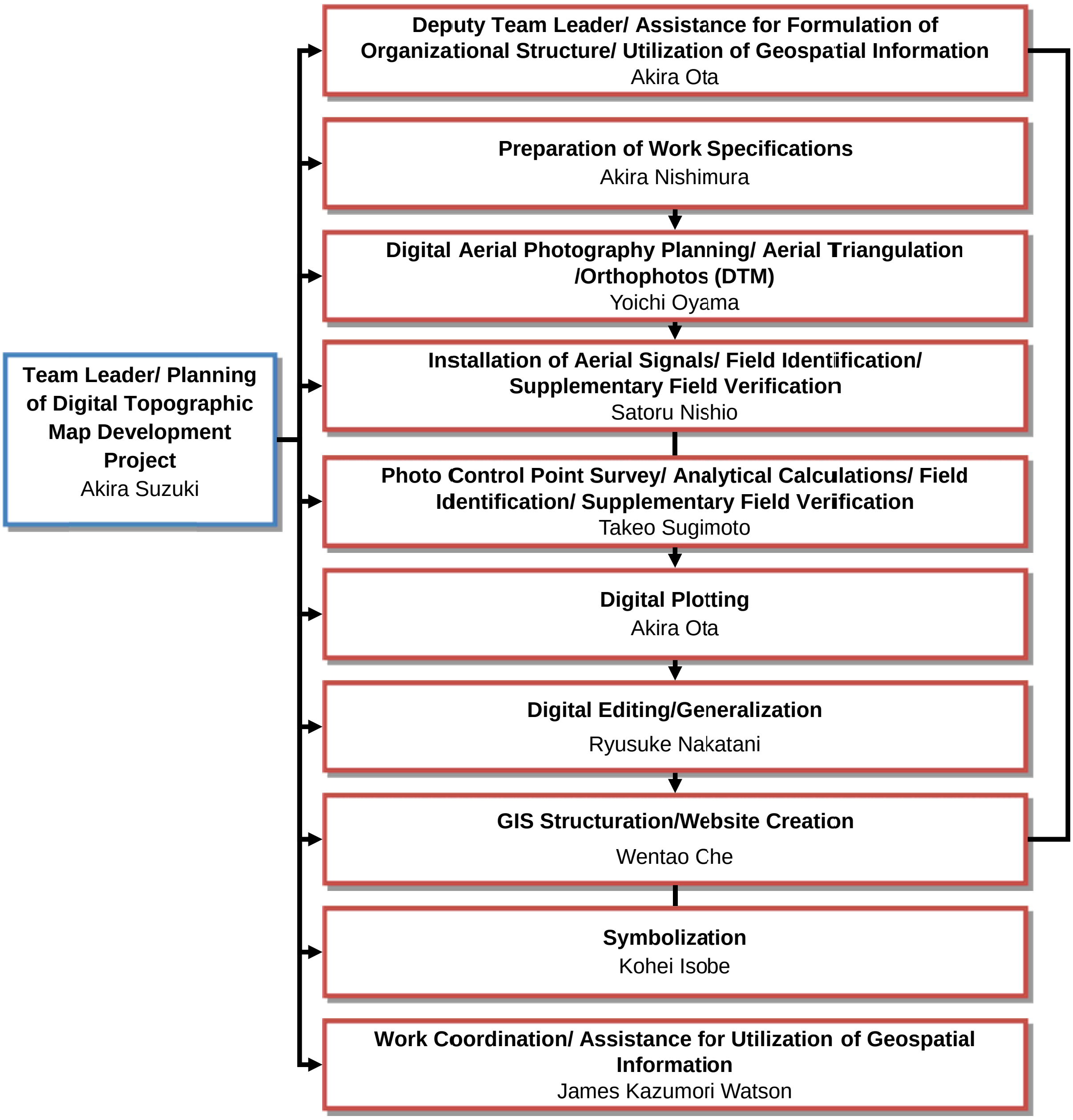


Figure 39 Formulation of Operation Plan and Flow of Implementation/Evaluation

6-3. Personnel Plan for the Study Team

The personnel plan for implementation of the Project is shown below.

Table 77 Personnel Plan

		Phase 1																											Phase 2									M/M					
		1st term							2nd term																													1st term		2nd term		Total	
		2013			2014												2015												2016														
Assignment	Name	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	4	5	6	7	8	9	ET	JP	ET	JP	ET	JP
Work in Ethiopia																																											
Team Leader/Project Planning	**Akira SUZUKI**		30			21					21				15					15		14					24					25				30		**1.70**		**4.80**		**6.50**	
Deputy Team Leader/Organization Formulation Assistance/Geospatial Information Utilization	**Akira OTA**		30																								38									22		**1.00**		**2.00**		**3.00**	
Preparation of Specifications	Akira NISHIMURA		45			60					30		30																									**3.50**		**2.00**		**5.50**	
Digital Aerial Photography Planning/ Digital Aerial Triangulation/ Digital Orthophoto (DTM)	**Yoichi OYAMA**		20									35												35														**0.67**		**2.33**		**3.00**	
Installation of Aerial Signals/ Field Identification/ Supplementary Field Verification	Satoru NISHIO					45												60																				**1.50**		**2.00**		**3.50**	
Photo Control Point Survey/ Analytical Calculations/ Field Identification/ Supplementary Field Verification	Takeo SUGIMOTO					60												60																				**2.00**		**2.00**		**4.00**	
Digital Plotting	Akira OTA											30		60						40				60						40		40						**0.00**		**9.00**		**9.00**	
Digital Editing/ Generalization	Ryusuke NAKATANI														30										45		45							45		45		**0.00**		**7.00**		**7.00**	
GIS Structuration/ Website Creation	Wentao CHE		30								30				30									60												60		**1.00**		**6.00**		**7.00**	
Symbolization	Kohei ISOBE																							45			45						45					**0.00**		**4.50**		**4.50**	
Work Coordination/ Geospatial Information Utilization Assistance	James K. WATSON		30			21					21							27				14						18								46		**1.70**		**4.20**		**5.90**	
																																					Total work in Ethiopia	**13.07**		**45.83**		**58.90**	
Work in Japan																																											
Team Leader/Project Planning	Akira SUZUKI	4					3		3										3							3									3		3		**0.35**		**0.75**		**1.10**
																																					Total work in Japan						
Reports	Submitting period	△ IC/R						△ PR/R	△ IC/R2											△ IT/R							△ PR/R								△ DF/R		△ F/R						
																																					Total	13.42		46.58		60.00	

Legend: Work in Ethiopia (black bar); Work in Japan (grey bar)

Appendix – 1

Minutes of Meeting

on the Inception Report (IC/R) 1

on the Progress Report (PR/R) 1

on the Inception Report (IC/R) 2

on the Interim Report (IT/R)

on the Progress Report (PR/R) 2

on the Draft Final Report (DF/R)

MINUTES OF MEETING

ON

THE INCEPTION REPORT

FOR

THE CAPACITY DEVELOPMENT PROJECT FOR DIGITAL TOPOGRAPHIC MAPPING IN THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

AGREED BETWEEN

ETHIOPIAN MAPPING AGENCY (EMA)

AND

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

ADDIS ABABA

November 25, 2013

Mr. Sultan Mohammed
Director General
Ethiopian Mapping Agency

Mr. Akira SUZUKI
Leader of the Study Team
JAPAN INTERNATIONAL
COOPERATION AGENCY (JICA)

I. Outline

The JICA Study Team (hereafter referred to as "the Study Team") for "The Capacity Development Project for Digital Topographic Mapping" (hereafter referred to as "the project") was dispatched to Addis Ababa, Ethiopia by the Japan International Cooperation Agency (hereafter referred to as "JICA"). The Team was headed by Mr. Akira SUZUKI.

The Study Team commenced the project in Ethiopia from 31st of October 2013, and started the discussion of the project details based on the Inception Report to the Ethiopian Mapping Agency (hereafter referred to as "EMA"). The list of members participated in the discussion are as shown in the Appendix.

II. Contents of Discussion

1. **Project Planning**
   Both organizations agreed upon the detailed plans for the 1st year and general plans for the following years of the project under discussion.

2. **Technology Transfer**
   Both organizations agreed that EMA will dispatch 16 personnel (8 teams of 2 personnel each) for the technology transfer in Field Identification and Supplementary Field Verification.

3. **Procurements**
   EMA requested the establishment of an air conditioner in the room in which technology transfer will be effected, due to the humidity in the rain season, the high temperature and the damage to the equipment from dust. The study team will report this request to JICA.

4. **Survey Standards**
   Both sides agreed that following standard shall be applied as the survey standard in the project.

Item	Standard
Reference Ellipsoid	Clarke 1880 modified a=6378249.1453m f=1/293.4663 b=6356514.9667m
Geodetic Datum	Adindan
Projection Method	UTM (Universal Transverse Mercator) Zone 37
Central Meridian	Long. 39°E
Scale Factor	0.9996 (on central meridian)
Coordinate Origin	Point of intersection of the central meridian and the equator. E=500,000.000m N=0.000m
Transformation Parameter	Δx=-162m, Δy=12m, Δz=206m (WGS 84→Adindan)
Annotation	This digital map was prepared jointly by the Japan International Cooperation Agency (JICA) under the Japanese Government Technical Cooperation Program and Ethiopian Mapping Agency (EMA), the Government of the Federal Democratic Republic of Ethiopia.

Appendix – Members of Discussion

List of Attendants		
	Name	**Position (Affiliated Organization)**
EMA Side	Mr. Sultan Mohammed	Director general (EMA)
	Mr. Ayele Teka	Director of Mapping Directorate (EMA)
	Mr. Girma Habte Giorgis	Director of Surveying Directorate (EMA)
	Mr. Kerlos Latebo	Director of Quality & Standard Directorate (EMA)
JICA Side	Mr. Akira SUZUKI	Team Leader (JICA Study Team)
	Mr. Akira OTA	Deputy Team Leader (JICA Study Team)
	Mr. James Kazumori WATSON	Coordinator (JICA Study Team)

MINUTES OF MEETING

ON

THE PROGRESS REPORT 1

FOR

THE CAPACITY DEVELOPMENT PROJECT FOR DIGITAL TOPOGRAPHIC MAPPING IN THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

AGREED BETWEEN

ETHIOPIAN MAPPING AGENCY (EMA)

AND

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

ADDIS ABABA

July 14, 2014

Mr. Sultan Mohammed	**Mr. Akira SUZUKI**
Director General	**Leader of the Study Team**
Ethiopian Mapping Agency	**JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)**

I. Outline

The JICA Study Team (hereafter referred to as "the Study Team") for the second term of "The Capacity Development Project for Digital Topographic Mapping" (hereafter referred to as "the project") was dispatched to Addis Ababa, Ethiopia by the Japan International Cooperation Agency (hereafter referred to as "JICA"). The Team was headed by Mr. Akira SUZUKI.

The Study Team commenced the project in Ethiopia from June 30, 2014, and started the discussion of the project details based on the Progress Report 1 to the Ethiopian Mapping Agency (hereafter referred to as "EMA"). The list of members participated in the discussion are as shown in the Appendix-1.

II. Contents of Discussion

1. **Implemented work in the first term**

   Both organizations agreed upon the contents implemented in the 1st term.

2. **Procurements in the first term**

   Both organizations agreed that the procurements of equipment for the 1st term by the study team have been completed.

Federal Democratic Republic of Ethiopia
Ethiopian Mapping Agency

Appendix -1

Members of Discussion

List of Attendants		
	Name	**Position (Affiliated Organization)**
EMA Side	Mr. Sultan Mohammed	Director general (EMA)
	Mr. Ayele Teka	Director of Mapping Directorate (EMA)
	Mr. Kerlos Latebo	Director of Quality and Control Directorate (EMA)
	Mr. Gebrealife Assefa	Director of IT Directorate (EMA)
	Mr. Belete Tirfie	Director of Planning and Business Development Directorate (EMA)
	Mr. Habtamu Zewdu	Deputy Director of Communication and Public Relation Directorate (EMA)
	Mr. Dereje Asefa	Coordinator of Change Management
	Ms. Aster Tiruneh	Team Leader of Digital Photogrammetry, Mapping Directorate (EMA)
	Mr. Kassaye Haiile	Team Leader of Digital Cartography, Mapping Directorate (EMA)
	Mr. Abenet Solomon	Team Leader of Digital Ortho Photogrammetry, Mapping Directorate (EMA)
	Mr. Nagasa Mekonen	Team Leader of Large Scale Survey, Survey Directorate (EMA)
	Ms. Beletech Zewdu	Team Leader of Quality Assurance, Quality and Standard Directorate (EMA)
	Ms. Tadelech Tadesse	Team Leader of Quality Control, Quality and Standard Directorate (EMA)
	Ms. Helen Abreha	Team Leader of Database Administration, IT Directorate (EMA)
	Mr. Teferi Waktola	Team Leader of Planning and Project Management, Planning and Business Development Directorate (EMA)
	Ms. Meron Birhane	GIS expert
JICA Side	Mr. Akira SUZUKI	Team Leader (JICA Study Team)
	Mr. Akira NISHIMURA	Discussion of Specifications (JICA Study Team)
	Mr. Wentao CHE	Website creation/Data structuration (JICA Study Team)
	Mr. James Kazumori WATSON	Coordinator (JICA Study Team)

Federal Democratic Republic of Ethiopia
Ethiopian Mapping Agency

MINUTES OF MEETING

ON

THE INCEPTION REPORT 2

FOR

THE CAPACITY DEVELOPMENT PROJECT FOR DIGITAL TOPOGRAPHIC MAPPING IN THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

AGREED BETWEEN

ETHIOPIAN MAPPING AGENCY (EMA)

AND

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

ADDIS ABABA

July 14, 2014

Mr. Sultan Mohammed
Director General
Ethiopian Mapping Agency

Mr. Akira SUZUKI
Leader of the Study Team
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

I. Outline

The JICA Study Team (hereafter referred to as "the Study Team") for the second term of "The Capacity Development Project for Digital Topographic Mapping" (hereafter referred to as "the project") was dispatched to Addis Ababa, Ethiopia by the Japan International Cooperation Agency (hereafter referred to as "JICA"). The Team was headed by Mr. Akira SUZUKI.

The Study Team commenced the project in Ethiopia from June 30, 2014, and started the discussion of the project details based on the Inception Report 2 to the Ethiopian Mapping Agency (hereafter referred to as "EMA"). The list of members participated in the discussion are as shown in the Appendix-1.

II. Contents of Discussion

1. **Project Planning**
   Both organizations agreed upon the detailed plans for the 2nd term and general plans for the following years of the project under discussion.

2. **Technology Transfer**
   Both organizations agreed that EMA will dispatch personnel for the technology transfer items shown in Appendix-2

3. **Procurements**
   Both organizations agreed the item description and it's quantity.

Appendix -1

Members of Discussion

List of Attendants		
	Name	**Position (Affiliated Organization)**
EMA Side	Mr. Sultan Mohammed	Director general (EMA)
	Mr. Ayele Teka	Director of Mapping Directorate (EMA)
	Mr. Kerlos Latebo	Director of Quality and Control Directorate (EMA)
	Mr. Gebrealife Assefa	Director of IT Directorate (EMA)
	Mr. Belete Tirfie	Director of Planning and Business Development Directorate (EMA)
	Mr. Habtamu Zewdu	Deputy Director of Communication and Public Relation Directorate (EMA)
	Mr. Dereje Asefa	Coordinator of Change Management
	Ms. Aster Tiruneh	Team Leader of Digital Photogrammetry, Mapping Directorate (EMA)
	Mr. Kassaye Haiile	Team Leader of Digital Cartography, Mapping Directorate (EMA)
	Mr. Abenet Solomon	Team Leader of Digital Ortho Photogrammetry, Mapping Directorate (EMA)
	Mr. Nagasa Mekonen	Team Leader of Large Scale Survey, Survey Directorate (EMA)
	Ms. Beletech Zewdu	Team Leader of Quality Assurance, Quality and Standard Directorate (EMA)
	Ms. Tadelech Tadesse	Team Leader of Quality Control, Quality and Standard Directorate (EMA)
	Ms. Helen Abreha	Team Leader of Database Administration, IT Directorate (EMA)
	Mr. Teferi Waktola	Team Leader of Planning and Project Management, Planning and Business Development Directorate (EMA)
	Ms. Meron Birhane	GIS expert
JICA Side	Mr. Akira SUZUKI	Team Leader (JICA Study Team)
	Mr. Akira NISHIMURA	Discussion of Specifications (JICA Study Team)
	Mr. Wentao CHE	Website creation/Data structuration (JICA Study Team)
	Mr. James Kazumori WATSON	Coordinator (JICA Study Team)

Appendix-2 Technology Transfer quantity and assignment (Draft)

No.	Item	Skeem	Method	Trainer	Term (mm/dd/yy) From	Term (mm/dd/yy) To	Days	EMA Directorate	EMA Director	EMA Leader	EMA Team	Trainees
1	Organization Formulation	Pickuping Problems Implementation of Operations	Discussion	Akira OTA	11/15/15 08/01/16	12/15/15 08/31/16	(30) (30) 0	Mapping Directorate, Planning & Business Development Directorate	Ayele Teka Belete Tirfie	DG Belete Ayele	EMA EMA EMA	7
2	Geospatial Information Utilization	JCC Seminar Distribution of Mapping	Discussion	Akira OTA	11/15/15 08/01/16	12/15/15 08/31/16	(30) (30) 0	Mapping Directorate, Planning & Business Development Directorate	Ayele Teka Belete Tirfie	DG Belete Ayele	EMA EMA EMA	7
3	Specifications	Work Specifications Map symbols Quality Control manual	Discussion	Akira NISHIMURA	06/30/14 09/01/14	07/17/14 10/09/14	(17) (38) 0	Quality & Standard Directorate, Mapping Directorate	Kerlos Latebou, Ayele Teka	Beleteh Tadeleche	Quality Assurance Quality Checking	6
4	Digital Aerial Photography Planning	Lecture about theory	Microstation, ArcGIS	Yoichi OYAMA	07/30/14 08/03/15	08/31/14 09/03/15	(32) (31) 0	Mapping Directorate	Ayele Teka	Aster	Digital Photogrammetry	6
5	Digital Aerial Triangulation	Lecture about theory	LPS	Yoichi OYAMA	07/30/14 08/03/15	08/31/14 09/03/15	(32) (31) 0	Mapping Directorate	Ayele Teka	Aster	Digital Photogrammetry	6
6	Digital Orthophoto	"Lecture about theory Practice with software"	LPS	Yoichi OYAMA	07/30/14 08/03/15	08/31/14 09/03/15	(32) (31) 0	Mapping Directorate	Ayele Teka	Abunnat	Digital Orthophotogrammetry	6
7	DEM (DSM,DTM)	"Lecture about theory Practice with software"	LPS	Yoichi OYAMA	07/30/14 08/03/15	08/31/14 09/03/15	(32) (31) 0	Mapping Directorate	Ayele Teka	Abunnat	Digital Orthophotogrammetry	6
8	Aerial Signals Installation	Lecture about theory Practice in the Field	***	Satoru NISHIO/ Takeo SUGIMOTO	01/19/15	03/17/15	(57) 0 0	Surveying Directorate	Girma	Birbiraw	Geodetic Survey	8
9	Field Identification	Lecture about theory Practice in the Field	Handy GPS	Completed								
10	Supplymentry Field Verification	Lecture about theory Practice in the Field	Handy GPS	Satoru NISHIO/ Takeo SUGIMOTO	01/19/15	03/17/15	(57) 0 0	Mapping Directorate	Ayele Teka	Israel Getachew	GIS Name Collection	18
11	Control Point Survey	Lecture about theory Practice in the Field	GPS receiver Leica Geo Office	Satoru NISHIO/ Takeo SUGIMOTO	01/19/15	03/17/15	(57) 0 0	Surveying Directorate	Girma	Birbiraw	Geodetic Survey	8
12	Geodetic Network Configuration	Lecture about theory Practice in the Field	GPS receiver Leica Geo Office	Satoru NISHIO/ Takeo SUGIMOTO	01/19/15	03/17/15	(57) 0 0	Surveying Directorate	Girma	Birbiraw	Geodetic Survey	8
13	Digital Plotting	"Lecture about theory Practice with software"	LPS, Microstation	Akira OTA	07/17/14 09/24/14 04/02/15 08/03/15 02/22/16 06/02/16	08/13/14 11/19/14 05/28/15 09/28/15 03/19/16 06/29/16	(27) (56) (56) (56) (26) (27)	Mapping Directorate	Ayele Teka	Aster Abunnat	Digital Photogrammetry Digital Orthophotogrammetry	6
14	Digital Editing	"Lecture about theory Practice with software"	Microstation	Ryusuke NAKATANI	11/17/14 06/02/15 10/20/15 04/02/16 08/02/16	12/12/14 07/29/15 12/14/15 04/29/16 08/29/16	(25) (57) (55) (27) (27)	Mapping Directorate	Ayele Teka	Kassaye Aster	Digital Cartography Digital Photogrammetry	6
15	Generalization	"Lecture about theory Practice with software"	Microstation	Ryusuke NAKATANI	11/17/14 06/02/15 10/19/15 04/02/16 08/02/16	12/12/14 07/29/15 12/13/15 04/29/16 08/29/16	(25) (57) (55) (27) (27)	Mapping Directorate	Ayele Teka	Aster Kassaye Abunnat	Digital Photogrammetry Digital Cartography Digital Orthophotogrammetry	6
16	Data Structuration (CAD -> SHP)	"Lecture about theory Practice with software"	Microstation, ArcGIS	Wentao CHE	06/30/14 11/17/14 08/03/15 07/04/16	07/25/14 12/12/14 09/28/15 08/29/16	(25) (25) (56) (56)	Mapping Directorate	Ayele Teka	Kassaye Aster Abunnat	Digital Cartography Digital Photogrammetry Digital Orthophotogrammetry	6
17	Website Construction	Lecture about theory Discussion about Website design	WEB Server, etc	Wentao CHE	06/30/14 11/17/14 08/03/15 07/04/16	07/25/14 12/12/14 09/28/15 08/29/16	(25) (25) (56) (56)	IT Directorate	Gibra Alife	Helen Tegust	Database Administration	5
18	Symbolization	"Lecture about theory Practice with software"	Microstation	***	05/17/15 11/03/15 05/18/16	06/27/15 12/14/15 06/28/16	(41) (41) (41)	Mapping Directorate	Ayele Teka	Aster Kassaye	Digital Photogrammetry Digital Cartography	5

MINUTES OF MEETING

ON

THE INTERIM REPORT

FOR

THE CAPACITY DEVELOPMENT PROJECT FOR DIGITAL TOPOGRAPHIC MAPPING IN THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

AGREED BETWEEN

ETHIOPIAN MAPPING AGENCY (EMA)

AND

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

ADDIS ABABA
June 11, 2015

Mr. Sultan MOHAMMED	**Mr. Akira SUZUKI**
Director General	**Project Team Leader**
Ethiopian Mapping Agency	**Japan International Cooperation Agency**

I. Outline

The JICA Study Team (hereafter referred to as "the Study Team") for the "The Capacity Development Project for Digital Topographic Mapping" (hereafter referred to as "the project") was dispatched to Addis Ababa, Ethiopia by the Japan International Cooperation Agency (hereafter referred to as "JICA").

The Study Team started led by Mr. Akira SUZUKI began the mission from June 1st, 2015, for the explanation on the contents of the Interim Report to the following members of the Ethiopian Mapping Agency (hereafter referred as "EMA"), shown in Attachment-1.

II. Contents of Discussion

The following major content was explained and agreed between the Study Team and EMA.

1. Work in Progress and planned work

Both organizations agreed upon the progress in the 2nd term and general plans for the following years of the project.

2. Technology Transfer

Both organizations agreed that EMA will continuously dispatch trainee personnel for the technology transfer.

3. Procurements

Both organizations agreed the quantity of procured items and items which are planned to be procured.

Attachment -1

Members of Discussion

List of Attendants		
EMA side	Mr. Sultan Mohammed	Director General
	Mr. Ayele Teka	Mapping Director
	Mr. Kerlos Latebo	Quality and Control Director
JICA side	Mr. Akira SUZUKI	Project Team Leader
	Mr. James K. Watson	Coordinator

MINUTES OF MEETING

ON

THE PROGRESS REPORT 2

FOR

THE CAPACITY DEVELOPMENT PROJECT FOR DIGITAL TOPOGRAPHIC MAPPING IN THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

AGREED BETWEEN

ETHIOPIAN MAPPING AGENCY (EMA)

AND

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

ADDIS ABABA
December 11, 2015

Mr. Ayele Teka
Mapping Director
Ethiopian Mapping Agency

Mr. Akira SUZUKI
Project Team Leader
Japan International Cooperation Agency

I. Outline

The JICA Study Team (hereafter referred to as "the Study Team") for the "The Capacity Development Project for Digital Topographic Mapping" (hereafter referred to as "the project") was dispatched to Addis Ababa, Ethiopia by the Japan International Cooperation Agency (hereafter referred to as "JICA").

The Study Team started led by Mr. Akira SUZUKI began the mission from November 25, 2015, for the explanation on the contents of the Progress Report 2 to the following members of the Ethiopian Mapping Agency (hereafter referred as "EMA"), shown in Attachment-1.

II. Contents of Discussion

The following major content was explained and agreed between the Study Team and EMA.

1. Completed work, Work in Progress and planned work

Both organizations agreed upon the implemented work progress for the 1st phase and the planned work items in the 2nd phase.

2. Technology Transfer

Both organizations agreed that the progress on technology transfer is according to schedule. The study team has received a request from EMA to evaluate the technology transfer progress with quantitative measurements.

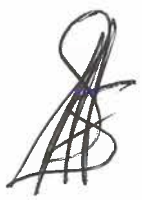
3. Joint coordinating committee

The contents discussed in the 3rd joint coordinating committee were agreed by both parties according to the minutes of meeting.

Attachment -1

Members of Discussion

List of Attendants		
EMA side	Mr. Ayele Teka	Mapping Director
	Mr. Kerlos Latebo	Quality and Control Director
JICA side	Mr. Akira SUZUKI	Project Team Leader
	Mr. James K. Watson	Coordinator



MINUTES OF MEETING

ON

THE DRAFT FINAL REPORT

FOR

THE CAPACITY DEVELOPMENT PROJECT FOR DIGITAL TOPOGRAPHIC MAPPING IN THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

AGREED BETWEEN

ETHIOPIAN MAPPING AGENCY (EMA)

AND

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

ADDIS ABABA
August 12, 2016

Mr. Sultan MOHAMMED	**Mr. Akira SUZUKI**
Director General	**Project Team Leader**
Ethiopian Mapping Agency	**Japan International Cooperation Agency**

I. Outline

The JICA Study Team (hereafter referred to as "the Study Team") for the "The Capacity Development Project for Digital Topographic Mapping" (hereafter referred to as "the project") was dispatched to Addis Ababa, Ethiopia by the Japan International Cooperation Agency (hereafter referred to as "JICA").

The Study Team started led by Mr. Akira SUZUKI began the mission from July 22, 2016, for the explanation on the contents of the Draft Final Report to the following members of the Ethiopian Mapping Agency (hereafter referred as "EMA"), shown in Attachment-1.

II. Contents of Discussion

The following major content was explained and agreed between the Study Team and EMA.

1. Work in Progress and planned work

Both organizations agreed upon the progress and completion in the 2nd term and general plans for the following phase of the project.

The following information must be updated based on the latest and agreed symbol regulation:

- P.20 Table.21, "Number of Topography and Features"

2. Technology Transfer

Both organizations agreed to the results and the evaluation of completed technology transfer.

3. Procurements

Both organizations agreed the quantity of procured equipment, hardware and software.

4. Recommendations for following phase

The study team has explained the proposed recommendation for the following phase to EMA.

Attachment -1

Members of Discussion

List of Attendants		
EMA	Mr. Sultan Mohammed	Director General
	Mr. Ayele Teka	Mapping Director
	Mr. Kerlos Latebo	Quality and Control Director
	Mr. Girma Habtegiorgis	Surveying Director
JICA study team	Mr. Akira SUZUKI	Project Manager
	Mr. Akira OTA	Deputy Project Manager
	Mr. Ryusuke NAKATANI	Map Editing Trainer
	Mr. James K. Watson	Coordinator

Appendix – 2

Minutes of Meeting

on the Joint Coordinating Committee

MINUTES OF MEETING

ON

THE JOINT COORDINATING COMMITTEE

FOR

THE CAPACITY DEVELOPMENT PROJECT FOR DIGITAL TOPOGRAPHIC MAPPING IN THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

AGREED UPON BETWEEN

ETHIOPIAN MAPPING AGENCY (EMA)

AND

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

ADDIS ABABA

15th July 2014

Mr. Sultan Mohammed
Director General
Ethiopian Mapping Agency

Mr. Kimiaki JIN
Chief Representative
Japan International Cooperation Agency Ethiopia Office

Mr. Akira SUZUKI
Leader of the Study Team
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

Ⅰ.Outline

Regarding to The Capacity Development Project for Digital Topographic Mapping, the Ethiopian Mapping Agency (hereby referred as EMA), Japan International Cooperation Agency (hereby referred as JICA) and the study team had jointly held the 2nd Joint Coordinating Committee on July 15th, 2014 in EMA office.

The attendance of the meeting is shown in the Attachment-1.

The contents of the meeting are shown as below.

Ⅱ. Contents

1. Work plan of the project

The study team explained the following contents to the attendant:

2. Implemented work reports

The study team reported the work that had been implemented in the term from November 2013 to the present period.

3. The report on utilization of GIS and digital map data

Data and utilization examples of the project site, data distribution regulations and copyright regulations of Japan were reported by the study team.

4. Selection of pilot area

EMA and the study team shown a candidate area for the pilot project, which is:

a. An area of approx. 190km^2 which include the town of Welenchiti

b. An area of approx. 190km^2 which include the town of Dera

5. Comments

The following comments from several organizations were made:

< Related to the website >

EMA: The data distribution on internet website will be possible with using the new web server, which will be established in a few months.

Study team: The website which will be established is for this project under EMA intranet, though it is possible to link the mentioned server and distribute the data through internet. Distribution regulations must be established by EMA and it will be notified to the JCC committee members.

< Related to the selection of pilot area >

JICA: Suggestion on the possibility to include the new airport planned area in to the candidate for the selection of pilot area.

MOT: The present status of the selection of the new airport is still under study, and the final decision will be announced around the end of 2015.

Study team: JICA and EMA will continue the discussion for pilot area selection, including the new airport area and all other possibilities will be seen in the future.

Appendix - 1. Attendance list

List of Attendance		
NAME	**Position**	**Organization**
Mr. Baselfew Zenebe	Senior Geoscientist	Geological Survey of Ethiopia
Mr. Dereje Girma	Senior Expert	Ministry of Finance and Economical Development
Mr. Atnafseged Kifle	Advisor	Ministry of Transport
Mr. Kimiaki Jin	Chief Representative	JICA
Mr. Yuichi Ichikawa	Assistant Representative	JICA
Ms. Abebawork Abebe	Program Officer	JICA
Mr. Sultan Mohammed	Director General	EMA
Mr. Ayele Teka	Mapping Directorate Director	EMA
Mr. Girma Habtegiorgis	Survey Directorate Director	EMA
Mr. Kerlos Latebo	Quality & Standard Directorate Director	EMA
Ms. Mebrat Samuel	Remote sensing and GIS Directorate Director	EMA
Mr. Habtamu Zewedu	PR & Communication Directorate Deputy Director	EMA
Ms. Aster Tiruneh	Digital Photogrammetry Team Leader	EMA
Mr. Tefferi Waktola	Planning & Project team leader	EMA
Mr. Dereje Assefa	Coordinator	EMA
Ms. Helen Abrha	Database team leader	EMA
Mr. Akira SUZUKI	Team leader	Study team
Mr. Akira NISHIMURA	Discussion of Specification	Study team
Mr. Wentao CHE	Data structuration/website construction	Study team
Mr. James WATSON	Coordinator	Study team

MINUTES OF MEETING

ON

THE JOINT COORDINATING COMMITTEE

FOR

THE CAPACITY DEVELOPMENT PROJECT FOR DIGITAL TOPOGRAPHIC MAPPING IN THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

AGREED UPON BETWEEN

ETHIOPIAN MAPPING AGENCY (EMA)

AND

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

ADDIS ABABA
JUNE 11, 2015

Mr. Sultan MOHAMMED	Mr. Takusaburo KIMURA
Director General	Senior Representative
Ethiopian Mapping Agency	Japan International Cooperation Agency

Japan International Cooperation Agency

鈴木平三

Mr. Akira SUZUKI
Project Team Leader
Japan International Cooperation Agency

I. Outline

Regarding to The Capacity Development Project for Digital Topographic Mapping, the Ethiopian Mapping Agency (hereby referred as EMA), Japan International Cooperation Agency (hereby referred as JICA) and the study team had jointly held the 3rd Joint Coordinating Committee on June 9th, 2015 in EMA office.

The attendance of the meeting is shown in the Attachment-1.

The contents of the meeting are shown as below.

II. Contents

The study team explained the following contents to the attendant.

1. Opening Speech

Upon the opening of the 3rd JCC meeting, Mr. Sultan Mohammed the Director General of The Ethiopian Mapping Agency made an opening address to the participants.

2. Project Introduction

The study team has explained the overall of the Project.

3. Implemented work reports

The study team reported the completed work and remaining work under progress, which is as scheduled.

4. The report on Mapping work in Japan

The Study team has reported the mapping work progress which is processed in Japan.

5. Work on Tourist Map

EMA has reported the progress on the creation of the Tourist Map of Adama.

6. Report on EMA WEB Portal Site

EMA demonstrated the new Geo portal site which will be connected with the Server installed for the project to disseminate the project output in the future.

- Land cover map of Ethiopia (2003) is available for free.

7. Comments, Questions and Answers from participants

Mr. Kimura: What kind of users is assessed to use the new web portal?

Mr. Sultan: The target of this portal is to let all people know what kind of data is available in EMA, not to limit or to reduce the access but to open to all users, as easy to use and visualized available data which will be categorized as free for charge.

- The payment system or pricing categorize is not yet finalized.

Mr. Kimura: As the tourist map is using data created by this project, is it possible to put JICA logo in the map? We hope these tourist maps will be created in other cities in the future.

Mr. Sultan: We would be beloved to put JICA logo in the tourist map with JICA's further assistance in creation.

- EMA requested to JICA on the support to finalize the Adama city tourist map.

Mr. Kimura: We need to know more detailed information about the progress of capacity building is made, such as the personnel, achievement and challenges.

Mr. Suzuki: The study team will apply the request to the next report and JCC.

Mr. Ayele: The number of EMA trainee is as followed:

Technology Transfer Items	Quantity
Field Identification	18
Field Verification	18
GCP Surveying	12
Aerial Signal Installation	12
Aerial Triangulation	4
Aerial Photography Planning	4
Orthophoto DTM Creation	4
Digital Plotting	6
Digital Editing	10
Symbolization	Starting from July 2015
GIS Structuration	3
Website Creation	3

Mr. Solomon: As the 1st phase will be accomplished in the end of this year, we want to see how EMA's capacity is built. Also, we suggest that the capacity building will be documented for spreading the knowledge internally and externally.
How frequently will the web portal be updated?

Mr. Sultan: EMA will have full transition with the capacity to create digital topographic maps, both in human and environment resource from the technology transfer and equipment procured from JICA through this project. In each technology transfer items, all will be documented so that the trainees can be the trainers and transfer the knowledge to others including engineers from other organizations. EMA's future vision is to establish a training center like K.I.S.M in Kenya, for the development of GIS and Mapping technology.

- The web portal update will be operated regularly from our IT directorate team. First we are planning to start by announcing free data download.

Mr. Sabit: I also am excited to see EMA's transition, and wiling to see the capacity development in a visualized way.
Does the technology transfer include satellite image processing?

Mr. Suzuki: Yes, it is included. The study team is using EMA's existing aerial image and newly acquired satellite image from JICA, and merged it to orthophoto image. The image processing methods are in the contents of technology transfer and required equipment procured by JICA.

Mr. Zelihune: Land use and land cover information should be included in the Adama city tourist map.
Do EMA have capacity to secure the data for your portal site?

Mr. Sultan: Data security, copyright and distribution policy is under discussion with INSA.

Mr. Ichikawa: We suggest EMA to take cooperation with other related organizations to create tourist map in the 23 cities.
Is the Adama tourist map able to be downloaded via internet?
We suggest project(EMA and Study team) to make awareness creation and invite more organizations to the continuing JCC meeting.

Mr. Sultan: The objective of the 23 city mapping is to create cadastral information. The tourist map is a secondary product from this and it is not the main target. Though we are planning to create more tourist maps in the future and we will take coordination with relative organizations such as the Ministry of Tourism and so on. In the next JCC we hope we can invite not only the main data users from this project, but organizations that are related to EMA's entire work.

8. Summary of Discussed Topics

A) EMA's new web portal site

- The capacity in EMA to manage (upload, update and secure) the data
- The establishment of data distribution policy

B) Technology Transfer

- Detailed information such as contents, achievement, evaluation and remaining challenges should be explained
- The results of the technology transfer should be spread to other staffs and related organization
- The expectations to EMA after capacity building

C) Tourist map

- Plan to create tourist maps for the 23 major cities with the Adama city tourist map as a model case.

9. Closing Speech

Mr. Takusaburo Kimura, Senior Chief Representative of JICA Ethiopia Office closed the meeting with his appreciation to all participants and the expectation to the fruitful meeting for the continuing JCC meetings.

Attachment - 1

Attendance List

	Name	Organization
1	Mr. Solomon Kebede	The Federal Urban Land and Land Related Property Registration and Information Agency, Ministry of Urban Development and Construction
2	Mr. Sabit Yasin Mohammed	Federal Integrated Urban Land Information P.O., Ministry of Urban Development and Construction
3	Mr. Yohanes Reddo	LAUD, Ministry of Agriculture
4	Mr. Dereje Bekele	East Showa Zone Urban Land Management Office
5	Mr. Zerihune Feyra	Oromia Integrated Urban Land Information System P.O.
6	Mr. Yedessa Dinssa	Oromia Regional Government Bureau of Rural Land and Environmental Protection
7	Mr. Zerai Hadera	Ethiopian Road Authority
8	Mr. Sultan Mohammed	Ethiopian Mapping Agency
9	Mr. Ayele Teka	Ethiopian Mapping Agency
10	Ms. Mebrate Samuel	Ethiopian Mapping Agency
11	Mr. Tefferi Waktola	Ethiopian Mapping Agency
12	Mr. Gezaegre G. Meskel	Ethiopian Mapping Agency
13	Mr. Israel Gebremeskel	Ethiopian Mapping Agency
14	Mr. Abebe Dubisa	Ethiopian Mapping Agency
15	Mr. Karlos Latebo	Ethiopian Mapping Agency
16	Mr. Gebra Alif Assefa	Ethiopian Mapping Agency
17	Mr. Escinolin Yiman	Ethiopian Mapping Agency
18	Mr. Takusaburo Kimura	Japan International Cooperation Agency
19	Mr. Yuichi Ichikawa	Japan International Cooperation Agency
20	Ms. Addisalem Ambaye	Japan International Cooperation Agency
21	Mr. Takuji Anata	Japan International Cooperation Agency
22	Mr. Akira Suzuki	JICA Study Team
23	Mr. James K. Watson	JICA Study Team

MINUTES OF MEETING

ON

THE JOINT COORDINATING COMMITTEE

FOR

THE CAPACITY DEVELOPMENT PROJECT FOR DIGITAL TOPOGRAPHIC MAPPING IN THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

AGREED UPON BETWEEN

ETHIOPIAN MAPPING AGENCY (EMA)

AND

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

ADDIS ABABA
DECEMBER 3, 2015

Mr. Ayele TEKA
Mapping Director
Ethiopian Mapping Agency

Mr. Kimiaki JIN
Chief Representative
Japan International Cooperation Agency

Japan International Cooperation Agency
1

鈴木平三

Mr. Akira SUZUKI
Project Team Leader
Japan International Cooperation Agency

I. Outline

Regarding to The Capacity Development Project for Digital Topographic Mapping, the Ethiopian Mapping Agency (hereby referred as EMA), Japan International Cooperation Agency (hereby referred as JICA) and the study team had jointly held the 4th Joint Coordinating Committee on December 3rd, 2015 in EMA office.

The attendance of the meeting is shown in the Attachment-1.

The contents of the meeting are shown as below.

II. Contents

1. Opening Speech

Upon the opening of the 4th JCC meeting, Mr. Sultan Mohammed the Director General of EMA made an opening address to the participants.

2. Introduction of JCC members

Attended JCC members have made self-introduction.

3. Project Introduction

Mr. Akira SUZUKI, from JICA study team has explained the implemented activities and planned targets of the project.

- Implemented activities
- Mapping work in Japan

4. Technology Transfer report

Mr. Kassaye Hailu, from EMA has reported the current status and planned technology transfer activities on digital topographic mapping which is implemented by Japanese experts to EMA staffs.

5. Presentation and discussion on utilization

Mr. Akira OTA, from JICA study team has made a presentation with the following topics related to product utilization.

- 1/10,000 topographic map utilization
- GIS data utilization
- Data sharing for efficient coordination between organizations

6. Product and Data distribution perspective by EMA

Mr. Ayele Teka, from EMA presented its organization's mandate, existing products and future plan of digital data sharing with formulation of policy and efficient usage. In the presentation the analog map distribution method and cost has been explained concerning the digital map data sharing policy will be presented based on NSDI framework.

7. Comments, Questions and Answers from participants

Mr. Wubished (MOWIE):

I understand the 1/10,000 utilization will be highly useful for planning issues. Not only Adama but in the future, some potential sites must be selected for similar mapping projects.

From Mr. Ayele's presentation, I noticed that some areas of Addis Ababa will be mapped using new satellites image. Why is not that possible to plan and update the whole area?

Technology transfer and capacity building is looking good progress. JICA project product is shown that data sharing will only by PDF format, PDF is not useful for software, do you have any plan to distribute vector data?

I think the production of tourist maps main target is to promote the tourist industry and not for cost recovery, how do you think?

Mr. Demeke (NPC):

Now I have understood that the products from this project contain lots of useful information for utilization. The technology and knowledge that have been transferred to EMA must be transferred not only to the selected staffs, but to more other staffs in EMA. How do you think to lead this issue to success?

Mr. Sultan (EMA)

MOA is now starting to plan a 0.15 to 0.4cm GSD aerial imaging for potential areas.

Concerning JICA project data, EMA will upload PDF format to our geo-portal and this will be free of charge, of course the vector data is existing and it will be available for distribution, though the price is planned to be fixed in first half of 2016.

The Addis Ababa update work is a pilot project for the engineers, founded by JICA. The target is not to cover the whole city, but to update the rapid development area.

The JICA project tourist map's price setting is based only by the printing cost; the raster data will be available in our portal site.

This project's main target is not only to produce maps. It is to build EMA's capacity for 1/10,000 topographic mapping in the three phases. Phase 1 is to transfer technology, EMA will conduct a pilot project in Phase 2, and phase 3 is for follow up assistance. After these three phases are completed, I believe the technology transfer will be successful.

Ms. Abebawork (JICA):

I noticed that EMA is looking for a distributor for the tourist map, though as an initial matter, most of Ethiopians do not understand the importance of geo-spatial information. So awareness creation must be made.

Mr. Sultan (EMA):

First we are thinking to start in collaboration with the ministry of education, and provide school atlas for awareness creation starting from young generations. Also, with the support of NPC, we can advocate the importance of Geospatial Information to the people.

Mr. Demeke (NPC):

Not only the understanding but also Software, hardware and man power is necessary for GI utilization. We will like to continuously support EMA to build its capacity.

8. Summary of Discussed Topics

- EMA's Data distribution method
- Mapping projects for Potential sites
- Pilot project for Addis Ababa
- Cost of tourist maps
- Technology transfer within EMA
- Awareness creation for map users

9. Closing Speech

Mr. Kimiaki JIN, Chief Representative of JICA Ethiopia Office closed the meeting with his appreciation to all participants and the expectation to the fruitful meeting for the continuing and final JCC meetings.

Attachment - 1

Attendance List

	Name	Organization
1	Mr. Mofu Abraham	Oromia Regional Government Bureau of Rural Land and Environmental Protection
2	Ms. Meeraph Habtemold	The Federal Urban Land and Land Related Property Registration and Information Agency, Ministry of Urban Development and Construction
3	Mr. Zerhi Hadera	Ethiopian Road Authority
4	Mr. Wubished Demeke	Ministry of Water Irrigation and Electricity
5	Mr. Demeke Tsehay	National Planning Commission
6	Mr. Sultan Mohammed	Ethiopian Mapping Agency
7	Mr. Ayele Teka	Ethiopian Mapping Agency
8	Mr. Girma H/Giorgis	Ethiopian Mapping Agency
9	Mr. Karlos Latebo	Ethiopian Mapping Agency
10	Mr. Gezaegre G. Meskel	Ethiopian Mapping Agency
11	Ms. Mebrate Samuel	Ethiopian Mapping Agency
12	Ms. Astel Firuneh	Ethiopian Mapping Agency
13	Mr. Kassaye Hailu	Ethiopian Mapping Agency
14	Mr. Dereje Assefa	Ethiopian Mapping Agency
15	Mr. Habtamu Leudu	Ethiopian Mapping Agency
16	Mr. Zelalem Masnlu	Ethiopian Mapping Agency
17	Mr. Tefferi Waktola	Ethiopian Mapping Agency
18	Mr. Fikelte Abebe	Ethiopian Mapping Agency
19	Mr. Kazuhiko Sasaki	Japan Embassy
20	Mr. Kimiaki Jin	Japan International Cooperation Agency
21	Mr. Yuichi Ichikawa	Japan International Cooperation Agency
22	Ms. Abebawork Abebe	Japan International Cooperation Agency
23	Mr. Akira Suzuki	JICA Study Team
24	Mr. Akira Ota	JICA Study Team
25	Mr. Kohei Isobe	JICA Study Team
26	Mr. Ryusuke Nakatani	JICA Study Team
27	Mr. James K. Watson	JICA Study Team

MINUTES OF MEETING

ON

THE JOINT COORDINATING COMMITTEE

FOR

THE CAPACITY DEVELOPMENT PROJECT FOR DIGITAL TOPOGRAPHIC MAPPING IN THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

AGREED UPON BETWEEN

ETHIOPIAN MAPPING AGENCY (EMA)

AND

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

ADDIS ABABA
July 29, 2016

Mr. Sultan Mohammed
Director General
Ethiopian Mapping Agency

松山剛士

Mr. Takeshi MATSUYAMA
Senior Representative
Japan International Cooperation Agency

鈴木平三

Mr. Akira SUZUKI
Project Team Leader
Japan International Cooperation Agency

I. Outline

Regarding to The Capacity Development Project for Digital Topographic Mapping, the Ethiopian Mapping Agency (hereby referred as EMA), Japan International Cooperation Agency (hereby referred as JICA) and the study team had jointly held the 5th Joint Coordinating Committee on July 26th, 2016 in EMA office.

The attendance of the meeting is shown in the Attachment-1.

The contents of the meeting are shown as below.

II. Contents

1. Opening Speech

Upon the opening of the 5th JCC meeting, Mr. Sultan Mohammed the Director General of EMA made an opening address to the participants.

2. Introduction of JCC members

Attended JCC members have made self-introduction.

3. Introduction

Mr. Akira SUZUKI, from JICA study team has explained the outline of the project, implemented activities and the target to opening JCC meetings to the participants.

4. Technology Transfer report and future vision

Mr. Ayele Teka, from EMA has reported the technology transfer activities on digital topographic mapping which is implemented by Japanese experts to EMA staffs. In addition, he also made a presentation about EMA's history, status and future plan of map production and dissemination.

5. Deliverables and utilization

Mr. Wentao CHE, from JICA study team has made a presentation about JICA project products and demonstrated GIS models and web publication for utilization. The presentation was specified on:

- project deliverables
- GIS sample models
- Data publication from EMA Geo-portal
- Internal data sharing within the organization

6. Comments, Questions and Answers from participants

Q: Mr. Befekadu Oluma, Geological Survey of Ethiopia

1. What is the cause of restriction of open data?
2. EMA is working on "Analog to Digital conversion of existing 1/50,000" works. Did this data become any help for the map production in JICA project?
3. How long will it take to produce large scale map for the country?

A: Mr. Sultan Mohammed, EMA

1. We need to designate useful archive open to the public by the skill based on JICA training. Digital data distribution will be set by EMA at 1st stage, the categorization will be free to access/restricted (meaning special request from Gov. Organization permit) and, free of charge/with payment. Then nationwide regulations based on NSDI will be established. We are planning to sell maps via internet using e-payment. Planning to make available EMA's product too.

A: Mr. Sultan Mohammed, EMA

3. 1/50,000 will be the topographic base map of Ethiopia. For high development area will be produced in larger scale. Such as Adama with infrastructure and Agriculture priorities (as a pilot area).

A: Mr. Akira Suzuki, JICA study team

3. We think Addis Ababa 1/5,000 is the most priority for now.

A: Mr. Ayele Teka, EMA

3. We are not planning to complete whole country with 1/10,000. Rather to select a development corridor to produce the time taking and expensive large scale map.

A: Mr. James Watson, JICA study team (answered after the session)

2. We did not use any existing map data for this project, due to the expiry of it which our target is to produce "up to date" maps, and the accuracy.

7. Closing Speech

Mr. Takeshi MATSUYAMA, Senior Representative of JICA Ethiopia Office closed the meeting with his appreciation to all participants attending to the meeting and for the fruitful final JCC meeting. He also expressed his hope to continuously support EMA in the coming 3rd phase, to further strengthen the agency capacity.

Attachment - 1

Attendance List

Name		Organization
1	Mr. Bamlaku Yilikai	Ethiopian Road Authority
2	Mr. Yohannes Teshome	National Planning Commission
3	Mr. Befekadu Oluma	Geological Survey of Ethiopia
4	Mr. Aman Muda	Oromia Rural Land Administration Bureau
5	Mr. Sultan Mohammed	Ethiopian Mapping Agency
6	Mr. Ayele Teka	Ethiopian Mapping Agency
7	Mr. Girma H/Giorgis	Ethiopian Mapping Agency
8	Mr. Karlos Latebo	Ethiopian Mapping Agency
9	Mr. Dereje Assefa	Ethiopian Mapping Agency
10	Ms. Astel Firuneh	Ethiopian Mapping Agency
11	Mr. Eskindir Ximam	Ethiopian Mapping Agency
12	Ms. Mebrate Samuel	Ethiopian Mapping Agency
13	Mr. Israel Gebremeskel	Ethiopian Mapping Agency
14	Mr. Abebe Dibiaz	Ethiopian Mapping Agency
15	Mr. Tefferi Waktola	Ethiopian Mapping Agency
16	Mr. Takeshi Matsuyama	Japan International Cooperation Agency
17	Mr. Gaku Saito	Japan International Cooperation Agency
18	Ms. Abebawork Abebe	Japan International Cooperation Agency
19	Mr. Akira Suzuki	JICA Study Team
20	Mr. Akira Ota	JICA Study Team
21	Mr. Wentao Che	JICA Study Team
22	Mr. Ryusuke Nakatani	JICA Study Team
23	Mr. James K. Watson	JICA Study Team
24		
25		
27		

Appendix – 3

Quality Control Report

Japan International Cooperation Agency (JICA)
Ethiopian Mapping Agency (EMA)

QUALITY CONTROL REPORT

September, 2016

Ethiopian Mapping Agency

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Chapter 1. QUALITY CONTROL REPORT

1.1. DEFINITIONS OF QUALITY CONTROL

In this “Quality Control Report” , method and criteria, result are described about “Quality Control” which is implemented based on the ”Accuracy Control Implementation/Accuracy Control Table Preparation Manual” in “The Capacity Development Project for Digital Topographic Mapping in the Federal Democratic Republic of Ethiopia”.

1.2. TARGET OF QUALITY CONTROL

Quality Control was implemented for following works.

1	Aerial Triangulation
2	Digital Plotting
3	Digital Editing / Digital Completion
4	Map symbolization
5	Data Structurization

Chapter 2. Quality Control in Each Work

2.1. Aerial Triangulation

2.1.1. Outline of the Target Area

(1) Existing photography area and block allocation

The target area locates in the south of Addis Ababa and there are some urban areas such as Nazret (Adama), Mojo in the middle of area. The Photography area is separated into 6 blocks and Aerial Triangulation was implemented block by block.

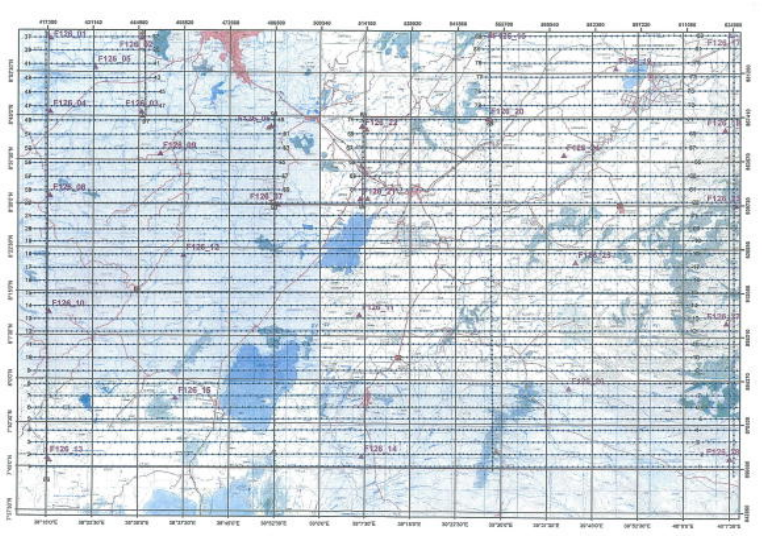


Figure 1 Photography Area

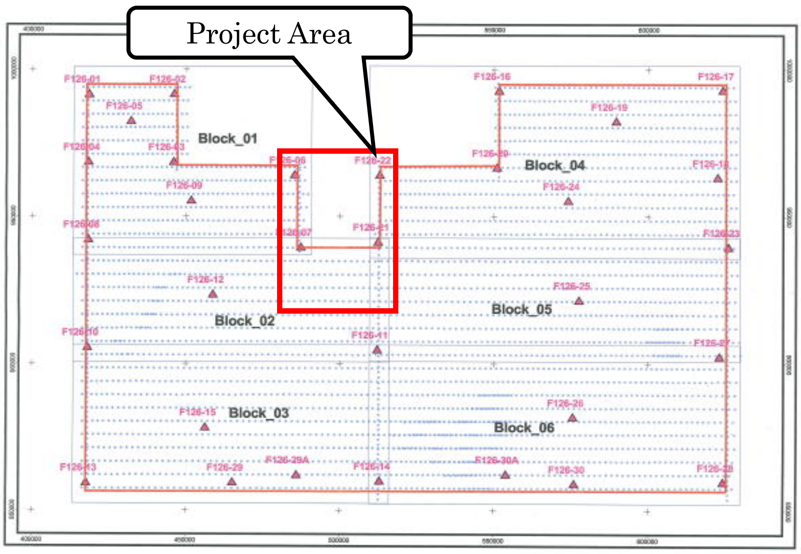


Figure 2 Block allocation for Aerial Triangulation

(2) Target blocks in this project

Each block has 5 GCPs (GCP: Ground Control Point) on the 4 corners and center of a block. 2 GCPs are shared in duplicate area between neighboring blocks, and 1 band is duplicated between neighboring blocks of North – South direction.

This project area is covered by Blok4 and Block5, therefore the study team verified the result of Aerial triangulation implemented by EMA and judged the accuracy is acceptable for 1/10,000 topographic map creation.

2.1.2. OUTLINE OF EXISTING AERIAL TRIANGULATION RESULTS (BLOCK4, 5)

(1) Block 4

Block4 composed with following specifications. There is a report of Aerial triangulation using 8 GCPs from EMA.

Table 1 Specification of Block 4

Location:	Northern Eastern part in the whole photography area
Flight course:	17 flight courses (14 courses: east - west direction, 3 courses: north – south direction)
Aerial photos:	817
Flight Scale:	1/63,097
Flight Height:	1640m
GCP:	8 points

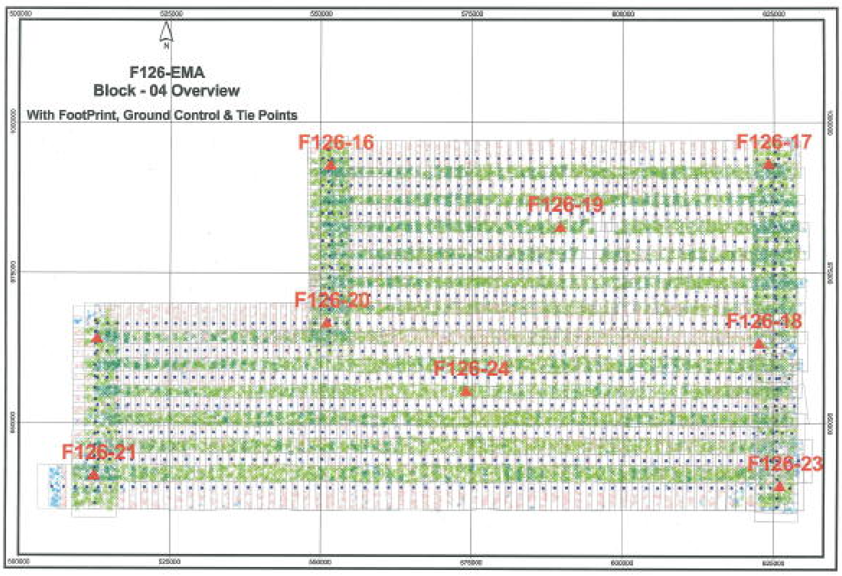


Figure 3 Block 4

(2) Block 5

Block 5 composed with following specifications. There is a report of Aerial triangulation using 8 GCPs from EMA.

Table 2 Specification of Block 5

Location:	Northern Eastern part in the whole photography area
Flight course:	24 flight courses (more than 13 courses: east - west direction, more than 3 courses: north – south direction)
Aerial photos:	797
Flight Scale:	1/67,809
Flight Height:	1995m
GCP:	5 points

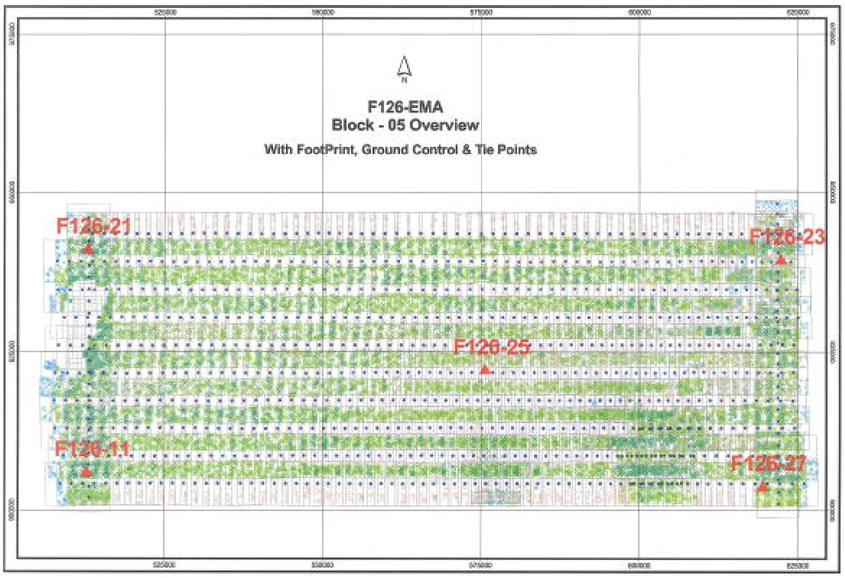


Figure 4 Block 5

2.1.3. VERIFICATION OF EXISTING AERIAL TRIANGULATION RESULTS (BLOCK 4, 5)

(1) Verification by "Accuracy Control Table"

The study team verified about block 4 and block 5 by "Accuracy Control Table" prepared from the report of Aerial triangulation from EMA.

"Acceptable Range" is referred to"Article117" in the "SURVEY WORK REGULATION".

Table 3　Accuracy Control Table of Block4

Accuracy Control Table for Aerial Triangulation

Project Name	Work Volume (Numb of Course and Photo)	Adjustment Method	Work Period	Name of Work Agency	Chief Engineer	Inspector
BLOCK 4	17 / 817	Bundle Method	From 2013 8 22 / To 2013 8 22	JICA	A. Suzuki	Y. Oyama

Course Number	Flying Height (m)	Photo Number	Number of Control Points: Horizontal Position (points)	Number of Control Points: Height (points)	Number of Control Points Excepted for Calculation: Horizontal Position (points)	Number of Control Points Excepted for Calculation: Height (points)	Difference of Inspected Point at Inspection / All Points except Fixed Point: Point Name	Difference: Horizontal Position (m)	Difference: Height (m)	Residual at Control Points at Final Adjustment (Weight0 in lower stand): Point Name	Residual: Horizontal Position (m)	Residual: Height (m)	Intersection Residual for Tie Points (Weight0 in lower stand) X: Standards Deviation (μm)	X: Max (μm)	Y: Standards Deviation (μm)	Y: Max (μm)	XY: Standards Deviation (μm)	XY: Max (μm)
1	6341	001～047	8	8	0	0				F126-16	2.123	1.188	0.9	7.5	8.0	7.8	1.2	7.8
2	6341	001～047								F126-17	1.755	0.500						
3	6341	001～047								F126-18	0.497	0.408						
4	6341	001～047								F126-19	2.045	0.242						
5	6341	001～047								F126-20	0.479	0.369						
6	6341	001～047								F126-21	0.131	0.133						
7	6341	001～066								F126-22	1.239	0.236						
8	6341	001～066								F126-23	0.120	0.115						
9	6341	001～066																
10	6341	001～066																
11	6341	001～066																
12	6341	001～066																
13	6341	001～067																
14	6341	001～017																
15	6341	001～019																
16	6341	001～018																
17	6341	001～018																

Item	Horizontal Position	Height
Residual at Control Point Standrds Deviation (m)	1.313	0.514
Difference of Inspected Point Standards Deviation (m)		
Residual at Control Point Maximum Residual (m)	2.123	1.188
Acceptable range	3.171	3.171

Acceptable range of Intersection Residual for Tie Points (μm)	Standards Deviation	Max
	4.2	8.4

Used Equipment	Digital Stereo Plotter	Operator		Inspected Period	man-day

Standards Deviation $=\sqrt{(\Sigma r^2/n)}$　　r = residual ,　n = Number of points

Table 4　Accuracy Control Table of Block5

Accuracy Control Table for Aerial Triangulation

Project Name	Work Volume (Numb of Course and Photo)	Adjustment Method	Work Period	Name of Work Agency	Chief Engineer	Inspector
BLOCK 5	24 / 797	Bundle Method	From 2013 8 22 / To 2013 8 22	JICA	A. Suzuki	Y. Oyama

Course Number	Flying Height (m)	Photo Number	Number of Control Points: Horizontal Position (points)	Number of Control Points: Height (points)	Number of Control Points Excepted for Calculation: Horizontal Position (points)	Number of Control Points Excepted for Calculation: Height (points)	Difference of Inspected Point at Inspection / All Points except Fixed Point: Point Name	Difference: Horizontal Position (m)	Difference: Height (m)	Residual at Control Points at Final Adjustment (Weight0 in lower stand): Point Name	Residual: Horizontal Position (m)	Residual: Height (m)	Intersection Residual for Tie Points (Weight0 in lower stand) X: Standards Deviation (μm)	X: Max (μm)	Y: Standards Deviation (μm)	Y: Max (μm)	XY: Standards Deviation (μm)	XY: Max (μm)
1	6815	001～067	5	5	0	0				F126-11	0.156	0.163	0.9	7.5	8.0	7.8	1.2	7.8
2	6815	001～033								F126-21	0.458	0.086						
3	6815	001～032								F126-23	0.084	0.062						
4	6815	001～033								F126-25	0.370	0.083						
5	6815	001～032								F126-27	0.161	0.053						
6	6815	001～033																
7	6815	001～032																
8	6815	001～033																
9	6815	001～032																
10	6815	001～033																
11	6815	001～032																
12	6815	001～033																
13	6815	001～032																
14	6815	001～033																
15	6815	001～032																
16	6815	001～033																
17	6815	001～032																
18	6815	001～033																
19	6815	001～032																
20	6815	001～030																
21	6815	001～031																
22	6815	001～030																
23	6815	001～025																
24	6815	001～029																

Item	Horizontal Position	Height
Residual at Control Point Standrds Deviation (m)	0.284	0.098
Difference of Inspected Point Standards Deviation (m)		
Residual at Control Point Maximum Residual (m)	0.458	0.163
Acceptable range	3.408	3.408

Acceptable range of Intersection Residual for Tie Points (μm)	Standards Deviation	Max
	4.2	8.4

Used Equipment	Digital Stereo Plotter	Operator		Inspected Period	man-day

Standards Deviation $=\sqrt{(\Sigma r^2/n)}$　　r = residual ,　n = Number of points

(2) Verification by Stereo Measurement of GCPs

The study team oriented stereo models from the "Exterior Orientation" of existing Aerial triangulation result. Then measured each GCP in the stereo environment and verified by comparing between measured value and "Acceptable Range" from "SURVEY WORK REGULATION".

From the result as below, Block4 was satisfied "Acceptable Range" however it is verified Block5 has a GCP (F126-27, locates southern eastern) which has big difference.

Table 5 Result of Stereo verification

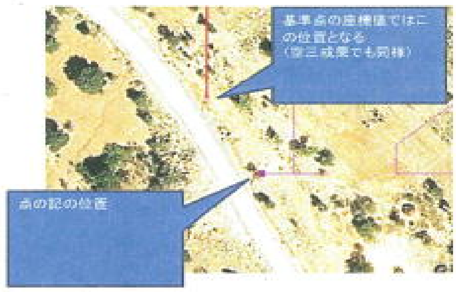
Block4 基準点較差

点番号	図化での計測値			標定点の座標値			較差((図化)-(実測)) (m)			(m)
	x	y	z	x	y	z	Dx	Dy	Dl	Dz
F126-16	551409.862	992724.074	1724.182	551408.877	992726.730	1721.934	-0.985	2.656	2.833	2.248
F126-17	623972.746	992919.162	951.501	623971.547	992917.925	952.600	-1.199	-1.237	1.723	-1.099
F126-18	622351.593	963244.154	1429.967	622351.273	963243.765	1431.279	-0.320	-0.389	0.504	-1.312
F126-19	589476.678	952412.076	1014.332	589477.856	952410.145	1015.459	1.178	-1.931	2.262	-1.127
F126-20	550805.623	966560.649	1489.515	550805.806	966560.372	1490.913	0.183	-0.277	0.332	-1.398
F126-21	512222.892	941222.262	1712.171	512221.938	941222.307	1713.522	-0.954	0.045	0.955	-1.351
F126-22	512712.815	963999.111	1970.862	512713.675	964000.631	1972.030	0.860	1.520	1.746	-1.168
F126-23	625826.982	939544.493	2922.778	625826.505	939544.027	2923.330	-0.477	-0.466	0.667	-0.552
					標準偏差		0.882	1.467	0.902	1.228
					二乗平均誤差				1.616	1.462

Block5 基準点較差

点番号	図化での計測値			標定点の座標値			較差((図化)-(実測)) (m)			(m)
	x	y	z	x	y	z	Dx	Dy	Dl	Dz
F126-11	511985.921	904712.743	2027.417	511985.212	904712.566	2027.110	-0.709	-0.177	0.731	0.307
F126-21	512222.640	941223.078	1713.112	512221.938	941222.307	1713.522	-0.702	-0.771	1.043	-0.410
F126-23	625827.494	939544.583	2923.495	625826.505	939544.027	2923.330	-0.989	-0.556	1.135	0.165
F126-25	577399.406	921560.276	2530.486	577400.385	921560.599	2530.332	0.979	0.323	1.031	0.154
F126-27	622866.102	902460.544	1589.574	622892.371	902419.108	1588.128	26.269	-41.436	49.061	1.446
					標準偏差		11.932	18.403	21.501	0.680
					二乗平均誤差				21.959	0.362

F126-27の異常値の問題



2.1.4. Consideration of Block 5

Above mentioned, only one GCP (F126-27) had big difference as 20 - 40m (other GCPs had no problem), If EMA used F126-27 into the Aerial Triangulation, it made effect to other point then the result of other GCPs might have also big errors such as 10m.

However, the actual result has no effect from F126-27, and after Stereo verification, the result of Aerial Triangulation looked normal.

Therefore the study team and EMA decided that the result of aerial triangulation had been acquired through the process as below.

A) In the existing Aerial Triangulation, Operator might find that F126-27 had error and the operator carried out the aerial triangulation without the point. The measured value of F126-27 was referred as tentative.
B) The operator inversion calculated ideal value of F126-27 using the tentative value in step “a” or measured ideal value of F126-27 by Stereo measurement.
C) The operator implemented aerial triangulation again using ideal value of F126-27 from step “b” then after verifying no big difference and no doubt for residuals of each GCP, reported as final Aerial Triangulation result.

As the result of consideration, inversion calculated value of F126-27 did not remain but direct measured value remained therefore was no possibility to reproduce of step “a” and “c” by the study team. And the study team leaded this issue to following conclusion.

- Except blunder error of F126-27, result itself had correct value.
- From the verification of tie condition between neighboring models and courses on the stereo model around F126-27, there was no negative effect.
- There were no negative effect in Block 5 from this issue and F126-27 was farthest point from target area in this project.

2.1.5. CONCLUSION

From the verification above, the study team and EMA concluded the existing AT result had no problem to be used continuous “1/10,000 Digital plotting work”.

2.2. DIGITAL PLOTTING

The accuracy control table shall be prepared as follows.

2.2.1. WORKFLOW OF "DIGITAL PLOTTING QUALITY CONTROL"

Workflow of Digital topographic map creation and "Digital Plotting"

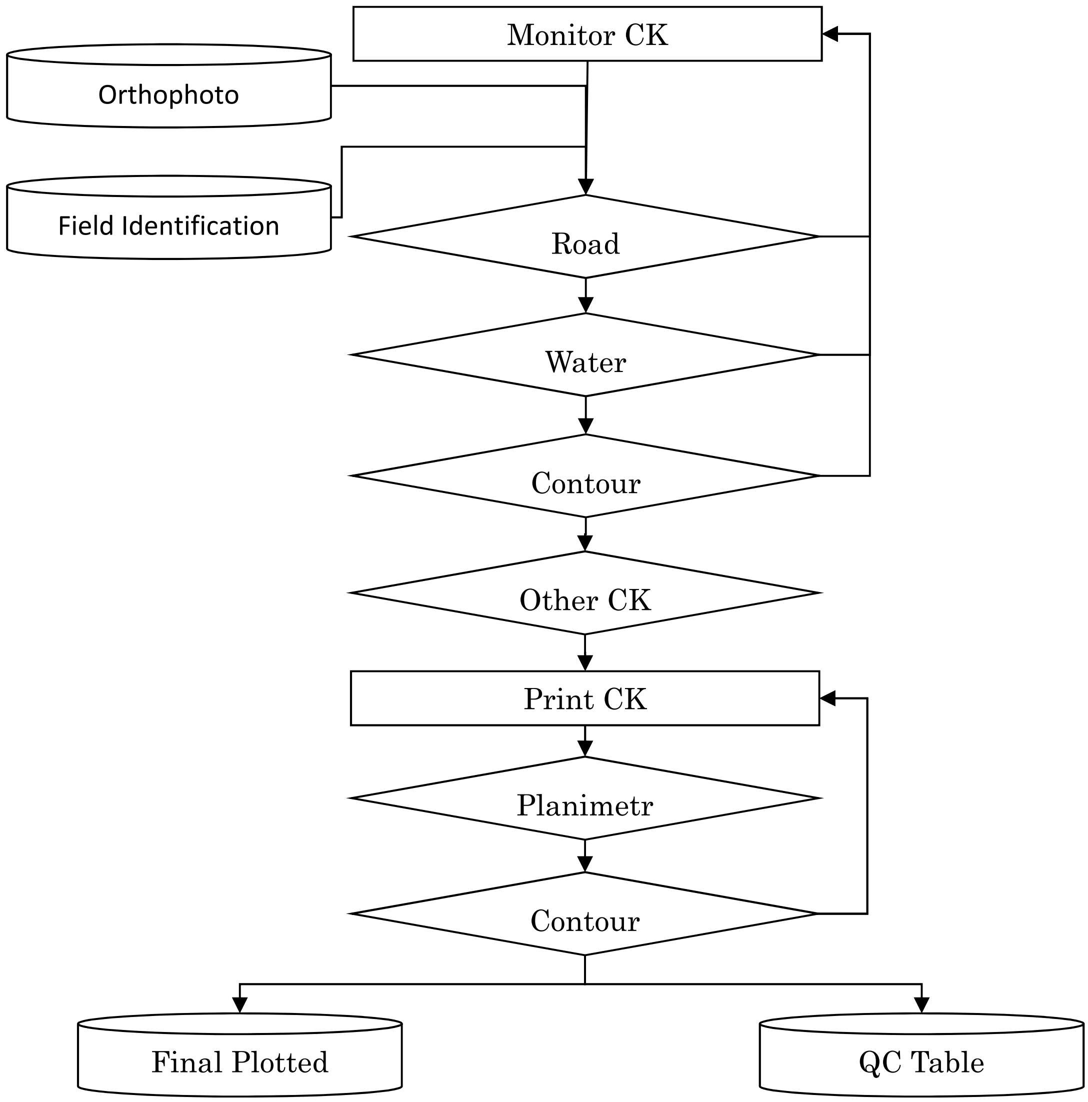


Figure 5 Workflow of "Digital Plotting" Quality Control

2.2.2. Monitor Visual Check

Plotted features shall be checked on the monitor by Features themselves and by comparing to "Orthophoto".

(1) Level Check

Show 1 Level in the monitor and check all Level 1 by 1. In case features which are in wrong level, they shall be move into correct level.

(2) Road Connection Check

Roads must satisfy following conditions. Show only "Road Type" levels and check each condition on the monitor. In case error or re-check points are found, put comment as follows.

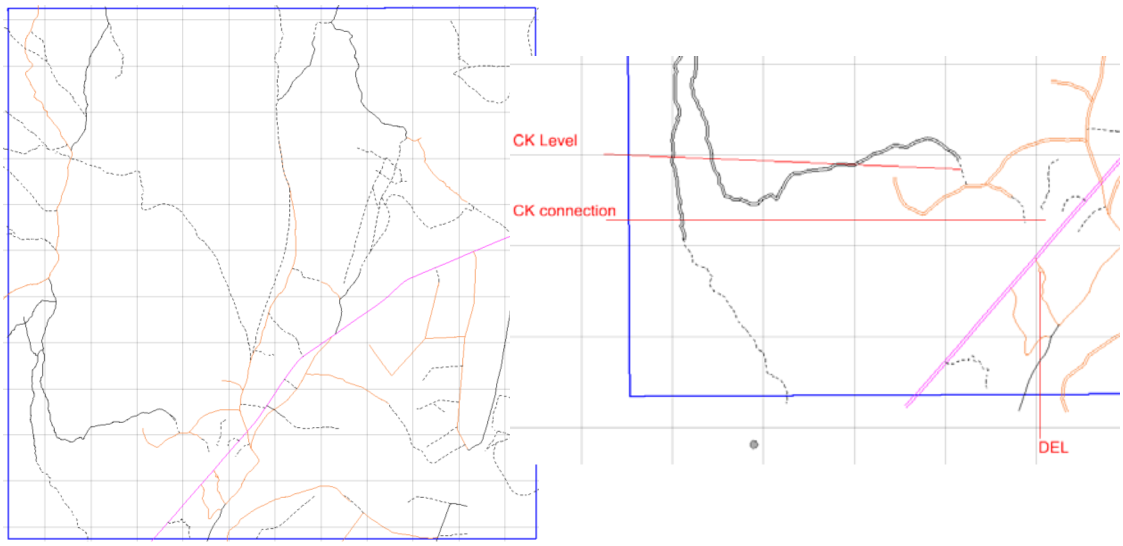


Figure 6 Result of "Road Connection" Quality Control

Table 6 Contents of "Road Connection" Quality Control

	Condition	Remarks
1	Road Existence	Check luck of "Remarkable", "Important", "major" Roads such as "Connection between major places", "Long". Check unnecessary Roads such as "Dense", "Short", "not Exist".
2	Physical Connection	Road must connect to next road at least 1 side.
3	Road Type gradual Connection	Road must connect and class must connect gradually to neighbor roads (not connect directly from Highway to Footpath).
4	Adequacy of Road Type	Road classification must be adequate based on "Use (for car, for people)", "Material", "capacity", "status"

(3) Water Body Connection Check

Water bodies such as “Lake& Ponds”, Rivers shall be checked by referring to “Road connection Check”.

(4) Contour& Spot Height Check

All contour lines shall be checked whose “Correct elevation”, “Relation to Spot Height”.

Table 7 Contents of “Contour & Spot Height” Quality Control

	Condition	Remarks
1	Zero m Contour	Check contour line whose elevation is 0m and add elevation
2	Blunder Elevation Contour	Check contour line whose elevation is extremely high and low and input adequate elevation.
3	Wrong number of decimals of Contour value	Check contour line whose elevation is not integer or 0.5m under the decimals and low and input adequate elevation.
4	Unconnected Contour	Check contour line which does not connect to neighbor and shall be connected it.
5	Consistency to Spot Height	Check Spot height whose location is not correct capering to contour line (ex: 1504.5m Spot height is located over 1505m contour) and it shall be corrected.

(5) Other Feature check

Remarkable features for the map because of their Importance or Size (Major roads / river / pond, Important / big Building, Features which were noted in Field Identification) shall be checked weather it has plotted.

”Tie (Joint)” between sheet shall be checked.

2.2.3. PRINTED MAP VISUAL CHECK

Contents of “Digital Plotting” are basically followings, and training program shall be planned based on these contents. The result of the “Questionnaire” shall be referred to weight for each content.

Table 8 Contents of "Print" Quality Control

		Condition	Remarks
Plani metric	1	Small features	Small features the length is less than 5mm on the map shall be removed. Seasonal rivers whose length is less than 1cm on the map shall be removed.
	2	Too much description	Too much description (Size, Shape, Density) beyond to 1/10,000 shall be modified
	3	Unconnected Feature	Unconnected feature such as Roads, Rivers, Contours shall be modified
	4	Label point	All label point shall be checked in an area which is enclosed by lines.
Conto ur	5	Contour shape	Contour shape shall be related to volleys (rivers)
	6	Spot height	Spot Height shall be located at least on Highest and Lowest point Spot Height shall be located each 4cm×4cm area

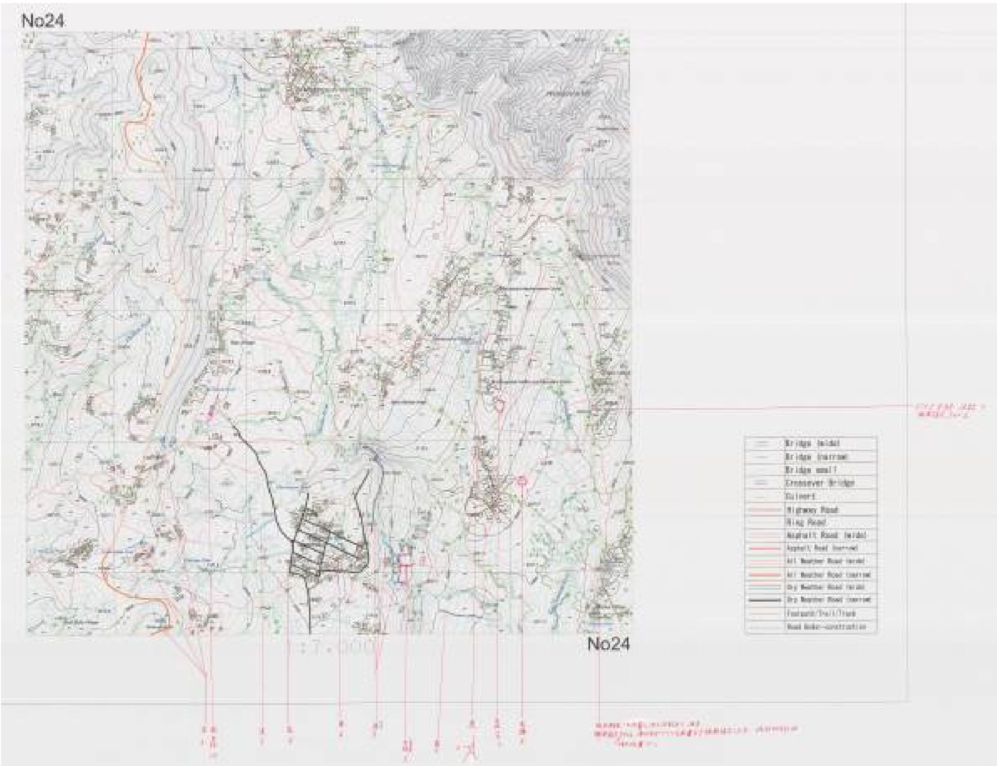


Figure 7 Result of Print Quality Control

2.2.4. ACCURACY CONTROL TABLE

When QC is finished, "Accuracy Control table" shall be prepared Sheet by Sheet to file and guaranty the quality. "Too much description" and "Lack of description" shall be counted and input into the table.

2.3. DIGITAL EDITING / DIGITAL COMPLETION

The accuracy control table shall be prepared as follows.

2.3.1. WORKFLOW OF "DIGITAL EDITING QUALITY CONTROL"

Workflow of "Digital Editing QC" is as below.

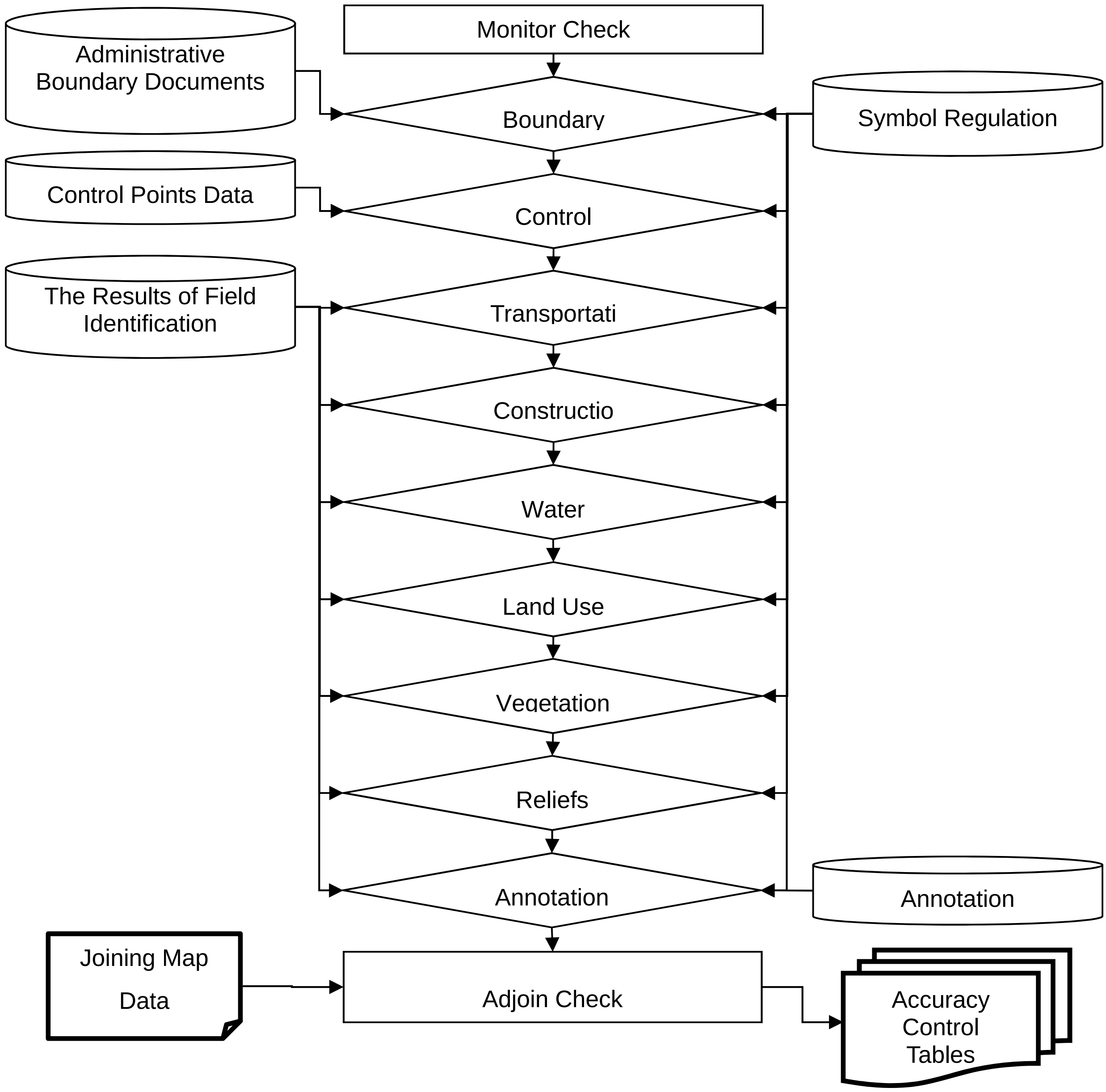


Figure 8 Work Flow of "Digital Editing" Quality Control

2.3.2. CHECKING METHOD

The verification of Editing data shall be carried out in each sheet in each feature class in the following steps. In accordance with the inspection item of the Accuracy Control Table, the necessary check shall be conducted for each feature classes. A number of errors found in the monitor check should be recorded in the Accuracy Control Tables.

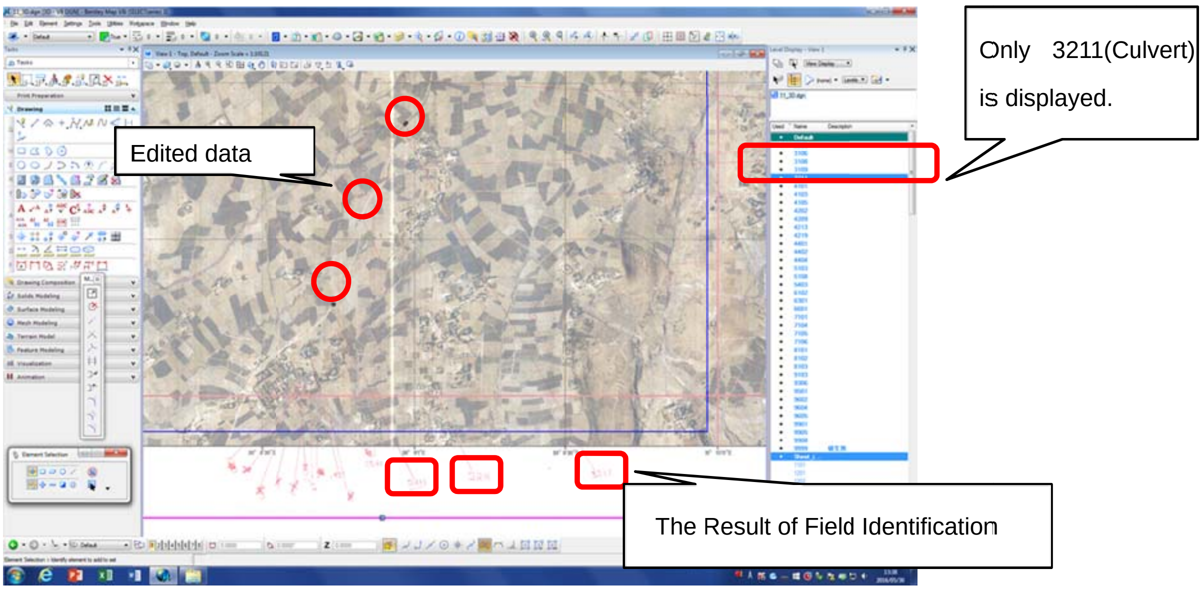
(1) Missing / Excess error check

At first, the documentation or data for comparison shall be prepared.

No.	Feature Class	Comparison
1	Boundary	Administrative Boundary Data
2	Control Points	Control Points Data
3	Transportation/Traffic Facilities	Results of Field Identification
4	Constructions	
5	Water	
6	Land Use	
7	Vegetation	
8	Reliefs	
9	Annotation	Annotation Documents Results of Field Identification

Only the data of the comparison feature class shall be displayed on the monitor, and count a number of the missing error and excess object for each class by comparing with the comparison.

< SAMPLE >



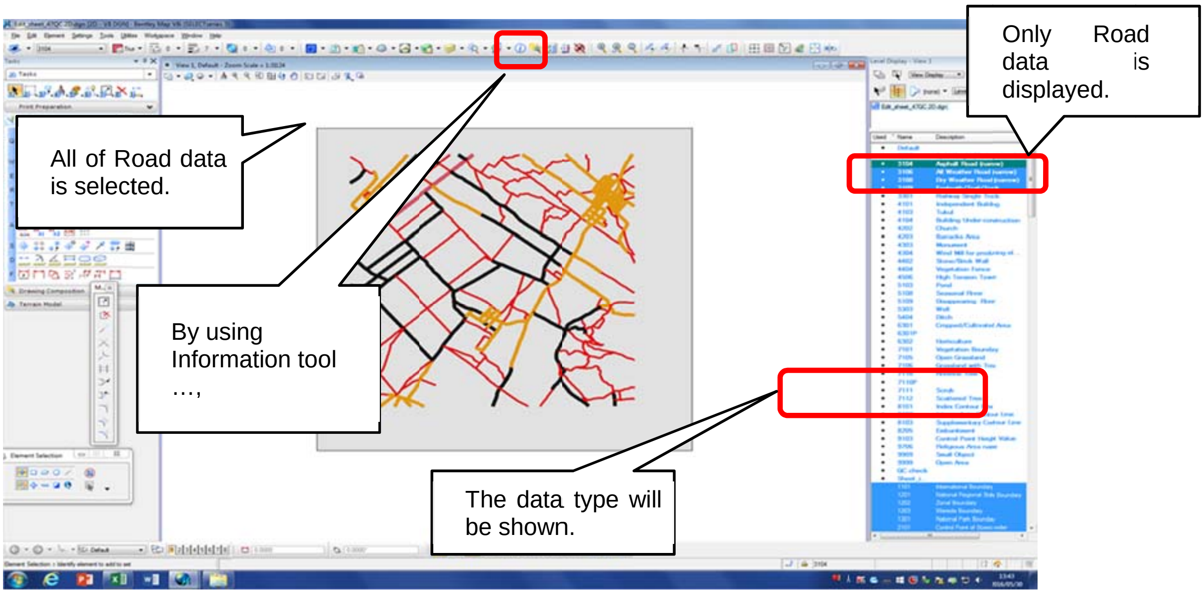
In this sample, only level '3211' is displayed and the background is the result of field identification. On the monitor, edited data shall be compared with the result of field identification. If missing data and excess data are found, count a number of these errors and record a number into the Accuracy Control Tables.

(2) Classification error check

There are two ways to check the classification error. In either way, the data specification shall be checked as compared to the symbol regulation and the results of field identification.

Display only one level and check the data type by "Information" tool.

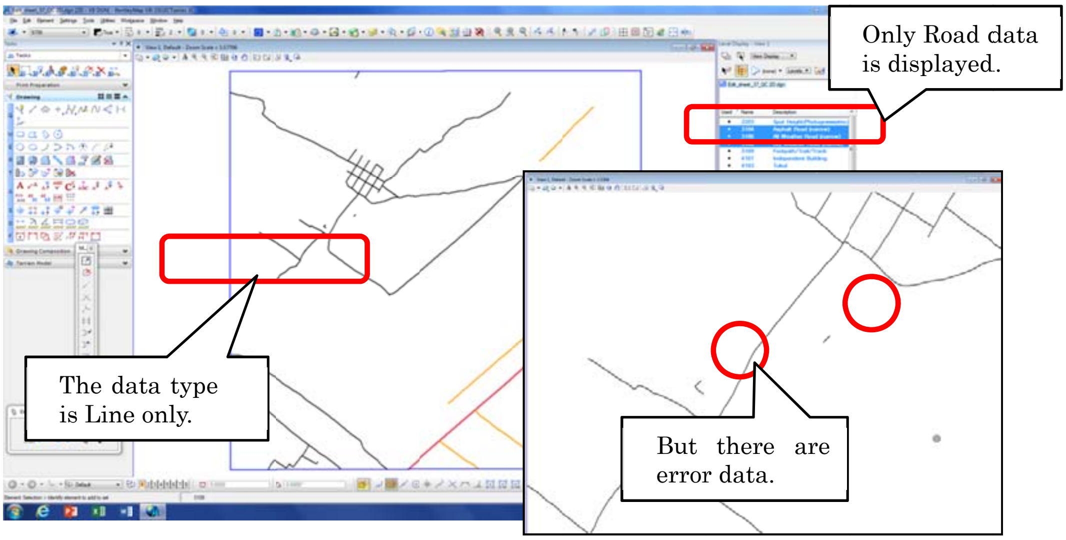
< SAMPLE >



In this sample, only road data is displayed and selected. By using 'Information' tool, the data type will be shown in the information window. In the symbol regulation, road data is defined as 'Line'. If there is other type data, count a number of these errors and record a number into the Accuracy Control Tables.

Display only one level and check visually by your eyes.

< SAMPLE >

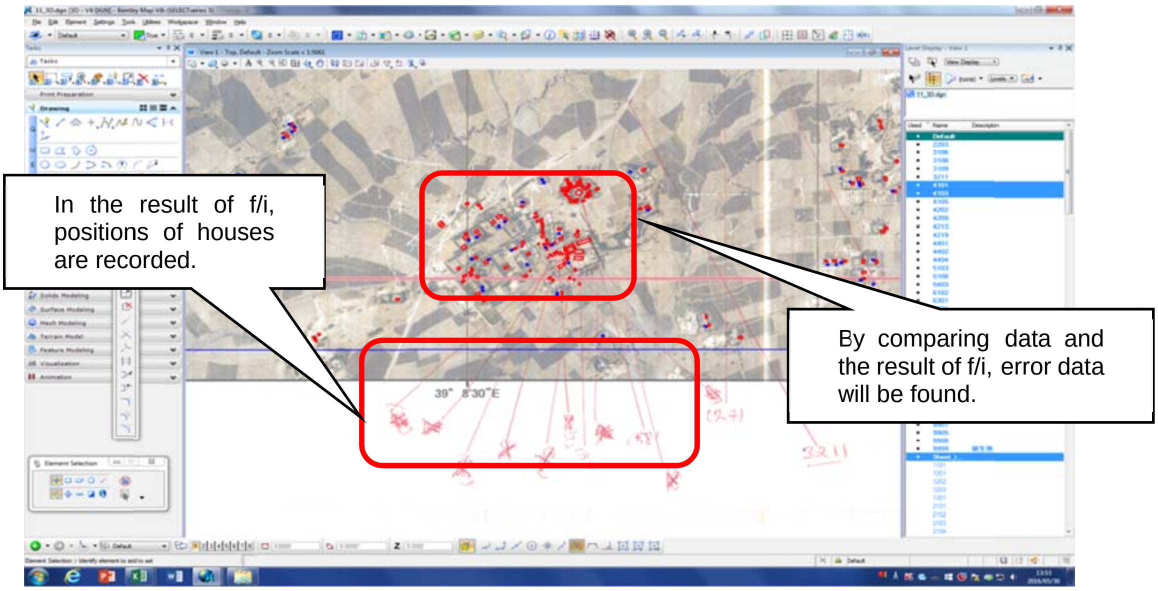


In this sample, only road data is displayed and data type is 'Line'. But by visual check, the error data is found.

(3) Position / Figure error check

By comparing with the results of field identification, position and figure shall be checked in each feature class.

< SAMPLE >

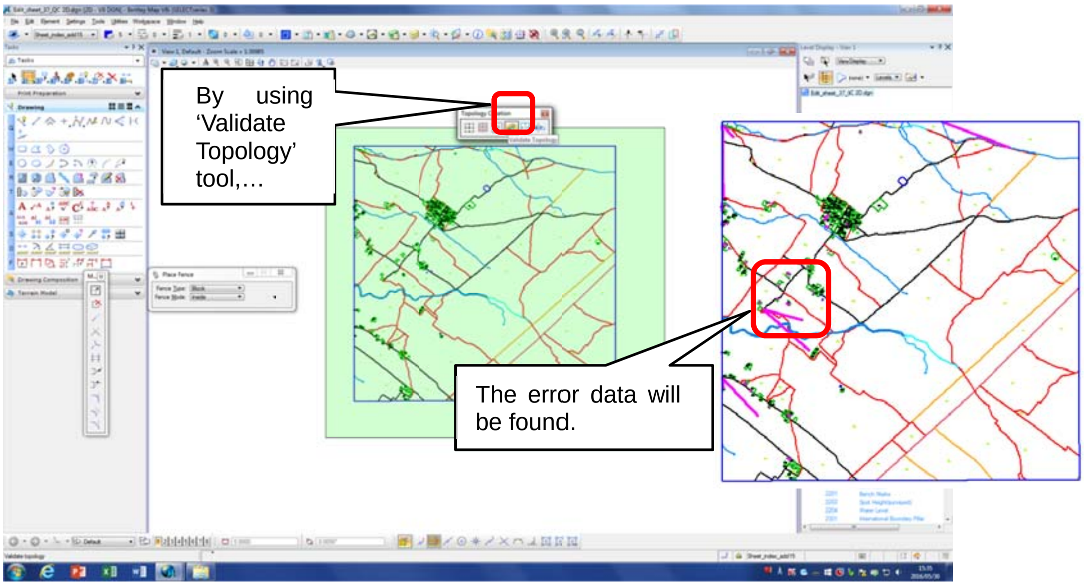


In this sample, only house data is displayed and the background is the result of field identification. By comparing the both data, the positioning error will be found.

(4) Polygon error check

Actually the polygon data will be created in the data structuration process. In editing process, it is very important whether the preparation for create polygon is completed or not. For checking the polygon preparation, "Validate Topology" tool on Bentley Map shall be used.

< SAMPLE >

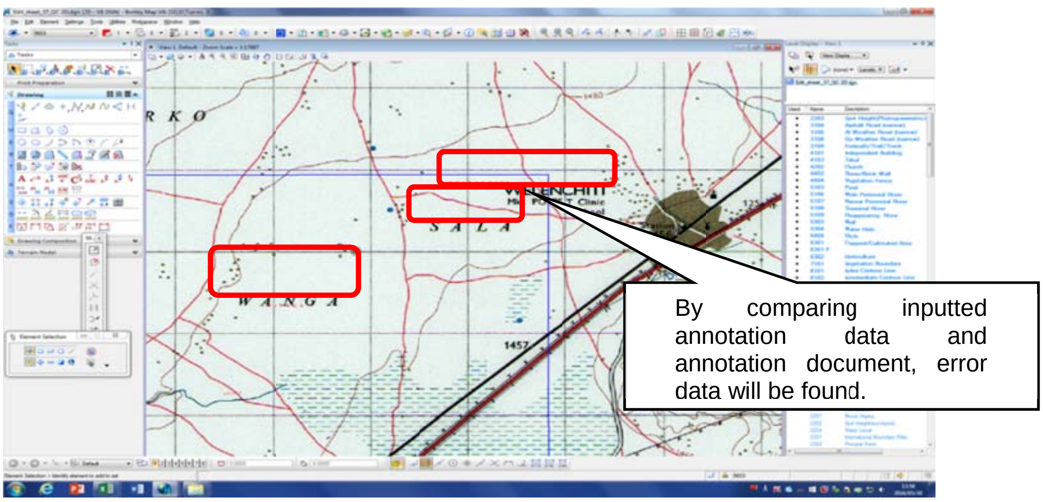


In this sample, by using 'Validate Topology' tool to the data for polygon, the error data will be found.

(5) Express / Spelling error check

All of the annotations inputted on the map data shall be checked express and spelling error by comparing with the annotation documents and the results of field identification.

< SAMPLE >

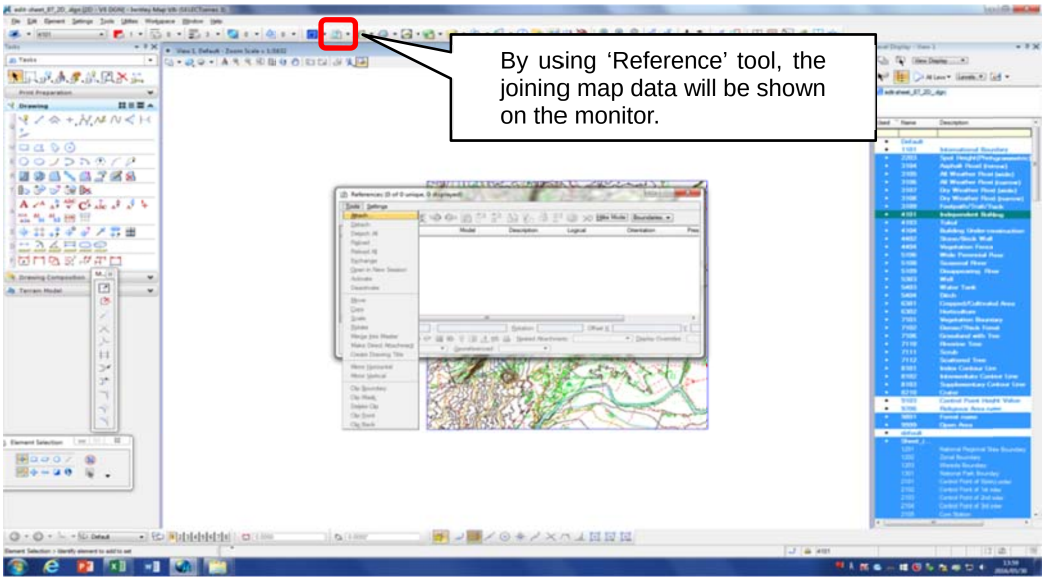


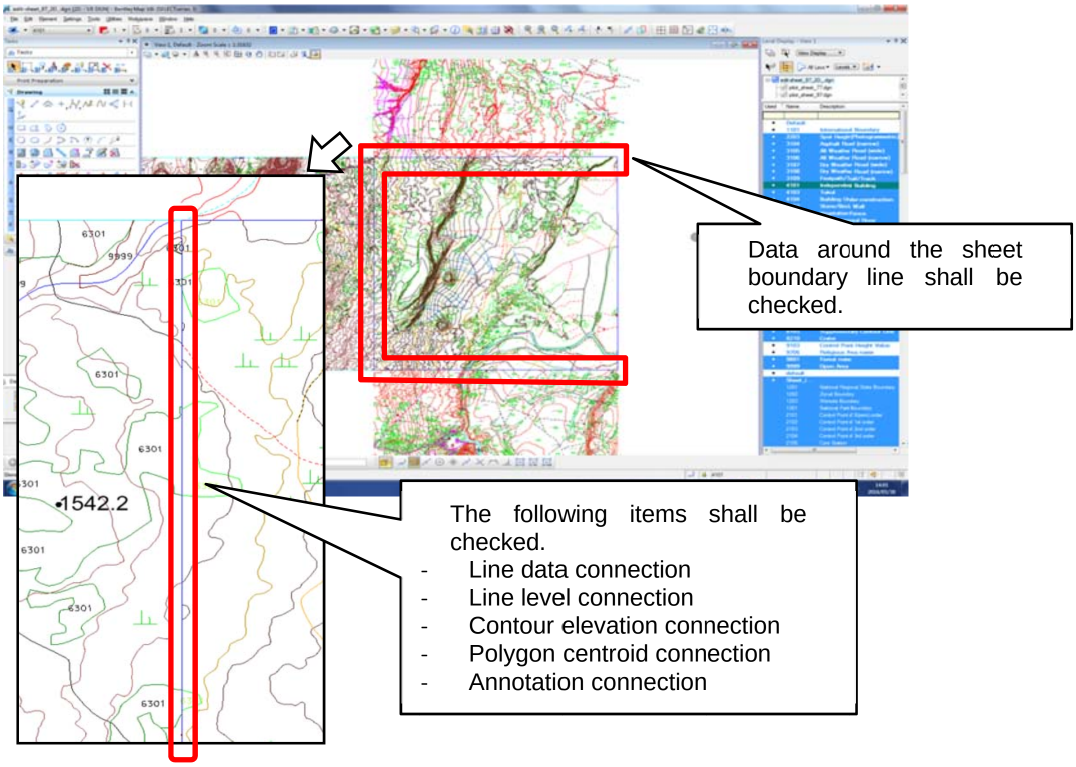
In this sample, only annotation data is displayed and the background is the annotation document. By comparing the both data, the express error and spelling error will be found.

(6) Adjoin error check

By using “Reference” tool, the adjoin error shall be checked visually.

< SAMPLE >





2.3.3. Accuracy Control Table

When QC is finished, “Accuracy Control table” shall be prepared Sheet by Sheet to file and guaranty the quality. “Too much description” and “Lack of description” shall be counted and input into the table.

2.4. SYMBOLIZATION

Print the PDF file which is created in the previous section on paper and inspect the resultant map. You must record the inspection results in the accuracy control sheet to keep the inspection history. This inspection must be conducted on every surrounding framework.

Write a check mark on a correct input on an inspection map and write an inspection symbol in red on an error. Inspection symbols are used to allow everyone to understand inspection results in the same way and conduct the inspection efficiently.

2.4.1. QUALITY CONTROL RULES

During the inspection, write either of the following abbreviated symbols to enter the inspection results.

Table 9 Rules for Quality Control

	Condition	Remarks
1	Add data >> A (Add)	Used if data is missing.
2	Delete data >> D (Delete)	Used if unnecessary data is found.
3	Change data >> CG (Change)	Used if data needs to be changed. Used also to correct an annotation. To mark an error in a top-down relationship of layers, write U/L (short for Upper/Lower) to indicate that the upper and lower layers must be swapped with each other.
4	Move data >> MV (Move)	Used to move data to another location.
5	Check data >> CK (Check)	Used if you cannot determine the correctness of data unless you recheck it in detail.
6	Clean data >> CL (Clean)	Used to mark a part that needs editing. Used if a joining of roads has not been edited or a hidden line of a contour has not been created.
7	No error >> ✔ (check mark)	Write a check mark in each grid of a surrounding framework if no error is found in it. Write a check mark also on marginal information if no problem is found with it.

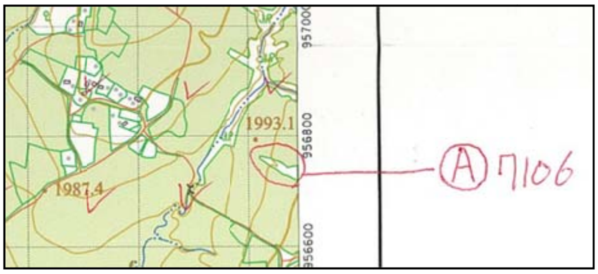
2.4.2. QUALITY CONTROL RULES IMPLEMENTATION

Hereafter, we explain each of the inspection symbols in detail.

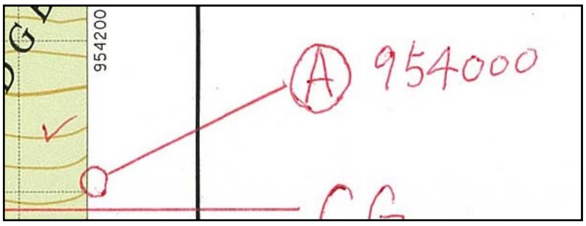
(1) Add data >> A (as "Add")

Used if data is missing. Write also the code of a planimetric feature to be added. The following shows an example.

In this example, the symbol of code 7106 is missing. This is an instruction to add the symbol.



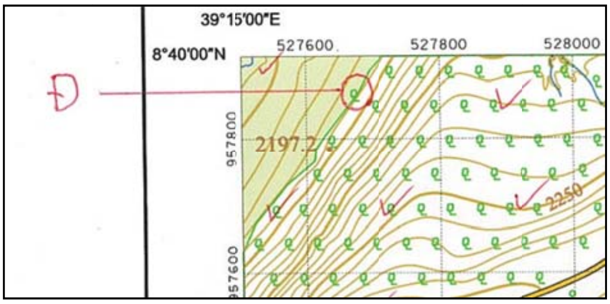
In the following example, missing coordinates of marginal information are marked.



(2) Delete data >> D (as “Delete”)

Used if data is unnecessary. The following shows an example.

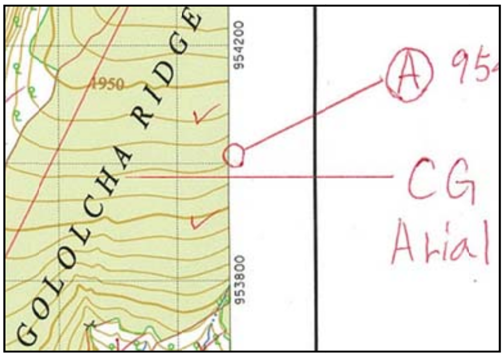
In this example, there is an instruction to delete an area symbol that is sticking out of a polygon.



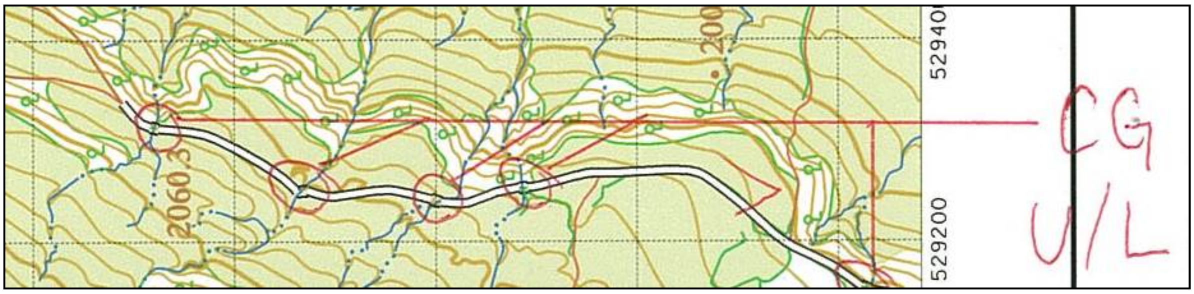
(3) Change data >> CG (as “Change”)

Used if data needs to be changed. Write also the code of a planimetric feature to be changed. The following shows an example. If the annotation is incorrect, write also a correct annotation. The same applies to a font error, etc.

In this example, an incorrect font is used for an annotation and an instruction is given to change it to a correct font.



In this example, a river comes over a road, which shows an incorrect top-down relationship of layers. An instruction is given to reverse the top-down relationship.



(4) Move data >> MV (as “Move”)

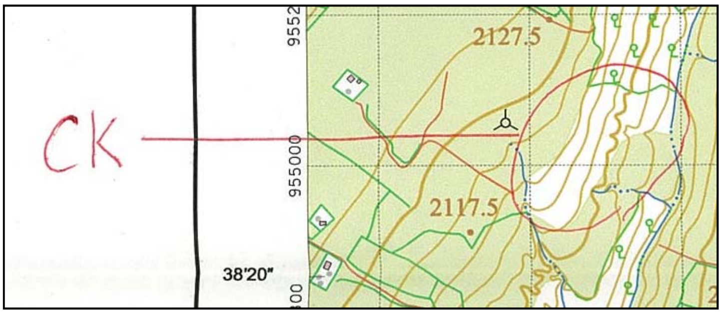
Used to move data to another location. Used to move a symbol to another location. The following shows an example.

In this example, an annotation overlaps with a road and an instruction is given to move it a little to eliminate this overlapping.

(5) Check data >> CK (as “Check”)

Used if you cannot determine the correctness of data unless you recheck it. Write a comment explaining what must be checked about the data. The following shows an example.

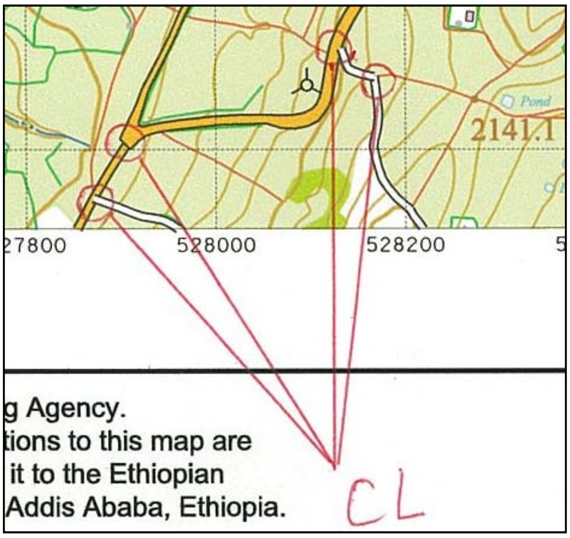
In this example, an area symbol may enter a polygon but there may not be a polygon there and an instruction is given to check the original data.



(6) Clean Data >> CL (as “Clean”)

Used to mark a part that needs editing. Used if a joining of roads has not been edited or a hidden line of a contour has not been created. The following shows an example.

In this example, a joining of roads needs editing. Write an instruction to connect the joining.



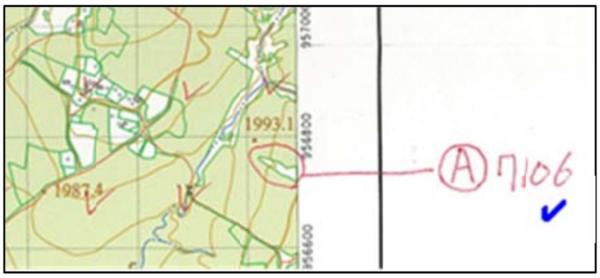
(7) No error >> ✔ (as “check mark”)

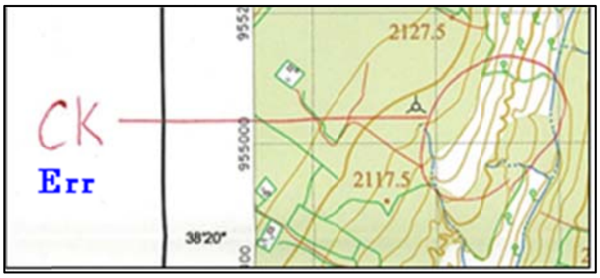
Write a check mark in each grid of a surrounding framework if no error is found in it. Write a check mark also on marginal information if no problem is found with it.

2.4.3. MAP INSPECTION

After the inspection is completed, the inspector shall give the inspection map to the worker after explaining the marked parts on it. The worker shall correct the data according to the instructions given as a result of the inspection.

The worker shall write a check mark in blue on the inspection map every time he/she corrects each of data. If "CK" is marked and the indicated detail is not an error, write "OK". If a part is corrected, write "Error" in blue.





If there are many errors, re-inspect the corrected map. If there are many errors, some of them may be left uncorrected. The inspection is complete when you have corrected all the errors.

2.4.4. ACCURACY CONTROL TABLE

An accuracy control sheet serves as a documentary evidence for proper accuracy control. Record the results of an inspection conducted in the previous step into an accuracy control sheet. Since an inspection is conducted in every process, similar accuracy control sheets shall be created in all the processes.

The following shows an accuracy control sheet. You need to fill out an accuracy control sheet in every process. Enter the results for each of the planimetric features to record them.

Project Name		Scale	1/10,000	Period	From：15/12/15	Operator	
Sheet name/Sheet number		Volume	41km^2		To： 15/12/24	Inspected by	
Implementation Organization		Project Leader				Final Inspected by	

Feature Class	Data Class / Feature Name	Error Items	Number of Errors
1. Boundary	International Boundary	Missing/Excess error	1
		Classification error	0
		Position/Figure error	0
	Administrative Boundary	Missing/Excess error	2
		Classification error	0
		Position/Figure error	1
	Other Boundary	Missing/Excess error	0
		Classification error	4
		Position/Figure error	2

Feature Class	Data Class / Feature Name	Error Items	Number of Errors
2. Control Points	Horizontal Control Point	Missing/Excess error	0
		Classification error	1
		Position/Figure error	1
	Vertical Control Point	Missing/Excess error	1
		Classification error	1
		Position/Figure error	0
	Vertical Control Point	Missing/Excess error	0
		Classification error	0
		Position/Figure error	0

The types of errors to be entered are classified as shown below.

Table 10 Type of Errors

Error type	Description
Missing/Excess error	If there is missing or excess data, enter the number of them. Enter this item for an error marked "A" or "D" in the inspection.
Classification error	If an error is found in the types of planimetric features, enter the number of them. Enter this item for an error marked "CG" in the inspection if it is due to a classification error. This item assumes that the error is eliminated in the previous process.
Position/Figure error	If an error is found in the locations and forms of planimetric features, enter the number of them. This item should be inspected in the previous process so if an error is found in the locations of annotations, enter this item. Enter this item for an error marked "MV" in the inspection.
Polygon error	Enter this item if a land use polygon or a vegetation polygon is not included in the polygon data. Enter this item for an error marked "A" when no area symbol is displayed in the inspection map.
Express/Spelling error	Enter this item if an annotation contains a spelling error. Enter this item for an error marked "CG" in the inspection if it is due to an annotation error.

During the inspection, enter errors with the following abbreviated symbols as follows:

(1) Add data >> A (as “Add”)

=> If data is added, count it as a "Missing/Excess error".

In this example, there is a missing "Annotation" and so write the following:

9. Annotation	Annotation	Missing/Excess error	1
		Classification error	0
		Position/Figure error	0
		Express/Spelling error	0

(2) Delete data >> D (as “Delete”)

=> If data is deleted, count it as a "Missing/Excess error".

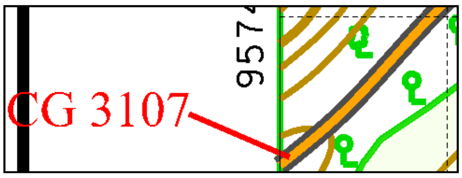
In this example, there is an excess "Annotation" and so write the following:

9. Annotation	Annotation	Missing/Excess error	1
		Classification error	0
		Position/Figure error	0
		Express/Spelling error	0

(3) Change data >> CG (as “Change”)

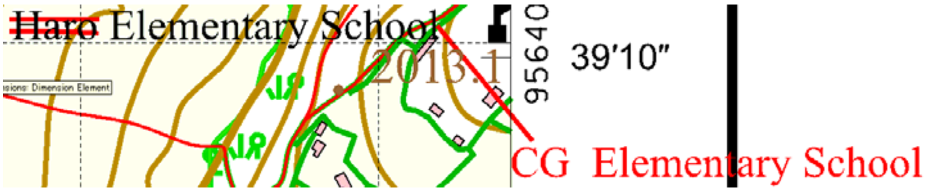
=> If data is changed, count it as a "Classification error" or "Express/Spelling error".

In this example, the "Road" type is incorrect and so write the following:



Road	Missing/Excess error	0
	Classification error	1
	Position/Figure error	0

In this example, the " Annotation " spelling is incorrect and so write the following:

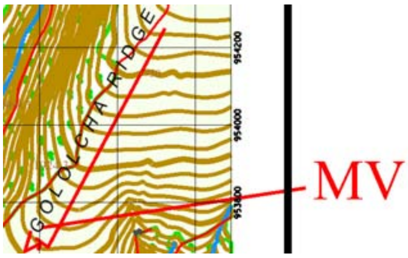


9. Annotation	Annotation	Missing/Excess error	0
		Classification error	0
		Position/Figure error	0
		Express/Spelling error	1

(4) Move data >> MV (as "Move")

=> If data is moved, count it as a "Position/Figure error".

In this example, the "Annotation" location is incorrect and so write the following:



9. Annotation	Annotation	Missing/Excess error	0
		Classification error	0
		Position/Figure error	1
		Express/Spelling error	0

(5) Check data >> CK (as "Check")

=> If an error is found, enter it in a type that matches the category of it. Determine the type of an error according to its category.

The accuracy control process is complete when you have entered all the errors found on the inspection map. If you conduct an inspection more than once, make a separate accuracy control sheet for every inspection to record the numbers of errors in the inspections. Using this record, you can check the error correction status of each surrounding frame.

File the accuracy control sheets to keep them. This process is complete when you finish filing them.

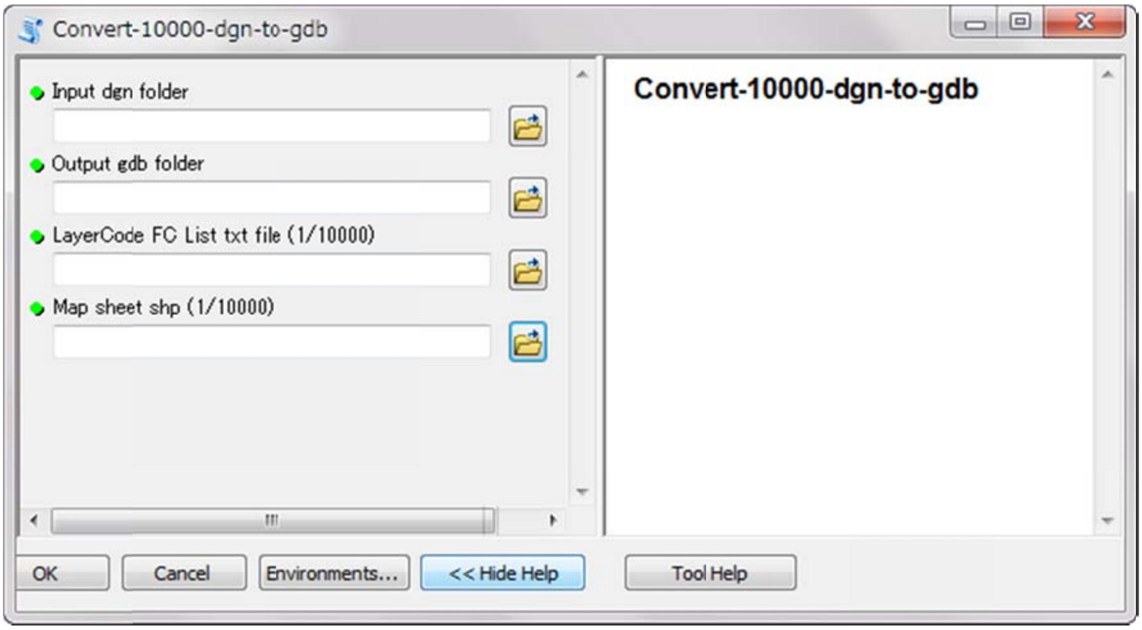
2.5. DATA STRUCTURIZATION

2.5.1. GEODATABASE DESIGN

The geodatabase designed for this JICA project is partially built on the existing geo-database used in EMA for ensuring that this design is easy to understand and implement. The data structures are designed to be flexible, extensible, and easily adapted by EMA. This design with ArcGIS for Desktop using a file geodatabase is easy and effective. During the final stage of design, JICA Team tested the scalability and workflows for EMA's 1/100000 geodatabase. JICA Team used this step to make the final adjustments to the geo-database designed for this project.

2.5.2. GEODATABASE CREATION

The data provided for this Project is from topographic data in the format of dgn which is well designed using 225 layers. The Geodatabases are created by converting those 225 layers in 54 sheets of dgn format to 54 file geo-databases using a Python script tool developed by JICA Team. There are 3 feature datasets and 19 feature classes in each file geodatabase. The following is the capture of the JICA tool. It can convert any number of dgn files in a folder. EMA staff can use this tool to process their dgn files to cover all the country.



2.5.3. TOPOLOGY ERROR CHECKING

In geodatabases, topology is the arrangement that defines how point, line, and polygon features share coincident geometry. Addressing topology is more than providing a data storage mechanism. In ArcGIS, the topology includes all the following aspects:

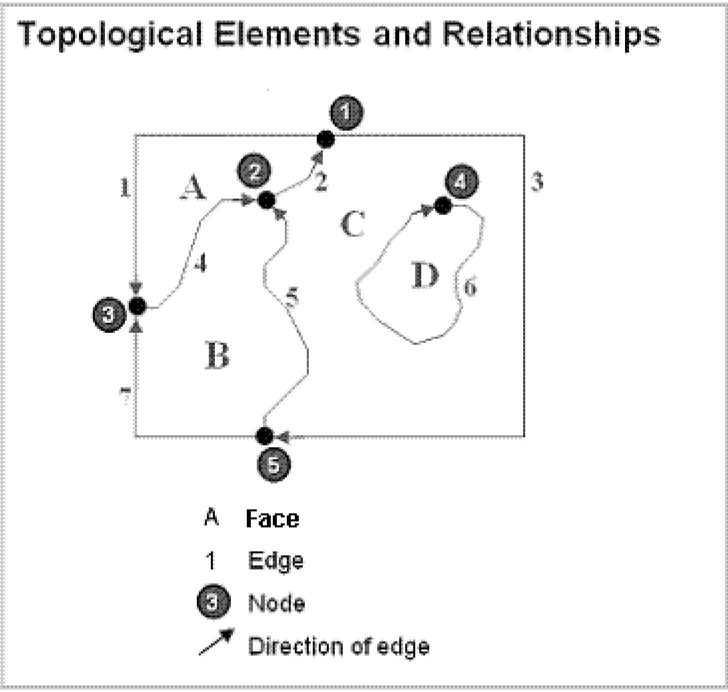
- The geodatabase includes a topological data model using an open storage format for simple features (feature classes of points, lines, and polygons), topology rules, and topologically integrated coordinates among features with shared geometry. The data model includes the ability to define the integrity rules and topological behavior of the feature classes that participate in a topology.
- ArcGIS includes topology layers in ArcMap that are used to display topological relationships, errors, and exceptions. ArcMap also includes a set of tools for query, editing, validation, and error correction of topologies.
- ArcGIS includes geoprocessing tools for building, analyzing, managing, and validating topologies.
- ArcGIS includes advanced software logic to analyze and discover the topological elements in the feature classes of points, lines, and polygons.
- ArcMap includes an editing and data automation framework that is used to create, maintain, and validate topological integrity and perform shared feature editing.
- ArcGIS for Desktop can navigate topological relationships, work with adjacency and connectivity, and assemble features from these elements.

Topology is a collection of rules that, coupled with a set of editing tools and techniques, enables the geodatabase to more accurately model geometric relationships. ArcGIS implements topology through a set of rules that define how features may share a geographic space and a set of editing tools that work with features that share geometry in an integrated fashion. A topology is stored in a geodatabase as one or more relationships that define how the features in one or more feature classes share geometry.

The features participating in a topology are still simple feature classes—rather than modifying the definition of the feature class, a topology serves as a description of how the features can be spatially related.

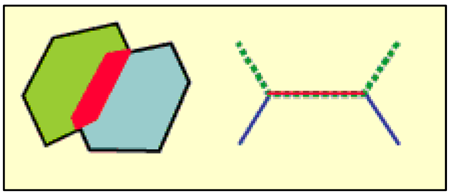
Why Topology?

Topology has long been a key GIS requirement for data management and integrity. In general, a topological data model manages spatial relationships by representing spatial objects (point, line, and area features) as an underlying graph of topological primitives—nodes, faces, and edges. These primitives, together with their relationships to one another and to the features whose boundaries they represent, are defined by representing the feature geometries in a planar graph of topological elements.



Topology Rules

Topology rules define the permissible spatial relationships between features. The rules you define for a topology control the relationships between features within a feature class, between features in different feature classes, or between subtypes of features. For example, the rule must not overlap is used to manage the integrity of features in the same feature class. If two features overlap, the overlapping geometries are displayed in red (such as shown by the overlapping red area in the adjacent polygons and the linear segment of the two lines below).

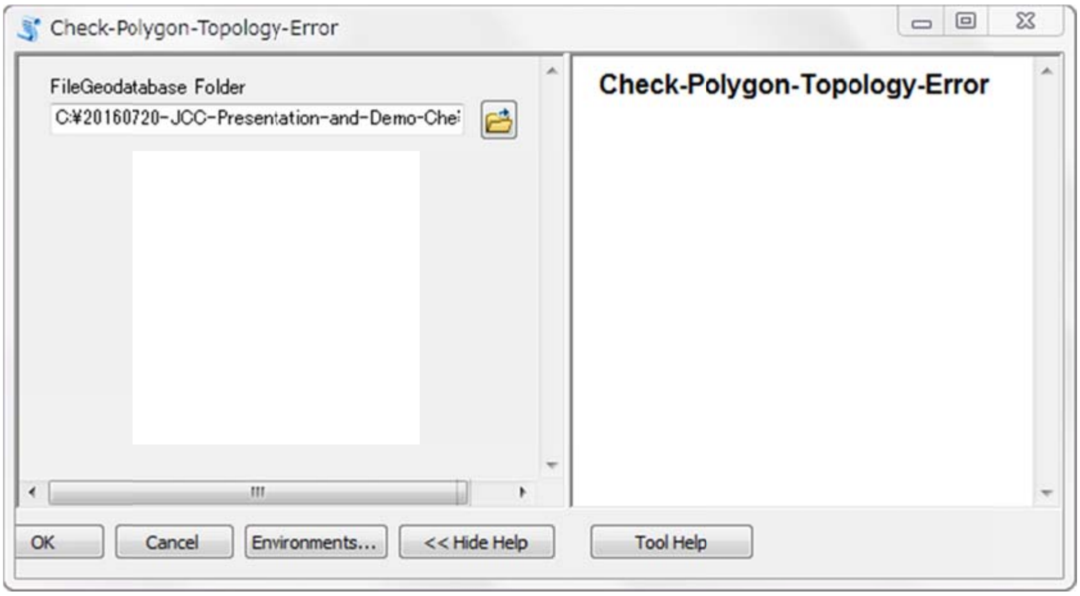


Topology Error Checking Tools

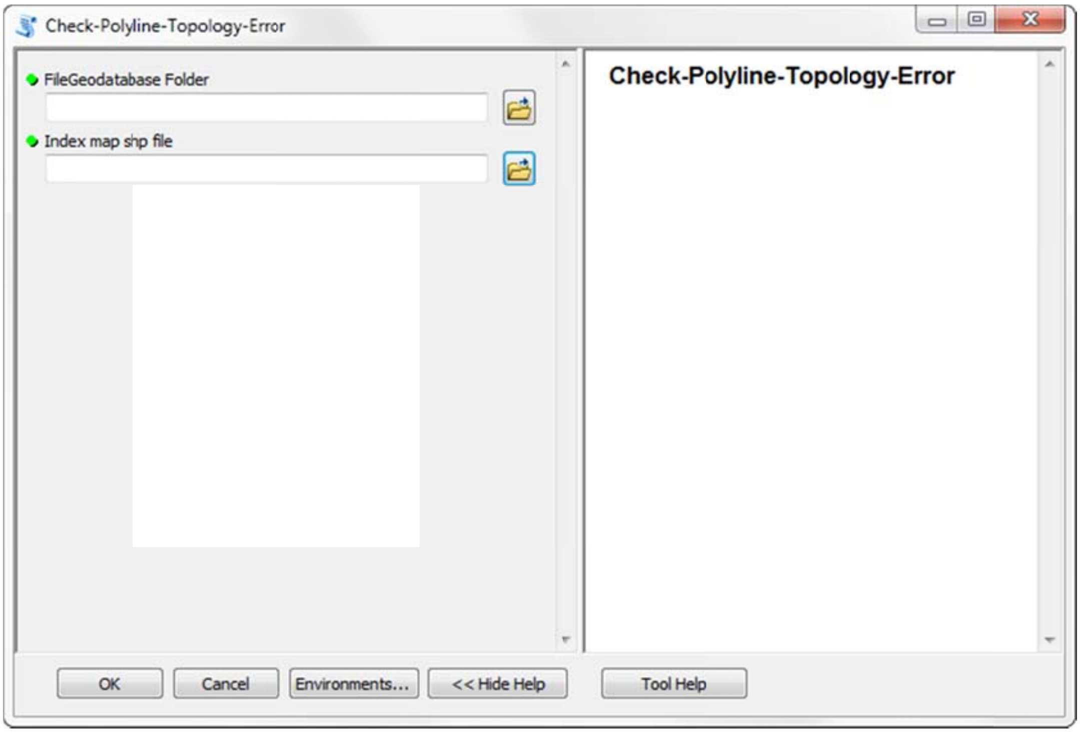
The topology rules for this JICA project are defined by the JICA team and EMA staffs with the detailed discussion for each feature class in the document GIS_Data_Structure_Field_Definition.xlsx.

The study Team developed two rule-based ArcGIS Python script tools for EMA to check the topology errors for polyline and polygon feature classes in all the file geodatabases. It can process any number of file geodatabases in a folder. All the results are recorded to a log file, and the errors are recorded in a different feature class for easy understanding the locations and types of the errors.

Check-Polygon-Errors.tbx



Check-PolyLine-Errors.tbx



End