

Ukraine

The State Service of Ukraine for Geodesy, Cartography and Cadastre (SSGCC)

The State Land Cadastre Center (SLCC)

**Creation of a National Geospatial Data
Infrastructure
in Ukraine
Final Report**

March 2018

Japan International Cooperation Agency (JICA)

Kokusai Kogyo Co., Ltd.

PASCO CORPORATION

Exchange Rate

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1 UAH=3.94JPY (OANDA rate, March, 2018)

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Creation of a National Geospatial Data Infrastructure in Ukraine

Map of the Project Location



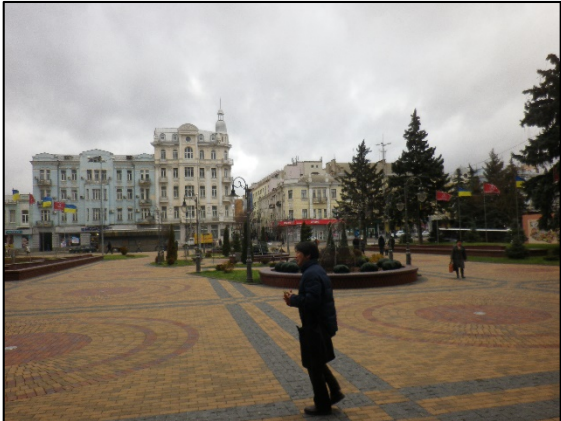
Photo Album



Office of SSGCC



Office of SLCC



Pilot Areas(Vinnytsia)



Pilot Areas(Vinnytsia)



1st Seminar



1st Seminar



Aerial Photography(Aircraft)



Aerial Photography(Digital Aerial Camera)



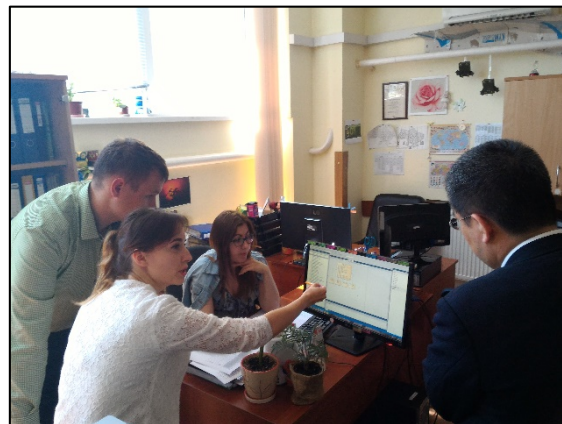
Specification



Specification



Product Specification



Product Specification



Technology Transfer (Field Identification)



Technology Transfer (Field Identification)



1st Collaboration with Operation Guidance Study Team



1st Collaboration with Operation Guidance Study Team



1st Training in Japan



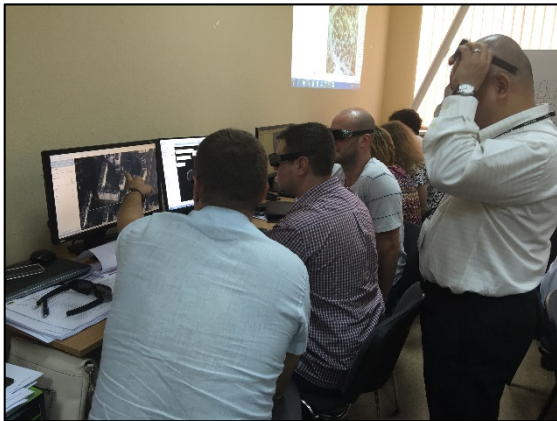
1st Training in Japan



Standards for Geographic Information



Standards for Geographic Information



Technology Transfer (Photogrammetry)



Technology Transfer (Photogrammetry)



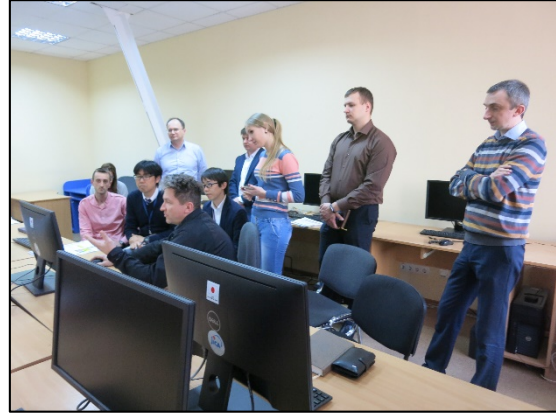
NSDI System Development



NSDI System Development



NSDI System Development



NSDI System Development



2nd Seminar



2nd Seminar



2nd Collaboration with Operation Guidance Study Team



2nd Collaboration with Operation Guidance Study Team



2nd Training in Japan



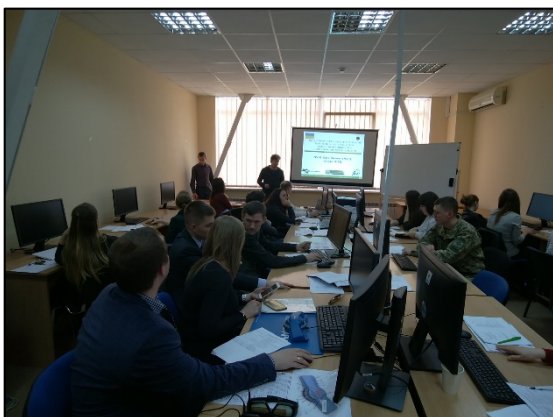
2nd Training in Japan



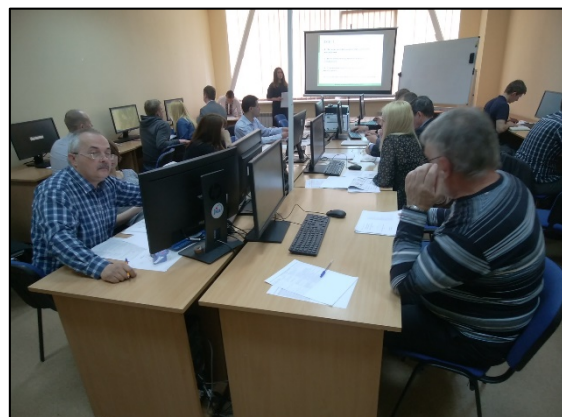
International Conference



International Conference



Workshop



Workshop



3rd Training in Japan



3rd Training in Japan



Inception Report (Explanation and Discussion)



Inception Report (Explanation and Discussion)



Interim Report (Explanation and Discussion)



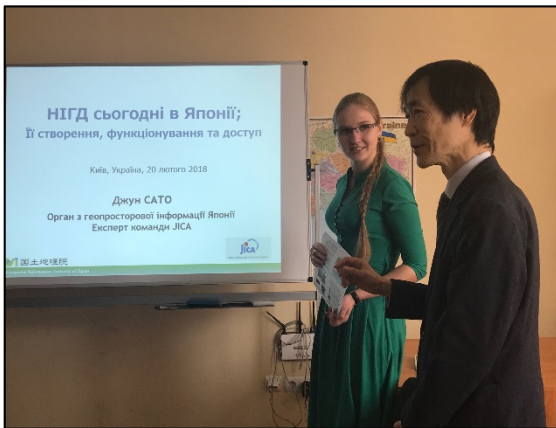
Interim Report (Explanation and Discussion)



Draft Final Report (Explanation and Discussion)



Draft Final Report (Explanation and Discussion)



3rd Collaboration with Operation Guidance Study Team



3rd Collaboration with Operation Guidance Study Team



3rd Seminar



3rd Seminar

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Abbreviation

API	Application Programming Interface
C/P	Counterpart
DTR	Department of Technical Regulation, Ministry of Economic Development and Trade of Ukraine
EU	European Union
FGDC	Federal Geographic Data Committee
GNSS	Global Navigation Satellite System
GIS	Geographical Information System
GSDI	Global Spatial Data Infrastructure
GSI	Geospatial Information Authority of Japan
IMF	International Monetary Fund
IMU	Inertial Measurement Unit
INSPIRE	Infrastructures for Spatial Information in the European Community
ISO	International Organization for Standardization
ISO/TC211	Technical Committee 211 Geographic information/Geomatics
IT	Information Technology
JICA	Japan International Cooperation Agency
JIS	Japanese Industrial Standards
JMP	Japan Metadata Profile
JPGIS	Japan Profile for Geographic Information Standards
JSGI	Japanese Standards for Geographic Information
KML	Keyhole Markup Language
MEDT	Ministry of Economic Development and Trade of Ukraine
M/M	Minutes of Meeting
NBS	National Body of Standardization
NCS	National Cadastre System
NGDI	National Geospatial Data Infrastructure
NSDI	National Spatial Data Infrastructure
OGC	Open Geospatial Consortium
OJT	On-the-Job Training
OSS	Open Source Software
PCC	Project Coordinates Committee
R/D	Record of Discussion
RGE	Large Scale Reference Database
RIGC	Research Institute of Geodesy and Cartography
RMSE	Root Mean Square Error
SSGCC	the State Service of Ukraine for Geodesy, Cartography and Cadastre
SALR	State Agency for Land Resource
S/C	Steering Committee
SLCC	State Land Cadastre Center
SNS	Social Networking Service
TMS	Tableau Map Service
UkrGIS	Ukraine Profile for Geographic Information Standards
UML	Unified Modeling Language
W/G	Working Group
WMS	Web Map Service
XML	Extensible Markup Language

Chapter 1 Outline of the Project

1.1 Background of the Project

Ukraine, with a total population of roughly 45.43 million as of 2012 and total land area of about 600,000 km² (1.6 times Japan's land area), is an Eastern European nation surrounded by the EU and Russia. Ukraine has much fertile land and is a net exporter of crops.

The Ukrainian Government has already prepared orthophotos (scale 1/10,000) and topographic maps (scale 1/100,000, 1/200,000) as Geospatial Information for the whole land area of Ukraine. In addition, for the nation's capital, Kiev, and Simferopol in the Crimea Peninsula, large scale 1/2,000 topographic maps have been prepared. (However, these geospatial information were old and didn't express current topographic features.) Furthermore, various agencies have prepared thematic maps such as contour maps, tilt maps and forest maps using these topographic maps. However, inefficient and unreasonable cases occurred in the preparation and management of Geospatial Information, such as the topographic map and the thematic map. For example, similar Geospatial Information was prepared several times due to the lack of coordination among related agencies and also the data were not shared or commonly used.

Given these circumstances, the Ukrainian Government decided to establish the National Spatial Data Infrastructure (NSDI) at a Cabinet meeting aiming to confirm integration of Geospatial Information, database and common ownership/use to prepare, manage and utilize Geospatial Information reasonably and effectively. However, the State Agency for Land Resources of Ukraine (Current SSGCC), which is in charge of National Spatial Data Infrastructure, had insufficient technologies related to the integration and management of Geospatial Information necessary for the establishment of the NSDI. In additions, the specification of geospatial information indispensable for sharing / common using based on the world standards, and sharing systems were lacked.

Based on this background, the Ukrainian Government (Especially, SSGCC, SLCC and RIGC) requested the Japanese Government to provide support for the establishment of NSDI. In response to a request from the Ukrainian Government, JICA had discussions with Ukraine about the contents of the Project (the Project for the Creation of a National Geospatial Data Infrastructure in Ukraine) and it was decided that JICA would carry out the Project.

1.2 Objective and Outputs of the Project

The Project objective was to develop a system of establishing and operating NSDI through the demonstration in a pilot area.

To achieve the objectives, the Project intended to achieve the following outputs.

Output 1: To draft a Plan for NSDI Creation and Operation

Output 2: To establish an institutional framework to implement the above plan

Output 3: To draft practical standards for geographic information and formulate an implementation plan

Output 4: To create an NSDI prototype to demonstrate its utilities

Output 5: To develop capacities of C/P and agencies related to the Project

1.3 Targets of the Project Activities

1.3.1 Target Agencies of the Project

The targeted agencies were the State Service of Ukraine for Geodesy, Cartography and Cadastre (SSGCC), the State Land Cadastre Centre (SLCC); and the related agencies.

1.3.2 Target Area of the Project Activities (Pilot Area)

The pilot area to create the NSDI data was Vinnytsia District, located about 200 km southwest of the Ukrainian capital city, Kiev.

1.4 Project Activity Items

The Project activities were divided into six components as shown below.

A. Preparation of a Plan for NSDI Creation and Operation (draft)

Ukraine's administrative structures, budgets of related agencies, organizational personnel, technical competence and available equipment will be researched. Furthermore, the Project will formulate a Plan for NSDI Creation and Operation (draft) based on the research results of evaluating and analysing an NSDI prototype.

B. Establishment of a cooperative framework for related agencies

The Project will study the required organizational structures of the Steering Committee (S/C) and Working Group (W/G) for the establishment and operation of NSDI. Furthermore, the Project will establish the S/C and W/G and provide support for their management.

C. Preparation of Standards for geographic information (draft)

The Project will examine and analyse the development status of the standards for geospatial information in Ukraine. Furthermore, the Project will prepare practical standards for geographic information (draft) and will assist to normalize it domestically.

D. Creation of an NSDI prototype

The Project will examine the specifications of the fundamental geospatial data and existing geospatial data, and prepare the product specifications, metadata and geospatial information, targeting the pilot area. Furthermore, it will design a concept and define functional requirements of web services, and develop them.

Outline of the pilot area

Location: Vinnytsia District located about 200 km southwest of the Ukrainian capital of Kiev.

Area: about 1,023 km²

E. Capacity development of C/P and related agencies

The Project will develop the capacity of its C/P through collaboration with Operation Guidance Study Team and counterpart training in Japan and the C/P will attend and give presentations regarding the NSDI in relevant international conferences. Furthermore, the Project will carry out technical transfer for the related agencies to enhance their capacities in creating geospatial information.

F. Report preparation, explanation, and consultation, and other activities

The Project will prepare reports, and explain and discuss the contents. Also, the Project will procure equipment that are required in the Project.

The flow of implementing the respective project activities was as follows.

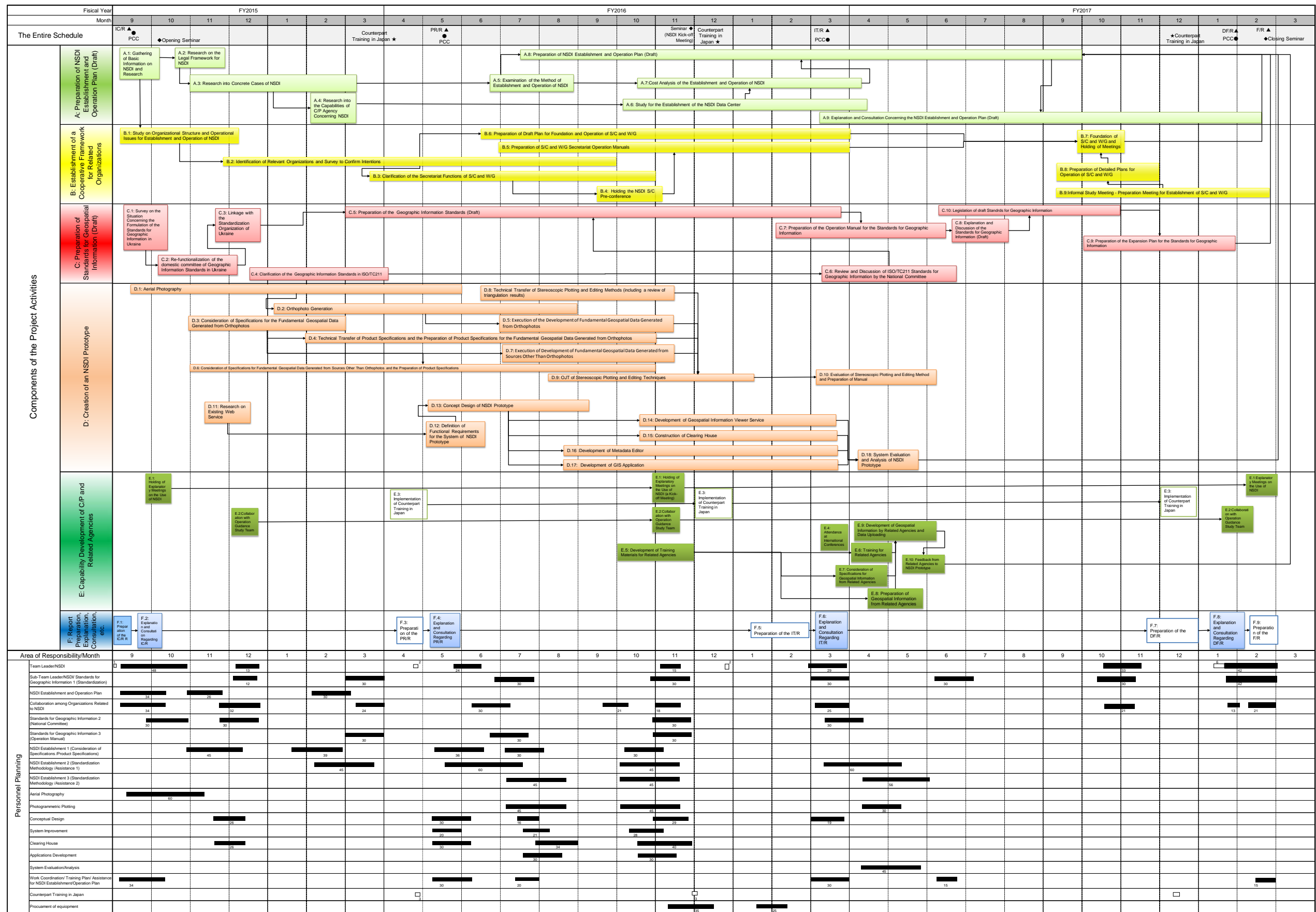


Figure 1 Flowchart of the Project

1.5 Project Schedule

The project was scheduled based on the following approximate Project Schedule.

Year/Month	FY 2015			FY 2016												FY 2017																	
	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3		
Preparation of NSDI Establishment and Operation Plans (draft)	■	■		■							■									■			■								■		
Establishment of a Cooperative Framework for Related Agencies	■		■			■				■			■							■				■		■			■				
Preparation of a Standards for Geographic Information (draft)	■		■							■										■				■					■				
Creation of NSDI Prototype	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
Capacity Development of C/P and Related Agencies	■		■																														
PCC, Seminar, Workshop, Training in Japan, etc.	●:PCC									●:PCC						★ Training in Japan							●:PCC								●:PCC		
	◆ Seminar							★ Training in Japan							◆ NSDI Seminar														★ Training in Japan				
Reporting	▲									▲																							
	IC/R									PR/R																							

Legend: ■: Working in Ukraine □: Working in Japan

1.6 Project Deliverables

The deliverables of the Project were as follows.

(1) Project Report

Table 1 List of Project Reports

Report	Language	No. of copies	Content
Inception Report (IC/R)	English	15	Matters related to the Project implementation plan, such as basic policy, methodology, work schedule, and personnel planning; technical transfer plan.
	Ukrainian	15	
Progress Report (PR/R)	English	15	Progress of the planning/foundation of the organizational structure for the establishment/operation of NSDI, progress of NSDI establishment/operation and prototype verification in the pilot area, results of technical transfer, outline of future activities, etc.
	Ukrainian	15	
Interim Report (IT/R)	English	15	Progress of the planning/foundation of the organizational structure for the establishment/operation of NSDI, progress of NSDI establishment/operation and prototype verification in the pilot area, results of technical transfer, outline of future activities, etc.
	Ukrainian	15	
Draft Final Report (DF/R)	English	15	Overall outcome of the Project.
	Ukrainian	15	
Final Report (F/R)	English	30	Overall outcome of the Project.
	Ukrainian	30	

(2) Deliverables of Technical Cooperation

Table 2 List of Deliverables of Technical Cooperation

Document	Language	Qty.	Remarks
NSDI Establishment/Operation Plan	English	1 set	
	Ukrainian	1 set	

Document	Language	Qty.	Remarks
(draft)			
Standards and Rules for Geographic Information (draft)	English Ukrainian	1 set 1 set	Practical standards for geographic information (draft)
Data Conversion Manual for NSDI-related Agencies	English Ukrainian	1 set 1 set	Data management manual for NSDI-related agencies.
Operation manual related to the standards for geographic information	English Ukrainian	1 set 1 set	

(3) Other Reports, etc.

Table 3 List of Other Reports, etc.

Item	Qty.	Remarks
PR materials		
① Printed matter (English)	190 copies	2 to 4 pages (A4 sized paper), describing the outline of Project activities, implementation procedure, coverage, outcome, conclusions, recommendations, etc.
② Printed matter (Ukrainian)	190 copies	
③ Electronic data	1 set	

Chapter 2 Project Implementation

2.1 Basic Policies of the Project

The Basic Policies underlying technical and operational aspects of Project implementation were as follows.

Basic Policies underlying technical aspects

Basic Policy 1: Define a framework of NSDI as one of long-term and sustainable policy measures to transform into a highly information-oriented society

Basic Policy 2: Promote understandings on utilities and necessity of NSDI and establish a system that facilitates an expansion of NSDI

Basic Policy 3: Establish a framework to prepare a draft of practical standards for geographic information

Basic Policy 4: Create an NSDI prototype in a pilot area and demonstrate its utilities

Basic Policy 5: Enable C/P to help strengthen capacities of agencies related to development of NSDI and geospatial information through which it strengthens its own capacities

Basic Policies underlying operational aspects

Basic Policy 1: With emphasis on capacity development, encourage C/P's initiatives in the Project operation and management

Basic Policy 2: Ensure quality of the outputs obtained in each specialized area of the Project by developing an operational framework to facilitate its activities

2.2 Implementation of the Project Activities

2.2.1 Project Implementation Structure

The Project was implemented by forming 5 teams corresponding to each project activity.

- * Planning Team (responsible for the preparation of a Plan for NSDI Creation and Operation (draft))
- * Steering Committee Team (responsible for the establishment of a cooperative framework for related agencies)
- * Standardizaion Team (responsible for the preparation of Standards for geographic information (draft))
- * Data Prototype Team (responsible for the creation of the data for the NSDI prototype)
- *System Prototype Team (responsible for the creation of a prototype NSDI system)

The Project framework and responsibility of each team are shown in the following figures.

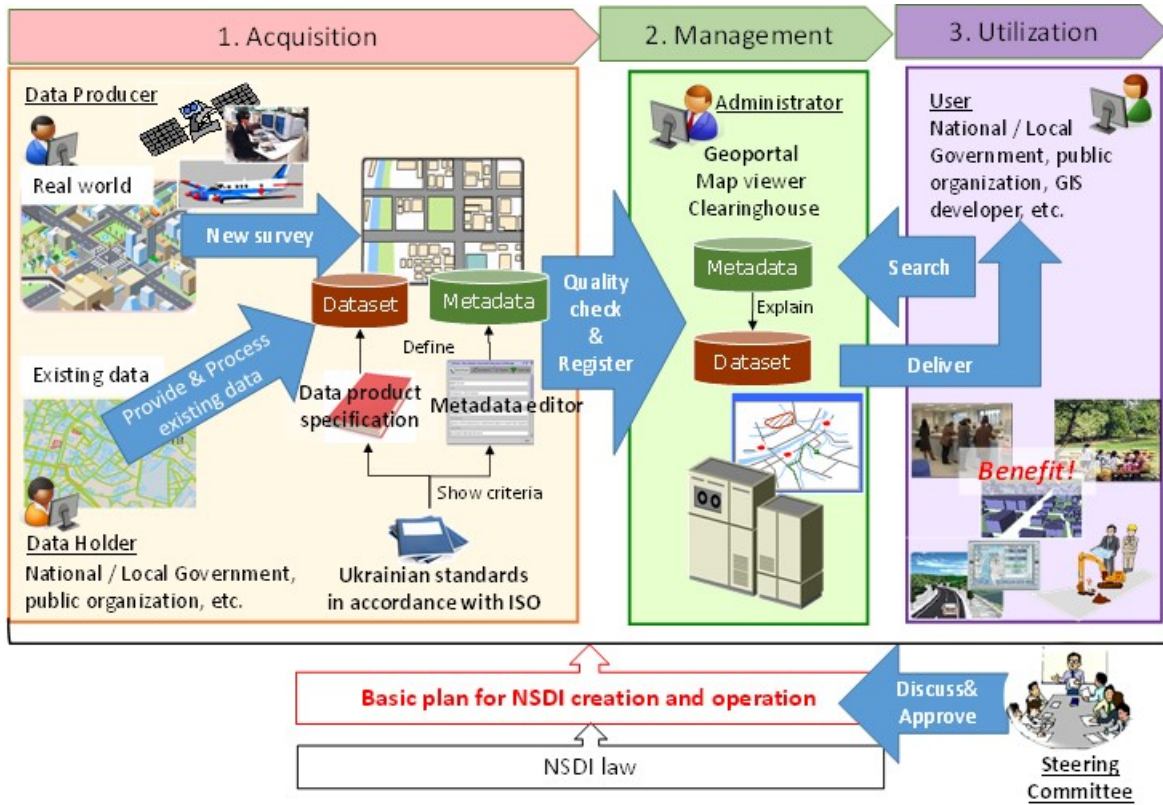


Figure 2 Project framework

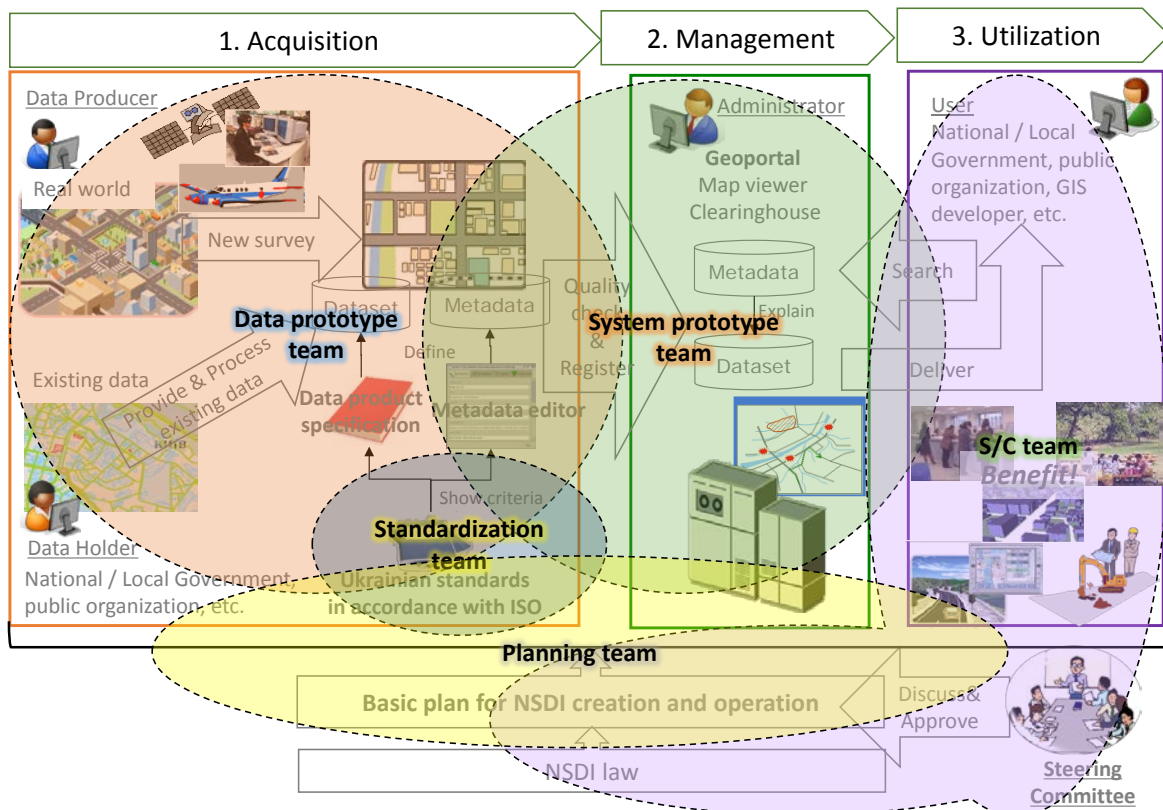


Figure 3 Responsibility of each study team

2.2.2 Project Activities to be implemented

The project activities of each field to be implemented were as follows.

A. Preparation of a Plan for NSDI Creation and Operation (draft)

- A1: Gathering of Basic Information on NSDI and Research
- A2: Research on the Legal Framework for NSDI
- A3: Research into Concrete Cases of NSDI
- A4: Research into the Capabilities of C/P Agency Concerning NSDI
- A5: Examination of the Method of Establishment and Operation of NSDI
- A6: Study for the Establishment of the NSDI Data Center
- A7: Cost Analysis of the Establishment and Operation of NSDI
- A8: Preparation of NSDI Establishment and Operation Plan (Draft)
- A9: Explanation and Consultation Concerning the NSDI Establishment and Operation Plan (Draft)

B. Establishment of a cooperative framework for related agencies

- B1: Study on Organizational Structure and Operational Issues for Establishment and Operation of NSDI
- B2: Identification of Relevant Organizations and Survey to Confirm Intentions
- B3: Clarification of the Secretariat functions of S/C and W/G
- B4: Holding the NSDI S/C Pre-conference
- B5: Preparation of S/C and W/G Secretariat Operation Manuals
- B6: Preparation of Draft Plan for Foundation and Operation of S/C and W/G
- B7: Foundation of S/C and W/G and Holding of Meetings
- B8: Preparation of Detailed Plans for Operation of S/C and W/G
- B9: Informal Study Meeting · Preparation Meeting for Establishment of S/C and W/G

C. Preparation of Standards for geographic information (draft)

- C1: Survey on the Situation Concerning the Formulation of the Standards for Geographic Information in Ukraine
- C2 Re-functionalization of the domestic committee of Geographic Information Standards in Ukraine
- C3: Linkage with the Standardization Organization of Ukraine
- C4: Clarification of the Geographic Information Standards in ISO/TC211
- C5: Preparation of the Geographic Information Standards (Draft)
- C6: Review and Discussion of ISO/TC211 Standards for Geographic Information by the National Committee
- C7: Preparation of the Operation Manual for the Standards for Geographic Information
- C8: Explanation and Discussion of the Standards for Geographic Information (Draft)
- C9: Preparation of the Expansion Plan for the Standards for Geographic Information
- C10: Normalization of draft Standards for Geographic Information

D. Creation of an NSDI prototype

- D1: Aerial Photography
- D2: Orthophoto Generation
- D3: Consideration of Specifications for the Fundamental Geospatial Data Generated from Orthophotos
- D4: Technical Transfer of Product Specifications and the Preparation of Product Specifications for the Fundamental Geospatial Data Generated from Orthophotos
- D5: Execution of the Development of Fundamental Geospatial Data Generated from Orthophotos
- D6: Consideration of Specifications for Fundamental Geospatial Data Generated from Sources Other Than Orthophotos and the Preparation of Product Specifications
- D7: Execution of Creation of Fundamental Geospatial Data Generated from Sources Other Than Orthophotos
- D8: Technical Transfer of Stereoscopic Plotting and Editing Methods
- D9: OJT of Stereoscopic Plotting and Editing Techniques
- D10: Evaluation of Stereoscopic Plotting and Editing Methods and Preparation of Manual
- D11: Research on Existing Web Services
- D12: Definition of Functional Requirements for the System of NSDI Prototype
- D13: Concept Design of NSDI Prototype
- D14: Development of Geospatial Information Viewer Service
- D15: Construction of Clearing House
- D16: Development of Metadata Editor
- D17: Development of GIS Applications
- D18: System Evaluation and Analysis of NSDI Prototype

E. Capacity development of C/P and related agencies

- E1: Holding of Explanatory Meetings on the Use of NSDI
- E2: Collaboration with Operation Guidance Study Team
- E3: Implementation of Counterpart Training in Japan
- E4: Attendance at International Conferences
- E5: Development of Training Materials for Related Agencies
- E6: Training for Related Agencies
- E7: Consideration of Specifications for Geospatial Information from Related Agencies
- E8: Preparation of Product Specifications for Geospatial Information from Related Agencies
- E9: Development of Geospatial Information by Related Agencies and Data Uploading
- E10: Feedback from Related Agencies to NSDI Prototype

F. Report preparation, explanation, and consultation, and other activities

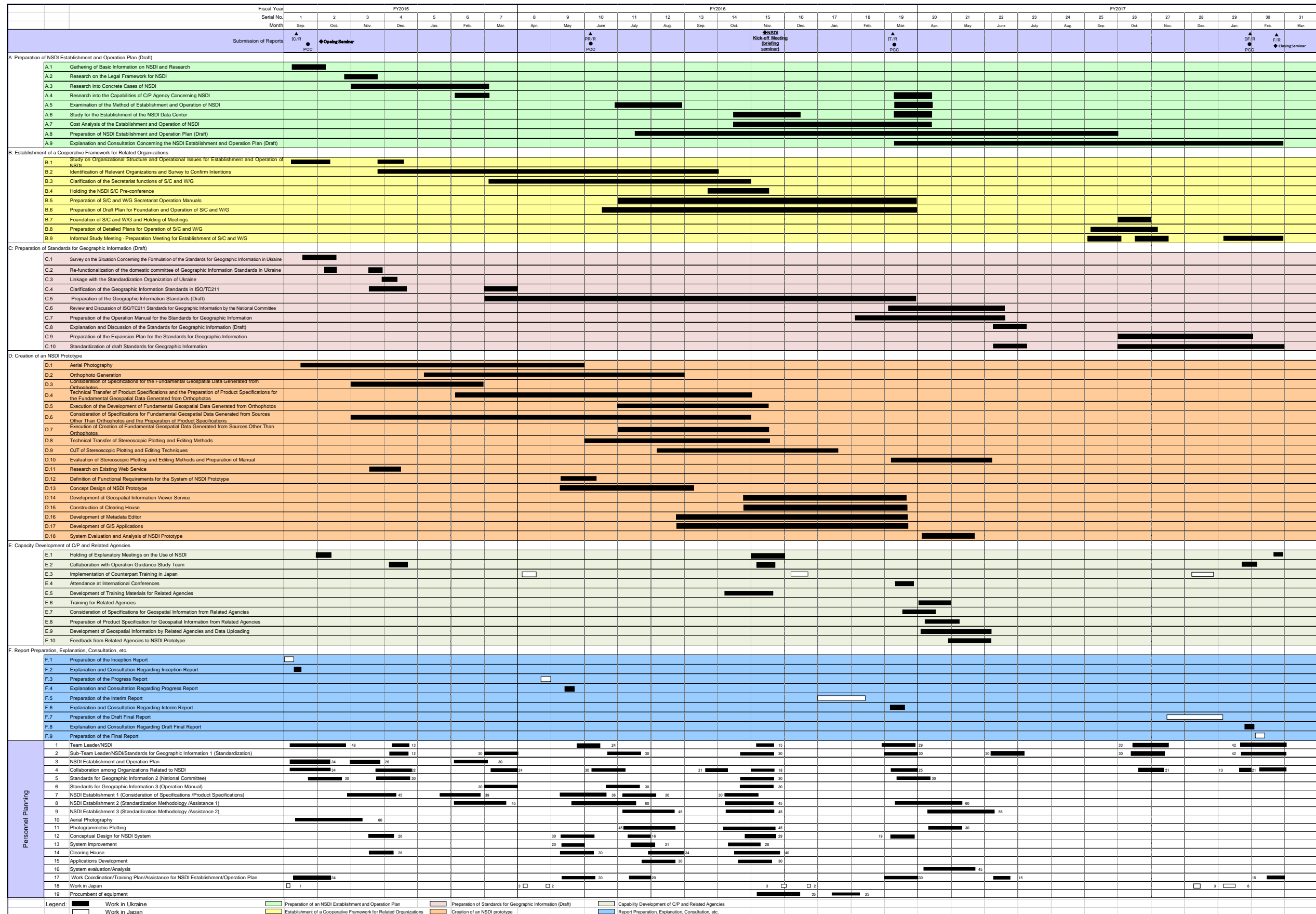
- F1: Preparation of the Inception Report
- F2: Explanation and Consultation Regarding Inception Report

-
- F3: Preparation of the Progress Report
 - F4: Explanation and Consultation Regarding Progress Report
 - F5: Preparation of the Interim Report
 - F6: Explanation and Consultation Regarding Interim Report
 - F7: Preparation of the Draft Final Report
 - F8: Explanation and Consultation Regarding Draft Final Report
 - F9: Preparation of the Final Report
 - Procurement of equipment for Project

2.3 Implemented schedule of the Project Activities

The implemented detailed schedule of the Project Activities was as follows.

Table 4 Detailed schedule of the Project



2.4 Composition and Mobilization of the Project Team

2.4.1 Composition of the Project Team

The five project teams that implemented the Project were composed of experts who had the following responsibilities.

No.	Project Implementing Team Name	Area of Responsibility of Team Expert
1	Team Leader	<ul style="list-style-type: none"> • Team Leader/NSDI
2	Planning Team (responsible for the preparation of a Plan for NSDI Creation and Operation (draft))	<ul style="list-style-type: none"> • NSDI Establishment and Operation Plan • Work Coordination/ Training Plan/ Assistance for NSDI Establishment/Operation Plan
3	Steering Committee Team (responsible for the establishment of a cooperative framework for related agencies)	<ul style="list-style-type: none"> • Collaboration among Organizations Related to NSDI
4	Standardization Team (responsible for the preparation of Standards for geographic information (draft))	<ul style="list-style-type: none"> • Sub-Team Leader/NSDI/ Standards for Geographic Information 1 (Standardization) • Standards for Geographic Information 2 (National Committee) • Standards for Geographic Information 3 (Operation Manual)
5	Data Prototype Team (responsible for the creation of an NSDI prototype about data)	<ul style="list-style-type: none"> • NSDI Establishment 1 (Consideration of Specifications/Product Specifications) • NSDI Establishment 2 (Standardization Methodology/Assistance 1) • NSDI Establishment 3 (Standardization Methodology/Assistance 2) • Aerial Photography • Photogrammetric Plotting
6	System Prototype Team (responsible for the creation of an NSDI prototype about systems)	<ul style="list-style-type: none"> • Conceptual design for NSDI System • System Improvement • Clearing House • Applications Development • System Evaluation/Analysis

2.4.2 Mobilization of the Project Team

Experts from each of the five teams in the Project implemented the Project activities in Ukraine as follows.

Chapter 3 Implemented Results of the Project

3.1 Implemented Results of the Project (Outline)

The implemented results of the Project, divided into five fields, are as follows.

(1) Preparation of NSDI Establishment and Operation Plan (Draft)

The basic research on NSDI, the research on the legal framework for NSDI and the research into concrete cases of NSDI were implemented at the preparation of NSDI establishment and operation plan (draft). As the results of the researches, the procedures of legislation for NSDI, the organization structures and the actual condition of works (its abilities) of the related agencies with NSD, the actual preparation of geographic information and the actual condition of IT technologies became clear. Also, the legal framework for NSDI became clear. Furthermore, the approach to NSDI establishment in Japan became clear.

Based on the results above mentioned, the method of the preparation and the management of NSDI data, the establishment of Data Center preparing NSDI data actually and the cost of NSDI establishment and operation focusing data preparation were analyzed.

Based on the results of researches and inspection basically, “NSDI establishment and operation plan (draft)” was prepared with the cooperation of the C/Ps. The draft plan is going to be approved through consultation by the SubGroup under the Ministry of Agrarian Policy and Food of Ukraine, or the S/C.

(2) Establishment of a Cooperative Framework for Related Organizations

The study on actual conditions of NSDIs in Japan and EU countries, where NSDIs are already operational, was implemented for forming into a needed organization to realize NSDI establishment and operation. The study was implemented focusing on procedures for forming an organization that will lead the establishment and operation of the NSDI, and on the operation system and contents of organization.

Based on the results of the study, the organization structure that will lead NSDI establishment and operation in Ukraine and a study of members were discussed. As a result, a steering committee (S/C) and a working group under S/C will be placed, and members were identified. Also, the function, operation manual and operation plan of the secretariat were formulated. Furthermore, the preparatory meeting and the study meeting for formulating S/C were held; which will help in the smooth operation of S/C and W/G after formulating S/C and W/G officially. The SSGCC is going to be a coordinator for the S/C and the W/G.

(3) Preparation of Standards for Geographic Information (Draft)

The formulation situation of Geographic Information Standards in Ukraine was studied for the preparation of Geographic Information Standards. The Geographic Information Standards in Ukraine are based on applying ISO19100 series that is defined in ISO/TC211, however, one of ISO19100 series was normalized and other ISO19100 series are undertaking normalization at the time of the study.

The organization responsible for standardization, the geographic information standardization domestic committee, TC103, is operational, but they are busy. Also, the agencies related to standardization and its categories in Ukraine were studied and revealed.

The geographic information standards of ISO/TC211 and JPGIS, which are applied in Japan, were arranged and the international standards targeting Geographic Information Standards to be prepared were identified.

Based on the identified international standards and JPGIS, the basic policies of preparation of UkrGIS, Geographic Information Standards Draft in Ukraine, was formulated and its review system was established.

The UkrGIS, Geographic Information Standards draft in Ukraine, was prepared applying the basic policies and its review system.

The prepared UkrGIS is going to be standardized in March 2018 according to the domestic normalization procedures in Ukraine.

(4) Creation of an NSDI Prototype

The pilot area to be targeted for NSDI prototype creation was reconfirmed and the aerial photography was implemented for Vinnytsia District as the pilot areas. Based on the results of aerial photography and Ground survey, the orthophoto of the pilot area was prepared with the technical cooperation of C/P agencies.

The Specification of NSDI data composing NSDI prototype was discussed with C/P agency and the product specifications were prepared. In the process of preparation of the specifications, the technology transfer for the preparation of the product specifications was implemented. Also, the technology transfer (Digital Plotting and Editing) for NSDI establishment was implemented using the results of aerial photography (aerial photo and orthophoto). At the same time, NSDI data in the pilot area was prepared based on the prepared product specifications. In the NSDI prototype system, the web-service operated by C/P agency was studied and the possibilities of utilization for NSDI prototype system development was considered.

After that, the NSDI prototype system establishment targeting the viewer service, the clearing house, the metadata editor and the GIS application was discussed with C/P agency and NSDI prototype systems were developed and the related data were installed. And NSDI prototype system to be developed were analyzed and the completion rate evaluated from the viewpoints of both the developer side and the user side; and it was clear that the system had reached a prototype level and the issues to be overcome before full scale operation were clarified.

(5) Capacity Development of C/P and Related Agencies

The 1st seminar with the meaning of the declaration of the start of the Project was held. Also, the 2nd seminar toward establishing S/C for NSDI establishment and operation was held. Furthermore, the 3rd seminar publishing the results of the Project was held.

With the objective that makes use of the knowledge of NSDI establishment and operation in Japan, the first operation guidance study team visited Kiev and gave the lectures, and inspected the pilot areas. Also, the second operation guidance study team visited Kiev again and gave the lecture about the organization structure of NSDI in Japan at the 2nd seminar and to C/P agency. The third operation guidance study team gave a lecture about the experience of NSDI

establishment and operation and NSDI activities in the future for C/P. Also, in the 3rd seminar, the third operation guidance study team introduced the NSDI establishment and the utilization of NSDI in Japan, and the actual status of dissemination for Geographic Information Standards.

The first counterpart training in Japan, with eight trainees from the C/P agency, was implemented focusing on the actual state of NSDI in the national agencies, the local governments and the private sector of Japan. Furthermore, the second counterpart training in Japan was implemented focusing the trends in ICT technologies of NSDI establishment and operation in Japan. In the third counterpart training in Japan, the national agencies to be the subject of NSDI establishment and operation, the local government activities and NSDI activities of the private sector were inspected.

C/P agency participated and gave the presentation in the Land and Poverty Conference 2017 organized by World Bank and held in the United States to disseminate the results of the Project and to improve their abilities about NSDI. The workshop of the preparation of the product specifications and data of the geographic information was implemented for the capacities building about NSDI of the related agencies.

(6) Report Preparation, Explanation, Consultation, etc.

The inception report, that summarized the object, basic policies and implementation methods of the Project (Sep, 2015), the progress report, that summarized the implementation status and the results of the Project as of April 2016 (May 2016) were prepared. Furthermore, the interim report, that summarized the progress (Implementation Status and Implemented Results) as of December 2016 was prepared. And the draft final report, that summarized the whole project was prepared (December 2017). After preparing each report, the report explanation/consultation meetings (including PCC meetings) were held.

The final report was prepared (February 2018) based on the results of the explanation/consultation meetings (including PCC meetings) of Draft Final Report.

Also, the equipment required in the Project was procured and the equipment were placed in the C/P agency.

3.2 Implemented Results of Project Activities in Each Field

3.2.1 Implemented Results of Preparation of NSDI Establishment and Operation Plan (Draft)

(1) Implementation of various surveys and results related to NSDI establishment and operation

1) Implementation of various surveys

The following surveys were implemented as the Project activities.

- *Survey of Organization, Abilities and Business contents of C/P agency
- *Survey of Organizations (State Enterprise, etc.) related to Geospatial Information
- *Survey of Legal Framework for NSDI
- *Survey for Actual Condition of IT technology

*Survey of NSDI Example

a. Results of Survey of Organization, Abilities and Business contents of C/P agency

The counterpart agencies in the Project were State Service of Ukraine for Geodesy, Cartography and Cadastre, SSGCC and State Enterprise State Land Cadastre Centre, SLCC under SSGCC and the organizational relationship of both was as follows.

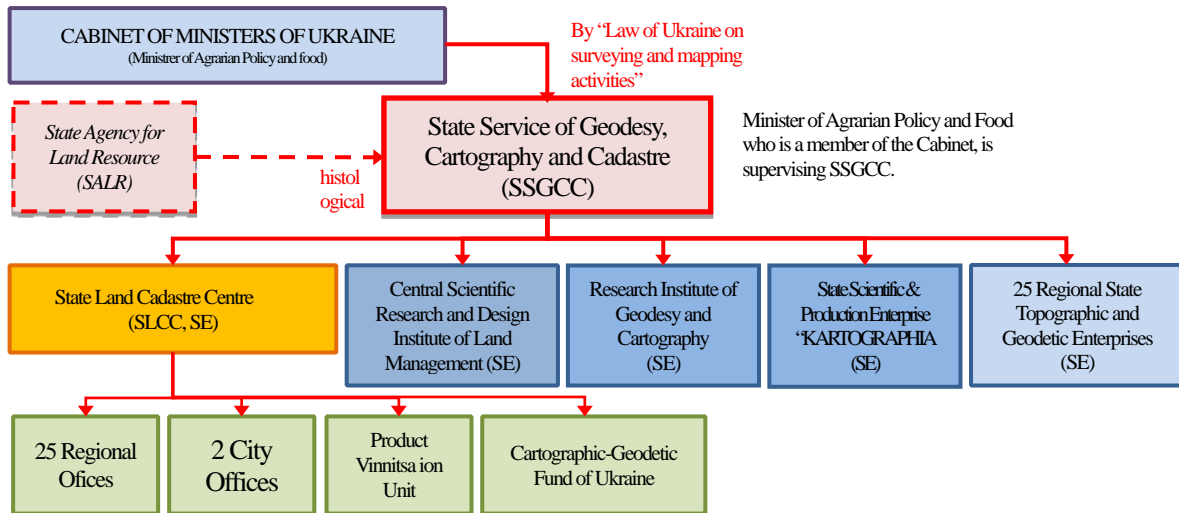


Figure 4 Organizational Relations of C/P Agencies

* State Service of Ukraine for Geodesy, Cartography and Cadastre (SSGCC)

The SSGCC is supervised by the Minister of Agrarian Policy and Food and the SSGCC has jurisdiction over such duties as surveying, geospatial information, cadastre development, and land management, but does not engage in developing, managing, or updating the data.

The SSGCC also has affiliates including the SLCC, state-owned enterprises including locally operating entities, and research institutes. Although allowed to employ 249 persons at maximum, the number of employees at present does not meet the capacity.

The sections related to NSDI, Information and Electronic Government Section are newly provided. However, they have not yet started planning and activities associated with NSDI and they manage various information system. Topographic Mapping and Toponym Section under Topography/Geodesy and Cartography Division will assume a role in coordinating NSDI, and the division is currently dealing with NSDI Act.

* State Enterprise State Land Cadastre Centre (SLCC)

The SLCC is a state-owned enterprise affiliated with the SSGCC, committed to developing, managing and updating geospatial data, primarily using a cadastre. Notably, with a local office operated in each oblast organically, the institution has a distinguished presence compared with other state-owned enterprises affiliated with the SSGCC, in terms of its operational coverage and the number of employee.

The SLCC has various kinds of resources to generate geospatial information. The SLCC has a National Cadastre System (NCS). The NCS was developed in the Rural Land Titling and Cadastre Development Project of the World

Bank, which lasted until 2013, in order to establish a national cadastre and title registry system, property rights in rural areas. In addition, the SLCC manages a data entry division with around 300 ArcGIS Licenses and digital aerial cameras.

b. Results of Survey of State Enterprise related to Geospatial Information

State Enterprises related geospatial information affiliated with the SSGCC include 29 entities related to topography and surveying and 26 related to land management. The other two are major state-owned enterprises, highlighted below.

*** Research Institute of Geodesy and Cartography (RIGC)**

RIGC engages in such duties as creating geospatial information for topographic maps, developing geodetic networks as well as software applications for a geoportal. It also serves as a secretariat of the domestic committee for Geographic Information Standards. The total number of employees is approximately 80, including about 60 technical staff. RIGC uses various kinds of software to generate geospatial information, such as ArcGIS, MapInfo's GIS software, and other tools (MicroStation, AutoCAD Map, ENVI, QGIS, ERDAS Imagine, GeoLAB <geodetic>, GAMMIO <coordinate transformation>, Easy Trace <developed in Russia>, and Digitals <developed in Ukraine>). Three large scanners and two large plotters are also available. With eight operators and four plotting machines, the institute uses ERDAS Imagine and Ukrainian Digitals to generate stereograms. Topographic maps at a scale of 1:100,000 and 1:200,000 are created and updated using aerial photographs as well as high-resolution satellite pictures including GeoEye, WorldView, and SPOT, while also using single images and stereo pairs. Initially available at low costs, the institute used to take new photographs, but now uses archives. It engages in control surveying required for aerial photogrammetry, operating nearly 70 GPS-based Control Stations (Active Stations).

Developed based on ArcGIS and QGIS, the institute applies such software development languages as PostgreSQL and Python. Software development also utilizes geoportal software known as SoftPro created in Ukraine. There are five development engineers.

*** State Scientific & Production Enterprise "KARTOGRAPHIA"**

This organization primarily engages in mapping coordination and publishing, covering topographic maps, road maps, tourist maps, and various thematic maps. These products are widely marketed through its own stores as well as sales partners.

*** State Enterprise Central Scientific Research and Design Institute of Land Management**

The institute primarily engages in land management, covering property transfers, land demarcation and revision, division and consolidation of land, reclassification of land, and preparation of documentation required for an appropriate estimate of properties. Its works are equivalent to duties assumed by Japanese 'land and house investigators.' The institute allocates a research section for land surveying and soil surveying.

c. Results of Survey of Legal Frameworks for NSDI

* In NSDI establishment and operation, the legal frameworks supporting NSDI are very important. From the view point of this, the legal frameworks supporting NSDI establishment and operation in Japan were studied.

The legal frameworks supporting NSDI of Japan are as follows

Table 6 Key Legal System for NSDI in Japan

Components of the legal system	Title of the applicable laws	Authorities concerned
Basic Act	Basic Act on the Advancement of Utilizing Geospatial Information (NSDI Act)	Office of Cabinet Secretariat
Ministerial ordinances	Items relating to fundamental maps prescribed under Section 3 of Article 2 of NSDI Act and Ordinance of MLIT for NSDI Act	Ministry of Land, Infrastructure, Transport and Tourism (MLIT)
Notice	Public notice of MLIT of technical standards for NSDI Act relating to development of fundamental maps prescribed under Section 3 of Article 2 of NSDI Act pertinent to the provision of Section 1 of Article 16 thereof	MLIT
Administrative act	Survey Act	MLIT
Notice	Work rules prescribed in the provision of Article 34 of Survey Act (Law No. 188 of 1949)	MLIT
Guidelines	Guidelines for Handling of Personal Information in Utilizing Geospatial Information	Council for Promotion of Geospatial Information Utilization
	Guidelines for Promoting Secondary Use of Geospatial Information	
National plan, etc.	Basic Plan for the Advancement of Utilizing Geospatial Information	Office of Cabinet Secretariat
Related laws	Act on the Protection of Personal Information Copyright Act Basic Approach for Disclosure of Government Data to Promote Secondary Use	

*The existing laws related to NSDI in Ukraine were studied based on the contents of NSDI Act (draft) of Ukraine and the results of the survey for the legal frameworks related to NSDI in Japan,

As a result, it was clear that the following existing laws were recognized as the legal frameworks for NSDI establishment and operation.

Table 7 Existing Laws Indicated in the draft NSDI Act in Ukraine

No.	Laws in force
1	The Constitution of Ukraine
2	The Land Code of Ukraine
3	The Law of Ukraine “On topographic, geodetic and cartographic activities”
4	The Law of Ukraine “On the State Land Cadastre”
5	The Law of Ukraine “On Land Management”
6	Law of Ukraine “On regulation of urban development”
7	The Law of Ukraine “On the State Registration of Ownership Rights to Immovable Property and their Limitations”
8	The Law of Ukraine “On Environmental Protection”
9	The Law of Ukraine “On the Scientific and Technical Activities”
10	The Law of Ukraine “On Standardization”
11	The Law of Ukraine “On Standards, Technical Regulations and Valuation Procedures of Accordance”
12	The Law of Ukraine “On Space Activity”

* NSDI Act in Ukraine, which is a basis of legal frameworks supporting NSDI establishment and operation, is under discussion (pre-enactment) at the National Assembly.

Procedures to legislate the NSDI Act are shown in the figure below. The SSGCC is primarily responsible for drafting the bill. The Ministry of Agrarian Policy and Food of Ukraine, which serves as a supervisor of this legislative process, subsequently coordinates to obtain feedback and requests from the related government agencies. Also, as is the usual process, the bill is then presented to the Parliament through the Ministry of Regional Development, Construction and Municipal Economy and the Cabinet. Alternatively, a political party may submit a bill (legislation by parliament members).

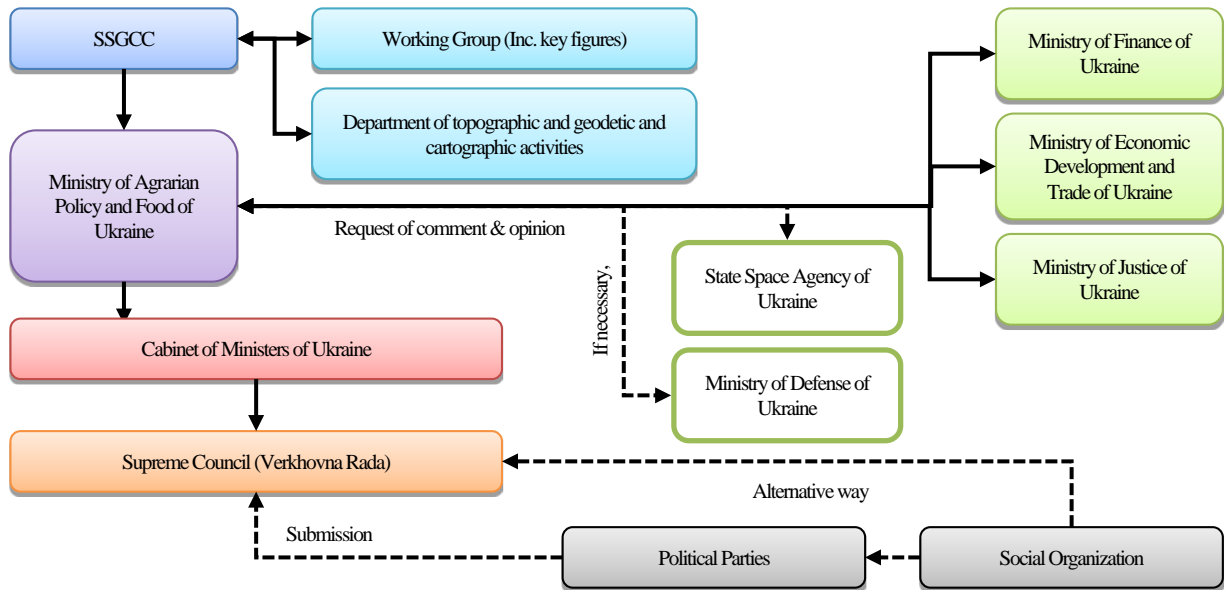


Figure 5 Procedures to Legislate the NSDI ACT in Ukraine

The figure below is a diagram illustrating relations among the organizations stipulated in the draft NSDI Act under discussion at present.

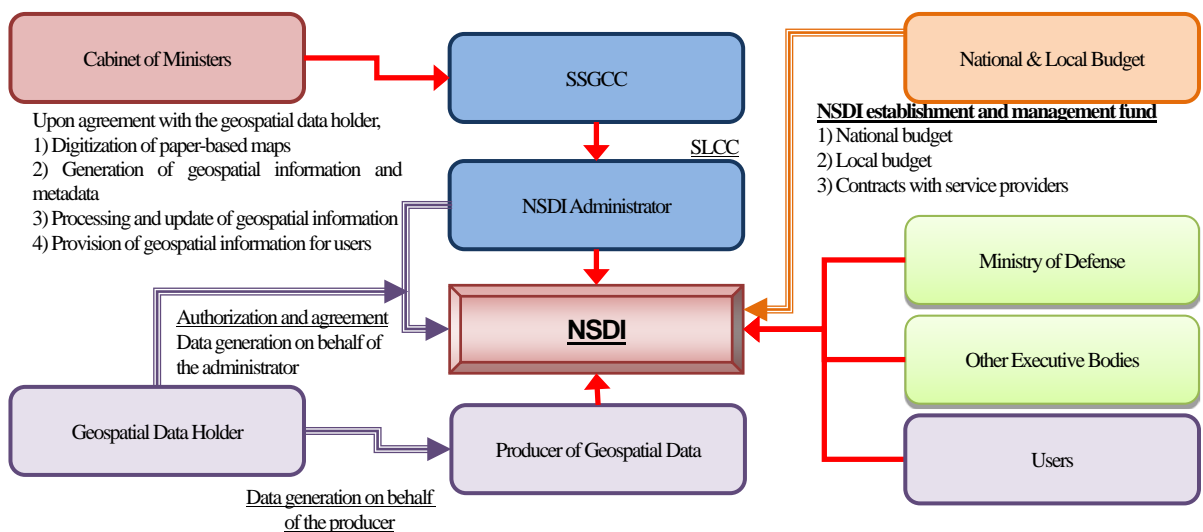


Figure 6 Interrelation of the Organizations Concerned with Ukraine's Current Draft NSDI Act

Also, the figure below is a diagram illustrating a linkage of the data and databases stipulated in the draft NSDI Act in Ukraine.

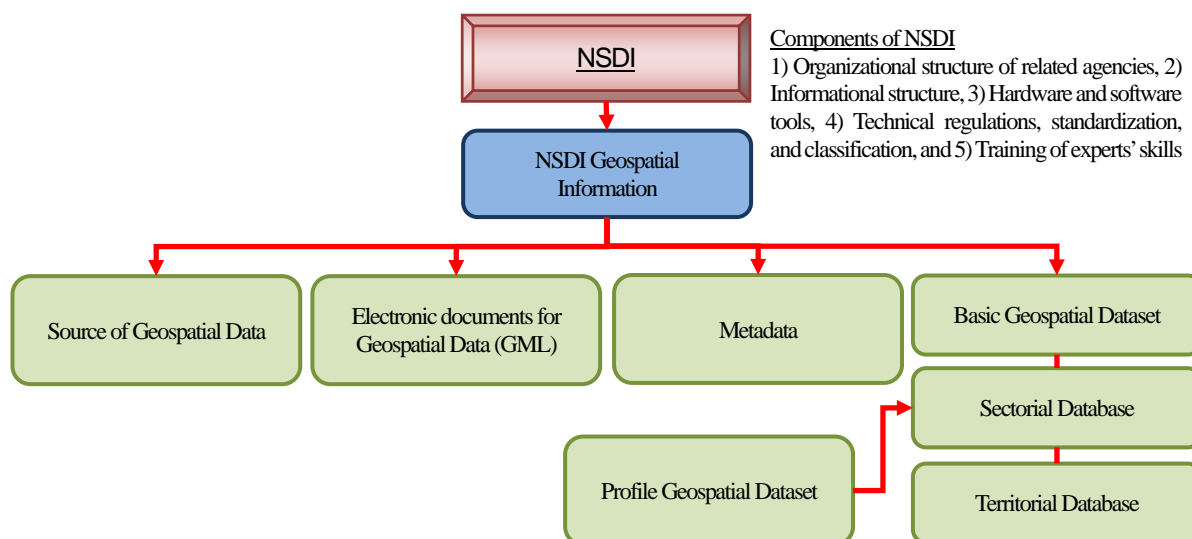


Figure 7 Links of databases indicated in the draft NSDI Act

* The EU Directives related to Geospatial Information were studied because Ukraine aims to become a member of the EU in the future.

It was clear that the EU directives were aggregated in INSPIRE.

d. Results of Survey of the Actual Situation of Preparation for Geospatial Information

The actual situation survey (preparation, specification, utilization) of geospatial information was implemented.

* The major geospatial information already developed in Ukraine is as provided in the table below. In addition to the central government agencies, local governments and utility providers in the private sector, such as telecommunications, electricity and gas, own the geospatial information to manage their systems. The geospatial information disclosed partly was paper based, but the information was being updated.

Table 8 List of Key Geospatial Information developed in Ukraine

No.	Name of geospatial information	Producer	Remarks
1	Basic topographic maps	RIGC	Digital, 1:100,000, 1:200,000
2	Basic topographic maps (for each oblast)	RIGC	Digital, 1:100,000, 1:200,000, Crimea (1:50,000)
3	Basic urban topographic maps	RIGC	Digital, 1:2,000 (Kiev and other) Other 1:10,000
4	Raster maps	RIGC	-
5	Publications of various kinds, etc.	SSPE "Kartographia"	Mapping coordination based on RIGC's data
6	National atlas	NSA IG	Six themes, 875 types of maps with 440 pages
7	Cadastre	Oblast office of SLCC	XML formation with graphical and attribute information
8	Soil maps	SLCC	Digitizing raster map data
9	Administrative boundary maps	SLCC	Digitizing raster map data
10	Orthophotos	SLCC	1:10,000 (the entire area), 1/5,000 (Village), 1/2,000 (cities with a population of more than 200,000 people)
11	Topography (contour)	SLCC	Digitizing raster map data

In addition to the above, cadastral data were partially prepared. Also, the geospatial information corresponding to each objective are prepared in the state enterprise under SSGCC, Ministry of Defence, Ministry of Home Affairs, Forest Resources Agency, Ministry of Energy and Coal Industry, Ministry of Public Works and Advanced Local Government. However, there were no unified specifications or regulations.

* The following Web-systems are working using the prepared geospatial information.

- Web System of State Border Information (State Border Service of Ukraine : <http://dpsu.gov.ua/ua/map.htm>)
- Web System related to Natural Resources (Ministry of Environment and Natural Resources: <http://www.menr.gov.ua/index.php/geoportal>)
- Web System of Control Point Network (Research Institute of Geodesy and Cartography : <http://dgm.gki.com.ua/map>)
- Web System of Urban Planning Information (Kiev city : www.mkk.gov.ua)

e. Results of Study of IT Technology Situation

IT technologies are widely available in Ukraine. The officials at C/P agencies are also competent. However, there are not enough highly skilled technicians with world-class skills and there is a lack of state-of-the-art technology. In particular, there is a disparity regarding availability of systems and equipment between large cities and local areas. Nonetheless, the government sector, including municipal bodies, is provided with the essential networks and computers. It should be noted that Ukraine supposedly intends to prepare an IT strategy and a national plan to initiate the electronic government system, but all the details have not been uncovered.

Compared with a decade ago, fiber-optic networks that underpin information and telecommunications infrastructure have been developing. As for mobile communication networks, GSM, a second-generation standard, is covering the country. While third-generation 3G services were launched in 2015, the fourth-generation 4G services have not started.

On the other hand, training programs related to the latest and advanced information and telecommunication technologies are not sufficiently provided. The country needs more educational institutions, updates of the existing systems and equipment as well as learning materials. To address these problems, Canada is implementing an online project (a correspondence course using the Internet) that provides highly advanced IT education. Officials of SLCC, which is this Project's C/P agency, are taking the lectures.

f. Results of Study of concrete cases of NSDI

To develop a plan for NSDI creation and operation (draft), the Project team has studied the major practical experiences of Japan in establishing and operating its NSDI, and shared them with the C/P agencies.

*** Outlines of the Japanese NSDI Act**

The Japanese NSDI Act includes General Provisions in Chapter 1, the Japanese NSDI Basic Plan in Chapter 2, and Key Policies in Chapter 3. Chapter 3 is comprised of three sections, including General Provisions in Section 1, Policies related to the Geospatial Information System in Section 2, and Policies related to Satellite Positioning

in Section 3. It encourages broader applications of geospatial information by facilitating the use and concerted application of satellite positioning technologies.

* The related agencies and its tasks are shown in the following figure.

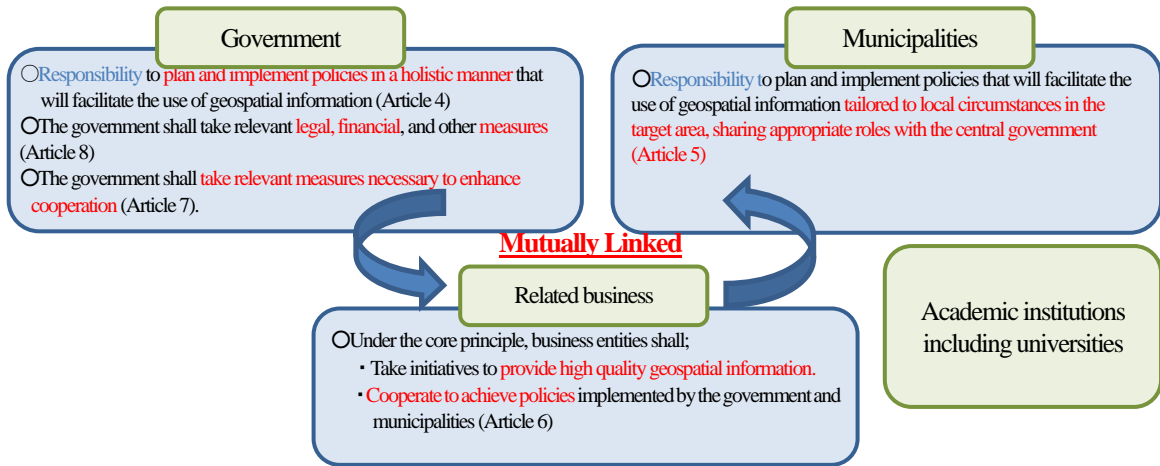


Figure 8 Roles prescribed by the NSDI Act

* Key activities related to NSDI

Key efforts to make geospatial information broadly available are the protection of personal information as well as intellectual property rights, consideration of the government’s security, and facilitation of access to public information. In Japan, some of these efforts are stipulated in work guidelines applicable to provision of geospatial information, incorporated into a legal framework prescribing NSDI.

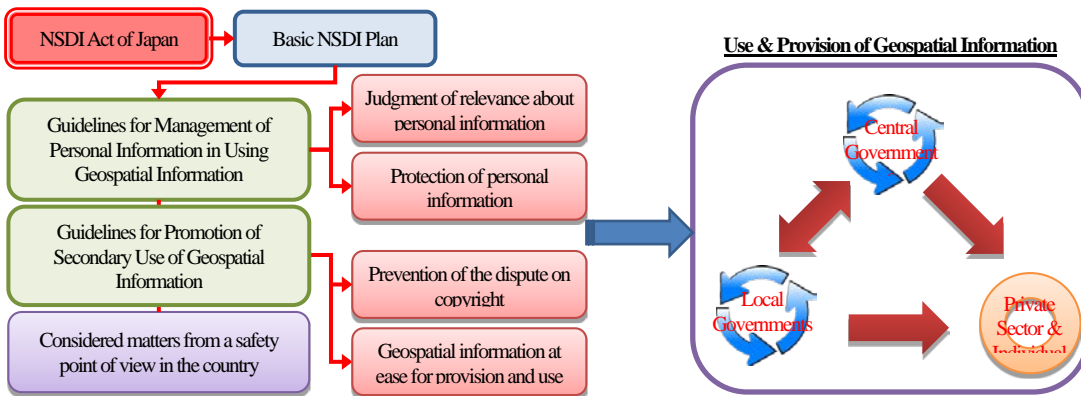


Figure 9 Key activities related to NSDI in Japan

(2) Examination of the method of Establishment and Operation of NSDI

1) Examination Items of the method of Establishment and Operation of NSDI

The following examinations in the method of Establishment and Operation of NSDI were implemented.

- * Organizational structure of NSDI establishment and operation
- * Preparation/Management system of NSDI data
- * Organization responsible for preparation of NSDI data

* Cost of NSDI establishment and operation

2) Implementation and Results of Examination of the method of Establishment and Operation of NSDI

a. Organizational Structure of NSDI establishment and operation

The part of NSDI Act (draft) that refers to the organizational structures under discussion in the national assembly at present, and the NSDI concrete cases were researched, and the organizational structures of NSDI in Ukraine were considered.

* It was clear that the establishment of organizational structures corresponding to each element (Infrastructure for sharing data, common rules for common use/sharing of data, system infrastructures for sharing data) composing NSDI was necessary to realize the basic concepts (ideal) of NSDI. It was evident that the Steering Committee, including Working Group, which was a comprehensive organizational structure for NSDI establishment and operation, and was composed by related governmental agencies, was needed. The necessity to clarify the following was also became clear: the roles and identification of an organization that establishes infrastructure sharing the data under S/C, the preparation of common rules and identification of an organization for their preparation for sharing data and the roles and identification of organization for accelerating the realization of common use of data.

b. Preparation/Management system of NSDI data

The preparation/management system of data using in NSDI was considered.

* The following five options related to the method of preparation/management of NSDI data were considered.

Table 9 Preparation/Management of NSDI data

Option	Way of NSDI data acquisition	Way of NSDI data management	Possible advantage	Remarks
1	One dedicated / representative data producer creates NSDI data	NSDI data are centralized into a specific geo-portal.	Clarification of the responsibility for creating and updating NSDI data.	Need the budget to establish and run the dedicated representative data producer. And expense of data creation will be substantial.
2	NSDI data are collected from holders of existing geospatial data	NSDI data are centralized into a specific geo-portal.	Extension of existing routines (daily business to manage facilities) to create Geospatial data	Need to consider how to create NSDI data in the region where there are no existing geospatial data.
3	NSDI data are collected from holders of existing geospatial data.	NSDI data are decentralized at separate geoportals run by holders of existing data.	Unnecessary to establish a dedicated administrator for running a specific geo-portal	Need to spread the geo-portal software to existing data holders in addition to the remarks on option 2
4	Cooperation between existing holders of data who submit their data to the geoportal and the representative data producer who creates data in the region where there are no existing geospatial data.	NSDI data are centralized into a specific geo-portal.	Expectation of economies of scale on data creation owing to joint data production.	Need to consider who will oversee the representative data producer.

Option	Way of NSDI data acquisition	Way of NSDI data management	Possible advantage	Remarks
5	Cooperation between existing data holders who submit their data to the geoportal and the representative data producer who creates data in the region where there are no existing geospatial data.	NSDI data are decentralized at separate geoportals that existing data holders run.	(The same as option 3 and 4.)	(The same as option 3 and 4.)

On the other hand, according to the NSDI Act that is under discussion in the national assembly, a new state enterprise (NSDI Data Centre) will be established under SSGCC and it is planned that all the geospatial information of the related ministries and the local governments will be gathered and operated in the organization. The following figure shows the structures of preparation/management for NSDI data based on the NSDI Act above mentioned.

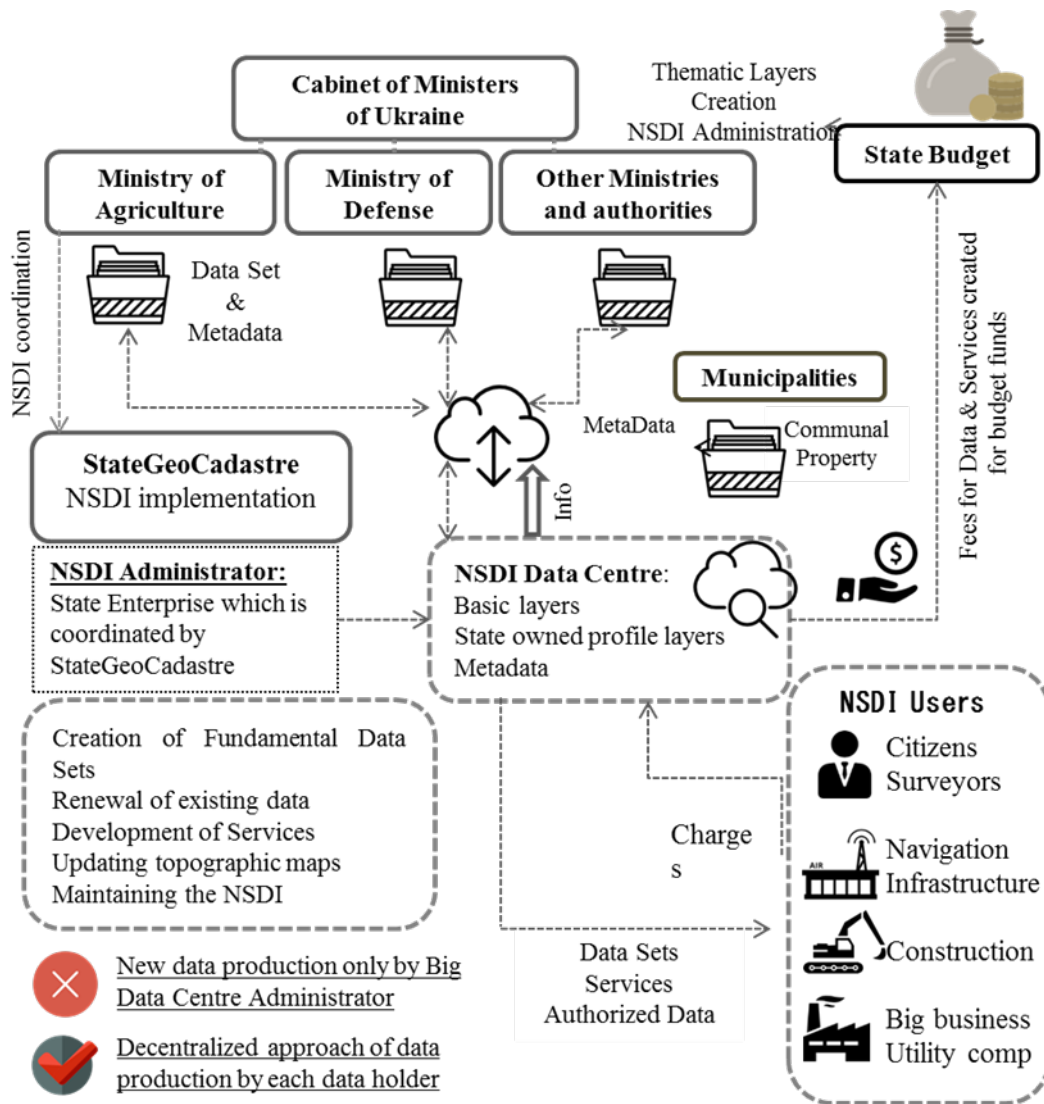


Figure 10 Draft operational structure of NSDI in Ukraine

c. Preparation organization of NSDI data

The establishment of NSDI Data Centre, that is positioned as an NSDI data preparation agency mentioned in the NSDI Act and the establishment and operation structure of NSDI data, was considered from the view points of new data preparation for Ukraine throughout the country and of the quality control of prepared data.

* The empirical values (such as required hours for preparing data) of NSDI data preparation (Fundamental Geospatial Data) in the prototype and the number of persons and equipment required for new NSDI data preparation for Ukraine throughout the country were calculated. Furthermore, the number of engineers, equipment and the space for setting this up were calculated.

d. Cost of NSDI establishment

Based on NSDI prototype, the number of person-days necessary for a new basic geospatial data creation with 1:2,000 scale by photogrammetry for the urban area of Ukraine (approximately 70,440 sq km) was estimated roughly. It can be possible to reduce the person-days by utilization of existing geographic data which governments and municipals have.

Table 10 Approximate number of person-days for a new basic geospatial data creation in the urban area of Ukraine

Process	Assumed efficiency	Total man-days
Aerial Photography	150 sq km/day	470 days
Simultaneous Adjustment	100 sq km/day	704 days
Orthophoto Creation	100 sq km/day	704 days
Field Identification	0.3 sq km/day	234,800 days
Digital Plotting	0.15 sq km/day	469,600 days
Filed verification	0.73 sq km/day	96,493 days
Digital Editing	0.15 sq km/day	469,600 days
Assumed total necessary person-days		1,272,372 days

Assuming that the data creation would be completed in five years and the number of work days per year is 220, the necessary number of staff personnel who directly work on NSDI creation was estimated to around 1,160. The necessary number of administrative staff needed for managing the estimated 1,160 staff was estimated to 130 by capturing around 10 percent of 1,160. Based on this assumption, the project team made an estimate of the required floor area for the NSDI Data Centre. Also, SSGCC submitted a budget estimate for the next fiscal year according to the project team analysis. The SSGCC submitted a budgetary request for establishment of the NSDI Data Centre in reference to the analysis.

Table 11 Building plan (Construction of new building where all staff including administrative and other staff)

Category	Room	Required floor area(sqm)		Remarks
		Range		
Office space	Office space	7,740	7,740	1,290 (all staff)×6.0 sqm=7,740 sqm
	Space for examining drawings	500	1,000	-400,0000 A0-sheets are stored. -20 to 40 staff is expected to work on examination.
	Conference rooms	500	1,000	Estimated 40 sqm/ 100 persons. 1,290 persons @ 40 sqm/100 persons =516 sqm

Category	Room	Required floor area(sqm)		Remarks
		Range		
Server room	Server room	500	1,000	Based on the floor plan for server room in the NSDI facility plan that was formally studied by the Ukrainian side
Other space	Warehouse	1,000	1,500	13 percent of office space
	Toilets	400	500	0.32 sq.m./staff personnel →1,290@0.32=412.8
	Machine/ electrical rooms	800	1,000	Elevator machine room, air-conditioning machine room, boiler room, etc.
	Electric generator room	50	50	Planned for backup power source
	Sub-total	11,490	13,890	
Others	Entrance room, hall, stairs, etc.	4000	5,000	Sub-total @ 35 percent
	Total	15,490	18,890	

Table 12 Building plan (Construction of new building where only administrative staff is accommodated).

Category	Room	Required floor area(sqm)		Remarks
		Range		
Office space	Office space	780	780	130 (all staff)×6.0 sqm=780 sqm
	Space for examining drawings	500	500	-400,000 A0-sheets are stored. - 20 staff is expected to work on examination.
	Conference rooms	50	100	Estimated 40 sqm./ 100 persons. 130 persons@40 sqm/100 persons =52 sqm.
Server room	Server room	250	500	Half of the server room in the above plan accommodating 1,290 personnel was estimated.
Other space	Warehouse	110	110	13 percent of office space
	Toilets	40	50	0.32 sqm./staff personnel →130@0.32=41.6
	Machine/ electrical rooms	260	300	Elevator machine room, Air-conditioning machine room, Boiler room, etc.
	Electric generator room	30	30	Planned for backup power source
	Sub-total	2,020	2,370	
Others	Entrance room, hall, stairs, etc.	700	830	Sub-total @ 35 percent
	Total	2,720	3,200	

(3) NSDI Establishment and Operation Plan (draft) Preparation

a. NSDI Establishment and Operation Plan (draft) Preparation

The NSDI Establishment and Operation Plan (draft) was prepared cooperating with C/P based on the result of various studies and analysis implemented, the results of Project such as establishment of cooperation among related agencies, preparation of Geographic Information Standards and NSDI prototype establishments. Firstly, the C/P and the Project Team examined and decided on the structure of the draft plan. After that, the C/P mainly examined a policy of NSDI, Principles and Goals and an organizational framework in accordance with the draft

NSDI act. On the other hand, the Project Team examined a draft activity plan for the advancement of establishment of NSDI. Finally we organized the draft NSDI Establishment and Operation Plan after reviewing each other.

In the consideration of NSDI Establishment and Operation Plan (draft), the consistency with the framework of NSDI management in the figure below indicated by the draft NSDI Act was paid attention.

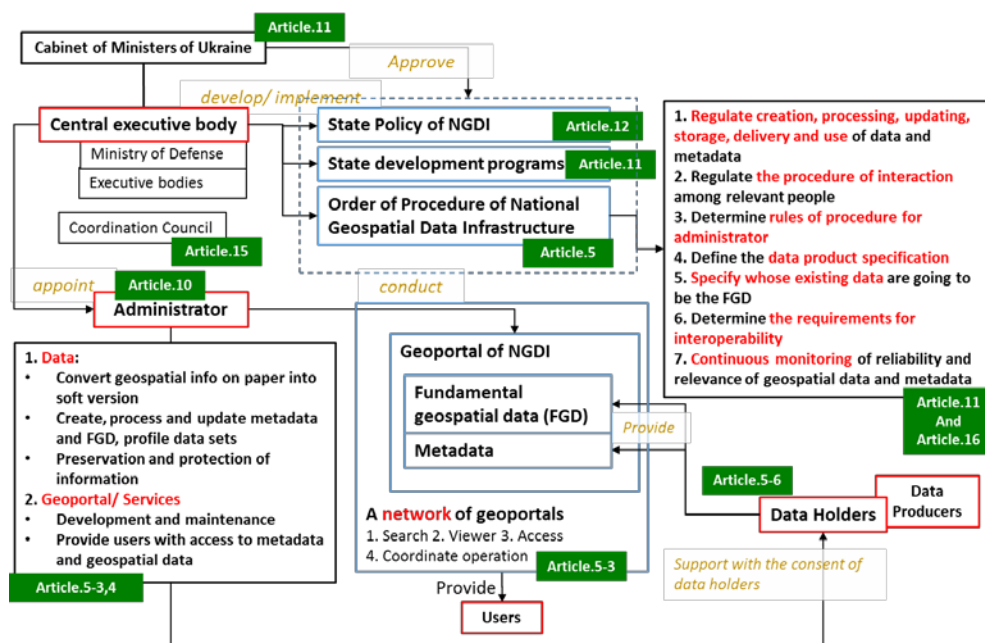


Figure 11 Framework of NSDI management indicated by the draft NSDI Act

In the NSDI Establishment and Operation Plan (draft), the activities plan (draft) after NSDI Act enacting is described in addition to the background of NSDI deliberation and the explanation of the basic policies toward NSDI establishments based on NSDI Act. The outline of the activities plan (draft) in the future is showed in the following table.

Table 13 Outline of Activities Plan (draft) in the future for NSDI Establishment and Operation

Activity	Principal Future Task	Key Point
1 Establishment of Operation System	Establish the Central Executive Body	The functions of the subgroup and relationship with governmental authorities can be transferred.
	Formulate measures for advancing the utilization of NSDI	It is important to specify how NSDI can contribute to solving social problems, which can be key triggers to accelerate NSDI creation.
2 Decide on rules of procedure of NSDI	Decide on product specifications for basic geospatial data	The draft product specification for NSDI prototype will be reviewed within governmental authorities and updated as necessary.
	Prepare standardized manuals on geospatial data creation	The outcome of data prototype creation will be reflected in existing manuals or regulations.
	Establish interoperability among authorities using geospatial data	UkrGIS will be referred from the rule approved by the Cabinet or a ministry and registered with the Ministry of Justice.
	Appoint an Administrator managing geospatial data and geo-portal	Expertise in survey, geospatial data creation, its quality control, system maintenance and standardization are required.

Activity	Principal Future Task	Key Point
3	Create geospatial data	Grasp existing geospatial data which can be turned into basic geospatial data
		Using existing data that governmental and local authorities have is an efficient way to establish NSDI.
		Prepare a state development program for data creation for the first five years
		Data creation should be carried out stepwise by specifying prioritized area and prioritized features.
		Monitoring system and quality control system should be established as Administrator's functions.
4	Enhance the geoportal and develop tools and services	Prepare a state development program for the geoportal
		Enhance the prototype of geoportal
		Develop tools and services
		It needs to consider the operational structure of geoportal. There are two ways, centralized and decentralized.
		All metadata from existing data holders should be registered with geoportals.
		Tools such as data conversion, quality check and services for a specific application field should be developed.
5	Public awareness activity and human resource development	Hold seminars to disseminate NSDI role and significance
		Develop an educational system
		Execute scientific research and development in the sphere of geographic information
		It is important to promote common understandings of relevant people in NSDI using the materials of the JICA project.
		It is important to foster experts on survey, GIS, ICT and standardization in order to realize sustainability of NSDI.
		It is important to keep up with technological progress and to establish an implementation system based on technical trends.

Table 14 Detail of Activities Plan

Principal Task	Goal	Targeted period of achievement	Responsible Parties
1. Establishment of Operation System			
1.1	Establish the central executive body	First meeting of the NSDI Coordination Council is held.	Three months after the Law is adopted.
1.2	Formulate measures for advancing the utilization of NSDI	Each ministry and agency belonging to NSDI Coordination Council create clear goals for the utilization of NSDI.	Six months after the Law is adopted.
			Ministry of Agrarian Policy, SSGCC
			SSGCC, NSDI Coordination Council
2. Decide on rules of procedure of NSDI			
2.1	Decide on product specifications for basic geospatial data	The first edition of product specification for basic geospatial data is approved by the central executive body and released on the geoportal.	A year after the Law is adopted.
2.2	Prepare standardized manuals on geospatial data creation	The standardized manual defining the procedures of basic geospatial data creation and quality evaluation is distributed to data holders and producers.	A year after the Law is adopted.
2.3	Establish interoperability among authorities using geospatial data	UkrGIS is referred to the rule approved by the Cabinet or an authorized ministry.	A year after the Law is adopted.
2.4	Appoint the Administrator managing geospatial data and geoportal	The administrator on NSDI starts creation of basic geospatial data and launches the first version of geoportal.	A year after the Law is adopted.
			SSGCC, Administrator
3. Create geospatial data			

Principal Task		Goal	Targeted period of achievement	Responsible Parties
3.1	Grasp existing geospatial data which can be turned into basic geospatial data	The inventory of all the geospatial data created with expenses of governmental or local authority is stored in the Cartographic-geodesic fund of Ukraine.	A year after the Law is adopted.	SSGCC, Administrator
3.2	Decide on the state development program for basic geospatial data creation for the first five years	The state development program for basic geospatial data creation is approved by the central executive body.	A year after the Law is adopted.	SSGCC, Administrator
3.3	Carry out basic geospatial data creation	Not less than 2/3 of prioritized basic geospatial data are created for the whole territory of Ukraine.	Five years after adoption of the state development program for basic geospatial data creation.	Governmental and local authorities, Administrator
4. Enhance the geoportal and develop tools and services				
4.1	Decide on the state development program for the geoportal	The state development program is approved by the central executive body.	A year after the Law is adopted	SSGCC, Administrator
4.2	Enhance the prototype of geoportal	The geoportal storing all metadata of geospatial data created by the expenses of governmental and local authorities is open to the public.	Two years after the Law is adopted.	Administrator
4.3	Develop tools and services	Ten or more services based on basic geospatial data are developed.	Five years after adoption of the state development program for geoportal.	Administrator, governmental and local authorities
5. Public awareness activity and human resource development				
5.1	Hold activities for growth of awareness on NSDI	The activities are held in the principal cities.	Five years after the Law is adopted.	SSGCC, Administrator
5.2	Develop educational system	Training courses related to NSDI are established.	Five years after the Law is adopted.	SSGCC, Administrator
5.3	Execute scientific research and development in the sphere of geographic information	Results of research and development related NSDI contribute to NSDI development, maintenance and utilization.	Five years after the Law is adopted.	SSGCC, Administrator, research institutions, universities

Table 15 Draft schedule for activities

Activity	Principal Future Task	After legislation					
		1st year	2nd year	3rd year	4th year	5th year	6th year-
Establish a management structure	Establish the central executive body						
	Formulate measures for advancing the utilization of NSDI						
Decide the order of procedure of NSDI	Consider product specification for basic geospatial data						
	Prepare standardized manuals on geospatial data creation						
	Establish interoperability among authorities						
	Appoint an Administrator managing geospatial data and geoportal						
Create geospatial data	Grasp existing geospatial data which can be turned into basic geospatial data						
	Prepare state development program for data creation for the first five years						
	Carry out basic geospatial data creation						
Enhance the geoportal and develop tools and services	Prepare the state development program for the geoportal						
	Enhance the prototype of geoportal						
	Develop tools and services						
Public awareness and human resource development	Hold seminars to disseminate NSDI role and significance						
	Develop educational system						
	Execute scientific research and development in the sphere of geographic information						

b. Explanation and Consultation Concerning the NSDI Establishment and Operation Plan (Draft)

In the process of the preparation of NSDI Establishment and Operation Plan (draft), the plan (draft) was explained and consultations were held with C/P. The draft plan is going to be approved through consultation by the SubGroup under the Ministry of Agrarian Policy and Food of Ukraine, or the S/C.

The SSGCC is making a plan to create a database on land use for advancement of efficient land reform using the NSDI prototype developed in this project. For example, the SSGCC is going to try efforts to ensure transparency in land use by acquisition of actual information on agricultural land and search for violation of the Land Act using a web service function of the NSDI prototype.

3.2.2 Implemented Results of Establishment of a Cooperative Framework for Related Organizations

(1) Survey of existing organizations with NSDI establishment and operation

1) Survey Implementation

The survey was implemented for the following nations and organization that had already established and started operating an NSDI.

- * Japan
- * EU (INSPIRE)
- * Germany
- * France

The survey was implemented targeting the background, organization type, and operation content of NSDI establishment and operation organizations established in each country / institution.

2) Results of Survey

a. Organization of NSDI establishment and operation in Japan

In Japan, based on the experience of the Great Hanshin Earthquake that occurred in 1995, the necessity of geospatial information (including sharing) became commonly recognized and an informal intra-ministerial meeting was organized as a place to consider realizing it. The informal intra-ministerial meeting became the organization for the establishment and operation of NSDI, and intermittent meetings were held as shown in the following table.

Table 16 NSDI committee in Japan

Period	Meeting body
1995 – 2005	1. Liaison meeting body among ministries and agencies related to Geographic System Information
2005 – 2008	2. Meeting body for promotion of positioning and geographic information system
2008 – now	3. Meeting body for promotion of advancement of utilizing geospatial information
2008 – now	4. Industry, government and academia liaison council for geospatial information
2007 – Now	5. Central Government, Parliament

The following figure shows promotion of utilization and advancement of geospatial information, or more specifically, an organizational structure for NSDI establishment and operation.

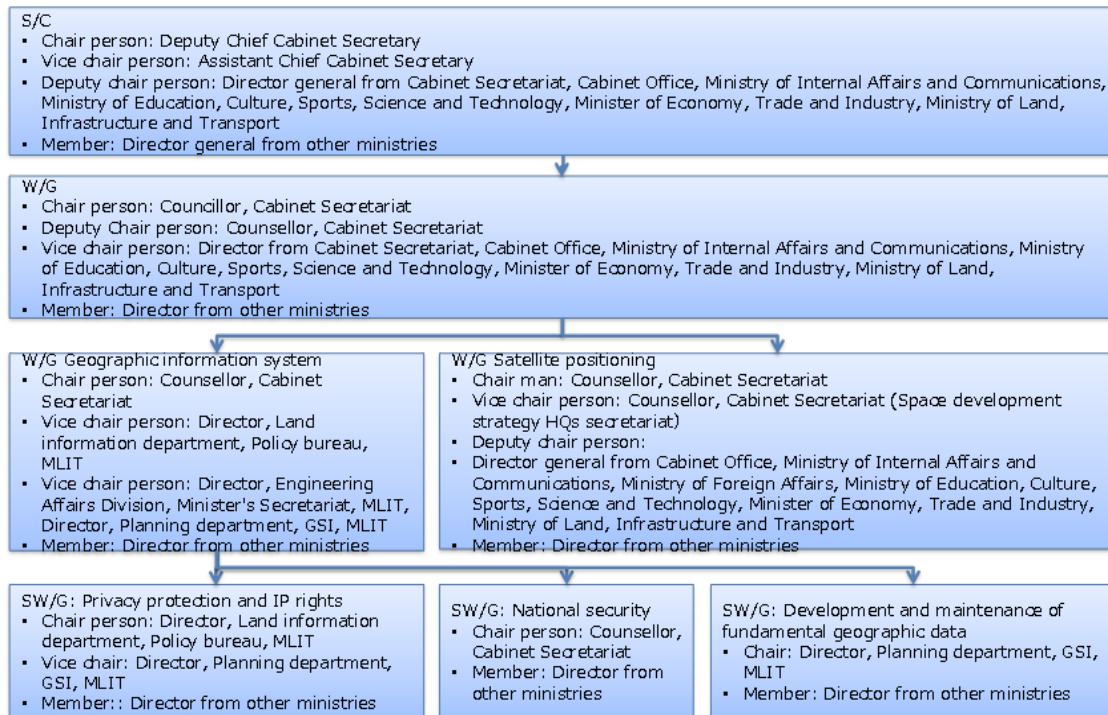


Figure 12 Structure of committee in Japan

As can be seen from this organizational chart, the organization is composed of Steering Committee (S / C) and Working Group (W / G). Also, the members of S/C and W/G are from related ministries and agencies. Furthermore, in the organization, organizational activities, related to NSDI establishment and operation and targeting the following tasks, are implemented.

- GIS (Geographic Information System)
- Satellite positioning and related matters
- Personal Information Protection Law, Copyright Law and related matters
- National security and related matters
- Preparation and maintenance of fundamental Geospatial Information and related matters

b. EU (INSPIRE) organization of NSDI establishment and operation

NSDI establishment and operation in the EU countries commenced through Directive 2007/2/EC of the European Parliament and of the Council of 14 March, 2007, establishing an Infrastructure for Spatial Information in the European Community (INSPIRE). INSPIRE, as organization of NSDI establishment and operation in the European Community, has the organization structure shown in the following figure.

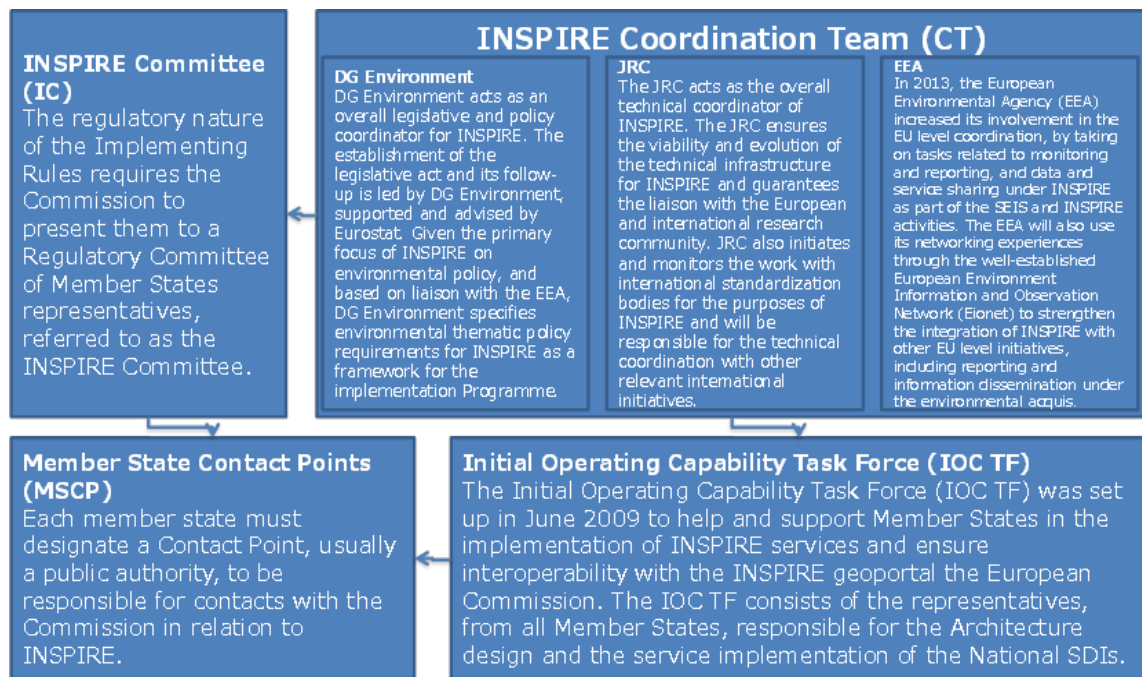
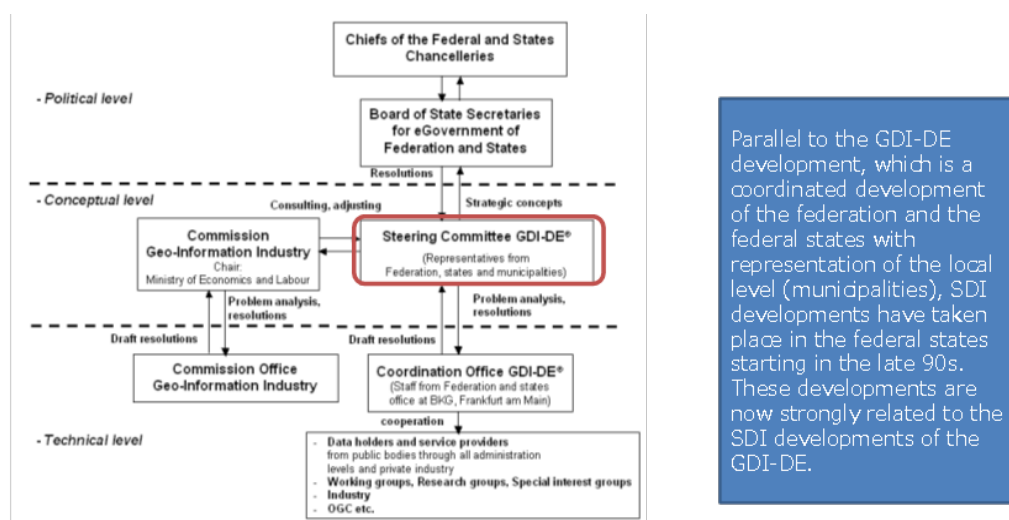


Figure 13 Framework of organizations for INSPIRE in the EU

The organization of INSPIRE was composed by INSPIRE Committee (IC) and INSPIRE Coordination Team (CT).

c. Organization of NSDI establishment and operation in Germany

In the case of Germany adopting the federal system, German NSDI S/C has an aggregation of independent SDI S/Cs in accordance with the government organizations. The following figure shows the organizational chart compliant with INSPIRE.



Parallel to the GDI-DE development, which is a coordinated development of the federation and the federal states with representation of the local level (municipalities), SDI developments have taken place in the federal states starting in the late 90s. These developments are now strongly related to the SDI developments of the GDI-DE.

<http://inspire.ec.europa.eu/reports/stateofplay2011/r011DEv132.pdf>

Structure of the GDI-DE since 2004
Realization of IMAGI's initiatives

Figure 14 NSDI S/C in Germany

d. Organization of NSDI establishment and operation in France

In the case of France, the organization of NSDI establishment and operation has been more centralized, as in Japan, and it is compliant with INSPIRE Directive, the same as Germany. The following figure shows the organization of NSDI establishment and operation in France.

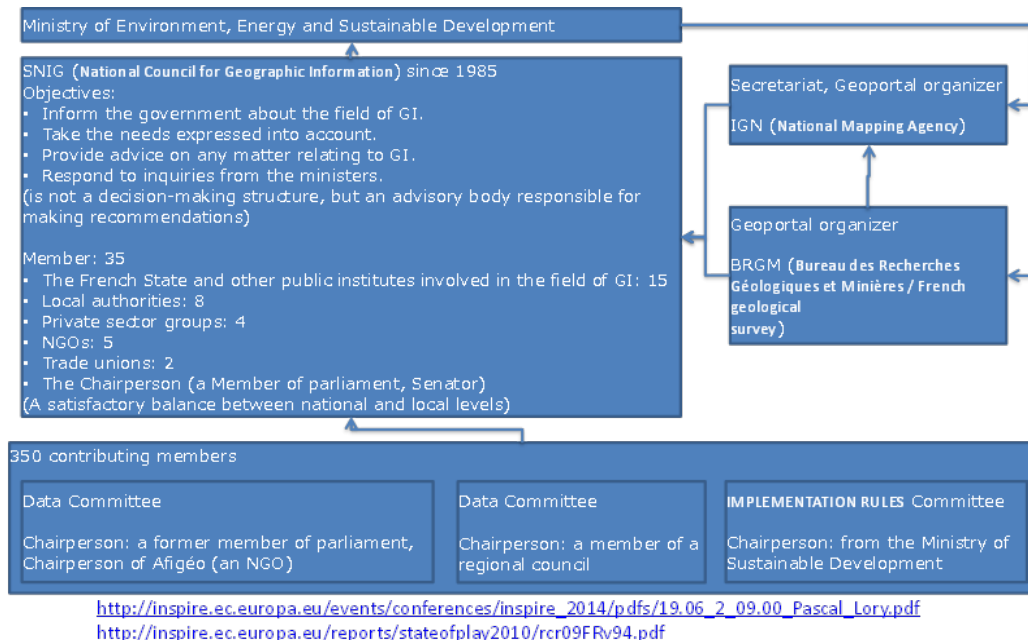


Figure 15 French NSDI S/C committee

SNIG (National Council for Geographic Information), which corresponds to S/C, which is the center of the organization of French NSDI establishment and operation, is composed of not only the national organizations but also NGOs and the private sector.

(2) Consideration of NSDI Establishment and Operation Organization in Ukraine

1) Consideration of Organization

The contents of NSDI Act in Ukraine, the framework of National organization in Ukraine and the results of organizational studies of NSDI establishment and operation in each country were considered from the view point of the formulation of NSDI establishment and operation organization. Also, confirmation of the intentions of the governmental organizations, which are expected to be members of the organization, was implemented as a part of the consideration.

2) Results of consideration of organizations

a. Organizational Structure

The plan for the following was formulated: NSDI establishment and operation organization consisting of a working group (W / G) responsible for the level of implementation of each work in NSDI establishment and operation and a steering committee (S / C) responsible for making decisions on the implementation of the work to be done. The following figure shows a formulated organizational structure.

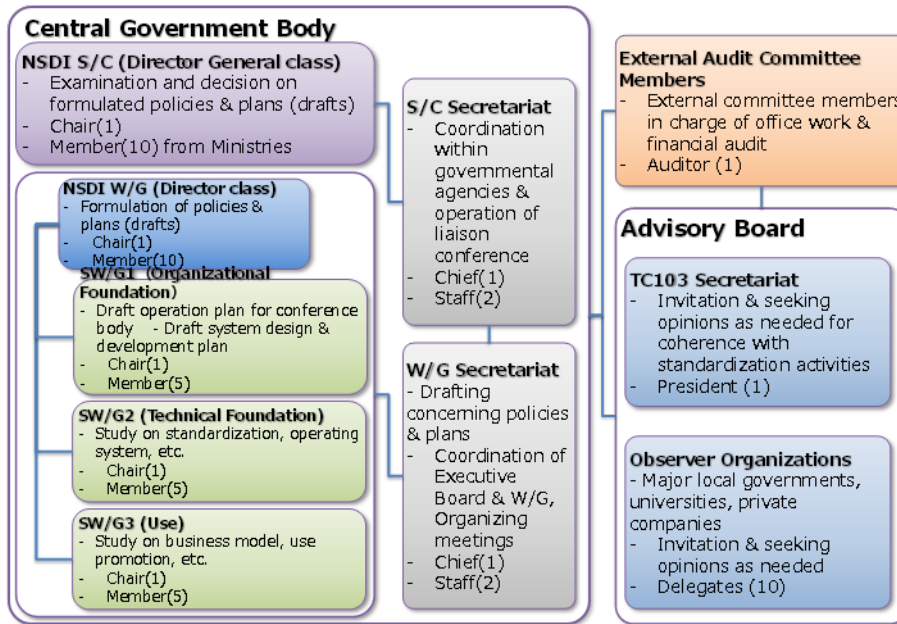


Figure 16 Proposed composition of the S/C and the W/G

In the organizational chart, in addition to the main organizations S / C and W / G, a secretariat to support its activities, external (third party) regulatory agencies and advisory agencies are stated.

b. Organizational constituents

Similar to the formulation of the composition of the organization, the constituents were targeted by the government agencies shown in the following figures.

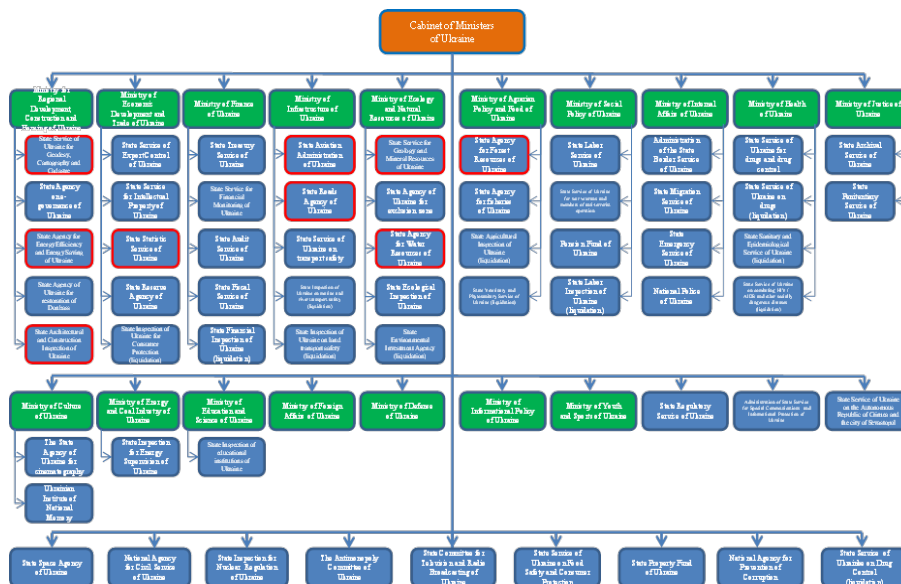


Figure 17 Structure of Ukrainian Government

The survey to confirm intentions was implemented to identify members of S/C and W/G from these governmental organizations. The following results were obtained.

Table 17 Survey results of intentions of relevant organizations

№	Central government authority	Meeting date	Signer	Contents	Propositions
1.	State Service for Statistics	29.07.2016	Effective Chairman I. Zhuk	Provides information as to certain issues	Does not oppose joint work meetings
2.	Ministry of Infrastructure	06.07.2016	First Deputy Minister Y. Kravtsov	Does not fall under the expertise of the Ministry	Did not provide SSGCC with any propositions as to the meetings
3.	Ministry of Regional Development, Construction and Household	25.07.2016	First Deputy Minister V. Nehoda	Doesn't oppose to holding work meetings with SSGCC and experts of the Project	Ready to participate if necessary
4.	State Architecture and Construction Inspection	20.07.2016	Chairman V.Kudriavtsev	Ready to cooperate within the framework of their expertise	
5.	State Agency of Energy Efficiency and Conservation	20.07.2016	Chairman S.Savchuk	The agency is interested in creation of NSDI	Propositions of meeting on 28.07.2016 at 14-30 (meeting was held). In case of SC creation, the Agency will provide a candidate for participation
6.	State Agency of Forest Resources	04.08.2016	Effective Chairman K. Yushkevych	Provides SSGCC with candidates	To SC: acting Head - Yuschevych Hrystyna Vasylivna (226-32-53); to WG: deputy Head of Forestry and Forest Reproduction Administration - Mateychuk Vasyl Ivanovych (234-09-40)
7.	SO "Air Traffic Service"	24.06.2016	Director D. Babeychuk	Provides SSGCC with filled questionnaire forms finalized by SO specialists	On letter from SSGCC
8.	Ministry of Foreign Affairs	09.08.2016	Deputy Minister V. Prystayko	Does not fall under the expertise of MFA of Ukraine	Ready to fully assist functioning of mentioned bodies and decision making within the framework of expertise
9.	State Service for Statistics	10.08.2016	Effective Chairman I.Zhuk	The candidate to S/C will be announced after appointment of service senior official	Suggests temporally including SC staff: associate director of Department of Population and Regional Statistics - Timonina Maria Borysivna (phone number 287 62 22); to WG: associate director of Department of Population and Regional Statistics. - Redchenko Svitlana Olexandrivna (phone number 287 43 55, s.redchenko@ukrstat.gov.ua)
10.	State Agency of Energy Efficiency and Conservation	16.08.2016	Chairman S.Savchuk	Provides candidates to W/G: Head of Department of Replacement of Traditional Types of Fuel - Shafarenko Juriy Anatoliyovych; Head of Department of Coordination of Scientific and Technological Activities; Deputy Renewable Energy Sources and Alternative Types of Fuel - Iljasov Valeriy Abdraschutovych; to S/C - after approval of provisions of S/C	Suggests: - in basic layer of "Engineer communications" include detailed information concerning electric and heating networks; - in basic layer of "Cadastre information" indicate end use of land parcels; - create profile layer with average metadata (for month, year) concerning air temperature, precipitation, direction and speed of wind, cloudiness, coefficient of solar radiation and number of sunny days, etc.
11.	State Aviation Administration	19.08.2016	Chairman O. Bilchuk	Sent letters on NSDI creation to Air Traffic Service, "Ukrainian company of Geospatial data" and institute "Ukrainian air project", asking to fill in the questionnaire and send it to SSGCC	Suggests enlisting specialists of mentioned organizations to SC staff

№	Central government authority	Meeting date	Signer	Contents	Propositions
12.	Ministry of Justice	19.08.2016	Director, Private Right department O. Ferens	No recommendations to staff; in case of receiving draft resolution from the Cabinet of Ministers of Ukraine - will participate in its processing within the framework of its expertise	Question of creating such bodies is adjusted by resolution from the Cabinet of Ministers from 17.06.2009 № 599; project of appropriate resolution is prepared and introduced in order established by Regulation of the Cabinet of Ministers of Ukraine, approved by Resolution of the Cabinet of Ministers of Ukraine from 18.07.2007 № 950
13.	Ministry of Ecology and Natural Resources	21.07.2016	Deputy Minister V. Vakarash	Provides SSGCC with candidates	To SC: Deputy Minister - Chief of Staff - Vakarash Viktor Mechailovych (authorized representative); Head of Department of Information Security and Electronic Services - Byluka Dmytro Borysovych To WG: Head of Sector of Land Resources Deputy of Conservation of Natural Resources - Kolmaz Yuriy Tomovych; Head of Department of Information Security and Electronic Services - Byluka Dmytro Borysovych
14.	Ministry of Agrarian Policy and Food	19.08.2016	First Deputy Minister M. Martyniuk	Provides SSGCC with candidates	To SC on part concerning creating prototype of NSDI: First Deputy Minister - Martyniuk Maxim Petrovych; to WG on part concerning creating prototype of NSDI: Deputy Head of Department. -Head of department of Use and Protection of Agricultural Lands, Improvement of Land Relations Department of Agriculture and Technology Policy in Agro-Industrial Complex - Rudenko Svitlana Viktorovna

Based on the study results, the following plan for identifying members of Ministries and Agencies composing S/C was prepared.

Members of Steering Committee
<ul style="list-style-type: none"> * Ministry of Defense of Ukraine * Ministry of Infrastructure of Ukraine * Ministry of Ecology and Natural Resources of Ukraine * Ministry of Agriculture and Food of Ukraine * State Space Agency of Ukraine * State Emergency Service of Ukraine * Research Institute of Geodesy and Cartography * State Agency for Energy Efficiency and Energy of Ukraine * State Statistics Service of Ukraine * State Agency of Forest Resources of Ukraine * State Service of Ukraine for Geodesy, Cartography and Cadastre * State Land Cadastre Center

(3) Consideration of Management/Construction of Organization for NSDI establishment and operation

1) Consideration of Management/Construction

The operational contents of S/C and W/G to be organized were considered based on the results of each study.

Also, the work contents of the secretariat supporting S/C and W/G activities were considered. Furthermore, the activities to be implemented toward establishing actual S/C and W/G were considered.

2) Results of Consideration of Management/Construction

a. Management of S/C and W/G

With the results of consideration based on the results of each study, the actions to be done (functions) that S/C and W/G have to carry out in NSDI establishment and operation were arranged divided into the following types of NSDI concepts: organizational infrastructure, technical infrastructure and utilizational infrastructure. The following table shows the list of activity contents (functions) of S / C and W / G.

Table 18 Draft of functions of S/C and W/G

Types	S/C Functions	W/G Functions	Details of implementation
Institutional infrastructure	Define constitution of the meeting body		Define the members and posts of the S/C consisting of the heads of organizations, the W/G consisting of the working-level officials from organizations, and the secretariat (Drafted by the secretariat of NSDI S/C)
		Draft S/C and W/G operation plan	Draft operation plan for the both S/C and W/G meeting bodies. The plan includes intervals of meetings, scale of meetings, major tasks and activities for S/C and W/G of the conference body. Submit the drafted plan to S/C.
	Approve S/C and W/G operation plan		Approve, reclaim, modify addition, and/or deletion the drafted operation plan.
		Draft NSDI long-term plan	Draft a long-term (about 3-6 years) plan concerning the institutional infrastructure and technical infrastructure, and the use of NSDI, as well as business model including cash flow.
	Approve NSDI long-term plan		Approve, reclaim, modify addition, and/or deletion the drafted NSDI long-term plan.
		Draft NSDI development plan (In an initial phase)	Draft an initial phase NSDI development plan. Submit the draft plan to the S/C.
	Approve NSDI development plan (In an initial phase)		Approve, reclaim, modify addition, and/or deletion the drafted NSDI development plan.
		Review and follow-up of long-term plan and development plan	Make analysis of periodical status of the long-term plan and development plan, and draft rolling plan. Submit the draft report and rolling plan to the S/C.
	Approve review and follow-up of long-term plan and development plan		Approve reclaim, modify addition, and/or deletion result of analysis made by W/G, and drafted rolling plan.
Technical infrastructure		Define a set of standards for the NSDI	Define a set of the standards necessary for NSDI implementation as of profile (Similar to Japanese JPGIS) from the international or national standards in collaboration with standardization body of geographic information (TK103). Submit to the drafted documents to S/C.
	Approve drafted a set of standards for the NSDI		Approve, reclaim, modify addition, and/or deletion the drafted the profile.
		Draft technical implementation schemes and guidelines	Develop technical implementation schemes and guidelines (Manuals) needed for the implementation of NSDI development plan. Submit to the drafted documents to S/C.
	Approve technical implementation schemes and guidelines		Approve, reclaim, modify addition, and/or deletion the drafted the manuals.
		Draft NSDI technical specifications	Develop technical specifications, such as data specifications for basic geographic spatial information data and implementation of information systems. Submit to the drafted documents to S/C.
	Approve NSDI technical specifications		Approve, reclaim, modify addition, and/or deletion the drafted the specifications.
User Layer		Study of business models	Study on NSDI relevant application services for self-sustainability of NSDI. Feedback the result to the rolling the long-term plan. Report the result to the S/C.
		Draft and implement measures for GIS utilization vitalization	Study and draft on GIS utilization vitalization measures. Feedback the result to the rolling the long-term plan. Report the drafted measures to the S/C
		Monitor NSDI usage	Monitor usage of NSDI periodically. Feedback the result to the rolling the long-term plan. Report the result to the S/C.
	Approve the Reports		Feedback the result to the rolling the long-term plan. Approve the reports made by the W/G and reflect the result to the rolling long-term plan.

Also, the management plan immediately after the establishment of S / C and W / C was prepared. The outline of the operation plan is as follows.

Table 19 Draft of operation plan of S/C

	Date	Main Working Items
1 st		Define constitution of the meeting body Approve S/C and W/G operation plan
2 nd		Approve NSDI long-term plan
3 rd		Approve NSDI development plan (in an initial phase)
4 th		Approve review and follow-up of long-term plan and development plan

5 th		Approve drafted set of standards for the NSDI
6 th		Approve technical implementation schemes and guidelines
7 th		Approve NSDI technical specifications
8 th		Approve the reports

As described above in the operation plan (draft), a future NSDI plan will be formulated as a reference plan based on the plan for NSDI Creation and Operation (draft).

b. Operation of other organization of NSDI establishment and operation

The works content of the secretariat that supports smooth activities of S/C and W/G were arranged, at the same time, the management manual of the secretariat of S/C and W/G was prepared to manage arranged works smoothly. The contents that showed the contents of manual were as follows.

Table 20 S/C and W/G secretariat operation manual contents (Draft)

1	NSDI S/C and W/G Outline	4	Holding S/C Meeting
1.1	NSDI outline	4.1	Drafting
1.2	NSDI S/C outline	4.2	Scheduling and announcements
1.3	NSDI W/G outline	4.3	Opinion inquiry by CMS
1.4	NSDI S/C W/G Secretariat Outline	4.4	W/G Draft explanation to the Chair
2	Enactment Process of Plans	4.5	Preparation of meeting logistics
2.1	Secretariat's duties	4.6	Minutes and recording
2.2	Mandating members	5	CMS (Contents Management System)
2.3	Moderating W/G S/C Meetings	5.1	Account management of CMS
2.4	CMS operation	5.2	Updating CMS
2.5	Drafting documents	6	annex
2.6	Issuing documents	6.1	Reward, travel Expenses, etc.
3	holding W/G Meeting	6.2	Purchasing standards, Documents
3.1	Drafting	6.3	Terminology
3.2	Scheduling and announcements	6.4	Abbreviations
3.3	Sharing draft through the CMS	6.5	Major publications
3.4	Examination of technological contents	6.6	Contact information
3.5	Holding W/G meeting		
3.6	Meeting minutes		

c. Establishment of S/C and W/G

At the 2nd project seminar held in November 2016, government officials who are supposed to comprise S/C, W/G participated; and it was a substantive pre-meeting of S / C, W / G establishment. Also, for the official establishment of S/C and W/G, it is essential to enact the NSDI Act, as of October 2017, incompatibilities between the NSDI Act and the current law were pointed out the during an inspection by the Ministry of Justice. Therefore the NSDI Act is currently being revised, and the timing of its enactment is uncertain. During this period (before enactment) without leagal support, an NSDI Sub Group has been established as a coordinating organization until the establishment of a meeting body to organize S/C and W/G within the government; which will become the permanent meeting bodies . NSDI Sub Group has been established as a focal point for communication and study sessions among related ministries and agencies during the period up to the establishment of NSDI S / C and W / G based on legal support.

The outline and function of NSDI Sub Group are as follows;

* Outline

NSDI Sub Group is a temporary consultation / advisory body established to recommend functions and development of NSDI under Ministry of Agrarian Policy and Food.

* Main activity contents

- NSDI Sub Group will make arrangements among central executive bodies and make recommendations to local executive bodies, local governments, private sectors, local infrastructures and local organizations about preparation, functions and development of NSDI.
- NSDI Sub Group will fulfill the role of cooperation point of contact with JICA, Eurogeographic and World Bank.
- NSDI Sub Group will formulate comprehensive recommendations for NSDI establishment.
- NSDI Sub Group will promote use of progressive experiences of foreign countries in NSDI establishment.
- NSDI Sub Group will discuss improvements of cooperation among organizational holders of geospatial data in NSDI establishment.

* Members of NSDI Sub Group

The members will be appointed based on Ordinance № 389 of Ministry of Agrarian Policy and Food, 28th July, 2017. Representatives of other public or non-governmental organizations engaged in activities related to international organizations, geospatial information, GIS and NSDI can be accepted to join sub group activities as observers.

* Holding of meetings

NSDI Sub Group will organize meetings regularly based on the activity plan. The outcomes of a meeting will be valid when more than half of the members attend. The secretariat will prepare a minutes of meeting for all the members based on the results of the meeting.

* Secretariat of NSDI Sub Group and its function

The secretariat will be established in SSGCC. The secretariat will prepare the necessary materials in advance of the meeting and provide them to the members.

d. Establishment of NSDI Sub Group and Holding of Meetings

NSDI Sub Group was established and the 1st meeting held on the 9th of November 2017.

The agenda of the meeting was as follows;

1. Organizational changes in composition of NSDI coordination subgroup – determination of the subgroup leader.
2. Presentation of concept of NSDI creation in Ukraine, vision of SSGCC, basic provisions of draft law on NSDI in Ukraine, basic assignments and subgroup's goals on NSDI coordination issues.
3. Introduction of the JICA Project “Establishment of NSDI in Ukraine”. Practical presentation of NSDI prototype creation outputs.
4. Approved work plan of the subgroup for the next period.

In addition, the following activity plan draft was proposed and was approved. At the same time, a common

understanding of NSDI was obtained among related organizations through explanation of NSDI concept and prototype demonstration.

No	Tasks		Compliance time limit	Person in charge
1	Develop Draft Operation Plan for NSDI creation and functioning, considering comments / notes from subgroup members		1st quarter 2018	SSGCC, subgroup members
2	Confirm Operation Plan for NSDI creation and functioning		2nd quarter 2018	Subgroup members
3	Suggest the list of geospatial data, property of organizations that are members of the subgroup and could be integral part of NSDI		1st quarter 2018	SSGCC, subgroup members
4	Present geographic information standards for Ukraine		2nd quarter 2018	SSGCC
5	Analyze and present to subgroup members possible business models of NSDI functioning by reference to the best practices		2nd quarter 2018	SSGCC

In addition, the participants to the meeting were as follows.

No.	Name	Position	Organization
1	Shemelynets Ludmyla Mykolayivna	First Deputy Head	SSGCC
2	Maliuk Oleksandr Oleksiyovych	Head of Department for Topographical, Geodetic and Cartographical Activities Chair of the subgroup	SSGCC
3	Makarenko Dmytro Gennadiyovych	Head of Division of International Relations of Department for International Cooperation and Land Market, Secretary of the subgroup	SSGCC
4	Kutsenko Anton Sergiyovych	Deputy Director General	State Enterprise«State Land Cadastre Center»
5	Karpinskyi Yurii Oleksandrovych	Acting Director	State Enterprise «Research Institute of Geodesy and Cartography»
6	Rudenko Svitlana Viktorivna	Deputy Management Director – Head of Division for Use and Protection of Agricultural Lands, Improvement of Land Relations of Department of Agriculture and Technical Policy in Agroindustrial Complex	Ministry of Agrarian Policy and Food of Ukraine
7	Kolmaz Yuriy Tomovych	Acting Head of Division for Protection of Land and Water Resources– Head of Department for Protection of Natural and subsurface Resources	Ministry of Ecology and Natural Resources of Ukraine
8	Pryshepa Sergiy Volodymyrovych	Head of Division of Organization of Topographic and Geodetic Production – Deputy Head of the Central Office of Military Topography and Navigation of the Head Department of Operational Support	Armed Forces of Ukraine
9	Bondarenko Oleg Petrovych	Head of Division of Accounting and Registration of Right Stating Documents for Military Lands – Deputy Head of Department of Accounting, Land Management and Use of Military Lands of Main Quartering Department	Armed Forces of Ukraine

No.	Name	Position	Organization
10	Kucherenko Oleksandr Volodymyrovych	Officer of the Division of Accounting and Registration of Right Stating Documents for Military Lands of Main Quartering Department	Armed Forces of Ukraine
11	Bahur Maksym Oleksandrovyh	Officer of Division of Monitoring of Possession and Use of Immovable Property and Lands	State Enterprises of Department of Monitoring, Normative and Methodological Support of Possession, Use and Control of Immovable Property and Lands
12	Mateichyk Vasyl Ivanovych	Head of Department of Forest Husbandry– Deputy Managing Director of Forest Husbandry and Forest Regeneration	State Agency of Forest Resources of Ukraine
13	Redchenko Svitlana Oleksandrivna	Deputy Head of Department of Population and Regional Statistics – Head of Division	Regional Statistics of State Statistics Service of Ukraine
14	Lenska Olena Oleksandrivna	Deputy Director of Department and Director of Division of Renewable Energy and Alternative Fuels	State Agency on Energy Efficiency and Energy Saving of Ukraine
15	Kryzhanivskiy Oleksandr Oleksandrovyh	Leading specialist of the department of Renewable Energy of Department of Renewable Energy and Alternative Fuels	State Agency on Energy Efficiency and Energy Saving of Ukraine
16	Zhylykov Andriy Oleksandrovyh	Head of Division of Remote Earth Sensing of Department of Space Policy and Development	State Space Agency of Ukraine
17	Yanchevsky Sergiy Leontiyovych	Head of Information and Analytic Department	National Center for Control and Testing of Aerospace Systems
18	Fesenko Vitaliy Volodymyrovych	Chief Specialist of Division of Engineering and Technical Measures and Protecting Constructions of Department for Population and Territory Protection of Department for Organization of Civil Security Measures	State Emergency Service of Ukraine
19	Dobrogursky Oleksandr Viktorovych	Chief Specialist of Division of Information Technologies and Information Protection of Department of Alerts, Telecommunications and Information Technologies of Department for Organization of Civil Security Measures	State Emergency Service of Ukraine
Invited:			
20	Akira Nishimura	Leader of the Expert Group	JICA
21	Keiji Yamada	JICA project expert, responsible for coordination issues	JICA
22	Tkach Alona Vasylivna	Interpreter of JICA project	JICA
23	Kyrylyuk Igor Viktorovych	Deputy Director of Department – Head of Division of Interactions with Other Cadastres and Informational Systems, and of Methodological Work of Department	State Land Cadastre of SSGCC
24	Bashlyk Denis Oleksandrovyh	Director of Department for International Cooperation and Land Market	SSGCC
25	Lavrentiev Viktor Petrovych	Deputy Director of Department– Head of Division for Organization of Topographical, Geodetic, and Cartographical Works of Department for Topographical, Geodetic, and Cartographical Activities	SSGCC
26	Sofienko Oleksandr Mykolayovych	Deputy Director of Department – Head of Division of State Geodetic Supervision of Department for Topographical, Geodetic, and Cartographical Activities	SSGCC

No.	Name	Position	Organization
27	Kizilova Natakiya Olegivna	Head of Division of Cartography and Geographical Names of Department for Topographical, Geodetic, and Cartographical Activities	SSGCC
28	Ischenko Viktor Valentynovych	Director General	State Enterprise «State Land Cadastre Center»
29	Bondarenko Dmytro Mykolayovych	Deputy Director of Department of Information Technologies	State Enterprise «State Land Cadastre Center»
30	Tarasenko Anton Vasylovych	Director of Department for Technological Support	State Land Cadastre of State Enterprise «State Land Cadastre Center»
31	Yeikovych Andriy Yuriyovych	Head of Division of System Administration of Department of Information Technologies	State Enterprise «State Land Cadastre Center»
32	Cherin Andriy Gennadiyovych	Candidate of Technical Sciences, Head of the Department of Geoinformational Systems and Technologies	State Enterprise “Research Institute of Geodesy and Cartography”
33	Lazorenko-Gevel Nadiya Yuriivna	Candidate of Technical Sciences, Research Scientist	State Enterprise “Research Institute of Geodesy and Cartography”
34	Zinenko Roman Oleksiyovych	Engineer – programmer of the Department of geoinformational systems and technologies	State enterprise “Research Institute of Geodesy and Cartography”

e. Holding an informal study meeting

Sub-Group organized the informal study meeting adding the experts from neighboring countries on 22rd February, 2018 apart from the above mentioned meeting. The sub-Group organized the round table discussion as a study meeting using the opportunity of inviting presenters from the neighboring countries in the 3rd seminar of the project. The member of Sub-Group centering on SSGCC relatives of a secretariat, the Project member, the Operation Guidance Study team of GSI, the invited presenters from Eurogeographics, UN GGIM Europe, Norway, Finland, Latvia, Poland, France, Germany, Slovenia, Moldova, Georgia, Belarus and Romani, attended the round table discussion. The major contents of the discussion were as follows;

- * Sharing the actual condition of preparation and utilization of data in each countries.
- * Sharing the tasks and the problems on the institution and the implementation.
- * Introduction of the actual status for the legal frameworks and the technical infrastructures in Ukraine.
- * Advices concerning about an establishment of NSDI S/C in Ukraine by comparing management system of NSDI in each countries.

Sub-Group plans to organize the meeting ever a quarter according to the matters decided in 1st meeting, however, the 2nd meeting will be planned to organize around on April, 2018. The major agendas on the 2nd meeting are going to be a discussion of NSDI operation plan, and a consensus formulation of sharing Geospatial data. The results of informal study meeting, round table discussion, will be to be reflected on a discussion at the 2nd meeting. Sub-Group is going to progress discussions according to the matters decided. In the meantime, registering NSDI Act draft for 7th session of the VIII convocation on 23rd February, 2018, it is necessary to discuss in parallel to dissolve the sub-group and establish an official S/C and W/G when the NSDI Act enact. There is no essential difference between activities contents of Sub-Group and official S/C, W/G. However, because Official S/C and

W/G will be permanent meeting bodies based on the legal framework, it is necessary to reconsider a member and management system of S/C and W/G. Sub-Group will be forecasted to continue its activities paying attention on a date of NSDI Act enforcing from now.

3.2.3 Implemented Results of Preparation of Standards for Geographic Information (Draft)

(1) Current status of Geographic Information Standards

1) Survey Implementation

The following surveys were implemented to recognize the current status of geographic Information Standards.

* Organization responsible for standardization of geographic information standards

* Current status of standardization of geographic information standards

2) Results of Survey

a. Organization responsible for standardization

The agency responsible for the practice of standardization of geographic information in Ukraine is the National Committee (Technical Committee 103: TC 103) on standardization of geographical information, of which the secretariat of RIGC (Research Institute of Geodesy and Cartography) under the SSGCC is a member.

TC 103 was proposed and established as a specialized institution to conduct activities for standardization of geographical information by Mr. Demis V. Novosellov of Arc-master Co., Ltd. (private company) and others on March 16, 2006. After that, its activities were officially certified, and TC 103 became a government approved TC (Technical Committee) based on The Law of Ukraine on Standardization.

b. Status of standardization of geographic information

The status of standardization in Ukraine, based on ISO's Geographic Information Standards, is as follows.

Table 21 Progress of making Geographic Information Standards in Ukraine

Number	Title	Work stage
ISO19101	Geographic information -- Reference model	Domestic Standardization in progress
ISO19110	Geographic information -- Methodology for feature cataloguing	Translation in progress
ISO19111	Geographic information -- Spatial referencing by coordinates	Translation in progress
ISO19112	Geographic information -- Spatial referencing by geographic identifiers	Translation in progress
ISO19113	Geographic information -- Quality principles	Translation in progress
ISO19114	Geographic information -- Quality evaluation procedures	Translation in progress
ISO19115	Geographic information -- Metadata	Translation in progress
ISO19136	Geographic information -- Geography Markup Language (GML)	Translation in progress

As shown in the table above, ISO 19101 is the only Geographical Information Standard that has achieved official national standardization.

Regarding Geographic Information Standards other than ISO 19101, they remain under translation from English to Ukrainian, and full-scale studies towards domestic standardization have not been conducted.

(2) Framework of Standardization of Geographic Information

1) Standardization Agency

a. National Standardization Agency

The standardization body including the Geographical Information Standard of Ukraine is the National Body of Standards (NBS), under the Ministry of Economic Development and Trade of Ukraine (MEDT) (as of December 2015; the time of the survey). The official name of NBS was "Ukrainian Research and Educational Center of Standardization, Certification and Quality".

This NBS is a government enterprise (State Enterprise: SE) established under the cooperation agreement of Ukrainian Law << Standardization. >> 05.06.2014 No. 1315-VII and the Government of Ukraine and EU and performs the following activities.

- Abolition of the Soviet era standard (GOST) before 1992
- Coordinating activities of Technical Committee (TC)
- Discussion/adoption of standards proposed by each technical committee
- Formation of technical committee in line with ISO, European Standardization Committee (CEN) and European Electrical Standardization Committee (CENELEC)

b. National accreditation body

There is an accreditation organization called "National Accreditation Agency of Ukraine (NAAU)" under the Ministry of Economic Development and Trade (MEDT) that is highly similar to the NSB mentioned above. This institution is equivalent to the Japan Accreditation Board (JAB), which conducts "Conformity Assessment" that evaluates whether products, services, and processes meet the standards and criteria.

2) Standardization system

There are two standardization systems in Ukraine. One of them is a standardization system that becomes a technical standard with enforcement by standardization. The other one is a standardization system in which the created standard is registered in "Standard Organization of Ukraine (SOU) Register" managed by NBS, and adoption of the standard is left to the user.

If the standard registered in the SOU Register becomes a mandatory technical standard, then the standards should be promulgated officially based on Ministerial Decree.

The definition of standardization and the outline of the procedure in the two standardization systems are as follows.

Type	Description
Mandatory	Standards based on ministerial decree. TC creates draft standards and submits them to NBS. NBS references them to the other related TC and revises them if needed. TC submits the final draft standards to the related government institutes. With this publication, the standard is legally bound. That can be regarded as the <i>de jure</i> standard in Ukraine.
Not mandatory (SOU register)	Draft standard created in TC is approved by the upper government institute and is registered to SOU Register in NBS. Registered information is open to the public so that anyone can view it. It is not forced by law, so use of the standard depends on the users. That can be regarded as the <i>de facto</i> standard in Ukraine.

3) Framework for standardization of Geographic Information Standards

Standardization of Geographic Information Standards is standardized in the following framework

- At the technical committee TC 103 (in charge of geographical information) for standardization under the NSB, consider and consult the standard of the geographic information standard and prepare a draft of the standard of the geographical information standard.
- The prepared geographic information standard draft is submitted to NBS.
- NBS considers the original draft that was submitted and at the same time inquires to other related technical committees (TC), and makes modifications as necessary based on the inquiry results.
- The draft of the geographic information standard that has been modified as necessary is circulated to relevant ministries and agencies. Moreover, it is made public on the Internet, etc. to obtain public comments from the public.
- The content of public comments from related public agencies and the public are reviewed and the contents of the standard is amended as necessary. Next, the geographic information standard is standardized and then issued from NBS.

(3) Arrangement of Geographic Information Standards

1) Arrangement of ISO/TC211 Geographic Information Standards

Upon preparation of the geographic information standard draft of Ukraine, the international standards on the latest geographic information currently defined by ISO / TC 211 were arranged.

International standards of representative geographic information standards in current ISO / TC 211 are as follows.

Table 22 Representative International Standards of Geographic Information

Types of Standard		Representative Standards
1	Standards that specify the infrastructure for geospatial standardization	ISO 19101 Reference model ISO 19103 Conceptual schema language ISO 19105 Conformance and testing ISO/IEC 19501-1 UML (Unified Modelling Language)
2	Standards that describe data models for geographic information	ISO 19109 Rules for application schema ISO 19107 Spatial Schema ISO 19108 Temporal Schema ISO 19123 Schema for coverage geometry and functions ISO 19111 Spatial referencing by coordinates ISO 19112 Spatial referencing by geographic identifiers
3	Standards for geographic information management	ISO 19110 Methodology for feature cataloguing ISO 19115 Metadata ISO 19157 Data quality (consolidates 19113 and 19114) ISO 19131 Data product specifications
4	Standards for encoding of geographic information	ISO 19118 Encoding ISO 19136 Geographic Markup Language ISO/TS19139 Metadata XML schema implementation
5	Standards for geographic information services	ISO 19117 Portrayal ISO 19128 Web map server interface ISO 19142 Web Feature Service

The international standards of Geographic Information were organized as shown in the above table, and at the same time, the roles and contents of each standard were shared with the C/P.

Also, the relationship between Geoportal's various functions expected to play an important role in NSDI establishment and operation and the geographic information standard draft were organized.

Table 23 Relation between Geoportal function and Geographic Information Standards in terms of Metadata

Functions	Detailed functions	Technical component	Major Relevant Standards
Submit & Store	Upload	Metadata elements	ISO19135
		XML	ISO19139
	Edit	Metadata elements	ISO19115
		XML	ISO19139
	Validate	XML	ISO19139
Search	Keyword, Category, Extent	Metadata elements	ISO19115
Delivery	Display a result of search	Metadata elements	ISO19115

Table 24 Relation between Geoportal function and Geographic Information Standards in terms of Product Specifications

Functions	Detailed functions	Technical component	Major Relevant Standards
Submit & Store	N/A (Geoportal will be developed in accordance with NGDI data specification.)	Document of Product Specifications	ISO19131
		Feature Catalogue	ISO19110
Search	View the document	Document of Product Specifications	ISO19131
	View the data structure	Feature Catalogue	ISO19110
Delivery	Download the document	Document of Product Specifications	ISO19131
	Download the data model	UML XML(GML)	ISO19109 ISO19118(ISO19136)

2) Organization of practical geographical information standards in Japan

To prepare the Geographic Information Standard draft of Ukraine, JPGIS (Japan Profile Geographic Information Standards), which is a practical geographical information standard of Japan, was organized.

JPGIS is a geographic information standard that extracts the minimum standards required for creating data product specifications and metadata from international standards relating to geographic information (ISO 19100 series).

The relationship between the role and composition of organized JPGIS and the international standards were as follows.

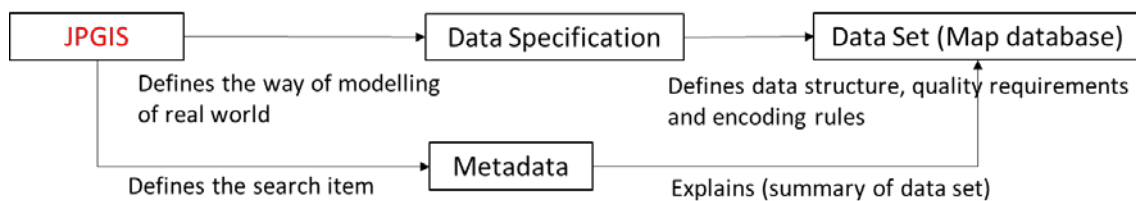


Figure 18 Overview of role of JPGIS

Components of JPGIS in detail

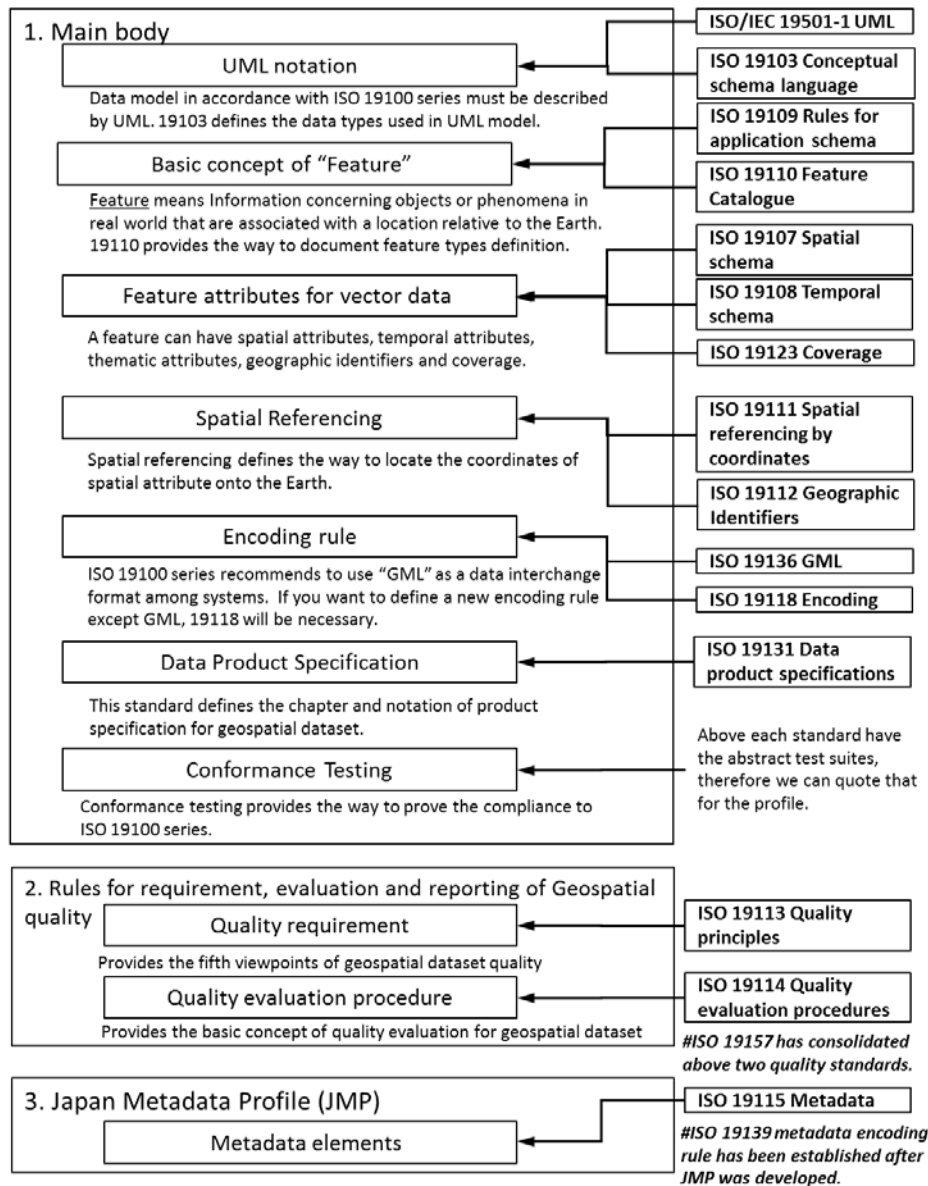


Figure 19 Structure of JPGIS and relation with the international standards

(4) Preparation of Geographic Information Standards draft

1) Basic Policies of Preparation of Geographic Information Standards

Since the preparation of the standard draft targeting all international standards of the ISO / TC 211 geographic information standard was a substantial amount of work and was intended to prepare a highly practical standard draft, a standards draft was intended to be prepared based on the following basic policies.

Basic Policy 1: Ukraine Profile for Geographic Information Standards (UkrGIS) shall be the minimum standard required from each international standard.

Basic Policy 2: With reference to the Japan Profile for Geographic Information Standards (JPGIS), a draft standard as a practical standard for Ukraine shall be prepared.

Basic Policy 3: Standards extracted from each international standard and examined shall be integrated into one document to ensure user's convenience.

2) Review system of geographic information standard draft

To consider the Geographic Information Standards draft, three working groups to extract, profile and translate standards, and an audit committee to review the results of consideration by each working group were established.

Table 25 Study framework of Geographic Information Standards (draft)

Study Framework	Major Role
Working group	<ul style="list-style-type: none"> • Study of International Standards for Geographic Information • Extract minimum criteria from International Standards for the practical standards to operate NSDI in Ukraine • Compile the Ukrainian Profile for Geographic Information Standards and its manual
Supervisory Board	<ul style="list-style-type: none"> • Verify the quality of current outcomes provided by the W/Gs • Make sure the pace of examination by W/Gs is adequate • Approve the draft Ukrainian Profile of Geographic Information Standards

3) Consideration of Geographic Information Standards draft

a. Selection of International Standards targeting Geographic Information Standards draft

The international standards targeting a Geographic Information Standards draft were considered and selected based on the basic policies. The international standards selected and targeted were as follows.

Table 26 Target of the international standards for creation of the draft Geographic Information Standards in this Project

The targeted International Standards			
ISO19101	Reference model	ISO19112	Spatial referencing by geographic identifiers
ISO19107	Spatial schema	ISO19115	Metadata
ISO19108	Temporal schema	ISO19118	Encoding
ISO19109	Rules for application schema	ISO19123	Schema for coverage geometry and functions
ISO19110	Feature catalogue	ISO19131	Data Product specifications
ISO19111	Spatial referencing by coordinates	ISO19157	Data quality

b. Consideration of International Standards

From the view point of profiles and translation, the selected International Standards were considered in the three W/Gs shown the following table.

Table 27 The responsibility of international standards of each W/G

Working Group	International Standard
W/G 1	ISO19101 Reference model ISO19115-1 Metadata ISO19131 Data product specifications ISO19157 Data quality
W/G 2	ISO19109 Rules for application schema ISO19110 Feature catalogue ISO19111 Spatial referencing by coordinates ISO19112 Spatial referencing by geographic identifiers
W/G 3	ISO19107 Spatial schema ISO19108 Temporal schema ISO19123 Schema for coverage geometry and functions ISO19118 Encoding

c. Study of roles and profiling of representative international standards selected

To extract minimum standards that constitute UkrGIS from the selected international standards, the use of standards was reviewed and organized from the perspective of Product specifications creator, Data creator, System developer, and User.

***ISO19107 (Spatial Schema)**

The use of ISO19107 was reviewed and organized as follows.

Table 28 Potential use case of ISO19107

Designer of Product Specification	Data Producer	System Developer	Data User
They only have to know which spatial object class can be used in application schema. They do not need to know sub-classes of spatial objects.	Basically it would be better for them to understand this standard. But usually it depends on the GIS/ CAD software they use. Most of GIS/ CAD software adopt their own model. The concept of topology is important to ensure geographic consistency.	They need to understand the structure of spatial schema when they convert data into GML for interoperability among computers.	When they try to understand geospatial data in GML, this spatial schema helps them understand the structure of spatial attributes.

The way of thinking for Topology is important and to confirm the consistency of data (ensuring there is no duplication or gaps between data), its concept shall be clarified in UkrGIS and it shall be applied in the data creation.

***ISO19108 (Temporal Schema)**

The use of ISO19108 was reviewed and organized as follows.

Table 29 Potential use case of ISO19108

Designer of Product Specifications	Data Producer	System Developer	Data User
They only have to know which temporal object class can be used in application schema. They do not need to know sub-classes of spatial object	Basically it would be better for them to understand this standard. But usually it depends on the GIS/ CAD software they use. Most of GIS/ CAD software adopt their own model.	They need to understand the structure of temporal schema when they convert data into GML for interoperability among computers.	When they try to understand geospatial data in GML, this temporal spatial schema helps them understand the structure of temporal attributes.

***ISO19109 (Rules for application schema)**

The use of ISO19109 was reviewed and organized as follows.

Table 30 Potential use case of ISO19109

Designer of Product Specifications	Data Producer	System Developer	Data User
General feature model is the most important concept of geospatial data in accordance with International standards. Every user needs to understand this concept model.			It is better for them to understand this standard when they read application schema in UML included in product specifications.

***ISO19110 (Feature Catalogue)**

The use of ISO19110 was reviewed and organized as follows.

Table 31 Potential use case of ISO19110

Designer of Product Specifications	Data Producer	System Developer	Data User
Feature types are documented in a product specifications in accordance with ISO19110.	Definition of each feature in a product specification comply with ISO19110.	If feature catalogue management system will be developed, they need to understand this standard.	A product specification shows the definition of each feature in accordance with this standard. Metadata also may have connections to feature catalogue.

***ISO19115-1 (Metadata)**

The use of ISO19115-1 was reviewed and organized as follows.

Table 32 Potential use case of ISO19115-1

Designer of Product Specification	Data Producer	System Developer	Data User
They order the data producer to create specific metadata elements in the product specification.	They need to understand the definition of each metadata element for creating metadata at the end of data creation.	They need to understand the structure of each metadata element for the development of metadata editor and clearinghouse.	They will encounter the elements of metadata when they ask the clearinghouse to search for the data which they want to utilize.

The international standard of metadata to be adopted by UkrGIS shall be the latest ISO 19115-1 (2014), and the corresponding metadata coding specification shall adopt ISO 19139 (2007) until ISO 19139-1 is issued.

While there is a difference in conceptual model between the old and new versions of the metadata specification, mapping between metadata elements is possible, and guidelines are prepared to explain the mapping method from ISO 19115-1 (2014) to ISO 19139 (2007), which have been chosen for the time being for operation.

Also, from ISO 19115-1 (2014), the metadata element on quality has been separated into ISO 19157, but in UkrGIS, the definition part of the metadata element is described by integrating different standards.

***ISO19118 (Encoding)**

The implementation specification ISO 19136 (GML: Geography Markup Language) for exchanging geospatial data scheduled to be adopted by UkrGIS conforms to ISO 19118 (encoding) which prescribes universal rules concerning the development of conversion rules for application schemas. Since ISO 19118 is one of the core concepts of standardization in the geographical information field, the required minimum standards were extracted from it and studied, and adopted in UkrGIS.

***ISO19123 (Schema for coverage geometry and function)**

The use of ISO19123 was reviewed and organized as follows.

Table 33 Potential use case of ISO19123

Designer of Product Specification	Data Producer	System Developer	Data User
They only have to know which coverage object class can be used in application schema.	Basically it would be better for them to understand this standard. But usually it depends on the GIS/ CAD software they use. Most of GIS/ CAD software adopt their own model.	They need to understand the structure of coverage when they convert data into GML for interoperability among computers.	When they try to understand geospatial data in GML, this coverage schema helps them understand the structure of coverage features.

The issues are pointed out for this international standard from the viewpoint of practicality. Thus ISO 19136 (GML), which is the encoding specification recommended by the geographic information standard, specifies the implementation specification of only a part of the elements defined by ISO 19123. The ISO19123 was considered regarding this point in UkrGIS.

*ISO19157 (Data Quality)

The use of ISO19157 was reviewed and organized as follows.

Table 34 Potential use case of ISO19157

Designer of Product Specification	Data Producer	System Developer	Data User
They need to define quality requirements in the product specification.	They need to understand the principles and evaluation procedures of data quality for quality management.	They need to know the concept of data quality for developing metadata editor, clearinghouse or data check tool.	Metadata shows data quality to compare several geospatial data which the data user is interested in.

ISO 19157 defines a new quality viewpoint "Usability" for geospatial information not adopted by JPGIS. Since it is a concept of quality that has not been used in Japan, it was examined, including its use.

4) Geographic Information Standards draft

Based on the basic policy of preparing geographic information standard drafts, standards selected from international standards were examined – under the review system that had been established – and Original UkrGIS, namely Geographic Information Standards of Ukraine, was prepared at Technical Committee TC 103. The status of the UkrGIS draft (status of adoption from international standards, responsible person and translation into Ukrainian) was as follows as of June, 2017.

Table 35 Progress of first edition of draft UkrGIS

№	Names of Standards ISO 19100 for Ukrainian profile UkrGIS	Ukrainian translation of ISO standard	Responsible person	Notes
1.	ISO 19101-1:2014. Geographic information -- Reference model -- Part 1: Fundamentals	Yes	N. Lazorenko-Hevel, Yu. Maksymova	Full
2.	ISO 19131:2007. Geographic information -- Data product specifications	Yes	N. Lazorenko-Hevel, Y. Maksymova	Full
3.	ISO 19109:2015. Geographic information -- Rules for application schema	Yes	N. Lazorenko-Hevel, Y. Maksymova	Selected parts to UkrGIS

4.	ISO 19110:2016 Geographic information -- Methodology for feature cataloguing	Yes	Prof. A.Lyashchenko	19110:2016, Selected parts to UkrGIS
5.	ISO 19107:2003. Geographic information -- Spatial schema	Yes	I. Patrekeev	Selected parts to UkrGIS
6.	ISO 19108:2002. Geographic information -- Temporal schema	Yes	D. Kuznetsova	Selected parts to UkrGIS
7.	ISO 19123:2005. Geographic information -- Schema for coverage geometry and functions	Yes	Prof. A. Lyashchenko	Selected parts to UkrGIS
8.	ISO 19118:2011 Geographic information -- Encoding	Yes	N. Lazorenko-Hevel, Y. Maksymova	Selected parts to UkrGIS
9.	ISO 19111:2007. Geographic information -- Spatial referencing by coordinates	Yes	Prof. Iur. Karpinskyi	Full
10.	ISO 19112:2003. Geographic information -- Spatial referencing by geographic identifiers	Yes	Prof. Iur. Karpinskyi	Full
11.	ISO 19115-1:2014. Geographic information -- Metadata -- Part 1: Fundamentals	Yes	N. Lazorenko-Hevel, Y. Maksymova	Selected parts to UkrGIS
12.	ISO 19157:2013. Geographic information -- Data quality	Yes	N. Lazorenko-Hevel, Y. Maksymova	Full

(5) Normalization of Geographic Information Standard draft

The draft Geographic Information Standards, UkrGIS, which was prepared as mentioned above, was planned to be normalized domestically, as per the intention of TC 103, the national committee of geographic information standards.

1) Consultation with NSB toward Domestic Normalization

To normalize it domestically, the TC103, the national committee of the geographic information standard, consulted with NBS, which is National Standardization Organization, about the pros and cons of domestic normalization, content of UkrGIS and domestic normalization procedure, schedule etc.

As a result of the consultation with NBS, the domestic normalization of UkrGIS was registered as the official domestic normalization project in NBS and it was decided that the domestic normalization of UkrGIS would proceed according to the process of domestic normalization (DSTU 1.2:2015 “Rules of Work on national Standards”) in Ukraine.

2) Normalization

a. Preparation of documents necessary for normalization

The UkrGIS prepared was organized as follows. In particular, the minimum number of rules were extracted from the existing standards group as practical standards and two regulations were prepared newly in Ukrainian. Also, the two other regulations were prepared by translating international regulations into Ukrainian. For ISO regulations that are sources of reference of Ukrainian regulations, only the cover sheet is translated into Ukrainian (called the “Cover Method”).

Table 36 Structure of UkrGIS

Category	Regulation Name
Profile for Standards	Rules of modeling of geospatial data
	Ukraine Metadata Profile
Identical translation	Data Quality
	Data Product Specification
Cover Method	ISO 19103:2017 Conceptual schema language
	ISO 19107:2017 Spatial schema
	ISO 19108:2017 Temporal schema
	ISO 19109:2017 Rules for application schema
	ISO 19110:2017 Methodology for feature cataloguing
	ISO 19111:2017 Spatial referencing by coordinates
	ISO 19112:2017 Spatial referencing by geographic identifiers
	ISO 19117:2017 Portrayal
	ISO 19118:2017 Encoding
	ISO 19119:2017 Services
	ISO 19123:2017 Schema for coverage geometry and functions
	ISO/TS 19127:2017 Geodetic codes and parameters
	ISO 19136:2017 Geography Markup Language (GML)
ISO/TS 19139:2017 Metadata -- XML schema implementation	

b. Publish UkrGIS and collect public comments etc.

UkrGIS normalized draft that was prepared as abovementioned was opened to the public on the NBS website and the collection of comments and/or opinions regarding the UkrGIS normalized draft was carried out.

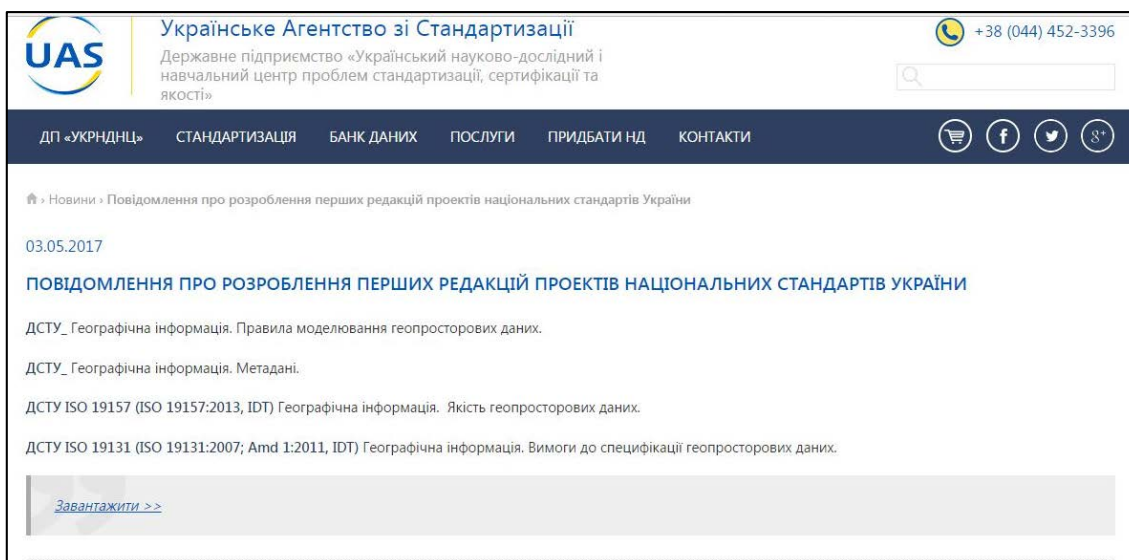


Figure 20 NBS website about UkrGIS

As a result, the following comments were collected.

Targeted regulation of comment/opinion	Number of comments
Rules of modeling of geospatial data	24
Ukraine Metadata Profile	0
Data Quality	9
Data Product Specification	27

There were many comments related to the appropriateness of translation from English to Ukrainian of technical terms.

c. Preparation of UkrGIS domestic normalization draft

The processing corresponding to the collected comments was implemented and the final consultation about the domestic normalization draft of UkrGIS with NBS was carried out. UkrGIS to be normalized in Ukraine was prepared.

d. Domestic Normalization of UkrGIS

The final draft of UkrGIS for national standard in Ukraine was submitted to NBS in November 2017. NBS has been verifying the consistency of definition of technical terms between UkrGIS and existing national standards, and the conformity of UkrGIS with the rules of grammar and general terms. UkrGIS is approved as a national standard in March 2018 after payment of registration fee.

(6) Preparation of Operation Manual for Geographic Information Standards

The operation frameworks and the functions of UkrGIS were consulted with C/P to disseminate and enlighten about UkrGIS, and an operation manual was prepared based on the results of consultation. The contents of the operation manual is as follows.

Table 37 Structure of Operation manual for UkrGIS

Chapter	Note	
1	Introduction	Objectives and background of operation manual
2	Establish a help desk for UkrGIS	Establishment of help desk for UkrGIS Procedures for receiving questions from and giving answers to users Preparation of composition draft of website for UkrGIS
3	Write up practical guidebooks	Preparation of following 5 Guidebooks (a) Introductory guide to UkrGIS (b) Practical guide for metadata (c) Manual on geospatial data modelling (d) Clause-by-clause guide to UkrGIS (e) Glossary between Ukrainian and English
4	Develop user support tools	Preparation of following 4 User Support tools (a) Feature catalogue service (b) Converter from UML into GML application schema (c) Data converter into geospatial data according to GML application schema (d) Quality check tool
5	Establish monitoring systems to certificate conformity with UkrGIS	Establishment of following 3 Monitoring Systems (a) Conformance test for data product specification (b) Conformance test for data set (c) Conformance test for service (software)
6	Develop an educational system	Establishment of Educational Program (Training Course) for UkrGIS Establishment of Qualification System

3.2.4 Implemented Results of Creation of an NSDI Prototype

(1) NSDI Data Preparation

1) Preparation of Orthophoto

a. Aerial Photography

Aerial photography was implemented for the final confirmed targeted area, Vinnytsia District..

*** Targeted Area of Aerial Photography**

As mentioned above, Vinnytsia District (area: approximately 1,023.63 km²), which eventually became the pilot area, became the area to be photographed.

*** Aircraft and Aerial Camera for Aerial Photography**

The aerial camera used for aerial photography was VisionMap - 3 EDGE owned by SLCC. It was decided that the aircraft for aerial photography equipped with this camera would be rented from GeoSolutions Company, based in Kiev City.

*** Aerial Photography Plan**

The aerial photography plan (including establishment of the photo control points) was prepared based on the performance of the aerial camera available, as shown below, and the specification of aerial photography.

Performance of Digital Aerial Camera: VisionMap – 3DEGE

Pixel Size: 7.4 μ m

Focus length: 0.30m

Size of Format of photograph: 4854 × 3232 pixel (Format of photograph integrated: 9600 × 78000 pixel)

Specification of Aerial Photograohy

Resolution on the ground: 5cm

Overlap: 55% (standard)

Sidelap: 77% (standard)

GPS/IMU aerial photography

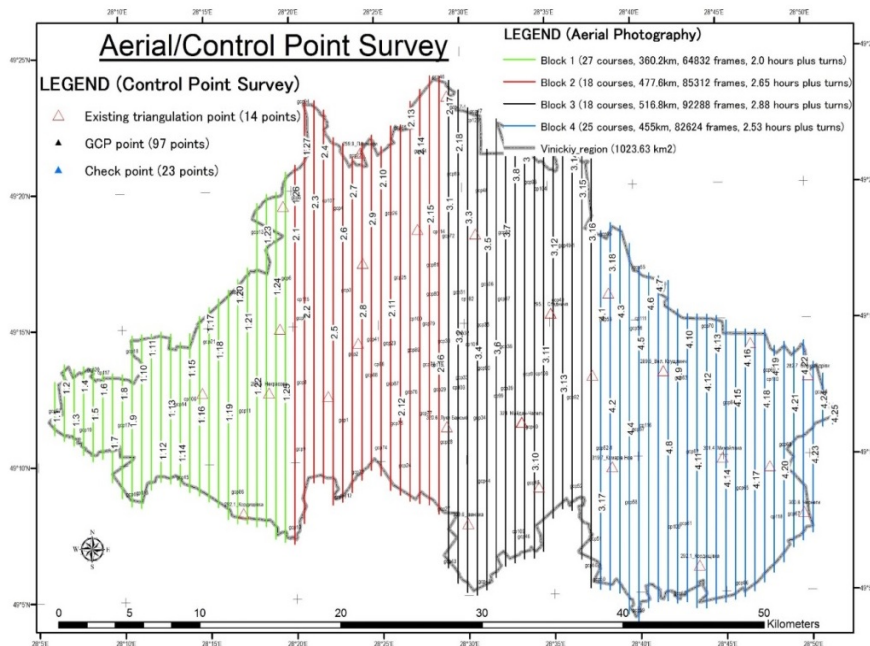


Figure 21 Plan of aerial photography and photo control points survey

The aerial photography was implemented in four blocks shown in the table below.

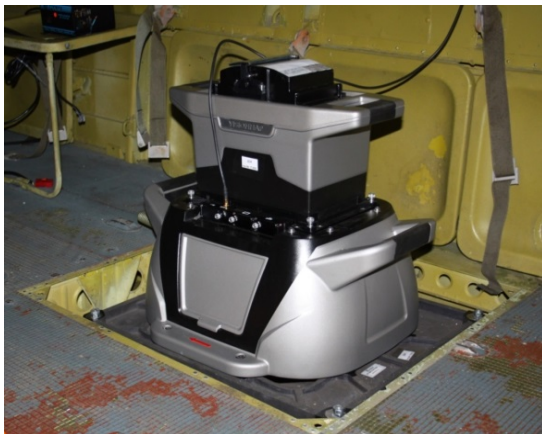
Table 38 Targeted areas (areas: 1023.63 km²) for the aerial photography was divided into four blocks.

	Block 1 (West suburban zone)	Block 2 (West urbanized area)	Block 3 (East urbanized area)	Block 4 (East suburban zone)
Number of courses	27 courses	18 courses	18 courses	25 courses
Distance of aerial photography	360.2 km	477.6 km	516.8 km	455.0 km
Assumed duration of flight	4.17 hours	4.07 hours	4.33 hours	4.53 hours
Assumed number of acquired frames	64,832 frames	85,323 frames	92,288 frames	82,624 frames
Number of photos after synthesis	Approx.10857 images (approx.10769 model)			

In addition, there were 125 planned photo control points, 23 of which were verification points of simultaneous adjustment.

*** Aerial Photography**

After setting up the necessary photo control points in late October 2015, SLCC's aerial digital camera was rented and installed in the aircraft. Aerial photography was undertaken between November 2015 to April 2016 and according to the aerial photography plan, it was completed. From the results of aerial photography survey there was no problem with subsequent work.



Aerial Digital Camera



Aircraft for Aerial Photography

b. Orthophoto Production

The simultaneous adjustment was implemented to get required elements for the orthophoto production and the orthophotos of all the pilot areas were produced with the technical cooperation of SLCC.

*** Implementation of Simultaneous Adjustment**

The simultaneous adjustment to obtain the horizontal position and elevation of tie points and the exterior orientation element of the aerial photographs necessary for orthophoto production was implemented by SLCC according to the progress of the aerial photography. The results of the simultaneous adjustment met the regulation of Ukraine and no problems occurred.

*** Orthophoto Production**

The orthophotos of all the pilot areas were produced in SLCC using the results of simultaneous adjustment.

2) NSDI Data Specification Preparation

In the preparation of NSDI data specifications in the NSDI Prototype Establishment, the specification of fundamental geospatial data, the preparation of which is mentioned in the NSDI Act that is going to be established in Ukraine, was targeted. Also, the specification to be prepared was finally prepared based on the format of product specifications based on the geographic information standards that are under development for domestic normalization.

a. Survey Standards

The survey standards (Reference Ellipsoid, Geodetic Coordinates System, Projection System and Height Standards, etc.) applied in the preparation of the fundamental Geospatial Data, listed below, was a result of consultation with the C/P.

Table 39 Survey standards of the Fundamental Geospatial Data

Survey	Adopted standards for the Project
Referenced ellipsoid	Krasovsky_1940 (equatorial radius a=6,378,245.0m, reciprocal value of oblateness 1/f=298.3)
Coordinates system	GCS_Ukraine_2000
Projection	Gauss Kruger Projection
Plane coordinates system	MSK_05(Plane rectangular coordinate, Vinnytsia) (MSK is adopted in Ukraine if the scale is larger than 1/5,000)
	Origin of coordinates :
	East longitude 28° 40' 00" , North latitude 0° 00' 00"
	Value of origin of coordinates : X(Northing)=0.0m, Y(Easting)=300,000.0m
Height standards	Baltic Sea 77 System (Based on the average sea level of Baltic Sea in 1977)

Note that this survey standard is the basic information of the reference system in the product specifications.

b. NSDI Data Items

The information of Data Items (Major Items) of Fundamental Geospatial Data which was mentioned in the latest NSDI Act were collected to select NSDI data items that are data items of the Fundamental Geospatial Data. Also, the following materials in the next table, including the information of data items of general topographic features, were collected together with C/P.

Table 40 Collected information resources

	Documents	References
1	Classification information displayed on topographical plans of scale 1: 5000, 1: 2000, 1: 1000, 1: 500	SLCC, 2000
2	Classification information displayed on topographic maps of scale 1:10 000, 1:25 000, 1:50 000, 1 100 000 1 200 000 1 500 000, 1 1000 000	SLCC, 1998
3	Standardization in the field of topographic, geodesic and cartographic activity, TOPOGRAPHIC DATABASE, Catalogue of objects and attributes	UKRAINE Agriculture Ministry, 2014

* Identify Acquisition Items of Topographic Feature

Referring to the items of fundamental geospatial data specified in the NSDI Act, and based on the above-mentioned existing data collected and organized, items of topography / features to be acquired were identified

through consultation with the C/P. In identifying items, the utilization of data in GIS was considered. Also, the concept of “major category” corresponding to the top of each item was introduced.

Table 41 Large categories of the Fundamental Geospatial Data.

No	Ukrainian	English
1	Картографічна основа	Cartographic base
2	Державна геодезична мережа	State Geodetic network
3	Державний кордон України. Адміністративні одиниці	State border of Ukraine. Administrative Units
4	Рельєф	Relief
5	Гідрографічні об'єкти та гідротехнічні споруди	Hydrographic objects and hydrographic constructions
6	Будівлі та їх частини	Buildings and their parts
7	Транспортні мережі	Transport networks
8	Інженерні комунікації	Engineering communications
9	Рослинність та ґрунти	Vegetation and soils
10	Кадастрова інформація	Cadastre information
11	Географічні назви об'єктів	Geographic names of objects

For the specified topographic features, the definition, acquisition criteria and acquisition method were decided through the consultation with C/P. In determining the definition, acquisition criteria and acquisition method, GIS usage and efficient data construction were considered as in the case of item identification.

Table 42 List of acquisition catalogue of features (partial)

No.	Topic		Group		Object		Data			Symbol	Form and size	Line thickness, Color	Definition	Collecting criteria and method	Data source	
	No.	Name	No.	Name	No.	Name	Code	T	L							P
49	04	Relief	02	Forms of relief that are not displayed in contour lines	27	terraces rising fields	040227	x					Slopes, sometimes straight break-off which divides two surfaces that are located at different heights	L - reflection of solid line of terraces rising fields P - reflection of polygon's contours which repeats the shape terraces rising fields counter-clockwise	Topographic maps/plans Stereopairs verification	Field
50	04	Relief	03	Elevation point	01	Elevation points	040301	x					A point with defined absolute height (elevation point)	Reflection of imaginary point of earth surface with defined absolute height in the point which is established stereoscopically by orthophoto maps, or inside the map symbol of topographic map plans or by methods of land survey	Topographic maps/plans Stereopairs verification	Field
51	04	Relief	04	Digital relief models	01	Digital relief model	040401						Digital presentation of earth surface relief, created on the basis of data about relief and topology of terrain	Using methods of spatial interpolation	Topographic maps/plans Stereopairs verification Manuals of LIDAR scanning	Field
*2	05	Hydrographic objects and hydrographic constructions	01	Water bodies	01	Seas	050101	x					Part of the ocean which is separated from it with dry land, aspect of moderate relief or islands, and has particular hydro-ecological mode, which is distinguished by its properties and water composition	Reflection of polygon's contours which repeats the shape of the sea counter-clockwise	Topographic maps/plans Stereopairs verification	Field
43	04	Hydrographic objects and hydrographic constructions	01	Water bodies	02	Lakes	050102	x					Natural water objects with slow water exchange, located in deep parts of dry land and are not connected by their subbranches with seas or oceans	Reflection of polygon's contours which repeats the shape of a lake counter-clockwise	Topographic maps/plans Stereopairs verification	Field
54	05	Hydrographic objects and hydrographic constructions	01	Water bodies	03	Water reservoirs	050103	x					Artificial water objects (dams) created with an aim to render the overflow and connected with hydroelectric power station operation or with other agricultural needs	L - reflection of imaginary central point of water reservoir (usually small underground reservoir) P - Reflection of polygon's contours which repeats the shape of water reservoir counter-clockwise	Topographic maps/plans Stereopairs verification	Field
55	05	Hydrographic objects and hydrographic constructions	01	Water bodies	04	Ponds	050104	x					Artificial objects for water storage aimed at water supply, irrigation, breeding of fish (pond fish culture) and swimming birds as well as for sanitary and sport needs	Reflection of polygon's contours which repeats the shape of a pond counter-clockwise	Topographic maps/plans Stereopairs verification	Field

Also, when acquiring data, a manual describing the acquisition method etc., shown below, which can be utilized, was prepared.

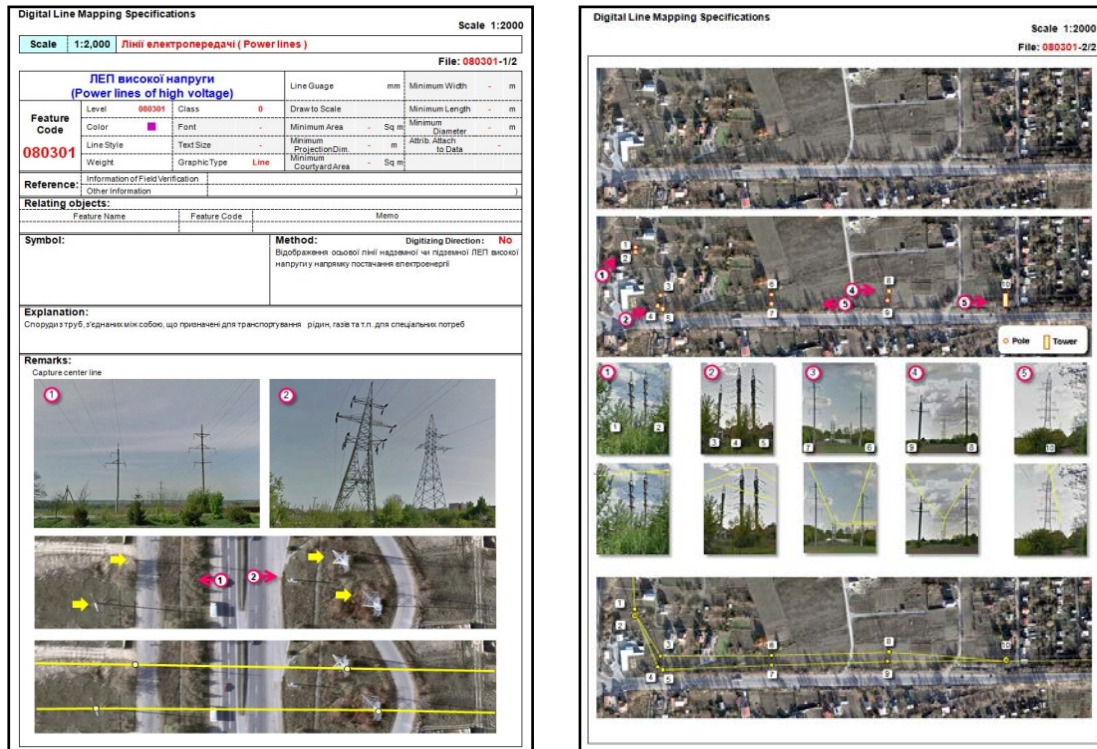


Figure 22 Example of Data Acquisition for Electricity Cable

c. Product Specifications Preparation

The product specifications of fundamental geospatial data were prepared according to the regulations of the product specifications of the geographic information standard draft targeting the geospatial data specified in the NSDI data items. The preparation of the product specifications was implemented by the technology transfer through the OJT method for the writing of product specifications, as described later.

* Geographic Information Standard draft applied for Preparation of Product Specifications

In preparing the product specifications, it was decided to prepare the product specifications based on UkrGIS of Geographical Information Standard in Ukraine prepared from International Standard of Geographic Information Standard determined by ISO / TC 211.

* Targeted Data Items

The data items dealt with in the product specifications were items selected in "Identification of NSDI data items".

* Compositions of Product Specifications Prepared

The composition of the product specifications to be prepared follows the UkrGIS regulations and is basically as follows.

1. Outline
2. Specification scope
3. Data product identification
4. Data content and structure

5. Reference system

6. Data quality

7. Data distribution

8. Metadata

9. Others

*** Data content and structure (Application schema)**

In “Data content and structure”, the UML diagram of data content and structure based on the 11 major categories and 176 topographic feature items specified in “NSDI data items” was prepared using Enterprise Architect software.

In addition, the major category has 11 packages and the topographic feature item has 176 classes.

01_Cartographic base (Картографічна основа)
<ul style="list-style-type: none"> + Orthophotomaps and orthophotoplans (Ортофотокarti та ортофотоплани) + Regular geographical grid (Регулярні географічні сітки) + Topographic maps and plans (Топографічні карти та плани)
02_State geodetic network (Державна геодезична мережа)
<ul style="list-style-type: none"> + Points of leveling networks (Знаки нівелірних мереж) + Strongholds (Опорні пункти)
03_State border of Ukraine. Administrative Units (Державний кордон України. Адміністративні одиниці)
<ul style="list-style-type: none"> + State border of Ukraine. Administrative Units (Державний кордон України. Адміністративні одиниці) + Settlements (Населені пункти) + Stuctural elements of settlements (Структурні елементи населених пунктів)
04_Relief (Рельєф)
<ul style="list-style-type: none"> + Digital relief models (Цифрові моделі рельєфу) + Elevation points (Позначки висот) + Forms of relief displayed in contour lines (Рельєф, виражений горизонталями) + Forms of relief that are not displayed in contour lines (Форми рельєфу, які не виражаються горизонталями)
05_Hydrographic objects and hydrographic constructions (Гідрографічні об'єкти та гідротехнічні споруди)
<ul style="list-style-type: none"> + Islands (Острови) + Nodes on hydrographic objects and hydrographic constructions (Вузли на гідрографічних об'єктах та спорудах) + Water bodies (Водойми) + Water courses and ditches (Водотоки і канали) + Water sources (Джерела води) + Waterfalls (Водоспади) + Waterworks (Гідротехнічні споруди) + Contours of hydrographic objects (Контур зміни типу гідрографічного об'єкту)
06_Buildings and their parts (Будівлі та їх частини)
<ul style="list-style-type: none"> + Adresses (Адреси) + Buildings (Будівлі) + Fences (Огорожі) + Parts of the buildings (Частини будівель)
07_Transport networks (Транспортні мережі)
<ul style="list-style-type: none"> + Constructions on transport networks (Споруди на транспортних мережах) + Nodes transport networks (Вузли транспортної мережі) + Rail vehicles (Рейковий транспорт) + Road network (Вулично-дорожня мережа) + Water transport (Водний транспорт) + Railway network (Залізнична мережа) + Air transport (Повітряний транспорт)
08_Engineering communications (Інженерні комунікації)
<ul style="list-style-type: none"> + Communication lines (Лінії зв'язку) + Constructions on engineering communications (Споруди на інженерних комунікаціях) + Nodes on engineering communications (Вузли на інженерних коунікаціях) + Pipelines (Трубопроводи) + Power lines (Лінії електропередачі)
09_Vegetation and soils (Рослинність та ґрунти)
<ul style="list-style-type: none"> + Contours of vegetation and soils (Контури рослинності та ґрунтів) + Forest blocks (Лісові квартали) + Plantations of technical crops (Плантації технічних культур) + Garden vegetation (Садова рослинність) + Glades (Просіки) + Aquatic vegetation (Рослинність водяна) + Grassland vegetation (Трав'яна рослинність) + Lichens (Лишайники) + Moss vegetation (Рослинність мохова) + Moors (Болота) + Separate trees (Дерева, що стоять окремо) + Shrub vegetation (Чагарникова рослинність) + Soils (ґрунти) + Stripes of trees plantations (Смуги деревних насаджень) + Tree vegetation (Деревна рослинність)
10_Cadaster information (Кадастрова інформація)
<ul style="list-style-type: none"> + Index cadaster map (Індексна кадастрова карта) + Land parcels (Земельні ділянки)
11_Geographic names of objects (Географічні назви об'єктів)
<ul style="list-style-type: none"> + Geographic names of objects (Географічні назви об'єктів)

Figure 23 11 Packages on the draft Product Specifications for NSDI Prototype

Also, the UML class diagram and the example of its content in the package are as follows.

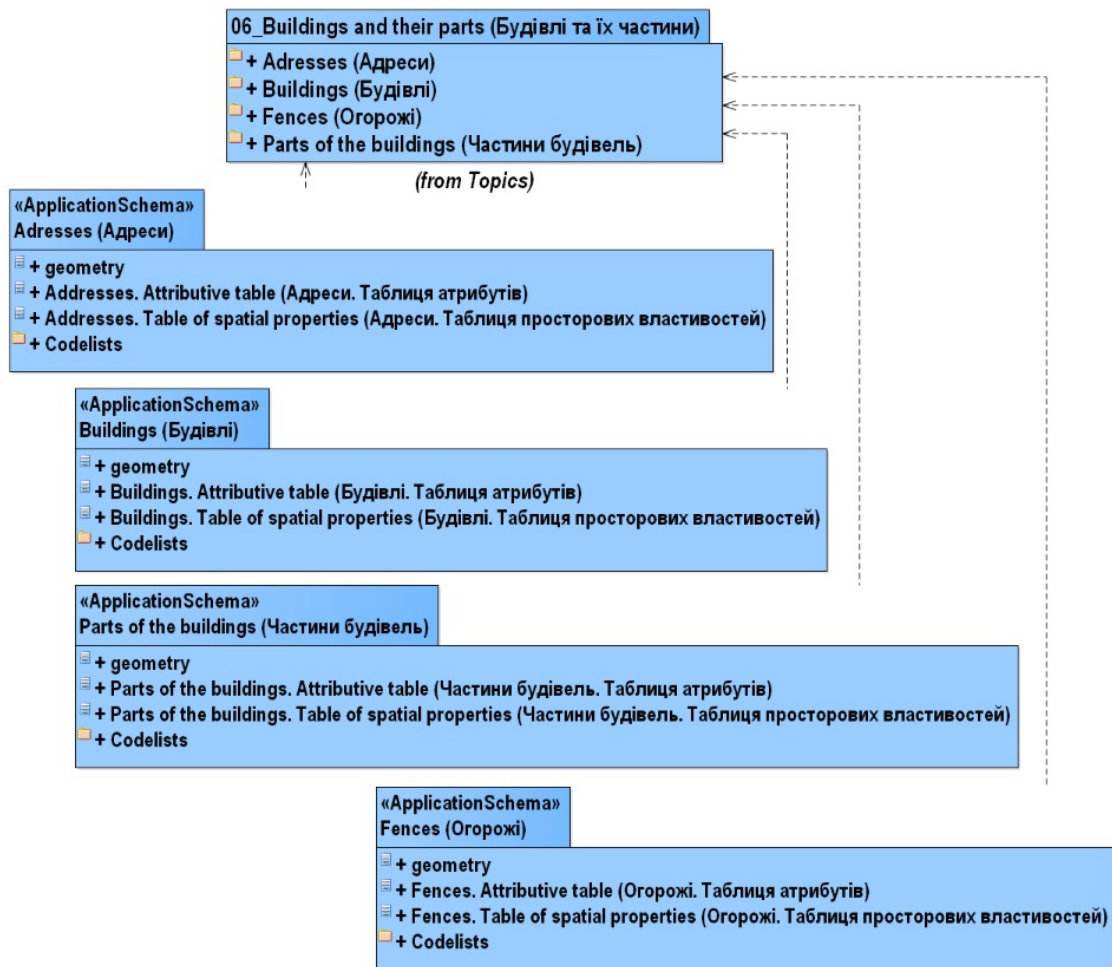


Figure 24 06_Buildings and their parts package (excerpt from the UML diagram)

Table 43 Contents of 06_Buildings and their parts package

No	Object Name	Attribute
1	Adresses (GM Point)	House number
		Name of the street
		Type of the street
2	Buildings (GM Surface)	Type
		Design features
		Fire resistance type
		Functional prescription
		Importance of building
		Material
		Number of floors
		Relative height
		Status
3	Parts of the buildings (GM Surface)	Type
		Character of location
		Design features
		Material

No	Object Name	Attribute
		State
4	Fences (GM Curve)	Type
		Material

The application schema documents were prepared describing a definition of each class attribute, acquisition criteria and domain, etc.

*** Reference system**

The reference system was prepared with a predetermined format adding requirements of the standards draft based on the contents decided by “Survey Standards”.

*** Data quality**

In the quality requirements of each topographic feature to be described in the product specifications, quality evaluation items were organized including data quality element, data quality sub-elements, quality evaluation method and conformity quality level. The following is a draft of the quality requirements.

Table 44 Draft of the Quality Requirement (partial)

Data quality scope		Non-spatial attributes		Spatial attributes	
Data quality elements	Data quality requirements	Data quality evaluation method		Data quality requirements	Data quality evaluation method
Completeness	Commission	error rate = 0%	Full inspection. Count the number of excess data by comparison with the reference data. Error rate (%) = (number of excess data) / (total number of data) * 100.	error rate = 0%	Full inspection. Count the number of excess data by comparison with the reference data. Error rate (%) = (number of excess data) / (total number of data) * 100.
	Omission	error rate = 0%	Full inspection. Count the number of absent data by comparison with the reference data. Error rate (%) = (number of absent data) / (total number of data) * 100.	error rate = 0%	Full inspection. Count the number of absent data by comparison with the reference data. Error rate (%) = (number of absent data) / (total number of data) * 100.
Logical consistency	Domain consistency	error rate = 0%	Full inspection. Using checking programs, count the number of data that are not in conformance with their universe of discourse. Error rate (%) = (number of non-conforming data) / (total number of data) * 100.	error rate = 0%	Full inspection. Using checking programs, count the number of data that are not in conformance with their universe of discourse. Error rate (%) = (number of non-conforming data) / (total number of data) * 100.
	Format consistency	error rate = 0%	Full inspection. Using checking programs, count the number of data that are not in conformance with the data format rules. Error rate (%) = (number of non-conforming data) / (total number of data) * 100.	error rate = 0%	Full inspection. Using checking programs, count the number of data that are not in conformance with the data format rules. Error rate (%) = (number of non-conforming data) / (total number of data) * 100.
	Topological Consistency	N/A	N/A	error rate = 0%	Full inspection. Using checking programs, count the number of data that are not in conformance with the topological characteristics in the universe of discourse. Error rate (%) = (number of non-conforming data) / (total number of data) * 100.
Positional accuracy	Absolute or external accuracy	N/A	N/A	See Table XXX	See Table XXX
Thematic accuracy	Non-quantitative attribute correctness	error rate = 0%	Full inspection. Count the number of incorrect data by comparison with the reference data. Error rate (%) = (number of excess data) / (total number of data) * 100.	N/A	N/A
	Quantitative attribute accuracy	error rate = 0%	Full inspection. Count the number of incorrect data by comparison with the reference data. Error rate (%) = (number of excess data) / (total number of data) * 100.	N/A	N/A
Temporal quality	Accuracy of a time measurement	error rate = 0%	Full inspection. Count the number of incorrect data by comparison with the reference data. Error rate (%) = (number of excess data) / (total number of data) * 100.	N/A	N/A
	Temporal consistency	error rate = 0%	Full inspection. Count the number of incorrect data by comparison with the reference data. Error rate (%) = (number of excess data) / (total number of data) * 100.	N/A	N/A

3) Technology Transfer

The technology transfer of preparation of product specification and establishment of NSDI Data were implemented. These technology transfers, by the OJT, involved preparing product specifications and establishing NSDI data.

a. Technology Transfer of Product Specifications

*** Technology transfer training of product specifications**

The training for technology transfer of basic contents related to the preparation of product specifications was implemented as the following contents.

Table 45 Training for Technology Transfer of introduction of Product Specifications

Object	To understand the basic concept of Product Specifications and contribute to create draft Product Specifications for NSDI Prototype Geospatial Information Data in the pilot area.	
Target	C/P in the Data Prototype team	
	Date	Syllabus
First Day	2016/02/15 (Mon)	Concept of Product Specifications, basic structure and relations with ISO/TC211
Second Day	2016/02/16 (Tue)	How to read Application Schema and UML Class Diagrams
Third Day	2016/02/17 (Wed)	Evaluation methods for quality of data
Forth Day	2016/02/18 (Thu)	Metadata and the coding
Fifth Day	2016/02/22 (Mon)	Concept of Product Specifications (Review), Evaluation exam and the review

The training for technology transfer was implemented via lecture style, referring to product specifications draft in Data Specifications / Technical Guidelines (<http://inspire.ec.europa.eu/index.cfm/pageid/2>) of INSPIRE. During the training period for C / P (trainee), up to 8 people attended, with a minimum of 6 people and the average attendance for five days was 6.8 people

The evaluation test was implemented on the last day of training to confirm how much C/P understood the contents of training. The purpose of the evaluation test was to specify which items of the training content were not fully understood and to eliminate insufficient understanding of the items through explanation after testing to deepen understanding the product specifications. The details of the evaluation test were "Degree of comprehension of composition of product specifications", "Degree of comprehension of UML class diagrams", "Degree of comprehension of data quality concepts", "Degree of understanding data encoding". Six members of the C/P sat the evaluation test on the final day of the training and most of them answered all the questions correctly. A complementary review for the C/P, who made incorrect answers, was provided to gain total comprehension.

Overall, through the five days of training, the C/P members understood the concepts and basic structure of Product Specifications, and reached a technical level sufficient to understand what is written by reading the UML class diagram.

*** Introduction of software for preparing product specifications and technical transfer training on its use**

The following software were introduced for preparing product specifications.

Table 46 Software for Product Specifications

Index	Description	
Software	Enterprise Architect	XMLSpy
Version	12.1 Desktop Edition	2016 Professional Edition - Release 2
Vendor	Sparx Systems Pty. Ltd.	Altova GmbH
License	Standard License	Concurrent-User License
Number of users	12	12

Index	Description	
Special feature of software	Widely used in the field of ICT as an UML editor. ISO/TC211 standards recommend using EA for creating UML class model.	Widely used in the field of ICT as an XML Validator or Editor

The introduced software, as described in the outline, is a preparation tool of the UML class diagram and the application schema document that constitute "data content and structure (application schema)", which is one of the main parts of product specifications. Technology transfer training of the basic contents such as preparation of UML class diagram using the introduced software was carried out to the C / P, as follows.

Table 47 Training of technical transfer for creation of UML Class Diagrams

Objectives	To understand the basic functions of Enterprise Architect for creating UML class model. To contribute to creating draft Product Specifications for NSDI Prototype Geospatial Information Data in the pilot area.	
Target	C/P of Data Prototype team	
	Date	Syllabus
First Day	2016/03/02 (Wed)	Review of Product Specifications and UML Class Diagrams The basic functions of EA
Second Day	2016/03/03 (Thu)	Function for creating new diagrams by EA
Last Day	2016/03/04 (Fri)	Function for automatic documentation by EA

In this technology transfer training, the basic function for preparing UML class diagram, among various software functions, was focused on and explained, and the technology transfer training for this was implemented in a form incorporating exercises for operating software on PC. The attendance status of the C/P for three days was a maximum of 9 people, minimum of 8 people. The average attendance for three days was 8.3 people per day.

The evaluation test was implemented on the last day of training to confirm how much C/P understood the contents of training. The purpose of the evaluation test was to specify which items of the training content were not fully understood and to eliminate insufficient understanding of the items through explanation after testing to deepen understanding about the preparation of UML class diagram by EA software.

Eight members of the C/P sat the evaluation test on the final day of the training, and while each of the members required varying times to complete the test, they all eventually were able to prepare a valid UML class diagram. Based on the above explanation, the C/P understood basic operation of preparation of UML class diagram using EA software through three days of training.

*** Preparation of Technology Transfer Manual and Technology Transfer Program**

The draft of technology transfer manual and technology transfer program (including schedule and syllabus) was prepared to disseminate the preparation techniques of product specifications (including techniques for preparation of product specifications using software) in SSGCC and SLCC.

Creation of the National Geospatial Data Infrastructure (NSDI) in Ukraine

Program of "Technical Transfer Session: Introduction of Data Product Specifications"

Date: 5 days

Time: 14:00-15:30 (1.5 hours) each day

Venue: Room: SLCC Building

Lecturers: Department of Technological Support of the State Land Cadastre, SLCC

Trainees: SLCC staff (newly in charge of NSDI)

Objectives: Introduction of Data Product Specifications, for the NSDI in Ukraine

Date	Day 1	Day 2	Day 3	Day 4	Day 5
Contents	- Required contents of Data Product Specifications (DPS) and related ISO standards - Compliant with ISO standards	- Application schema and Unified Modeling Language (UML) class diagram - How to get (read) information from UML class diagrams	- Five elements of data quality - Evaluation procedures of data quality	- Metadata - Encoding (Geography Markup Language (GML))	- Summary of DPS - Short test
Remarks					

Figure 25 Draft of Technical Transfer Programme and schedule (partial)

In preparing the draft, the following were referred to InterNet: the contents of "Technology transfer training of product specifications"; "Training of technical transfer for creation of UML Class Diagrams"; and the educational materials related to INSPIRE.

b. Technology transfer of NSDI data preparation

The technology transfer of NSDI data preparation was carried out targeting orthophoto preparation, photogrammetry system (digital plotting) and preparation using existed data.

* Orthophoto Digitizing, and Introduction of software system that is used in photogrammetry system

Prior to implementation of technology transfer, for the software ArcGIS, to be used for orthophoto digitization, it was decided to use 12 licenses from 300 licenses of ArcGIS owned by the C/P, SLCC, for technology transfer. These licenses were prepared together with PCs. The outline of ArcGIS software prepared was as follows.

Table 48 Software to digitize orthophotos

Items	Description
Software	ArcGIS
License	License for Concurrent Users (CU)
Versions	10.2.2 Desktop
Vendor	ESRI
Types of License	Standard License
Description	It is widely used for GIS data creation and editing.

The Photogrammetry System introduced, software for photogrammetry system of HEXAGON GEOSPATIAL and its hardware, was good for digital plotting/editing.

* Technology transfer of Orthophoto Digitalization and Photogrammetry System

The technology transfer training of NSDI data preparation by orthophoto digitalization and photogrammetry system was implemented through division into the two periods shown below. In addition, the technology

transfer training was carried out by the OJT method which prepares geospatial data of about 11 km² in the pilot area in the NSDI prototype based on the prepared product specifications.

Table 49 Contents of Technical Transfer Training 1

Objectives	C/P understands the basic skills about Photographic Survey, and contributes to creation of Geospatial data in NSDI prototype (from data acquisition to editing) in the pilot area.	
Target	C/P of Data Prototype Team, SLCC Officers	
	Date	Main contents of the training
1st	(7/25 (Mon))	Project Overview, brief explanation about the training, examination
2nd	(7/26 (Tue))	Establishment of work environment, explanation about the software
3rd	(7/27 (Wed))	Explanation about acquisition method of features of transport
4th	(7/28 (Thu))	Explanation about acquisition method of features of water-side
5th	(7/29 (Fri))	Explanation about acquisition method of features of building
6th	(8/1 (Mon))	Explanation about acquisition method of features of land-use
7th	(8/2 (Tue))	Explanation about acquisition method of other features
8th	(8/3 (Wed))	Digitizing Orthophotos and Stereoscopic mapping by trainees
9th	(8/4 (Thu))	Digitizing Orthophotos and Stereoscopic mapping by trainees
10 th	(8/5 (Fri))	Digitizing Orthophotos and Stereoscopic mapping by trainees
11th	(8/8 (Mon))	Explanation about editing method, Quality Check method
12th	(8/9 (Tue))	Training on Editing and Quality Check by trainees
13th	(8/10 (Wed))	Training on Editing and Quality Check by trainees
14 th	(8/11 (Thu))	Review of data created by trainees
Final	(8/12 (Fri))	Overall review of the training and explanation of data to creation method for prototype

Table 50 Contents of Technical Transfer Training 2

Objectives	C/P understands the basic skills about Photographic Survey, and contributes creation of Geospatial data in NSDI prototype (from editing to GIS structuring) in the pilot area.	
Target	C/P of Data Prototype Team, SLCC Officers	
	Date	Description
1st	(10/24 (Mon))	Introduction of this training, visual inspection of prototype data
2nd	(10/25 (Tue))	Implementation of visual inspection and editing the data
3rd	(10/26 (Wed))	Explanation about GIS structuring and logical inspection
4th	(10/27 (Thu))	Implementation of logical inspection and editing the data
Final	(10/28 (Fri))	Lecture of quality management, overall review of the training, examination

The technology transfer training was carried out focusing on the data preparation, based on the product specifications of Fundamental Geospatial Data as a NSDI data.

- The technology transfer training of how to construct the working environment of the software and system to be used and basic usage thereof was carried out first. Before technology transfer training of construction of working environment, the reconstruction of the stereo model using the simultaneous adjustment results implemented by technical cooperation were confirmed.
- Next, the preparation flow of Fundamental Geospatial data was explained and it was requested to grasp the overall picture of data construction. After that, the technology transfer training was carried out according to this data preparation flow.

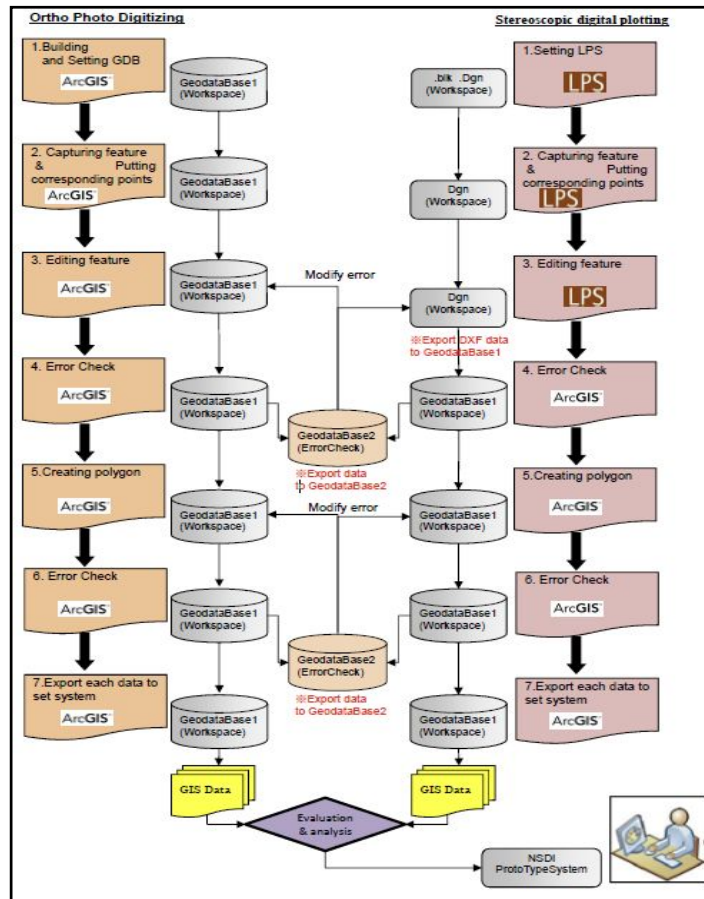


Figure 26 Flow of Creation of Fundamental Geospatial Data from orthophotos

- In the product specifications of Fundamental Geospatial Data, topographic features to be acquired are recognized as objects which are composed of point data, line data and surface data, and the relationship of topographic features has an adjacency (Topology) and furthermore, it is regulated to have attribute information. The following methods applied to the preparation of such data were also subject to the technology transfer training.
This is a method to acquire the shape of the topographic features on the line at the beginning, acquire the point (representative point) having the attribute information within the closed area, and then automatically polygonise it. In this method, the attribute information is automatically inherited, and the topology between adjacencies is also retained. Also, the generation of minute polygons can be prevented.
- The technology transfer training of acquisition method of topographic features, according to the acquired items list for data producer prepared at the stage of product specifications preparation, was implemented. At the same time, the acquired items list was updated by the feedback of technology transfer training.
- The technology transfer training of method of editing acquired data was implemented, and at the same time, the technology transfer training of method of accuracy control based on the process specification was implemented.

Table 51 Image of the Accuracy check list

Accuracy Control Table for Digital Editing							
Project Name		Scale		1/10,000	Period	From :14/11/15	Operator
Sheet name/Sheet number		Volume		39km ²		To : 14/11/30	Inspected by
Implementation Organization		Project Leader					Final Inspected by
Feature Class	Data Class / Feature Name	Error Items	Number of Errors	Feature Class	Data Class / Feature Name	Error Items	Number of Errors
1. Boundary	International Boundary	Missing/Excess error	0	2. Control Points	Horizontal Control Point	Missing/Excess error	0
		Classification error	0			Classification error	0
		Position/Figure error	0			Position/Figure error	0
	Administrative Boundary	Missing/Excess error	1		Vertical Control Point	Missing/Excess error	0
		Classification error	0			Classification error	0
		Position/Figure error	1			Position/Figure error	1
	Other Boundary	Missing/Excess error	0		Vertical Control Point	Missing/Excess error	0
		Classification error	1			Classification error	0
		Position/Figure error	1			Position/Figure error	3
3. Transportation/Traffic Facilities	Road	Missing/Excess error	2	5. Water	Water Area (polygon)	Missing/Excess error	1
		Classification error	1			Classification error	2
		Position/Figure error	0			Position/Figure error	0
	Road Facilities	Missing/Excess error	2		Water Area (non-polygon)	Position/Figure error	0
		Classification error	1			Polygon error	3
		Position/Figure error	0			Missing/Excess error	0
	Railway	Missing/Excess error	0		Natural Object in the Water Area (polygon)	Classification error	2
		Classification error	0			Position/Figure error	1
		Position/Figure error	1			Missing/Excess error	2
	Railway Facilities	Missing/Excess error	3		Classification error	0	
		Classification error	0		Position/Figure error	0	
		Position/Figure error	0		Polygon error	2	

- The technology transfer training of GIS structuration was implemented to use data for GIS after editing acquired data. Also, the technology transfer training of quality evaluation method of product specifications was implemented as a final step of data preparation.
- Evaluation of Results of Technology Transfer Training
The degree of understanding of technology transfer training of participants was evaluated on the final day. The items of degree of understanding to be evaluated were as follows.

Table 52 Contents of examination for the training

Contents	
1	Concept of NSDI
2	Digitizing Orthophotos/ Mapping skills
3	Digitizing Orthophotos/ Mapping procedures
4	Software operation
5	Procedure of establishing environment for software operation
6	Criteria of feature data acquisition
7	Method to create data based on the field survey
8	Method to read features from photographs
9	Method for Quality Control
10	Method for revision of the feature data

The evaluation results for degree of understanding were as follows.

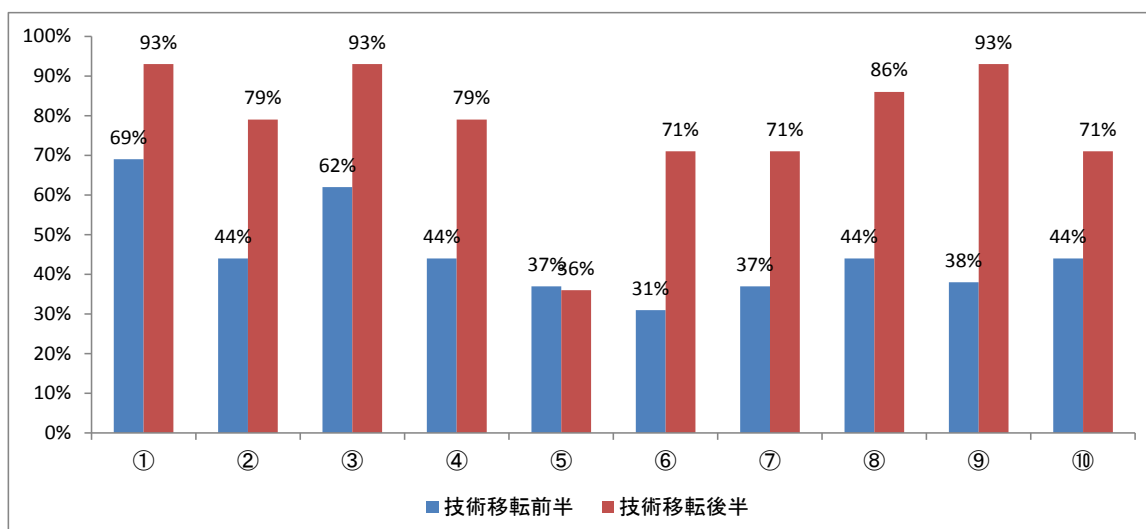


Figure 27 Level of understanding before/after the training

4) NSDI Data Preparation

The fundamental geospatial data, which is NSDI data, was prepared using the technology transfer result of data preparation targeting about 11 km² of the pilot area, Vinnytsia District, based on its product specifications.

Statistical data such as the time required for preparation of data were collected.

a. Data Item of Fundamental Geospatial Data based on the Product Specifications

A list of prototype topographic features of the fundamental geospatial data to be prepared was as follows.

Table 53 Topographic feature list of Prototype Data of Fundamental Geospatial Data

Package		Topographic Feature
01	Cartographic base	Orthophotomap and orthophotoplans
		Regular geographic grid
		Topographic maps and plans
02	State geodetic network	Points of leveling networks
		Strongholds
03	State border of Ukraine. Administrative Units	State border of Ukraine. Administrative Units
		Settlement
		Territories of structural and planning elements of settlements
		Functional territories
04	Relief	Digital relief models
		Elevation points
		Forms of relief displayed in contour lines
		Negative forms of relief
		Positive forms of relief
05	Hydrographic objects and hydrographic constructions	Water bodies
		Water courses and ditches
		Islands
		Water supply constructions
		Contours of hydrographic objects
06	Buildings and their parts	Buildings

Package		Topographic Feature
		Fences
07	Transport networks	Street network
		Railway network
		Constructions on transport networks
08	Engineering communications	Pipelines
		Power lines
		Constructions on engineering communications
09	Vegetation and soils	Contours of vegetation and soils
		Forest blocks
		Garden vegetation
		Grassland vegetation
		Separate trees
		Shrub vegetation
		Stripes of tree plantations
10	Cadastral information	Index cadastral map
		Land parcels
11	Geographic names of objects	• Geographic names of objects

b. Targeted Areas of Preparation of Fundamental Geospatial Data of Prototype

Considering the characteristics of the urban area, urban suburbs, forest/farmland, etc., the preparation area of prototype data was specified in an area of about 11 km² (3.2 km north-south × 3.5 km east-west) in the Vinnystsia District.

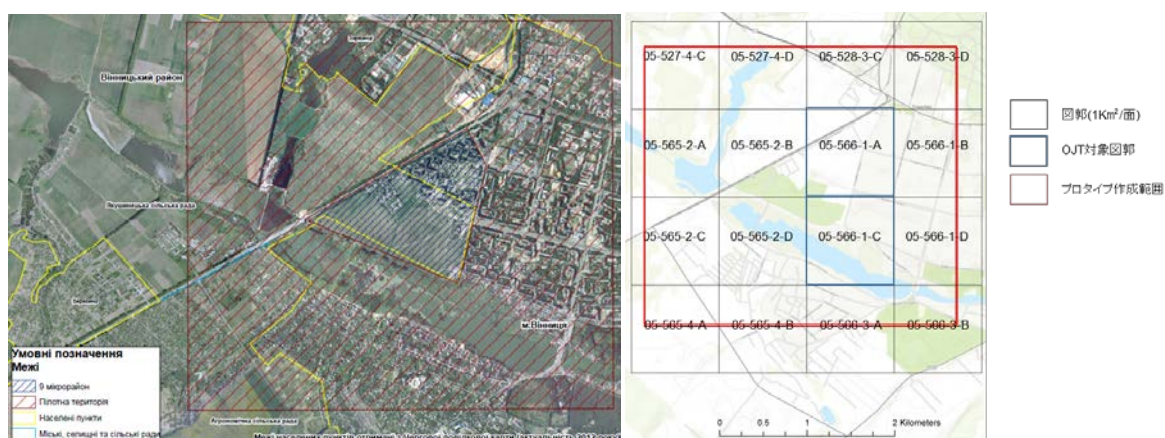


Figure 28 Target Area of Prototype Preparation

c. Field Identification

The field identification was carried out to acquire attribute information of fundamental geospatial data. The explanation and orientation of a work method were carried out on June 8 and June 9, 2016, and five C/P carried out the field identification for about two weeks from June 9, 2016 to June 24, 2016. In the field identification, the scale 1:2,000 orthophotos (16 sheets) and the code table of topographic features to be acquired for the field identification were used.



Figure 29 Grid Index of orthophotos for the Fieldwork

Based on the prepared code table of topographic features, the field identification was carried out by applying the work method of filling the code of the topographic features and the necessary notes, confirmed on site, in the orthophotos.

d. Data Acquisition by Orthophoto Digitization and Photogrammetry System

The data acquisition was implemented based on the product specifications and the results of field identification. Data acquisition was carried out through on-the-job training-based technology transfer and using the results of technology transfer training on the use of photogrammetry systems and orthophoto digitizing.

In the process of data acquisition, it became clear that the topographic features and a part of its attribute information, which are described in product specifications and to be acquired, needed to be obtained from materials, etc., owned by the administrator.

Also, in the data acquisition, the method of orthophoto digitizing and the method of stereoscopic three dimensional plotting were compared and evaluated from the view points of working hours, technical difficulties, accuracy and skill. The following table shows the results of the comparison and evaluation.

Method	Advantages	Disadvantages
Orthophoto Digitizing	<ul style="list-style-type: none"> * Do not need any specified skills * Input system is cheaper than a stereoscopic system * Do not need a lot of software 	<ul style="list-style-type: none"> * Accuracy of plane position depends on accuracy of orthophoto * Impossible to take height information * There is an influence of inclination of images for high buildings
Binocular vision (3 dimensions plotting)	<ul style="list-style-type: none"> * A photo interpretation in plotting is easy than in orthophotos (Possible to draw upon height information) * Possible to skip preparation of orthophoto * Possible to use height information 	<ul style="list-style-type: none"> * Need a skill to acquire data in 3 dimensions * A photogrammetric system is expensive * Depending on the photogrammetric system, different software is used; therefore, Operators need to have knowledge of a variety of software.

The acquired data was evaluated for quality, based on the product specifications, after the process of editing and GIS structurizing. In the quality evaluation the positional accuracy was measured using the re-plotted data as true values to measure the root-mean-square error, RMSE; which was found to be 0.711 m. This is within the applicable value of the quality control .

The output of prototype data prepared was as follows.

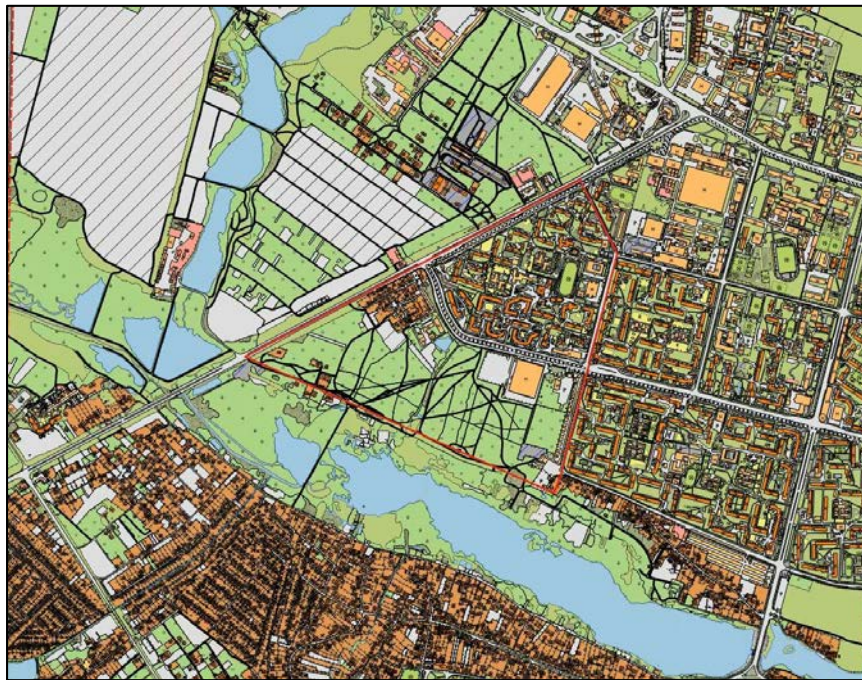


Figure 30 Created Prototype Data

e. Statistical Materials related to Prototype Establishment for Fundamental Geospatial Data

To compare the work efficiency of orthophoto digitizing and data preparation method by photogrammetry system (digital three-dimensional plotting), the working time required to prepare data of each topographic feature was recorded. Recording of working time is classified as follows considering characteristics of topographic features.

- | |
|--|
| <p>~Type1~</p> <ul style="list-style-type: none"> ▣ Road(km): Calculate the length of the Road ▣ Hydrographical(km): Calculate the length of the Hydrographical ▣ Railway(km) : Calculate the length of the Railway ▣ Fence(km): Calculate the length of the Fence ▣ Powerline(km)): Calculate the length of the Powerline <p>~Type2~</p> <ul style="list-style-type: none"> ▣ Building : Count the number of building ▣ Structure: Count the number of structure <p>~Type3~</p> <ul style="list-style-type: none"> ▣ Land use(km2): After creating polygon, GIS analysis ▣ Street light: After creating point, Count the number of street light ▣ Contour |
|--|

Figure 31 Topographic feature items for record of working time

Each working time required to acquire the classified topographic feature was recorded in the following format.

Team	A	Framework	05_0565_4_A					
		Caputuring	: Caputuring feature by Streoscopic or Degitizing					
		Editting	: Edittind data					
		Error Check	: Visually and logical check					
		GIS Structure	: Creating polygon and Export shapefile					
Date	Feature	Worktype	StartTime	EndTime	Time	Quantity	Remarks	
8/16	Road	Caputuring	9:00	13:00	4:00	0.5		
8/16	Road	Caputuring	14:30	16:00	1:30	0.7		
8/17	Hydrographical	Caputuring	9:00	12:00	3:00	0.5		
8/19	Building	Caputuring	9:00	13:00	4:00	30		
8/19	Building	Caputuring	14:00	17:00	3:00	50		
8/22	Land use	Caputuring	9:00	13:00	4:00			
8/22	Land use	Caputuring	14:00	17:00	3:00			
8/23	Land use	Caputuring	9:00	13:00	4:00			
8/24	Structure	Caputuring	9:00	13:00	4:00	30		
8/24	Structure	Caputuring	14:00	17:00	3:00	30		
8/25	Structure	Caputuring	9:00	13:00	4:00	30		
8/26	Powerline	Caputuring	9:00	13:00	4:00	1		
8/29	Street light	Caputuring	9:00	13:00	4:00	100		
8/29	Street light	Caputuring	14:00	17:00	3:00	120		
8/30	Street light	Caputuring	9:00	13:00	4:00	100		
8/31	All	Editting	9:00	13:00	4:00			
8/31	All	Editting	14:00	17:00	3:00			
9/1	All	Error Check	9:00	13:00	4:00			

Figure 32 Records of working hours (Digitizing)

The statistical information of working hours that were collected by the above activity will be utilized in the preparation of the fundamental geospatial data preparation plan.

*** Examination of possibility to utilize existing data in data preparation**

It was clarified that Vinnytsia City, the target pilot area, has already established the geospatial data independently. The project team decided to verify the possibility that the geospatial data already developed by Vinnytsia City could be utilized for the preparation of the fundamental geospatial data that is about to be prepared as a prototype.

- Obtaining existing geospatial data of Vinnytsia City

The existing geospatial data of Vinnytsia City was obtained through C/P organization. The geographic areas of obtained existing geospatial data was as follows.



Figure 33 Extent of the existing data from Vinnytsia City

- Specification of existing geospatial data of Vinnytsia City

The specification of existing geospatial data obtained was as follows.

Table 54 Existing Data in Vinnytsia City

Items	Description
Creation method	Digitization of the existing map and stereoscopic plotting
Regulations	Classification information displayed on topographical plans of scale 1: 5000, 1: 2000, 1: 1000, 1: 500
Tools	Mapping facility in Ukraine
Year of creation	After 2010
Scale	1:2000
Objectives	City Planning, land use
Data format	Shape data

Also, the topographic feature items to be included in the existing geospatial data were as follows.

Table 55 Features included in the existing data in Vinnytsia City

	Ukraine	English
1	Автостоянки в містах	Parkings in towns
2	Блискавковідводи	Lightning protectors
3	Будинки з колонами замість частини або всього першого поверху	Houses with columns instead of part or the whole first floor
4	Будівлі	Buildings
5	Будки трансформаторні	Transformer vaults
6	Вісь вулиці	Street axis
7	Газони	Lawns
8	Газорегуляторний пункт (ГРП)	Gas control point
9	Ганки закриті кам'яні	Covered stone porches
10	Горизонталі(основні2-1)	Contour lines (main 2-1)
11	Горизонталі додаткові(5-1)	Additional contour lines (5-1)
12	Горизонталі основні	Main contour lines
13	Горизонталі потовщені	Index contour lines
14	Городи	Vegetable gardens
15	Дамби і вали позамасштабні	Conventional dams and swells
16	Дерева що стоять окремо	Separate trees
17	Дитячі майданчики	Playgrounds
18	Ділянки зі зритою поверхнею(знак)	Areas with levelled surface (sign)
19	Ділянки зі зритою поверхнею	Areas with levelled surface
20	Зарості очерету	Cane brushwoods
21	Зображення	Images
22	Кам'яні, залізобетонні огорожі заввишки 1 м та більше	Stone and reinforced concrete fences with height of 1 m and more
23	Канави сухі	Dry ditches
24	Квартали	Blocks
25	Колодязі з ручним насосом	Wells with hand pump
26	Колодязі оглядові(люки)	Manholes (hatchway)
27	Колодязі	Wells
28	Косметичний шар білий	White esthetic layer
29	ЛЕП направлення низької напруги	Direction of power lines of low voltage
30	ЛЕП повітряні дротяні на забудованій території низької напруги	Air power lines of low voltage on built-up area
31	Лінії зв'язку повітряні дротяні на забудованій території	Air wire communication lines on built-up area
32	Лінія КОНТУР	Line CONTOUR
33	Лінія направлення зв'язку	Line of communication direction
34	Лінія проїзду	Drive line
35	Лінія чорна	Black line
36	Ліхтарі електричні двойні	Double electric torches
37	Ліхтарі електричні одинарні	Single electric torches
38	Ліхтарі електричні(декоративні)	Electric torches (decorative)
39	Майданчики будівельні	Construction sites
40	Межа без бортового каменю	Boundary without border stone
41	Межа з бортовим каменем	Boundary with border stone
42	Межі зміни покриття	Boundary of pavement change
43	Мости довжиною до 1 м на автомобільних дорогах	Bridges on automobile roads with length up to 1 m
44	Навіси на стовпах	Sheds on poles
45	Навіси-козирки	Sheds with sun breakers
46	Огорожі дротяні з дротяної сітки (вольтєри)	Wire fences made of wire netting (enclosures)
47	Огорожі металеві вис-1 м і більше	Metal fences with height of 1 m and more
48	Огорожі шиферні на фундаменти	Slate fences on footing
49	Підпирні стінки прямовисні	Plumb retaining wall
50	Пішохідні стежки	Pedestrian paths
51	Площадки	Landings
52	Позначки висот	Elevation marks
53	Показчик напрямку схилів (бергштрихи)	Pointers of slope directions (bergstrichs)
54	Покриття	Pavement
55	Польові та лісові дороги (край пунктир)	Field and forest roads (edge dotted line)
56	Польові та лісові дороги	Field and forest roads
57	Прожектори	Searchlights
58	Проїжджі частини з покриттям	Traffic areas with pavement
59	Рослинність трав'яна степова	Grass vegetation of steppes
60	Ряди дерев (алеї) на вулицях	Tree raws (avenues) on the streets
61	Сквери, парки, бульвари	Squares, parks, boulevards
62	Смуги деревних насаджень шир від 3 до 8 мм та вис-4 м та більше	Stripes of tree plantations with width from 3 to 8 mm and height of 4m and more
63	Спортивні споруди	Sport constructions
64	Стовп дер круглий	Round wooden pole
65	Стовп ЗБ круглий	Round reinforced concrete pole
66	Стовп мет круглий	Round metal pole
67	Струмки з невизначеною береговою лінією	Streams with unfixed coastline
68	Сходи для підйому на різні споруди	Stairs for arising on different constructions
69	Трав'яна рослинність лук	Grass vegetation of meadows
70	Трамвайні колії	Tram tracks
71	Трибуни	Tribunes
72	Тротуари доріжки з твердим покриттям	Sidewalks walks with hard pavement
73	Труби під дорогами (вихід)	Pipes under roads (exit)
74	Укоси без знаку	Slopes without sign
75	Укоси неукріплені в масштабі плану	Unrevetted slopes in plotting scale
76	Укоси неукріплені позамасштабні	Conventional unrevetted slopes
77	Фруктові цитрусові сади	Fruit and citrus gardens
78	Церкви, костьололи, кірхи	Churches, cathedrals, protestant churches

-
- Examination of possibility to utilize existing geographical spatial data of Vinnytsia City for fundamental geospatial data

Based on the product specifications of the fundamental geospatial data, the contents of the spatial attributes and the thematic attributes, including the topographic feature items, were compared and examined.

As a result, the existing geospatial data of Vinnytsia City was categorized for the fundamental geospatial data as follows.

1. The spatial attribute and the thematic attribute of the existing geospatial data could be used as the fundamental geospatial data (26 topographic feature items)
 2. Only the spatial attributes of the existing geospatial data could be used as the fundamental geospatial data (39 topographic feature items)
 3. Only the thematic attributes of the existing geospatial data could be used as the fundamental geospatial data (1 topographic feature item)
 4. Both the spatial attributes and thematic attributes of the existing geospatial data could not be used as the fundamental geospatial data (12 topographic feature items)
- The quality evaluation (including quality conformity level) of the positional accuracy regulated on the product specifications of the fundamental geospatial data applied for the existing geospatial data was carried out. The standard of the positional accuracy was the result of re-plotting characteristic points of buildings and roads. Using this re-plotting data to calculate the RMSE (Root Mean Square Error) of the deviation from the results, a RMSE of 0.843m was obtained. Therefore, it was clarified that this value was within the applicable value of the quality control .
 - It was clarified that the method of preparation of NSDI data (including Fundamental Geospatial Data) was not only preparation by a new survey but also preparation of data which can be applied to the existing geospatial data. From these results, in the preparation of data of the future, it was clarified that it was necessary to consider a method of preparation of NSDI data to be prepared including a method of inspection of the existing data.

(2) Establishment of NSDI Prototype System

1) Research on existing web services

Toward establishment of NSDI Prototype System, an investigation was conducted to review the usefulness of existing Web services. Firstly, a main target of Web services for the investigation was identified. Secondly, information resources of the Web services were collected and analysed. Based on the result, the basic policy of using the existing Web services for establishment of NSDI Prototype System was formulated.

a. Identification and survey of existing web services targeted for survey

In the NSDI prototype system, the following services were identified as subjects for survey of existing web services that may be utilized.

Table 56 Target for the research of existing Web Services

Name of Web services	Description
National Cadastre System (NCS)	A cadastre management system created and funded by the Project implemented by World Bank. This system consists of two parts: a GIS related part and an administrative system for the cadastre management which does not include GIS function.
NSDI Pilot System in Fastiv City	A Web service developed by C/P for consideration of NSDI which references geospatial information. It has not been practically operated yet.

For the identified existing web service, a survey on its design material, manual material, software / hardware architecture, development structure, etc. was carried out.

b. Survey result of existing web services

The survey results of two existing web services surveyed were as follows.

* National Cadastre System (NCS)

1. Outline of Web System

- NCS is classified into two types of system: the internal-use system for the government officers; the open-to-public system which is available on the Internet.
- Although both systems have GIS functions, these are basically used as an administrative system to view and register the application information related to cadastre.
- Documents handled by NCS require electronic storage and paper storage, and NCS can automatically create these documents on the system.
- Nation-wide cadastral information is registered in NCS. In addition, as geospatial information, orthophotos, land shapes, land use regulation and information related to populations are registered.
- Information on land registration and spatial shape is sent from the local institution in XML format. This information is registered using the internal system at the centre of NCS. Data in the XML format includes graphic data, professional attribute data, and metadata.

2. Development Documents

There was a document related to the development of NCS, and the outline of the table of contents structure was as follows.

1. Terms of Reference
2. Technical and Working Documentation
3. Operational Documentation
4. Testing Documentation

3. Software Architecture

The architecture of the NCS software was as shown in the following figure.

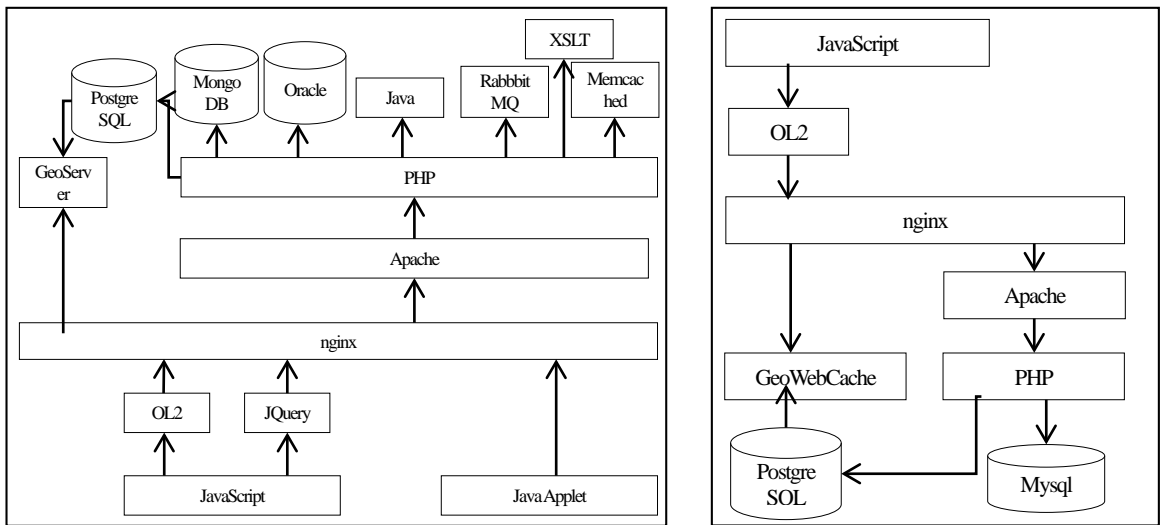


Figure 34 Architecture of the NCS internal-use system (left) and of the NCS open-to-public system (right)

4. Hardware Configuration

NCS is being operated on 15 physical servers. Also, NCS is operated by virtual machines using virtualization technology and is divided into three types of clusters: NCS internal-use cluster, NCS open-to-public cluster, and cluster for data preparation and testing. The virtual machine on each cluster runs scale-up/ scale-out so as to adapt to the operation conditions. Data is saved in storage that has approximately 1,500 TB data capacity in total.

5. Development System

The development system of NCS is shown in the figure below, and several organizations shared the development works and advanced development.

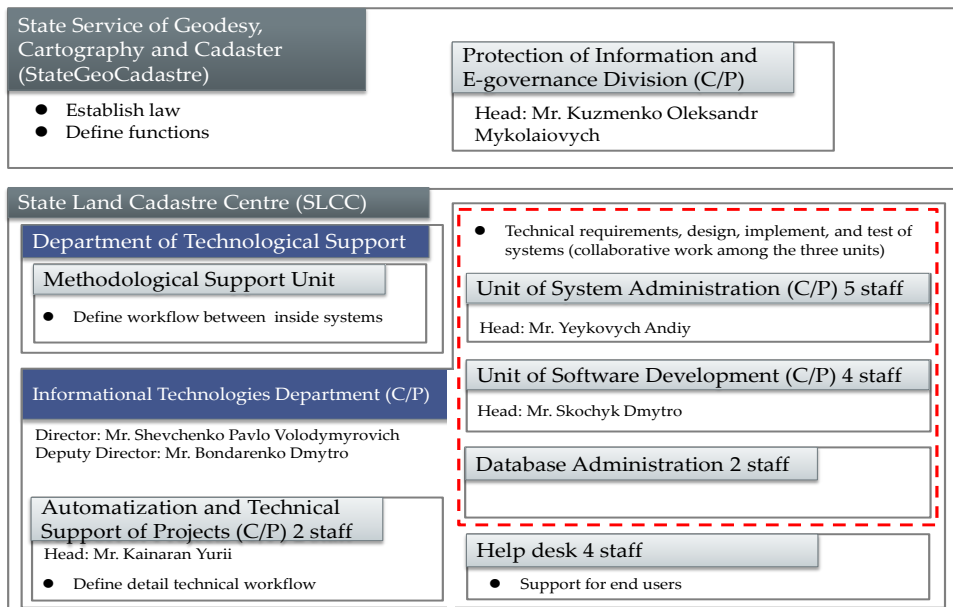


Figure 35 Development Team of NCS

* NSDI Pilot System of Fastiv City

1. Outline of Web System

- It is a system voluntarily developed by the C/P before September 2015. It is not a system that is actually being operated.
- The various forms (paper, digital) of data, such as soil, water, plantation, administrative division, sanitary zone, development master plan, raster data, etc. of Fastiv City were collected and were registered in the system. It is a web service that runs on the browser, and it is possible to refer to the registered information.

2. Software Architecture

The software architecture of Fastiv City NSDI pilot system is basically the same as the GIS part of NCS.

3. Hardware Configuration

Fastiv City NSDI pilot system builds a test environment utilizing a part of NCS's virtual environment infrastructure.

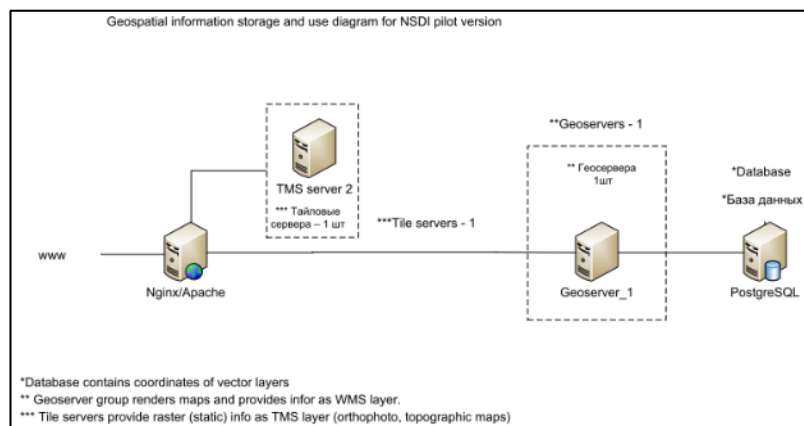


Figure 36 Logical structure of the virtual server in the NSDI Pilot System in Fastiv City

c. Usage policy of existing web services

Based on the results of survey for the existing Web Service, the usage policies on NSDI Prototype System were as follows.

- Establishment of NSDI prototype system will be advanced utilizing Software Architecture of NCS and the NSDI Pilot System in Fastiv City.
- Source of the existing Web services will not be copied; however some logic such as spatial analysis may be used, as necessary.

2) Establishment of NSDI Prototype System

The establishment of NSDI prototype system consisted of development of geospatial information viewer service, clearinghouse, metadata editor and GIS application.

First, the requirements of these system functions were defined, a conceptual design was prepared based on them, and individual NSDI prototype systems were developed. And, the development process and usage of the developed prototype system were analyzed and evaluated from the viewpoint of developers and users.

a. Requirements Definition of NSDI Prototype System Function

The requirements definition of the system function was decided to be carried out in the following workflow.

Procedure 1: Preparing function list by case study

To be a reference for the requirements definition of the system function, a list of functions is prepared as a case study of a system actually being operated (existing NSDI system). A list of functions is prepared from applications and manuals that are in operation.

Procedure 2: Organization of AS-IS task list

The tasks and problems related to geospatial information viewer service, clearing house, metadata editor, and GIS application are investigated and it is organized as AS-IS task list.

Procedure 3: Consideration of TO-BE and NEXT Model

Based on the AS-IS task list, the state of the system that should exist is organized as TO-BE model. Also, the state realized by NSDI prototype is organized as NEXT model.

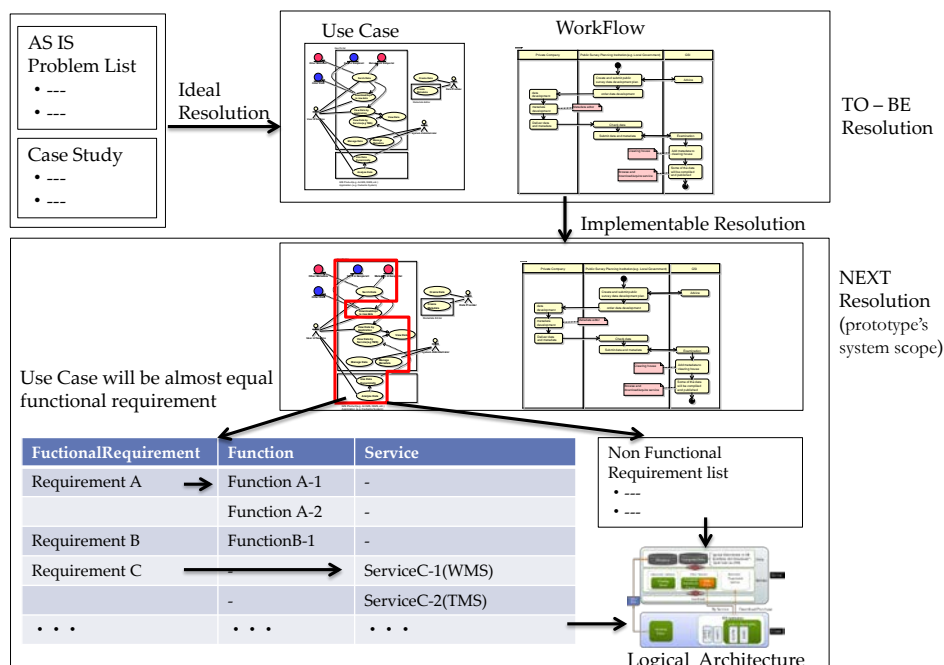


Figure 37 Workflow of Definition of Functional Requirements of the systems

1. Preparing Function List by Case Study

To prepare a function list by case study, the whole picture of Japan Geographical Survey Institute system (GSI Map, Clearinghouse, Metadata Editor, etc.), similar to NSDI prototype system, was explained and the following items that seem to be related to the prototype system were explained at the same time.

- Search function of library of geospatial information
- Structure and search function of clearing house
- How to use the GSI Map
- Fundamental Geospatial Data download service
- Metadata Editor

Based on these explanations, a list for the following system functions as a case study of the system was prepared.

- Geospatial Information Clearing House
- Metadata Editor for a Public survey
- GSI Map

Table 57 Function List of the Clearing House of GSI

ID	Functions
GSIC-1	Metadata search (by free-word)
GSIC-2	Displaying list of the search results (with a page forwards/backwards function)
GSIC-3	Sorting function (by relations, ascending/descending, date)
GSIC-4	Tab page structure (datasets, organizations, groups)
GSIC-5	Organization search (by free-word)
GSIC-6	Filtering function: Organizations, groups, tags, file formats, licenses (multiple-choice is available)
GSIC-7	Displaying Metadata
GSIC-8	Displaying geographical area
GSIC-9	Preview function of Metadata
GSIC-10	Download function of Metadata
GSIC-11	Index map: changing background maps
GSIC-12	Index map: zoom-in/ zoom-out
GSIC-13	Index map: Metadata spatial search

Table 58 Function List of the Metadata Editor of GSI

ID	Functions	Remarks
GSIM-1	Creating Metadata	
GSIM-2	Input mode for basic information	To input the minimum adequate information, including some items of JMP 2.0
GSIM-3	Input mode for detailed information	To input mandatory and optional items of JMP 2.0
GSIM-4	Import function of the survey management file	
GSIM-5	Input support function: inputting coordinates by Web map	
GSIM-6	Displaying Tree-View in the input mode for detailed information	
GSIM-7	Validation function of inputted information (checking function for mandatory items, etc)	
GSIM-8	Printing	
GSIM-9	Saving	

2. Organization of AS-IS task list

Issues and problems for the C/P related to Clearing House and Metadata Editor were investigated and consulted, and the results were organized as AS=IS task list, as follows.

- Even for experts in the geographic information field, it is difficult to find all the necessary data.
- Other agencies are not aggressive in provision or disclosure of the data.
- Since the collapse of the Soviet Union, it has become difficult to provide services for systems that manage

urban planning and topographic maps.

- In large cities (Kiev, Vinnytsia, etc.), the system remains, but in the rural areas, the system is gone, it becomes difficult to search for geospatial information.
- It has not been necessary to prepare metadata so far. However, it is understood that distribution of data can be facilitated by preparing metadata and utilizing Internet technology.

Also, regarding the tasks realized by the geospatial information viewer service, because there is no service that can be evaluated at the present time, it was difficult to identify the tasks. However, technical tasks regarding the following points were raised by the C/P.

- Software Technologies applied
- User Interface
- Service standards adopted for distributing geospatial information (Ex: WMS, TMS)
- How to collaborate with Clearinghouse / Metadata Editor

3. TO-BE Model/NEXT Model

Based on the results of organization of the AS-IS task list, TO-BE (Ideal) and NEXT (Prototype) models were considered. The viewpoints noted in this consideration were as follows.

- Consider roles based on the assumed system users and the perspective of their users.
- Specify the use case (function).
- Consider the scope of the assumed system.
- Consider system users (outerwear) and stakeholders of functions (use cases).
- Adjust from time to time based on new requests and tasks that arise while developing models.

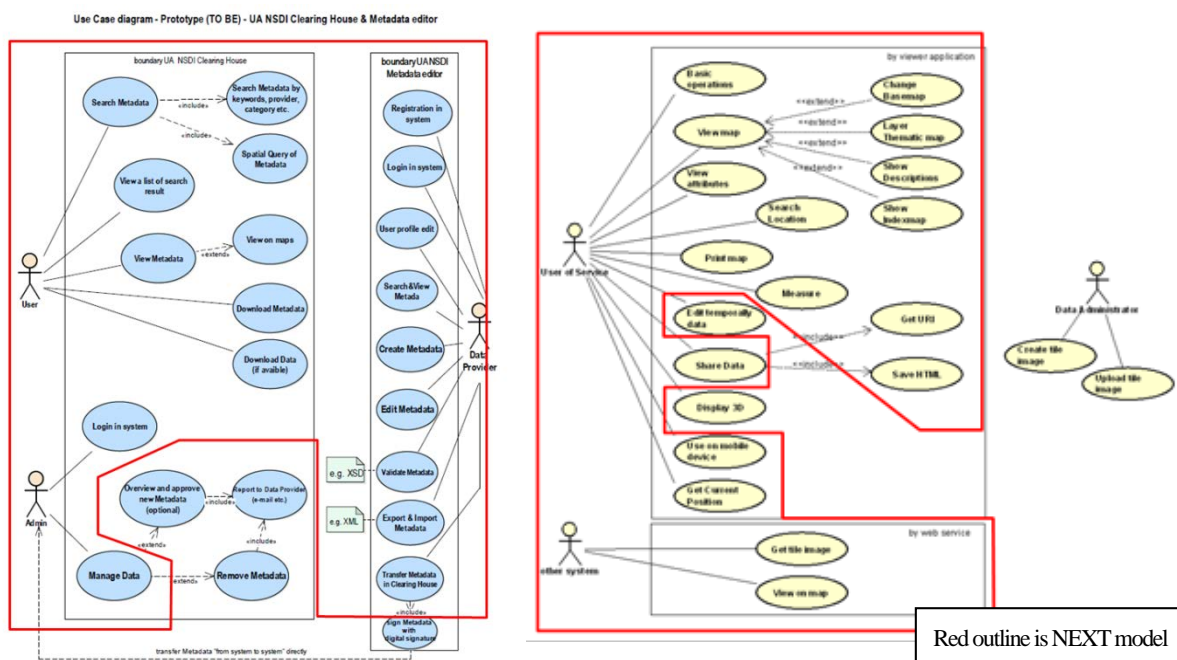


Figure 38 Use-case diagram for Clearing house, Metadata Editor and Geospatial Information Viewer

Based on the NEXT (prototype) model shown in the above use case diagram, the required functions are organized as shown below. With regard to requested functions, it was decided to adjust from time to time based on new requirements that arise while developing models. It was decided to gradually develop the function through prioritizing development. This was done by dividing the function into three types of priority: highest priority (Group A); priority (Group B); and lowest priority (Group C).

Table 59 Functional requirement for Clearing House (NEXT Model)

UKR (Next) Clearing House function list

ID	Group	Fundamental requirements (≅UserCase)	Functionalty	Remarks
UKRCH- 1		Search metadata	Search metadata with free keywords	
UKRCH- 2		Search metadata by keywords, provider, category etc.	Search metadata by keywords, provider, category, creating date, data free/pay status etc.	This “search list” will be based on “future” specifications about the metadata form and details
UKRCH- 3		Spatial query of metadata	On map – spatial query of metadata	
UKRCH- 4		Spatial query of metadata	On map – switch query of base map	
UKRCH- 5		Spatial query of metadata	On map – zoom in and out	
UKRCH- 6		View list of search results	Show list of the search results (multiple page views if there are many results)	
UKRCH- 7		View list of search results	Sort options (relevance, ascending/descending of names, date)	
UKRCH- 8		View list of search results	Filtering by provider, category, date, formats etc (multiple value filtering)	
UKRCH- 9		View metadata	Show metadata	
UKRCH- 10		View metadata	Preview metadata	
UKRCH- 11		View on maps	Show geographic extents of data on maps	
UKRCH- 12		Download metadata	Download metadata	
UKRCH- 13		Download data	Download data (if available)	
UKRCH- 14		Login to system	Login in system like an admin user	Admin user only
UKRCH- 15		Manage metadata	Manage metadata	Admin user only
UKRCH- 17		Delete metadata	Delate (or archive) metadata from Clearing House	Admin user only; Maybe not “Delete “, but “Archive” Metadata

Table 60 Functional requirement for Metadata Editor (NEXT Model)

UKR (Next) Metadata Editor function list

ID	Group	Fundamental requirements (≅UserCase)	Functionalty	Remarks
UKRM- 1		Registration in system	Creat new “Data provider user” account	
UKRM- 2		Login to system	Login in metadata editor like a registered user	

UKRM- 3		Login to system	Password reminder (by email)	
UKRM- 4		User profile edit	Profile overview	
UKRM- 5		User profile edit	Change account password	
UKRM- 6		Search & view metadata	Search metadata with free keywords and create date	
UKRM- 7		Search & view metadata	Show list of the search results (multiple page views if there are many results)	
UKRM- 8		Search & view metadata	Sort options (relevance, ascending / descending of names, date)	
UKRM- 9		Creat / edit metadata	Create new metadata set	
UKRM- 10		Creat / edit metadata	Open early saved metadata set	
UKRM- 11		Creat / edit metadata	Basic input mode	
UKRM- 12		Creat / edit metadata	Detail input mode	
UKRM- 13		Creat / edit metadata	Set metadata set area on map	
UKRM- 14		Creat / edit metadata	On map – switch options of base maps	
UKRM- 15		Creat / edit metadata	On map – zoom in and out	
UKRM- 16		Creat / edit metadata	Input support – drop – down lists for city name etc (optional)	
UKRM- 17		Creat / edit metadata	Save metadata set	
UKRM- 18		Validate metadata	Mandatory or not	
UKRM- 19		Validate metadata	Field type validation (date, integer, string etc)	
UKRM- 20		Export&import metadata	Save metadata on local computer in xml file	
UKRM- 21		Export&import metadata	Import (upload) metadata set in metadata Editor from computer	
UKRM- 22		Transfer metadata	If metadata set is valid and not already transfered – user can transfer metadata set to “Clearing House Adminii” for overview and approval; from Editor to Clearing House system directly	

Table 61 Functional requirements for Geospatial Information Viewer (NEXT model)

ID	Group	Fundamental requirements (≡UserCase)	Functionalty	Remarks
UKRV-1	A	Basic operation	Basic operations with maps	
UKRV-2	A	View Map	Map viewing	
UKRV-3	A	Change base map	Ability to change basic map	
UKRV-4	A	Layer thematic map	Ability to connect and change thematic layers	
UKRV-5	B	Show description	Ability to look at dataset description	With link to Clearing house
UKRV-6	B	Show index map	Ability to show the place where you look at	
UKRV-7	B	View attributes	Viewing of dataset attributes	
UKRV-8	A	Print part of map	Ability to print definite part of the map with displayed data on it	
UKRV-9	A	Measure tools on map	Set of standard tools for measuring (distance, area)	
UKRV-21	B	Search Location	Search address by Geocoding database	With Google Maps Geocoding API
UKRV-10	B	Share Data	Information sharing	
UKRV-12	C	Save in some digital format	Saving information in some digital format	
UKRV-13	C	Use on mobile devices	Ability to use Geospatial Information Viewer on mobile devices, such as smartphone, iPad, etc.	Provided by using responsive design of user`s interface

UKRV-14	C	Get current user position	Function of automatic position-finding within Geospatial Information Viewer.	
UKRV-15	C	Login in system (Optional)	Authorization in system.	
UKRV-18	B	Get tile image	Share map tile to external systems via TMS, WMS	External systems (services)
UKRV-19	B	View on map	Show other map (e.g. google maps, open street map) via service	External systems (services)
UKRV-20	C?	Put user marker on map	Put user marker on map	Login user only. The maker is stored in server.

*** System Requirements Definition of GIS Application**

Regarding the GIS application, as a result of consultation with the C/P, instead of developing a new function, it was decided to prepare a document for analyzing with NSDI data utilizing ArcGIS or open source software QGIS, owned by C/P.

b. Conceptual design of NSDI prototype

Based on the results of existing Web services survey, existing Web service utilization policy and the results of the definition of the requirements of existing Web service, the conceptual design of Clearinghouse, Metadata Editor, Geospatial Information Viewer Service and GIS Application was implemented.

*** Logical architecture (Services composing NSDI, Relationship among Services, and Interface)**

Since multiple services were planned to be developed in the NSDI prototype system establishment, a logical architecture diagram that clarifies the overall image of services realized from multiple services and the relationship between services was prepared.

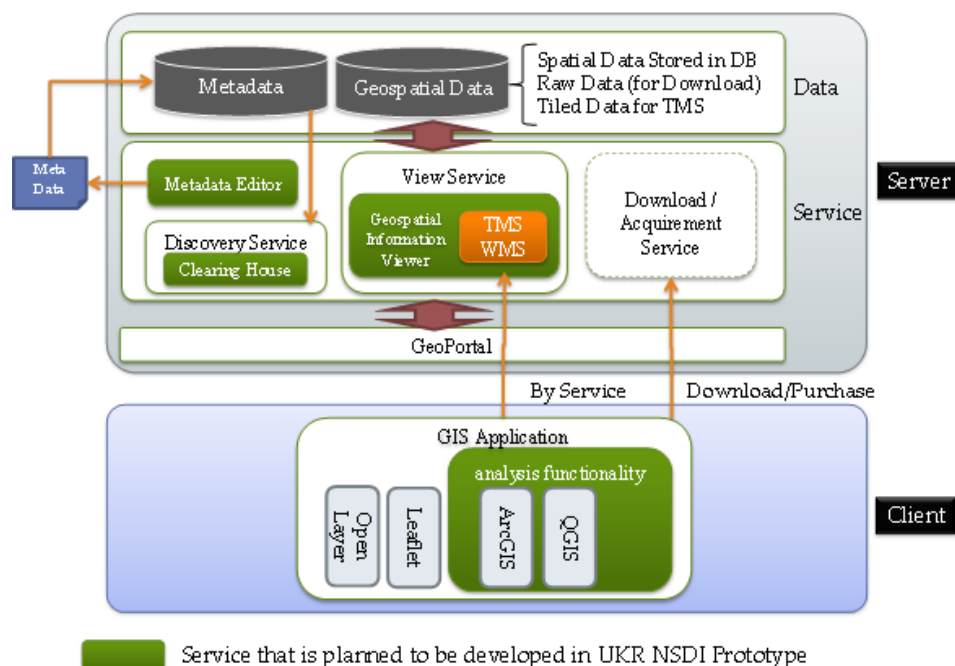


Figure 39 Logical architecture

*** Technical architecture (method to realize each service and technology to be adopted)**

Following the logical architecture, the ways of realizing specific services and the techniques to be adopted were examined showing candidate methods and techniques.

In the examination of the technical architecture of the geospatial information viewer service, GSI maps, Japanese civic services distributing geospatial information and NCS architecture were targeted. As a result of examination, it was decided to proceed with development based on the architecture of NCS.

In the examination of the technical architecture of the clearing house, from the viewpoint of its frequency of use and open source use, GeoNetwork (<http://geonetwork-opensource.org/>), CKAN (<http://ckan.org/>) and the European Open Source Metadata Editor (EUOSME) were targeted. As a result of examination, for the following reasons, it was decided to proceed with development based on GeoNetwork.

- In GeoNetwork, many of the requirement definitions of the system are implemented as the default function, making it is possible to more easily satisfy the requirement definitions.
- Since it has a metadata editor function, there is no need to develop clearinghouse and metadata editor separately.
- It conforms to ISO and INSPIRE standards by default.
- It is confirmed by the European Development Committee (JRC: Joint Research Center <https://ec.europa.eu/jrc/en>) that the affinity with the EU's Clearing House is high.

Based on the above examination results, it was decided to develop it based on the following technical architecture.

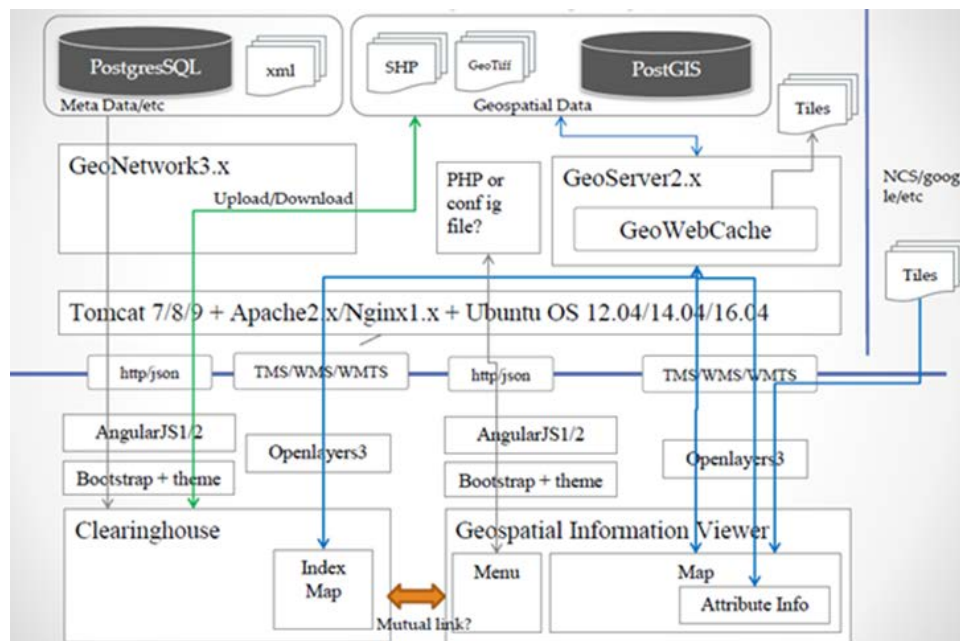


Figure 40 Technical architecture

c. NSDI Prototype System Development

* Developmnt of Geospatial Information Viewer Service

The development of Geospatial Information Viewer Service was implemented based on the results of the

requirement definitions related to the prototype system functions.

- System Development

It was developed based on the function decided by the requirement definitions of the prototype system function. The results of each function development were as follows.

Table 62 Results of Geospatial Information Viewer development

ID	Group	Functional requirements (≡Use Case)	Status
UKRV-1	A	Basic operation	Done
UKRV-2	A	View Map	Done
UKRV-3	A	Change base map	Done
UKRV-4	A	Layer thematic map	Done
UKRV-5	B	Show description	Done
UKRV-6	B	Show index map	Done
UKRV-7	B	View attributes	Done
UKRV-8	A	Print part of map	Done
UKRV-9	A	Measure tools on map	Done
UKRV-21	B	Search Location	Done
UKRV-10	B	Share Data	Done
UKRV-12	C	Save in some digital format	Done
UKRV-13	C	Use on mobile devices	Done
UKRV-14	C	Get current user position	Done
UKRV-15	C	Login in system (Optional)	Done
UKRV-18	B	Get tile image	Done
UKRV-19	B	View on map	Done
UKRV-20	C	Put user marker on map	Not Done

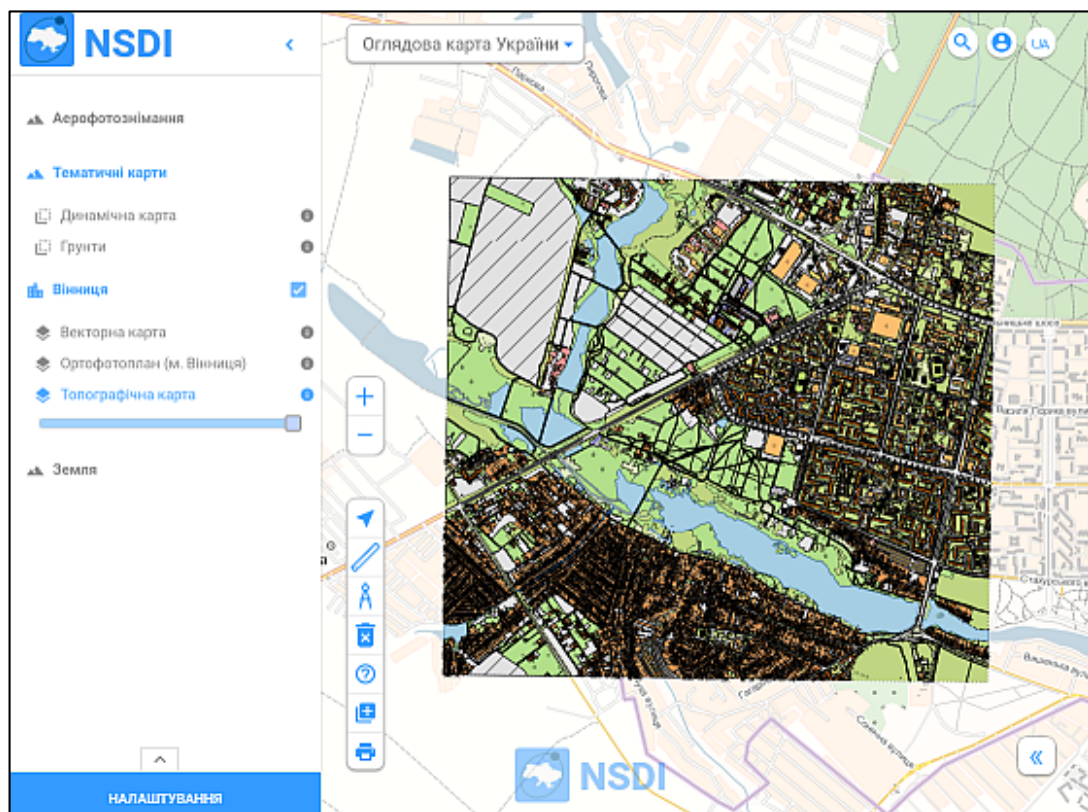


Figure 41 Screen Image of Geospatial Information Viewer

- Environment construction/Data loading

The environment of the geospatial information viewer service was set up and installation of the following data was advanced.

1. Background picture

The data shown in the following table was installed as a background picture. Also, GoogleMaps and OpenStreetMap became available as background pictures.

Table 63 Background data for Geospatial Information Viewer

Background data name	Overview
Orthophoto	Orthophoto which was developed as a prototype of fundamental geospatial data.
Topographic Map	Vector data which was developed as a prototype of fundamental geospatial data.

2. Thematic Map

The vector data trialed that was prepared by the data examination team was loaded.

* Clearing House Development

- System development

The environment of the GeoNetwork was set up and the following function was customized.

Table 64 Development and customization of Clearing House

Development and customization item	Overview
Response to Ukrainian language	Translating GeoNetwork user interface into Ukrainian.

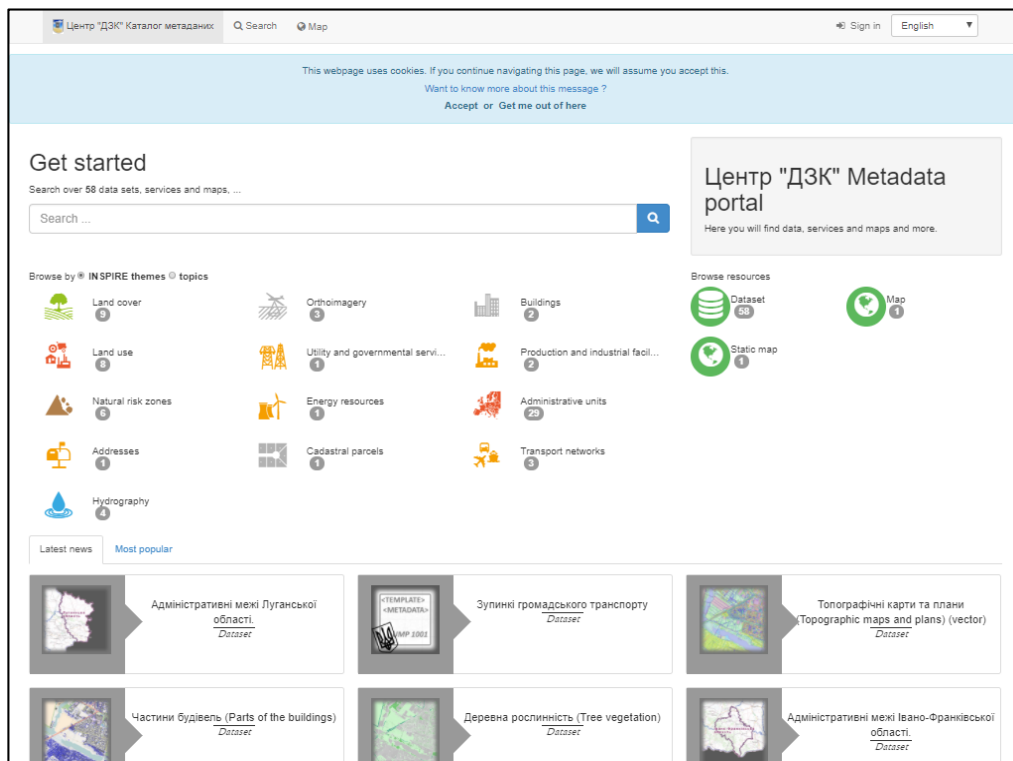


Figure 42 Screen Image of Clearinghouse

- Environment construction/Data loading

Using a metadata editor that is advancing development together with the clearinghouse, the loading of metadata are carried out on the C / P side.

*** Metadata Editor Development**

• System Development

The environment of the GeoNetwork was set up and the function was customized.

Table 65 Development and customization of Metadata Editor

Development and customization item	Overview
Development of UMP (Ukraine Metadata Profile) Template	Metadata template for inputting metadata of UMP standard, which was considered by the geospatial standardization team, is developed.

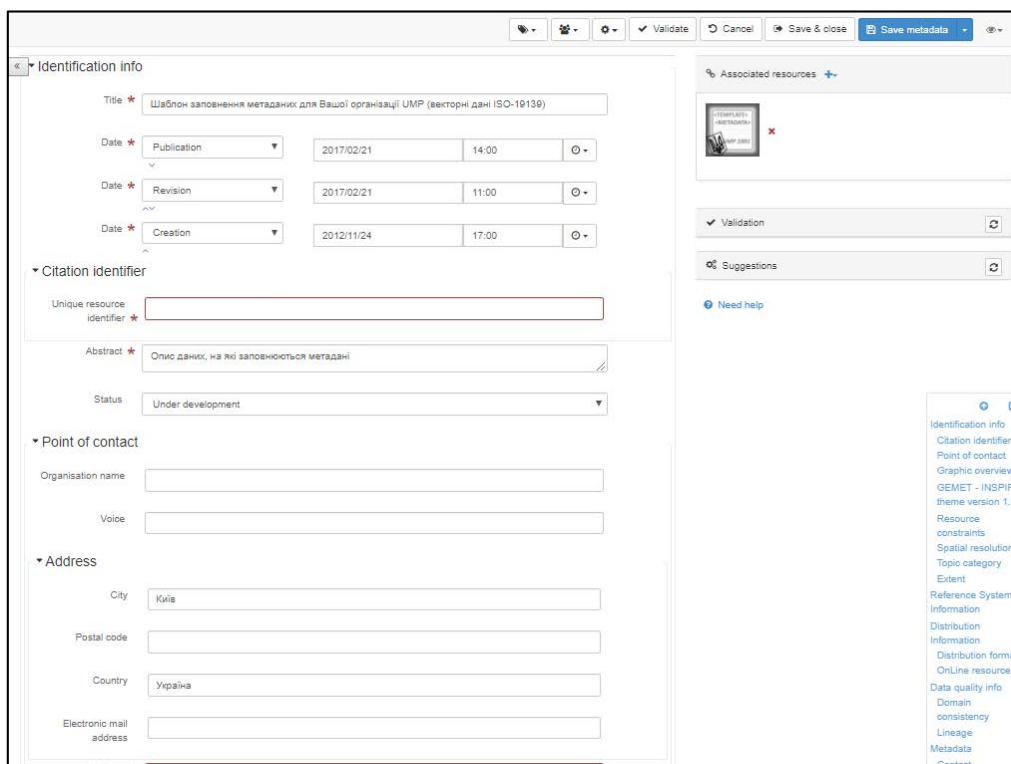


Figure 43 Screen Image of Metadata Editor

• Environment construction/Data loading

The workshop for a metadata loading was held and the trial of data loading using metadata editor was carried out.

*** GIS Application Development**

To prepare the document of the analysis case, a workshop for case studies was held and the candidates of the analysis cases shown below were organized. Also, it was developed to access the data loaded on the geospatial information viewer service via the service interface of WMS/TMS.

Table 66 Candidate for analysis case

Layer for analysis	Analysis case
Vegetation	Classify layer using type of the vegetation and allow producers of food to receive information on the optimal location to cultivate fruits and other crops.

Layer for analysis	Analysis case
Boundaries of Administrative Units	Classify areas by yield of crops. Yield information is available from State Statistics Service of Ukraine.
Boundaries of Administrative Units	Classify areas by population. Information about population is available from State Statistics Service of Ukraine.
Roads	Classify roads by pavement.
Ponds (Water bodies) and Land (LandParcel)	Display if ponds are leased or not.
Buildings	Classify buildings by type of material which they were constructed with to consider priority of actions for natural disasters (fires).
Hydrographic objects and DEM	Visualize flood zones to consider priority of actions for natural disasters.

3) Analysis/ Evaluation of NSDI Prototype System

a. Development Results of NSD Prototype Systems

It was confirmed whether the defined requirement functions were implemented in the developed NSDI prototype systems.

* Geospatial Information Viewer Services

It was confirmed that the requirement definition terms shown in Table 54 were implemented, except UKR-20. And since the requirement of UKRV-20 was low in implementation priority and it was a supplementary user service function, it was judged that it would be appropriate to implement it as a programming exercise when there was time.

* Clearinghouse/Metadata Editor

It was confirmed that the requirement definitions of Clearinghouse/Metadata Editor, shown in tables 52 and 53, were implemented by successfully modifying the GeoNetwork, an open source application with a proven track record.

* GIS Application

Since the system part of GIS application was WMS/TMS of Geospatial Information viewer Service, it was confirmed that the analysis documents (Usage explanation document including analysis example using QGIS) described in the requirement definitions were prepared.

b. Performance Evaluation of NSDI Prototype System

The performance of the developed NSDI Prototype System were evaluated.

* Speed Test of Web Loading

The speed test of Web loading was carried out using Pingdom Web Speed Test—a speed test tool on the Web—and GT metrix. As shown in the following table, the results of test expressed the good evaluation relatively.

Table 67 Results of Speed Test for Web Loading

Test Objects	Tool	Measurement Point	Loading Time	Evaluation
Geospatial Information Viewer Service	Pingdom	Stockholm	1.48 sec	A (91)
	GTmetrix (YSlow)	Vancouver	5.00 sec	B (80%)
Clearinghouse (GeoNetwork)	Pingdom	Stockholm	1.13sec	B (83)
	GTmetrix (YSlow)	Vancouver	14.70sec	B (84%)

* Vulnerability test of System

The vulnerability test of system was carried out using a vulnerability test tool, ZAP. ZAP tests the vulnerability by attacking the system in practice, as well as giving countermeasure tips. The results of test were as follows.

Table 68 Results of Vulnerability Test (Viewer)

Geospatial Information Viewer	
Risk Level	Vulnerability detection count
High	0
Medium	1
Low	6
Informational	0

Table 69 Results of Vulnerability Test (Clearinghouse)

Clearinghouse	
Risk Level	Vulnerability detection count
High	0
Medium	4
Low	9
Informational	0

- Vulnerability of Geospatial Information Viewer

One count of medium risk level was detected. Six counts of low level risk were detected, but these were not serious. It is easy to correct.

- Vulnerability of Clearinghouse

Four counts of medium risk level were detected, and it was easy to take measures for two of them. It was a little difficult to take measures for the detected vulnerability of the compiler that prepared executable files.

Regarding the low risk level, it was not serious and it was easy to correct.

c. Usability Evaluation

The User Test (Survey of weakness of system operation) and the Usability evaluation (System affinity survey) were carried out targeting Geospatial Information Viewer Service and Clearinghouse. The surveys were implemented in the workshop of NSDI prototype for the related agencies.

* User Test

The user test was to measure the completion rate of the following works corresponding to each system within a limited amount of time.

- Work 1 : Identify a Geospatial Information Data, and search the identified data using Clearinghouse and download the data.
- Work 2 : Identify a Geospatial Information Data and display the identified data with Viewer. Connect to the clearinghouse through the Link of the displayed data, and download the data.

Works 1 and 2 were divided into 3 steps and 5 steps respectively and the work completion rates for each step were collected, and the final completion rate of works 1 and 2 were collected.

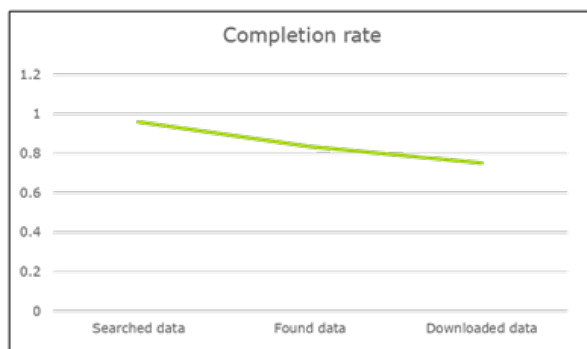


Figure 44 Aggregate Results of Work 1

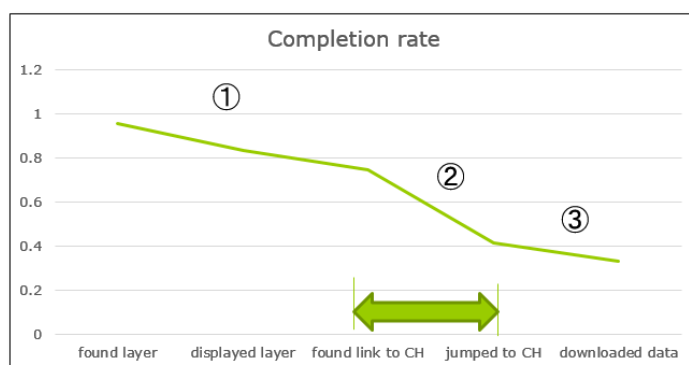


Figure 45 Aggregate Results of Work 2

- The incomplete rate of each step of Work 1 were almost constant at approximately 10.4% and the final completion rate was 75%.
- The incomplete rate of each step of Work 2 were 10.4% (step 1), 33.4% (step 2), 8.3% (step 3) with a little difference and the final completion rate was 33.0%.

Based on the results, it was clear that the cooperation between the geospatial information viewer service and the clearinghouse had weak points. The fact was to be reflected on the system improvements.

*** Usability Survey**

The usability survey was implemented by a questionnaire form.

In the questionnaires, the evaluation in 10 steps were carried out for 7 evaluation elements related to the the users' affinity with the developed systems.

The results of the survey were as follows.

Table 70 Survey Results of Usability (Questionnaire Survey)

Evaluation Factor	Targeted Evaluation	
	Clearinghouse	Geospatial Information Viewer
1. Favorability rating	5	5
2. Feeling of use	7	7
3. Reliability of content	4	4
4. Easy to understand operation	4	3
5. Easy to understand configuration	4	4
6. Easy to read	8	7
7. Good response	8	8

In the interpretation of the results, it was necessary to pay attention to the following points.

- Those targeted in the questionnaire were complete beginners at using the developed NSDI prototype system, and the only operation experience they had was during the explanation of operation method implemented just before the questionnaire and the limited time during the user test.
- Depending on the evaluation factor, there was a possibility that a negative bias may affect the results of the user test performed immediately before.

Taking the above important points into consideration, it is difficult to evaluate the evaluation factor 3. Also there is a possibility that a negative bias may affect evaluation factors 1, 4 and 5. On the other hand, evaluation factors 2, 6 and 7 do not target important points.

Based on the above, it was assessed that the developed prototype system was easy for users to read, and had a good response and feeling of use.

3.2.5 Implemented Results of Capacity Development of C/P and Related Agencies

The following Project activities were undertaken: three seminars, three technical cooperations with the operation guidance study team for capacity building of C/P, three training trips to Japan, one international conference attendance, and capacity building works related to NSDI establishment and operation for related agencies.

(1) Seminar

Seminar for publicizing the Project and announcing the results of the Project, and the seminars for NSDI S/C, W/G pre-meeting were held.

1) 1st seminar held

The first seminar was held for C/P agencies and organizations related NSDI with the aim of widely recognizing the outline of the Project, NSDI's efforts and its effectiveness in Japan.

The 1st seminar got about 100 participants on October 9, 2015 in the next program and was carried out in Kiev.

Table 71 Program of the first seminar

Topic	Presenter	
1. Opening Address	Mr. Maksym Martyniuk	Chairman of SSGCC
2. Welcome Address	Ms. Hiromi Nakano	Japanese Embassy in Ukraine
3. Importance of Geographic Information: Case Study in Ukraine	Mr. Dmytro Makarenko	Acting Project Manager SSGCC
4. Outline of Project	Mr. Akira Nishimura	JICA Project team Team Leader
5. Pilot Project	Ms. Alla Kovalova	SLCC
6. Case Study in Japan	Mr. Keiji Yamada	JICA Project team
7. Q&A Session		
8. Closing Remarks	Mr. Maksym Martyniuk	Chairman of SSGCC

By holding the 1st seminar, it was realized to share the outline of the Project and the outline of NSDI construction and operation in Japan with C/P and related organizations. In addition, the importance and the usability of NSDI were understood. Furthermore, an article on the seminar was also published in related magazines.

2) 2nd Seminar held

The 2nd seminar was held with the aim of widely recognizing and understanding NSDI activities in the Project, including a call for expressions of intention to establish the S/C, which plays an important role in the establishment and operation of NSDI.

The 2nd seminar got about 150 participants on November 9, 2016 in the next program and was carried out in Kiev.

Table 72 Program of the second seminar

Topic	Presenter	
1. Opening Address	Mr. Maksym Martyniuk	First Deputy Minister of Agrarian Policy and Food of Ukraine
2. Welcome Address	H. E. Mr. Shigeki Sumi	Ambassador of Japan to Ukraine
3. Video Appeal	Mr. Mick Cory	General Secretary and Executive Director of Eurogeographics
4. INSPIRE Towards European SDI	Mr. Vlado Ceyel	Technical Project Officer Unit for Digital Economy, JRC, European Commission
5. Coordination Committee for NSDI in Japan	Mr. Hidenori Fujimura	Head of International Affairs Division. Geospatial Authority of Japan
6. Experience of Poland in Establishment of Coordination Framework for NSDI	Mr. Dominik Kopczewski	Head Office for Geodesy and Cartography of Poland
7. NSDI in Norway	Mr. Helga Onsrud	Head of International Relations, Norwegian Mapping Authority
8. Benefits for data holders from NSDI operation and data sharing	Mr. Andrew Coote	Director at Consultingwhere Ltd, United Kingdom
9. JICA Project on NSDI Creation in Ukraine	Mr. Akira Nishimura	JICA Project Leader
10. Draft Law and concept for NSDI Creation in Ukraine	Mr. Oleksander Maliuk	Director of Department for Topography, Geodesy and Cartography, State Geo Cadastre
11. Open Session (Q&A session)		
12. Closing Remarks	Mr. Oleh Tsvia	Acting Chairman of State Geo Cadastre

In the 2nd seminar, it was widely recognized that S/C and W/G, which are indispensable for the establishment and operation of NSDI, would be officially established. And at the same time the contents of NSDI activities in each country were shared among participants. Also, because there were many participants from the related organization that are supposed to composing S/C, It was realized to deepening understand NSDI establishment/operation.

3) 3rd Seminar

The 3rd seminar was held with the aim of widely recognizing and understanding the processes/results of the Project, the actual status of the concepts of the policies of SDI in countries and NSDI to promote to realize the NSDI establishment/operation, and NSDI application.

The 3rd seminar got about 150 participants on February 22, 2018 in the next program and was carried out in Kiev.

Table 73 Program of the third seminar

Topic	Presenter	
1. Opening Remarks	Mr. Maksym Martyniuk(Proxy)	First Deputy Minister of Agrarian Policy and Food of Ukraine
2. Opening Remarks	H. E. Mr. Shigeki Sumi	Ambassador of Japan to Ukraine
3. Opening Remarks	Mrs. Liudmyla Shemelynets	First Deputy Chairman of State Service of Ukraine for Geodesy, Cartography and Cadastre

Topic	Presenter	
4. Opening Remarks	Mr. Takaaki Kawano	JICA Residents Representative in Ukraine
Session 1. INITIATIVES OF NSDI ESTABLISHMENT IN UKRAINE:		
5. JICA Project on NSDI Creation in Ukraine	Mr. Akira Nishimura	JICA Project Leader
6. Prototype of National Spatial Data Infrastructure in Ukraine	Mr. Oleksandr Maliuk	Director of Department for Topography, Geodesy and Cartography, StateGeoCadastre
Session 2. GEOSPATIAL POLICY ON PAN=EUROPEAN LEVEL		
7. Geospatial Policy and Representation of Eurogeographics	Mr. Dominik Kopczewski	Chair of Policy Knowledge Exchange Network, Eurographics
8. Activities of UN GGIM Europe regarding geospatial data management	Mr. Tomaz Petek	Member of UN=GGIM: Euro Executive Committee
9. Development of European Location Service	Mr. Saulis Urbanas	Services Development Consultant, Eurogeographics
SESSION 3. SDI INITIATIVES AND TECHNOLOGICAL SOLUTIONS FOR BETTER GOVERNANCE IN CENTRAL EUROPE		
10. INSPIRE implementation: how it was done in Poland?	Mr. Grazyna Kierznowska, Ewa Surma	Head Office for Geodesy and Cartography of Poland (GUGIK)
11. Implementation of INSPIRE in Germany	Mrs. Dr. Ing. Anja Hopfstock	Member of the Coordination Office SDI Germany, Federal Agency for Cartography and Geodesy
12. NSDI implementation in Slovenia	Mr. Tomaz Petek	Survey and Mapping Authority of Republic of Slovenia
13. New information technologies in the land management in France	Mr. Robert Levesque	Director of National Federation SAFER
SESSION 4. SDI EXPERIENCE: NORTH EUROPE, BALTIC & JAPAN		
14. Experience of Norway in establishment and utilization of NSDI	Mr. Helge Onsrud	Director of International Services, Norwegian Mapping Authority (Kartverket)
15. Cooperation and Sustainability are pillars for a successful SDI in Sweden	Mr. Peter Wasstrom	Head of International Services Department Swedish Mapping, Cadastral, Land Registration Authority (Landmatriat)
16. Policy Report on the Spatial Data Infrastructure in Finland	Mr. Pekka Halme	Director for Strategic Development, National Land Survey of Finland
17. Latvian Geospatial Information Agency and its role in National Geospatial Information Infrastructure of Latvia	Colonel Martin Liberts	Director of Latvian Geospatial Information Agency
18. NSDI/Standards of Geospatial Information in Japan	Mr. Jun Sato	Geospatial Information Authority of Japan (GSI)
SESSION 5. SDI DEVELOPMENT: PERSPECTIVE FROM EAST EUROPE & BALCAN		
19. Development of Spatial Data Infrastructure in Moldova	Mrs. Maria Ovdii	Director of Topography and Geodesy Department Land and Cadastre Agency of Moldova
20. Geospatial data in state informational systems of state land cadaster in Belarus	Mrs. Marina Litreva & Mrs. Aksana Pavliukevich	Head of GIS Department of State Enterprise "National Cadstral Agency" / Head of GIS Division of Project Institute "Belgiprozem"
21. SDI in Croatia: shifting from NSDI 1.0 to NSDI 2.0	Mr. Tomislav Ciceli	Head of Spatial Data Infrastructure Division State geodetic administration of Croatia

Topic	Presenter	
22. NSDI in Romania: Status of implementation	Mr. Constantin Ene & Mrs. Adriana Poggi	Director of Geographic Information Systems Directorate / Head of International Relations Department National Agency for Cadastre and Land Registration of Romania
23. Closing Remarks	Mr. Oleksandr Kolotilin	Acting Chairman of State Geo Cadastre

In the 3rd seminar, the results of the project and the policies and contents of NSDI in each country were widely shared, and the results of 3rd seminar became the initiator of the establishment and operation of NSDI in Ukraine and at the same time, the policies of future activities by SSGCC and SLCC which are a real Key-player of NSDI establishment and operation were confirmed.

(2) Cooperation with Operation Guidance Study Team

The operation guidance study team conducted collaborative activities in Kiev three times with the aim of introducing, explaining and lecturing activities in Japan related to the establishment and operation of NSDI.

1) 1st Cooperation with Operation Guidance Study Team

a. Study Team Activity

In December 2015, lectures and presentations were given to SSGCC and SLCC officials on the background, outline and legal framework of the NSDI law of Japan, the NSDI data prepared and its application method.

Furthermore, the lecture and the presentation about the position of the Geospatial Information Authority of Japan as the role of the administrative organ of geospatial information based on the NSDI Act, the specifications, the preparation and the publication method of the fundamental geospatial data prepared based on the Law, and the Geospatial Library as the promotion activities of utilization of NSDI data, were given.

After each lecture / presentation, questions such as affiliation and use purpose of the copyright of the prepared NSDI data, economic effect of the data preparation, preparation/revision costs and detailed specifications and update interval of fundamental geospatial information and its cost, etc., were explained.

It was recognized that the degree of understanding of lectures and presentation contents on C/P side was high and the interest in NSDI construction / operation was high. As a result, C/P understand the importance of NSDI Act in NSDI establishment/operation, the preparation method of NSDI data and the outline of application method of NSDI data and at the same time C/P recognized the roles of management organization of geospatial information in NSDI.

b. Pilot Area Visitation

In December 2015, Operation Guidance Study Team visited Vinnytsia District, a pilot area, and made a courtesy visit to Vinnytsia City Hall in the center of the pilot area. And Operation Guidance Study team exchanged opinions with the city officials on sharing of NSDI data after its preparation.

2) 2nd Cooperation with Operation Guidance Study Team

a. Study Team Activity

At the 2nd seminar in November 2016, a presentation was given about the content and establishment process of

NSDI related Acts in Japan, and the composition, the organizational structure and the actual status of S/C based on NSDI Act. In addition, in the same month, the legal background related to promotion of NSDI in Japan, the organizational structure (S/C and W/G of NSDI) and its roles as a promoting organization of NSDI, and its promotion cases were introduced to staff of SSGCC, SLCC and related organizations. Furthermore, the role of the Geospatial Information Authority of Japan in the promotion system, that is, the development of spatial information infrastructure and provision and utilization of geospatial information in emergencies such as in case of a disaster were introduced.

As the activities results, it was deepening to understand organization composition and mission of S / C as organization for promoting NSDI.

b. Participation of TAIEX NSDI Conference by EU

The operation guidance study team participated in the workshop on geospatial data infrastructure development strategy of TAIEX (Technical Assistance Information Exchange Instrument of the European Commission) held on November 10 and 11, 2016. In the workshop, the actual state of NSDI establishment and operation of the EU countries (Sweden, Croatia, Germany) was reported, and the operation guidance study team specified its contents as reference points for teaching on establishment and operation of NSDI in Ukraine.

3) 3rd Cooperation with Operation Guidance Study Team

In February 2018, lectures and presentations were given to SSGCC officials on the current conditions of NSDI establishment/operation in Japan and the roles of GSI (Geographic Information Authority of Japan) for a future NSDI activities in Japan.

As a results, the actual condition of the establishment and the utilization of NSDI in Japan are reconfirmed and at the same time, the role of the organization that manages the geospatial information in the future NSDI was recognized.

Also, in the 3rd seminar of February 2018, the presentation of the dissemination of NSDI/Geographic Information Standards in Japan were given, and the actual status of NSDI activities in Japan are shared among the related parties. Ukraine received positive reaction and support for the establishment/dissemination of NSDI.

(3) Implementation of Counterpart Training in Japan

Three trips to Japan for Counterpart Training were implemented for C/P Agencies with the aim of giving the C/Ps an understanding of the actual situation of NSDI establishment and operation in Japan, and for them to then utilize this knowledge in the establishment and operation of NSDI in Ukraine.

1) 1st Counterpart Training in Japan

The 1st Counterpart Training in Japan was implemented from 4th April, 2016 for 11 days.

a. Objective of the counterpart training in Japan

Objectives of the 1st counterpart training in Japan were to understand practical activities of NSDI establishment and operation in Japan through experience of lectures and fieldworks.

b. Participants of the counterpart training in Japan

The participants were the following eight members.

SSGCC	: 3 persons
SLCC	: 2 persons
RIGC	: 2 persons
Vinnytsia City Office	: 1 person

c. Overview of the training

The counterpart training in Japan was implemented at the following institutes by lecture and inspection tour in accordance with the objectives. In addition, a lecture about 'concept of NSDI' was held at the beginning of the training for re-confirmation of concept of NSDI.

- Ministry of Land, Infrastructure, Transport and Tourism, National Spatial Planning and Regional Policy Bureau : Overview of cadastral survey and GIS using NSDI data in aforementioned organizations
- Ministry of Internal Affairs and Communication, Statistics department : Overview of statistical GIS using NSDI data which are operated by Statistics department
- Statistics centre : Overview of Statistics GIS using NSDI data
- Geospatial Information Authority of Japan (GSI): NSDI Act in Japan, overview of the Fundamental Geospatial Information and GSI map which is open to public. Fieldwork of facilities in GSI
- Institutes related to Geographic Information Standards : Overview of Standardization system. History of Geographic Information Standardization in Japan. Technical certificates system of Geographic Information Standards
- Local municipality : Overview of the Integrated GIS using NSDI data in Urayasu City
- Private firm : Current status of private firm addressing NSDI
- Ministry of Internal Affairs and Communications : Current status of local municipality addressing NSDI

d. Implementation results of the training

For the objectives of the training mentioned above, there were various training institutes. Since the background of the trainees was diverse as well, they attentively listened to the lectures and discussions were very active with many questions from the trainees, and it was evaluated that certain results were achieved (It was important results that the actual conditions of NSDI establishment/operation that was studied in the lectures and the presentations were acquired.). As for background of the enthusiastic questions and participation by the C/Ps, it is assumed that contents of the training were directly or indirectly related to their duties of NSDI in Ukraine.

2) 2nd Counterpart Training in Japan

The 2nd Counterpart Training in Japan was implemented from 5th December, 2016 for 11 days

a. Objective of the counterpart training in Japan

Objectives of the 2nd counterpart training in Japan were to gain an understanding of the trends of ICT technology related to NSDI establishment/operation in Japan.

b. Participants of the counterpart training in Japan

The participants were the following eight members.

SLCC : 5 persons

RIGC : 2 persons

Vinnytsia City Office : 1 person

c. Overview of the training

The counterpart training in Japan was implemented at the following institutes by lecture and inspection tours in accordance with the objectives. In addition, a lecture about ‘concept of NSDI (2)’ was done at the beginning of the training for re-confirmation of concept of NSDI.

- Geospatial Information Authority of Japan : Providing System of various Geospatial Information, System of Preparation/Updating of Fundamental Geospatial Data, and Outline of and Tour of inspection of its facilities of Geospatial Information Authority of Japan
- NSDI Promotion Agency : Promotion of ICT platform establishment in a local government
- Research Institute : Activities of Centre for Spatial Information Science
- Local Government : Outline of Regional Integrated GIS using NSDI data in Mie Prefecture
- Private Sector : Actual status of Positioning Information Business, Actual status of Web Mapping Technologies and its Business, Actual status of Integrated GIS for Public Administration, Development of Integrated GIS for Public Administration, Actual status of Measures related to Geospatial Information, G-spatial platform and G-Space

d. Implementation results of the training

The trainings were mainly carried out in the private sector related to NSDI establishment/operation actually based on the objectives of training and the job contents of the abovementioned trainees (engineers who mainly do practical work on NSDI establishment/operation).

In each training, the trainees understood how NSDI establishment/operation works in Japan are carried out in practice based on their experience of its actual work. And they understood the actual status and the trends of private sector business in NSDI establishment/operation of Japan from the view point of IT technology. In the training besides that at private sector companies, the newest technical trends and the measures of Japan related to the application of ICT technologies in NSDI establishment/operation were gained.

3) 3rd Counterpart Training in Japan

The 3rd Counterpart Training in Japan was implemented from 12th December, 2017 for 10days

a. Objective of the counterpart training in Japan

Objectives of the 3rd counterpart training in Japan were to grasp the trends of NSDI establishment and operation entities (including collaboration with relevant organizations), and to introduce NSDI's utilization.

b. Participants of the counterpart training in Japan

The participants were the following eight members.

SSGCC : 2 persons

SLCC : 4 persons

RIGC : 2 persons

c. Overview of the training

The counterpart training in Japan was implemented at the following institutes by lecture and inspection tours in accordance with the objectives. In addition, a lecture about ‘concept of NSDI (3)’ was done at the beginning of the training for re-confirmation of concept of NSDI.

- * Geospatial Information Authority of Japan : Promotion measures of Basic Act on the advancement of Utilizing Geospatial Information, System of Preparation/Updating of Fundamental Geospatial Data, Outline of GSI Map, and Outline of and Tour of inspection of its facilities of Geospatial Information Authority of Japan
- * Japan Association of Surveyors, Japan Map Center: Quality Control and Supply/Deliver of Geospatial Information as a base of NSDI utilization
- * Local Government, etc.: Outline of Wide Integrated GIS using NSDI data in Ichinomiya city in Gifu Prefecture/Kumamoto city in Kumamoto Prefecture, and Actual condition of utilization of Geospatial information in Road Management Center
- * Research Institute: Collaboration efforts of Geospayial information utilization related to disaster privention in Kyusyu University, and Research of Spacial Information Science (G - Spatial Platform) in Association for Promption of Infrastructure Geospatial Information Distribution

d. Implementation results of the training

Objectives of the counterpart training in Japan were to grasp the trends of NSDI establishment and operation entities (including collaboration with relevant organizations), and to introduce NSDI's utilization, and the NSDI's utilization was targeted mainly. For this point, it can be evaluated that for Ukraine, which is going to prepare and utilize NSDI data from now on, it has become a reference to practical examples of utilization. Furthermore, the real experiences of the practical utilization were meaningful for motivating NSDI construction.

Also, the trainings related to NSDI establishment and operation in GSI showed a good example how the organization as same as GSI in Ukraine, to which the trainee belongs, carries out activities (planning/implementation of promotion measures, preparation/publishing of NSDI data) in NSDI establishment and operation., and it can be evaluated that it has become meaningful to them.

Furthermore, the participants expressed to hold a reporting meeting of the training results in Ukraine and to reflect it on the activities of S/C to be established.

(4) Attendance at International Conference

For the purpose of publicizing the Project outcome and improving the capacity of the C/P concerning the NSDI, two staff from the C/P participated and presented at an international conference.

a. Overview of International Conference

The international conference attended was “Land and Poverty Conference 2017: Reaponsible Land Governance – Towards an Evidence-Based Approach”.

The conference was held at the World Bank headquarters in Washington DC, USA from 20th March, 2017 to 24th March, 2017. The theme of the conference was “Land and Poverty”, but there were various themes related to the Land Market and the Land Taxation and the main themes were ones related to the policies and analysis of land markets, not technical themes.

b. Attendance of International Conference

Two staff from SSGCC and Project Team member attended the abovementioned international conference. The session of “Political and Economic Challenges of Land Policy Reform” at the conference was related to Ukraine. About 50 persons including Vice Minister of Agriculture of Ukraine, First Secretary of Embassy of Ukrainian, Kiev Economic Institute staff, and SSGCC staff attended the session.

In the session, Vice Minister of Agriculture of Ukraine and First Secretary of Embassy of Ukrainian gave a presentation overviewing and prospects of land market open policy at first, and after that, the assistance to Ukraine by the World Bank was introduced.

After this presentation, staff from SSGCC gave the presentation about NSDI technical infrastructures, legal infrastructure establishment/actual status of progress and tasks towards preparation of NSDI data of Ukraine.

In the question-and-answer session after these presentations, there was a question from the Myanmar government officials concerning the composition of committee of Ukraine from the concern for the composition of S/C of NSDI.

From the above process, the significance, contents and future activities, etc. of this Project were fully appealed at the international conference.

(5) Capacity Development of Related Agencies

Agencies related to NSDI establishment and operation were specified and for specified agencies, the capacity development for various technologies was implemented. The capacity development for related agencies was implemented in the workshop for related agencies.

1) Geospatial Information Preparation

At the step of specification of related agencies to be targeted for capacity development, the actual status of geospatial information preparation and preparation plan of each related agency was to be clarified to a certain extent.

a. Geospatial Information Specification Consultation

In NSDI act, the contents and preparation of Fundamental Geospatial Data was mentioned. Also, in NSDI Prototype establishment, the specifications of Fundamental Geospatial Data was prepared and the fundamental geospatial data were prepared based on the specifications. From the above circumstances, in the discussion of Geospatial Information specification of related organizations, data that will be provided to Fundamental Geospatial Data within the geospatial information possessed by the related organizations were identified and the contents of its specifications were discussed.

b. Preparation of Product Specification of Geospatial Information

The related organizations discussed the preparation of their product specifications based on the explanation of the process for the product specifications of the Fundamental Geospatial Data. As a result, the related organizations recognized the importance of the preparation of the product specifications for their geospatial data to establish NSDI.

c. Geospatial Information Preparation and Data Publication

Concerning the preparation of Geospatial Data, the lectures related to its methods were carried out in the workshops to the related organizations. Also, concerning to the publicity of data, the metadata of existing data will be uploaded to the clearinghouse.

2) Geospatial Information Workshop

Together with the C/P, the workshop contents and workshop materials were prepared, and the C/Ps were appointed as lecturers. The workshop was carried out over two days aiming for the common understanding of NSDI prototype establishment/operation and of the Fundamental Geospatial Data, and future cooperation with related agencies, and targeting the specified related agencies.

a. Specifications of Related Agencies

The targeted agencies were specified for the capacity building considering relationships to NSDI construction / operation and geospatial information. The specified agencies were as follows.

Table 74 Specified related agencies

Theme name	Name of data source (provider)
State border of Ukraine. Administrative Units	State Frontier Service of Ukraine and its local subdivisions
Hydrographic objects and hydrographic constructions	State Agency of Water Resources of Ukraine and its local subdivisions
Buildings and their parts	Oblast, region and local public administrations
Transport networks	State Agency of Automobile Roads of Ukraine and its local subdivisions
	Public Incorporated Enterprise "Ukrzaliznytsia"
	River Information Service of Waterways of Ukraine
	Branch of State Enterprise "State Hydrographic Cartography" "Ukrmorcartographia"
Engineering communications	Transport Utility Enterprise
	Public Incorporated Enterprise "Ukrtelecom" and its local subdivisions
	Public Incorporated Enterprise "Ukrtransgaz" and its local subdivisions
	Energetic companies and their local subdivisions
Vegetation and soils	Maintenance companies for Water Supply Networks and their local subdivisions
	State Agency of Forest Resources of Ukraine and its local subdivisions
	State Enterprise «Institute of Soil Preservation of Ukraine» and its local subdivisions

b. Preparation of Workshop Plan and Workshop Materials

The workshop plan including workshop contents/instructors, etc. based on the workshop objectives was discussed and examined with the C/P.

Also, the materials, such as a manual (Preparation method of Product Specifications) for the technology transfer of geospatial information, were prepared in line with the contents of the workshop.

c. Implementation of Workshop

The workshop of the capacity development for related agencies was carried out over two days in April 2017.

The contents of workshop were as follows.

NATIONAL GEOSPATIAL DATA INFRASTRUCTURE IN UKRAINE: OUTCOMES OF PROTOTYPE CREATION AND PERSPECTIVE OF FUTURE COOPERATION WITH RELATED ORGANIZATIONS

Day 1

№	Time		Duration of lecture	Topic of the lecture	Content
1	10:00	10:05	0:05	Opening remarks	1. Opening remarks
2	10:05	10:35	0:30	NSDI in Japan	1. Past and present of NSDI in Japan 2. Future objectives of NSDI in Japan 3. Modern approaches
3	10:35	11:00	0:25	NSDI Creation in Ukraine and draft Law of Ukraine "On NSDI"	1. Development of NSDI in Ukraine
4	11:00	11:45	0:45	Standardization in sphere of geographic information	1. Role of standards in NSDI 2. Thematic fields and standardization geoinformation objects 3. Infrastructure of geographic information standardization 4. International standards on geographic information 5. Experience of implementation ISO standards 19100 in INSPIRE 6. National profile of standards on geographic information
-	11:45	11:55	0:10	Break	
5	11:55	12:15	0:20	Specifications of basic datasets of National Geospatial Data Infrastructure	1. Objective of creation of geospatial data specifications 2. Content of basic datasets 3. Draft standard ДСТУ ISO 19131 Geographic information. Requirements to geospatial data specifications 4. Draft specifications of basic datasets of NSDI
6	12:15	13:00	0:45	UML class diagrams	1. General information on UML class diagrams 2. Main elements of UML class diagrams 3. Overview and short description of how to work in program «Enterprise Architect»
-	13:00	14:00	1:00	Lunch break	
7	14:00	15:00	1:00	Overview of prototype of National geospatial data infrastructure	1. Model of data prototype structure 2. Overview of fundamental geospatial datasets 3. Overview of prototype structure
8	15:00	16:00	1:00	Discussion of basic dataset packages	1. Overview of developed requirements to datasets by related organizations (list of objects, main and additional attributes)
9	16:00	17:00	1:00	Conclusion of discussion results	1. Time for related organizations (suggestions, discussion of work peculiarities, etc.)

Day 2

№	Time		Duration of lecture	Topic of the lecture	Content
1	10:00	11:30	1:30	Data creation for National geospatial data infrastructure	I. DATA CREATION FOR NSDI 1. General information on the pilot territory 2. Workflow description 3. Results of NSDI prototype creation 4. Comparing of data collecting methods 5. Calculation of time expenditure II. BRIEF OVERVIEW OF QGIS SOFTWARE
-	11:30	11:40	0:10	Break	
2	11:40	12:00	0:20	Data quality	1. Overview of draft standard ДСТУ ISO 19157 Geographic information. Geospatial data quality 2. Main elements of data quality evaluation 3. Main methods of data quality evaluation
	12:00	12:20	0:20	System evaluation of NSDI prototype	1. Usability test for NSDI web services
3	12:20	13:00	0:40	Metadata catalogue (NSDI Metadata Editor). Input and search of information on metadata in the catalogue.	1. General information on metadata catalogue 2. Metadata input to metadata catalogue 3. Template creation in metadata catalogue 4. Search of metadata in metadata catalogue
-	13:00	14:00	1:00	Lunch break	
4	14:00	15:00	1:00	NSDI Data Viewer (Map). NSDI map	1. General information on NSDI map 2. Overview and basic operations with the map 3. Basic layers 4. Thematic layers 5. Toolbox on the map 6. Additional features of the map 7. Connection with metadata catalogue
5	15:00	16:30	1:30	Discussion and evaluation of NSDI system	1. General discussion of NSDI system 2. Contribution of related organizations to NSDI 3. System evaluation (Questionnaire survey)
6	16:30	17:00	0:30	Concluding remarks	1. Concluding remarks

As a result of the workshop implementation, Participants understood the basic parts of how to prepare product specifications based on geographic information standards. They also understood the outline of the NSDI prototype built in the project.

The lecturers of each part of the workshop were staff of SSGCC – who are C/Ps. A total of 43 participants came from 14 agencies including the C/P organizations of SSGCC and SLCC, and private sector organizations besides the specified agencies.

3) Feedback to NSDI prototype

In the development of NSDI prototype system, several NSDI prototype systems for the sharing and common use of data were developed and data was prepared.

a. Feedbacks to data preparation

The data preparation was carried out by photogrammetric methods basically based on the product specifications prepared based on the geographic Information Standards, targeting the basic geospatial data mentioned in the NSDI act. Also, in the process of data preparation, the consideration of possibilities for extracting existing data was carried out, and the statistical information about productivity of data preparation by

the photogrammetric methods was obtained.

Based on the processes and the results, the following feedbacks are considered for the data preparation.

- * The objectives should be clear and the specification should be prepared for the data preparation.
- * For the method of data preparation, the application of various methods shall be considered on the premise that the product specifications are satisfied.
- * In the preparation of the data, the utilization of existing data (free of charge, conditions of provision) will be discussed, and it will be aimed to prepare the data reasonably.
- * The statistical information of data preparation by the photogrammetric method will be used in the data preparation plan based on the NSDI act.

b. Feedback to NSDI Prototype System

In the development of NSDI prototype system, Geospatial Information Viewer, Clearing house, Metadata Editor and GIS Application were developed after considering required functions, etc. Also, after developments, the various surveys were carried out to analyze and evaluate the system developed.

Based on the processes and the results, the following feedbacks are considered for the development and improvement of the systems.

- * The NSDI Prototype System developed satisfied the specifications at first. In the analysis and the evaluation, however, there were improvement points and therefore, the following improvement points are appointed and will be paid attention to in the next system development.
 - Proper Use of Icon Function (Viewer Service)
 - Optimization of Initial screen (Viewer Service)
 - Setting the hierarchy level of the layer (Viewer Service)
 - Switch language displayed on the screen
- * The homogeneity in the operation of the developed system should be ensured. In particular, the user manual for Metadata Editor will be prepared and the validity and homogeneity of the quality of metadata will be ensured.
- * An additional system development to practice the NSDI philosophy will be aimed for. In particular, a download system of data and a download charging system with data provision (download) will be aimed for.

3.2.6 Implemented Results of Report preparation, explanation, and consultation, and other activities

(1) Preparation of Each Report

Various reports were prepared in the course of the Project, starting with the Inception Report, a Progress Report, an Interim Report and a Final Report.

1) Inception Report Preparation

The Inception Report, including Project purposes, results, basic policies based on work contents, and implementation methods, work schedule, personnel plan was prepared in English and Ukrainian around the beginning of September 2015.

2) Preparation of Progress Report

The Progress Report that summarized the implementation status and results of the Project activities until April 2016 was prepared in English and Ukrainian. It included the following contents.

- Overview of Project
- Implementation Status and Results of Project Activities, and Tasks and Countermeasures
- Project Activities in the future

3) Preparation of Interim Report

The Interim Report that summarized the implementation status and results of the Project activities until December 2016 was prepared in English and Ukrainian. It included the following contents.

- Overview
- Details of implementation status and implementation results, and tasks based on work items, and remedial policy
- Implementation scheduled of Project work in the future

4) Preparation of Draft Final Report

In January 2018, the Draft Final Report that summarized the implementation status and results of all Project activities was prepared in English and Ukrainian. It included the following contents.

- Overview of Project
- Implementation of Project
- Implementation Results of Project
- Towards Establishment and Operation of NSDI

5) Preparation of Final Report

The Final Report that summarized the implementation status and results of all Project activities was prepared in English and Ukrainian based on the results of explanation/consultation of draft final report in January 2018. It included the following contents.

- Overview of the Project
- Implementation of the Project
- Implementation results of the Project
- Towards Establishment and Operation of NSDI

(2) Explanation and Consultation Regarding Report

After each report was prepared, the explanation and consultation regarding report were implemented for the C/P and the PCC (Project Coordinate Committee), and the contents of explanation / consultation was confirmed with a minutes of meeting (M/M) by both sides.

1) Explanation and Consultation Regarding Inception Report

The explanation and consultation regarding the contents (Objectives, Results, Basic policies of works, Implementation method, Work schedule and Personnel plan) of Inception Report was implemented on 11th September, 2015 with the participation of 9 staff from SSGCC and 6 staff from SLCC. In the consultation, apart from the contents of works, the Study Team asked to appoint/identify staff as counterparts.

The inception report was approved through the process of explanation and consultation. In the appointment and identification of counterparts, 16 staff were appointed and identified later.

The explanation and consultation regarding the inception report at PCC was implemented on 18th September, 2015, with the participation of the various relevant agencies such as SSGCC, SLCC, RIGC and JICA, which are the members of PCC. In the explanation and consultation, the chairman of PCC asked to change the pilot area from Fastiv City to Vinnytsia District. The change of the pilot area was confirmed by JICA later.

The content of Inception Report was finally confirmed through the explanation and consultation at PCC.

2) Explanation and Consultation Regarding Progress Report

The explanation and consultation regarding the progress report (Overview of project, Implementation status and results of project works in detailed based on the work item, Task and countermeasures, Schedule of project works in future) was implemented on 2nd June, 2016 obtaining participants from the C/Ps (SSGCC, SLCC and related Agencies) and members of PCC.

The content of Progress Report was finally confirmed through the above explanation and consultation.

3) Explanation and Consultation Regarding Interim Report

The explanation and consultation regarding the interim report (Overview of project, Implementation status and results of project works, Task and countermeasures, Schedule of project works in future) was implemented on 2nd June, 2016 obtaining participants from the C/Ps (SSGCC, SLCC and related Agencies) and members of PCC.

The content of Interim Report was finally confirmed through the above explanation and consultation.

4) Explanation and Consultation Regarding Draft Final Report

The explanation and consultation regarding the implemented results of the project was implemented based on the draft final report, on 31st January, 2018 obtaining participants from the C/Ps (SSGCC, SLCC and related Agencies), members of PCC and JICA Ukraine Office.

The content of Draft Final Report was finally confirmed through the above explanation and consultation.

(3) Procurement of Equipment for the Project

The equipment necessary for the operation of the Project were procured separately for general office equipment, technology transfer equipment, and server/storage equipment, and the equipment were delivered to the C/P's office for installation.

1) Procurement of General Office Equipment

As general office equipment the following equipment were procured on 15th October 2015 and the equipment were delivered to the office of the Project and installed.

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- Complex Copy Machine (including accessories such as ink, etc.) Xerox WC7225 CP – S 1 set
 - Projector Acer X1383WH(WXGA 3100 ANS II Lm) 1 set
 - Screen for Projector Acer T82 – WD1MW 1 set

2) Procurement of Technology Transfer Equipment

The technology transfer equipment was procured at four separate occasions.

a. Procurement of Equipment related to Desktop PC

As equipment related to desktop PC the following equipment was procured on 11th May 2016 and the equipment were delivered to the office of SSGCC/SLCC and installed.

- Desktop Computer DELL Precision T1700 12 sets
- UPS (Uninterruptible power system) APC Smart-UPS 1000 12 sets
- Antivirus Software Norton Security Deluxe for 2 years 12 licenses
- Business Software Adobe Acrobat XI pro 12 licenses

b. Procurement of Equipment 1 related to Stereoscopic Mapping

As equipment 1 related to Stereoscopic Mapping the following equipment were procured on 19th May 2016 and the equipment were delivered to the office of SSGCC/SLCC and installed.

- UPS (Uninterruptible power system) APC Smart-UPS 1000 LCD 220V 1 set
- Antivirus Software Security software (24 months) 1 license
- Business Software Adobe Acrobat XI pro 1 license
- Desktop computer for Stereoscopic Mapping HP Z440 1 set
- 3D LCD Monitor for Stereoscopic Mapping BENQ XL2411Z 1 set
- 3D Glasses for Stereoscopic Mapping (including additional supply) NVIDIA 3D Vision 4 sets
- USB Topo mouse for Stereoscopic Mapping Intergraph Topo Mouse 1 set
- Stereoscopic Mapping Software 6 (Bentley MicroStation V8i, Bentley Map V8i) 1 set

c. Procurement of Equipment 2 related to Stereoscopic Mapping

As equipment 2 related to Stereoscopic Mapping the following equipment were procured on 19th and 20th February 2016 and the equipment were delivered to the office of SSGCC/SLCC and installed.

- Stereoscopic Mapping Software 1 (HEXAGON GEOSPATIAL IMAGINE) 1 set
- Stereoscopic Mapping Software 4 (HEXAGON GEOSPATIAL PRO600 CART) 1 set
- Stereoscopic Mapping USB hardware key 1 set

d. Procurement of Other Software

As other software the following software were procured on 19th and 20th February 2016 and the software were installed to PC of the office of SSGCC/SLCC.

- UML Modelling tool Software Enterprise Architect 12 Licenses
- XML Editor Software XMLSpy 12 Licenses

3) Procurement of Equipment for Server/ Storage

As Equipment for Server/Storage the following equipment were procured on 25th January 2017 and the equipment were delivered to the office of SSGCC/SLCC and set up.

- 19 inch Server Rack (HP 42U600x1075mm Advanced Shock Rack with 2PDU) 1 set
- UPS (Uninterruptible power system) (HP R7000 4U IEC-32A HV INTL UPS) 1 set
- Server Blade Enclosure (HP BLc7000 CTO 3 IN LCD Plat Enclosure) 1 set
- SAN Switch (HP B-series 8/12c BladeSystem SAN Switch with 2xSFP(8GB)) 2 sets
- L3 Switch (Ethernet Switch 6125G 3Yr Support 4h 24x7 (with c7000)) 2 sets
- Blade Server (HP BL660c Gen9E5-v4 10/20GB FLB CTO Blade[844352-B21]) 2 sets
- Storage Server (HPE MSA 2040 ES SAN DC SFF Storage (4xPorts FC 8Gb)) 1 set
- Virtual Machine Software Vmware vSphere Standard 1 set
- Laptop Personal Computer HP ENVY/ 13" 1 set

Chapter 4 Towards development and operation of NSDI

This project has been carried out under the purpose of achieving 5 outputs that plays a part in implementing development and operation of NSDI in Ukraine, represented as follows.

Output 1: To create NSDI development and operation plan (draft).

Output 2: To develop organizational framework to promote the plan.

Output 3: To create practical geographic information standard (draft) and establish a promotion plan.

Output 4: To develop prototype for demonstrating the usefulness of NSDI.

Output 5: To build capacity of C/P and stakeholders for NSDI development and operation.

4.1 Project outcomes

In this project, following outputs toward development and operation of NSDI were obtained.

4.1.1 Outputs in various operational fields

(1) NSDI development and operation plan (draft)

In this project, the C/P and the project team jointly developed “Ukraine NSDI development and operation plan (draft)” according to the draft NSDI Act and the result of NSDI prototype creation. The draft plan is going to be approved through consultation by the SubGroup under the Ministry of Agrarian Policy and Food of Ukraine, or the S/C.

(2) Organizational framework for promoting NSDI development and operation

Organization and staff, mission, etc. for promoting NSDI were established based on the result of survey and analysis of NSDI promoting organization in various countries including Japan. Because NSDI law had not yet been established, unofficial conference and study meeting of NSDI Sub Group was conducted in order to start the activity of promoting organization smoothly after the establishment of the law.

(3) Geographic information standard

Referencing ISO geographic information standard which is a global standard relating to data etc. on NSDI and practical geographic information standard adopted in Japan, “Draft of Ukraine Geographic Information Standard (UkrGIS)” was created. This draft is currently under the process of domestic standardization, and will be approved and issued in time.

(4) NSDI prototype

Targeting a part of Vinnitsa city as a NSDI prototype, product specification based on UkrGIS was created and basic geospatial data referred in NSDI bill was prepared. Also, the creation technologies of a product specification and a basic geospatial data were transferred to C/P.

Moreover, geospatial information viewer, clearing house, metadata editor etc. were developed as systems for NSDI data sharing and common utilization, and they were made operational on the internet site (portal site).

It was confirmed that NSDI prototype was useful and necessary information (necessary technologies and resources) for the full scale operation was obtained.

(5) Capacity building for NSDI development and operation

Due to the collaboration work with Ukraine member (C/P) during project period, ability relating to NSDI development and operation in 4 fields mentioned above was strengthened. Also for the relating organization other than C/P, ability relating to general idea of NSDI, geographic information standard, NSDI data preparation and NSDI system was strengthened.

4.1.2 Other outcomes

(1) Operation guidance survey team

Operation guidance survey team conducted lecture relating to NSDI development and operation in Japan (activity of the promoting organization, establishment of geographic information standard, preparation and disclosure of NSDI data, NSDI system and utilization of NSDI etc.) in Kyiv for the relating organizations, and the contents were understood by the relating organizations.

(2) Training in Japan

C/P were able to learn the actual state of NSDI development and operation in Japan (actual condition of promoting organization, dissemination of geographic information standard, actual condition of NSDI data preparation, actual condition of sharing and common utilization of NSDI data etc.) through 3 times of trainings in Japan.

4.2 Towards NSDI development and operation

The deliberations on the NSDI Act in the parliament has started in January 2018, it is expected that the draft NSDI Act will be adopted in the near future. To ensure an establishment of NSDI for the whole territory of Ukraine, it is necessary to continue sustainable enhancement of the outcomes of the JICA project.

(1) To establish the management structure

a. Establishment the central executive body

The first step towards implementation of NSDI in Ukraine is to establish the central executive body and the NSDI Coordination Council in accordance with NSDI Act. The Subgroup on NSDI coordination was established under the Ministry of Agrarian Policy and Food as a temporary body before the NSDI Act is adopted. The functions of the Subgroup and relationship with governmental authorities will be transferred.

b. Formulate measures for advancing the utilization of NSDI

Each ministry and agency belonging to NSDI Coordination Council should create clear goals for utilization of NSDI. Especially, it is important to address social problems, which can be key triggers to accelerate the utilization of NSDI. The best way to promote NSDI sustainably is to provide the best performance in a most relevant use case.

(2) To decide on the rules of procedure of NSDI

a. Decide on product specifications for basic geospatial data

Product specifications for basic geospatial data will be a part of important rules about the procedure of NSDI creation. Draft product specifications were developed for NSDI prototype of JICA project. The governmental authorities of the NSDI coordination council will review the draft product specifications, which define the structure, feature definition and quality requirement of basic geospatial data. After that, the draft product specifications will be updated as necessary.

b. Prepare standardized manuals on geospatial data creation

The basic geospatial data that will represent essential information of infrastructure in Ukraine must comply with product quality. It is necessary to proceed with standardization of procedures for geospatial data creation, update and quality evaluation through improvement of the data creation manual developed under the JICA project.

c. Establish interoperability among authorities using geospatial data

NSDI must ensure interoperability of geospatial data within the geo-spatial community in Ukraine in order to realize smooth operation. The UkrGIS developed under the JICA project will be referred from a technical regulation approved by the Cabinet or a ministry.

d. Appoint the administrator managing geospatial data and geoportal

The NSDI administrator is needed to have expertise in survey, geospatial data creation, quality control, geospatial system development and maintenance. Also, the central executive body needs to define the powers of the administrator over data holders of governmental and local authorities. Part of powers will be exercised by an existing system such as “Cartographic-geodesic fund of Ukraine” to collect existing geospatial data.

(3) To create geospatial data

a. Grasp existing geospatial data which can be turned into basic geospatial data

One of the efficient ways to create basic geospatial data is to utilize existing geospatial data which governmental or local authorities keep maintenance of for each specific purpose. A census of existing geospatial data should be carried out, because there is an issue that the total number of existing geospatial data sets in Ukraine is uncertain currently.

b. Decide on the state development program for basic geospatial data creation for the first five years

The plan for basic geospatial data creation should be made taking into account the results of above-mentioned census and estimated volume of works. It is practical that data creation will be carried out stepwise by specifying prioritized areas and features.

c. Carry out basic geospatial data creation

In order to assemble geospatial datasets into basic geospatial data, the administrator has to address the coordination among governmental or local authorities who are geospatial data holders. Especially essential is the establishment of topographic monitoring and quality control system for locality condition. Sustainable maintenance of NSDI can be ensured by proper advice of the administrator about geospatial data creation to data

holders.

(4) To enhance the geoportal and develop tools and services

a. Decide on the state development program for the geoportal

One of the key points to be considered is the operational structures of geoportal. There are two ways to run geoportal, centralized or decentralized. In addition, price policy has to be considered if the geoportal uses paid system of access to geospatial data.

b. Enhance the prototype of geoportal

The prototype of geoportal developed under the JICA project has basic necessary functions for NSDI operation. The expansion of server capabilities, ensuring secure network access and development of a billing function will be points for consideration towards official start of operations.

c. Develop tools and services

Provision of data conversion tools and quality check tools is useful for data producers to ensure logical consistency of geospatial data. In addition, provision of feature catalogue service that is a repository of feature definition, and specific application services based on basic geospatial data set would be requested.

(5) Public awareness activities and human resource development

a. Hold activities for growth of awareness on NSDI

The JICA project has prepared a lot of materials used for workshop and training. With the utilization of the materials, NSDI coordinator or NSDI administrator should hold workshops, seminars, joint projects with stakeholders on different levels not only at Kyiv but also at other principal cities.

b. Develop educational system

It is important to foster experts on survey, GIS, ICT and standardization. Especially, because UkrGIS is new for the geo-spatial society of Ukraine, training courses on standardization should be developed.

c. Execute scientific research and development in the sphere of geographic information

Government-industry-academia collaboration should be promoted to keep up with technological progress in the sphere of geographic information.