Republic of Moldova
Agency for Land Relation and Cadastre

PROJECT FOR CREATION OF DATABASE FOR BASE MAP FOR DEVELOPMENT OF NATIONAL SPATIAL DATA INFRASTRUCTURE IN THE REPUBLIC OF MOLDOVA

Final Report

(Summary)

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JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

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Abbreviations

ALOS	Advanced Land Observing Satellite
ALRC	Agency for Land Relations and Cadastre
CP	Counterpart
CPU	Central Processing Unit
DEM	Digital Elevation Model
DMC	Digital Mapping Camera
GIS	Geographic Information System
GML	Geography Markup Language
GPS	Global Positioning System
ICT	Information and Communication Technology
INSPIRE	Infrastructure for Spatial Information in the European Community
ISO/TC211	ISO/TC 211 Geographic information/Geomatics
IT	Information Technology
JAXA	Japan Aerospace Exploration Agency
JICA	Japan International Cooperation Agency
KML	Keyhole Markup Language
NGIS	National GIS Committee
NSDI	National Spatial Data Infrastructure
OGC	Open Geospatial Consortium
OJT	On the Job Training
RPC	Rational Polynomial Coefficient
UCD	UltraCamD
UML	Unified Modeling Language
UPS	Uninterruptible Power Supply
WFS	Web Feature Service
WMC	Web Map Context
WMS	Web Map Service

1. Outline of the Study and its impact

1-1. Outline and objectives of the Study

Objectives

The aim of the Study was to prepare the latest geographic spatial data over the land by creating 1:50,000 topographic map data and GIS database that would facilitate a wide variety of its utilizations. The Study also aimed to develop the measures which encourage wide range of people to utilize those data in various scenes, and to implement technology transfer to the counterpart (ALRC) regarding the newest technologies about digital mapping and GIS database creation.

Benefits

The outputs of this study will not only form the foundation for the establishment of e-Government which is explicitly mentioned in the National Development Strategy of the Government of Moldova, but also contribute significantly to the development of the National Spatial Data Infrastructure (NSDI), a priority issue of the country.

1-1-1. Study Area

The area to be targeted in the Study covers territory of the country except for the region that lays in eastern part of River Nistru (the Transnistria area) as shown in Figure 1. The total area accounts for 30,000km^2.

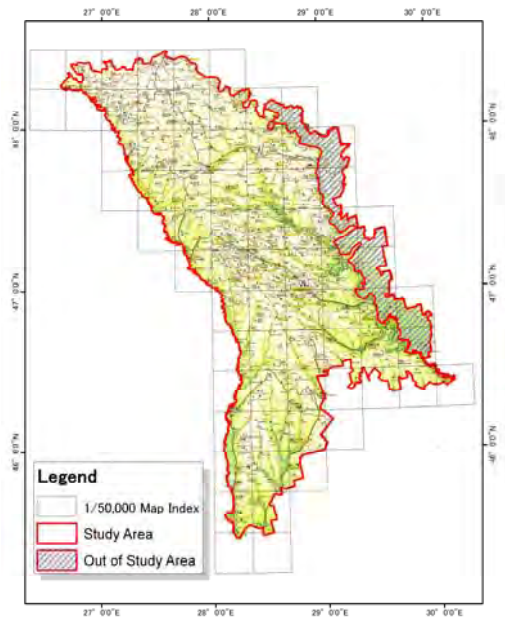


Figure 1 Study Area

1-1-2. Workflow

The workflow of the Study is shown in the following figure.

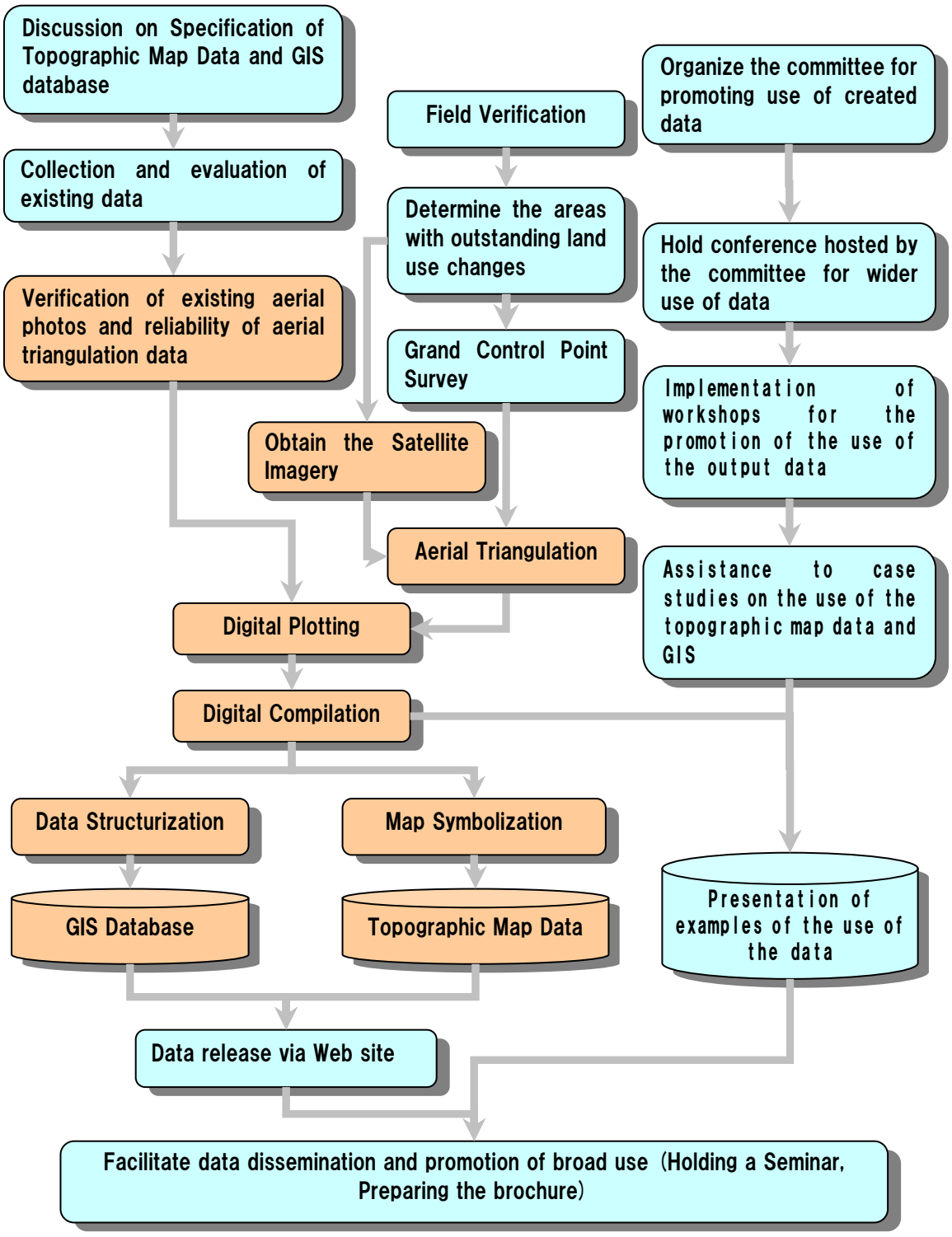


Figure 2 Workflow of the entire study

1-1-3. Implementation structure in the Study

Implementation structure between Moldovan side and Japanese side in the Study is shown below.

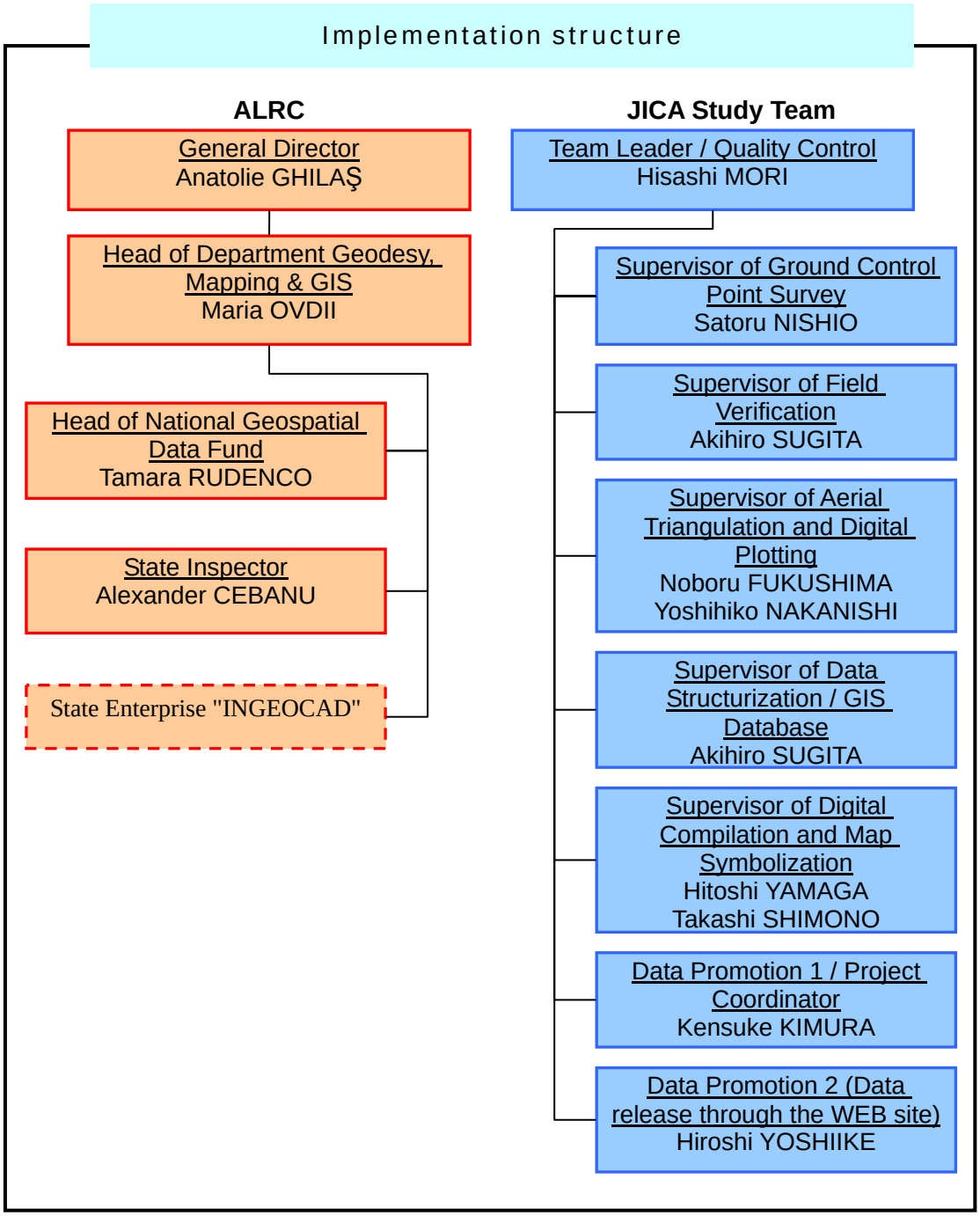


Figure 3 Implementation structure in the Study

1-2. Outcomes

The contents of the Study and its volume are as follows.

【1】 Creation of topographic map data in a scale of 1:50,000

Item	Quantity	Spec.	Remarks
Creation of topographic map data	Approx. 16,200km^2	1:50,000	By use of existing aerial photographs.
	Approx. 13,800km^2		By use of satellite imagery.
Field verification	30,000km^2		To be contracted out to local consultant.
Aerial Triangulation (aerial photograph)	30,000km^2		Need to verify the reliability of existing data.
Aerial Triangulation (satellite imagery)	48 scenes		Approx. 13,800km^2
Preparation of GIS database	30,000km^2	1:50,000	
Symbolization	30,000km^2	1:50,000	

【2】 Technology Transfer

Item	Description	Main aims
GCP survey, leveling and analysis	Field reconnaissance for selection of GCPs	・ Understand about GCP survey indispensable for creating topographic map data (with the use of satellite imagery, in particular). ・ How to use GPS equipment and conduct analysis with it. ・ How to prepare photo control point descriptions
	GCP survey	
	Leveling	
	GPS analysis	
Field verification	Preliminary photo interpretation	・ How to preliminary photo interpretation. ・ Method for field verification using orthophotos. ・ Method for field verification depending on map scale. ・ How to make use of a handy GPS receiver. ・ How to make use of a GPS-enabled digital camera. ・ How to organize the results.
	Field verification	
	Organization of field verification results	
Aerial triangulation	In case of satellite imagery In case of aerial photographs	・ How to operate a digital photogrammetric system and software. ・ How to import the result of GCP survey, aerial photographs and satellite imagery. ・ Difference between aerial photographs and satellite imagery. ・ How to evaluate aerial triangulation results.
Digital plotting	In case of satellite imagery In case of aerial photographs	・ How to operate a digital photogrammetric system and software. ・ Data acquisition depending on the data types. ・ Data acquisition depending on map scale (Particularly focusing on the knowledge and know-how in featuring objects for medium scale mapping). ・ Method of inspecting the data plotted.
Digital compilation	Optimization of plotted data	・ How to operate the software ・ Understanding of data cleaning ・ Understanding of methods to correct various types of errors

Item	Description	Main aims
	Creation of topology for GIS data	・ Understanding of the creation of topology of line, point and polygon data ・ Understanding of methods to correct various types of errors
Map symbolization	Allocation of symbols onto topographic map data.	・ How to operate the software ・ Understanding of map symbols ・ Priority order among the symbols (establishment of an order among layers) ・ Representation of symbols on maps at different map scales (creation, transfer and cartographic generalization of map symbols by data type) ・ Inspection methods ・ Understanding of spot colors and process colors ・ Difference between final prints and plotter printouts
Data structurization / GIS database	Digital data structurization Database creation	・ Understand about GIS. ・ How to operate GIS software. ・ Method of extracting GIS database from compiled data. ・ Establishment of topology and error correction. ・ How to utilize GIS data.

【3】 Facilitation of data dissemination and its wider use

Measure	Target	Outline
Making a survey to various users	Relevant parties including private sector	・ Overview of current data utilization. ・ Analyze potentiality of data use.
Holding seminar	Relevant parties, data users in the field of GIS database and topographic map data, staff of overseas donor authorities and the press	・ Thoroughly inform the significance and operation method of digital base maps ,and report the outputs from the Study. ・ Introduce examples of application use for GIS analysis.
Holding workshop	Engineers concerned of the related parities	・ Discussion on methodology and sharing operational knowledge and technology transfer.
Distribution of data via Web	All citizens and foreign users	・ Disseminate the vector data resulting from the Study to the public in addition to orthophotos already distributed.

1-3. Impact of the Implementation of the Study (What the Implementation of the Study Brought to the Counterpart)

1-3-1. Successful Updating of Geospatial Information over the Entire Land

In Moldova, the 1:50,000 scale topographic maps created in the 1980's in the time of the former Soviet Union have been used as the national base maps which are basis of national development. Therefore, creation of digital topographic map data has been awaited in order to update geospatial data and meet a variety of data needs including use in GIS.

The implementation of this project led to establishment of a foundation for the national development in the form of the creation of the latest digital geospatial data of the entire territory of Moldova as GIS data.

1-3-2. Acquisition of Accurate Geospatial Data on the Land with Satellite Imagery

The JICA Study Team (hereinafter referred to as "the Team") purchased satellite imagery of an area (of approx. 13,800 km^2) where relatively remarkable change in land use patterns has taken place outside the inland agricultural area in order to include as much new geographic information as possible in the geospatial data to be created in the study and used the imagery in the creation of accurate geospatial data of the territory. The team purchased 159 scenes of the satellite imagery and used them successfully for the renewal of topographic map data, which could not have been done with the aerial photographs (taken in 2007) used for photogrammetry.

1-3-3. Firm Technology which enable updating of Geospatial Data by the Counterpart themselves

The counterpart personnel were able to learn the technologies to update geospatial data by actually practicing updating of the topographic map data of a map sheet with the above-mentioned satellite imagery in this study. With this achievement, the counterpart personnel are now able to update geospatial data for changes in land use patterns which may occur in future.

1-3-4. Stimulating the Use of the Data in a Wide Area for National Land Development and Conservation

The GIS Data Sharing Council was established for the promotion of effective use of the output data while the Study was being implemented. Sharing of GIS data at the meeting in future is expected to prompt sector-wide information exchange among the member institutions of the meeting and extension of the data use to a wide area.

1-3-5. Upgrading of the Geospatial Data Dissemination System on the Web

The installation of a new server in the e-Government Center located at a different place from ALRC has made it possible to update geospatial data newly created in this study for distribution in the web. The new server, which has a faster CPU and more memory than the existing one, will improve the accessibility to the digital topographic information data (Vector data) and will upgrade the service contents. The improved accessibility and the upgraded services are expected to increase the number and diversity of users.

1-3-6. Secure Movement to Establish a System to Utilize and Share Geospatial Data by Enacting Relevant Laws through the Learning from Japan

JICA Training Program was carried out in Japan over nearly 2 weeks for 5 trainees invited from the counterpart. They visited mapping agency of Japan, private companies related geo-spatial data development and non-profitable organization concerning geo-spatial data dissemination and research in order to learn the differences of technology and administration between Japan and the republic of Moldova.

As a fruit of the training, a strong will was expressed for establishing a system to utilize geospatial data and to enact relevant laws based on their achievement in the training once they were back in Moldova.

1-4. Preferable Step Advancing toward NSDI

1-4-1. Current Situation and Challenge

The National Development Strategy advocates the development of NSDI. The e-Government Center was established in 2010 under the e-Government Initiative. A major objective of the establishment of the Center is the development of e-Government by making full use of information and communication technology (ICT) to improve governance and services to the citizens. The government ministry and agency servers, which in the past were operated and maintained separately and independently, are now managed centrally at the e-Government Center. The Center has 20 staff members. None of them is knowledgeable about NSDI.

The use of IT and the creation of an environment for the use of IT are essential elements in the development of NSDI for data sharing. The Study has confirmed that the IT environment in Moldova is suited to such use of IT.

Meanwhile, the creation of basic topographic map data (at a scale of 1:50,000) in the Study, which marked a great step in the development of NSDI, has led to a rapid increase in the motivation to develop NSDI on the part of the government organizations concerned. However, the problems and questions listed below will have to be resolved if NSDI is to be developed.

<u>In relation to policy</u>

- While the government recognizes the importance of NSDI, concrete measures concerning NSDI have not been put in place.
- Laws and regulations relating to NSDI have not been established.
- There is little cooperation in relation to NSDI between the organizations concerned.
- Although the government intends to follow the INSPIRE directive, it has not made a definitive decision on the technical specifications for geospatial data.
- Shortage of human resources (The development of human resources is essential for the

development and management of NSDI.)

- Insufficient budget

In relation to the IT environment

- Whether the level of IT in Moldova is suited to the development and management of NSDI.
- Whether it will be possible to obtain hardware and software within or from outside the country when the need for such hardware/software may arise.

NGIS Committee and Current Situation Concerning Geospatial Data

The NGIS Committee was established in 2002 for the purpose of promoting the use of GIS in Moldova. The committee, consisting of 37 members from 22 organizations, has not taken any concrete action so far. One of the major reasons for this inactivity is that, since many of its members are senior officials of their respective organizations, it has not been possible to hold a committee meeting attended by all the members. However, in the committee meeting convened in response to the call for a meeting and the agenda raised in the final seminar of the Study, a clear consensus emerged regarding the need to establish a working group consisting of experts and policy makers in various areas and the need to prepare the specifications for geospatial data, and regarding the implementation of cooperation in the establishment of the working group. This development has raised expectations for more vigorous activities to promote the use of GIS.

Various organizations have created geospatial data independently in accordance with their own needs, and there is no consistency at all in the data created by the different organizations. Therefore, the cost of the creation of topographic map data has been expended more than once, and problems emerge when the attempt is made to combine the data created by different organizations.

In addition, detailed urban planning is expected to produce the need for large-scale (e.g. 1:5,000) topographic map data of urban areas.

The table below shows the organizations expected to take responsibility for the actual activities involved in the development of NSDI, and the tasks for which those organizations are expected to take responsibility after the completion of the Study.

Organization	Task(s)
ALRC	Leadership in the technical aspects of the development and management of NSDI, as the organization responsible for creation and maintenance of geospatial information; Creation of geospatial data for the development of the data infrastructure
NGIS	Preparation of technical specifications and establishment of

	standards and systems for the use of data for the development of NSDI; A study of the promotion of the use of geospatial information
e-Government Center	Centralized control of the servers of the ministries and agencies concerned; a clearing house for the geospatial data

The existing NGIS Committee shall establish a working group, and the members of the working group, together with experts including foreign advisors, shall have regular technical work meetings with a representative of ALRC acting as chairperson, this activity to be implemented immediately and leading to the development of NSDI.

”The NSDI Development Action Plan” should be formulated as an output of these work meetings within a year of the establishment of the working group. The action plan should include the following.

- Purpose(s) of the development of NSDI and guidelines for its use in practical work;
- Definition of stakeholders and their responsibilities;
- Description of work for which each stakeholder is responsible, and the policy for implementation of the work (by the stakeholders themselves, or outsourced to specialist consultants);
- Year of implementation and duration of each stage of development; and
- Budget plan.

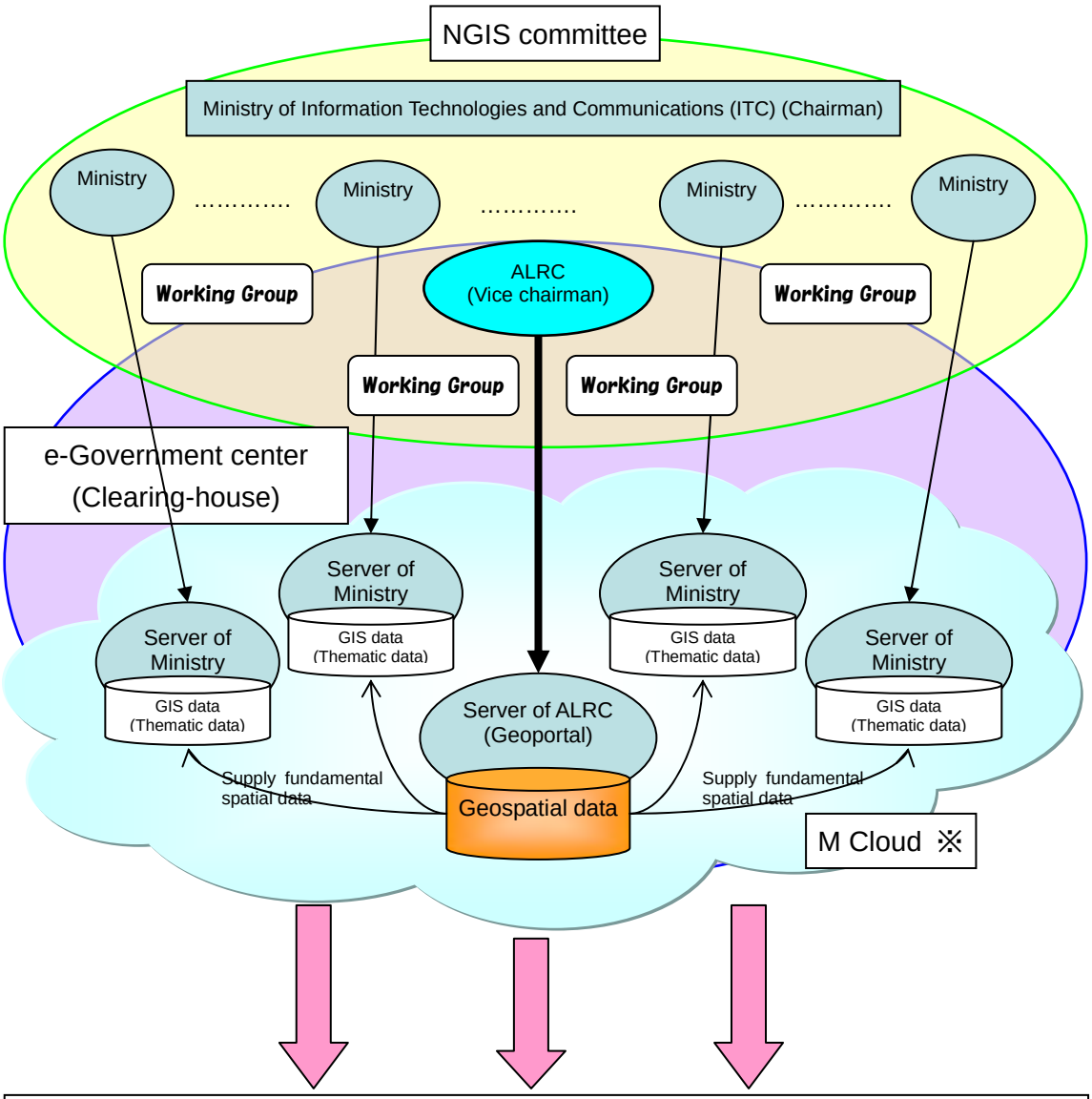


Figure 4 Future Ideal Situation among ALRC, NGIS committee and e-Government Center

※ The Government of the Republic of Moldova and the e-Government Center is developing and implementing "M-cloud" based on "Cloud Computing" technology from 2011.

1-4-2. Possibility of extensive uses for NSDI

The topographic map data in the 1 50,000 scale that was created in this Study is expected to be effectively used for formulating the master plans of national land and the guidelines for ecosystem-based natural environmental conservation. For the NSDI that can be built in the future, its application examples as expected are as follows:

(1) Master Plans of National Land

A. Master Plan of Urban Development

The 1:50,000 scale topographic maps are expected to be most suitable for formulation of master plans of regional-level development and improvement to draw up the basic plans for the appropriate locations, developable sites and development types of an urban area (including residential districts, commercial zones, industrial districts and public facilities) based on the future estimation of population, commercial sales and industrial production.

B. Master Plan of Agricultural Development

The land resource assessment at the national land level is mandatory for conservation and new development of agricultural lands. For this purpose, the 1:50,000 scale topographic map data is not only adequate to categorize the terrain, but also it allows the extraction and analysis of appropriate information (not too detailed and not too rough) from the viewpoint of river basin management. Therefore, it is possible to assess the potential productivity of agricultural lands based on this data and information.

C. Trunk Road Network Concept

In Moldova where the functional trunk roads are not fully developed at the national level, it is desired to formulate the Master Plan of distribution of trunk road networks in which the existing trunk roads and the sub-trunk road networks are categorized into levels to distribute the future road traffic in an appropriate manner to those. The 1:50,000 scale topographic map data contains the appropriate information on the present status of land use, conservation areas, and predicted traffic volumes, which are necessary for formulation of such a Master Plan.

(2) Formulation of Guidelines of Natural Environmental Conservation

In Moldova, the Master Plan of National Land Environmental Conservation has not been formulated based on the scientific knowledge from the viewpoints of disaster risk assessment and ecosystem conservation at the national land level. Therefore, the 1:50,000 scale topographic map data can be effectively used as an indispensable information source which is appropriate for formulating the following master plans:

A. Master Plan of Natural Disaster Prevention

In the agricultural country of Moldova, the 1:50,000 scale topographic maps can be used effectively to assess potential disasters and predict occurrences and expansion of landslides and soil erosion by overlapping the terrain undulations, land use status, vegetation cover information and river system data on the map data, thereby contributing to land conservation, and productivity maintenance and improvement. In drawing up the Master Plan of Flood Prevention in Areas, the basic plan of disaster prevention can be formulated by making use of simulation of disaster area scale and its expansion due to river floods based on accurate monitoring of land use in basins, inhabitable areas and public facilities.

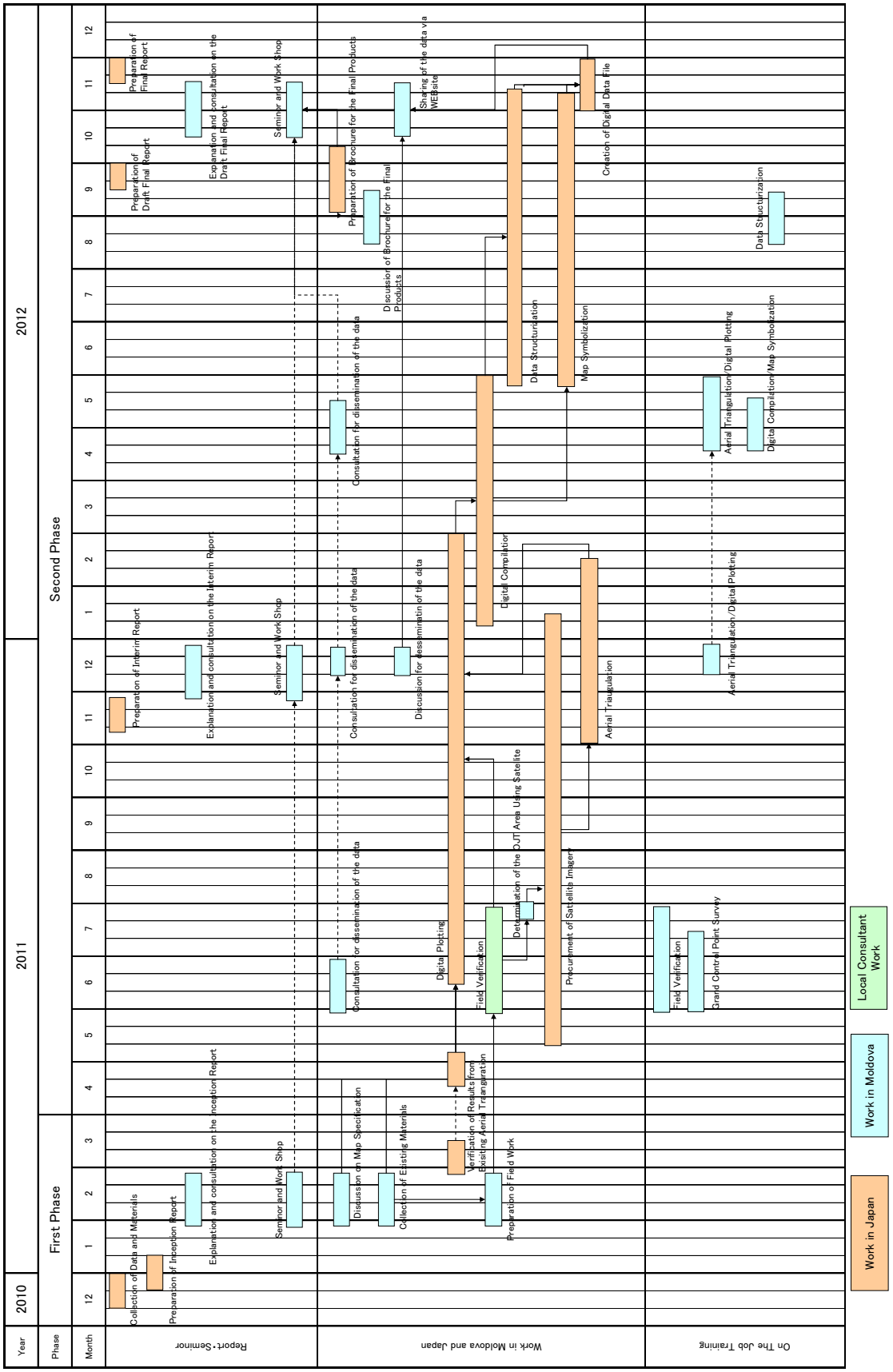
B. Natural Environmental Conservation Plan

From the standpoint of ecosystem conservation, the 1:50,000 scale topographic map data contains effective information for drawing up the master plan of environmental conservation. Within this master plan the information on designation and review of the environmental conservation districts and assessment of hot spots at the national land level is incorporated from the viewpoints of forest conservation and revitalization plans, and biodiversity maintenance in Moldova's poor forest areas.

2. Contents of the work performed

2-1. Implementation Schedule

The schedule and a flowchart of the Study are shown on the following page.


Year
Phase
Month
2010
2011
2012
First Phase
Second Phase
Report・Seminor
Work in Moldova and Japan
On The Job Training
Collection of Data and Materials
Preparation of Inception Report
Explanation and consultation on the Inception Report
Seminor and Work Shop
Preparation of Interim Report
Explanation and consultation on the Interim Report
Seminor and Work Shop
Preparation of Draft Final Report
Explanation and consultation on the Draft Final Report
Seminor and Work Shop
Preparation of Final Report
Discusson on Map Specification
Collection of Existing Materials
Preparation of Field Work
Verification of Results from Existing Aerial Triangulation
Digital Plotting
Field Verification
Determination of the OJT Area Using Satellite
Procurement of Satellite Imagery
Digital Compilation
Aerial Triangulation
Consultation for dissemination of the data
Discussion for dissemination of the data
Consultation for dissemination of the data
Consultation for dissemination of the data
Preparation of Brochure for the Final Products
Preparation of Brochure for the Final Products
Discussion of Brochure for the Final Products
Sharing of the data via WEB site
Data Structurization
Map Symbolization
Creation of Digital Data File
Aerial Triangulation/Digital Plotting
Aerial Triangulation/Digital Plotting
Digital Compilation/Map Symbolization
Field Verification
Grand Control Point Survey
Data Structurization
Local Consultant Work
Work in Moldova
Work in Japan

2-2. First Phase

【1】 Preparation of Inception Report and meeting for its explanation

(1) Work in Japan

The Team prepared the Inception Report (in Japanese and in English) for the implementation of this study after having analyzed and studied the terms of reference, Report of the Detailed Design Formulation Study (draft) and collected references and held discussion with the counterpart organization on the policies on the study as a whole, technical work and technology transfer.

Meantime, map symbols were elaborated looking up 1) Specification for (proposed) symbols and output drawing on the Survey Operation Manual (for National Base Map) issued by JICA in December 2006 (hereinafter referred to “Survey Operation Manual”), 2) Specification for creation of map symbols issued by Geospatial Information Authority of Japan and the Standard for map symbols prepared former Soviet Union, which has been used in the mapping projects implemented by PASCO and KOKUSAI KOGYO.

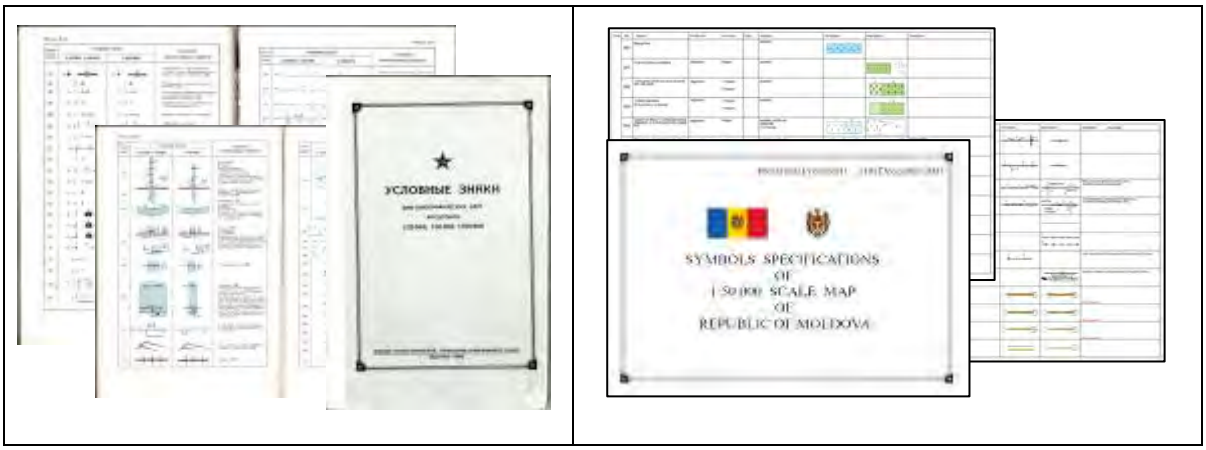


Figure 5 Booklet of Standard for map symbols used in former Soviet Union (Left), and a new specification of map symbols that is created by the Team

(2) Work in Moldova

The Team prepared the Inception Report on the basis of what was mentioned in the preceding paragraphs, explained the contents of the report to the counterpart personnel in Moldova and held discussion with them on the points on which they had questions. The contents of the discussion were summarized in the Record of Discussion on which the representatives of the both parties put their signatures.

Thirty-five staff members of the counterpart organization participated in the discussion.


Figure 6 View of the meeting for explaining I/C Report, Signing the M/M of the meeting

【2】 Gathering existing relevant data and Consultation

Collection and examinations were conducted for preparing necessary data to be needed in the Study.

Table 1 List of data collected

Item		Contents	Remarks
Data of existing aerial photographs	Aerial photographic Image Data	Aerial photos which were taken in the Orthophoto program sponsored by Norway	8,780 scenes
	Calibration report on the aerial camera	Specification of the camera used in the Norwegian project	2 types of digital cameras * DMC manufactured by ZI Imaging Co. * UltraCamD manufactured by Vexel Co.
	Results of Aerial Triangulation	Data obtained from Norwegian Orthophoto project	Computation data from aerial triangulation targeting 30,000 km^2 (PATB model, SummitEvolution model, ZI model)
	Report on quality control	Information concerning the quality control performed in the Orthophoto project	Detail descriptions formulated by the operated company and the counterpart
	Orthphotographs	Imagery in digital format	5,466 scenes
	Data for DTM	Data created in the Orthophoto project	
	Descriptions of GCP	GCP details recorded in the Orthophoto project	Not yet confirmed if all of them are available

Others	Date for geodetic reference points	GCP details recorded in the Orthophoto project	Available to refer through the Web Site disclosed by the counterpart. (http://www.geoportal.md/) (Only in Russian)
	Existing topographic maps (1:50,000)	Scanned raster data	135 sheets
	Administrative boundary data		
	List of codes for objectives	Criteria for plotting in the 1/5000 line mapping program that counterpart is involved in.	

【3】 Discussions of Specifications

(1) Map symbols

Specifications for symbols and other representations, those for data and other details necessary for creating 1:50,000 topographic map were seriously discussed among counterpart personnel and the Team. Both side eventually reached consent for which the M/M was prepared for detailing agreed issues.

(2) Quality control

The Team decided to practice quality management of the outputs of the Study in accordance with the Overseas Survey Operation Manual (for National Base Map, English Version) and the accuracy control sheet to be prepared at each stage of the work.

【4】 Verification of the Existing Aerial Triangulation Outputs

The Team examined the outputs of the aerial triangulation with the aerial photographs taken in 2007 obtained from the counterpart organization and verified that the values of horizontal positioning accuracy and X parallax were within the ranges of the allowances.

【5】 Preparatory work necessary for the field verification task

The Team contacted with a local company for the field verification to be conducted in the second phase. The field verification was conducted not only in areas where significant secular change was expected to have occurred but in the entire study area to incorporate the latest information in the 1:50,000 scale topographic map data to be created.

The Team selected the company described in the table below as the subcontractor of the field verification in a tender with the past experience and technical capacity taken into consideration.

Table 2 List of companies invited to the tender

Company Name	Address	Name of Director
"BLOM" Ltd	Valea Trandafirilor Str, 24A, Chisinau, MD Tel: (+ 373 22) 26 10 45 E-mail: office@blom.md	Vasile CHIRIAC

【6】 Selection of map sheet for OJT

The Team selected a map sheet for the OJT. The selected map sheet is for an area with a diversity of land use and many secular changes in the outskirts of Chisinau. Different types of topography including urban areas and hills are found in the area. The satellite image of the area was in the imagery procured in this study.

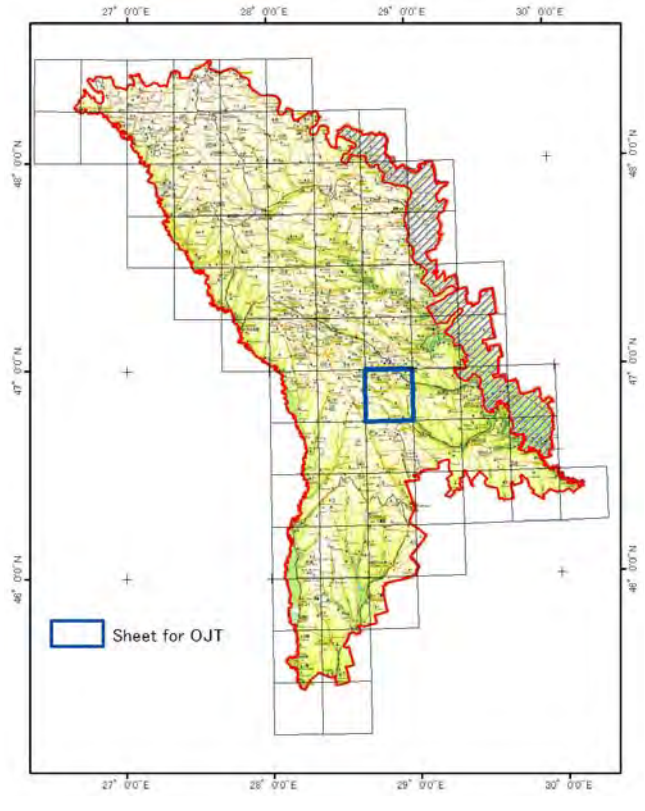


Figure 7 Map sheet for OJT

【7】 Holding Seminar and Workshop

With the aims of effective utilization of digital map data and outreach of the Study results, assuming that existing committee like NGIS or newly planned committee would be involved, technical seminar was held with attendance of administrative bodies and the presses.

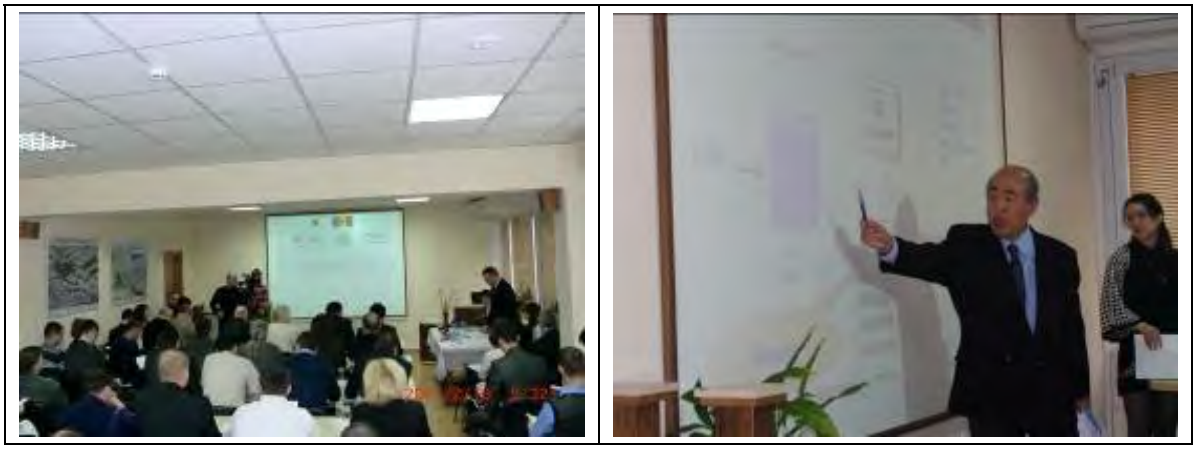


Figure 8 Seminar scenes

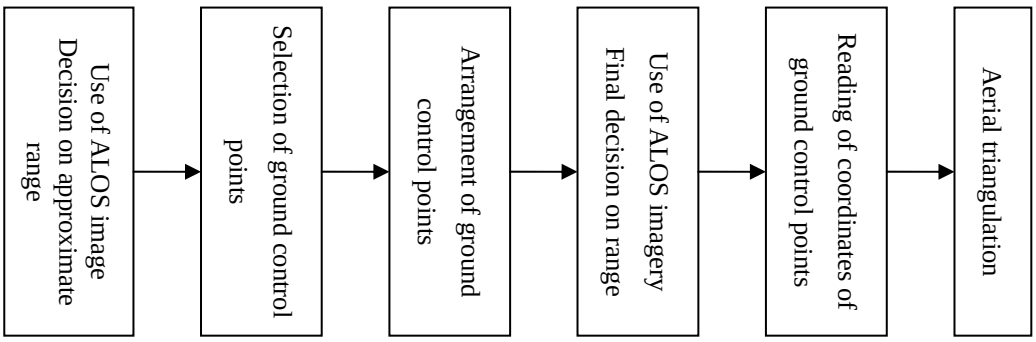
【8】 Facilitation of data dissemination and promotion of effective utilization

The Team carried out a user questionnaire in order to study the methods of the distribution of the output data, practical measures to promote the data use and new areas for the data use. In order to facilitate the use of the geospatial data, the team also visited the governmental organizations mentioned below which were potential users of the data for GIS, etc. and explained the outputs of this study to their staff members.

2-3. Second Phase

【1】 Ground Control Point survey

The satellite imagery used for plotting was assumed to be ALOS (PRISM) and the number of scenes was assumed to be 65 (approx. 20,700km^2). The local coordinate system used in the previous aerial triangulation was used in the aerial triangulation in the area. The following workflow was followed in the process of selection and adjustment of control points.



For the selected 138 ground control points, the approximate coordinates and images were summarized for the sake of subsequent tasks and listed in the ground control point detailed list.

【2】 Field Verification

This field verification operation was carried out not only on the area where significant secular changes were expected, but on the entire Study area in June and July 2011. The field verification is intended to be used not only as data for interpreting ground features, vegetation, etc. during digital plotting or digital compilation but also for facilitating up-to-date information on 1:50,000 topographic maps to be created.


Figure 9 Scene of field verification by the local subcontractor

【3】 Selection of Areas for the Use of Satellite Imagery and Procurement of the Satellite Imagery

The counterpart requested the Team regarding areas for satellite imagery because of the following reasons:

- Areas receiving damage from floods that occurred after the taking of existing aerial photographs (2007), i.e., in 2008 along the Dniester River and in 2010 close to the Romanian border
- Urban developments in the environs of the capital
- Lack of existing aerial photographs covering border

However, as the Team discovered later that it was difficult to obtain appropriate imagery taken by satellites other than ALOS, the Team and the counterpart had discussion on the satellite imagery and agreed on the procurement of the satellite imagery of the areas shown in the Figure 10 and the areas in which the satellite imagery was to be used for the creation of digital topographic map data (a total area of 13,800 km^2).

The total number of the scenes of satellite imagery procured for the Study was 159. (As three different images from three different directions are taken for a single area in the ALOS satellite imagery, the total number of models was 53.)

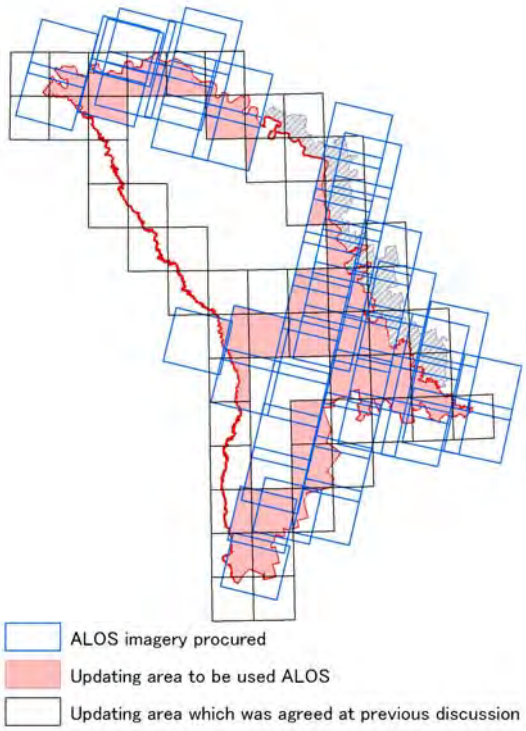


Figure 10 Areas for the procurement of satellite imagery and the areas for the use of satellite imagery for the creation of topographic map data provided in the final agreement

【4】 Aerial triangulation (Satellite images)

The Team implemented aerial triangulation using a digital photogrammetric system in order to construct stereo models required for digital plotting using the satellite imagery.

As shown in Figure 10, not all the scenes of ALOS imagery procured in the Study are contiguous. Therefore, separate adjustment calculation was conducted for the 42-scene (14 models x 3 scenes) area in the north and the 102 scene (34 models x 3 line) area in the south.

Figure 11 Scenes of the satellite imagery used in the aerial triangulation

【5】 Digital plotting

The satellite imagery and the existing aerial photographs were used for the digital plotting of areas of ca. 13,800 km^2 and 16,200 km^2, respectively, in the total study area of 30,000 km^2. The digital plotting systems used in the two plotting procedures are shown in the table below.

	Software Name
Digital Photogrammetric System	Summit Evolution LPS
Data Plotting	AutoCAD Map MicroStation

【6】 Digital compilation

The digital compilation task included the integration of line data, data cleaning such as deletion of obsolete data, edge matching of adjacent maps on the vector data resulting from the digital plotting task, while compiling the data according to the field verification results.

【7】 Data Structurization / GIS Database

The data for which the digital compilation is completed was structurized in GIS-applicable ways, according to the agreements reached in the discussion on the specifications. The format of the GIS database created by the structurization is the Geodatabase Format used in "ArcGIS," software of ESRI.

The data was structurized by map sheet. The figures below show the processes of data structurization by map sheet.

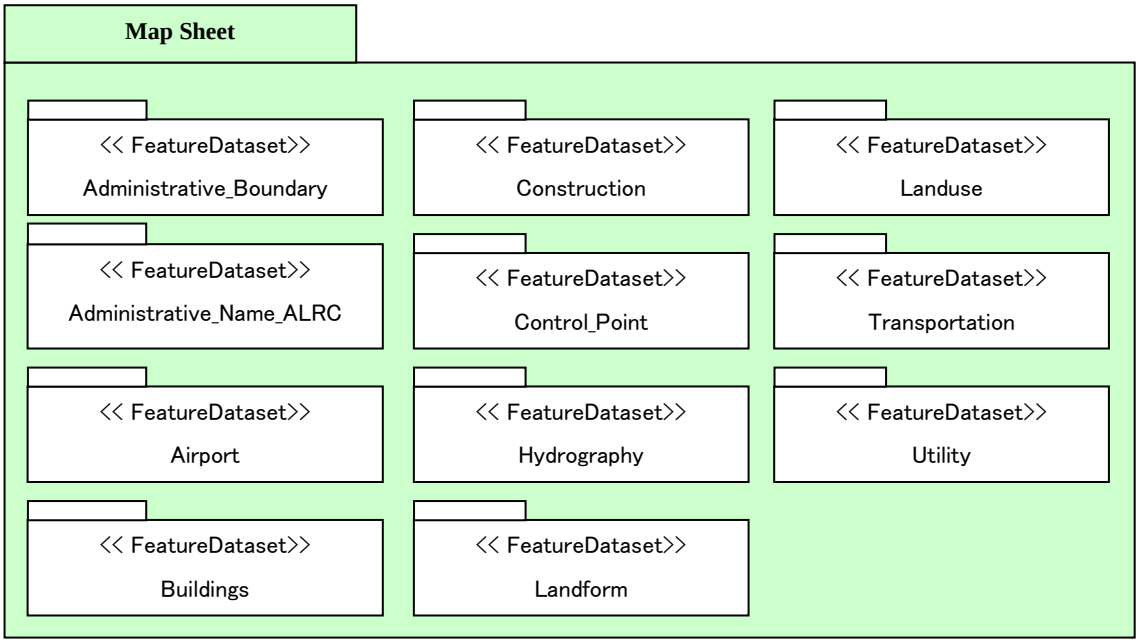


Figure 12 UML class diagram of GIS data

【8】 Map symbolization

The Team created topographic map data from the digitally compiled data by applying the map symbols determined at the discussion on specifications to the digitally compiled data and by processing them in the map adjustment.

The figures below show an example of map symbolization.

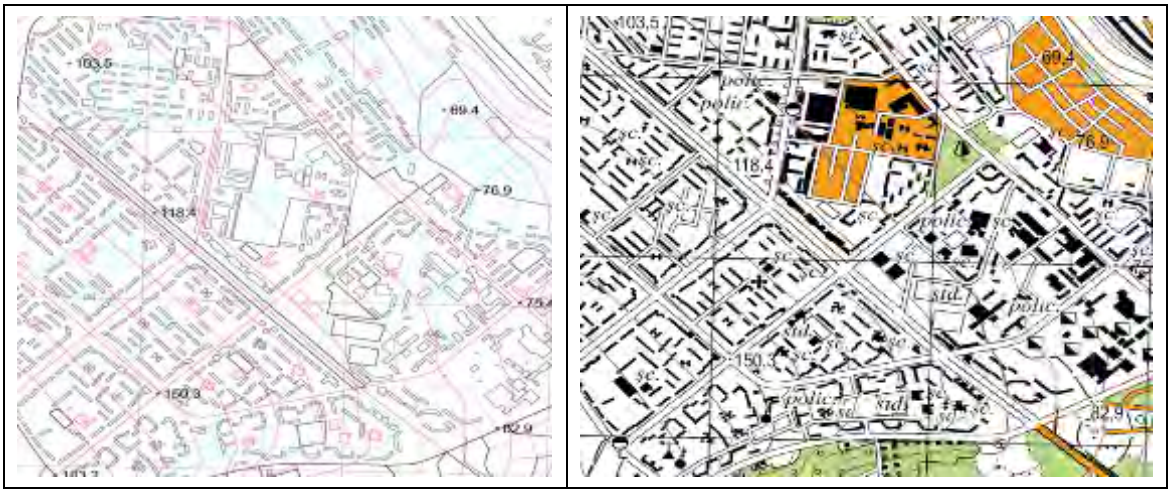


Figure 13 Maps before the symbolization (left) and after the symbolization (right)

【9】 Creation of brochures

As a tool of data use promotion, a brochure summarizing the contents and outputs from the Study has been prepared under agreement between the ALRC and the Team.

The brochure contains following topics.

- Mission of ALRC
- Historical review
- Aim of the Study and brief introduction of outputs
- Contribution to Moldova and ALRC
- Implication of active data utilization
- Implementation structure of the Study

【10】 Creation of digital data files

The topographic map data, GIS database and so on were saved and stored in removable storage media. As the total size of the data including the satellite imagery was approx. 100 GB, the data was saved on an external hard disk.

【11】 Holding Seminar

The seminars were held twice during the 2nd phase.

In the interim seminar, intermediate achievement was presented and participants were encouraged to utilize newest geospatial data to be prepared at a wide variety of scenes in each organization. A total of 73 people from 15 government offices including the Cabinet Office, 9 national organizations and 21 research institution/state enterprises attended in the seminar.

Figure 14 Interim Seminar scenes

The final seminar has been held to call for the positive use of created data by demonstrating the outputs published by ALRC. A final seminar was on 1st November, 2012 with approximately 130 participants from related ministries, agencies, organizations and academia.

Figure 15 Final seminar scenes

【12】 Discussion of Draft Final Report

The Team explained about the Draft Final Report to the counterpart and discussed the contents, the result and other details of the Study.

3. Technology Transfer

The Team transferred the latest technologies required for the creation of digital geospatial data to the staff members of the counterpart organization. The transferred technologies were those used in ground control point survey, field verification, aerial triangulation, digital plotting/compilation and map symbolization.

3-1. Equipment installed for implementation of Technology Transfer

The Team held discussion with the counterpart organization on equipment and materials for the technology transfer. The team ordered and procured the equipment and materials described in the table below on the basis of the outcomes of the discussion.

Table 3 List of materials and equipment for technology transfer

Equipment	Q'ty	Place of procurement
GPS survey equipment	2	Procured in Japan
GPS analysis software	1	Procured in Japan
Note PC for GCP survey analysis	1	Procured in Japan
Handy GPS receiver (with rechargeable batteries)	4	Procured in Japan
Digital camera (with data storage media)	4	Procured in Japan
Basic software for Aerial Triangulation (AT), digitization and compilation	1	Procured in Japan
Software for AT, digitization and compilation (Stereo viewing)	1	Procured in Japan
Software for AT (Block adjustment)	1	Procured in Japan
Software for AT (DEM generation)	1	Procured in Japan
Basic software for digitization and compilation	1	Procured in Japan
Software for digitization and compilation (DEM editing)	1	Procured in Japan
Software for digitization and compilation (Data acquisition)	1	Procured in Japan
Software for digitization and compilation (Data editing)	1	Procured in Japan
GIS structurization software	1	Procured in Moldova
GIS utilization software (3D analysis)	1	Procured in Moldova
GIS utilization software (Spatial analysis)	1	Procured in Moldova
GIS utilization software (Network analysis)	1	Procured in Moldova
Map symbolization software	1	Procured in Japan
Image processing software	1	Procured in Japan
Workstation (for the digital plotter)	1	Procured in Japan
Personal computer	1	Procured in Japan

Equipment	Q'ty	Place of procurement
Printer (A3 size, with supplies)	1	Procured in Moldova
Stereoscopic display	1	Procured in Japan
Mouse for photogrammetry	1	Procured in Japan
HDD for the data server	1	Procured in Moldova
Compound machine（map scanner and printer for printed maps）with supplies (A0size)	1	Procured in Moldova
Uninterrupted power supply (UPS)	2	Procured in Moldova

3-2. Ground Control Point Survey

The table below shows the contents of the technology transfer in ground control point survey. The technology transfer described below was implemented in accordance with this plan.

Table 4 shows the five staff members of the counterpart organization who participated in the technology transfer.

Item	Description	Main aims
GCP survey, leveling, and analysis	Field reconnaissance for selection of GCPs	・ Understanding about GCP survey indispensable for creating topographic map data (with the use of satellite imagery, in particular). ・ How to use GPS equipment and conduct analysis with it. ・ How to make pricking. ・ How to formulate a description of GCP.
	GCP survey	
	Leveling	
	Analysis	

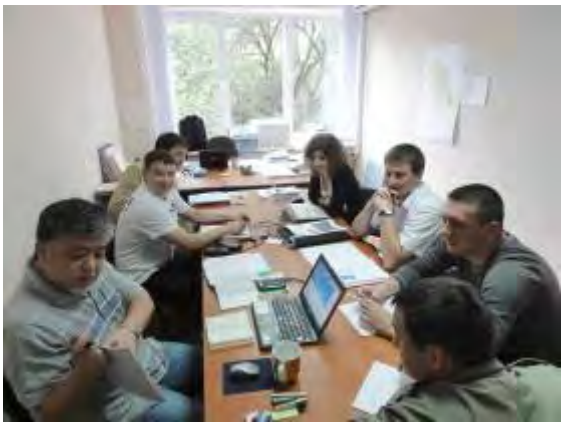
Table 4 Participants of the technology transfer in ground control point survey

	Participants	Affiliation
1	Mr. BOLOHAN Ion	ALRC
2	Mr. DANII Ivon	ALRC
3	Mr. MIHOV Vladimir	ALRC
4	Mr. EREMIA Ion	ALRC
5	Mr. NAGORNEAC Constantin	INGEOCAD

The Team established the indicators and their target values for the evaluation of the level of achievement of the technology transfer in field verification as shown in the table below. The team confirmed that both target values had been achieved.

Evaluation item	Index	Target level	Result
Participation in technology transfer	Number of days of participation	80% or higher	100% participation
Result of test observation and analysis	GPS observation field book and calculation book	Within accuracy of required quality	Achieved

Test observation



Indoor training

Figure 16 Technology transfer (in ground control point survey)

3-3. Field Verification

The table below shows the contents of the technology transfer in field verification. The technology transfer described below was implemented in accordance with this plan.

Table 5 shows the five staff members of the counterpart organization who participated in the technology transfer.

Item	Description	Main aims
Field verification	Preliminary photo interpretation	・ How to conduct preliminary photo interpretation ・ Method for field verification using orthophotos ・ Method for field verification depending on map scale ・ How to make use of a handy GPS receiver ・ How to make use of a GPS-enabled digital camera ・ How to organize the field verification result
	Field verification	
	Organization of field verification results	

Table 5 Participants of the technology transfer in field verification

	Participants	Affiliation
1	Mr. BOLOHAN Ion	ALRC
2	Mr. DANII Ivon	ALRC

3	Mr. MIHOV Vladimir	ALRC
4	Mr. EREMIA Ion	ALRC
5	Mr. NAGORNEAC Constantin	INGEOCAD

The Team established the indicators and their target values for the evaluation of the level of achievement of the technology transfer in field verification as shown in the table below. The team confirmed the successful transfer of the technologies for field verification in the evaluation using these indicators and targets.

Evaluation method		Index	Target level	Result
Willingness to participate in technology transfer		Number of days of participation	80% or higher	100% participation
Actual operation	Preliminary photo interpretation	Understanding of preliminary photo interpretation operation	Field verification items to be checked are marked on orthophotos.	No problem
	Field verification	Accurate field verification of verification items	Using handy GPS receivers, verification results are recorded at accurate positions using specified symbols.	No problem
	Organization	Organization of verification results on new orthophotos	All the verified items are transcribed.	No problem

Teaching by the Team member

Field verification by the counterpart engineer

Figure 17 Technology transfer (in field verification)

3-4. Aerial Triangulation

The table below shows the contents of the technology transfer in aerial triangulation. The technology transfer described below was implemented in accordance with the plan.

Table 6 and 7 shows the six staff members of the counterpart organization who participated in the technology transfer.

Item	Description	Main aims
Aerial triangulation	In the case where satellite imagery is used In the case where aerial photographs are used	・ How to operate the hardware and software ・ How to import satellite imagery/aerial photographs and the result of the GCP survey ・ Difference between satellite imagery and aerial photographs ・ How to evaluate a report on the result of aerial triangulation

Table 6 Participants of the technology transfer in aerial triangulation (1st half) (December 2011)

	Participants	Affiliation
1	Ms. Rudenco Tamara	ALRC
2	Ms. Svetlana Zaharchina	INGEOCAD
3	Mr. Paharikov Igor	INGEOCAD
4	Ms. Scurtu Cristina	INGEOCAD

Table 7 Participants of the technology transfer in aerial triangulation (2nd half) (April–May 2012)

	Participants	Affiliation
1*	Ms. Svetlana Zaharchina	INGEOCAD
2*	Ms. Scurtu Cristina	INGEOCAD
3	Ms. Cusnir Lucia	ALRC
4	Mr. Sergiu Chirilor	Military Topography Centre, Ministry of Defense

*: participation in both 1st and 2nd

Figure 18 Technology transfer (in aerial triangulation)

3-5. Digital Plotting

The table below shows the contents of the technology transfer in digital plotting. The technology transfer described below was implemented in accordance with this plan.

Table 8 shows the four staff members of the counterpart organization who participated in the technology transfer.

Item	Description	Main aims
Digital plotting	In the case where satellite imagery is used In the case where aerial photographs are used	・ How to operate the hardware and software ・ How to acquire data by data type ・ How to acquire feature data at different map scales (difference in the specifications for data acquisition by difference in plotting scale and ground resolution) ・ How to inspect plotted data

Table 8 Participants of the technology transfer in digital plotting

	Participants	Affiliation
1	Ms. Svetlana Zaharchina	INGEOCAD
2	Ms. Scurtu Cristina	INGEOCAD
3	Ms. Cusnir Lucia	ALRC
4	Mr. Sergiu Chirilor	Military Topography Centre, Ministry of Defense

The team decided to have practice with the materials provided by the participants as requested by them in the second half of the technology transfer. As the team was convinced that the participants could carry out digital plotting independently by solving problems by themselves through trial and error after the completion of the technology transfer from the observation of their activities in the practice, the team has concluded that the main aims of the

technology transfer in digital plotting have been achieved.

Figure 19 Technology transfer (in digital plotting)

3-6. Digital Compilation

The table below shows the contents of the technology transfer in digital compilation. The technology transfer described below was implemented in accordance with this plan.

The table 9 below shows the five staff members of the counterpart organization who participated in the technology transfer.

Item	Description	Main aims
Digital compilation	Optimization of plotted data	・How to operate the software ・Understanding of data cleaning ・Understanding of methods to correct various types of errors
	Creation of topology for GIS data	・Understanding of the creation of topology of line, point and polygon data ・Understanding of methods to correct various types of errors

Table 9 Participants of the technology transfer in digital compilation

	Participants	Affiliation
1	Mr. Cebanu Alexandru	ALRC
2	Mr. Rudenco Tamara	ALRC
3	Mr. Nagornese Constantin	INGEOCAD
4	Mr. Paharicov Igor	INGEOCAD
5	Mr. Andrei Ceban	Military Topography Centre, Ministry of Defense

The quality of the result of the practice on digital compilation produced by the participants

themselves, an indicator of the level of their understanding of the transferred technologies, was good. Many of the questions that they asked during the technology transfer were related to their ordinary work. The Team expects further improvement of their technical capacity with their self-help effort from the above-mentioned observation.


Figure 20 Technology transfer (in digital compilation)

3-7. Map Symbolization

The table below shows the contents of the technology transfer in map symbolization. The technology transfer described below was implemented in accordance with this plan.

The table 10 below shows the seven staff members of the counterpart organization who participated in the technology transfer.

Item	Description	Main aims
Map symbolization	Allocation of symbols onto topographic map data.	・How to operate the software ・Understanding of map symbols ・Priority order among the symbols (establishment of an order among layers) ・Representation of symbols on maps of different map scales (creation, transfer and cartographic generalization of map symbols by data type) ・Inspection methods ・Understanding of spot colors and process colors ・Difference between final prints and plotter printouts

Table 10 Participants of the technology transfer in map symbolization

	Participants	Affiliation
1	Mr. Cebanu Alexandru	ALRC
2	Ms. Rudenco Tamara	ALRC
3	Mr. Nagornese Constantin	INGEOCAD
4	Mr. Paharicov Igor	INGEOCAD
5	Mr. Andrei Ceban	Military Topography Centre, Ministry

		of Defense
6	Ms. Mutac Liubomira	INGEOCAD
7	Ms. Chiriac Ioana	INGEOCAD

The focus of this technology transfer was on the transfer of technologies on the operation required for the symbolization in the Study using the data obtained in the OJT and manuals prepared beforehand and creation of symbolized data, because the counterpart was familiar with the operation of the older version of Illustrator through the use of it in their ordinary work. Thus their understanding on map symbolization was deepened.

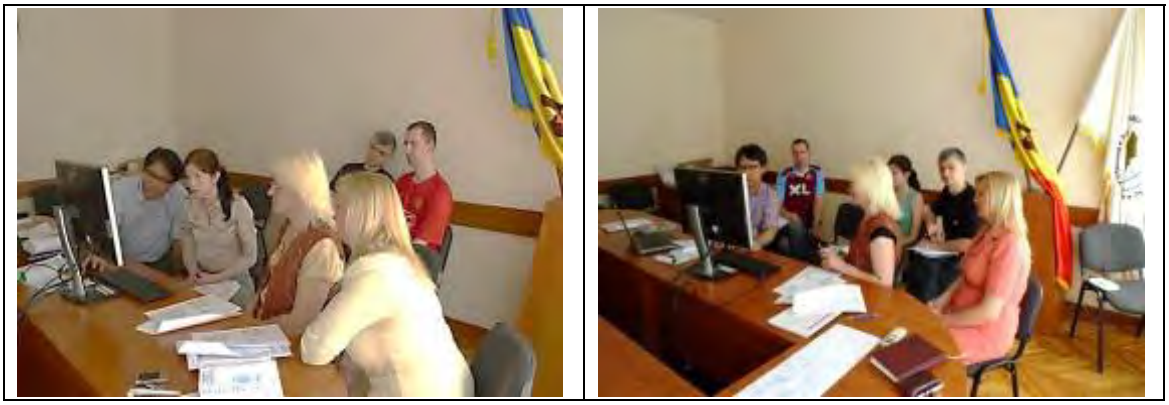


Figure 21 Technology transfer (in map symbolization)

3-8. Data Structurization/GIS Database

The table below shows the contents of the technology transfer in data structurization/GIS database. The technology transfer described below was implemented in accordance with the plan.

The table 11 below shows the five staff members of the counterpart organization who participated in the technology transfer.

Item	Description	Main aims
Data structurization / GIS database	Structurization of digital data Creation of a database	・ Understanding of the concept of GIS ・ How to operate GIS software ・ How to create GIS data from compiled data ・ How to create topology and correct errors ・ How to use the GIS data

Table 11 Participants of the technology transfer in data structurization/GIS database

	Participants	Affiliation
1	Ms. OVDII Maria	ALRC
2	Ms. RUDENCO Tamara	ALRC

3	Mr. DANII Ivan	ALRC
4	Mr. PAHARIKOV Igor	INGEOCAD
5	Mr. RORLOGA Iurii	Institute of Pedology, Agrochemistry and Soil Protection "Nicolae Dimo"

Figure 22 Technology transfer (in data structurization/GIS database)

The Team concluded that the participants had the basic knowledge of GIS data on the basis of the result of the questionnaire and hearing survey conducted before the technology transfer. Therefore, the team explained examples of quality management of geospatial information data in Japan to the counterparts in most parts of the technology transfer to urge them to discuss how they should use and extend the use of the methods for the quality management of the geospatial information data among them.

The counterpart already has the basic technologies required for creation and updating of geospatial information data. Therefore, the Team concludes that the counterpart will be able to implement the work practiced in the Study without problems.

4. Promotion and Extension of the Use of Geospatial Data

4-1. The Current State and Future Trends of the Use of Topographic Map Data

The Team examined the current state and future trends of the use of topographic map data of Moldova in order to extend the use of the output of the Study, geospatial data, and promote its application.

4-1-1. Current State of the Use of Map Data

(1) Users of Topographic Map Data and their Demands as revealed by a questionnaire survey

In the first seminar held in Phase 1, questionnaires were distributed to ask the participants about their usage of topographic data which were created by ALRC. The results were analyzed to grasp the tendency of map data utilization.

- Demand for Geospatial Data and its Future

The respondents were mainly government organizations involved in policies relating to agricultural development, geological and resource surveying, meteorological observation, urban development, the natural environment, etc. It is supposed, therefore, that the principal users of 1:50,000 topographic maps are mainly this kind of ministry, agency or organization. Furthermore, these organizations are very familiar with GIS technology and many of them answered that they "want to use" or "feel the need to use" it in their daily operations. It can be easily estimated, therefore, that the demand for topographic map data, particularly digital data, will increase in the future, centering on these organizations.

From the questionnaire results, it is considered desirable to build a digital database of geographical information and distribute it over the Web in order to expand the demand for topographic map data. In this case, it is advised that ALRC should play a central role in distributing and updating this data, and that a system offering easy access and a method of providing low-cost, speedy services should be considered in terms of both the hardware and software components.

- For the Promotion of the Use of Geospatial Data

Looking at the methods by which the user organizations acquire and use topographic map data and the types of data they use, we see that the most frequently used is topographic map data mainly to a scale of 1:50,000 and 1:5,000, and the most frequent type of data acquisition is digital data. For other map scales, paper-based maps still seem to be being used. In order to dramatically expand use of the data, ALRC needs to inform general users of the versatility, ease

of updating and ease of other handling of digital topographic map data, which can be compatible to any map scale.

Improvement in the quality of the Web distribution of topographic map data is important as an effective means to expand its use.

(2) Distribution of Geospatial Data through the Internet and its Current and Future Use

ALRC has constructed a Geoportal System (http://geoportal.md/) for users of topographic map data both inside and outside Moldova and distributed the data to users widely through the Internet in order to promote the use of geospatial data over a wide area. The access record to the Geoportal reveals that approx. 2,000 users visit every weekday to gather geographic information (ortho data and topographic map data) through it at present (Google Analytics Survey 2012).

The survey result revealed that the total number of accesses to the Geoportal in the period of approx. one year (August 2011 – September 2012) was 471,859 and that approx. 80 % of the visitors were returning users. Users in Moldova accounted for approx. 94 % of the geoportal users, while those in the three neighboring countries, Ukraine, Romania and Russia, accounted for 2.5 %. In addition, there were approx.1,000 accesses from European countries including Italy and Germany.

4-1-2. Distribution and Use of Geospatial Data at the Web Site

(1) Types of Distributed Data

ALRC is currently supplying data including orthophotos to ordinary users through Web distribution as a means to extend and promote the use of geospatial data in a wide area as mentioned above.

The following geospatial data is available from the Geoportal System:

- ✓ Orthophotos;
- ✓ Raster topographic maps (1:50,000) created from paper maps; and
- ✓ DTM created from orthophotos.

The outputs of this project, digital topographic maps (1:50,000), will also be made available from this Geoportal System.

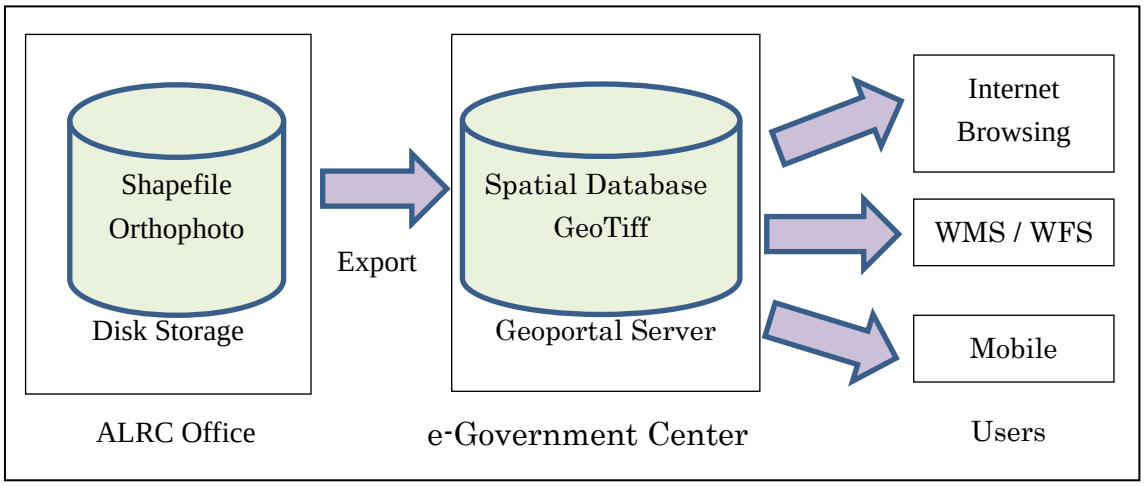


Figure 23 Flow of geospatial data

(2) Functions of the Geoportal System

The Geoportal System provides its users with features including browsing, sharing, editing and analysis of geospatial data. Its main functions include:

- ✓ user management;
- ✓ printing map images;
- ✓ distance and area measurement;
- ✓ editing layers;
- ✓ map data query (import/export);
- ✓ data publishing using WMS/WFS;
- ✓ routing; and
- ✓ mobile access from smartphones.

The Geoportal operated by ALRC provides these functions at present. Registered users can be benefit from those services free of charge.

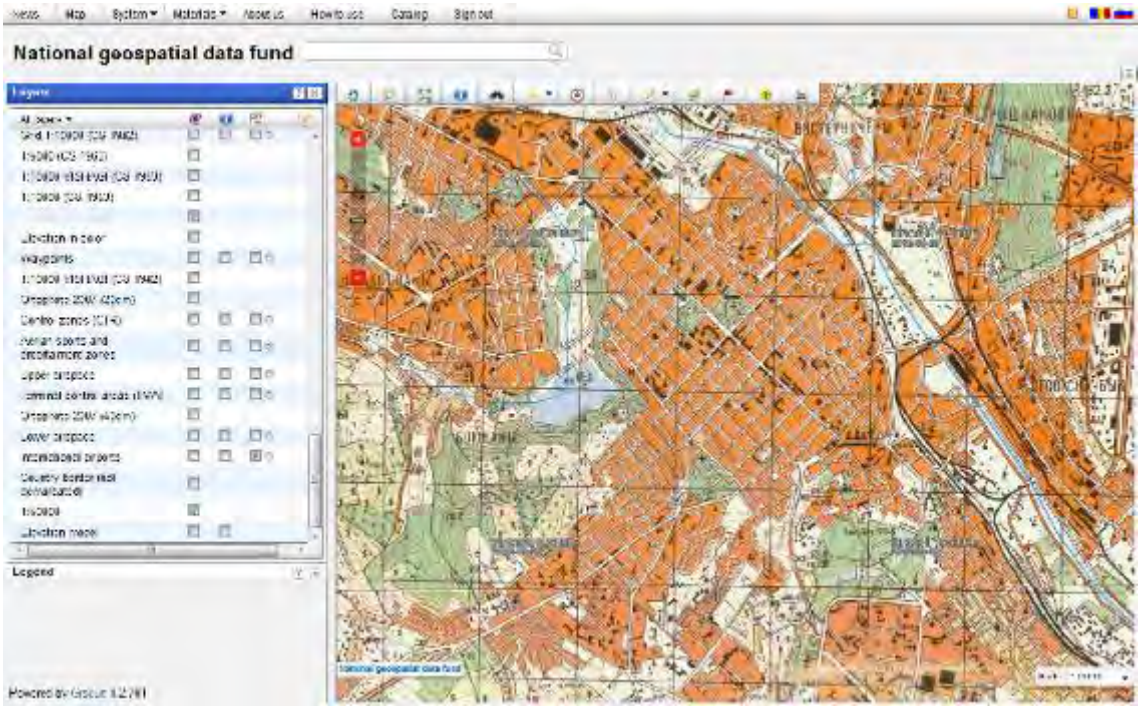


Figure 24 An example of icons with functions to use data services on the screen of the Geoportal

4-2. Problems in Supply of Data and Sound Data Distribution

4-2-1. Technical Problems in Distributing Large Amounts of Data

The Geoportal system in operation is a data distribution system on the Web developed for the distribution of orthophotos in the orthophoto project assisted by Norway. The functions in the system are still being expanded and new data for distribution is still being added to the system. The current state and components of the system are described in the following.

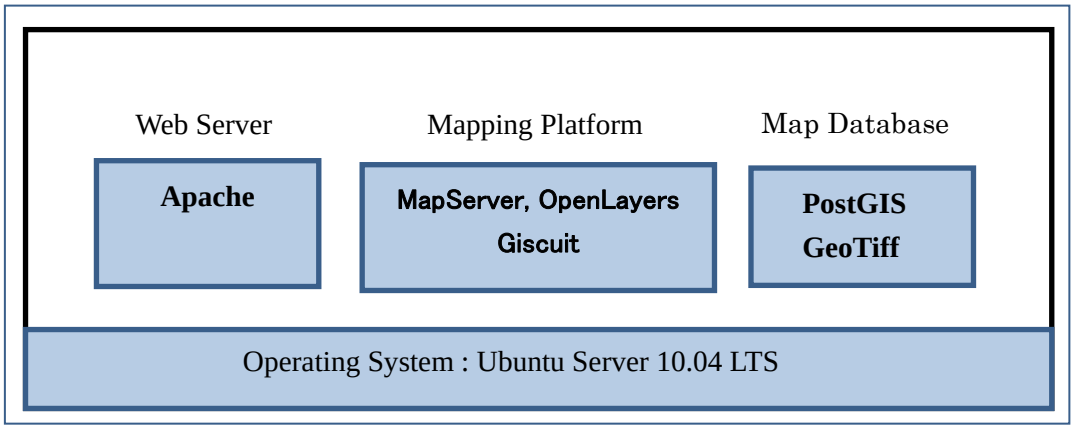


Figure 25 Components of the system

The original plan was to use the server currently in use at the e-Government Center located at a different place from ALRC for the distribution of the output data of the Study, geospatial data (1:50,000 digital topographic data). However, it was revealed later that the capacity of the server installed in the center was too small to handle the new output, the GIS data. Therefore, it was decided that a new server was to be installed as part of this project.

This new server shall have a larger capacity disk, faster CPU and more memory than the existing one in order to accommodate the new geospatial data to be added.

4-2-2. Prospects for the Dissemination and Promotion of the Use of Geospatial Data in Future

ALRC has decided to connect its geospatial data to INSPIRE (Infrastructure for Spatial Information in Europe) in accordance with a policy of the government and has been making preparation for the connection.

Creation of geospatial data and reconstruction of the Geoportal System will be required to make the system compatible with INSPIRE. The major requirements include the following:

A. Conformity to the Implementing Rules shall be required for the following:
   1. Metadata
   2. Data Specifications
   3. Network Services
   4. Data and Services Sharing
   5. Monitoring and Reporting

B. Geospatial data shall be compatible with that of neighboring countries, as there is the need to match geospatial data of rivers, roads and railways crossing national boundaries at the boundaries to make geospatial data seamless in the EU Zone.

Meanwhile, ALRC wishes to replace the Geoportal System currently in use with a new geoportal system based on ArcGIS as a measure to make its system compliant with international standards such as ISO and INSPRIRE. Such replacement will require a study on the cost of introducing the new system and assistance to engineers.

4-2-3. Problems in the Management and Operation of the Geoportal System

ALRC is still trying to promote and extend use of geographic information to the public by improving the geoportal for the distribution of geospatial data consisting of ortho data and topographic map data on the Web. However, ALRC has no expert responsible for designing a

data distribution system and technical maintenance of the system. The Geoportal system in operation is mostly managed and operated by two staff members. A full-time worker of ALRC is responsible for the management of the geospatial data and system administration, while an outsourced local consultant is taking charge of system development and maintenance. ALRC pays 4,000 euros a year to the consultant for his/her service as a necessary expense. ALRC always have trouble finding budget to pay the expense. ALRC depends on outsourcing for the establishment of a new geoportal with a new data distribution system. ALRC cannot be considered to have a financially and technically stable foundation for the reasons mentioned above.

Establishment of an independent system for the management and maintenance of the geospatial data system is urgently required in order for ALRC to respond to users with a wide variety of individual needs.

The distribution of topographic map data is being provided free of charge at present. However, if the costs of maintaining the system including the payment to the consultant mentioned above are taken into consideration, the operating costs of ALRC will increase. Such an increase will be a financial burden, which hinders establishment of sound operation of the organization and investment in new technologies. ALRC is considering charging fees for the provision of some types of data in future. Establishment of a sound financial foundation will be a significant future task for ALRC. A study on distribution of data with fees, which are decided on the basis of appropriate cost calculation, and introduction of independent accounting systems to some departments are among the measures to establish such foundation.

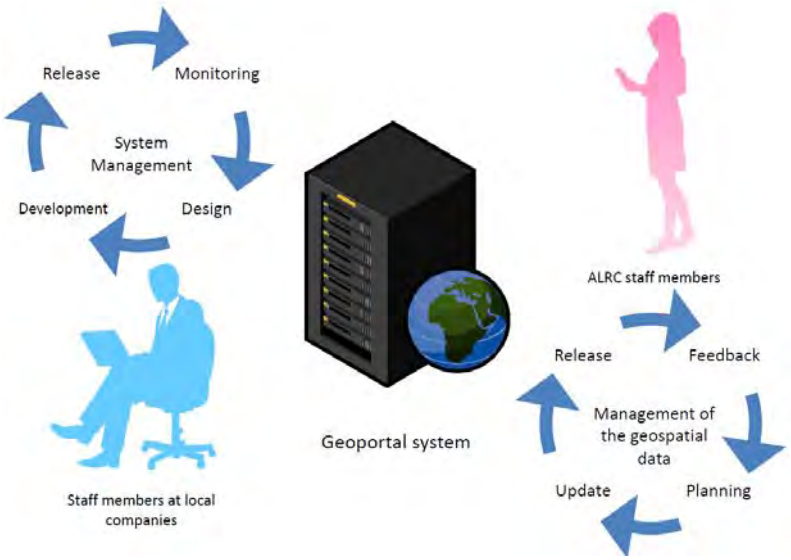


Figure 26 Conceptual diagram of the operation and management of the Geoportal for data distribution

5. Recommendation

5-1. The challenge to face

ALRC, the main counterpart, is composed of four departments including the Administrative Department. The main duty of these departments is technical supervision of geodetic surveys and map creation. The actual technical work is implemented by four state enterprises, including INGEOCAD which supervises the work. Personnel of ALRC are engaged in accuracy control, operational management and establishment of operating procedures. In this sense, they are considered to be performing the duty of management engineers who need to have highly-sophisticated knowledge and experience. At present, while ALRC has many staff members who are generally classified as administrative workers, it has very few middle-level engineers who are engaged in the actual work of surveys and map creation.

Moldova has achieved great success in organizing land information, creation of cadastres for land property management and creation of orthophotos for national land protection and management with assistance from donors, such as the World Bank and Norway, since its independence from the former Soviet Union in 1991. However, it is behind the neighboring countries and countries in Europe in the areas of geographic information technology, mapping and photogrammetry.

The implementation of the Study has brought the latest technologies and equipment for map creation to Moldova. From now on, the Moldovan side will have to use such tangible and intangible assets to update geospatial data and to improve, expand and reform organizational structure including staff composition so that new maps can be created without external assistance.

The implementation of this project has also enabled the launch of the “New Geoportal,” a data delivery system from the GIS database using the e-Government Center, for further reinforcement of efforts for the promotion and extension of the use of the data created in the Study.

5-2. Recommendation

Establishment of a System for the Use of Geographic Information as an Essential Tool for the Realization of National Strategies

The digitization of the geospatial data of the land of Moldova achieved in the Study will contribute significantly to accurate planning in a short time of the measures for the land conservation and national development, including urban planning, development of road and transport networks, measures against meteorological disasters, disaster prevention measures,

cadastre management, agricultural measures, forest conservation and conservation of the natural environment. It will be essential to use the digitized GIS data as a tool to support decision-making on policies, in particular. It will be necessary to realize the following measures intended for promotion of use and application of the output data quickly.

1. Upgrading of the geoportal so that it ensures quick access to the GIS database
2. Conformation of the data created in the study to the European standards (INSPIRE) for technical integration of the data at the international level after the establishment of GIS and enactment and amendment of laws required for the conformation
3. Establishment of NSDI, one of the national development strategies of Moldova, in the near future

Partial Reorganization and Modernization of the Administration Concerning Surveys and Mapping in Moldova

The state enterprises and ALRC are independent organizations performing separate functions at present. However, their technical levels do not satisfy the international standards for map creation organizations. The state enterprises have capacity to use new technologies for digital mapping for large-scale topographic and cadastral maps because they have young and relatively competent mapping and survey engineers. The Team recommends that the Moldovan side conducts a study on the standards for the new organizational design which can fully respond to technical requests for digital mapping from both inside and outside the country and administrative needs by incorporating the technical capacity mentioned above into the implementation system in the national administration on map creation and use, restructuring the existing organization of ALRC and developing a legal system. The team recommends that the Moldovan side make efforts to reform ALRC to an organization providing geospatial data services which deserves to be a member of the e-Government which is advocated by the Government of Moldova.

Establishment of a Sound Fiscal Base ALRC

The topographic map data are distributed from the Geoportal free of charge at present. However, the inclusion of the new geospatial data in the distribution service is expected to increase the operating costs of the service. Therefore, the Team recommends that ALRC introduces a fee-charging data distribution system applicable to certain types of data and services with the fees decided on the basis of appropriately calculated costs and an independent accounting system to the Service Department for the establishment of a sound fiscal base.

To Bear a Role of an Opinion Leader

At present, neither ALRC nor INGEOCAD can serve as an opinion leader in the NGIS Committee sufficiently, because neither has sufficient human resources or equipment in GIS technology. Therefore, the Team hopes for upgrading of the level of technical advice and other services provided by the council by establishing its secretariat in the new organization to be created and assigning experts to the secretariat to provide those services.