The Government of the People's Republic of Bangladesh
Survey of Bangladesh (SOB)

Project for Strengthen the Capacity on Advanced Mapping of SOB for Building Digital Bangladesh

(Making the Roadmap to Establishing NSDI)

Final Report

December 2017

Japan International Cooperation Agency

Asia Air Survey Co., Ltd.
Kokusai Kogyo Co., Ltd.
Pasco Corporation

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List of Abbreviation

No.	Abbreviation word	An official name
1	a2i	Access to Information
2	ADB	Asian Development Bank
3	ADP	Annual Development Plan
4	AIGID	Association for Promotion of Infrastructure Geospatial Information Distribution
5	AP	Aerial Photographs
6	API	Application Programming Interface
7	BADC	Bangladesh Agricultural Development Cooperation
8	BARI	Bangladesh Agricultural Research Institute
9	BBS	Bangladesh Bureau of Statistics
10	BCC	Bangladesh Computer Council
11	BDMAP	Bangladesh Digital Mapping Assistance Project
12	BERC	Bangladesh Energy Regulatory Commission
13	BIG	Geospatial Information Agency, Badan Informasi Geospatial
14	BIP	Bangladesh Institute of Planners
15	BIWTA	Bangladesh Inland Water Transport Authority
16	BMD	Bangladesh Meteorological Department
17	BN	Bangladesh Navy
18	BNHD	Bangladesh Navy Hydrographic Department
19	BPDB	Bangladesh Power Development Board
20	BPN	Ministry of Land and Spatial Planning, Kementerian Agraria dan Tata Ruan, Badan Pertanahan Nasional
21	BRTA	Bangladesh Road Transport Authority
22	BSTI	Bangladesh Standards and Testing Institution
23	BTRC	Bangladesh Telecommunication Regulatory Commission
24	BUET	Bangladesh University of Engineering and Technology
25	BUTM	Bangladesh Universal Transverse Mercator
26	BWDB	Bangladesh Water Development Board
27	CBS	Central Bureau of Statistics
28	CEGIS	Center for Environmental and Geographic Information Services
29	CORS	Continuously Operating Reference Station
30	D/D	Detail Design

No.	Abbreviation word	An official name
31	DDM	Department of Disaster Management
32	DESC	District e-Service Center
33	DESCO	Dhaka Electric Supply Company Limited
34	DEM	Digital Elevation Model
35	DFID	Department for International Development
36	DFR	Draft Final Report
37	DLRS	Department of Land Records and Surveys
38	DMR	Dhaka Metro Rail
39	DNCC	Dhaka North City Corporation
40	DOICT	Department of Information and Communication Technology
41	DPDC	Dhaka Power Distribution Company Limited
42	DPP	Development Project Proposal
43	DRGA Fund	Debt Relief Grant Assistant Fund
44	DSCC	Dhaka South City Corporation
45	DST	Department of Science and Technology
46	DU	University of Dhaka
47	DUET	Dhaka University of Engineering & Technology
48	ERD	Economic Relations Division
49	EU	European Union
50	FGD	Fundamental Geospatial Database
51	FGI	Fundamental Geospatial Information
52	FR	Final Report
53	F/S	Feasibility Study
54	GCP	Geodetic Control Point
55	GI	Geospatial Information
56	GIS	Geographic Information System
57	GLONASS	Global Navigation Satellite System
58	GML	Geography Markup Language
59	GNI	Gross National Income
60	GNSS	Global Navigation Satellite System
61	GPRS	General Packet Radio Service
62	GPS	Global Positioning System
63	GSB	Geological Survey of Bangladesh

No.	Abbreviation word	An official name
64	GSI	Geospatial Information Authority of Japan
65	HTTPS	Hypertext Transfer Protocol Secure
66	IC/R	Inception Report
67	ICT	Information and Communication Technology
68	IDMS	Improvement of Digital Mapping System
69	ISO	International Organization for Standardization
70	IT	Information Technology
71	IWM	Institute of Water Modeling
72	JIS	Japanese Industrial Standards
73	JISC	Japanese Industrial Standards Committee
74	KKLH	Ministry of Forest, Kementerian Kehutanan dan Linqkungan Hidup
75	KP	Ministry of Agriculture, Kementerian Pertanian
76	KPI	Key Point Installation
77	LAPAN	Indonesian National Institute of Aeronautics and Space, Lembaga Penerbangan dan Antariksa Nasional
78	LG	Local Government
79	LGED	Local Government Engineering Department
80	M/M	Minutes of Meeting
81	Mirpur DMC	Mirpur Digital Mapping Center
82	MIST	Military Institute of Science and Technology
83	MLIT	Ministry of Land, Infrastructure, Transport and Tourism
84	MOA	Ministry of Agriculture
85	MOCHTA	Ministry of Chittagong Hill Tracts Affairs
86	MOD	Ministry of Defence
87	MODMR	Ministry of Disaster Management and Relief
88	MOE	Ministry of Education
89	MOE	Ministry of Environment
90	MOEF	Ministry of Environment and Forest
91	MOEMR	Ministry of Energy and Mineral Resources
92	MOF	Ministry of Finance
93	MOF	Ministry of Food
94	MOF	Ministry of Forest
95	MOFA	Ministry of Foreign Affairs

No.	Abbreviation word	An official name
96	MOFL	Ministry of Fisheries and Livestock
97	MOH&FW	Ministry of Health and Family Welfare
98	MOHPW	Ministry of Housing and Public Works
99	MOMAF	Ministry of Marine Affairs and Fisheries
100	MOP	Ministry of Planning
101	MOPA	Ministry of Public Administration
102	MOPME	Ministry of Primary and Mass Education
103	MOPTIT	Ministry of Posts, Telecommunications and Information Technology
104	MOPW	Ministry of Public Works
105	M/P	Master Plan
106	MPENR	Ministry of Power, Energy and Mineral Resources
107	MRT	Mass Rapid Transit
108	MSL	Mean Sea Level
109	NASA	National Aeronautics and Space Administration
110	NESS	National e-Service System
111	NGO	Non-Governmental Organization
112	NLA	National Land Agency
113	NLB	Network Load Balancer
114	NSDI	National Spatial Data Infrastructure
115	NSU	North South University
116	NWRD	National Water Resources Database
117	O&M	Operation and Maintenance
118	ODBC	Open Database Connectivity
119	OGC	Open Geospatial Consortium
120	OJT	On-the-Job Training
121	OSM	Open Series Map
122	OSM	Open Street Map
123	PMO	Prime Minister’s Office
124	PNT	Position, Navigation and Timing
125	POI	Point of Interest
125	PR activity	Public Relations activity
126	PR/R	Progress Report
127	PUPR	Ministry of Public Works and Public Housing, Kementerian Pekerjaan Umun

No.	Abbreviation word	An official name
		dan Perumahan Rakyat
128	PWD	Public Works Department
129	QZSS	Quasi -Zenith Satellite System
130	R/D	Record of Discussion
131	RAID	Redundant Arrays of Inexpensive Disk
132	RAJUK	Rajdhani Unnayan Kartripakkha / Capital Development Authority
133	REB	Bangladesh Rural Electrification Board
134	RHD	Roads and Highways Department
135	RINEX	Receiver Independent Exchange Format
136	RS	Remote Sensing
137	RTHD	Ministry of Road Transport and Bridges
138	RTK	Real Time Kinematic
139	RTK-GNSS	Real Time Kinematic - Global Navigation Satellite System
140	SI	Satellite Imagery
141	SOB	Survey of Bangladesh
142	SPARRSO	Bangladesh Space Research and Remote Sensing Organization
143	SSL	Secure Sockets Layer
144	TC/SC	Technical Committee/Sub Committee
145	TITAS	TITAS Gas T&D Co., Ltd.
146	TM	Topographic Maps
147	TS	Total Station
148	UAV	Unmanned Aerial Vehicle
149	UDD	Urban Development Department
150	UI	User Interface
151	UN DESA	United Nations Department of Economic and Social Affairs
152	UNDP	United Nations Development Programme
153	UNFPA	United Nations Population Fund
154	UN-GGIM	United Nations Committee of Experts on Global Geospatial Information Management
155	USAID	United States Agency for International Development
156	USGS	United States Geological Survey
157	UTM	Universal Transverse Mercator
158	VPN	Virtual Private Network

No.	Abbreviation word	An official name
159	WARPO	Bangladesh Water Resources Planning Organization
160	WASA	Water Supply and Sewerage Authority
161	WB	World Bank
162	WG	Working Group
163	WGS-84	World Geodetic System 1984
164	WMS	Web Map Service
165	WMTS	Web Map Tile Service

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Chapter 1 Background of the Project

Chapter 1 Background of the Project

The background of the Project are described below.

1.1 Background of the Project

For many years, the development of highly accurate and up-to-date topographical maps, that are necessary for national land development, conservation, disaster management, etc., has not been carried out in the People's Republic of Bangladesh (hereafter, "Bangladesh").

As a result, preparation and management of plans for infrastructure development, land-use, urban development, disaster prevention, etc. by the government and the private sector has been inefficient.

In order to solve this issue, from the 1990s, the Government of Japan has been carrying out technical cooperation programs in the field of geospatial information with Survey of Bangladesh (hereafter, "SOB"), the national survey and mapping organization in Bangladesh.

In addition, the Bangladesh Digital Mapping Assistance Project (BDMAP) has been carried out between 2009 and 2013, in order to strengthen the capabilities in the three areas of planning, operation, and technology related to digital topographic maps preparation, in the IDMS Project which is currently being implemented by SOB.

As a result of the continuous cooperation to date as well as the results of BDMAP, the capabilities of SOB staff in digital topographic maps preparation, planning, and management have been greatly improved.

SOB staff are capable of planning and managing the digital topographic maps preparation project by themselves.

The Bangladesh Government has adopted the "Digital Bangladesh 2021" policy with the aim of disseminating computer technology and the use of modern technology.

In the 6th Five Year Plan (2011 to 2015) formulated in the year 2010, planning of land use plans for sustainable land and water resource use, establishment of an E-Center, introduction of E-Governance, introduction of wireless broadband, introduction of digital land records and surveying records, etc., have been announced.

SOB has carried out PR activities in order to widely and broadly disseminate the survey results such as by preparation of booklets regarding the sale of map products, etc., displaying a list of products on its website, and providing booths at exhibitions, etc.

However, the data itself is provided off-line, and the procedures for use of topographical map products, etc., are complex and take time due to regulations and ordinances, etc. Therefore, their use is not being promoted at this stage.

The development of geospatial information in Bangladesh is steadily expanding with cooperation from the Government of Japan, and at the present stage, the advanced use of geospatial information is being promoted. Therefore, it is necessary to develop policies and measures in this respect.

Now, SOB needs organizational strengthening such as establishment of technologies introduced to date, preparation and update of accurate geospatial information, promotion of utilization of geospatial information by various users in the future in order to construct National Spatial Data Infrastructure (hereafter, "NSDI"), including continuously operating reference stations (hereinafter, CORSs).

Against this background, in August 2012, the Bangladesh Government requested the Japanese Government for technical cooperation to SOB in developing the legal system, establishment of its technologies and becoming self-reliant.

Thereafter, an R/D was concluded for the Period from October 2013 until December 2016.

Based on the delay to the project due to the local safety situation in November 2016, the R/D was amended to extend the cooperation period until March 2018, so the technical cooperation project is being implemented.

1.2 Objective of the Project

The objective of the Project is to contribute to the achievement of Digital Bangladesh 2021 through the preparation of roadmap for construction of NSDI including CORSs.

1.3 Area covered by the Project

The area covered by the project is the whole of the national land of Bangladesh, with a base of activities at the SOB Tejgaon office in Dhaka City.

Furthermore, in order to confirm the status of use of NSDI in third countries, a survey will be implemented with the Indonesian Geospatial Information Agency, etc., in Jakarta, Indonesia.

1.4 Scope of the Project

The Project will be implemented based on the R/D on 27th of August 2013, and in order to achieve the above objectives, "The Roadmap for Construction of NSDI (Draft)" will be formulated through discussions and the results of survey with SOB, Bangladesh counterpart organization.

In addition, workshop will be held in order to share the objectives and details of the Project with relevant government organizations and agencies and other users, in order to deepen the understanding of the necessity and significance of NSDI and the utilization of geospatial information.

1.5 Project implementation schedule

The implementation schedule of the Project are shown in Table 1.5.1.

Table 1.5.1 Project implementation schedule

No.	Work Items	2017								
		April	May	June	July	August	September	October	November	December
1	Collection, sorting and analysis of relevant documents and information									
2	Preparation, explanation and discussion of the Inception Report									
3	Analysis of the relevant laws and ordinance concerning NSDI									
4	Identification and survey of organizations related to NSDI									
5	Summary of present status of development of continuously operating reference stations and policies for future development									
6	Overview of NSDI in third countries and analysis of status of utilization									
7	Prerparation of the Progress Report									
8	Explanation and discussion of the Progress Report									
9	Investigation on the appropriateness and necessity of introduction of continuously operating reference stations, and potential for utilization									
10	Preparation of roadmap (draft) for the NSDI establishment in Bangladesh									
11	Identification and summary of the benefits of introduction of NSDI									
12	Implementation of workshop on NSDI									
13	Preparation of the Draft Final Report									
14	Explanation and discussion of the Drat Final Report									
15	Preparation of the Final Report									
16	Submission of the Final Report									
17	Contributoers meeeting and Workshop		▲ 1st contributors meeting			▲ 2nd contributors meeting	▲ Workshop			

Work in Japan　Work in Bangladesh　Work in Indonesia

Source: The Project Team

1.6 Project members and assignment period

The names, assignments and assignment periods of the Project Team members are as follows:

Name & Assignment	Assignment period	Days
Mr. Toru Watanabe (Leader/NSDI Planning)		
Bangladesh	6 May 2017 - 26 May 2017	21 days
Indonesia	11 June 2017 - 17 June 2017	7 days
Bangladesh	8 July 2017 - 21 July 2017	14 days
Bangladesh	1 August 2017 - 11 August 2017	11 days
Bangladesh	29 August 2017 - 15 September 2017	18 days
Bangladesh	14 October 2017 - 3 November 2017	21 days
Mr. Zenichi Chiba (Legal Framework)		
Bangladesh	6 May 2017 - 26 May 2017	21 days
Bangladesh	8 July 2017 - 21 July 2017	14 days
Bangladesh	1 August 2017 - 11 August 2017	11 days
Bangladesh	2 September 2017 - 15 September 2017	14 days

Mr. Yoshikazu Fukushima (Continuously Operating Reference Point)

Bangladesh	18 July 2017 - 4 August 2017	18 days
Bangladesh	23 September 2017 - 4 October 2017	12 days

Mr. Hiroto Fujita (System Concept Design)

Bangladesh	15 May 2017 - 26 May 2017	12 days
Indonesia	11 June 2017 - 17 June 2017	7 days
Bangladesh	19 July 2017 - 11 August 2017	24 days
Bangladesh	29 August 2017 - 15 September 2017	18 days
Bangladesh	14 October 2017 - 3 November 2017	21 days

Mr. Kunihiro Ishii (Geographic Information Standards)

Bangladesh	13 May 2017 - 26 May 2017	14 days
Bangladesh	23 July 2017 - 4 August 2017	13 days

1.7 Collaborators for the Project

For the implementation of the Project, cooperation and suggestion of following persons were obtained.

Professor Dr. Eng. Shibasaski Ryosuke, Center for Spatial Information Science, Tokyo University
Professor Md. Mafizur Rahman, Department of Civil Engineering, BUET
Dr. Colonel Mahmudun Nabi (Retd) (ex. Director of Defence Survey of SOB)

Chapter 2 Preparation, Explanation and Discussion of the Reports

Chapter 2 Preparation, Explanation and Discussion of the Reports

The outline of preparation, explanation and discussion of the Inception Report are described bellows.

2.1 Inception Report

Outline of the preparation, explanation and discussion of the Inception Report are described as follows:

2.1.1 Preparation of Inception Report

Prior to the first works in Bangladesh, additional information that can be obtained within Japan were collected. Based on the analysis results of the obtained information, the basic policies and implementation plan for the Project were compiled and the Inception Report was prepared in Japan.

2.1.2 Explanation and discussion of Inception Report

The Project Team submitted the Inception Report (draft) to SOB in the morning of 7 May 2017.

In the afternoon of 7 May 2017, an explanation meeting of the Inception Report to SOB by the Project Team was held.

The date, location and attendants for the explanation meeting of the Inception Report were as follows:

Explanation meeting of the Inception Report
Date and time: 7 May 2017 15:00 - 16:00
Location: Office of Director of Defence Survey
Attendants: SOB side
M. A. Rouf Howlader, Director of Defence Survey, SOB
Md. Abul Kalam, Director of Development Survey, SOB
Md. Mosharaf Hossain, Deputy Director of Administration, SOB
Mr. Nayon Chandra Sarker, Assist. Director of Geodesy, SOB
Md. Abul Hossain, Assistant Director of Survey, SOB
Maj. Md. Zakir Hossain, MOD
Mr. Bokuro Urabe, JICA long-term expert

The Project Team
Mr. Toru Watanabe, Team Leader/NSDI Planning
Mr. Zenichi Chiba, Legal Framework of NSDI

The Following are the items concerning the implementation policies and methods of the Project emphasized and requested by the Project Team, and SOB agreed them.

a) The main body of the Project is SOB. The Project Team will support the activities of SOB and give the advice to them, if necessary.

b) It is necessary to execute the survey effectively due to the short period of the Project.

c) It is necessary to secure the safety during the survey in Bangladesh.

d) The Project Team requested SOB to arrange the staff of SOB for interview survey to the relevant organizations of NSDI.

2.1.3 Minutes of Meeting for Inception Report

After completion of the explanation meeting of the Inception Report, Minutes of Meeting was prepared between SOB and the Project Team.

The Minutes of Meeting for the Inception Report is shown in Annex-1.

2.2 Progress Report

The outline of preparation, explanation and discussion of the Progress Report are described bellows.

2.2.1 Preparation of Progress Report

Based on the results of the 1st work in Bangladesh such as survey for legal framework of NSDI, interview survey to the related organization of NSDI, issues and lessons learned from the construction, operation and maintenance of NSDI in Indonesia, the basic concept for the preparation of road map of NSDI in Bangladesh was formulated and the Progress Report (PR/R) was prepared.

2.2.2 *Explanation and discussion of Progress Report*

The Project Team submitted the Progress Report (draft) to SOB in the afternoon of 9 July 2017.

The several times of explanation and discussion of the Progress Report were held between SOB and the Project Team.

The main items discussed between SOB and Project Team were as follows:

a) In SOB, the maps to be opened to the public is called as "Open series maps" and also, the maps to be open to the limited organization is called as "Restricted maps". Therefore, SOB

requested to use these words on the Progress Report, and the Project Team agreed this.

b) Generally, in Bangladesh, "mid-term" is used instead of "middle term". Therefore, SOB requested the Project Team to correct it, and the Project Team agreed it.

c) There are several spelling mistakes and abbreviation word on the Progress Report. Therefore, SOB requested to correct these mistakes and the Project Team agreed it.

d) Concerning Chapter 4, Clause 4.2 Investigation on status of introduction of geographic information standards and its result, SOB requested the Project Team to change this expression and the Project Team agreed it.

The date, location and attendants for the explanation meeting of the Progress Report were as follows:

Explanation meeting of the Progress Report

Date:	9 July 2017 - 13 July 2017
Location:	Office of each staff of SOB
Attendants:	SOB side
	Md. Abul Kalam, Director of Development Survey, SOB
	Md. Mosharaf Hossain, Deputy Director of Administration, SOB
	Mr. Nayon Chandra Sarker, Assist. Director of Geodesy, SOB
	Md. Abul Hossain, Assistant Director of Survey, SOB
	The Project Team
	Mr. Toru Watanabe, Team Leader/NSDI Planning
	Mr. Zenichi Chiba, Legal Framework of NSDI

2.2.3 Minutes of Meeting for Progress Report

After completion of the explanation meeting of the Progress Report, Minutes of Meeting was prepared between SOB and the Project Team.

The Minutes of Meeting for the Progress Report is shown in Annex-2.

2.3 Draft Final Report

The outline of preparation, explanation and discussion of the Draft Final Report are described bellows.

2.3.1 Preparation of Draft Final Report

Based on the survey results executed after discussion of the Progress Report with SOB such as

adequacy of the establishment of CORSs in Bangladesh, road map (plan) for the establishment of NSDI in Bangladesh, cost and effect of NSDI in Bangladesh and so on, the Draft Final Report was prepared.

2.3.2 Explanation and discussion of Draft Final Report

The Project Team submitted 10 copies of the Draft Final Report to SOB on 16 October 2017. The explanation meeting of the Draft Final Report to SOB was held on 23 October 2017 by the Project Team.

The main items discussed between SOB and Project Team were as follows:

a) The Project Team explained that not only all the government organizations but also academic and private sectors will be participated in NSDI. This mean that the construction and operation of NSDI is a national project of Bangladesh. Therefore, NSDI should be included in the next five year plan for the smooth construction and operation of NSDI.

   The Surveyor General requested to the short term experts project team to explain the contents of Draft Final Report to Secretary of MOD, especially the relation between NSDI and five year plan in Bangladesh, and the short terms experts project team agreed it.

b) The Project Team explained that the specifications and configuration of NSDI platform and estimated cost for the construction of NSDI shown in the Draft Final Report is a tentative idea. The specifications and configuration of NSDI platform (full version) and necessary cost have to be reviewed based on the evaluation of NSDI proto type project.

   SOB agreed to review the specifications and configuration of NSDI platform (full version) and necessary cost based on the evaluation of NSDI proto type project.

c) The Project Team explained the method for the selection of CORS location from the view points of single RTK survey available area (30 km from CORS) as a reference. Also the Project Team recommended that it is necessary to minimize the single RTK survey non-available area (over 30 km from CORS) as much as possible.

   The Project Team also recommended that CORS station should be arranged to be able to use other CORS for single RTK survey even though one CORS become out of order.

   SOB is now executing the point selection of CORSs and the comments of the short term experts project team will be counted for the selection of CORSs.

d) The Project Team explained that the working group under the Executive Committee is necessary for the smooth operation and management of NSDI. SOB agreed the necessity of working group under the Executive Committee.

The date, location and attendants for the explanation meeting of the Draft Final Report were as

follows:

Explanation meeting of the Draft Final Report
Date: 23 October 9:30 - 11:00
Location: SOB, DMC office
Attendants: SOB Side
Brigadier General Zakir Ahmed, psc, Surveyor General, SOB
M.A. Rouf Howlader, Director of Defence Survey, SOB
Md. Abul Kalam, Director of Development Survey, SOB
Md. Mosharaf Hossain, Deputy Director of Administration, SOB
Major Pankaj Mallik, ASG, Deputy Director (Survey), SOB
Md. Masudur Rahman, Deputy Director, SOB
Md. Shafiqur Rahman, Deputy Director, SOB
Mr. Nayon Chandra Sarker, Assist. Director of Geodesy, SOB
Major Ahsan Kabir, Project Officer, SOB
Major Md. Kamal Uddin, Assistant Director (Survey), SOB
Mr. Syed Mohammad Masum, Assistant Director (Survey), SOB
Mr. Ganesh Chandra Roy, Assistant Director, SOB
Md. Ibrahim Khalil, Assistant Director, SOB
Md. Shahidul Islam, Consultant for server, SOB
Mr. Bokuro Urabe, JICA Long-term Expert
Ms. Monoara Tamanna Khan

JICA Side
Mr. Hiroaki Nakatsuka, Representative of JICA Bangladesh Office

The Project Team
Mr. Toru Watanabe, Team Leader/NSDI Planning
Mr. Hiroto Fujita, System Concept Design

2.3.3 Minutes of meeting of Draft Final Report

After completion of the explanation meeting of the Draft Final Report, Minutes of Meeting was prepared between SOB and the Project Team.

The Minutes of Meeting for the Draft Final Report is shown in Annex-3.

2.4 Explanation meeting to MOD

The explanation meeting for the outline of the Draft Final Report to MOD, requested by Surveyor General, was held on 30 October 2017.

The outline of the explanation meeting to MOD are as follows:

Explanation meeting of the Draft Final Report to MOD

Date: 30 October 2017 16:00 - 17:20

Location: Meeting room of MOD

Agenda: 1) Introduction of participants
2) Address and explanation of current projects of JICA by Surveyor General of SOB
3) Explanation of the Draft Final Report by the Project Team
4) Explanation of NSDI Pilot Project by Mr. Urabe, Long-term Expert
5) Question and answer

Attendants: MOD side
Mr. Akhter Hussain Bhuiya, Secretary, MOD
Ms. Khaleda Pervin, Additional Secretary, MOD
Ms. Afia Khatun, Joint Secretary, MOD
Mr. Md. Azizul Islam, Deputy Secretary, MOD
Mr. Shaikh Mohammad Jobayed Hossain, Senior Assistant Chief, MOD

SOB side
Brigadier General Zakir Ahmed, psc, Surveyor General, SOB
Mr. M.A. Rouf Howlader, Director of Defence Survey, SOB
Mr. Md. Abul Kalam, Director of Development Survey, SOB
Major Ahsan Kabir, Project Officer, SOB
Md. Mosharaf Hossain, Deputy Director of Administration, SOB
Major Pankaj Mallik, Assistant of Surveyor General, SOB
Mr. Bokuro Urabe, Long-term Expert

JICA Bangladesh Office
Mr. Hitoshi Ara, Senior Representative of JICA Bangladesh Office
Mr. Hiroaki Nakatsuka, Representative of JICA Bangladesh Office

Project Team
Mr. Toru Watanabe, Team Leader/NSDI Planning
Mr. Hiroto Fujita, System Concept Design

2.5 Final Report

The outline of preparation of the Final Report are described as follows:

Based on the comments from SOB, the draft final report was corrected and final report was prepared in Japan.

The final output of the Project are as follows:

a)	Final Report (English)	SOB	15 sets
		JICA	5 sets
b)	Final Report (Japanese)	JICA	5 sets
c)	CD-R (English)	SOB	1 set
		JICA	2 sets
	CD-R (Japanese)	JICA	2 sets

Chapter 3 Collecting, Sorting and Analysis of Relevant Documents and Information

Chapter 3 Collecting, Sorting and Analysis of Relevant Document and Information

Collection, sorting and analysis of relevant documents and information concerning NSDI in Bangladesh, Japan and countries surrounding Bangladesh have been implemented.

3.1 Disclosure of geospatial information in each country

Geospatial information is positioned as one component of social infrastructure, enabling searching to be performed using the address, place name, coordinates or other such location information, can be effectively utilized for socioeconomic activities by combining it with various information, and is expected to have extremely large social benefits.

However, the current mechanisms are not adequate to actually achieve this concept for society and provide benefits to society, making it necessary to promote shared usage of map data.

If common map data is utilized by many users, all users can access the same information (attribute data) pasted to locations and planimetric features (building, roads, etc.) on the map data.

However, in the event different map data is used, there is a higher possibility that information (attribute data) pasted to certain locations and planimetric features on maps will not be correctly relayed to other users.

It is considered that easy, certain and the most effective way to keep this from issues is for society as a whole to implement shared use of a base map for which the positional accuracy is guaranteed that enables common use of map data with a variety of applications.

For this purpose, it is necessary that users can freely access geospatial information, and in particular base map data.

The results of organization of geospatial information that has been disclosed to the public in Bangladesh, Japan and countries surrounding Bangladesh are shown in Table 3.1.1.

3.2 Disclosure of geospatial information in Bangladesh

The status of disclosure of geospatial information in Bangladesh is described in this section.

3.2.1 Survey of Bangladesh (SOB)

The Survey of Bangladesh (SOB) has released a system that can perform monitoring of the status of the position of CORSs and receivers. By registering, users can download observation data for CORSs for a charge.

The background map for the monitoring system is an Open Street Map (OSM).

In addition, SOB has published a website of geodetic control points using by Google Maps from July 2017.

Table 3.1.1 Web disclosure status of geospatial information in various countries

Country	Organization	Type	Web site name	Contents	Base Map	Download	Download type
Bangladesh	Survey of Bangladesh (SOB)	Government	Sensor Map	GNSS CORS Data	OSM	Paid	RINEX
			SOB Geodetic Control Points	Geodetic control points	Google Maps	Browsing only	-
	Bangladesh Computer Council (BCC)	Government	GeoDASH	Thematic maps	Bing Aerial, Mapbox, OSM	Free (allowed by owners)	KML, GeoJSON, Excel, CSV, GML, Shape, PNG, PDF, JPEG
	Local Government Engineering Department (LGED)	Government	GIS Portal	Base maps, Thematic maps	Original map	Free	PDF
			Digital Map Download	District Map, Upazila Map, Road Map	-	Free	JPEG, PDF
			Road Database	Road information	-	Browsing only	-
	Bangladesh Bureau of Statistics (BBS)	Government	Small Area Atlas Bangladesh	Thematic maps	-	Free	PDF
	Bangladesh Navy Hydrographic Department (BNHD)	Government	Charts	Charts	-	Free (low resolution)	JPEG
	Bangladesh Space Research and Remote Sensing Organization (SPARRSO)	Government	Geoportal	Thematic maps	-	Free	PDF
	Geological Survey of Bangladesh	Government	Maps	Thematic maps	-	Free (low resolution)	JPEG, PDF
Japan	Geospatial Information Authority of Japan (GSI)	Government	Geospatial Information Library	Catalog site	-	Serching only	-
			GSI Maps	Topographic maps, Ortho photo, DEM Thematic maps	Topographic map(GSI), Orho imagery(GSI)	Browsing only	-
			Fundamental Geospatial Data download service	Base map, DEM	Topographic map(GSI), Orho imagery(GSI)	Free	JPGIS(GML), ASCII
			Cartograph and Arerial Photo browsing service	Topographic maps, Ortho photo, Aerial photo	Topographic map(GSI), Orho imagery(GSI)	Free (low resolution) With cost (high resoulution)	JPEG
			GNSS Earth Observation Network System	GNSS CORS Data	Topographic map(GSI), Orho imagery(GSI)	Free (registered users)	RINEX
			Control point survey results browsing service	GCP	Topographic map(GSI), Orho imagery(GSI)	Free (registered users)	PDF
	Ministry of Land, Infrastructure, Transport and Tourism (MLIT)	Government	National Land Numerical Information download service	Thematic maps, Census data	-	Free	GML, Shape, CSV
	Association for Promotion of Infrastructure Geospatial Information Distribution (AIGID)	Institute	G-space platform	Base maps, Thematic maps, Static data, Dynamic data	Topographic map(GSI), Orho imagery(GSI)	Free and with cost	PDF, EXCEL, Shape, XYZ, WORD, GeoJSON, TIFF, JPEG
	Saitama City	Local government	Download site of Topographic map	Topographic map	-	Free	PDF
	Osaka City	Local government	Map Navi Osaka	Topographic map, Cadastral map, Thematic maps, Ortho imagery	Topographic map, Orho imagery	Browsing only	-
Indonesia	Geospatial Information Agency (BIG)	Government	Ina-Geoportal	Topographic map, Thematic maps	ArcGIS Online	-	-
	National Land Office (BPN)	Government	Peta Online	Cadastral map	OSM	Browsing only	-
	Ministry of Public Works (PUPR)	Government	SIGI-PU	Thematic maps	ArcGIS Online	Browsing only	-
			Portal Geospasial Infrastruktur Kementerian PUPR	Thematic maps	ArcGIS Online	Browsing only	-
India	Department of Science & Technology (DST)	Government	National Spatial Data Infrastructure	Topographic map	Topographic map	Free	PDF, Converter
Thailand	Geo-Informatics and Space Technology Development Agency	Government	Thai SDI				
Bhutan	National Land Commission	Government	Bhutan GeoSpatial Portal	Thematic maps	ArcGIS Online	Free (allowed by owners)	Shape
Sri Lanka	Survey Department	Government	Geo Sri Lanka	Sheet map, Metadata	ArcGIS Online		Converter
	Survey Department	Government	Land Information System	Cadastral map	ArcGIS Online	Browsing only	-

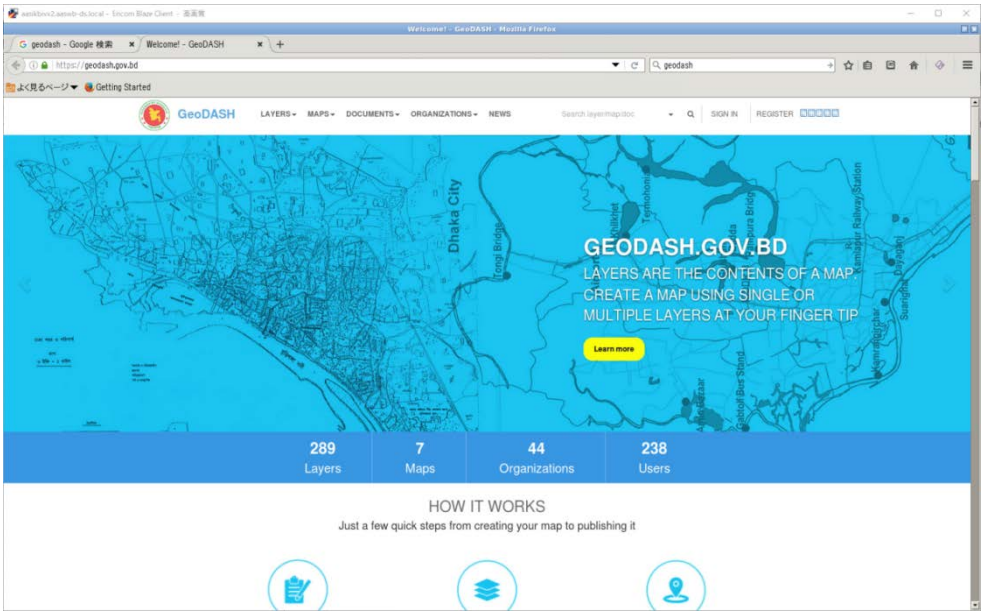
Source: The Project Team

3.2.2 Bangladesh Computer Council (BCC)

The Bangladesh Computer Council (BCC) is building a Geospatial Information Sharing System (GeoDASH) with the objective of achieving unified management and sharing of disaster information (Refer to Figure 3.2.1).

As of June 8, 2017, 238 users from 44 organizations have registered, and 289 layers have been uploaded. Users can upload and download data, and freely create maps.

The background map uses the Web map service which allows OSM and other data to be utilized free of charge.



Source：GeoDASH, BCC

Figure 3.2.1 Top screen of GeoDASH (https://geodash.gov.bd/)

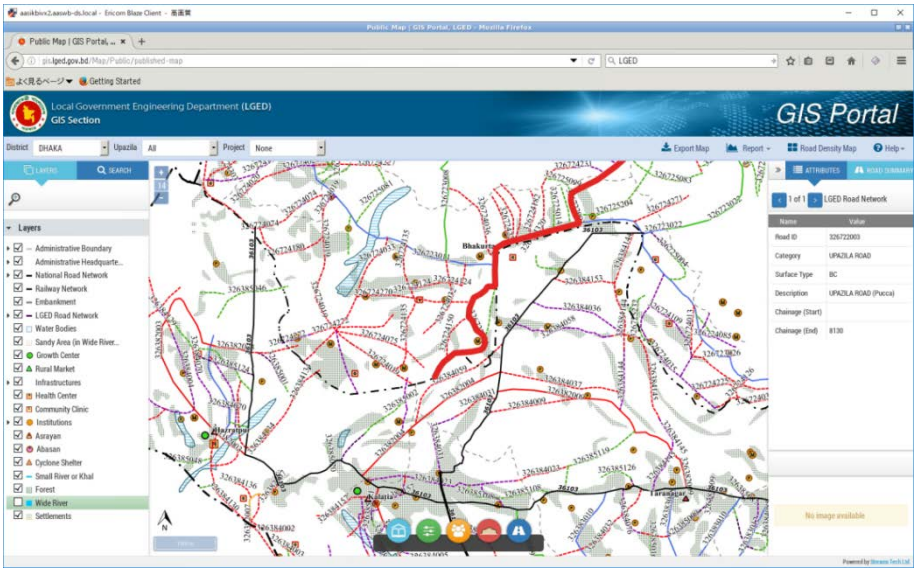
3.2.3 Local Government Engineering Department (LGED)

The Local Government Engineering Department (LGED) in Bangladesh has built a GIS Portal, and released information on administrative boundaries, road networks and facilities managed by LGED (Refer to Figure 3.2.2).

The background map uses maps (District Map, Upazila Map) prepared by the LGED.

Websites that enable District Maps, Upazila Maps and Road Maps to be downloaded in PDF or JPEG format have been built.

Furthermore, the LGED is also building websites that enable searching for information on the names, length, paving status and other information on roads being managed by the organization, and is actively releasing the information.



Source: GIS Portal, LGED

Figure 3.2.2 GIS portal screen image of LGED
(http://gis.lged.gov.bd/Map/Public/published-map)

3.2.4 Other organizations

Other organizations that handle geospatial information in Bangladesh are also building websites that enable viewing and downloading of information that they possess in PDF or JPEG format.

3.3 Disclosure of geospatial information in Japan

The disclosure status of geospatial information in Japan is described in this section.

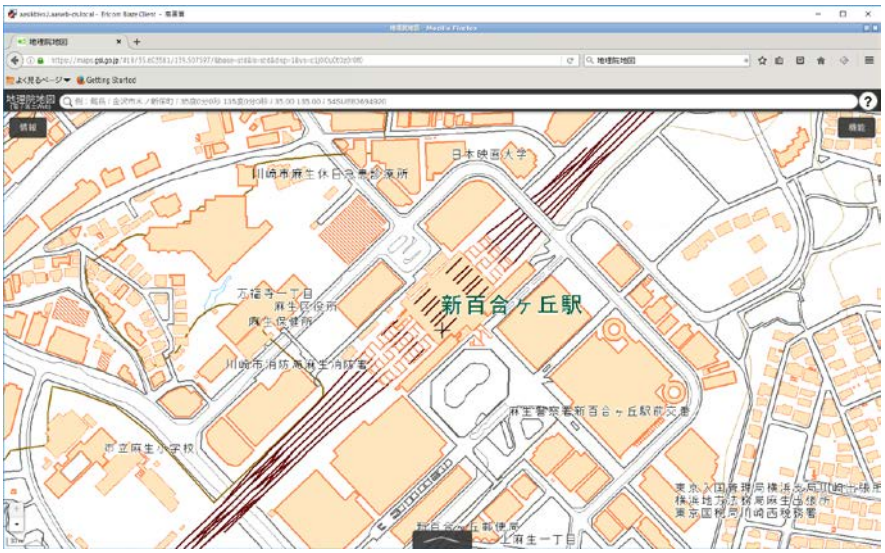
3.3.1 Geospatial Information Authority of Japan

The Geospatial Information Authority of Japan operates the “Geospatial Information Library” that enables geospatial information to be easily searched for, browsed and obtained over the internet, releases topographic maps, base map information, aerial photo images (ortho-images) developed by the Geospatial Information Authority of Japan as Geospatial Information Authority maps, and builds a system that enables overlay and display of over 1,800 types of geospatial information such as land condition maps and disaster condition maps (Refer to Figure 3.3.1).

Due to the fact that the Geospatial Information Authority tiles used for the background of the Geospatial Information Authority map are provided in XYZ form that supports many web map APIs, they can easily be used for building of websites and application development.

In addition, various services has been built, including a browsing service for control points and other results that enables the coordinates values of continuously operating reference stations,

triangulation points, benchmarks and other points to be confirmed and printed, a browsing service for maps/aerial photos that enables viewing of maps from 1890 and aerial photos before World War II, and a download services for base map information that enables base map data to be downloaded in vector format allowing secondary processing, providing an environment in which users can obtain geospatial information according to the individual objective.



Source: Geospatial Information Authority of Japan

Figure 3.3.1 Screen image of map from Geospatial Information Authority of Japan (https://maps.gsi.go.jp)

The usage status of geospatial information services provided by the Geospatial Information Authority of Japan is organized in Table 3.3.1, which illustrates that usage has steadily grown every year since the provision of services was started.

Table 3.3.1 Usage Status of Geospatial Information Services Provided by Geospatial Information Authority of Japan

Result Record	Unit	2013	2014	2015	2016
		Record	Record	Record	Record
Number of GIS Portal Uses	Times	-----	6,000	16,000	25,000
Number of Location Reference Information Downloads	Times	100,000	120,000	140,000	150,000
Number of Public Survey Website Accesses (Page Views)	Times	3,067,075	2,798,033	2,754,108	2,914,583
Number of Continuously Operating Reference Station (CORS) Observation Data Downloads	Times	-----	-----	168,800,000	217,300,000
Browsing of Electronic National Base Map/ Number of Users (1:25,000 conversion)	Sheets	38,765,118	39,216,116	40,815,505	68,280,246
Number of Lake Chart Views Based on Geospatial Information Authority of Japan Map	Times	94,369	373,758	443,379	448,296
Number of Global Map Data Tile Views	Times	-----	53,645	55,027,428	65,962,491
Number of Base Map Information Downloads	Times	4,375,728	9,842,040	12,484,814	15,340,324
Number of Geospatial Information Library Uses	Times	4,732,259	5,185,459	6,061,603	6,595,589

Source: Prepared by the Project Team using Administrative Operation Review Sheet for Fiscal 2015 and Administrative Operation Review Sheet for Fiscal 2016 (interim report) from the Ministry of Land, Infrastructure, Transport and Tourism

3.3.2 Ministry of Land, Infrastructure, Transport and Tourism

The Ministry of Land, Infrastructure, Transport and Tourism develops basic information concerning geography, land usage, public facilities and other such features related to national land as GIS data in order to drive forward national spatial plans, national land use plans and other national land policies as national land numerical information, and provides this data free of charge for items where practical from the perspective of disclosure, taking into consideration the Basic Act on the Advancement of Utilizing Geospatial Information.

3.3.3 Association for Promotion of Infrastructure Geospatial Information Distribution

The Association for Promotion of Infrastructure Geospatial Information Distribution established and operates the Geospatial Information Center to enable geospatial information possessed by public, private and other organizations to be freely combined and obtained from one location in order to achieve integration/fusion of diverse data and value creation transcending the barriers of organizations in the fields of industry, government and academia.

The Geospatial Information Center began operation in November 2016, and as of June 2017, 577 data items have been registered, which users can browse, download and purchase.

The background map used for the screen to confirm the map data is a Geospatial Information Authority tile.

3.3.4 Other organizations in Japan

In Japan, large-scale topographic maps (1:2,500 scale, etc.) are mainly developed by local governments, and some local governments are developing websites that release the map information they possess and allow the information to be searched for, browsed and/or downloaded.

3.4 Disclosure of geospatial information in countries surrounding Bangladesh

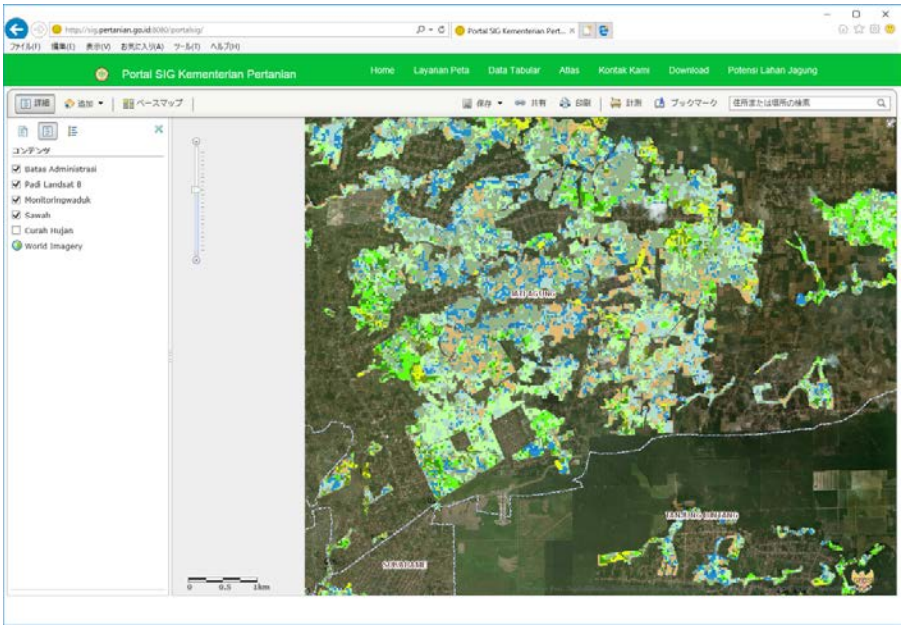
The disclosure status of geospatial information in countries surrounding Bangladesh is described in this section.

3.4.1 Indonesia

The Geospatial Information Agency in Indonesia (Badan Informasi Geospatial) developed Ina-Geoportal in the “National Land Spatial Data Development Project” implemented by JICA, has created a wide-ranging network that connects related ministries and agencies, built a website for release of information to the general public, and released 1:25,000 scale topographic map data.

ArcGIS Online (ESRI) has been adopted as the platform for Ina-Geoportal, which allows registered

users to freely create maps. In addition, vegetation condition and other primary data can be browsed on the website of the Ministry of Agriculture (Refer to Figure 3.4.1).



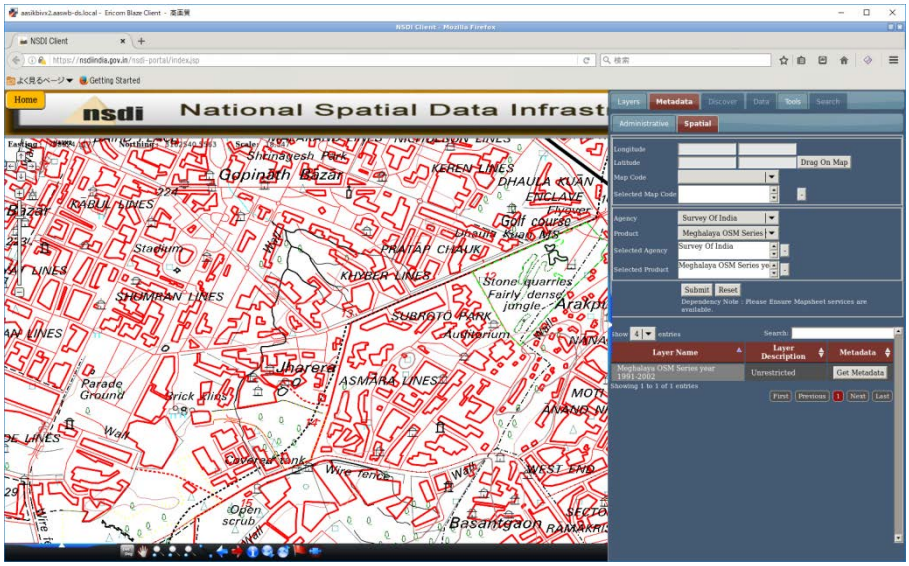
Source: Ministry of Agriculture in Indonesia

Figure 3.4.1 Public website of the Ministry of Agriculture in Indonesia
(http://sig.pertanian.go.id:8080/portalsig/)

3.4.2 India

The Department of Science & Technology in India has built the National Spatial Data Infrastructure as a website that releases various information concerning NSDI.

This website allows documents related to NSDI and coordinate conversion software to be downloaded. Open Series Maps (OSM) developed by the Survey of India are used for the background map (Refer to Figure 3.4.2).



Source: National Spatial Data Infrastructure, Survey of India

Figure 3.4.2 Image of OSM public website in India
(https://nsdiindia.gov.in/nsdi-portal/index.jsp)

3.4.3 Thailand

The Geo-Informatics and Space Technology Development Agency in Thailand has built ThaiSDI as a portal website for NSDI to release documents concerning NSDI (Refer to Figure 3.4.3). A link to the National Geospatial Catalogue which appears to be a catalog website for geospatial information, but the website could not be accessed as of June 2017.

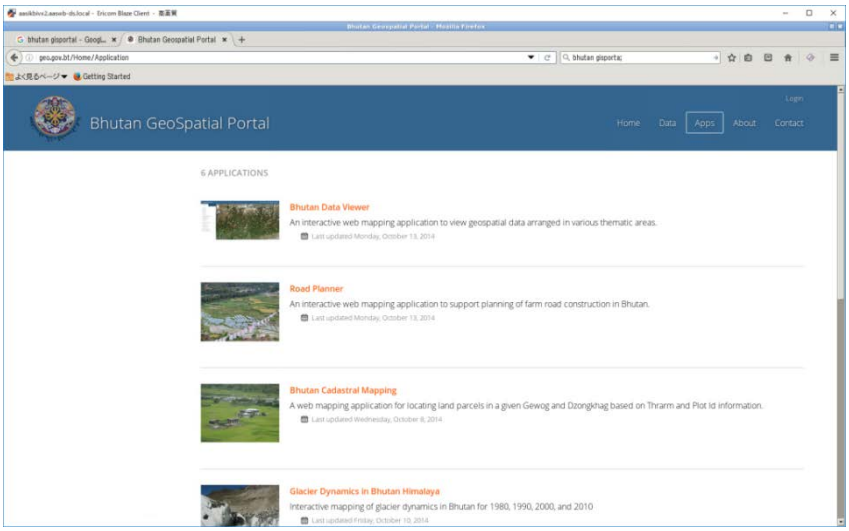
Source: ThaiSDI

Figure 3.4.3 ThaiSDI top screen (http://thaisdi.gistda.or.th/en/)

3.4.4 Bhutan

The National Land Commission in Bhutan has built the Bhutan GeoSpatial Portal using ArcGIS Online which releases river condition, road network, land cover, administrative boundary and other data.

A system has been built that enables a portion of the data to be downloaded in a format that allows secondary usage (Refer to Figure 3.4.4).



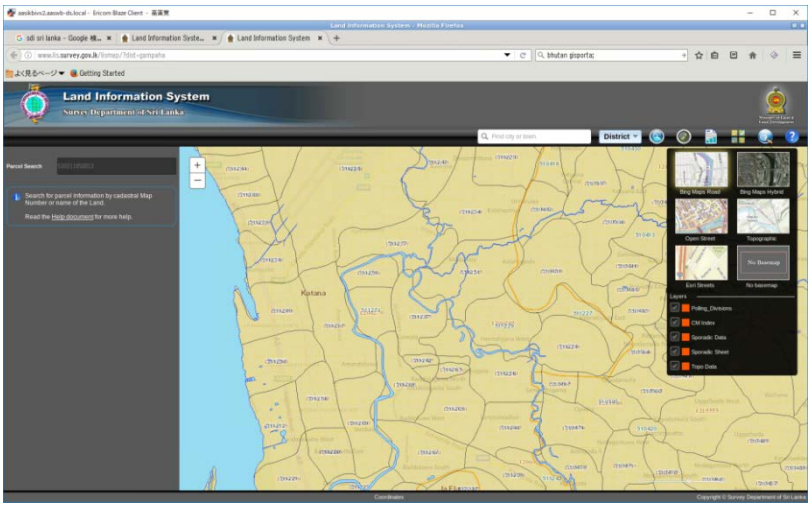
Source: Bhutan GeoSpatial Portal

Figure 3.4.4 Image of Bhutan GeoSpatial Portal data confirm screen
(http://geo.gov.bt/Home/Application)

3.4.5 Sri Lanka

The Survey Department in Sri Lanka has built the Geo Sri Lanka website, and releases sheet index map for topographic maps and metadata developed by the Survey Department.

In addition, cadastral information (cadastral maps) is released on the Land Information System website (Refer to Figure 3.4.5), and ArcGIS Online is the platform for both websites.



Source: Geo Sri Lanka

Figure 3.4.5 Image of Sri Lanka land information system screen
(http://www.lis.survey.gov.lk/lismapdata/)

3.5 Status of policies related to geospatial information in each country

The status of policies etc. related to geospatial information in each country is described in this section.

3.5.1 Approach concerning geospatial information in Bangladesh

The status of the approach concerning geospatial information in Bangladesh is described in this section.

1) Digital Bangladesh

In accordance with the manifest of the current government of Bangladesh called “Vision 2021”, the Perspective Plan of Bangladesh 2010 - 2012 was prepared which described eight priority areas, under which it is providing support to creative people in order to achieve a Digital Bangladesh that strives to introduce and incorporate Information Technology (IT) throughout the country.

The following four constituent elements of a Digital Bangladesh have been outlined, indicating that the development of geospatial information is a field that has a very close relationship.

a) Change to digital government: Digitization of government services to streamline government functions

b) Utilization of ICT in business: Simplify access from overseas, promote ICT business in the country, provide human resources to various countries in order to achieve use of ICT as a

policy in business fields

c) Dissemination of ICT to entire population: Building of environment enabling entire population to access network

d) Human resource development: Develop/nurture human resources possessing advanced ICT expertise to achieve Digital Bangladesh policy

The Access to Information Programme (a2i Programme) has been formulated as an integral part of the efforts to facilitate the change to digital government in Bangladesh, and work is proceeding on the building of a system that allows all public bulletins, announcements, notices and other information provided by the government to be accessed using a uniform code with mobile phones and other IT devices from anywhere in the country.

Under this program, the National Portal of Bangladesh (www.bangladesh.gov.bd) is being designed, built and operated with the objective of becoming a gateway for the 25,000 websites operated by all government and official agencies, from the various associations, consortiums and other organizations to government ministries and agencies.

The content that is being provided includes official information concerning health, education, business, agriculture, environment, human resource development and employment offers.

Establishment of the District e-Service Center (DESC) at all 64 local government capitals was started in 2001 with the objective of providing one-stop government services for residents and boosting the transparency of government, and 407 digital centers have been established to provide one-stop government services to 4,547 administrative villages, 321 towns and 11 cities.

In addition, work is proceeding on the building of the National e-Service System (NESS), which will directly connect the DESC and digital centers with the respective ministries and agencies of the central government and provide integrated government services.

These centers will share geospatial information and serve an important role in upgrading the quality of government services.

2) International seminar on National Spatial Data Infrastructure (June 1 - 2, 2016)

JICA and SOB held an International Seminar on National Spatial Data Infrastructure (NSDI) on June 1 and 2, 2016, and Honorable Prime Minister Sheikh Hasina talked about the importance and necessity of NSDI during the opening ceremony, and said that activities should be performed to facilitate a policy decision to build NSDI as soon as possible.

In addition to this seminar being attended by organizations related to domestic geospatial information in Bangladesh, lecturers from Japan, Indonesia, India and other regions were invited, deepening the understanding of participants in NSDI while using case studies in other countries as

reference, and discussions were held in preparation for building of NSDI tailored to the needs of Bangladesh.

An overview of the international seminar is described below.

Date: June 1 - 2, 2016
Location: Hotel Sonargaon, Ball Room
Overview: In order to complete digital map data for the entire nation of Bangladesh, manage the geospatial and other information possessed by other agencies with the same platform, and proceed with the building of a system (NSDI) that can be effectively utilized in various fields, such as city planning, disaster preparedness and business.
Lecturer: Key Note Speaker Dr. Hiroshi Murakami
Deputy Director General, Geospatial Information Authority (GSI), Japan
Technical Session
Bangladesh (8), Japan (3), Indonesia (1), India (1)

3.5.2 Approach concerning geospatial information in Japan

The status of the approach concerning geospatial information in Japan is described in this section.

1) Liaison conference of related ministries/agencies on geospatial information system (GIS)

In the aftermath of the Great Hanshin-Awaji Earthquake that struck this region on January 17, 1995, the geospatial information possessed by the respective related agencies such as large scale maps and road network related data could not be mutually utilized.

Therefore, work could not quickly and effectively proceed to obtain a grasp of the extent of the damage at the earliest point possible and provide support for rescue activities immediately after the earthquake.

In consideration of these lessons, the Government of Japan strongly recognized the importance of standardizing spatial data, established the Liaison Conference of Related Ministries/Agencies on Geospatial Information System (GIS) in September the same year, and the government proceeded with the development of a GIS and the creation of an environment allowing mutual usage in a planned and integral manner.

In 2005, the Liaison Conference of Related Ministries/Agencies on GIS evolved and was reorganized into the Positioning/Geographical Information Promotion Committee in order to promote linkage between GIS and satellite positioning.

Upon passage after this of the Basic Act on the Advancement of Utilizing Geospatial Information in 2007, the committee was renamed the Geospatial Information Utilization Promotion Committee on June 5, 2008.

2) GIS action program 2002 - 2005 (February 2002)

This program was formulated with the objective of forming the base environment for use of GIS, streamlining government through the effective use of GIS and delivering high quality government services.

The following items were implemented in accordance with this program.

a) Establishment of geographical information standard and G-XML[1] that prescribe standard for spatial data conversion method etc.

b) Development of 1:25,000 scale digital maps that covers entire country with uniform standard and 1:2,500 scale digital maps for urban planning areas

c) Digitization of government geographical information/development of system and guidelines from standpoint of promoting circulation

d) Revision of Real Property Registration Act to enable handling of electronic maps

e) Upgrading of local tax grant safeguards system concerning integrated GIS for local governments

f) Establishment of 21 Web GIS sites at related ministries and agencies

3) GIS action program 2010 (March 22, 2007)

The objectives of this program consist of creating a society that utilizes geospatial information in an advanced manner, heightening standards to an appropriate level as base map information which are the premise for this, formulating standards/rules to promote distribution of geospatial information and building a system to facilitate cooperation between industry, government and academia.

In addition, the following measures were implemented in a concentrated manner as basic policy for this program from the standpoint of addressing socioeconomic conditions in Japan, international state of affairs such as GIS measure results, issues to this point and outlook for progress of IT society in the future, and effectively, efficiently promoting GIS policy measures.

a) Development and updating of base map information

b) Protection of private information, secondary use of data, consideration of impact on national security

c) One-stop service for provision of base map information

d) Promote development of cadastral maps, and maps for registry offices

[1] G-XML was established on 2001 as a part of Japanese Industrial Standards for geospatial information exchange in Japan.

4) Basic act on the advancement of utilizing geospatial information (NSDI) (May 30, 2007, Act No.63)

This law describes the basic policy for Japan as a country to promote utilization of geospatial information, that it is the responsibility of the government to perceive geospatial information in a broad manner and build a common infrastructure to promote multifaceted utilization, and states that a common infrastructure for satellite positioning is a large pillar.

5) Basic plan for the advancement of utilizing geospatial information

First Period:	Fiscal 2008 - 2011	Cabinet Decision on April 15, 2008
Second Period:	Fiscal 2012 - 2016	Cabinet Decision on March 27, 2012
Third Period:	Fiscal 2017 - 2021	Cabinet Decision on March 24, 2017

The basic plan was prepared in accordance with Article 9 of the Basic Act: “In order to accomplish policies for the advancement of utilizing geospatial information in a comprehensive and well-planned manner, the state government must formulate a basic plan for the advancement of utilizing geospatial information”.

A plan was prepared and various measures are being implemented in consideration of the results/status of achievement of the basic plan and changes in the social situation related to geospatial information.

First Period Basic Policy

a) Configure guidelines concerning development/provision/distribution of geospatial information and promote provision/distribution of geospatial information

b) Promote development/provision of base map information

c) Establish advanced technical infrastructure for satellite positioning and promote utilization

d) Strengthen cooperation between industry, government and academia concerning promotion of geospatial information utilization

Second Period Basic Policy

a) Sustainable development of geospatial information in response to social needs and support for new uses

b) Development and use of practical quasi-zenith satellite system and expansion overseas

c) Deep penetration and establishment of geospatial information into society

d) Rebuilding from Great East Japan Earthquake and contributing to building of sustainable country resistant to disasters

Third Period Basic Policy

a) Contribute to formation of sustainable country resistant to disasters

b) Create of new transportation/distribution services

c) Contribute to high quality of life that is safe/secure in elderly society with decreasing population

d) Energize local industry and create new industries/services

e) Overseas expansion of technology/systems using geospatial information and provision of international contribution

6) Action plan for promoting utilization of geospatial information (Geospatial action plan)

In order to drive forward the Basic Plan for the Advancement of Utilizing Geospatial Information, the Government of Japan reviewed the specific objectives, achievement period and other details of various policies, and is doing a follow up on the achievement status each fiscal year.

7) Laws/acts concerning development of geospatial information

There are the following laws/acts concerning the development of geospatial information.

a) Survey Act

b) Aerospace Basic Act

c) Basic Act on Ocean Policy

d) Basic Act on Science and Technology

e) Basic Act on the Advancement of Utilizing Public and Private Sector Data

f) Basic Act for National Resilience

3.5.3 Development status of legal system for geospatial information in countries surrounding Bangladesh

The development status of the legal system concerning geospatial information in the countries surrounding Bangladesh is described in this section.

1) Development status of legal system for geospatial information development in Indonesia

Law No. 26 of 2007 stipulates that the government has an obligation to prepare land use planning maps (Spatial planning maps) at the national, regional and local level.

Presidential Regulation No. 85 of August 2007 states that geospatial data shall be shared by domestic government organizations and local governments by means of a national network.

Law No. 4 that was issued in April 2011 states that a single base map shall be used as a national framework for geospatial information and that surveying be shared.

Presidential Regulation No. 94 of December 2011 recognizes Badan Informasi Geospatial (BIG) is the only agency that provides base maps and is also the coordinator organization for activities involving geospatial information.

Presidential Regulation No. 6 of May 2012 states that BIG shall closely cooperate with the National Institute of Aeronautics and Space regarding the provision of high-resolution satellite image data.

Presidential Regulation No. 27 of 2014 states that 57 government ministries and agencies, 34 provincial governments and 514 local governments shall be connected by a geospatial information network centered around the National Geoportal.

Presidential Decree No. 9 of 2016 declared that development of the One Map Policy with a position accuracy level of 1:50,000 scale is to be accelerated.

2) Development status of legal system for geospatial information in countries surrounding Bangladesh

The development status of the legal system concerning geospatial information in India, Thailand, Bhutan and Sri Lanka is shown in Table 3.5.1.

Table 3.5.1 Development status of legal system for geospatial information in countries surrounding Bangladesh

Component of NSDI	India	Thailand	Bhutan	Sri Lanka
Legal Framework	-The Geospatial Information Regulation Bill (Draft, 2016)		-Land Act of Bhutan 2007	-Survey Act
Policy Framework	-National Geospatial Policy (Version 1.0, April 2016) -National Map Policy (2005) -National Data Sharing and Accessibility Policy-2012 (NDSAP-2012) -Civil Aviation Requirement (2012) -Remote Sensing Data Policy (2001 and 2011)		-Geo-information Policy of Bhutan (First Draft, July 2016)	
Geographic Information Standards	-NSDI Metadata Standard -NSDI Metadata Standard Version 2.0 -National Spatial Data Exchange (NSDE) Format -Data Specifications -Conceptual Data Model for 1:50,000 Scale Topographic Data -Standard for Bio-geo -Database Version 1 -Data Content Standards - Soils (Draft Version 2.0)	-The adoption of Geographic Information Standard -The standard document published -Metadata Implementation for Thailand Spatial Data Infrastructure		
Strategy, Action Plan, Present Status	-National Spatial Data Infrastructure (NSDI) - Strategy and Action Plan -NSDI Present Status -National Spatial Data Infrastructure - India ASPIRATION (July 2011)	-NSDI Action plan year 2554-2558 Buddhist Year (2011-2015) -Status of Thailand's GeoSpatial Data Infrastructure and Systems (2016) -The development of Thailand Spatial Data Infrastructure (NSDI)		-Sri Lanka Spatial Data Infrastructure Road Map Draft Report (November 2014)

Source: The Project Team

3.6 Organization structure in each country

The organization structure concerning NSDI in each country is described in this section.

3.6.1 Organization structure concerning NSDI in Bangladesh

In response to the statement by Honorable Prime Minister Sheikh Hasina at the NSDI International Seminar held in Bangladesh in June 2016, preparations have been started for the establishment of a committee that will conduct a review for the introduction of NSDI under the control of the Ministry of Defence of Bangladesh.

There are 43 ministries (53 agencies), 353 departments (As of June 2017), and many ministries and agencies that conduct operations that use geospatial information (Refer to Table 3.6.1).

Table 3.6.1 Relationship of ministries and agencies to geospatial information

No.	Ministry/Agency	Type	Relationship with Geospatial Information
1	President's Office	User	General use for location/position confirmation
2	Prime Minister's Office	User	General use for location/position confirmation
3	Cabinet Division	User	General use for location/position confirmation
4	Armed Forces Division	Preparer	Navy (BN) implements hydrographic surveys in ocean.
5	Ministry of Chittagong Hill Tracts Affairs (MOCHTA)	Preparer	Uses for planning and development activities in hilly district in Chittagong
6	Ministry of Primary and Mass Education (MOPME)	User	Uses for position confirmation and statistical analysis of primary education institutions
7	Ministry of Agriculture (MOA)	Preparer	Uses for agricultural policy, development planning, regulations, monitoring and other purposes
8	Ministry of Civil Aviation and Tourism	Preparer	Uses for airport facility management and planning, preparation of sightseeing master plan, sightseeing maps and other purposes
9	Ministry of Commerce	User	Uses for registered company management and statistical analysis
10	Ministry of Road Transport and Bridges (RTHD)	Preparer	Uses for road and bridge planning and management, and transport policy In the Road Maintenance & Management System (http://www.rthd.gov.bd/road_maintenance.php), Google Maps is used for position confirmation.
11	Ministry of Cultural Affairs	User	Uses for confirmation of position of cultural assets, historic sites and other locations
12	Ministry of Defence (MOD)	Preparer	SOB develops national base map and national control points.
13	Ministry of Food (MOF)	User	Uses for policy decision support and statistical analysis
14	Ministry of Education (MOE)	User	Uses for position confirmation and statistical analysis of secondary and higher education institutions
15	Ministry of Power, Energy and Mineral Resources (MPEMR)	Preparer	Uses for preparation of mineral resource exploration and geological maps, power development and power transmission management
16	Ministry of Environment and Forest (MOEF)	Preparer	Uses for forest preservation and forest resource development, forest inventory and environmental conservation Forest Cover of Bangladesh has been released on a website. (http://www.bforest.gov.bd/

No.	Ministry/Agency	Type	Relationship with Geospatial Information
			site/page/c588003a-63f7-445f-b553-f8b85f993f49/Map-showing-forest-types-and-location)
17	Ministry of Public Administration (MOPA)	User	General use for location/position confirmation
18	Ministry of Fisheries and Livestock (MOFL)	User	Uses for fishery stock development and facility management, livestock national census, and fishery and livestock farm establishment plans
19	Ministry of Finance (MOF)	User	General use for location/position confirmation
20	Ministry of Foreign Affairs (MFA)	User	General use for location/position confirmation
21	Ministry of Health and Family Welfare (MOH&FW)	User	Uses for medical facility site planning, public hygiene, infectious disease measures and statistical analysis
22	Ministry of Home Affairs	User	Uses for position of police stations, security planning and security measures etc.
23	Ministry of Housing and Public Works (MOHPW)	Preparer	Uses for city planning and housing development plans. RAJUK has released Dhaka City Map on a website (http://www.rajukdhaka.gov.bd/rajuk/image/template/DHAKA%20CITY-ARMY%2048X%2072FINAL%20MAP.jpg).
24	Ministry of Industries	User	Uses for industrial facility development plans BSTI is an agency concerning standardization
25	Ministry of Information	User	Uses for location and position confirmation etc. in public relations and other activities
26	Ministry of Textiles and Jute	User	Uses for policy planning, surveys and statistical analysis for textile industry
27	Ministry of Labour & Employment	User	Uses for employment measures, to obtain grasp of industrial structure between localities, etc.
28	Ministry of Law, Justice and Parliamentary Affairs	User	General use for location/position confirmation
29	Ministry of Land	Preparer	DLRS prepares cadastral maps.
30	Ministry of Local Government, Rural Development and Co-operatives	Preparer	LGED prepares regional plans/local government piping diagrams for management. WASA prepares maps for sewage/drainage system management.
31	Ministry of Planning	Preparer	BBS prepares statistical maps. Uses for support for decision making on medium to long term plans.
32	Ministry of Posts, Telecommunications and Information Technology	User	BCC has built GeoDASH as a Geo Portal website, and is building a system to share various types of data that is possessed by agencies related to disaster and other types of information.
33	Ministry of Religious Affairs	User	General use for location/position confirmation
34	Ministry of Shipping	Preparer	BIWTA conducts inland water hydrographic surveys.
35	Ministry of Social Welfare	User	Uses for social welfare policy planning, measures to fight poverty and statistical analysis
36	Ministry of Women and Children Affairs	User	General use for location/position confirmation
37	Ministry of Water Resources	Preparer	BWDB prepares irrigation maps
38	Ministry of Youth and Sports	User	General use for location/position confirmation
39	Ministry of Liberation War Affairs	User	General use for location/position confirmation
40	Ministry of Expatriates Welfare and Overseas Employment	User	General use for location/position confirmation
41	Ministry of Railways	User	Uses for railways plans and facility management
42	Ministry of Science and Technology	User	Uses for nuclear power station plans, facility management, safety measures, etc.
43	Ministry of Disaster Management and Relief	Preparer	DDM prepares flood hazard and other maps.

Source: The Project Team

3.6.2 Structure of geospatial information utilization promotion committee in Japan

The Geospatial Information Utilization Promotion Committee in Japan consists of the Geospatial Information Utilization Promotion Committee with the Cabinet Secretariat serving a central role as well as the director generals of the related government agencies, an administrative board comprised of the directors of divisions in charge at the related government agencies to facilitate smooth operation of the committee, and working groups which conduct specialized review of specific individual items.

3.7 Development status of geospatial information in Bangladesh

The existing Geospatial Information in Bangladesh has been individually prepared and developed by SOB which is the national surveying/mapping agency in Bangladesh, as well as by other respective agencies for unique purposes.

The main agencies consists of the Department of Land Records and Survey (DLRS) which conducts cadastral surveys, Bangladesh Navy (BN) which conducts hydrographic survey (ocean), Bangladesh Inland Water Transport Authority (BIWTA) which conducts hydrographic survey (inland water), Local Government Engineering Department (LGED) which prepares Upazila maps, Dhaka Water Supply and Sewerage Authority (Dhaka WASA) which prepares water supply and sewerage facility maps, the Bangladesh Water Development Board (BWDB) which prepares irrigation maps, and Bangladesh Bureau of Statistics (BBS) which prepares census maps.

Due to issues resulting from the history of surveying/topographic map preparation in Bangladesh and the fact that the objective of preparing the data differs depending upon the respective type of geospatial information, the reference ellipsoid, map projection, precision and length unit vary based on the agency that prepares the data.

The reference ellipsoid, map projection and length unit of the geospatial information used for

a)	SOB	Data prepared	National control points 1:25,000 & 1:5,000 scale topographic maps
		Reference ellipsoid	WGS-84
		Projection method	BUTM
		Length unit	Meters (m)
b)	LGED	Data prepared	Upazila map
		Reference ellipsoid	Everest 1830
		Projection method	Lambert Conformal Conic Projection
		Length unit	Meters (m)
c)	BBS	Data prepared	Statistic census maps

	Reference ellipsoid	Everest 1830
	Projection method	Lambert Conformal Conic Projection
	Length unit	Meters (m)
d) DLRS	Data prepared	Cadastral maps (Mouza Map)
	Reference ellipsoid	Everest 1830
	Projection method	Cassini Projection (Transverse equidistant conical projection)
	Length unit	Feet
e) Dhaka WASA	Data prepared	Water supply/sewerage facility maps
	Reference ellipsoid	WGS-84
	Projection method	UTM
	Length unit	Meters (m)

The private sector adds POI (Points of Interest) to maps prepared by SOB and DLRS, and sells them as Guide Maps (national version and city versions).

The Office of the Prime Minister of Bangladesh Access to Information (a2i) Programme began releasing street views for Dhaka and Chittagong captured in cooperation with Google.

Chapter 4 Relevant Legal System for NSDI

Chapter 4 Relevant Legal System for NSDI

This chapter describes the results of investigating the relevant legal system for NSDI in Bangladesh and its contents.

4.1 Investigation of legal framework of NSDI

This section describes the results of investigating the relevant legal framework for NSDI in Bangladesh.

4.1.1 Legal restrictions on handling of geospatial information

In building and operation of NSDI aimed at promoting the sharing, provision, and distribution of geospatial information as one of its purposes, any restriction on handling of geospatial information is a large negative element.

Therefore, investigation was conducted on the current legal restrictions on handling of geospatial information in Bangladesh.

1) Previous handling of geospatial information of SOB

The various responsibilities of SOB, a national surveying and mapping organization, are defined in the operation regulations of the Ministry of Defence and include surveying, maintenance of control points, and topographic mapping.

A law generally called the Survey Act in Bangladesh defines the implementation of cadastral survey to be conducted by the Department of Land Records and Surveys (DLRS) and does not define geodetic and topographic surveys, etc.

The handling of geospatial information owned by SOB was strictly managed according to the definition in the "Ordinance on Classification, Provision, and Management of Maps" and "Ordinance on Classification, Management, and Provision of Aerial Photos" under the jurisdiction of the Ministry of Defence.

Therefore, cumbersome procedures had to be carried out by any third party who wished to obtain or utilize geospatial information and this caused a difficult situation for practical uses.

Table 4.1.1 Acts related to surveys and maps in Bangladesh

Name of law	Year of enactment	Jurisdiction	Outline
Operational Regulations of the Ministry of Defence	1982	Ministry of Defence	These operational regulations of the Ministry of Defence also cover the responsibilities of SOB. The major responsibilities of SOB include geodetic survey, topographic survey (creation and maintenance of topographic maps), other survey, management of aerial photos in Bangladesh, and provision of outputs.
Ordinance on Classification, Provision, and Management of Maps	1972		Applied to maps to be managed and provided by SOB. Maps are classified by presence or absence of restrictions on use.
Ordinance on Classification, Provision, and Management of Aerial Photos	Unknown		Applied to aerial photos to be managed and provided by SOB for other than military purposes and classified into confidential and public aerial photos.
Survey Act (An Act to provide for the survey and demarcation of land)	1875	Ministry of Land	Defines the implementation of geodetic survey to be conducted by the Department of Land Records and Surveys (DLRS) that belongs to the Ministry of Land.

Source: The Project Team

2) Current and future handling of geospatial information

Legally speaking, the above regulations must be complied with at present because the procedure of enacting a New Survey Act to promote open geospatial information has not yet been completed.

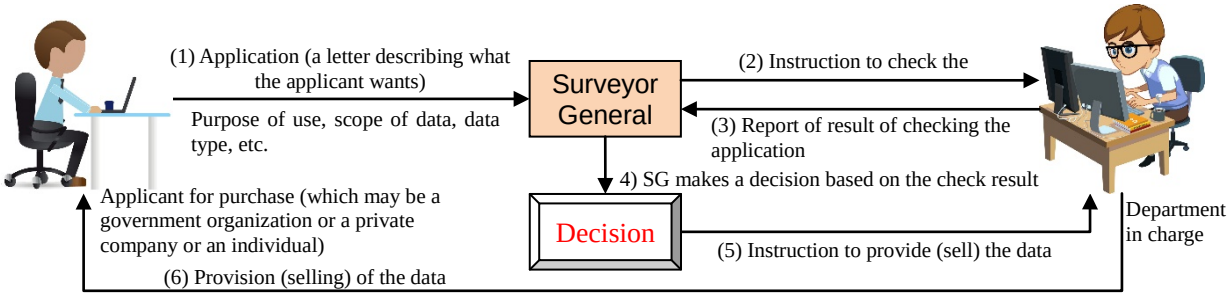
However, SOB is applying the regulations flexibly to provide the outputs created so far in the JICA project (Refer to Table 4.1.2).

Table 4.1.2 Current statuses of handling geospatial information by SOB

Geospatial information		Type	Handling status
Topographic maps	1:5,000	Open series and restricted maps	Open series maps are available for purchase as printed maps, PDF, and digital data.
	1:25,000	Open series and restricted maps	Open series maps are available for purchase as printed maps, PDF, and digital data.
	1:50,000	Restricted maps	With restrictions
Compilation maps	1:250,000	Restricted maps	With restrictions
	1:500,000	Restricted maps	With restrictions
	1:1,000,000	Open series maps	With restrictions
Orthophoto	1:5,000	Unknown	Unknown. Aerial photos are permitted depending on the purpose of use.
	1:25,000	Unknown	Unknown. Aerial photos are permitted depending on the purpose of use.
DEM data		Unknown	Unknown
Control point data		Open data	Available for purchase

Source: Prepared by the Project Team based on the existing materials and the results of interview survey on SOB

The digital data of topographic maps can be acquired in a procedure shown in Figure 4.1.1 and has already become available. Furthermore, the website of SOB shows a list of geospatial information available as a free service to citizens.



Source: Prepared by the Project Team based on the results of interview survey on SOB

Figure 4.1.1 Digital data provision procedure by SOB

This procedure apparently takes a few days but seems to require a little more time if the Surveyor General of SOB is absent. There was reportedly a case in the past where the procedure was completed in one day.

The unit price of digital topographic map data (Vector format) is Taka 250.- per sheet/layer. One sheet of digital topographic map data (Vector format), which consists of six layers (administrative boundaries, annotations, facilities, water areas, topographic features, and roads/railways), costs Taka 1,500.- per sheet.

There are two types of printed topographic maps: Open series and restricted maps. There are the following two differences between these two versions:

a) The open series topographic maps do not show all the Key Point Installations (KPIs). However, some KPIs are shown.

b) The open series topographic maps do not show one-kilometer grid lines.

The open series topographic maps are immediately available to anyone for purchase as long as they are in stock (A purchaser needs only to fill out an application form and pay the price.). The price is Taka 150.- per sheet.

The acquisition of information on control points (GPS points and benchmarks) can be applied for in the same way as for digital topographic map data. The unit price of information on one control point is Taka 100.-. Anyone who wants to purchase it must come to SOB in Dhaka.

SOB is planning to reconsider the distribution method in consideration of the convenience of those who live in a remote place after NSDI is built.

The prices of the geospatial information cannot be determined only by SOB and the Ministry of Defence. The Ministry of Finance has the final say in determining the prices.

3) KPIs

KPI, an abbreviation for Key Point Installation, means an important facility in terms of

national defence and public security and is restricted for showing on a topographic map.

KPIs are under the jurisdiction of the Ministry of Home Affairs. The ministries and agencies are required to submit information on KPI candidates to the Ministry of Home Affairs and then this Ministry designates KPIs. Security guards and other required staff must be stationed at the designated facilities.

The representative KPIs include designated government buildings, large bridges, antenna facilities for telephone networks, etc., power stations, and oil storage bases and tanks.

The list of KPIs created by the Ministry of Home Affairs is provided to the Ministry of Defence and then to SOB. The Ministry of Defence and SOB determine which KPIs should be shown on topographic maps (the Ministry of Home Affairs does not have authority to determine this).

At present, this selection is flexibly determined to hide a minimum-required number of KPIs and express as much information as possible on topographic maps.

4) Other restrictions and precautions on geospatial information

a) Aerial photography

Aerial photographs can also be taken by other organizations than SOB if the prescribed procedure (acquisition of permission for flight and aerial photography) is complied with.

However, there remain the regulations that films should be developed at the photo lab at SOB and that the negatives, aerial photos, etc. should be submitted to SOB after completion of the Project.

These regulations, which assume the use of analog cameras, must be revised for digital cameras, which are in the mainstream at present.

Furthermore, the area over an airport used to be designated as photography-prohibited area but is reportedly no longer so.

b) Legal restrictions on geospatial information of other government organizations

The Upazila maps prepared by LGED are able to download from Web system, and there is no legal restrictions for utilization of these Upazila maps.

Due to the fact that there is no regulations regarding projection and coordinates system for the preparation of Upazila maps, it is possible to change the projection and coordinates system of Upazila maps without legal procedures.

Meanwhile, the Mouza map (cadastral maps) are prepared based on the existing Survey Act, 1875 by DLRS.

The existing Survey Act 1875 does not mention about the projection and coordinates system for the preparation of Mouza maps.

It is considered that the projection and coordinates system to be used for Mouza maps are mentioned in the regulation of DLRS, however, further investigation will be necessary.

c) UAVs and drones

The Ministry of Defence and SOB do not impose any restriction or condition on the flight of UAVs and drones. The regulations by the Civil Aviation Authority are unknown.

Photography and measurement using UAVs and drones must be examined in the future.

d) Private survey companies

Private survey companies must be registered with SOB before they are contracted by local governments, etc. to carry out survey operations.

A license is granted to a private company after SOB checks whether it can meet the required quality level of survey outputs based on the numbers of engineers, survey equipment, etc.

Furthermore, private companies do not need a survey permission from SOB regarding the implementation of ground survey, etc. However, the procedures for a national government, police, etc. are required.

4.1.2 Status of enactment of NSDI Act and New Survey Act

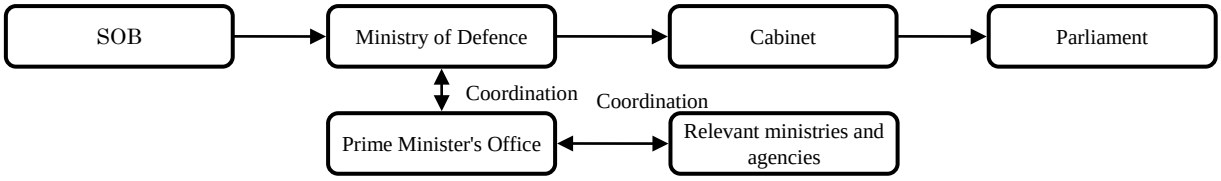
Investigation was conducted on the status in which SOB is promoting enactment of NSDI Bill and New Survey Bill in preparation for building and operation of NSDI.

1) Procedure of enactment

As of May 2017, SOB completed creating two bills and submitted them to the Ministry of Defence, its supervising authority.

The NSDI Bill is under examination by the Ministry of Defence and the New Survey Bill has been submitted by the Ministry of Defence to the Prime Minister's Office.

After coordination with the Ministry of Defence and other relevant ministries and agencies, they will be submitted to the Cabinet and the Parliament.



Source: Prepared by the Project Team based on the results of interview survey on SOB

Figure 4.1.2 Procedure of enactment

2) Composition of bill

At present, the NSDI Bill of Bangladesh has the composition shown in Table 4.1.3.

Table 4.1.3 Overview of composition of NSDI Bill

No.	Composition		Overview
1	Preamble	Reason for enactment	Common platform, redundant development of data, utilization of data, etc.
2	Chapter 1	Definitions, etc.	Definitions of terms, roles of SOB, contribution to national development, environment, and study, etc.
3	Chapter 2	Promotion system	Structure of promotion system, participating organizations, authorities, responsibilities, establishment of NSDI plan, etc.
4	Chapter 3	Management and budget	Data classification, cost sharing, etc.
5	Chapter 4	Ensuring of safety and distribution	Responsibilities of director-general of SOB, copyrights, distribution, metadata, etc.
6	Chapter 5	Violation and ruling	Violations, penalties (existing penal laws), etc.
7	Supplementary provisions	Miscellaneous	Compliance, translation of laws into English, etc.

Source: SOB

The remarkable points are Clause 23 and 24 of Chapter 3 on the NSDI Bill.

Clause 23 Provision and utilization of geospatial information to be opened
The geospatial information will be provided to citizens in general with no charge.

Clause 24 Provision and utilization of geospatial information on NSDI
1) Only government organizations will be able to use the geospatial information on NSDI.
2) Other organizations will be able to use the geospatial information on NSDI with a approval of surveyor general of SOB.

As mentioned above, on the NSDI Bill, it is clearly mentioned that the geographic information of SOB will be able to use by other organizations to promote the utilization of geospatial information and dissemination of NSDI.

The Japanese NSDI Act, which has been enacted as a basic act[1], cannot be compared simply with the bill of Bangladesh. However, the overview of its composition is shown in Table 4.1.4 for reference.

[1] A basic act specifies the basic principles such as national systems and policies in a sector that bears importance in the national administration and takes precedence over other acts regarding items that belong to the same sector as the basic act.

Table 4.1.4 Overview of composition of Japanese NSDI Act

No.	Composition		Overview
1	Chapter 1	General	Purposes, definitions, basic principles, obligations of national and local governments, etc.
2	Chapter 2	Basic plan	Establishment of Basic Plan for the Advancement of Utilizing Geospatial Information
3	Chapter 3	Basic measures	
4	Section 1 General		Survey and research, dissemination of knowledge, human resource development, personal information protection, etc.
5	Section 2 Geospatial information system		Development, utilization, and distribution of base map information, research and development of GIS, etc.
6	Section 3 Global positioning		Liaison and coordination regarding global positioning, promotion of research and development, etc.
7	Supplementary provisions		

Source: Basic act on the advancement of utilizing geospatial information

Individual acts such as the Survey Act define the regulations on relevant organizations and individual rights, procedure for approval and licensing of entry to business, etc.

When the NSDI Act was enacted in Japan, therefore, the Survey Act was revised to ensure consistency with the NSDI Act. The major revisions of the Survey Act[2] are as follows:

a) Provision of the basic survey outputs such as maps via the Internet
Start of free-of-charge supply of base map information via the Internet.

b) Relaxation of regulations on the procedure for approving duplication of survey outputs
This revision approved commercial use of duplication, which was previously prohibited.

c) One-stop procedure for applying for approval of duplication and use of public survey outputs
The Geospatial Information Authority of Japan is able to apply for approval on the Internet on behalf of a local government.

d) Disclosure of installation of survey-related permanent monuments[3] or temporary markers, etc.
The Act was thus revised to prevent illegal contamination and contribute to convenience of potential users.

At present, the New Survey Bill of Bangladesh has the composition shown in Table 4.1.5.

[2] Source: "Introduction to Basic Act on the Advancement of Utilizing Geospatial Information" edited by Ryosuke Shibasaki, published by Nihon Kajo Publishing Co., Ltd.
[3] Survey monuments and markers, which are indicators to be used for survey, include orienting stones of control points.

able 4.1.5 Overview of composition of New Survey Bill

No.	Composition		Overview
1	Chapter 1	Definitions	Definitions of terms, precedence over the conventional act, etc.
2	Chapter 2	Establishment of SOB	Location, responsibilities, activities (such as survey types), etc. of SOB
3	Chapter 3	Director-General of SOB	Authorities, responsibilities, etc. of Surveyor General of SOB
4	Chapter 4	Budget, etc.	Survey with the government budgets, sharing of budgets, licenses, survey markers, etc.
5	Chapter 5	Violations and penalties	Violations, penalties (existing penal laws), etc.
6	Supplementary provisions	Miscellaneous	Employment by director-general of SOB, etc.

Source: SOB

The New Survey Bill lists the violations as (1) interference with survey activities, (2) destruction of survey markers, (3) survey and mapping without licenses, (4) illegal survey, (5) acquisition of survey licenses using false reports, (6) violations of SOB guidelines, (7) use of false geospatial information, (8) use of survey markers without authorization, and (9) use of illegal geospatial information.

The remarkable point is Clause 3 of the New Survey Bill.

Clause 3 Utilization of maps and data by organizations

1) All government organizations, local governments, nongovernment organizations and organizations for development programs have to follow the projection, coordinates system and data designated by SOB.

2) All government organizations, local governments, nongovernment organizations and organizations for development programs are approved to use the maps and geospatial information according to need.

It is considered that this Clause aims to promote the provision and mutual utilization of geospatial information to support the construction and operation of NSDI.

At present, no inconsistency with the NSDI Bill is found.

3) NSDI promotion system

The NSDI Bill specifies that SOB will serve as the secretariat to play a central role in building and operating NSDI.

Furthermore, it also defines the establishment and authorities of the NSDI Committee to manage building and operation of NSDI (refer to Table 4.1.6).

Table 4.1.6 NSDI promotion system (proposed) in NSDI Bill

Level	Name	Class	Remarks
1	National Committee	Minister level	Consists of 30 or so ministers and equivalents and is chaired by the Prime Minister.
2	Technical Committee	Secretary level	Chaired by the Secretary of the Minister of Defence and also includes members from universities.
3	Executive Committee	Director level	Consists of directors of other ministries and agencies and is chaired by the Surveyor General of SOB.

Source: SOB

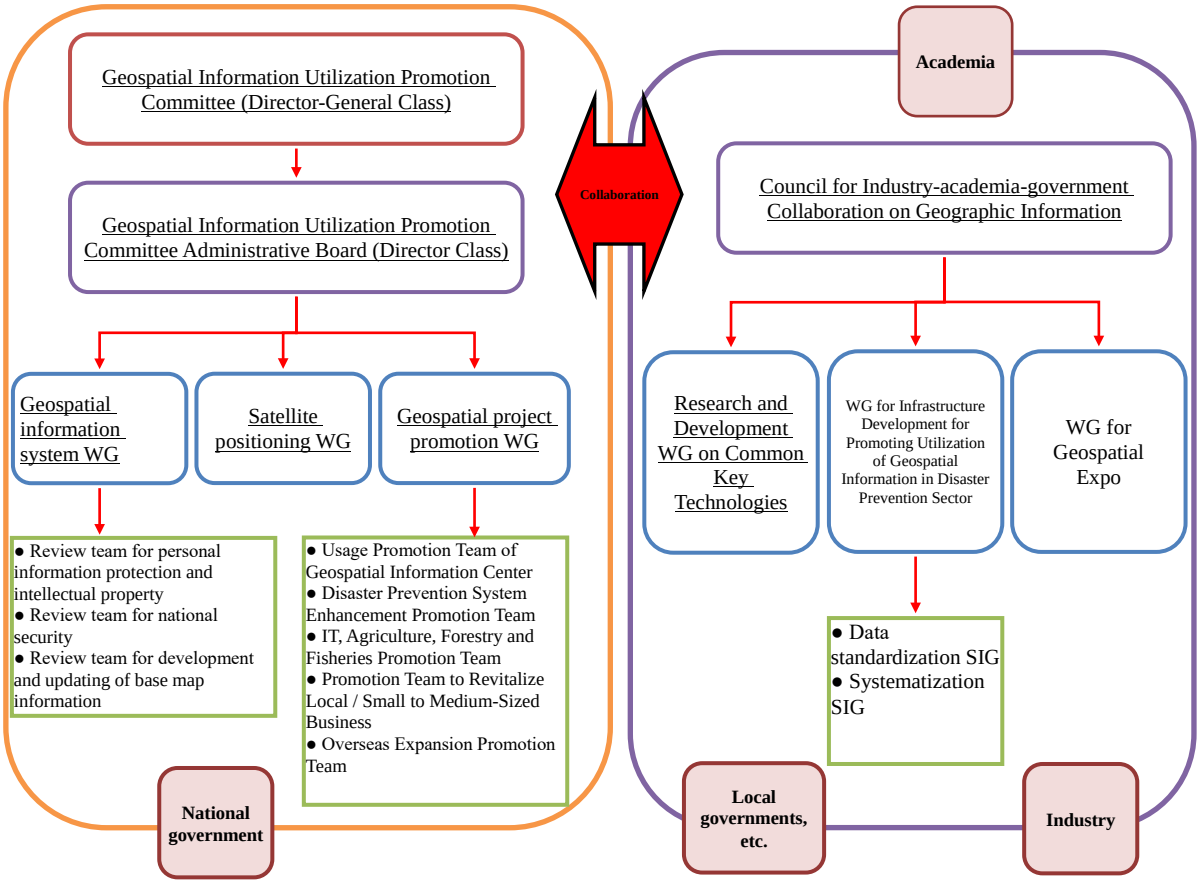
The NSDI Bill defines the high-level organizational structures and authorities but does not describe the working-level staff.

Therefore, it is necessary to organize a working group that consists of working-level staff to deal with each of expected problems.

Figure 4.1.3 shows NSDI promotion system in Japan for reference. This promotion system is not defined in the NSDI Act but established according to a decision made by the Chief Cabinet Secretary.

The Geospatial Information Utilization Promotion Committee (Director-general class), NSDI promotion system in Japan, is chaired by the Deputy Chief Cabinet Secretary and attended by members who are director generals of ministries and agencies.

A working group consists of directors of divisions of ministries and agencies.



Source: Cabinet Secretariat (Geospatial Information Utilization Promotion Committee)

Figure 4.1.3 NSDI promotion system in Japan (reorganized in December 2015)

4) Conventional SOB-related regulations and New Survey Act

The conventional regulations and guidelines are still in effect and impose various restrictions. However, they mainly concern 1:50,000 scale printed maps and are not applicable to the 1:5,000 scale and 1:25,000 scale digital topographic maps (open series topographic maps).

The New Survey Act concerns the 1:5,000 and 1:25,000 scale topographic maps, etc. (open series topographic maps) and defines also the creation, provision, usage, etc. of them.

Note that its consistency with the conventional internal regulations was already confirmed when IDMS and BDMAP were implemented. When the New Survey Act comes into effect, therefore, the conventional regulations will be overwritten with it.

Any SOB internal regulation created by SOB takes effect upon approval by the Ministry of Defence. Any organizational reform of SOB also takes effect upon approval by the Ministry of Defence as long as the number of personnel remains within the total fixed number.

4.1.3 Relevant acts, policies, etc. for NSDI

The major existing acts and policies were investigated because consistency with not only the NSDI Act but also other acts and policies must be considered in building and operation of NSDI.

1) Copyright acts

A system for promoting secondary usage of geospatial information is required for building and operation of NSDI. The copyright acts were investigated because copyrights are closely related to secondary usage.

Note that whether maps are recognized as copyrighted materials depends on the copyright acts and court precedents of a concerned country.

In Japan, not all the maps and geospatial information but rather only those with confirmed creativity or originality are considered as copyrighted materials. Final decisions are made according to court ruling.

In a case in a certain country, maps and geospatial information were recognized as copyrighted materials in consideration of costs required to build the database.

In Bangladesh, the Copyright Act has been enacted. However, the protection of and attention to copyrights seem not to be so commonly recognized.

On the other than, LGED, that has been handling geospatial information and GIS for many years, was confirmed to pay attention to the copyrights of the high-resolution satellite images of the private sector.

In Bangladesh, the Copyright Act was in 2000 instead of the old copyright ordinance (Ordinance No. XXXIV of 1962) in 1962 at East Pakistan Era.

The responsible organization is the Ministry of Low, Justice and Parliamentary Affairs.

In case of Copyright Act in Japan, the works without creativity will not be judged as copyrighted works. The Copyright Act in Bangladesh also places importance on the creativity of works.

Followings are the copyrighted works authorized by the Copyright Act in Bangladesh.

Copyrighted works:
- Literary work, dramatic work, musical work, artistic work
  (Painting, Carving, Design, Drawing, Graving, Photo, Architectural structure, other art works)
- Cinematographic films
- Sound recordings
- Broadcast
- Computer programs

Maps are included in the category of artistic work, and the publications by the government organizations are defined as copyrighted works.

Accordingly, topographic maps and maps of SOB are authorized as copyrighted works. However, it is not clear the definition of publications by the government organizations.

In the Copyright Act, the topographic maps as database and the secondary copyrighted works are not defined, and further discussion is necessary during the construction and operation of NSDI.

2) Personal information protection act

In Bangladesh, no personal information protection act has been enacted yet. However, the enactment of such act is highly likely in view of the world trend. Therefore, attention must be paid to the protection of personal information in the geospatial information in building and operation of NSDI.

At present, the geospatial information closely related to personal information at present consists of land records (land register).

DLRS, which has jurisdiction over the matter, separately manages figural information on land boundaries and attributive information such as land owners in a database (although links between data can be created), paying considerations to personal information.

3) National property act

In the policies of NSDI and open data, geospatial information may possibly be provided free of charge to a third party.

If such information is a national property with copyrights, consistency with the disposal clause in a national property act must be ensured.

Therefore, such act in Bangladesh was investigated but only a clause on land was found and no other description on national properties was found.

4) Open data

There are generally restrictions on utilization and commercial use of public data owned by a national or local government.

However, this data has such high utility value in economic activities that the idea of converting public data to open data is spreading over the world. The establishment and implementation of open data strategies are progressing in the developed countries including Japan.

In the U.K., the Ordnance Survey, which is famous for its strict license management, is providing geospatial information (1:10,000 scale) free of charge.

The NSDI of the U.K. (called "UK Location") is integrated into an open data portal, which

constitutes an example of linkage between open data and NSDI. The open data portals of Japan and the U.S.A. also handle geospatial information.

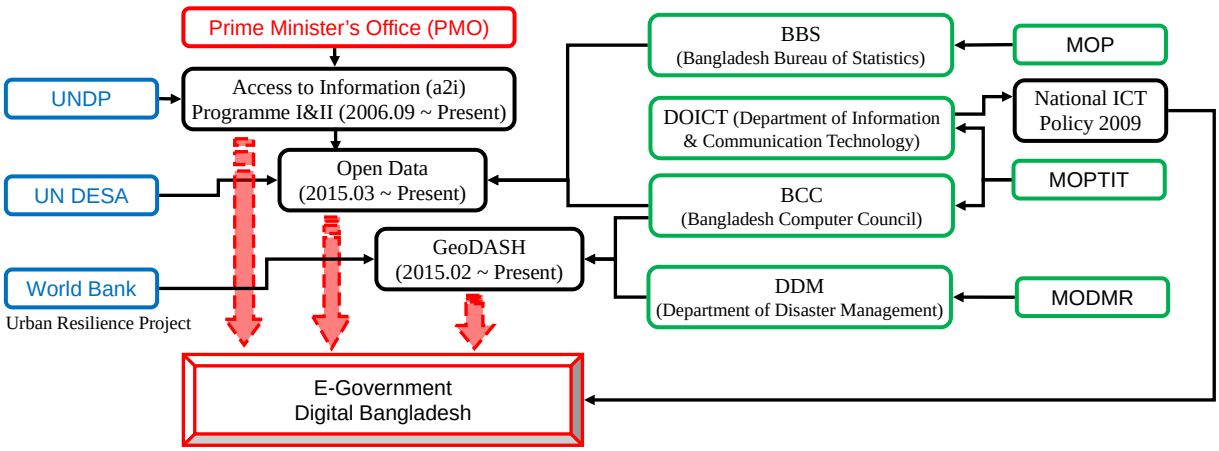
In Bangladesh, the a2i Programme implemented on the initiative of the Prime Minister's Office (2007 to 2018 with UNDP/USAID assistance) is working on open data (data.gov.bd) and the Bangladesh Bureau of Statistics (BBS) is running the portal site of open data.

However, the ministries and agencies including BBS are under various restrictions on information disclosure so that disclosure of data has not progressed. Additionally, geospatial information has not been registered nor disclosed.

For BBS, for example, provision of statistic data at cost is required and free-of-charge disclosure is difficult.

The project for building a portal site does not concern building of legal frameworks or linkage between relevant ministries and agencies.

Figure 4.1.4 shows the correlation among the projects in ICT sector, such as a2i programme, open data, and relevant organizations.



Source: The Project Team

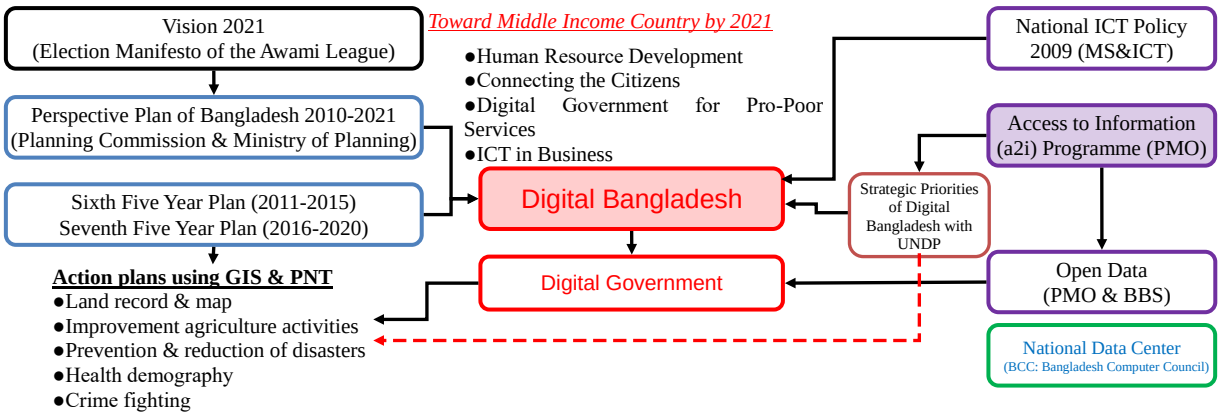
Figure 4.1.4 Correlation between projects in ICT sector and relevant organizations

5) a2i programme and Five Year Plan (National development plan)

The a2i Programme (Access to Information Programme) serves as the core of Digital Bangladesh and plays the role of promoting it.

This program receives assistance from UNDP and has an implementation system at the Prime Minister's Office. It concerns the open data and GeoDASH projects implemented by other ministries and agencies.

To include building and operation of NSDI in the 8th Five Year Plan (2021 to 2025), it is indispensable to understand and involve the a2i Programme.



Source: The Project Team

Figure 4.1.5 Relationship between National Development Plan, Digital Bangladesh, and a2i Programme

In the Five Year Plan so far, geospatial information is mentioned a little in the Open Government Data Strategy but not so much in the development plan or policies of the entire government.

On the other hand, some action plans in the land, agriculture, and disaster prevention sectors using GIS and satellite positioning are found.

Since there is a plan to include the Data Sharing Policy in the 8th Five Year Plan (2021 to 2025), it is considered important to involve NSDI in it.

Note that the target data includes not only geospatial information but also the entire data of the government so that it is considered necessary that SOB should participate in it.

Furthermore, guidelines must be created to enable sophisticated use of GIS and geospatial information in NSDI.

6) Standards and guidelines on ICT

The Bangladesh Computer Council (BCC) summarizes standards, guidelines, etc. on building and operation of ICT systems of government organizations as the Bangladesh National Enterprise Architecture (http://nea.bcc.gov.bd/).

The Bangladesh National Enterprise Architecture includes system design for applications, data structures, operation methods including costs, interoperations between organizations, hardware configuration including communications, and security.

These standards and guidelines must be complied with in the examination of the IT service of NSDI.

4.1.4 Legal system of Bangladesh

The legal system of Bangladesh is shown in Table 4.1.7.

Table 4.1.7 Legal system of Bangladesh

No.	Name	Overview
1	Constitution of People's Republic of Bangladesh	The Constitution is the supreme law of Bangladesh.
2	Act of Parliament	An Act of Parliament is enacted by the resolution of the Parliament.
3	Order (Presidential Order)	An Order has equivalent effect to an Act of Parliament. The President no longer has this authority after the Parliament is established. There are still Orders that are in effect at present.
4	Ordinance	According to Article 93 of the Constitution, an Ordinance is issued if the Parliament is not in session or has been dissolved, for example, if the country is under martial law.
5	Rules	Rules are established when an Act is enacted. Normally, an Act defines effects and Rules are established to specify the content of the Act.
6	Regulations	Regulations are lawful legal instruments that have effects in Bangladesh. Laws that are promulgated by a martial law commander under martial law are called "Regulations."

Source: The Project Team

Most of the Acts define the Rules, and the Acts specify that Rules have effects.

After an Act is enacted, a ministry drafts Rules and carefully verifies that they do not conflict with the Constitution or a superior law.

After Rules are established, the ministry promulgates the legal Rules and later the government promulgates them together with the Ministry of Law, Justice and Parliamentary Affairs.

Since neither the current NSDI Act nor the New Survey Act defines the details, the Rules that define the details must be established.

4.2 Investigation on status of introduction of geographic information standards

The geographic information standard of Bangladesh is an important element in promoting utilization, sharing, distribution, etc. of geospatial information in construction and operation of NSDI.

Concerning geographic information standards, an expert committee ISO/TC211 (Geographic Information/Geomatics, No. 211 Technical committee) under International Organization for Standardization (ISO) prepares the international standards.

Open Geospatial Consortium (OGC), which is a liaison organization of ISO/TC211, is also the international organization for geographic information standards.

Government organizations of countries such as USGS and NASA, private companies such as ESRI and Google and so on are participating in OGC and preparing the standards for interface and encoding.

A part of standards prepared by OGC are proposed to ISO/TC211, and become international

standards (ex. Web Map Service and Geography Markup Language).

The standards issued by ISO/TC211 and OGC are shown in Annex-4 and 5.

Although Bangladesh is not a member of ISO/TC211, the introduction of a geographic information standard is indispensable in construction of NSDI.

The standards discussed by ISO/TC211 are summarized as follows:

a) Standards that specify the infrastructure for geospatial standardization
b) Standards that describe data models for geographic information
c) Standards for geographic information management
d) Standards for geographic information services
e) Standards for encoding of geographic information
f) Standards for specific thematic areas

Source: http://www.isotc211.org/Outreach/ISO TC 211 Standards Guide.pdf

These standards are discussed and prepared by the geographic information experts of countries and organizations, and show the framework and rules for the description.

The quick route for the preparation of geographic information in Bangladesh is to refer these standards. The published standards are able to purchase as documents.

The published standards will be modified according to the technology development. Therefore, to grasp the current status of standardization, it is necessary to participate in the activities of these organizations.

Table 4.2.1 shows the participating countries of South and Southeast Asia in ISO/TC211. Bangladesh is not a member of ISO/TC211.

Japan is a P (Participating) member and the representative organization is "Japanese Industrial Standards Committee (JISC)".

Concerning the expert committee for geographic information (ISO/TC211), "Association of Precise Survey and Applied Technology in Japan" is authorized as the home deliberation association, and organize the home deliberation committee.

The draft of international standards are discussed by the home deliberation committee members consisting the experts relating GIS from government, academic and commercial sectors.

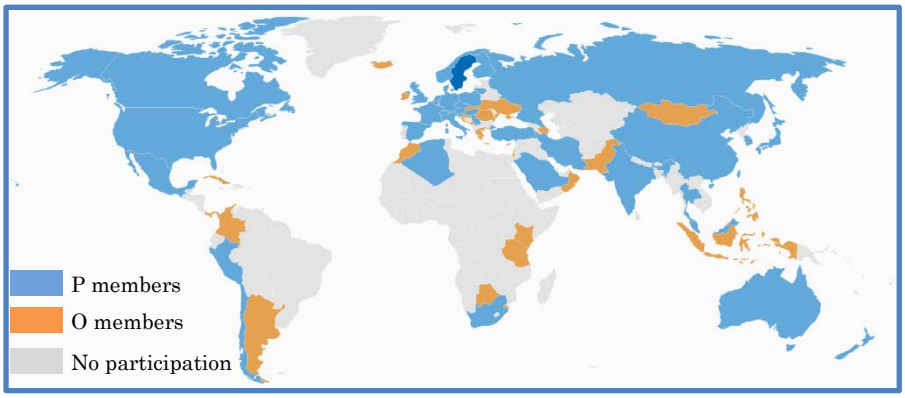
To participate in ISO/TC211 as a country, it is necessary to formulate the committee mentioned above.

Table 4.2.1 Participants in ISO/TC211 from south and southeast Asia (as of June 2017)

Classification	Country name (South and Southeast Asia <ASEAN> only)
P members (39)	India, Malaysia, Singapore, and Thailand
O members (29)	Pakistan, Brunei, Philippines, and Indonesia
No participation	Bangladesh, Sri Lanka, Nepal, Bhutan, Myanmar, Cambodia, Laos, and Vietnam

Source: ISO/TC211

The P (Participating) members have a voting right and promised to contribute to establishing a standard. The O (Observing) members do not have a voting right.



Source: ISO/TC211

Figure 4.2.1 Participants in ISO/TC211 (as of June 2017)

During the short project period, the researchers and engineers who have deep knowledge of geospatial information standards were not found in Bangladesh.

The dean at the University of Dhaka responded in the interview survey that there was no researcher on geographic information standards.

The professor of BUET also expressed the same opinion regarding geospatial information standards.

However, the Compatibility of GIS Data and Development of Guidelines for Metadata, Data Sharing Protocol and National GIS Data Policy (issued in 2009), which is aimed at sharing geospatial information based on the assistance of UNDP, DFID, and EU, implemented the guideline establishment, investigation, etc. on GIS data policies, metadata[4], and sharing procedures.

This investigation is an example of referencing the ISO/TC211 standard on metadata so that the personnel are considered to have some experience.

Data Architecture Standards prepared by Bangladesh National Enterprise Architecture (http://nea.bcc.gov.bd/), which is operated by BCC, recommends the utilization of ISO/TC211.

To participate in ISO/TC211 as a country, it is necessary to authorize the home deliberation association.

[4] Metadata is defined as data on data elements including data descriptions, data owner, access paths, access rights, and data update.

In case of Japan, the home deliberation association is "Association of Precise Survey and Applied Technology in Japan", not a government organization.

However, similar association such as "Association of Precise Survey and Applied Technology in Japan" was not found in Bangladesh.

It is considered that SOB should be the home deliberation association, and the conditions for the home deliberation association are as follows:

(1) The association has the framework for the consensus building of stake holders, and to forge a convergence of opinion as a country. P member have to establish the home deliberation committee under the association.

(2) The association has the framework for the necessary administration works properly.

Note 1: Stake holders mean Produces, Users, Consumers, Academic experts in a neutral position and so on.

Note 2: The activities of the home deliberation association do not include all scope of TC/SC. However, the home deliberation association has to have a function to request or to ask to the proper relevant organizations to fulfill the conditions of (1).
In principle, the members of the home deliberation committee are not limited to the persons who belong to the specific organizations or economic organizations.

Note 3: O members are not always have to establish the home deliberation committee.

Note 4: The home deliberation association is able to collect the necessary cost for the activities of association from the associate participants. However, it is necessary to obtain the consensus of the home deliberation committee. Also, it is necessary to prescribe this on the administrative regulation of the home deliberation committee, and transparency and economic operation have to be secured.

Source: ISO/IEC office processing textbook

Academic experts not belonging in the counterpart agencies should be participated in the home deliberation organization. Therefore, the operation and management of the home deliberation organization seems to be difficult under the technical cooperation program of JICA.

In case where the activities concerning geospatial information standards is included in the technical cooperation program in JICA, it is necessary to set up the proper and suitable project goal.

4.3 Future vision of NSDI assumed by SOB and others

At present, the relevant organizations including SOB and the Prime Minister's Office are considered not to have any specific future vision of NSDI yet.

The NSDI Bill specifies that short-term, mid-term, and long-term NSDI plans will be established. More specific future visions are expected to be created as these plans are established.

Table 4.3.1 shows the immediate problems and key points identified through the interview survey conducted this time.

Table 4.3.1 Immediate problems and key points

No.	Sector	Problems and key points
1	Legal framework	1) Is it not necessary to discuss the content of the NSDI Bill among the relevant organizations? 2) How can the basic principles, significances, and purposes of NSDI be defined and where should they be included? 3) What are measures for including NSDI in the Five-year Plan?
2	Promotion system	1) How many and which ministries, agencies, and organizations should be included in the promotion system? (Operation will be difficult when many people are involved.) 2) Which organization will chair the meetings and serve as the secretariat? (It is defined in the NSDI Bill.) 3) How should the structure of the working-level meeting be?
3	Geographic information standard	1) Although it takes time to establish a geographic information standard as a national standard, specifications are necessary. 2) What kind of members should the committee consist of?
4	Geospatial information	1) Which organization should manage data? (SOB, National Data Center, etc.) 2) How should the specifications of geodetic systems be migrated?
5	ICT environment	1) It is necessary to organize and collaborate on platforms to prevent redundancy of similar services. 2) How can the National Data Center be utilized?

Source: The Project Team

Chapter 5 Identification and Survey for Organizations Related to NSDI

Chapter 5 Identification and Survey for Organizations Related to NSDI

The outline of the identification and interview survey to the organizations related to NSDI are as bellows:

5.1 Identification of organizations related to NSDI

The organizations related to NSDI for interview survey were selected mainly from the organizations that participated in the 1st NSDI contributors meeting which was held in 15 May 2017 at Mirpur Office of SOB (Digital Mapping Center).

The organizations to be invited to the 1st NSDI contributors meeting were selected by SOB before the Project Team arrived at Dhaka for the first survey in Bangladesh. The names of organizations participated in the 1st NSDI contributors meeting are shown in Table 5.1.1.

Table 5.1.1 Organizations participated in the 1st NSDI contributors meeting

No.	Organizations participated in NSDI contributors meeting
1	Ministry of Defence (MOD)
2	Bangladesh Bureau of Statistics (BBS)
3	Space Research and Remote Sensing Organization (SPARRSO)
4	Local Government Engineering Department (LGED)
5	Rajshahi Unnayan Kartripakkha (RAJUK)
6	Geological Survey of Bangladesh (GSB)
7	Bangladesh Agricultural Development Cooperation (BADC)
8	Department of Land Records & Surveys (DLRS)
9	Bangladesh Metrological Department (BMD)
10	Department of Disaster Management (DDM)
11	Dhaka North City Corporation (DNCC)
12	Dhaka South City Corporation (DSCC)
13	Bangladesh Computer Council (BCC)
14	World Bank
No.	Organizations not participated in NSDI contributors meeting
1	Roads and Highways Department (RHD)
2	Bangladesh Water Development Board (BWDB)
3	Water and Sewerage Authority (WASA)
4	Access to Information Programme (a2i)

Source: The Project Team

The organizations which are considered as the main users of NSDI or main organizations for the establishment of NSDI in Bangladesh were selected from the organizations that participated in the 1st NSDI contributors meeting, and interview survey to these organizations were executed.

The reasons for the selection of these organizations were as follows:

a) Access to Information Programme (A2i programme)
Access to Information Programme is the organization promoting "Digital Bangladesh" that is the national policy of the Government of Bangladesh.

b) Bangladesh Computer Council (BCC), GeoDASH
Bangladesh Computer Council has already started IT service (GeoDASH) approximately one year ago.

Therefore, it is necessary to consider the relationship between NSDI and GeoDASH of Bangladesh Computer Council.

c) Bangladesh Bureau of Statistics (BBS)
Bangladesh Bureau of Statistic has already started IT service (Open data).

Therefore, it is necessary to consider the relationship between NSDI and IT service of Bangladesh Bureau of Statistics. Furthermore, it is considered as the main user of NSDI.

d) Local Government Engineering Department (LGED)
Local Government Engineering Department is the most advanced organization utilizing GIS and GIS data, and has extensive experience in this filed in Bangladesh.

Therefore, it is considered as the main user of NSDI.

e) Ministry of Defence (MOD)
New Survey Act (draft) and NSDI Act (draft) were prepared by SOB and was and will be submitted from the Ministry of Defence to the Prime Minister Office.

Therefore, it is necessary to grasp the basic idea of the Ministry of Defence concerning these two Acts.

f) Department of Land Records and Survey (DLRS)
It is considered as the main user of NSDI. Furthermore, the Department of Land Records and Survey is the organization responsible for the administrative boundaries.

g) Department of Disaster Management (DDM)
It is considered as the main user of NSDI.

h) Water and Sewerage Authority (WASA)
It is considered as the main user of NSDI.

i) Dhaka South City Corporation (DSCC)
It is considered as the main user of NSDI.

j) Dhaka University
It is necessary to obtain the comments for the issues concerning the construction of NSDI in Bangladesh from the viewpoint of academy.

The main purposes and questions of interview survey are as follows:

a) Current situation of IT service of each organization
b) Geospatial information and data possessed by each organization and purpose of utilization

c) Necessary geospatial information and data (scale, accuracy, area, data format, etc.) for each organization and future utilization plan
d) Issues concerning geospatial information and data of each organization
e) Issues for the establishment and operation of NSDI
f) Request for SOB

5.2 Execution of interview survey to organizations related to NSDI

Table 5.2.1 shows the schedule of interview survey executed by the Project Team and the staff of SOB.

Table 5.2.1 Schedule of interview survey

Date	Week	AM	PM
16 May 2017	Tue		WASA, TITAS Gas T&D Co., Ltd.
17 May 2017	Wed	MOD	DLRS
18 May 2017	Thu	BCC and GeoDASH	
19 May 2017	Fri	Holiday	
20 May 2017	Sat	Holiday	
21 May 2017	Sun	a2i Programme	DSCC Due to the reasons of demonstration near DSCC, an appointment was canceled.
22 May 2017	Mon	BBS	DDM
23 May 2017	Tue	Dhaka University	Japanese long-term experts of LGED, LGED
24 May 2017	Wed	Report to JICA Bangladesh Office	

Source: The Project Team

5.3 Results of interview survey to organizations related to NSDI

The outline of the interview survey to organizations related NSDI are as follows:.

5.3.1 Ministry of Defence (MOD)

The main purpose of interview survey to The Ministry of Defence (MOD) is to obtain the comments concerning NSDI promotion framework.

Date and time of interview survey: 17 May 2017 10:20 - 10:45
Summary of interview survey: As shown in Table 5.3.1

Table 5.3.1 Results of interview survey to MOD

Interview items	Results of interview survey
1) Provision of geospatial information	-----
2) Preparation of geospatial information	-----
3) Necessary geospatial information	-----
4) Issues relating geospatial information	-----
5) Issues at the construction of NSDI	1) It is considered that a large National Committee is not recommended taking into account the need for the smooth and quick policy decision making. 2) Considering national security and finance, the Ministry of Home Affairs

Interview items	Results of interview survey
	and the Ministry of Finance should be included in the National Committee. 3) Taking into consideration issues such as determination of international boundary and so on, working group(s) may be organized under the Implementation Committee.
6) Request to SOB	1) Leading player for construction of NSDI
7) Other	1) The organization responsible for national asset (national land) is the Ministry of Land, not the Ministry of Finance.

Source: Prepared by the Project Team based on the results of interview survey

5.3.2 a2i Programme (Prime Minister's Office)

The main purpose of interview survey to a2i Programme is to obtain the comments concerning NSDI promotion framework.

Date and time of interview survey: 21 May 2017 10:10 - 10:55
Summary of interview survey: As shown in Table 5.3.2

Table 5.3.2 Results of interview survey to a2i programme

Interview items	Results of interview survey
1) Provision of geospatial information	-----
2) Preparation of geospatial information	-----
3) Necessary geospatial information	-----
4) Issues relating geospatial information	1) The development plan and policy of the Government of Bangladesh does not clearly make mention of NSDI and mutual utilization of geospatial information. However, these are mentioned a little on "Government Data Strategy".
5) Issues at the construction of NSDI	1) It is recommended that "Bangladesh Telecommunication Regulatory Commission" should participate in the NSDI Committee. 2) It is considered that cooperation and coordination with GeoDASH and DLRS is important for the establishment of NSDI. 3) It is considered that the guideline will be necessary for the utilization of geospatial data and GIS data on NSDI, and also, coordination meeting among the ministries will be necessary.
6) Request to SOB	-----
7) Other	1) It is planned that "Data Sharing Policy" will be included in the next Five Year Plan. Therefore, it is considered that NSDI may be able to mentioned in "Data Sharing Policy" of the next Five Year Plan.

Source: Prepared by the Project Team based on the results of interview survey

5.3.3 Bangladesh Computer Council (BCC) and GeoDASH

Bangladesh Computer Council (BCC) under the Ministry of Posts, Telecommunication and Information Technology is responsible for GeoDASH which is established with the cooperation of World Bank, National Data Center and whole IT domain.

The main purpose of interview survey to BCC is to discuss the cooperation possibility for the

construction of NSDI with GeoDASH.

Date and time of interview survey: 18 May 2017 14:55 - 16:25
Summary of interview survey: As shown in Table 5.3.3

Table 5.3.3 Results of interview survey to BCC and GeoDASH

Interview items	Results of interview survey
1) Provision of geospatial information	1) GeoDASH is operating platform only and does not prepare any geospatial information data.
2) Preparation of geospatial information	1) GeoDASH does not prepare any geospatial information data.
3) Necessary geospatial information	1) GeoDASH does not prepare any geospatial information data.
4) Issues relating geospatial information	1) GeoDASH is a Geo Portal System to share the information and data relating urban disaster prevention which were prepared by the projects of World Bank, the Ministry of Food & Disaster Management & Relief and other ministries. However, activities concerning legal aspects have not been implemented by GeoDASH.
5) Issues at the construction of NSDI	1) In case of mutual utilization of platform between GeoDASH and NSDI, strengthen the capacity of system is necessary. Furthermore, it is possible to corporate the technical training and capacity development to the relevant NSDI organizations during and after the establishment of NSDI. 2) All government data is stored in National Data Center in Bangladesh. Therefore, it is considered that the data on NSDI will also be store in National Data Center. 3) There are many private companies in the business field of geospatial information in Bangladesh. However, it is considered that only 4～5 companies have sufficient technical level.
6) Request to SOB	1) It is considered that mutual utilization of platform between GeoDASH and NSDI is available.
7) Other	-----

Source: Prepared by the Project Team based on the results of interview survey

5.3.4 Local Government Engineering Department (LGED)

The Local Government Engineering Department (LGED) is under the Ministry of Local Government, Rural Development & Co-operatives. This organization consists of 12 units. The activities using GIS was started from 1992.

The main purpose of interview survey to LGED is to discuss about the utilization of geospatial information after the construction of NSDI and mutual data utilization among the organizations.

Date and time of interview survey: 23 May 2017 15:30 - 17:10
Summary of interview survey: As shown in Table 5.3.4

Table 5.3.4 Results of interview survey to LGED

Interview items	Results of interview survey
1) Provision of geospatial information	1) LGED prepares GIS database for planning, monitoring and implementation of own projects, and the GIS database is updated every year. 2) In addition, a GIS portal system, which is able to access by any one, was

Interview items	Results of interview survey
	already established. 3) Upazila map (Sub-district map) is a base map used by LGED, and down lord of these maps by PDF format is available from the web site.
2) Preparation of geospatial information	1) Thematic maps such as percentage of road pavement, road density, road length, location of primary school and so on are already prepared.
3) Necessary geospatial information	1) Latest geospatial information and/or digital topographic maps
4) Issues relating geospatial information	1) Mutual data utilization and human resources development are important for the establishment of NSDI. 2) Concerning the IT service, it is necessary to judge from the viewpoint of stability, necessary cost and ability of users.
5) Issues at the construction of NSDI	It is considered that the important factors for the establishment of NSDI are; 1) Mutual data utilization by the different organizations is important. Especially, the role of SOB, which is the national survey and mapping organization that prepares geospatial data which is the basic information of NSDI, is the most important for the establishment of NSDI. 2) Data updating in a short period time and interval is necessary. 3) There are several platforms already in Bangladesh. Therefore, SOB should judge on how to cooperate and coordinate with the existing platforms. Furthermore, the cooperation with DLRS is necessary. 4) Concerning the NSDI Act, the discussion among the stakeholders are not yet executed. Therefore, discussion among the stakeholders will be necessary in near future.
6) Request to SOB	1) Data lease by SOB
7) Other	1) Both English and Bengali should be shown on the portal site. 2) Also, user interface should be considered.

Source: Prepared by the Project Team based on the results of interview survey

5.3.5 Bangladesh Bureau of Statistic (BBS)

Bangladesh Bureau of Statistic (BBS) is an under organization of the Ministry of Planning, and preparing and providing of census data.

The main purpose of interview survey to BBS is to discuss about the utilization of geospatial information after the construction of NSDI and mutual data utilization among the organizations.

Date and time of interview survey: 22 May 2017 10:55 - 11:50
Summary of interview survey: As shown in Table 5.3.5

Table 5.3.5 Results of interview survey to BBS

Interview items	Results of interview survey
1) Provision of geospatial information	1) Statistic data and statistic maps 2) In 1998, BBS executed the national census with the corporation of United Nations Population Fund. 3) Aerial photos covering whole territory of Bangladesh were taken for the

Interview items	Results of interview survey
	national census. Using the aerial photos and cadastral maps of DLRS, the national census was executed by BBS. The national census which were executed in 2011 is the first national census using digital maps in Bangladesh.
2) Preparation of geospatial information	1) Statistic maps
3) Necessary geospatial information	1) Digital topographic data which will be able to use for statistic maps
4) Issues relating geospatial information	1) Regarding "Open Data", every government organizations in Bangladesh including BBS have some restrictions for the data publication, and it is considered that the degree of data publication in Bangladesh is not enough level.
5) Issues at the construction of NSDI	1) At present, there is no coordination committee concerning "Open Data" in Bangladesh. 2) it is considered that BBS will be able to corporate with data sharing and so on.
6) Request to SOB	1) It is considered that BBS will be able to corporate with the construction of NSDI for the utilization of common base maps and data.
7) Other	1) GIS is used for statistic survey and so on.

Source: Prepared by the Project Team based on the results of interview survey

5.3.6 Department of Disaster Management (DDM)

Department of Disaster Management (DDM) is preparing the data of disaster prevention sector, such as hazard maps and so on.

The main purpose of interview survey to DDM is to discuss about the utilization of geospatial information after the construction of NSDI and mutual data utilization among the organizations.

Date and time of interview survey: 22 May 2017 14:35 - 15:30
Summary of interview survey: As shown in Table 5.3.6

Table 5.3.6 Results of interview survey to DDM

Interview items	Results of interview survey
1) Provision of geospatial information	1) Data of disaster prevention sector such as hazard maps
2) Preparation of geospatial information	1) Hazard maps
3) Necessary geospatial information	1) DDM has an interest in CORSs. 2) In Bangladesh, there are many types of disasters. Therefore, it is considered that CORSs will be effective measures for the disaster survey.
4) Issues relating geospatial information	1) At present, only one staff engaged in GIS. Therefore, development of human resources has the most high priority. 2) Preparation of community level hazard maps is the role of DDM. At present, sub-district level hazard maps have been already prepared.
5) Issues at the construction of NSDI	1) Due to the difference of coordinates system adopted by the organizations, data overlapping is not able to executed. This issue was already found and recognized on GeoDASH. 2) It is considered that NSDI is a good idea. However, DDM is participating in GeoDASH, and data concerning disaster prevention sector are preparing by DDM.
6) Request to SOB	1) In past time, DDM tried to obtain the topographic data from SOB.

Interview items	Results of interview survey
	However, it was not able to get it. The hurdle for the utilization of the topographic data of SOB was very high. 2) It is necessary to establish the system to be able to use geospatial information of SOB.
7) Other	1) Landslide disaster at north-east region and Chittagong hilly area, cyclone, drought, flood, earthquake at north region, seismic sea wave are the main disaster in Bangladesh. 2) Disaster survey when the disaster strike is also important, however, the capacity development of the staff regarding GIS is the most important issue in DDM. For the disaster survey, high-tech equipment are not used at present.

Source: Prepared by the Project Team based on the results of interview survey

5.3.7 Water and Sewage Authority (WASA)

Water and Sewage Authority (WASA) is a government corporation operating water supply and sewage system in Dhaka City. The facilities information such as water pipes, meters and other components are managed by GIS.

The main purpose of interview survey to WASA is to discuss about the utilization of geospatial information after the construction of NSDI and mutual data utilization among the organizations.

Date and time of interview survey: 16 May 2017 14:50 - 15:50
Summary of interview survey: As shown in Table 5.3.7

Table 5.3.7 Results of interview survey to WASA

Interview items	Results of interview survey
1) Provision of geospatial information	1) The utility information and data are sharing with other organizations for the development project in Dhaka City. However, consultation and coordination among the organizations are necessary.
2) Preparation of geospatial information	1) Data of pipelines and water meters are managed by GIS. 2) 1:5,000 scale topographic maps from SOB and data from the private companies are used as basic maps. Secular change correction such as house and road data are executed by the staff of WASA.
3) Necessary geospatial information	1) Due to the rapid change at Dhaka City, it is necessary to execute secular change correction at all times. Therefore, latest digital topographic data of Dhaka City is needed. 2) From the view point of business contents of WASA, more large scale of digital topographic data is necessary, especially, urban area.
4) Issues relating geospatial information	1) Data updating interval of WASA does not coincide with the digital topographic data updating interval of SOB. Therefore, it is necessary to update the data by WASA itself.
5) Issues at the construction of NSDI	1) Issues caused by the difference of coordinates are recognized.
6) Request to SOB	1) WASA has a strong interest in NSDI. 2) Release of digital topographic data of SOB
7) Other	1) The numbers of the staff of GIS section are 7～10 persons.

Source: Prepared by the Project Team based on the results of interview survey

5.3.8 Department of Land Records & Surveys (DLRS)

Department of Land Records & Surveys (DLRS) is the organization preparing and managing the cadastral maps and land registration.

The main purpose of interview survey to DLRS is to discuss about the utilization of geospatial information after the construction of NSDI and mutual data utilization among the organizations.

Date and time of interview survey: 17 May 2017 14:15 - 16:00
Summary of interview survey: As shown in Table 5.3.8

Table 5.3.8 Results of interview survey to DLRS

Interview items	Results of interview survey
1) Provision of geospatial information	1) Cadastral maps (Mouza Map) 2) Land register book 3) Cadastral maps are provided to the every users as Taka500.-/sheet. Basically, there is no restrictions for purchasing of cadastral maps.
2) Preparation of geospatial information	1) The scale of cadastral maps (Mouza Map) are, ① Rural area (1:3,960) ② Semi-urban area (1:1,980) ③ Urban area (1:1,980) ④ Mega-city (1:792) 2) The unit of distance is inch/yard. 3) Map projection is Cassini Projection.
3) Necessary geospatial information	1) The cadastral maps are prepared by the staff of DLRS. 2) The scale of topographic maps of SOB and the scale of cadastral maps are different. Therefore, it is not able to use the topographic maps of SOB directly for the cadastral mapping.
4) Issues relating geospatial information	1) It is recognized that the map projection (Cassini projection) is one of the issue of the existing cadastral maps. 2) It is considered that the unification of the map project is important.
5) Issues at the construction of NSDI	1) Unification of coordinates system 2) Transfer to metric system
6) Request to SOB	1) Provision of geodetic control points data 2) Provision of orthophoto
7) Other	1) The data center for the management of cadastral data was established with the cooperation of Asian Development Bank in the central office of DLRS. The data center in the central office, backup data center and 53 branch offices are connected by network. 2) Total Stations are used for the cadastral survey. Also, 6 sets of GPS (1 sets consists of 4 GPS receivers, total 24 GPS receivers) are used for cadastral survey. When NSDI is established, the utilization of aerial photo (orthophoto) will be considered for cadastral survey.

Source: Prepared by the Project Team based on the results of interview survey

5.3.9 Dhaka University (Faculty of Earth & Environmental Science)

The dean of the Faculty of Earth & Environment Science of Dhaka University was a facilitator for the NSDI International Seminar panel discussion which were held last year in Dhaka City.

The comments concerning NSDI from the academic viewpoint were obtained.

Date and time of interview survey: 23 May 2017 9:05 - 9:50
Summary of interview survey: As shown in Table 5.3.9

Table 5.3.9 Results of interview survey to Dhaka University

Interview items	Results of interview survey
1) Provision of geospatial information	-----
2) Preparation of geospatial information	-----
3) Necessary geospatial information	1) Geospatial information to be able to use for investigative research
4) Issues relating geospatial information	1) Concerning ISO/TC211, it is considered that there is no researcher in Bangladesh. In past time, geospatial data standard were tried to be determined and applied by the several projects executed by the donor countries. However, due to the insufficient recognition of the Central Government of Bangladesh, ISO/TC211 did not become widely used in Bangladesh.
5) Issues at the construction of NSDI	1) The important factors for the establishment of NSDI are, ① Development of human resources in the field of NSDI ② Realistic design and development of infrastructure of NSDI ③ Decision-making method for establishment, operation and coordination of NSDI ④ High level persons of the Government of Bangladesh will become to understand the necessity and importance of NSDI 2) Concerning the chairman of the committee, organizations such as SOB, BBC are considered likely candidates. However, it is considered that the necessary qualifications for the chairman of committee are, ① Knowledge of NSDI ② High position ③ Experience and management and operation knowledge
6) Request to SOB	-----
7) Other	1) It is recommended that development of human resources will be executed using examples from other countries.

Source: Prepared by the Project Team based on the results of interview survey

5.3.10 TITAS Gas T&D Co., Ltd.

TITAS Gas T&D Co., Ltd. is a government corporation supplying gas to the whole Bangladesh territory.

The main purpose of interview survey to TITAS Gas T&D Co., Ltd. is to discuss about the utilization of geospatial information after the construction of NSDI and mutual data utilization among the organizations.

Date and time of interview survey: 16 May 2017 16:00 - 16:30
Summary of interview survey: As shown in Table 5.3.10

Table 5.3.10 Results of interview survey to TITAS Gas T&D Co., Ltd.

Interview items	Results of interview survey
1) Provision of geospatial information	-----
2) Preparation of geospatial information	1) Gas pipeline network information 2) Gas value locations information
3) Necessary geospatial information	1) The most important information is the locations of valve along the gas pipelines. To minimize the gas shut down area for the road and subway construction as much as possible, gas pipeline network information is also important. 2) Furthermore, to reduce the traffic jam caused by the construction, data and application software are necessary. 3) The basic data used for facility management is old topographic maps. Therefore, latest geospatial information is needed.
4) Issues relating geospatial information	1) TITAS Gas T&D Co., Ltd. manages huge gas pipeline network, and it is necessary to update the geospatial information at all times.
5) Issues at the construction of NSDI	No comment due to the lack of knowledge of NSDI.
6) Request to SOB	-----
7) Other	Data updating and application development are executed by outsourcing.

Source: Prepared by the Project Team based on the results of interview survey

5.3.11 Japanese Long-term Experts of Local Government Engineering Department

Hearing from the Japanese long-term experts at the Local Government Engineering Department was executed.

The comments concerning the utilization of geospatial information after the construction of NSDI and mutual data utilization among the organizations from the viewpoint of Japanese experts, who are sending to the Bangladesh Government organizations except SOB, were obtained.

Date and time of interview survey: 23 May 2017 14:30 - 15:20
Summary of interview survey: As shown in Table 5.3.11

Table 5.3.11 Results of interview survey to JICA long-term experts of LGED

Interview items	Results of interview survey
1) Provision of geospatial information	1) The main works of LGED are infrastructure development such as construction of rural roads, cyclone shelter, school buildings, irrigation system, small size water resources and so on. For the planning of these development, Upazila maps, which have no elevation data, are used as base maps at present.
2) Preparation of geospatial information	-----
3) Necessary geospatial information	1) For the planning, 1:25,000 scale topographic maps is effective and sufficient. 2) Cadastral maps (Mouza map) could not overlap on the other maps due to the reason of the difference of coordinates system and horizontal accuracy and so on. 3) In addition, the boundary lines between private lands and government lands are not clear on the cadastral maps.

Interview items	Results of interview survey
	4) For the land acquisition necessary for the construction of infrastructures, the land acquisition boundary lines were decided on site with the landowners. However, it is not certain that all landowners participated for determination of the boundary lines of land acquisition at the sites.
4) Issues relating geospatial information	1) The elevations shown of the field surveyed maps are used for the planning and design of irrigation structures and so on. However, there is a issue that the elevations shown on the field survey maps does no coincide with the actual elevations. 2) This was not come to an issue until now. However, the issue caused by the discrepancy of elevation is becoming clear gradually.
5) Issues at the construction of NSDI	-----
6) Request to SOB	The digital topographic data of SOB will be very useful for the works.
7) Other	-----

Source: Prepared by the Project Team based on the results of interview survey

5.4 Summary of interview survey to organizations related to NSDI

The results of the interview survey to the organizations related to the NSDI are summarized as shown in Table 5.4.1.

Table 5.4.1 Summary of interview survey to organization related NSDI

Interview items	Results of interview survey
1) Provision of geospatial information	1) Several government organizations prepare the geospatial information for their own works and these data are opened through GeoDASH. 2) There is a difference in the knowledge and technical level concerning NSDI among the organizations. Furthermore, within one organization, there is a difference in the knowledge and technical level concerning NSDI among the sections or units. 3) Several organizations are already started the activities relating NSDI. Therefore, it is necessary to consider the relationship between their activities and NSDI.
2) Preparation of geospatial information	1) Many government organizations and so on prepare the geospatial information for their own works.
3) Necessary geospatial information	1) The contents of geospatial information data necessary for each organization are different. However, every organization hope that 1;25,000 and 1:5,000 scale digital topographic data, DEM data, geodetic control points data and so on of SOB can be used freely. 2) The most important and useful data on NSDI is 1:5,000 scale digital topographic data at Dhaka Metropolitan area. However, the existing 1:5,000 scale digital topographic maps were published on 2004 (aerial photography was taken in 2003). Therefore, latest 1:5,000 scale digital topographic data are needed. 3) Many organizations understand that the periodical updating of geospatial information are necessary
4) Issues relating geospatial information	1) The issues caused by the difference of coordinates system, height datum and discrepancy of the administrative boundary data are recognized by many organizations. Without the unification of these data, mutual data utilization by the relevant organizations is difficult.

Interview items	Results of interview survey
	2) Every organizations consider that mutual data utilization will be promoted by the construction of NSDI.
5) Issues at the construction of NSDI	1) Every organizations recognize the necessity of mutual utilization of information and data, and is in a positive way for the establishment and utilization of NSDI. 2) Every organizations understand that many issues have to be solved for the construction of NSDI, and strong leadership is essential to solve these issues for the construction of NSDI. 3) The fundamental data on NSDI is geospatial information (digital topographic data). SOB is the national survey and mapping agency in Bangladesh. Therefore, every organizations recognize that SOB should be the main player for the construction of NSDI. 4) Cooperation with and effective utilization of the existing platform such as GedoDASH are necessary.
6) Request to SOB	1) Many organizations hope that SOB will release the digital topographic data on NSDI.
7) Other	1) Every organizations hope for the technical support concerning the utilization of the NSDI, when NSDI is established.

Source: Prepared by the Project Team based on the results of interview survey

5.5 Necessary requirement for NSDI in Bangladesh from the view points of interview survey results

Based on the results of interview survey to the organizations related to NSDI, the necessary requirement for construction of NSDI in Bangladesh are summarized as follows:

a) All government organizations, academic sector and private sector will be involved in the construction of NSDI. Therefore, NSDI should be constructed as a national strategy in Bangladesh. From this point of view, NSDI should be included in Digital Bangladesh, which is the policy of the country, and next 5 year development plan.

b) For the construction of NSDI in Bangladesh, it is necessary to cooperate with and utilize the existing platform such as GeoDASH and so on.

   By the cooperation with and utilization of the existing platform, it is possible to reduce the initial investment cost, and also, to be able to use the knowledge and experiences at the construction of the existing platform.

c) To promote the mutual data utilization among the organization related to NSDI, it is necessary to execute the following activities promptly.

   - Unification of coordinates system
   - Unification of height datum
   - Unification of administrative boundary data
   - Unification of place names and address

- Etc.

d) To promote the utilization of NSDI and mutual data utilization among the organization related to NSDI after the construction of NSDI, human resource development at every organizations are essential and it is necessary to promote this activity.

Chapter 6 Present Status of Continuously Operating Reference Stations and Future Development Policy

Chapter 6 Present Status of Continuously Operating Reference Stations and Future Development Policy

The results of hearing from the Geodesy of SOB concerning the present situation of the existing continuously operating reference stations (CORSs) and future development plan are as follows:

6.1 Present status of the existing CORSs in Bangladesh

The present status of the existing CORSs in Bangladesh are as follows:

6.1.1 Present status of the geodetic control points network and CORSs in Bangladesh

SOB started the establishment of geodetic control points network for the whole land of Bangladesh from 1990s with the technical cooperation of the Government of Japan.

After completion of the technical cooperation for the establishment of geodic control points network with the Government of Japan, SOB continued the establishment of geodetic control points network by themselves. Table 6.1.1 shows the current status of geodetic control points of SOB as of June 2017.

Table 6.1.1 Current status of geodetic control points of SOB (as of June 2017)

Geodetic control points	Constructed	Destroyed	Remaining
1st order horizontal control points (GPS points)	278 points	-18 points	260 points
2nd order horizontal control points (GPS points)	817 points	0 point	817 points
1st order vertical control points (BMs)	741 points	-75 points	662 points
2nd order vertical control points (BMs)	1,549 points	-5 points	1,544 points
Total	2,597 points	-102 points	2,495 points
3D control points	788 points		

Source: SOB

In 2011, SOB established 6 points of CORSs at the following locations using DRGA fund.

a) Dhaka, Dhaka Division
b) Khluna, Khluna Division
c) Rajshahi, Rajshahi Division
d) Rangpur, Rangpur Division
e) Moulvibazar, Sylhet Division
f) Chittagong, Chittagong Division

Figure 6.1.1 shows the locations of the existing CORSs. Photo 6.1.1 and Photo 6.1.2 show the external appearance of the existing CORS. All the existing CORSs are established on the roof top of the buildings.

Photo 6.1.3 and Photo 6.1.4 show the internal components of the existing CORS (receiver, transmitter and battery), and the electric power is supplied by solar panel.

Photo 6.1.5 and Photo 6.1.6 show the server for CORSs which was installed in SOB office.

Source: SOB

Figure 6.1.1 Locations of the existing CORSs

Source: SOB

Photo 6.1.1 CORS (side face)

Source: SOB

Photo 6.1.2 CORS (front face)

Source: SOB

Photo 6.1.3 CORS (inside)
(receiver, transmitter and battery)

Source: SOB

Photo 6.1.4 CORS (inside)
(receiver, transmitter and battery)

Source: SOB

Photo 6.1.5 Server of CORS (outside)

Source: SOB

Photo 6.1.6 Server of CORS (inside)

Figure 6.1.2 is the front view and side view of the existing CORS showing the positional relation of solar panel, GNSS antenna and equipment box for receiver, transmitter and battery.

Figure 6.1.3 is the front view and side view showing the pillar architecture of GNSS antenna of the existing CORS.

Figure 6.1.4 shows the antenna of GNSS of the existing CORS.

Figure 6.1.5 shows the existing CORS including stockade fencing (front view, south side, when

gate is opened).

Figure 6.1.6 shows the existing CORS including stockade fencing (front view, south side, when gate is closed).

Figure 6.1.7 shows the existing CORS including stockade fencing (plain view, when gate is closed).

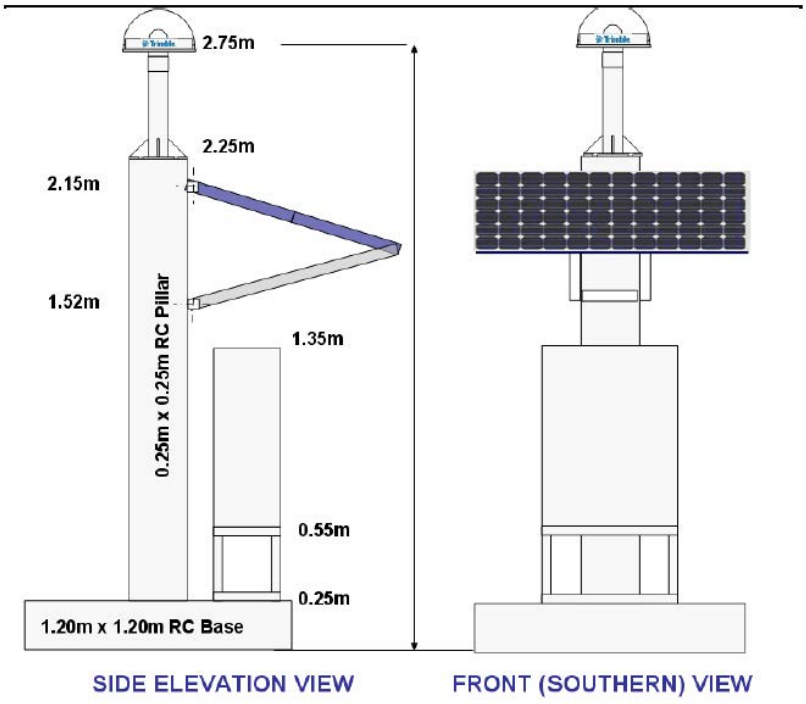
Electric power is supplied by solar panel and stable. The existing CORSs are established on the roof top of the building and also surrounded by the stockade fencing. Therefore, it is considered that the existing CORSs will not be damaged by man-made source.

According to the explanation of SOB, lighting protection rod is installed, and 2 water proof measures are taken for the existing CORSs.

One is to broaden the roof width of box of CORS installing GNSS equipment and battery and so on not to entering the rainfall into the side of box to CORSs, the other is to use rubber packing at the door of box of CORS.

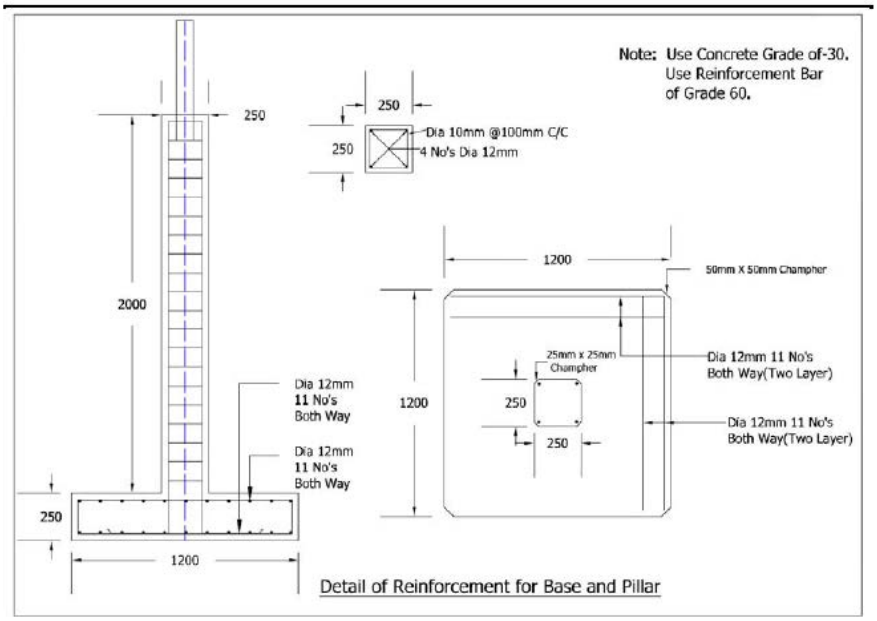
By these countermeasures, the rainfall does not enter into the box of CORS directly. However, the rust at the lower part of box of CORS was found and plastic tape is used not to enter the rainfall into the inside of box of CORS.

It is considered that further investigation is necessary concerning water proof measures.



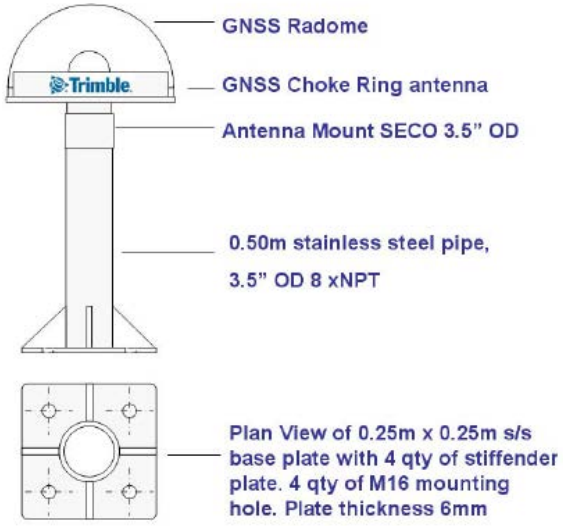
Source: SOB

Figure 6.1.2 Solar panel of CORS



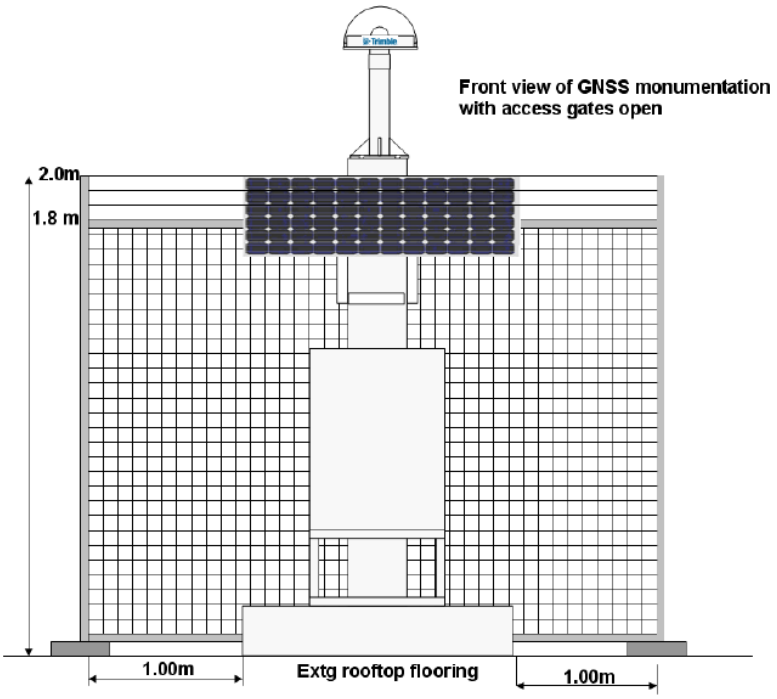
Source: SOB

Figure 6.1.3 Pillar of CORS



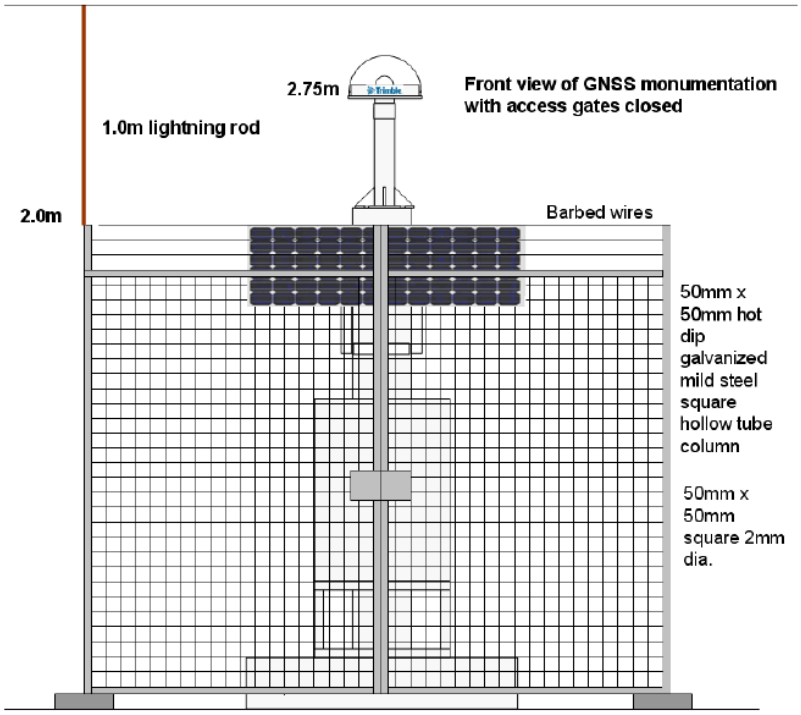
Source: SOB

Figure 6.1.4 Antenna of GNSS



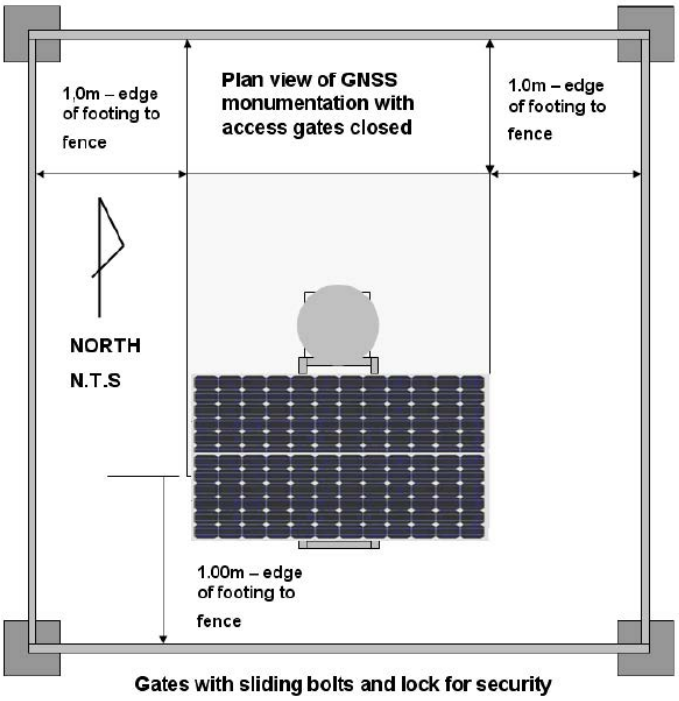
Source: SOB

Figure 6.1.5 Front view (south side) of CORS (when gate is opened)



Source: SOB

Figure 6.1.6 Front view (south side) of CORS (when gate is closed)



Source: SOB

Figure 6.1.7 Plan view of CORS

According to the explanation of SOB, the contract price for the establishment of 6 points of the existing CORSs was approximately Taka58,500,000.- (approximately US$730,000.-) and consisting following 5 items.

Constitution, design and installation of the existing CORSs including safety measures were executed by Trimble India based on the contract with SOB.

a) Equipment such as receiver, transmitter and so on
b) Installation operation
c) Training in Bangladesh
d) Maintenance (1 year guarantee + 3 years maintenance (every 3 months))
e) Factory training (Shanghai factory, China) and visiting tour for utilization of CORSs in China

After completion of the contract between SOB and Trimble India, SOB made the maintenance contract for 16 months with approximately Taka4,300,000.- (approximately US$54,000.-) + parts expenses with Bangladesh company.

According to the explanation of SOB, after establishment of the 6 points of CORSs, 3 times serious troubles (2 times at Rajshahi station, 1 time at Dhaka station) have been occurred, and receiving panel has been exchanged.

During the Project, CORS at Rajshahi showed the trouble, and investigation for trouble was requested to the Bangladesh private company by SOB.

The data transmission between server and CORS at SOB head office is connected by optical cable, and the CORSs locating outside of Dhaka City are connecting by mobile telecommunication with GPRS.

The ordinary data transmission time from CORSs to server at SOB head office at Dhaka should be less than 1 second.

However, due to the reason of large mobile telecommunication users around Khulna, the data transmission time from CORS at Khulna to server at SOB head office at Dhaka becomes more than 3 second frequently. This phenomena also occurs at other CORSs.

Satellites of GPS and GLONASS are using for CORSs and data acquisition interval is 1 second. GNSS receiver can save 5 months data in the memory, and at the time of periodical inspection of CORSs, the data saved in the memory are copied to flash memory at site.

The data at server of CORS is copied to hard disk every month as backup data, and the trouble of server is few.

According to the explanation of Trimble India, there was a trouble on the transmission port of internet. However, Trimble India did not explain the reason of the troubles to the staff of SOB. There was also no description of the reason of troubles on the maintenance report submitted by Trimble India.

According to the explanation of SOB, the troubles of the existing CORSs occurred not only in rainy season but also in dry season.

SOB also explained that the server room for the existing CORSs in SOB office has the issue of dew condensation in rainy season, Therefore, air conditioner and dehumidification machine are equipped at the server room.

SOB provides two types of data of CORSs to users. One is post processing data and the other is real time processing data, and not only government organizations but also private organizations can purchase these data.

Several users per a month utilize this serve of SOB and the price of post processing data is Taka300.-/day.

The real time processing data is for single RTK survey only at present, and the price of this service is Taka10,000.-/3 months. SOB is considering that new price will be applied for the real time processing data for network RTK survey, but, the price is not yet decided.

To increase the users of CORSs data, and also, using Bangladesh Government budget for the operation and maintenance of CORSs, the price of this service is set as comparatively row price.

For the utilization of this service of SOB, registration to SOB is necessary. Normally, the users will receive the data by CD-ROM from SOB, or by downloading as an optional extra.

6.1.2 Future development plan for CORSs of SOB

The future development plan for CORSs of SOB is described on the application form for grand aid from Japan "Densification of GNSS CORS (Continuously Operating Reference Station) Network and Establishment of Two Tidal Stations in Bangladesh".

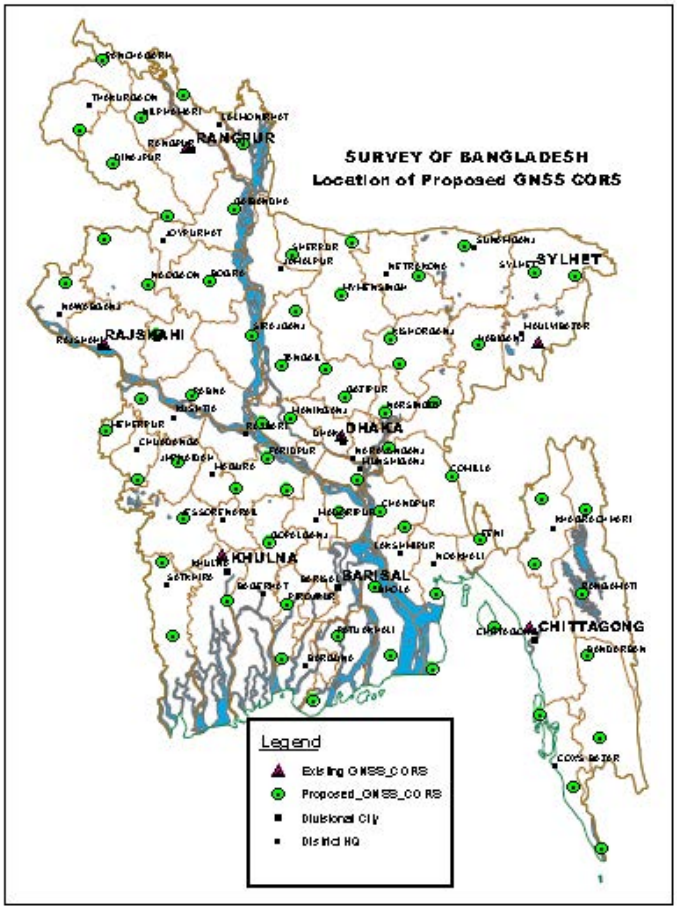
According to this application form, SOB is planning to establish a total of 70 points of CORSs in whole country, and 2 tidal stations.

Figure 6.1.8 shows the locations of CORSs proposed by SOB.

All 70 locations of CORSs were selected on the map. However, the field survey for the locations of CORSs has not yet been executed, and land ownership has not yet been confirmed.

The existing CORSs (6 locations) were established on the military land. Therefore, it is necessary to get a prior permission to enter into military land for the maintenance and other activities.

Therefore, SOB is planning to establish new CORSs on the government land such as weather observation stations of the Meteorological Department and others.



Source: SOB

Figure 6.1.8 Proposed locations of CORSs by SOB

6.2 Validity of the establishment of CORSs in Bangladesh

The validity, necessity and availability of utilization of CORSs in Bangladesh are as follows:

6.2.1 Purpose of the establishment of CORSs in Bangladesh

The CORSs in Japan were established for the monitoring of crustal movement caused by earthquake or volcano. In 2008, the technical specifications for the utilization of CORSs for public survey (survey and mapping using government budget), and started to be used for infrastructure development projects and so on.

In Japan, the CORSs are using for the establishment of control points for cadastral survey, and RTK survey are executed to obtain the cadastral boundary data in rural area. A lot of the field survey are now executing using CORSs due to the reason of dissemination of GNSS equipment in Japan.

In Europe, the CORSs for survey purpose have been already established and used for efficient geodetic survey and cadastral survey.

In U.S.A. and Australia, due to the large national territory, the CORSs are established mainly for urban areas, and the CORSs are not so established in the agricultural and desert area in the internal region of these countries.

In ASEAN region, many countries are under establishment and/or updating of CORSs for the purpose of geodetic survey, cadastral survey and disaster prevention purpose and so on.

In Indonesia, CORSs are used not only for survey purpose but also for crustal movement observation due to the earthquakes and volcano. In Thailand, an experimental test for utilization of CORSs for automatic operation of construction machines such as grader and/or agricultural machines such as combine with the cooperation of Japan is in operation.

As mentioned above, CORSs were established for the utilization of geodetic survey and cadastral survey at first, and depend on the circumstances in each country, the utilization of CORS become more wider.

In Bangladesh, operation and utilization of CORSs were already started after establishment of 6 CORSs in December 2011.

The purpose of establishment (densification) of CORSs requested by the Government of Bangladesh is for the utilization of geodetic survey and cadastral survey and also for the utilization of disaster management.

6.2.2 Validity of the establishment of CORSs in Bangladesh

SOB operates 6 CORSs after establishment without serious troubles up to now.

The issues relating hardware such as failures of CORSs, slow data transmission time and so on are pointed out from the several users. However, SOB has a favorable opinion for the operation of CORSs from the users.

At present, CORSs are using not only geodetic control point survey but also the engineering survey for the infrastructure development projects in Bangladesh.

Due to the recognition of convenience of CORSs for survey and mapping, the number of GNSS equipment, and range and volumes of survey works using CORSs in Bangladesh are increasing step by step.

Furthermore, according to digital Bangladesh by the Government of Bangladesh, raster data of register books and cadastral maps were prepared, and it is possible to access to these data from anywhere in Bangladesh and by any one through internet.

Almost all the cadastral maps were prepared in day of old and does not have an enough horizontal accuracy. Therefore, digital cadastral maps using CORSs are now preparing on a trial basis, and project proposal for digital cadastral maps production is already submitted to the Government of Bangladesh.

Considering the above-mentioned situation in Bangladesh, the validity of densification of CORSs in Bangladesh is appropriate.

6.3 Necessity of the establishment of CORSs in Bangladesh

The CORSs will be used mainly for the geodetic survey, cadastral survey and engineering survey for infrastructure development and so on in Bangladesh.

The present utilization of CORSs in Bangladesh is as follow:

6.3.1 Utilization of CORSs for ground control points survey

SOB started the establishment of the 1st order geodetic control points network at the northern part of Bangladesh including the establishment of geodetic datum and calculation of world geodetic coordinates system by the technical cooperation of the Government of Japan which was executed form 1992 to 1994.

SOB established the 1st order geodetic control points network at the southern part of Bangladesh from 2001 to 2003.

In Bangladesh, only some university and SOB are able to execute long rage GNSS observation which the points distance is more than several dozen km.

Therefore, many governmental organizations and private survey companies in Bangladesh have no experience and capability for the implementation of long rage GNSS observation, and many private survey companies in Bangladesh have total station only.

Due to the flat topography in Bangladesh, it may be difficult to keep the visibility during the field survey using total station. Therefore, it is difficult to establish control points by the field survey using total station, especially, at the remote area from the existing geodetic control points.

In order to increase the density of geodetic control points for the utilization of field survey by total station and GNSS equipment, SOB started the establishment of the 2nd order geodetic control points network from 2009.

By the establishment of the 2nd order geodetic control points by SOB, government organizations and private survey companies in Bangladesh become able to execute GNSS survey using geodetic control points established by SOB, and also able to follow the national coordinates system adopted by SOB.

After the establishment of 6 CORSs in December 2011, it is possible to execute GNSS survey more effectively at the surrounding areas of the existing CORSs.

As a result of these activities of SOB, the importance and necessity for the unification of coordinates system are recognized by the central government of Bangladesh, and the survey using geodetic control points and CORSs of SOB becomes popular in Bangladesh at present.

The cadastral survey and cadastral mapping in many developing countries were started from a long time ago, and the issues relating the horizontal accuracy and different coordinates system of cadastral survey and mapping become issues at present.

To improve the horizontal accuracy of cadastral maps and unification of coordinates system, currently, DLRS started the digital cadastral mapping based on the geodetic control points established by SOB.

The control points are established not only by SOB but also by DLRS and other government organizations in Bangladesh.

Therefore, in case where CORSs are established with a point distance of approximately 70 km, it is considered that CORSs will contribute to the accurate and efficient survey for the establishment of control points and other survey works in Bangladesh.

6.3.2 Utilization of CORSs for cadastral survey

In Bangladesh, the cadastral maps were prepared from a long time ago, and it is necessary to prepare new accurate cadastral maps.

The conventional cadastral maps are prepared by the following method in Bangladesh.

a) The control points and supplementary control points for cadastral survey were established by traversing by the staff of DLRS at Dhaka main office.

b) Based on the established control points and supplementary control points for cadastral survey, cadastral maps were prepared by plain table survey by the local staff of DLRS.

To improve the working efficiency for land transactions and tax collection, DLRS is planning to prepare digital cadastral maps instead of the conventional cadastral maps (analogue cadastral maps).

Currently in Bangladesh, through the Digital Bangladesh, raster data of land registry books and cadastral maps are preparing by DLRS, and these data are supplied to the local governments to be able to browse by the people living in countryside in Bangladesh.

From 2009, by the cooperation of EU, DLRS prepared digital cadastral maps at 3 Upazilas on a trial basis. Also, SOB cooperated the technical training to the staff of DLRS relating the RTK survey technique.

Based on these activities, DLRS is now proposing for digital cadastral mapping project covering 61 districts out of a total of 64 districts, excluding hilly area, to the Bangladesh Government with 5 years project period (Development Project Proposal (DPP)).

However, considering the present capability and technical level of DLRS, some staff of DLRS considers that an approximately 10 years will be necessary for the implementation of this project.

According to the project proposal of DLRS, cadastral survey (data acquisition of land owners boundary) will be executed directly by the staff of DLRS Dhaka head office. Therefore, it is considered that the technical training to many survey staff of DLRS will be necessary.

DLRS is planning to establish 70,000 control points in total for cadastral survey at 61,410 cadastral map (Mouza map) sheets area for the implementation of this project.

DLRS is interested in the utilization CORSs which will be established by SOB for the establishment of control points for cadastral survey effectively and promptly by GNSS observation.

At present, DLRS has no idea to start the digital cadastral mapping from the high priority area such as urban area or industrial area.

Table 6.3.1 and Table 6.3.2 show the current situation of the incomplete cadastral map sheets by DLRS. Total numbers of cadastral map sheets in Bangladesh are 61,410 sheets.

The numbers of incomplete cadastral map sheets executing by the ordinary cadastral survey method are 19,841 sheets.

Field survey works for 19,182 cadastral map sheets out of a total of 19,841 cadastral map sheets has been already completed.

However, the legal procedure completed cadastral map sheets are 14,570 sheets (75.9 % of total incomplete cadastral map sheets).

It is understood that the legal procedure for cadastral maps takes a lot of time. Preparation of digital cadastral maps also shows the same trend.

Table 6.3.1 Numbers of incomplete cadastral maps executed by ordinary cadastral survey method

Number of cadastral maps	Numbers of incomplete cadastral maps executing by ordinary cadastral survey method (Starting date: before 2007)
Number of incomplete cadastral maps	19,841
Numbers of field survey completed cadastral maps	19,182
Numbers of legal procedure completed cadastral maps	14,570

Source: Prepared by the Project Team based on the results of hearing from DLRS

Table 6.3.2 Numbers of incomplete digital cadastral maps

Numbers of cadastral maps	Numbers of digital cadastral maps (Starting date: after 2008)
Numbers of incomplete cadastral maps	125
Numbers of field survey completed cadastral maps	51
Numbers of legal procedure completed cadastral maps	20

Source: Prepared by the Project Team based on the results of hearing from DLRS

Network RTK survey is the new technology using CORSs as network, and it is possible to obtain the coordinates of observation point accurately and at short time within the area surrounded by CORSs.

Due to short observation time and accuracy, without the establishment of control points, it is possible to establish supplementary control points directly, or it is possible to obtain the boundary information of land owners directly by this technology.

Table 6.3.3 shows the utilization method of CORSs for cadastral mapping and cost reduction effect by the utilization of CORSs in Bangladesh.

Table 6.3.3 Utilization method of CORSs for cadastral mapping (Mouza map) and cost reduction effect

Method	Utilization method	Cost reduction effect	Note
1	Control points for cadastral survey will be established by GNSS observation.	It is not necessary to set up GNSS receiver on CORS. Therefore, the work efficiency of GNSS observation will be increased approximately 1.5 - 2.0 times, and the cost and work period of control points survey will be decreased.	Target numbers of control points is approximately 70,000 points.
2	Supplementary control points for cadastral survey at the area with few high buildings and open sky will be established by network RTK survey and TS (traversing).	Supplementary control points for cadastral survey will be established directly by network RTK survey, and the supplementary control points in the village area will be established by TS (traversing). It is not necessary to establish the control points for cadastral survey. Therefore, cost for establishment of control points will be decreased.	Target number of control points is approximately 49,000 points at cultivation area (approximately 70% of Bangladesh territory).
3	Cadastral boundary will be obtained directly by network RTK without establishment of control points and supplementary control points.	It is not necessary to establish control points and supplementary control points for cadastral survey. Therefore, these cost will be decreased. However, this method can be applied for open sky area only.	Target area is cultivation land and open sky area (approximately 70% of Bangladesh territory.

Source: The Project Team

The method 1 is agreed by DLRS, however, method 2 and 3 are under review by DLRS at present.

6.3.3 Utilization of CORSs for infrastructure development projects in Bangladesh

In Bangladesh, GNSS equipment and/or total station are used for engineering survey such as longitudinal profiling and cross section survey, determination of land acquisition boundaries and so on for the infrastructure development projects such as highway, bridge, railway, airport, sea port and so on.

The area within 30 km from the existing 6 CORSs such as Dhaka City, Chittagong City, the GNSS data received by CORSs transmit to the datacenter of SOB head office at Dhaka in real time, and these data will transmit to the rover (a kind of GNSS equipment) which will be set up at the survey point in real time.

Rover will calculate the coordinates based on the data transmitted from datacenter of SOB head office at Dhaka in real time. This survey method is called as single RTK survey.

By single RTK survey, it is possible to obtain the coordinates of rover in real time, and also to be able to show the observation positions such as corner of building, road edge, fence and etc. on the display.

At the area more than 30 km from CORSs, field survey by traversing using the existing geodetic control points (monuments) or RTK survey using GNSS equipment with data transmission facility and rover (not using CORSs) are executed.

SOB executes single RTK survey for infrastructure development project such as railway construction, airport construction project and so on. Private survey companies in Bangladesh also execute engineering survey for the infrastructure development project using GNSS equipment and total station by the contract with consultants or construction companies.

Also, GNSS equipment are used for hydrographic survey, and RTK survey are used at the surrounding area of CORSs in Bangladesh.

The SOB's regulation that single RTK survey have to be executed within the distance of 30 km from CORSs are well recognized by government organizations and also private survey companies in Bangladesh, ant it is judged that single RTK survey is well established survey method in Bangladesh.

The densification of CORSs will widen the single RTK survey area drastically and efficient and prompt survey work will become available. therefore, the interviewed organizations expressed the strong interest in the densification of CORSs.

As mentioned above, it is judged that the densification of CORSs will contribute the national development of Bangladesh from the view point of efficient and prompt survey.

6.4 Utilization possibility of CORSs in Bangladesh

The present and future utilization of CORSs in Bangladesh are as follows:

6.4.1 Utilization for RTK survey in Bangladesh

By the densification of CORSs, the single and network RTK survey area will increase drastically and utilization of RTK survey for engineering survey for infrastructure development projects will be more popular.

Therefore, it is considered that the numbers of GNSS equipment will increase in Bangladesh.

For the promotion of utilization of CORSs and new technology development, training and lecture relating CORSs and RTK survey to the users will be necessary, and SOB should take a leadership for this activities.

6.4.2 Contribution for geoid survey and disaster prevention measures by GNSS survey

SOB executes the establishment of 3D (horizontal coordinates and elevation) geodetic control

points network by leveling and GNSS observation using 6 existing CORSs.

The main purpose of the establishment of 3D geodetic control points network is to provide the basic information for forecast and prevention measures for flood and high tide water in Bangladesh.

3D geodetic control points have the information of horizontal coordinates and elevation from Mean Sea Level (geoid height) and elevation from ellipsoid (ellipsoid height).

The water on the surface on Earth such as flood water and high tide water will flow from the high point to the low point according to the geoid undulation.

Currently in Bangladesh, to obtain the geoid height, it is necessary to execute leveling from the existing bench mark to the observation point.

SOB is increasing the numbers of 3D geodetic control points based on the existing CORSs, and collecting the information of geoid heights and heights observed by GNSS (ellipsoid heights).

The final target of SOB is to prepare the conversion parameters form ellipsoid heights to geoid heights at whole territory of Bangladesh.

After the completion of conversion parameters from ellipsoid heights to geoid heights, it is possible to determined the accurate elevation by GNSS survey.

For example, it is possible to prepare the accurate elevation data at wide area efficiently and promptly by the utilization of GNSS equipped mobile (mobile mapping system) and conversion parameter for flood forecast and prevention measures.

In Japan, the conversion parameter was prepared by GNSS observation at the existing bench marks in the early stages.

In Bangladesh, it is considered that the conversion parameter from ellipsoid heights to geoid heights will be prepared in years to come.

6.4.3 Other availability for utilization of CORSs in Bangladesh

In Japan, the automatic operation system of agriculture machines and construction machines by GNSS observation using CORSs becomes reality.

The price of this kind of system is expensive at present, and the introduction of this kind of system into Bangladesh may be in the days ahead.

However, the price of equipment to be able to determine the coordinates (which has not enough accuracy for survey and mapping purpose) will become very cheap due to the increase of users demands and development of mass production technology.

Currently, it is not sure what kind of equipment will be introduced into Bangladesh. Because, this will depend on the cost and effect by the utilization of equipment in Bangladesh and also the user's idea for utilization of these kind of equipment.

The promotion activities for the utilization of CORSs by the government and private sectors will be necessary. Because, CORSs are the fundamental infrastructure for the positioning by GNSS.

6.5 Increase of work efficiency of ground control point survey by GNSS using CORSs

The purpose of establishment of CORSs is different country by country. However, common purpose of establishment of CORSs is utilization for survey purpose, especially GNSS observation.

By the utilization of CORSs, the work efficiency of GNSS survey will be improved, and ground control point survey, cadastral survey and engineering survey will be able to execute more efficiently and economically.

In general, GNSS survey will be executed by 3 sets or 4 sets of GNSS receivers as one set.

The work efficiency of GNSS observation by 4 sets of GNSS receivers as one sets, with and without utilization of CORS are as follows:

6.5.1 GNSS observation method not using CORSs

GNSS observation method using 4 GNSS receivers and without CORSs is as follows:

a) 2 GNSS receivers will be set up on the existing geodetic control points (monuments).

b) Coordinates and elevations of 2 existing geodetic control points (monuments) will be obtained from SOB.

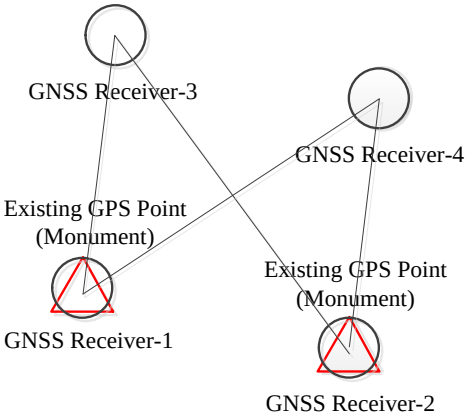
c) 2 GNSS receivers will be set up on the new points.

d) The coordinates of new 2 points will be obtained by one time of GNSS observation using 4 GNSS receivers.

e) The GNSS observation efficiency on one time of GNSS observation can be calculated as follows:

GNSS observation efficiency = Number of new point/Number of GNSS receivers
= 2 points/4 sets = 0.5

Figure 6.5.1 shows the GNSS observation method using 4 GNSS receivers and without CORSs.



2 GNSS Receivers for the existing GPS points (Monuments)
2 GNSS receiver for new points

Source: The Project Team

Figure 6.5.1 GNSS observation method using 4 GNSS receivers and without CORSs

6.5.2 GNSS observation method using one CORS

GNSS observation method using 4 GNSS receivers and one CORS is as follows:

a) 1 GNSS receiver will be set up on the existing CORS and 1 GNSS receiver will be set up on the existing geodetic control point (monument).

b) Coordinates and elevations of 1 existing geodetic control point (monument) will be obtained from SOB.

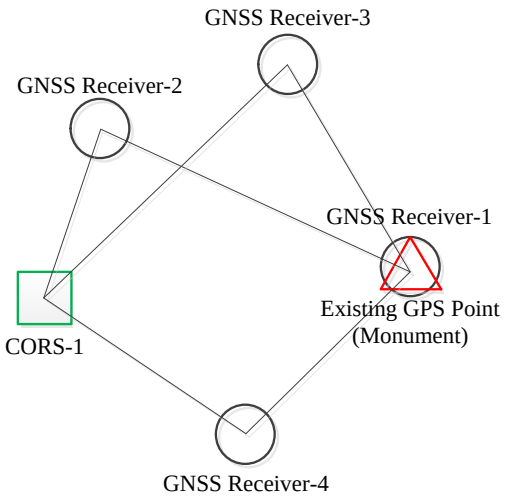
c) 3 GNSS receivers will be set up on the new points.

d) The coordinates of new 3 points will be obtained by one time of GNSS observation using 4 GNSS receivers.

e) The GNSS observation efficiency on one time of GNSS observation can be calculated as follows:

GNSS observation efficiency = Number of new point/Number of GNSS receivers
= 3 points/4 sets = 0.75

Figure 6.5.2 shows the GNSS observation method using 4 GNSS receivers and one CORS.



1 CORS will be used
1 GNSS Receiver for the existing GPS point (Monuments)
3 GNSS receiver for new points.

Source: The Project Team

Figure 6.5.2 GNSS observation method using 4 GNSS receivers and 1 CORS

6.5.3 GNSS observation method using more than 2 CORSs

GNSS observation method using 4 GNSS receivers and more than 2 CORSs is as follows:

a) 4 GNSS receivers will be set up on the new points.

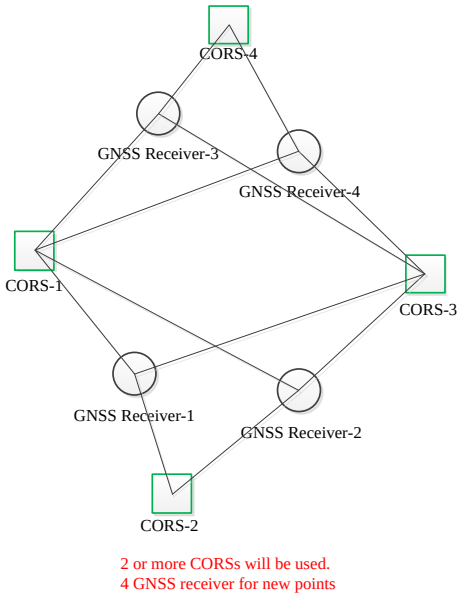
b) Coordinates and elevations of more than 2 existing geodetic control points will be obtained from SOB.

c) The coordinates of new 4 points will be obtained by one time of GNSS observation using 4 GNSS receivers.

d) The GNSS observation efficiency on one time of GNSS observation can be calculated as follows:

GNSS observation efficiency = Number of new point/Number of GNSS receivers
= 4 points/4 sets = 1.00

Figure 6.5.3 shows the GNSS observation method using 4 GNSS receivers and more than 2 CORSs.



Source: The Project Team

Figure 6.5.3 GNSS observation method using 4 GNSS receivers and 2 CORSs or more

6.5.4 Work efficiency improvement of ground control point survey by GNSS receivers and CORSs

Generally, the ratio between office works (preparation, computation and so on) and field works (observation and so on) of ground control points survey is estimated as an approximately 30% : 70%.

Table 6.5.1 shows the work efficiency of ground control points survey using GNSS calculated based on the ratio of office works and field works of ground control points survey, and the GNSS observation efficiency using 4 GNSS receivers and CORSs.

The office work efficiency will not change whether CORSs are available or not.

Table 6.5.1 Work efficiency of ground control points survey using 4 GNSS receivers and CORSs

GNSS observation method	Office work (a)	Field work (b)	GNSS observation efficiency (c)	Work efficiency of ground control points survey by GNSS observation (a+b×c)
CORS is not available.	0.3	0.7	0.5	0.650
1 point of CORS is available.	0.3	0.7	0.75	0.825
2 points or more CORSs are available.	0.3	0.7	1.00	1.000

Source: The Project Team

The work efficiency of ground control points survey using 4 GNSS receivers and one CORS is 1.27 times (0.825/0.650) higher than the work efficiency of ground control points survey using 4 GNSS receivers and without CORS.

The work efficiency of ground control points survey using 4 GNSS receivers and more than 2 CORS is 1.54 (1.000/0.650) times higher than the work efficiency of ground control point survey using 4 GNSS receivers and without CORS.

Table 6.5.2 shows the work efficiency of ground control points survey using 3 GNSS receivers and CORSs.

Table 6.5.2 Work efficiency of ground control points survey using 3 GNSS receivers and CORSs

GNSS observation method	Office work (a)	Field work (b)	GNSS observation efficiency (c)	Work efficiency of ground control points survey by GNSS observation (a+b×c)
CORS is not available.	0.3	0.7	0.33	0.531
1 point of CORS is available.	0.3	0.7	0.66	0.762
2 or more points of CORSs are available.	0.3	0.7	1.00	1.000

Source: The Project Team

The work efficiency of ground control points survey using 3 GNSS receivers and one CORS is 1.44 times (0.762/0.531) higher than the work efficiency of ground control points survey using 3 GNSS receivers and without CORS.

The work efficiency of ground control points survey using 3 GNSS receivers and more than 2 CORSs is 1.88 (1.000/0.531) times higher than the work efficiency of ground control point survey using 3 GNSS receivers and without CORS.

The price of GNSS receiver for ground control points survey become lower than before. However, for the government organization and private company in developing countries, the cost for procurement of many GNSS receivers is still high. Therefore, the organizations possessing many GNSS receivers in developing countries are limited to SOB and DLRS such as national survey and mapping agency.

Considering the work efficiency of ground control points survey using GNSS and CORSs mentioned above, it is judged that the organizations having small numbers of GNSS receivers and private companies have many advantage of CORSs utilization.

6.6 RTK survey using CORSs

At present, RTK survey using CORSs becomes popular, and RTK survey consists of following two survey methods.

a) Single RTK survey using 1 CORS
b) Network RTK survey using more than 3 CORSs

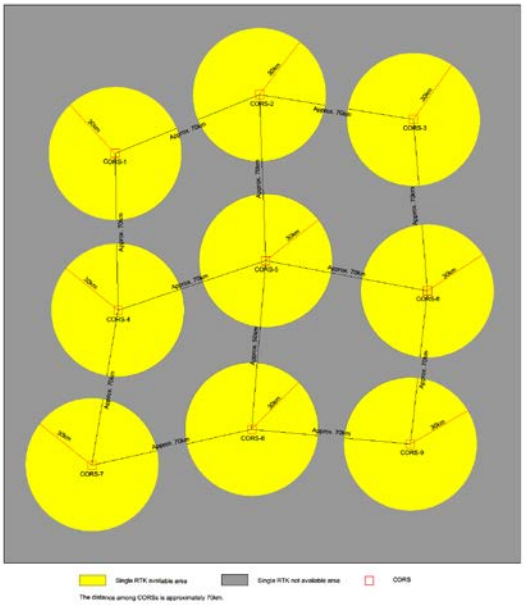
The availability of network RTK is fully depend on the density of CORSs (distance between CORSs).

According to the regulation of SOB, it is requested that single RTK survey should be executed within the distance of 30 km from CORSs.

Based on this regulation of SOB, the relation among the distance between CORSs, single RTK survey available area, network RTK survey available area and efficiency of RTK survey becomes as follows:

6.6.1 In case where the distance between CORSs is approximately 70 km

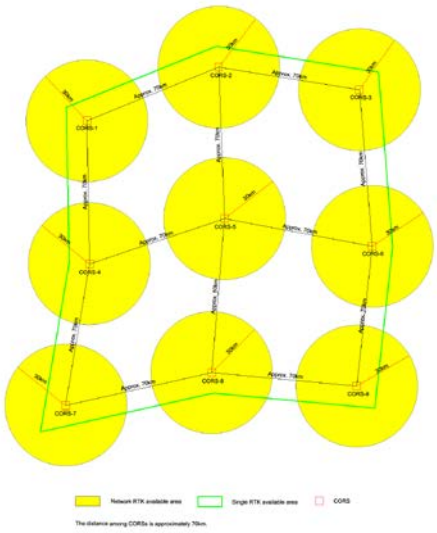
Figure 6.6.1 shows the available single RTK survey area (yellow color, less than 30 km from CORS) and the unavailable single RTK survey area (grey color, more than 30 km from CORS) in case where the distance between CORSs is approximately 70 km.



Source: The Project Team

Figure 6.6.1 Available single RTK survey area (yellow color) and unavailable single RTK survey area (gray color) in case where the distance between CORSs is approximately 70 km

Figure 6.6.2 shows the available single RTK survey area (yellow color, less than 30 km from CORS) and the available network RTK survey area (inside of green line) in case where the distance between CORS is approximately 70 km.



Source: The Project Team

Figure 6.6.2 Available single RTK survey area (yellow color) and available network RTK survey area (inside of green line) in case where the distance between CORSs is approximately 70 km

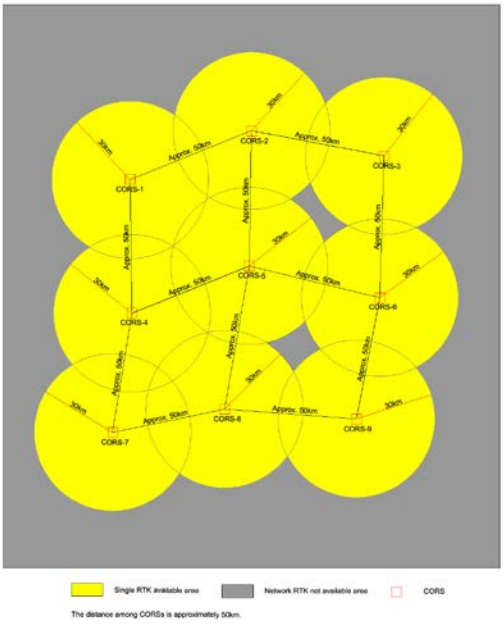
As shown in Figure 6.6.1, single RTK survey is not available at quite large area surrounded by 9 CORSs in case where the distance of CORS is approximately 70 km.

At the area apart from more than 30 km from CORSs, GNSS receiver and rover which have data transmission function, and the existing geodetic control points (monuments) will be used for RTK survey.

Therefore, at least, one GNSS receiver has to be set up on the existing geodetic control points (monument), and the observation efficiency of single RTK survey will be decreased same as ground control points survey by GNSS observation.

6.6.2 In case where the distance between CORSs is approximately 50 km

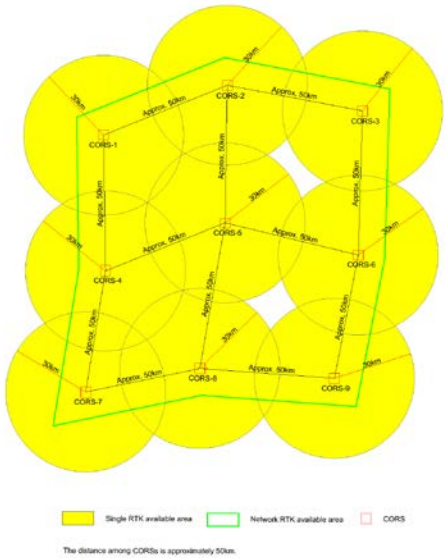
Figure 6.6.3 shows the available single RTK survey area (yellow color, less than 30 km from CORS) and the unavailable single RTK survey area (grey color, more than 30 km from CORS) in case where the distance between CORSs is approximately 50 km.



Source: The Project Team

Figure 6.6.3 Available single RTK survey area (yellow color) and unavailable single RTK survey area (grey color) in case where the distance between CORSs is approximately 50 km

Figure 6.6.4 shows the available single RTK survey area (yellow color, less than 30 km from CORS) and the available network RTK survey area (inside of green line) in case where the distance between CORS is approximately 50 km.



Source: The Project Team

Figure 6.6.4 Available single RTK survey area (yellow color) and available network RTK

survey area (inside of green line) in case where the distance
between CORSs is approximately 50 km

As shown in Figure 6.6.3, single RTK survey is available at almost all area surrounded by 9 CORSs in case where the distance of CORSs is approximately 50 km. However, small unavailable single RTK survey area may be remained depend on the CORSs distribution.

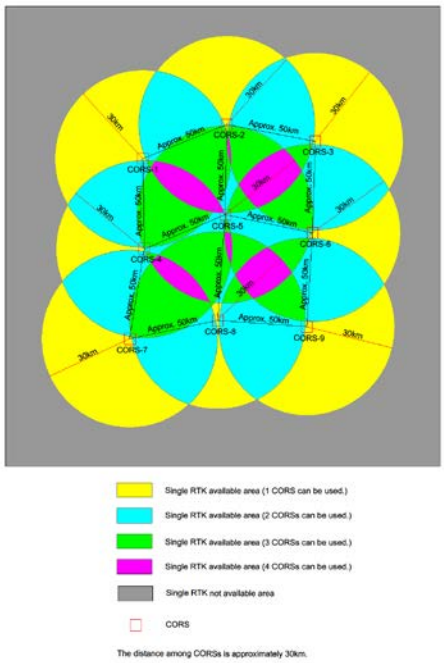
At the unavailable single RTK survey area, one GNSS receiver has to be set up on the existing geodetic control points (monument). However, due to the limited unavailable single RTK survey area, the observation efficiency of single RTK survey may not be decreased so much.

6.6.3 In case where the distance between CORS is approximately 30 km

Figure 6.6.5 shows the available single RTK survey area (less than 30 km from CORS), and the available single RTK area is classified by the available numbers of CORSs.

As shown in Figure 6.6.5, single RTK survey is available at all area surrounded by 9 CORSs in case where the distance between CORSs is approximately 30 km.

Furthermore, it is possible to select CORS to be used for single RTK survey from several CORSs, and it is possible to respond flexibly to the trouble of CORS at the field survey.

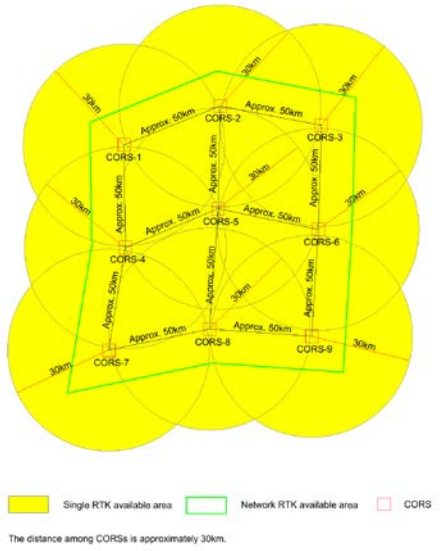


Source: The Project Area

Figure 6.6.5 Available single RTK survey area in case where the distance between
CORSs is approximately 30 km

(classification by available number of CORSs)

Figure 6.6.6 shows the available single RTK survey area (yellow color, less than 30 km from CORS) and the available network RTK survey area (inside of green line) in case where the distance between CORS is approximately 30 km.



Source: The Project Team

Figure 6.6.6 Available single RTK survey area (yellow color) and available network RTK survey area (inside of green line) in case where the distance between CORSs is approximately 30 km

As shown in Figure 6.6.6, not only single RTK survey but also network RTK survey are available at all area surrounded by 9 CORSs in case where the distance between CORSs is approximately 30 km.

6.6.4 Relation between the distance of CORSs, available RTK survey area and number of CORSs

As mentioned above, the single RTK survey available area depends on the distance between CORSs.

In case where the distance between CORSs is approximately 30 km, not only network RTK survey, but also single RTK survey will become available, and it is possible to execute single and network RTK survey efficiently and accurately.

However, the total numbers of CORSs will become approximately 2.8 times in case where the distance between CORSs reduces to 1/2. As a matter of course, not only the initial investment cost for the construction of CORSs, but also the maintenance and operation cost, and updating cost of CORSs will increase.

Therefore, it is necessary to consider the density of CORSs (distance between CORSs) considering the purpose and method of utilization of CORSs, initial investment cost, maintenance and operation cost and updating cost of CORS.

6.7 Initial investment cost, maintenance and operation cost of CORSs

The initial investment cost, maintenance and operation cost of CORSs are as follows:

6.7.1 Initial investment cost of CORSs

Figure 6.7.1 shows the approximate initial investment cost for the establishment of CORSs and tide observation stations described in the document of application form for grand aid from Japan "Densification of GNSS CORS network and establishment of two tidal stations in Bangladesh" prepared by SOB.

Table 6.7.1 Initial investment cost for the construction of CORSs and tide observation stations

Items	Amount (US$)
1) CORS	
Construction cost	US$8,240,000.-
Equipment cost	US$2,430,000.-
Sub-total	US$10,670,000.-
2) Tide observation station	
Construction cost	US$3,625,000.-
Equipment cost	US$1,038,000.-
Sub-total	US$4,663,000.-
3) Supervision of works	US$800,000.-
4) Total amount	US$16,133,000.-

Source: Application Form for Grand Aid from Japan, Survey of Bangladesh

Figure 6.7.2 shows the spilt of works and expense distribution by Bangladesh side and Japan side for the construction of CORSs and tide observation stations.

Table 6.7.2 Split of works and expense distribution for the construction of CORSs and tide observation stations

Work items	Bangladesh side	Japan side
1) Preparation of point selection criteria for CORS 2) Preparation of point selection criteria for tide observation station	Criteria will be prepared jointly. Training for point selection will be executed jointly.	
1) Point selection of CORSs 2) Point selection of tide observation stations	Implementation	Implementation
1) Negotiation with/land & building owners	Implementation	No implementation

Work items	Bangladesh side	Japan side
1) Preparation of specifications of CORS and datacenter	Comments for specifications will be made.	Specifications will be made.
1) Construction of CORSs 2) Construction of tide observation stations	Negotiation with land/ building owners and telecommunications firm	Implementation of construction
1) Setting up of equipment	Negotiation with land/ building owners and telecommunications firm	Execution of setting up of equipment
1) Operation training	Selection of trainee	Training will be executed.
1) Maintenance and operation	Implementation	No implementation

Source: The Project Team

6.7.2 Failure rate of the existing CORSs and maintenance cost

The maintenance and operation cost consists of the cost relating datacenter and CORSs (GNSS receiver and so on), and currently, the cost relating CORSs (GNSS receiver and so on) is very expensive due to the reason of frequent exchange of telecommunication board and so on of GNSS receiver of CORSs.

The telecommunication board of GNSS receiver of CORSs was exchanged 4 times during past 5 years and 8 months after establishment of 6 CORSs. Therefore, the failure ratio of GNSS receiver is calculated as approximately 11.8% /point/year.

Failure ratio = 4 times/(5.67 years×6 CORSs) = 0.118 = 11.8% /point/year

The maker of GNSS receiver of CORSs of SOB and Geospatial Information Authority of Japan (more than 50% of total number of CORSs in Japan) is same.

However, the failure ratio of GNSS receiver of CORSs of Geospatial Information Authority of Japan, which is calculated based on the frequency of telecommunication board exchange of GNSS receiver in 2015 and 2016, is approximately 0.9 % /point/year.

Currently, one CORS has temperature data transfer trouble from CORS to datacenter.

In Japan, the data transfer trouble ratio from CORS to datacenter in 2016 is approximately 0.1% per a year. In Japan, countermeasure for data transfer trouble are taken only when the trouble report is sent from CORS to datacenter.

As mentioned above, it is judged that the failure ratio of GNSS receiver of CORS of SOB is considerably higher than the failure ratio of GNSS receiver of CORS in Japan.

It is considered that the difference of failure ratio and data transfer trouble ratio between Bangladesh and Japan are caused by the difference of installation condition of GNSS receiver and telecommunication device in Bangladesh and Japan.

To reduce the failure ratio and data transfer trouble ratio of GNSS receiver of CORS, necessary countermeasures have to be taken at the construction stage of CORS.

For this purpose, it is recommended to adopt the countermeasures to protect GNSS receiver and data transmission device in Japan, which are suitable in Bangladesh.

By the reducing of failure ratio and data transfer trouble ratio of GNSS receiver of CORS, it is possible to reduce the operation and maintenance cost of CORS of SOB.

Currently, SOB made a maintenance contract of 6 CORSs during 16 months with Bangladesh private company as approximately Taka4,300,000.- (approximately US$54,000.-) ＋ spare parts cost.

The annual maintenance cost of the existing CORS per a point is calculated as US$6,750.-/point/year.

US$54,000.-/6 points/16 months×12 months = US$6,750.-/point/year

In case where this amount of maintenance cost per a point is applied for the total numbers of CORSs (6 existing CORSs and 70 new CORSs, total 76 CORSs), the annual maintenance cost is calculated as US$513,000.- /year.

US$6,750.-/point/year×76 points = US$513,000.-/year

It is considered that this amount is considerably expensive as maintenance cost of CORSs for SOB. Therefore, it is necessary to consider the maintenance method (content of maintenance contract) after the construction of CORSs to reduce the amount of maintenance cost.

6.7.3 Issues to be considered for the establishment of CORSs and datacenter

Following are the major issues to be considered for the establishment of CORSs in Bangladesh.

1) Location of CORS

Concerning the CORSs around the south delta area, Chittagong hilly area and international border line area, it is necessary to review the availability from the viewpoints of security, maintenance (accessibility), restriction for entering into these area and so on. It is necessary to alter the locations of CORSs, if necessary.

Furthermore, it is necessary to execute the field survey for suitable site selection, and land ownership for all proposed CORSs. Especially, the negotiation with land owner or building owner has to be executed and completed by SOB prior to the construction of CORSs.

For the selection of suitable locations, it is necessary to prepare checking list, and based

on this checking list, field survey has to be executed.

For the selection of location, it is necessary to select several candidate sites for one CORS, final location will be selected from the several candidate locations based on field survey results.

From the viewpoint of utilization of CORSs, it is recommended that the allocation of CORSs around the large city such as Dhaka Metropolitan area and Chittagong City will be more dense.

The natural reserve area, forest reserve area and so on should be excluded from the locations of CORSs. Therefore, it is necessary to check these data preliminarily.

2) Conditions of candidate location for CORSs

CORSs are planned to be established on the rooftop of Bangladesh Government buildings from the viewpoint of safety for equipment.

Also, it is necessary to secure the upper sky clearance on CORSs.

The data transmission system of mobile telephone is used for data transfer from CORSs to datacenter. Therefore, it is necessary to check that the candidate points are included in mobile telephone service area and enough data transmission speed is secured.

6.8 Tide observation stations construction plan

The outline of tide observation station construction plan of SOB are as follow:

6.8.1 Existing tide observation station of SOB

SOB established tide observation station at the river mouth of Krnaphuli River at Chittagong in 1993 by the technical cooperation of the Government of Japan, and keeps the operation of tide observation continuously up to now.

Checking and maintenance of tide gauge are executed by 3 staff of SOB at Chittagong. Checking and maintenance of the structure (excluding tide gauge) are executed by the staff of local government.

SOB executes the tide observation continuously around 25 years at Chittagong. During this period, no erosion or sedimentation around the tide observation station at Chittagong has occurred, and SOB did not encounter the serious troubles relating facilities and equipment of tide observation station.

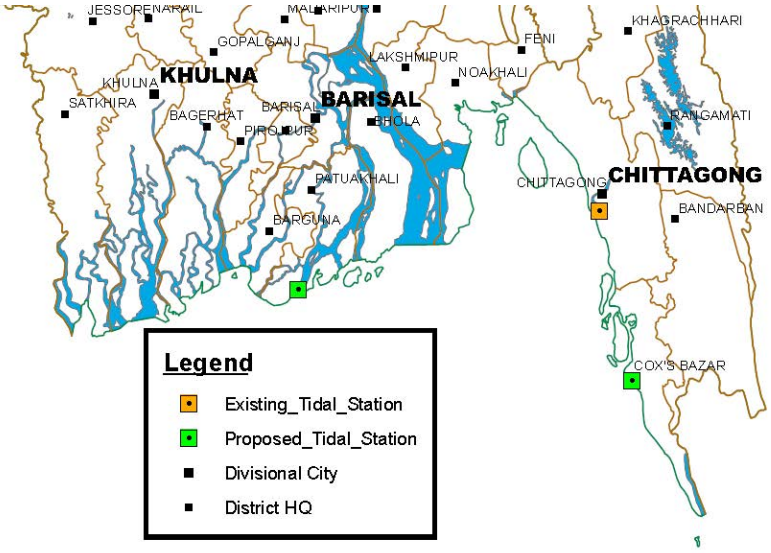
At the beginning of the establishment of tide observation station at Chittagong, the recording paper and ink were used for tide observation recording. However, due to the unavailability of recording paper (made in Japan) in Bangladesh, SOB decided to change the recording method from analogue method to digital method using PC.

Currently, 6 seconds interval digital tide observation data are saved in PC at tide observation station, and digital tide observation data send to SOB head office at Dhaka from Chittagong by memory card.

SOB supplies the information of monthly mean sea level and yearly mean sea level based on the tide observation data to the authorities concerned.

6.8.2 Natural conditions at the candidate locations of tide observation stations

Figure 6.8.1 shows the proposed locations of tide observation stations (Cox's Bazar and Kuakata) by SOB.



Source: SOB

Figure 6.8.1 Proposed locations of tidal observation stations by SOB

Locations of tide observation stations were selected on the maps. However, field survey for the locations of tide observation stations has not yet been executed, and land ownership has not yet been confirmed.

Generally, for the suitable location of the tide observation station, it is necessary to meet a following requirements.

a) It is necessary to keep an approximately 1.5 m - 2.0 m water depth at the time of low tide around the tide observation tower.

b) It is necessary to built a catwalk connecting between tide observation tower and coastal land. Therefore, the short distance between tide observation tower and coastal land is one of the important key factor for the selection of location of tide observation station.

   A shallow beach is not a suitable location of tide observation station. Therefore, a steep bathymetric feature near shore line is recommended for the location of tide observation station.

c) A location with no coastal line change is recommended for the tide observation station site. In case of heavy erosion coastal area, the facilities which will be constructed on coastal land may be destroyed due to coastal erosion. In case of heavy sedimentation coastal line area, the water depth around the tide observation tower will become shallow, and the area around the tide observation tower will finally become land.

d) It is recommended that the location of tide observation station has no direct influence of ocean waves by the shape of coastal lines.

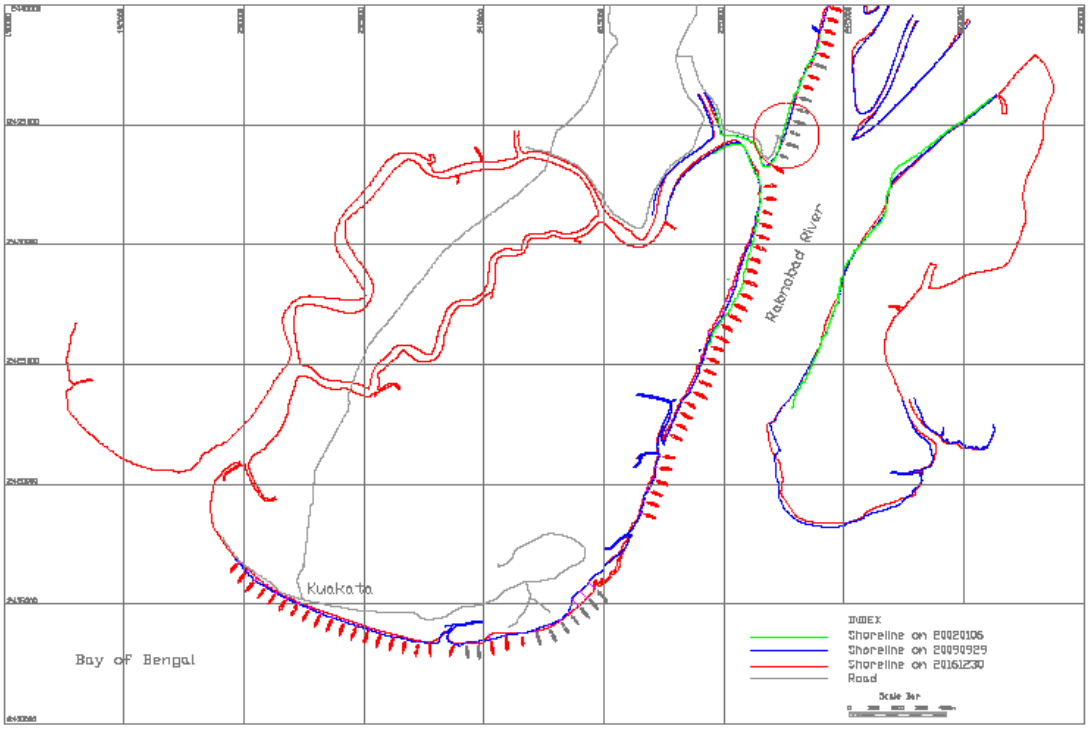
e) It is necessary to select the suitable location that the tide observation tower will not be destroyed by the large ships, in case the tide observation tower will be constructed around the existing jetty or heavy ship navigation area.

f) By any possibility, it is necessary to establish the tide observation station in the river, it is recommended to select the location of tide observation station at the river mouth as much as possible to avoid the influence of water flow from the upstream of the river.

6.8.3 Coastal line change around the candidate site of tide observation station at Kuakata

It is considered that the shore line of the proposed tidal observation station at Kuakata by SOB has an erosion of approximately 15 m - 20 m/year. Therefore, it is necessary to select the location of tide observation station carefully at Kuakata.

Figure 6.8.2 (Annex-6) shows the coastal line change among 6 January 2002, 29 September 2009 and 30 December 2016 based on Google Earth images, and volumes of coastal line changes were estimated.



Source: The Project Team

Figure 6.8.2 Costal line change around the candidate location of tide observation station at Kuakata estimated by Google Earth images

The numeric values shown in Figure 6.8.2 are the volumes of coastal line change between 29 September 2009 and 30 December 2016 (approximately 7 years and 3 months).

The volumes of coastal line change are different location by location. The largest volume of coastal line changes is approximately -200 m (-27.5 m/year), and smallest volume of coastal line changes is approximately -50 m (-6.9 m/year) around the proposed location of tide observation station by SOB.

Red color circle shown in Figurer 6.8.2 is considered as the most stable coastal line around the proposed location of tide observation station at Kuakata by SOB.

According to the Google Earth image, jetty is under construction at the point marked by red color circle and the hinterland of this point is under land reclamation at present.

Due to the large scale of this jetty and land reclamation area, it is considered that the location of this jetty was selected carefully based on the sufficient survey.

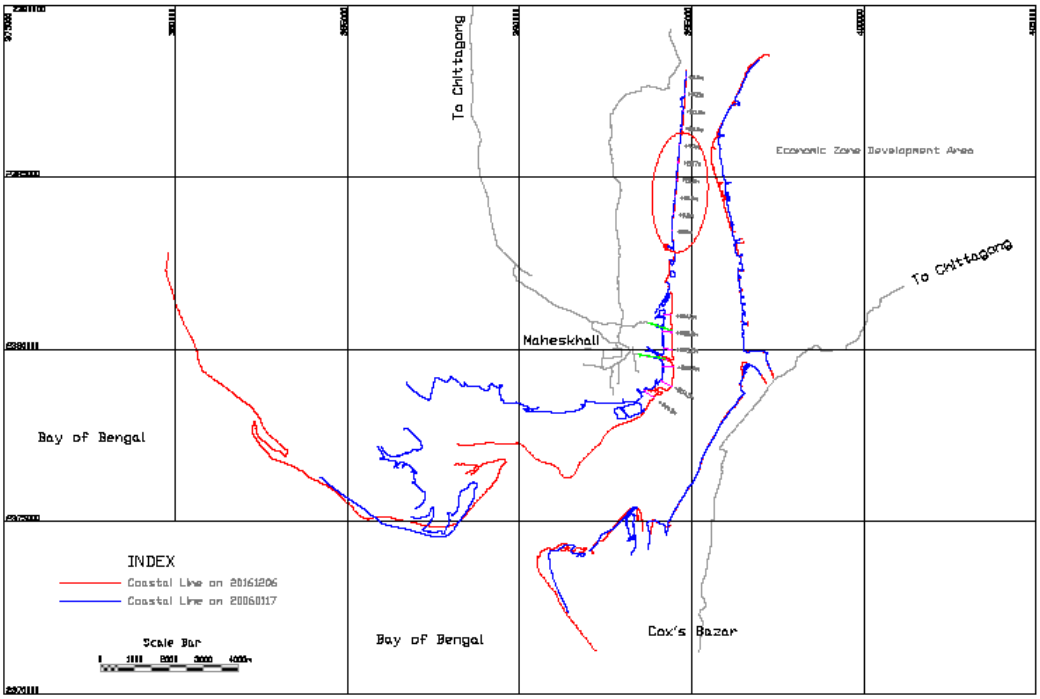
Therefore, it is considered that the most suitable location for tide observation station around Kuakata is the area around this jetty.

However, this is the suitable location judged by the coastal line change, and final location of tide observation station has to be selected based on natural condition survey such as geological survey, bathymetric survey and so on.

6.8.4 Costal line change around the candidate site of tide observation station at Cox's Bazar

The proposed location of tide observation station at Cox's Bazar locates at the inside of river flowing at north direction of Cox's Bazar.

Figure 6.8.3 (Annex-7) shows the coastal line change between 17 January 2006 and 6 December 2016 based on Google Earth images, and volumes of coastal line changes were estimated.



Source: The Project Team

Figure 6.8.3 Costal line change around the candidate location of tide observation station at Cox's Bazar estimated by Google Earth images

The figures shown in Figure 6.8.3 are the volumes of coastal line change between 17 January 2006 and 6 December 2016 (approximately 10 years and 11 months).

It is considered that both left and right bank of this river has sedimentation. However, it is considered that the sedimentation of right bank is smaller than the sedimentation of left bank of this river.

Therefore, the coastal line marked by red color ellipse is considered as the most suitable location for tide observation station around the proposed site by SOB.

However, this is the suitable location judged by the coastal line change, and final location of tide observation station has to be selected based on natural condition survey such as geological survey, bathymetric survey and so on.

6.8.5 Issues to be considered for the construction of tide observation station

Followings are the major issues to be considered for the construction of tide observation station.

1) Location of tide observation station

The location suitable for tidal observation station will be bounded by the natural condition such as land topography, bathymetric feature, coastal line condition (erosion or sedimentation), geology and so on.

Especially, the coastal line in Bangladesh has heavy erosion or sedimentation, and the stable coastal line is limited. Therefore, a careful field investigation for the location selection will be necessary.

It is difficult to select the location of tide observation station on government land due to the reasons mentioned above. Also, it is necessary to build the house for security guard and catwalk between tide observation tower and the land and so on.

Therefore, it is considered that the land acquisition for the tide observation station will be necessary, and prior negotiation with land owner will be essential.

2) Natural condition around the tide observation station

Natural condition around the tide observation station is mentioned in Clause 6.8.2 "Natural conditions at the candidate locations of tide observation stations".

3) Tide observation equipment

Float type tidal observation equipment is recommended, because, SOB is familiar with this type of equipment as well as its maintenance.

Chapter 7 Summary and Analysis of Overview and Utilization Statuses of NSDI in Third Country

Chapter 7 Summary and Analysis of Overview and Utilization Statuses of NSDI in Third Country

This chapter describes the results of investigation on the overview and utilization statuses of NSDI in Indonesia.

7.1 Purpose of investigation in third country

As a reference case for building of NSDI in Bangladesh, interview survey was conducted on the utilization statuses and issues of NSDI in Indonesia, particularly, issues and problems encountered in the operation of NSDI after construction in Indonesia.

NSDI in Indonesia was started to connect Geospatial Information Agency (Badan Informasi Geospatial: BIG) which is the national survey and mapping agency in Indonesia and the organization to supply the geospatial information as the fundamental information on NSDI and the main 10 ministries in Indonesia. After this, network was expanded to the local governments, universities and so on.

The following five out of the eleven relevant ministries and agencies for NSDI in Indonesia, including the Geospatial Information Agency (BIG) of Indonesia, were chosen and investigated.

a) Geospatial Information Agency
(Badan Informasi Geospatial: BIG)

BIG is a national survey and mapping agency in Indonesia, and the main organization on NSDI in Indonesia. BIG supplies the geospatial information (digital topographic data) on NSDI in Indonesia.

b) Ministry of Public Works and Public Housing
(Kementerian Pekerjaan Umum dan Perumahan Rakyat: PUPR)

The Ministry of Public Works and Public Housing is in charge with the public works (irrigation, road, housing and so on), and PUPR is preparing and managing the necessary information for their works using geospatial information and GIS. PUPR is the user of NSDI in Indonesia, and one of the ministries among the main 11 ministries at the construction of NSDI in Indonesia.

c) Ministry of Land and Spatial Planning
(Kementerian Agraria dan Tata Ruan, Badan Pertanahan Nasional: BPN)

BPN is in charge with the land management in Indonesia, and preparing the land records using geospatial information and GIS. BPN is the user of NSDI in Indonesia, and one of the ministries among the main 11 ministries at the construction of NSDI in Indonesia.

d) Ministry of Agriculture
(Kementerian Pertanian: KP)

KP is in charge with the agricultural policy in Indonesia, and executing the monitoring for the area under crop and harvest scenario using remote sensing technology. KP is the user of NSDI in Indonesia, and one of the ministries among the main 11 ministries at the construction of NSDI in Indonesia.

e) Ministry of Forestry
(Kementerian Kehutanan dan Linqkungan Hidup)

The Ministry of Forestry is in charge with forest policy in Indonesia, and executing the monitoring for the forest management and illegal logging and so on using remote sensing technology. Ministry of Forestry is the user of NSDI in Indonesia, and one of the ministries among the main 11 ministries at the construction of NSDI in Indonesia.

The interview survey at the Ministry of Forestry could not take place because the Ministry answered that audit was in progress and that the major members could not spare time for the survey when an appointment for the survey was asked for.

Additionally, information was collected from the private and academic sectors of Indonesia to reinforce the results of the interview survey to the relevant government organization for NSDI in Indonesia.

7.2 Overview and utilization statuses of NSDI in Indonesia

The outline of interview survey to the organizations related to NSDI in Indonesia are as follows:

7.2.1 Geospatial Information Agency (BIG) of Indonesia

Visit date and time: June 13, 2017 10:00 to 11:30
Investigation result overview: As shown in Table 7.2.1

Table 7.2.1 Results of interview survey to BIG

Interview items	Results of interview survey
1) Role of organization	1) BIG is positioned as an organization that plays the role of developing geospatial information in Indonesia in the 2011 Act No. 4 and is carrying out operations based on this Act. 2) Before this Act was enacted, BIG was in charge of creating topographic maps with a scale of 1:25,000 and smaller. After the enactment of this Act, however, BIG is able to create topographic maps with a scale of 1 25,000 and larger and is in charge of supervising large scale topographic maps (with scales of 1:1,000 to 1:5,000) to be created by local governments. 3) Whereas the organizations such as local governments also develop large scale topographic maps as in the past, BIG is to provide technical assistance and

Interview items	Results of interview survey
	accuracy control. Furthermore, it was legally decided that large scale topographic maps shall be developed by the organizations such as local governments according to the specifications of BIG. 4) Furthermore, NSDI has been built and started operating according to the acts and regulations/criteria related to the 2011 Presidential Order No. 94 by BIG.
2) Necessary geospatial information and data for the organization	-----
3) Current status and issues	1) The 2014 Presidential Regulation No. 27 determined the development of the National Geospatial Information Network and specified that the relevant organizations should share geospatial information. 2) This Regulation established a plan to connect 57 ministries and agencies, 34 provincial governments, 514 local governments, and 34 universities and institutions over a network. 3) As of 2017, the numbers of connected organizations are 28 ministries and agencies, 21 provincial governments, 21 local governments, and 18 universities and institutions. 4) The September 2016 Presidential Order No. 9 specified to pursue early realization of the One Map Policy based on the 1:50,000 scale topographic maps.
4) Effect of the NSDI	1) This Act decided that all the maps (geospatial information) developed according to the One Map Policy can be used free of charge.
5) Effect developed by the NSDI	1) There is an increasing need for large scale topographic maps (1:5,000 scale or more larger) so that BIG plans to promote development of them using high-resolution satellite images (such as Digital Globe). 2) Although BIG wants to develop large scale topographic maps with the photogrammetry method using digital aerial photos, securing of a budget is posing a problem.
6) Issues at the utilization of the NSDI	1) There are five important mainstays in promoting NSDI (Policy & Regulation, Governance, Human Resources, Standards, and Technology), none of which can be spared. 2) Various efforts are needed to ensure these elements: Manifestation of national policies, development of relevant legal systems, ensuring of human resources, utilization of leading-edge technologies, securing of necessary budgets, and assistance to activities. 3) The completion of developing geospatial information is by no means the end of development. Activities to maintain the freshness of information (data update) must be periodically conducted. BIG aims to update data once every five years but is not doing so due to budget problems.

Source: Prepared by the Project Team based on the results of interview survey

7.2.2 Data Center of Ministry of Public Works and Public Housing (PUPR) of Indonesia

Visit date and time: June 12, 2017 12:30 to 14:30

Investigation result overview: As shown in Table 7.2.2

Table 7.2.2 Results of interview survey to PUPR

Interview items	Results of interview survey
1) Role of organization	1) PUPR is an organization in charge of public works such as water resources, roads, housing policies, etc. in Indonesia and consists of six departments and a data center (Center for Data and IT). 2) PUPR conducts operations in the entire Indonesia. It plans to implement a huge number of projects from 2015 to 2019 (improvement of a total of 65 dam sites, approx. 1,000 km of highways, approx. 2,350 km of national roads, waterworks, etc.). Therefore, the utilization of GIS is essential in its operations.
2) Necessary geospatial information and data for the organization	1) 1:50,000 scale and 1:25,000 scale digital topographic data 2) Various thematic maps 3) Base maps can be used free of charge. However, BIG provides data offline (via HDD, etc.) because the data volume is too large.
3) Current status and issues	1) The intranet of PUPR is expanding as the need arises. In 2016, a 1G bps environment was constructed. 2) Circuit upgrade is required to distribute Big Data such as geospatial information in NSDI. 3) The elements required for the operation of the Data Center are the organization, human resources, IT technology and standardization.
4) Effect of the NSDI	1) PUPR, one of the organizations connected with NSDI, is creating various thematic map data based on the 1:50,000 scale digital topographic map data. 2) All the efforts on NSDI are based on the One Map Policy, which is aimed at preventing different organizations from having different base map information or redundant data.
5) Effect developed by the NSDI	1) The relevant ministries and agencies plan to create about 40 types of thematic map data between 2015 and 2019. 2) The developed information is utilized to build data warehouses, WebGIS (SIGI.PU.GO.ID), and Web portal site (Infrastructure Geospatial Portal). In addition, workshops are held for each sector in pursuit of human resources development.
6) Issues at the utilization of the NSDI	1) PUPR thinks that the most important element in the utilization of NSDI after building is human resources apart from the budgetary and technical problems. 2) PUPR is identifying points to be improved and creating business plans through analysis of its current statuses using 10 indexes such as development cost, operation cost, and operability.

Source: Prepared by the Project Team based on the results of interview survey

7.2.3 Ministry of Land and Spatial Planning (BPN) of Indonesia

Visit date and time: June 14, 2017 12:45 to 14:30

Investigation result overview: As shown in Table 7.2.3

Table 7.2.3 Results of interview survey to BPN

Interview items	Results of interview survey
1) Role of organization	1) BPN is managing land parcels and land uses as one of its major operations. 2) Approx. 100 million land parcels are registered in Indonesia. Validation was completed on approx. 46% of them and digital conversion (plotting) was completed on approx. 25% of them in total. The work is in progress with completion scheduled for 2025.
2) Necessary geospatial information and data for the organization	1) Large scale topographic maps are required as NSDI for operation assistance to BPN. For urban areas, digital topographic maps with a scale of 1:5,000 or larger are required. 2) Base maps with scales of 1:2,000 or 1:1,000 are required to display parcels in land registers in urban areas. 3) Although BIG is requested to create large scale digital topographic maps, no data has been developed yet for many of the areas.
3) Current status and issues	1) The circuit speed is slow in a certain area (eastern area of Indonesia) where satellite communications are used. 2) The system for monitoring is encountering incidents in which information updated by a branch is not displayed at a location where it should be displayed. It is also encountering many incidents in which land parcel data overlaps each other. There are various possible causes: Problem in location accuracy during survey, error in data creation, and problem in registration and update methods. Whereas these problems should be examined and fixed as appropriate, follow-up training for the persons in charge is required to prevent recurrence of the same problems. Furthermore, BPN thinks that these problems can be prevented if there are base maps that are large scale topographic maps.
4) Effect of the NSDI	1) Land parcels and information in registry can be checked online on the system using data for which plotting has been completed. 2) All the data is stored at the Data Center in Jakarta. A backup system for it is available. 3) All the branches in the country (approx. 400) are connected over a network and can use land parcel information on a real time basis. 4) They can also update information and add registrations over a network.
5) Effect developed by the NSDI	1) There are two types of systems available: One for internal use and another for public disclosure. Information that can be referenced is restricted according to the user level. There are two types of systems available for internal use: One for browsing of information and another for monitoring. 2) Each of the systems need to be logged in separately. However, the same database is referenced by them. 3) Land parcels can be referenced on the site for public disclosure. The scope of disclosure for attribute information is under review at present.
6) Issues at the utilization of the NSDI	1) There are six elements to be considered in terms of land management for promotion of NSDI: Hardware, software, data, training, public value, and support. 2) Particularly important elements are data and support. BPN considers it is important to develop, operate, and maintain data (information).

Source: Prepared by the Project Team based on the results of interview survey

7.2.4 Ministry of Agriculture (KP) of Indonesia

Visit date and time: 14:00 to 15:30, June 15, 2017

Investigation result overview: As shown in Table 7.2.4

Table 7.2.4 Results of interview survey to KP

Interview items	Results of interview survey
1) Role of organization	1) The Ministry of Agriculture manages information on vegetation and cropland statuses analyzed from Landsat images as geospatial information. 2) Using Landsat images provided by LAPAN at intervals of 16 days, the Ministry analyzes the vegetation and cropland statuses in the entire Indonesia in four days, summarizes the results for each administrative unit, and creates reports.
2) Necessary geospatial information and data for the organization	1) Base maps mainly in use are artificial satellite images. 2) Data from other organizations are administrative boundary data from BIG and rainfall data from the Meteorological Agency. 3) The Ministry is considering using data for the management and maintenance of cropland and the restrictions on development (e.g., information on forest conservation areas) although such use has not been realized yet.
3) Current status and issues	1) The operation manual for the system is prepared and distributed as a leaflet in an effort to promote public use.
4) Effect of the NSDI	1) The analysis results (mesh data) are stored on the server for Ina-Geoportal (in the Ministry) and shared inside the Ministry, among the branches, and with other government agencies.
5) Effect developed by the NSDI	1) The data is available for public disclosure for reference-only use. 2) The biggest advantage of building of Ina-Geoportal is that the information sharing has been facilitated.
6) Issues at the utilization of the NSDI	1) The current issue of NSDI is how the hardware such as servers can be updated because nearly five years have passed since introduction. 2) The Ministry is thinking of increasing the number of licenses of ArcGIS (only two licenses at present) but has not done so yet due to budgetary restrictions. 3) The Ministry has not experienced discontinuation of technologies due to migration of personnel because there is little personnel reshuffle at the headquarters and outpost agencies. It is considered that the passing on of technologies is an issue to be solved for other ministries and agencies because reshuffle occurs every few years.

Source: Prepared by the Project Team based on the results of interview survey

7.2.5 Private and academic sectors

The comments from academic sector and private sector for NSDI in Indonesia are shown in Table 7.2.5.

Academic sector: Dr. Agus Suharyanto, Brawijaya University (Universitas Brawijaya)

Private sector: P.T. Exsa International Co., Ltd.

Table 7.2.5 Results of interview survey to academic sector and private sector

Interview items	Results of interview survey
1) Role of organization	-----
2) Necessary geospatial information and data for the organization	1) Geospatial information and various thematic data for research and investigation
3) Current status and issues	1) The interviewees hope that a system that facilitates searching of data will be devised. They have difficulty finding where each item of data is located so that it is necessary to take measures to promote utilization of NSDI by general users. 2) It will take time for downloading provincially.
4) Effect of the NSDI	1) It is possible to use various geospatial information and thematic data at countryside.
5) Effect developed by the NSDI	-----
6) Issues at the utilization of the NSDI	1) Digital data purchased for research and investigation purposes is not recognized as an expense on an accounting basis. 2) Legal interpretation on whether provision of data is free or charged should be clarified. Data available for a charge should be recognized as an expense in the accounting processing.

Source: Prepared by the Project Team based on the results of interview survey

7.3 Issues on the construction of NSDI in Indonesia

Based on the results of interview survey to the organizations related to NSDI in Indonesia, the issues on the construction of NSDI in Indonesia are summarized as follows:

7.3.1 Contents of the project executed by loan assistance by the Government of Japan

The project for the construction of NSDI in Indonesia by loan assistance by the Government of Japan consisted of following 2 components.

Component 1: 1:50,000 scale digital topographic data production at Sumatra
Component 2: Construction of NSDI connecting main 11 ministries

This project did not included the activities to promote the operation and utilization of NSDI and also mutual utilization of geospatial information among the organizations related to NSDI.

Therefore, it is considered that this project was formulated on the condition that the activities to promote the operation and utilization of NSDI and also mutual utilization of geospatial information among the organizations related to NSDI will be executed by the Indonesia side itself.

Normally, the activities to promote the operation and utilization of NSDI and also mutual utilization of geospatial information among the organizations related to NSID should be executed prior to or in parallel with the construction of NSDI platform.

It is presumed that NSDI in Indonesia was constructed without any plans and activities for the promotion and utilization of NSDI and also mutual utilization of geospatial information among the

organizations related to NSDI, and after the construction of NSDI, these activities were started.

Through the interview survey to the organizations related to NSDI in Indonesia, there was a comment that the mutual utilization of geospatial information within the ministry was pressed forward, however, the mutual utilization of geospatial information among the ministries was just started.

It is considered that the many operational issues on NSDI in Indonesia at present (ex. mutual utilization of geospatial information among the organizations, discrepancy in interpretation of regulations or rules, etc) were caused by the time difference between the construction of NSDI and the activities for the operation and promotion of NSDI.

7.3.2 NSDI platform in Indonesia

Through the construction of NSDI in Indonesia by loan assistance by the Government of Japan, the main 11 ministries in Indonesia were connected directly by network, and same system was installed in these 11 ministries.

Due to the rapid improvement of telecommunication infrastructure and development of computer technology after the construction of NSDI in Indonesia, following issues were occurred at present.

a) Same system was installed to the main 11 ministries at the same time. Therefore, it is difficult to adjust the system according to the business contents of each ministry, necessary geospatial information, data volume, and computer technology development.

b) According to the improvement of internet and telecommunication technology, inevitability of the connecting among the main 11 ministries directly by network becomes low.

   It is considered that the initial cost and also maintenance and operation cost of NSDI in Indonesia became high due to the connection among the main 11 ministries directly by network.

Considering the telecommunication and IT circumstance in Indonesia at that time of construction of NSDI in Indonesia, it is considered that this was the unavoidable choice. However, by this choice, the initial investment cost and maintenance and operation cost of NSDI in Indonesia became high.

Also, by the introduction of the same system to the main 11 ministries at the same time, the system updating of the main 11 ministries has to be updated almost at the same time.

From the view point of the budget of the Government of Indonesia, the Government of Indonesia has to allocate the necessary system updating cost for the main 11 ministries around the same time. Therefore, it is considered that the budget allocation for system updating becomes difficult.

7.4 Issues on the operation of NSDI in Indonesia

Based on the results of interview survey to the organizations related to NSDI in Indonesia, the issues on the operation of NSDI in Indonesia are summarized as follows:

7.4.1 Mutual data utilization among organizations

Every organizations in Indonesia engaged in the construction of NSDI according to One Map Policy, national policy of Indonesia. However, mutual data utilization among the organizations related to NSDI does not press forward, and this is the future task in NSDI in Indonesia.

In case that the system related geospatial information is introduced in the organization, the first target is the utilization and mutual utilization of geospatial information among the departments and sections within the organization.

After the progress of the utilization and mutual utilization of geospatial information among the departments and section within the organization on some level, mutual utilization among the different organizations will be tried, and it is considered that this is a common process of data utilization.

To promote the mutual data utilization among the different organizations, it is necessary to solve not only the technical issues such as different coordinates system, data format, horizontal accuracy and so on but also the issues relating regulations and rules of each organization, and it will take a long time for solving these issues.

To solve these issues, plans for the promotion of mutual utilization of geospatial information among the different organizations is essential, and it is necessary to execute the promotion activities prior to and in parallel with the construction of NSDI.

In the case of NSDI in Indonesia, it is considered that any activities for the promotion of mutual data utilization among the different organizations were not executed prior to the construction of NSDI platform, and postponed after the construction of NSDI platform, and this is the main reason not progressing the mutual data utilization among the different organizations in Indonesia.

7.4.2 Large scale digital topographic mapping plan

The base map on NSDI in Indonesia is 1:25,000 scale and 1:50,000 scale digital topographic data. However, the demand for more large scale digital topographic data such as 1:5,000 or 1:2,500 scale digital topographic data at the urban area increased in Indonesia.

One of the issues on NSDI in Indonesia is that the preparation of large scale digital topographic data at the urban area does not progress.

Previously, in Indonesia, BIG, national survey and mapping agency in Indonesia, engaged in the

national base maps covering whole territory of Indonesia (scale is 1:25,000, 1:50,000 and smaller scale) and provincial governments engaged in the preparation of the large scale topographic maps called as urban base maps.

The budget amount of provincial government is different province by province. Therefore, in case where the provincial government with small amount of budget, these provincial governments are difficult to prepare the urban base maps due to the shortage of budget for the preparation of urban base maps.

Based on the Act No.4 in 2011, BIG is able to prepare 1:5,000 scale urban maps. However, basically, the budget for the preparation of urban maps is the budget of provincial government. Therefore, the circumstance not progressing the 1:5,000 scale urban mapping is not improved.

The map scale level necessary for the works of PUPR and KP in Indonesia is 1:25,000 - 1:50,000 level. Therefore, the digital topographic data provided by BIG on NSDI (1:25,000 scale at Java Island and 1:50,000 scale at other area) is suitable for their works.

As mentioned in Clause 7.2.3, the map scale level for the work of BPN in Indonesia is 1:1,000 - 1:5,000 level. therefore, the digital topographic data provided by BIG on NSDI is not suitable for their works.

This situation is caused by the difference of the work contents of each ministry. Also, according as the progress of mutual utilization of geospatial information among the organizations, the demand for more large scale of geospatial information will be arose. This Phenomenon will be arose not only in Indonesia but also in advanced countries.

At present, the scale level of geospatial information used by PUPR and KP in Indonesia is 1:25,000 - 1:50,000 level. However, according as the change of needs for geospatial information, more large scale geospatial information have to be prepared.

To prepare the large scale geospatial information (digital topographic data), huge amount of budget and time will be necessary. Therefore, scheduled preparation and updating of geospatial information is essential.

7.4.3 Digital topographic data updating plan

Updating interval of digital topographic data is a issue of NSDI in Indonesia. BIG plans to update the digital topographic data every 5 years. However, due to the shortage of budget, it was impossible to execute updating of digital topographic data in a planned way.

Due to the huge land territory of Indonesia (1,919,440 km^2), preparation of national base maps covering whole territory of Indonesia is a big business.

BIG started the preparation of 1:50,000 scale national base maps instead of old maps from 1980s,

however, the area always covered by the cloud such as Irian Jaya Province does not yet covered by the national base maps.

Due to the huge land territory of Indonesia, the budget and time necessary for the preparation and updating of geospatial information as the basic data of NSDI will become huge.

To execute the preparation and updating of geospatial information in a planned and consistent way, the understanding by the Government of Indonesia for the necessity of geospatial information and budget allocation are essential.

In Indonesia, NSDI platform was constructed in advance. It is presumed that the necessary budget amount for the operation, maintenance and updating of NSDI platform was not so considered at the planning and construction of NSDI in Indonesia.

According as the progress of utilization of geospatial information in Indonesia, and the increase of demand for the geospatial information from the related organizations to NSDI, the importance of periodical preparation and updating of geospatial information to maintain the value of NSDI is recognized. This is a current situation in Indonesia.

7.4.4 NSDI platform updating plan

Approximately 5 years has been already passed after the construction of NSDI platform in Indonesia. Within a few years, it is necessary to update NSDI platform, and budget allocation for updating of NSDI platform is a issue of NSDI in Indonesia at present.

There is a possibility that this budget allocation issue become serious. As mentioned above, the same system was introduced in the main 11 ministries of Indonesia at a time. Therefore, system updating of the main 11 ministries should be executed at a time also.

For this purpose, Indonesia Government has to allocate the necessary amount of budget for updating of system at the main 11 ministries at a time, and ratio of the necessary budget related to NSDI at the updating period (account year) will become higher than the ordinary period (account year).

It is presumed that this phenomenon was caused by the placement priority on the construction of NSDI platform, and no plan for the necessary budget allocation for the operation, maintenance and updating of NSID platform.

Not only NSDI but also any other system, after the introduction of the system, it is impossible to back to the previous conditions. Therefore, it is necessary to allocate the budget for operation, maintenance and updating of the system at all times.

At the time of system updating, it is necessary to judge that the same level system as the system used will be introduced or upgraded systems will be introduced, in consideration of the advance in

computer technology, increase of data volume caused by the digitalization, new functions necessary for own work and so on.

In Japan, in case where the government organizations introduce this kind of system, within several years after introduction of the system, the government organizations will start the budget allocation to be able to execute system updating smoothly.

7.4.5 Human resources development plan

Every organizations recognized that human resources development is important for the construction, operation and utilization of NSDI. However, in case where the personnel relocation is executed in the short interval within the organization, continuation of technology in the organization will become difficult.

This issue is caused by the personnel relocation of the organization, and it is presumed that the degree of this issue will be different organization by organization.

For the operation, maintenance and utilization of NSDI and geospatial information, 3 types of engineers will be necessary.

For the management and operation of NSDI platform, programmer and system engineer will be necessary.

At the same time, for the utilization of geospatial information, that is the main purpose of NSDI, photogrammetric engineer who will prepare the geospatial information (digital topographic data) will be necessary.

Furthermore, GIS engineer will be necessary for the preparation of thematic data using geospatial information on NSDI.

GIS engineer is required not only the knowledge and experience of GIS software but also the wide knowledge and experience of the preparation of thematic data.

One of the issue at the government organization in the developing country, the knowledge and experience will be accumulated in personnel and not accumulated in the organization.

In fact, in cases where the engineer with wide knowledge and experience moves to other department or section, or retired from the organization, the technical level of the department or section will come down.

KP in Indonesia pointed out this issue. However, this issue will be different organization by organization, and different countermeasure will be necessary organization by organization.

7.4.6 NSDI construction and dissemination plan

NSDI in Indonesia was started to connect the main 11 ministries by network, and 57 ministries, 34 provincial governments, 514 local governments, 34 universities will be connected by network eventually.

At present, 28 ministries, 21 provincial governments, 21 local governments and 18 universities have been connected by network, Indonesia has a long way to go for the completion of this target.

The budget amount to be able to allocate for NSDI and related activities from the national budget of the government has upper limit. Therefore, it is impossible to execute all project or activities related to NSDI at a time.

According to the mid-term and long-term plan for the construction of NSDI platform, operation, maintenance, utilization and mutual utilization of geospatial information and so on, the construction of NSDI and necessary activities have to be implemented step by step.

7.5 Precept from the issues at the construction and operation of NSDI in Indonesia

Based on the precept form the issues at the construction and operation of NSDI in Indonesia, the items to be consider for the construction of NSDI in Bangladesh are summarized as follows:

7.5.1 NSDI platform construction plan

NSDI in Indonesia was constructed to connect the main 11 ministries by network, and the same system was introduced in the main 11 ministries at a time.

Considering the telecommunication circumstance and IT technology at the time of the construction of NSDI in Indonesia, it is presumed that this is a appropriate plan for the construction of NSDI in Indonesia.

However, it is considered that not only the initial investment cost but also the operation and maintenance cost of NSDI became expensive.

The telecommunication circumstance and IT technology at the time of the construction of NSDI in Indonesia and current telecommunication circumstance and IT technology in Bangladesh is different.

Therefore, it is necessary to prepare the plan for the construction of NSDI in Bangladesh considering the advance in computer technology, improvement of telecommunication circumstance and so on after the construction of NSDI in Indonesia.

Due to the limitation of budget allocation for the construction of NSDI platform and related activities, it is recommended that the system with over specifications should not be constructed at

the beginning, and also excessive investment for NSDI platform with over specifications at the beginning should not be done.

It is recommended that the first NSDI platform is on an appropriate scale and has the flexibility for the improvement and modification corresponding to the advance in technology, change of the demands, social circumstance and so on.

For this purpose, the construction, operation and utilization of NSDI should be planned by the effective utilization of the existing systems as much as possible.

7.5.2 NSDI platform updating plan

For the updating of NSDI platform and system, considerable amount of budget will be necessary. In case where NSDI platform and system of government organizations will become necessary at a time, the amount for updating of NSDI platform and system will be concentrated at some period (account year).

From the viewpoint of national budget allocation, the concentration of this kind of expenditure is not desirable, and this kind of expenditure should be allocated evenly at every year.

At the first stage of the construction of NSDI in Indonesia, same system was introduced at the main 11 ministries at a time, and the budget allocation for the system updating at the main 11 ministries is the issue in Indonesia at present.

For the construction of NSDI in Bangladesh, it is necessary to make consideration not to occur this kind of situation.

7.5.3 Basic data updating plan

Concerning the updating of the digital topographic data, as the fundamental data of NSDI, it is necessary to consider from the following two points of view.

a) Technical level and capacity of SOB for the preparation and updating of digital topographic maps

   In case where the preparation and updating of digital topographic mapping plan, which is over capacity and technical level of SOB, is made, SOB will not be able to execute the preparation and updating of digital topographic maps according to plan. In this case, it is necessary consider the outsourcing of some works.

b) Necessary budget for the preparation and updating of digital topographic maps

   It is necessary to allocate the amount of budget necessary for the preparation and updating of digital topographic maps stably every year.

From the above-mentioned two points of view, the plan for preparation and updating of the digital topographic maps, as the fundamental information of NSDI, should be prepared, and budget allocation to the Government of Bangladesh has to be requested.

As a result, the geospatial information, which will be released on NSDI in Bangladesh, will be able to keep the freshness of geospatial information, and will be used by many organizations, and utilization of NSDI and mutual utilization of geospatial information will be promoted.

7.5.4 Promotion activities for the utilization of NSDI

Through the construction of NSDI in Indonesia by loan assistance by the Government of Japan, the main 11 ministries in Indonesia were connected directly by network and same system was installed in these 11 ministries in advance.

This project did not include the activities to promote the operation and utilization of NSDI and also mutual utilization of geospatial information among the organizations related to NSDI.

Therefore, the activities to promote the operation and utilization of NSDI and also mutual utilization of geospatial information among the organizations related to NSDI were tried to execute organization by organization independently.

For the construction of NSDI in Bangladesh, it is necessary to execute the activities for promotion of utilization of geospatial information, and also mutual utilization of geospatial information among the organizations related to NSDI prior to the construction of NSDI in Bangladesh.

Chapter 8 Roadmap to Establish NSDI (Proposed)

Chapter 8 Roadmap to establish NSDI (Proposed)

A roadmap for the establishment of NSDI (proposed) in Bangladesh has been formulated as described below.

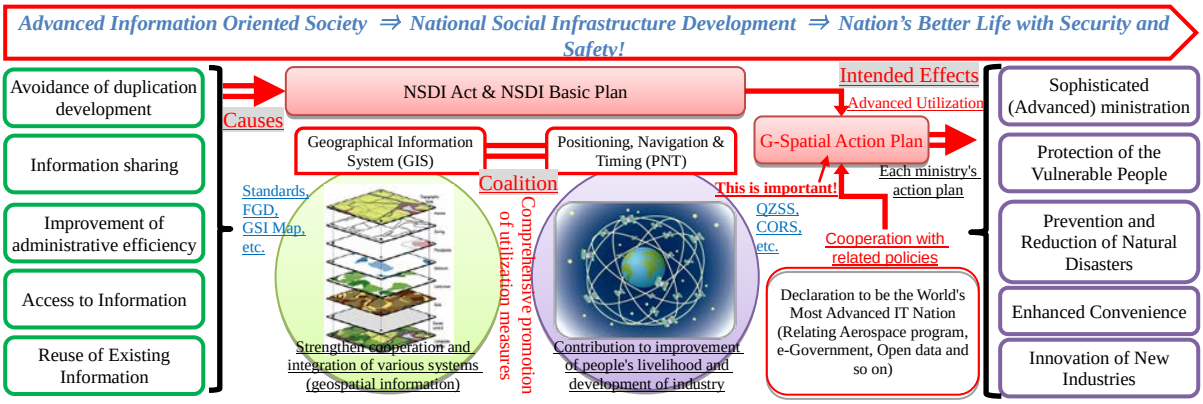
8.1 Concept for Establishment and Operation of NSDI (proposed)

The concepts for establishment and operation of NSDI (proposed) in Bangladesh have been determined as described below.

8.1.1 Concept for establishment and operation of NSDI in Japan

Establishment of NSDI was launched when the geographic information system (hereinafter referred to as "GIS") was utilized in the Great Hanshin and Awaji Earthquake in 1995 for grasping the disaster situations and preparing a reconstruction plan.

Organizing a "Liaison Committee of Ministries and Agencies related to GIS" in the Cabinet, the government took an initiative to efficiently develop GIS and promote the cross-reference of the data, drawing on a lesson that its agencies were unable to do so in the event of the said disaster. This was the beginning of establishing NSDI in Japan.



Source: Kokusai Kogyo Co., Ltd.

Figure 8.1.1 Concept of NSDI in Japan

In 2007, "Basic Act on the Advancement of Utilizing Geospatial Information (hereinafter referred to as "NSDI Act")" that is known as NSDI Act of Japan, was enacted. And in its Article 3, nine basic principles concerning NSDI establishment and operation are defined.

1. Implementation of comprehensive and systematic measures that are a. development and provision of geospatial information, b. promotion of utilize geographic information systems and satellite positioning, c. human resource development, d. strengthening collaboration with relevant ministries, agencies and institutions

2. Implementing the relationship measures for exerting a synergistic effect for a policy of the promotion of the use of geospatial information
3. Ensuring an environment that will consistently provide highly reliable Satellite Positioning, Navigation and Timing services
4. Management of effective and efficient public facilities, promotion of disaster prevention measures and utilization, development and conservation of the national land, protection of people's lives, body and property
5. Efficiency and sophistication of public administrative management
6. Provide a variety of services (⇒ Contribution to improvement of the convenience of citizens)
7. Creation and development of a variety of business and harmony with the environment
8. Utilization of the proposed technology and ingenuity by the private sector
9. Consideration of infringement to individual rights and interests, and to ensure the country's safety

In 2008, the 1st Cabinet resolution of the "Basic Plan for the Advancement of Utilizing Geospatial Information" was approved based on the NSDI Act.

The basic plan has been revised for 4 to 5 years, and the following is the transition of these basic policies.

Table 8.1.1 History of NSDI basic plan in Japan

1st Basic Plan	2nd Basic Plan	3rd Basic Plan
April 2008 - March 2012	April 2012 - March 2017	April 2017 - March 2022
1) Prepare draft guidelines related to the development, provision and distribution of geospatial information, and promote the provision and distribution of it. 2) Promote the development and provision of FGD. 3) Promote the establishment and utilization of a high-tech base for Space-based PNT. 4) Strengthen ties among business, academia and government as they relate to the utilization of geospatial information.	1) Developing continuous geospatial information to meet society's needs and applications to new uses. 2) Domestic and overseas development and utilization of practical quasi-zenith satellite systems. 3) Further dissemination and establishment of the geospatial information in society. 4) Recovery from the Great East Japan Earthquake and contribution to sustainable land-use that is highly resistant to disaster	1) Contribution to strong for disasters and sustainable land formation. 2) Creation of new transportation and logistics services. 3) Contribution to high-quality living with safety & security in population declining & elderly society. 4) Revitalize local industries, create new industries and new services. 5) Overseas development of technologies and mechanisms utilizing geospatial information, progress of international contribution.

Source: The Project Team

Measures concerning NSDI of each ministry and agency are formulated and implemented the G-spatial action plan (measures for each ministry or agency) based on these basic plans. There are about 200 total G-spatial action plans in total.

When the concepts for establishment/operation of NSDI in Japan are placed into the roadmap, base map information for the geographical information system, geographical information standards, maps provided by the Geospatial Information Authority of Japan, and basic plans such as quasi-zenith satellites for satellite positioning, and Continuously Operating Reference Station (CORS) as well as G-spatial action plans are activities that are listed in the roadmap.

8.1.2 Digital Bangladesh

In developing the roadmap (proposed) for the establishment and operation of NSDI in Bangladesh, "Digital Bangladesh" which is the core policy of the current administration is organized as follows:

The second phase of the Hashina administration, which was established in 2009, has proposed the "Vision 2021" aiming to become a middle-income country by 2021 which is the 50th anniversary of independence.

And they advocates "Digital Bangladesh" aiming at ICT throughout the country, and work on social and economic development.

This policy is composed of e-Government aiming to improve the transparency and efficiency of administration, economic growth measures utilizing ICT, training of ICT human resources, and so on.

Table 8.1.2 Basic concept of Digital Bangladesh

Human Resource Development	"Digital Bangladesh" requires human resources with advanced ICT technology, and implements human resources development and development. In addition, education using ICT technology (e-learning) would be implemented.
Connecting Citizen	All citizens ensure access to "Digital Bangladesh" regardless of the gap between rich and poor, literacy abilities, and the place of residence in urban and rural areas. It is intended that citizens continuously obtain benefits from "Digital Bangladesh", and contribute disclosure of information to policies to each layer.
Digital Government for Pro-Poor Services	It consists of two components: electronic civil service tailored to citizen's lifestyles and electronic administration that delivers electronic civil service. Priority is given to services in the fields of education, health, agriculture, social security and others.
ICT in Business	In the business field aims, a) Access to new markets such as e-commerce and electronic bidding, b) Training and promotion of the ICT sector to support "Digital Bangladesh", c) Cultivating ICT sector as the export sector for acquisition of foreign currency.

Source: The Project Team

As a result of the present stage, a digital center in a rural area called "Union Information Service Center" was established, and equipped with internet service, training using copy machine and personal computer, job information, mobile banking, some administrative procedures such as birth registration and so on.

Other achievements include mobile application development for simplifying government related procedures, introduction of electronic signature, domestic Wi-Fi network development, ICT & language club, computer training and so on.

In addition, ICT industry in Bangladesh is rapidly growing, and more than 400 companies mainly export to Europe and the United States.

The export value of software/IT outsourcing (about half of software development) in 2013 - 2014 is about 125 million US$, which is about four times as large as five years.

In the survey on the e-Government of the United Nations, Bangladesh is the third medium-ranking development situation in the 4-stage evaluation.

In the evaluation of 2016, improvement can be confirmed in the index of online service and communication environment.

All the top 20 countries in this survey are high-income countries, and although it is low-income countries (surveyed points), it can be confirmed that the efforts of Bangladesh of 124/193 countries are gradually achieving results.

Table 8.1.3 E-Government development index of the United Nations

Year	Country Name	Income Category	GNI (US$)	Rank	E-Government Development Index			
					Online Service	Communication Infra	Human Capital	Total
2012	Bangladesh	Low-Income	-	150	0.4444	0.0641	0.3889	0.2991
2014			830	148	0.3465	0.0941	0.3866	0.2757
2016			1,080	124	0.6232	0.1193	0.3973	0.3799

※Since the criteria / method and so on of the survey differs according to the survey year, only similar search years are extracted. GNI stated the amount at the time of the United Nations survey.
Source: UNE-Government Survey 2012, 2014, 2016

8.1.3 Concept for establishment and operation of NSDI (proposed)

In the establishment and operation of NSDI in Bangladesh, contributing to "Digital Bangladesh" is indispensable, and it is necessary for consistency as policy.

Furthermore, NSDI that can be expected to contribute to a Digital Bangladesh is described below.

Table 8.1.4 NSDI content that can contribute to Digital Bangladesh

Basic Concepts for Digital Bangladesh	Contributions to be made by the established NSDI
Human Resource Development	ICT technology that utilizes geospatial information and satellite position is indispensable for establishment/operation of an NSDI, and as in the case with a “Digital Bangladesh”, development of human resources with advanced ICT technology is required for establishment/operation of NSDI. This will lead to development of human resources for an information society. In addition, this technology is also applied to geographical education that utilizes geospatial information, and e-learning in the disaster prevention and environmental fields, and can be expected to contribute to a wide range of human resource development.
Connecting Citizen	The utilization of geospatial information for public access to information facilitates smooth and effective understanding and transmission of information. In particular, this is effective to promote understanding of information, regardless of the literacy of the persons receiving the information.
Digital Government for Pro-Poor Services	Utilization of geospatial information for public and other facilities is indispensable for the formulation or release of various plan proposals and operation/maintenance of infrastructure when establishing digital government and upgrading citizen services. In addition, in the field of disaster prevention/reduction, this can also be applied to the preparation/dissemination of hazard maps using geospatial information, or disaster information transmission services using satellite positioning.
ICT in Business	The objectives of establishing/operating an NSDI include the creation of new services that utilize geospatial information and satellite positioning technology, and the development of industry, and it is expected that this will contribute to economic growth and a transition to an information society.

Source: The Project Team

Therefore, based on the speech by the Honorable Prime Minister Sheikh Hashina at the NSDI International Seminar in 2016, the organization of the Digital Bangladesh mentioned above, and the

content of Technical Cooperation Project application form by SOB and so on, the concept for establishment and operation of NSDI (proposed) is as follows:

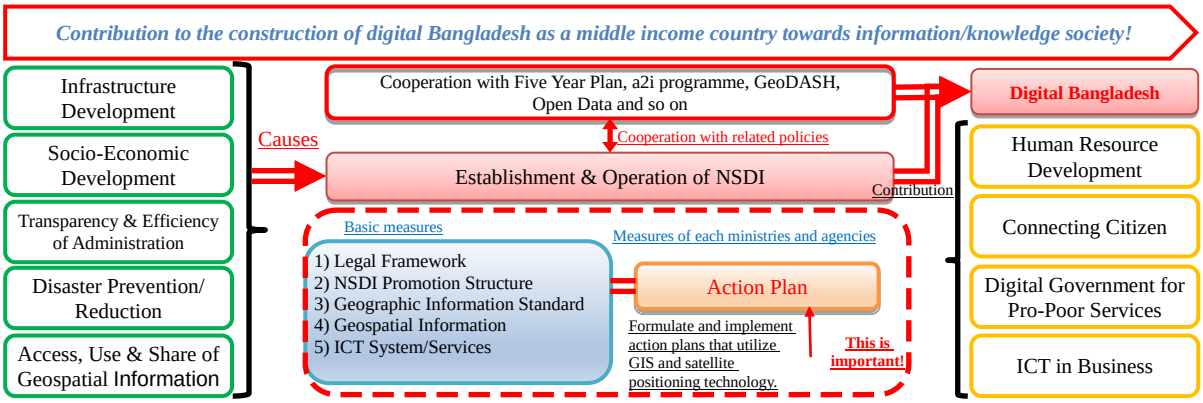


Figure 8.1.2 Concept of NSDI in Bangladesh (proposed)

Source: The Project Team

In order to achieve the objectives of establishment and operation of NSDI in Bangladesh mentioned above, basic principles concerning basic measures and formulation and implementation of action plan of each ministry and agency are suggested as follows:

1. As basic measures for establishment and operation of NSDI, development and provide of geospatial information, promote the use of GIS and satellite positioning technology (CORS), human resource development, research & development, and strengthen cooperation among related organizations.
2. 1) Effective and efficient management of public facilities, 2) Promotion of disaster prevention/ reduction measures, 3) Use, maintenance and preservation of the land, 4) Improvement of agricultural productivity, and 5) Protection of the people's lives and property, are applied GIS and satellite positioning technology.
3. Improve the efficiency, sophisticated (advanced) and transparency of administrative management of the central and local governments.
4. Provide diverse services that contribute to the improvement of convenience for citizens regardless of difference of rich and poor, literacy abilities, place of residence in urban and rural areas.
5. Create and develop diverse businesses utilizing GIS & satellite positioning and harmonize with the environment.
6. Pay attention to protection of personal information, promotion of secondary use of public data, and consideration of national security.

Reference Overall goal of technical cooperation project application form by SOB

- All government, the private and non-profit sectors and academia will be able to access, utilize, and share necessary geospatial information through NSDI.
- All organizations/sectors will be integrated under one umbrella with similar policies, standards and procedures under which organizations interact to foster more efficient use, management and production of spatial data.
- Bangladesh government will be prepared for natural disasters by academic analysis and predictions using observation data of GNSS/CORS and Tidal stations.
- Bangladesh will be moving forward into an information and knowledge based society-especially with the emphasis on Information Technology naming the country as “Digital Bangladesh.”

8.2 Basic Concept for Formulation of Roadmap for Establishment of NSDI (Proposed)

Based on the objectives of establishment and operation of NSDI and these basic principles, formulate and propose a roadmap (proposed) for establishment and operation of NSDI.

8.2.1 Points to consider before the formulation of roadmap for establishment of NSDI

There are a number of points to consider before the formulation of a roadmap for establishment of NSDI that are outlined below.

a) Setting of period for roadmap to build NSDI

b) Review/determination of disclosure range/release method for SOB geospatial information

c) Vision for Geo Portal website (Model system building)

d) NSDI Act (proposed) and NSDI Committee

e) Preparation of updated geographic information that matches the demands of NSDI users

f) Relationship of NSDI, Digital Bangladesh and Five Year Plan

The basic concept for formulation of a roadmap for establishment of NSDI (proposed) has been organized as described below.

8.2.2 Setting of period for roadmap to build NSDI

Before building NSDI, it is necessary to clearly recognize that simply establishing the laws (for example, NSDI Act and Survey Act) and creating a system which is operated in an appropriate manner will not result in utilization of NSDI by many users.

Many technical, legal, administrative and other issues must be solved in order to build NSDI, operate it in an appropriate manner and have it utilized by many users, and this will take quite a bit of time.

For example, building of NSDI during the dawn of this technology in Japan was implemented with a Ten Year Plan.

a) Infrastructure formation period (3 years: 1996 - 1998): Building of rules/structure
   - Development of national spatial data infrastructure
   - Standardization of geospatial information
   - Formulation of long-term plan for GIS dissemination/promotion

b) Dissemination period (3 years: 1999 - 2001): Development of infrastructure
   - Development, dissemination and updating of national spatial data infrastructure (nationwide development)

- Provision of various types of technical support

c) Operation period: Action plan to enhance quality of life of citizens with GIS (4 years: 2002 - 2005): Working level dissemination
- GIS action program 2002 - 2005
- Promote streamlining of government using GIS
- Full-fledged dissemination support for GIS

Accordingly, in order to create a roadmap (proposed) to build NSDI in Bangladesh, it is necessary to first designate three periods similar to those in Japan when building NSDI during the dawn of this technology in consideration of the activity content and track record at each agency related to NSDI: 1) Preparation period, 2) Infrastructure formation/Dissemination period and 3) Operation period (Mid-term plan and long-term plan).

During the dawn of NSDI in Japan, there were very few case studies in other countries that could be used as reference, and a lot of time was spent in a process of trial and error.

However, as for NSDI construction in Bangladesh, since there are a number of case studies in other countries including Japan that can be used as reference, it is expected that the implementation period can be reduced.

Therefore, the 1st period (infrastructure formation period) will be planned with a term of 3 years, which took 6 years in Japan.

After this, plans will be matched with the 8th and 9th Five Year Plan in Bangladesh.

It is considered to be appropriate that the three main stages outlined below be designated for the roadmap (proposed) to build NSDI in Bangladesh.

a) Preparation period

Period:	Now - June 2018
	(Designated in accordance with accounting year in Bangladesh)
Objective:	Implement preparation work required to build NSDI
Main activities:	•Building of Geo Portal website (Prototype version)
	•Passage of Survey Act (Including required regulations)
	•Promotion of NSDI Act (Including required regulations)
	•Determination of disclosure range/method of SOB geographic information
	•Preparation for expansion of CORSs
	•Completion of digital topographic map (1:25,000 and 1:5,000 scale)
	•Preparations for establishment of NSDI Committee

b) First period (Infrastructure formation)

Period:	July 2018 - June 2021

(Designated in accordance with accounting year in Bangladesh)

Objective: Building and operation of NSDI, solving of various issues

Main activities:
- Building of NSDI platform
- Passage of NSDI Act (Including required regulations)
- Establishment of NSDI Committee and working group activities (Activities to solve various issues)
- Creation of primary data/demonstration of updating
- Expansion of CORSs
- Updating and release of digital topographic map for Dhaka City
- Review of base map updating technique
- Changing SOB organization and development of human resources/ management system

c) Second period (Dissemination period) (Mid-term plan)

Period: July 2021 - June 2026 (8^{th} Five Year Plan period)
(Designated in accordance with Five Year Plans in Bangladesh)

Objective: Promote utilization of NSDI

Main activities:
- Periodic updating of base maps
- Development/updating of primary data with high importance
- Formulation of digital topographic map development plan in other local cities, and implementation
- Formulation and implementation of promotion plan of geographic information standards
- Expansion/deployment of NSDI platform
- Operation, dissemination and use promotion of CORSs
- Periodic activity of working group
- Consideration of creation of new services and industries using GIS and Satellite positioning

d) Third period (Operation period) (Long-term plan)

Period: July 2026 - June 2031 (9^{th} Five Year Plan period)
(Designated in accordance with Five Year Plans in Bangladesh)

Objective: Promote utilization of NSDI

Main activities:
- Examination of human resource development methods including other ministries concerning GIS, and implementation
- Periodic updating of base maps
- Renewal of NSDI platform
- Dissemination of GIS into the work of government agencies
- Enhance map literacy of citizens
- Consideration of creation of new services and industries using GIS and Satellite positioning

8.2.3 Review/determine disclosure range/method for SOB geospatial information

Geospatial information is the information that comprises the foundation of NSDI, and the results of interviews of the agencies related to NSDI during the first field survey clarified that this is recognized by the various agencies in Bangladesh.

These survey results are organized below.

a) Topographic maps prepared/managed by SOB are indispensable for the Geo Portal base map which is a constituent element for NSDI.

b) Agencies that use NSDI have the potential to change expectation levels for NSDI depending upon what information is released.

c) There are usage limits for the data that is prepared and managed by SOB, and these need to be organized as a premise for a discussion of to what extent data can be released.

d) Ultimately, the various agencies including SOB will clarify the data that can be legally released on NSDI.

The content of the geographic information created/possessed by SOB, and a proposal for the data that should be released when building NSDI and the release method are compiled in Table 8.2.1.

Based on this proposal, it is considered that the most important issues that SOB must address at the earliest point possible is to determine the content of the geographic information to be provided/released on NSDI and the release method, and clearly explain the policy to the various agencies related to NSDI.

Table 8.2.1 Release method on NSDI for geographic information possessed by SOB (Proposed)

Data	Area	Type	Year of Preparation	Volume	Present regulation of SOB			Data to be opened on NSDI		Online site for purchase		Note
					Printed map	PDF data	Digital data	Image data	Digital data	PDF data	SHP data	
1:5,000 topographic mpas	Dhaka	Open version	Prepared in 2004. Aerial photos was taken in January 2002.	122	Avaialble	Avaialble	Avaialble	○	×	○	○	
		Restrict version		122	Restricted	Restricted	Restricted					
	Sylhet	Open version	Digital plotting has been finished. Topographjic maps will be finished by the end of 2018.	36	Avaialble	Avaialble	Avaialble	○	×	○	○	
		Restrict version		36	Restricted	Restricted	Restricted					
	Rajshahi	Open version	Digital plotting has been finished. Topographjic maps will be finished by the end of 2018.	40	Avaialble	Avaialble	Avaialble	○	×	○	○	
		Restrict version		40	Restricted	Restricted	Restricted					
	Khulna	Open version	Digital plotting has been finished. Topographjic maps will be finished by the end of 2018.	90	Avaialble	Avaialble	Avaialble	○	×	○	○	
		Restrict version		90	Restricted	Restricted	Restricted					
	Barishal	Open version	Digital plotting has been finished. Topographjic maps will be finished by the end of 2018.	42	Avaialble	Avaialble	Avaialble	○	×	○	○	
		Restrict version		42	Restricted	Restricted	Restricted					
	Chittagong	Open version	Digital plotting has been finished. Topographjic maps will be finished by the end of 2018.	120	Avaialble	Avaialble	Avaialble	○	×	○	○	
		Restrict version		120	Restricted	Restricted	Restricted					
1:25,000 topographic maps	Hilly are of Chittagong	Restrict version	Year of preparation is not clear.	116	Restricted	Restricted	Restricted					
	Whole country	Open version	Digital plotting has been finished. Topographic maps will be finished by the end of 2017.	988	Avaialble	Avaialble	Avaialble	○	×	○	○	
		Restrict version		988	Restricted	Restricted	Restricted					
1:50,000 topographic maps	Whole country	Restrict version	Oriiginal topographic maps was preparea 1940s, and was 1 inch 1 mile map.	267	Restricted	Restricted	Restricted					
1:250,000 maps	Whole country	Restrict version	Compiled map	27	Restricted	Restricted	Restricted	○	×	×	×	It will be used as base maps.
1:500,000 maps	Whole country	Restrict version	Compiled map	6	Restricted	Restricted	Restricted					
1:1,000,000 maps	Whole country	Open version ?	Compiled map and used as the base map of thematic maps.	1	Restricted	Restricted	Restricted	○	×	×	×	It will be used as base maps.
1:5,000 orthophoto	Dhaka	Unkown	Already prepared in 2004. Aerial photos was taken in January 2002.	122	Unkown			○	×	○	×	
	Sylhet	Unkown	Orthophoto by aerial triangulation data only has benn already prepared.	36				○	×	○	×	
	Rajshahi	Unkown	Orthophoto by aerial triangulation data only has benn already prepared.	40				○	×	○	×	
	Khulna	Unkown	Orthophoto by aerial triangulation data only has benn already prepared.	90				○	×	○	×	
	Barishal	Unkown	Orthophoto by aerial triangulation data only has benn already prepared.	42				○	×	○	×	
	Chittagong	Unkown	Orthophoto by aerial triangulation data only has benn already prepared.	120				○	×	○	×	
1:25,000 orthophoto	Whole country	Unkown	Orthophoto by aerial triangulation data only has benn already prepared.	988				○	×	○	×	
DEM data	Whole country	Unkown	Under preparation	1	Unkown			○	×	×	○	
BM	Whole country	Open	1st order BM	662	Available			○	×	○	×	
		Open	2nd order BM	1450	Available			○	×	○	×	
GPS points	Whole country	Open	1st order GPS point	260	Available			○	×	○	×	
		Open	2nd order GPS point	797	Available			○	×	○	×	
CORS	6 cities	Open		6	Available			○	×	×	○	Rrregistration is necessary.

○ Data will be opend on NSDI.
× Data will not be opend on NSDI.

Source: The Project Team

8.2.4 Vision for Geo Portal website (Mode system building)

The Geo Portal website is provided in order to search for and to obtain information related to geospatial information.

Multiple government agencies in Bangladesh have already established websites in order to release geospatial information to the general public in Bangladesh.

The BCC has already established and is operating a data sharing system (main objective is disaster information management) called GeoDASH using open source software, and 245 layers had been registered by 44 organizations as of June 2017.

In the “Project for Strengthening Capacity on Advanced Mapping” currently being implemented by JICA, Geo Portal website (prototype) will be built for test operation of NSDI by June 2018.

Normally, the period required for system design, development and building is estimated to be six months to a year, including the preparation period for requirement determination and other matters concerning system development.

However, by using the existing systems that have been built with open source for which there is a track record of building such systems in Bangladesh, this period can be shortened.

Furthermore, the overall cost required for building NSDI can be reduced by effectively utilizing the existing systems (avoiding redundant investments), enabling the system operation and maintenance costs after building to be reduced.

In consideration of the above facts, the following framework was established with the assumption that the overall configuration (proposed) of NSDI Portal when building NSDI would be built in a cooperative manner with the existing data sharing systems (Refer to Figure 9.3.1).

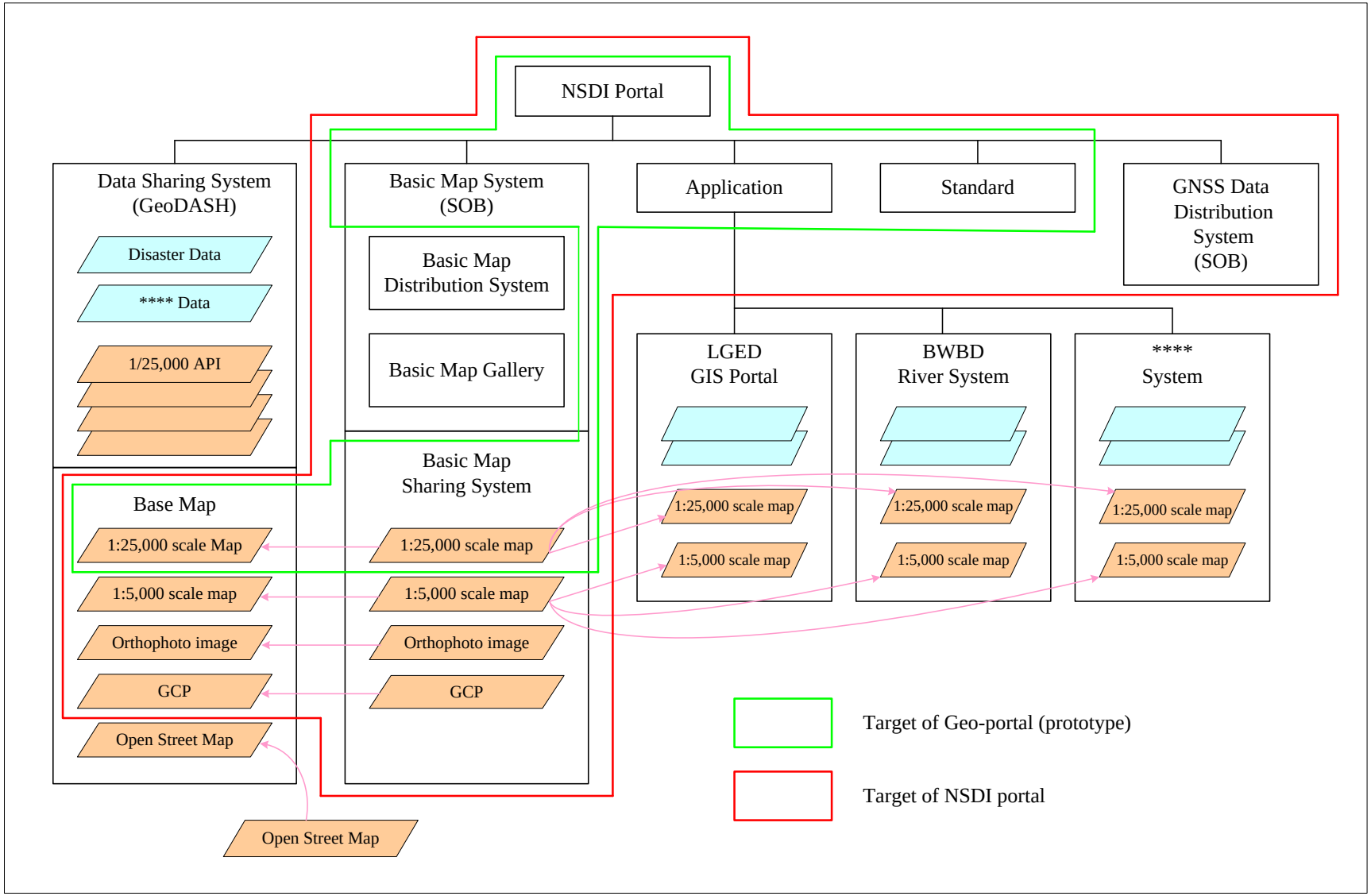
a) Systems administrated by SOB
   - Basic map system: Basic map distribution system, Basic map gallery
   - Basic map sharing system: Topographic map (1:25,000 and 1:5,000 scale), Ortho, GCP, other data

b) System administrated by BCC
   - Data sharing system (GeoDASH): Disaster data, other data

c) Systems administrated by various government agencies
   (Examples: LGED GIS Portal, BWBD River System)

d) Standards

e) GNSS data distribution system



Source: The Project Team

Figure 8.2.1 Concept diagram for Geo Portal website (prototype version) (proposed)

First, in the prototype version, the Basic Map Sharing System will be built by utilizing the GeoDASH platform.

After the system is built, delivery settings will be made for the WMS (Web Map Service) and WMTS (Web Map Tile Service) so that the background maps (1:25,000 and 1:5,000 scale topographic maps) can be referred to from other systems.

After the delivery settings have be made, consultation will be performed by the website administrators of BCC, LGED and other organizations, with requests made to perform settings for changing of background maps on each system, and operation demonstration performed.

After operation is demonstrated with the prototype version, the Basic Map System will be built.

The Basic Map System will be a catalog website for the topographic map data, control point data and other such data, enabling data to be downloaded in a format that allows secondary processing.

When the data is provided for a charge, system building will be performed with a focus on security, provided with a function that allows payment by credit card or other means.

8.2.5 NSDI Act (proposed) and NSDI Committee

The NSDI Act (proposed) prepared by SOB has already been submitted to the Ministry of Defence, and the Ministry of Defence will submit it to the Prime Minister’s Office, and it will be passed after approval by the parliament in Bangladesh.

This NSDI Act proposes that an NSDI Committee will be established in order to build and operate NSDI in Bangladesh.

The proposed NSDI Committee has the following three-layer structure.

a) National Committee — Headed by Prime Minister (Minister level committee)

b) Technical Committee — Headed by Secretary of MOD (Secretary level committee)

c) Executive Committee — Headed by Surveyor General of SOB (Department level committee)

The members on the committees with the above three-layer structure are as follows: 1) National Committee: Minister from each ministry, 2) Technical Committee: Secretary from each ministry and agency and 3) Executive Committee: Manager of each department.

According to this NSDI Act (proposed), the Technical Committee prepares NSDI policies, the Executive Committee implements operation of NSDI, and the National Committee is in charge of

final approval.

However, in order to build/operate NSDI and promote utilization, many technical and operational issues need to be solved in cooperation with various related agencies, and it is envisioned that it would be difficult for the ministers, secretaries and department managers in charge comprising these three layers of committees to make the time to frequently meet.

Accordingly, the working groups under the Executive Committee need to review the various issues described below in a specific manner and submit the results and recommended measures to the Executive Committee.

1) Technical issues for geospatial information on NSDI

Technical issues for geospatial information on NSDI are as follows:

a) Unification of administrative boundaries
Work will be performed to unify the administrative boundary data which differs for each agency. It will be necessary to conduct ground survey for review purposes.

b) Coordinates conversion
Work will be performed to unify the coordinates system which differs for each agency. It will be necessary to perform technology transfer with seminars and other methods.

c) Unification of elevation standard
Work will be performed to unify the elevation standard used by each agency or clarify the difference. It will be necessary to conduct ground survey for review purposes.

d) Unification of geographic names
Work will be performed to unify the Bengali and English geographic names.

e) Unification of address display format
Work will be performed to unify addresses and the address display format. This is necessary to develop an address dictionary and implement address matching.

f) Unification of map symbols
Work will be performed to unify the map symbols used by each agency. It will be more convenient for users if the map symbols are unified.

g) Data standardization
The product specifications, metadata, format and other settings required when sharing data will be made.

h) Other work

2) Issues for operation/utilization of NSDI

Issues for operation/utilization of NSDI are follows:

a) Measures to promote utilization
Efforts will be made to facilitate utilization of NSDI in order to achieve economic development and solve issues.

b) Data release policy
Work will be performed to unify the data release and other policies of each agency, and a review of the rights and other issues will be conducted.

c) Development/updating of data
Development of base and other maps/planning of updating/techniques will be reviewed.

d) Human resource development
Efforts will be made to facilitate human resource development at each agency.

e) Utilization measures for CORSs
Efforts will be made to facilitate utilization of CORSs.

f) Building/expansion/operation of platform
The problem points for building/expansion/operation of NSDI platform will be reviewed.

g) Other

It is recommended to establish the following two working groups since if a working group was established for each issue, it would result in many working groups, making it difficult from the aspect of securing human resources at each ministry/agency, and creating complications from the operation/management perspective of activities.

In consideration of the importance of each issue handled by these two working groups, the issues will be reviewed in order and solutions will be found.

a) Technical Working Group
Committee that reviews technical issues for geographic information on NSDI

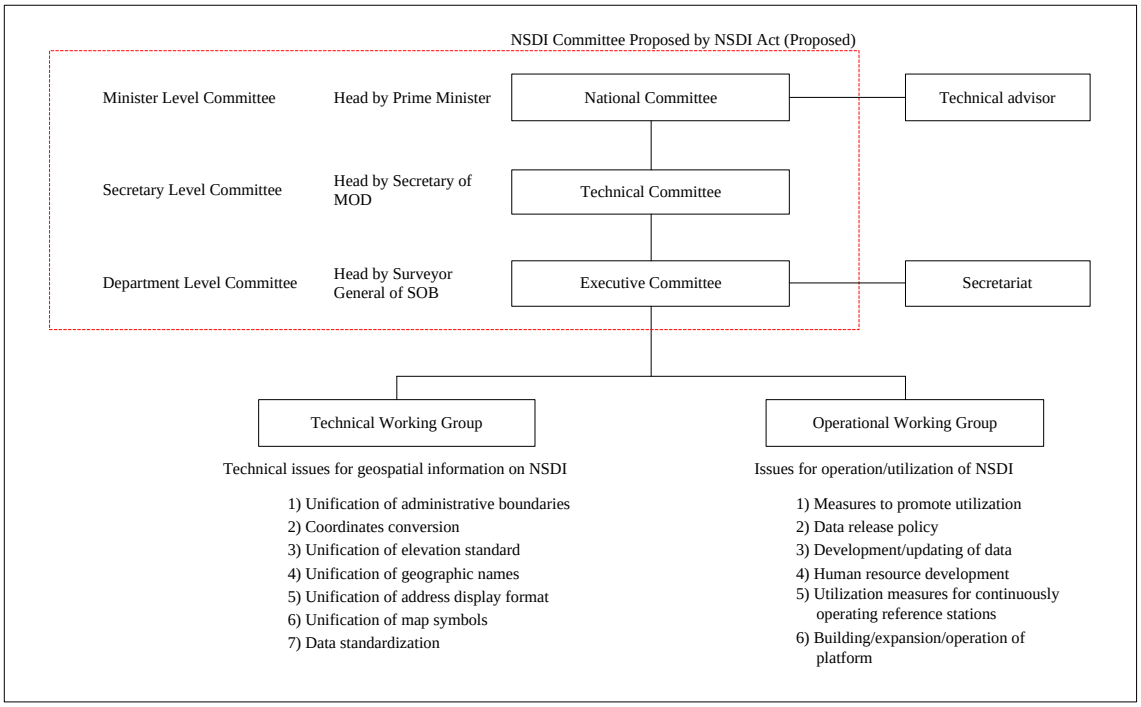
b) Operational Working Group
Committee that reviews issues for operation/utilization of NSDI

In addition, it is considered that a secretariat needs to be established between the Executive Committee and working groups.

Furthermore, since it is expected that there will be many National Committee members who do not have knowledge concerning the specific content and technical issues of NSDI, a technical adviser should be added to the National Committee.

Since plans call for members from the academic sector to participate in the Technical Committee, and the members from the academic sector that are participating can provide technical advice, it is considered that the provision of a technical adviser is not needed.

A concrete image of NSDI Committee (proposed) is shown in Figure 8.2.2.



Source: The Project Team

Figure 8.2.2 NSDI committee configuration (proposed)

8.2.6 Preparation of updated geographic information that matches the demands of NSDI users

The 1:5,000 scale digital topographic maps that covers Dhaka Metropolitan area possessed by SOB was created/issued with technical assistance from Japan in 2004.

Since 1:20,000 scale aerial photographs were taken in January 2003 in order to create this 1:5,000 scale digital topographic maps, the content that is expressed in this 1:5,000 scale digital topographic maps is as of January 2003.

Dhaka Metropolitan area has undergone major transformation over the past 10 years, including large-scale housing land development in various locations, rebuilding of many buildings in the city, and construction of flyovers on the main roads.

Fifteen years have already passed since the aerial photographs were taken that were used to make the 1:5,000 scale digital topographic maps covering Dhaka Metropolitan area that was issued in 2004, resulting in the judgment that it is time for the map to be updated.

On the other hand, geospatial information for Dhaka Metropolitan area will constitute a large portion of the use of NSDI when NSDI is built in Bangladesh from the perspective of economic development, urban development and other such matters in Dhaka Metropolitan area.

However, even if SOB releases the current 1:5,000 scale digital topographic maps on NSDI, it is difficult to say that this matches the demands of NSDI users since quite a few years have passed since the map was created.

SOB is in the process of preparing 1:25,000 scale digital topographic maps for the entire nation of Bangladesh and 1:5,000 scale digital topographic maps for the main cities (Sylhet, Rajshahi, Khulna, Barisal, Chittagong) in Bangladesh other than Dhaka City.

According to SOB, 1:25,000 scale digital topographic maps will be completed by around the end of 2017, and 1:5,000 scale digital topographic maps will be completed by around the end of 2018.

The digital plotting work has already been completed, and the remaining work is digital cartography work.

Up until now, since SOB was engaged in IDMS related work, it did not have the capacity in terms of personnel or equipment to implement new projects.

However, since SOB will have the personnel and equipment needed to implement new projects in 2017 and after, it is considered that a project to update the 1:5,000 scale digital topographic maps for Dhaka Metropolitan area needs to be implemented as soon as possible.

Updating of 1:5,000 scale digital topographic maps for Dhaka Metropolitan area and releasing of data on NSDI should be completed by fiscal year 2020 which is NSDI Infrastructure Formation/Dissemination Period in Bangladesh.

8.2.7 Relationship of NSDI, Digital Bangladesh and Five Year Plan

Currently, in the Digital Bangladesh being implemented by the Access to Information (a2i) Programme under the Prime Minister’s Office, building, operation and promoting utilization of NSDI is not clearly stated.

Similarly, building, operation and promoting utilization of NSDI is not clearly stated in the 7th Five Year Plan (2016 - 2020) formulated by the Government of Bangladesh.

However, from the perspective of the building/operation status of NSDI in countries surrounding Bangladesh, the increase in the demand for geospatial information required for various types of development planning due to high economic growth in Bangladesh (annual GDP growth rate of 6 - 7 %), streamlining/speeding up/reducing cost at government agencies in Bangladesh, etc., it is considered that building NSDI and promoting access to geospatial information in Bangladesh is indispensable in order to facilitate further development of society as a whole in Bangladesh.

In order to smoothly proceed with the building/operation/use promotion of NSDI in Bangladesh and secure the cooperative structure between the related ministries & agencies/required budget, it is important that clear rules be established to define building/operation/use promotion of NSDI in Bangladesh in which Digital Bangladesh has been set as a policy of the government of the country, and that building/operation/use promotion of NSDI be defined in the next 8th Five Year Plan (2021 - 2026).

For this purpose, after the NSDI Act (proposed) which stipulates the formation of NSDI Committee is passed, it is important that specific policies/measures for building/operation/use promotion of NSDI be promptly configured and that the required activities be started.

At the same time, SOB needs to establish a cooperative structure with agencies related to NSDI, and proactively move forward with activities for building/operation/use promotion of NSDI.

8.3 Roadmap for Establishment of NSDI (Proposed)

The start of the 2018 fiscal year (July 2018) in Bangladesh was set as the time base starting point to facilitate preparation of the roadmap for establishment of NSDI (proposed) in Bangladesh, and a 15 year roadmap (proposed) until 2031 was prepared.

The roadmap for establishment of NSDI (proposed) in Bangladesh which was prepared taking into consideration the items described to this point is shown in Table 8.3.1.

8.4 Activity Overview of Roadmap for Establishment of NSDI (Proposed)

An overview of the respective activities in the roadmap for establishment of NSDI (proposed) is shown below.

8.4.1 Legal Framework

An overview of the activities concerning the legal framework for NSDI is shown below.

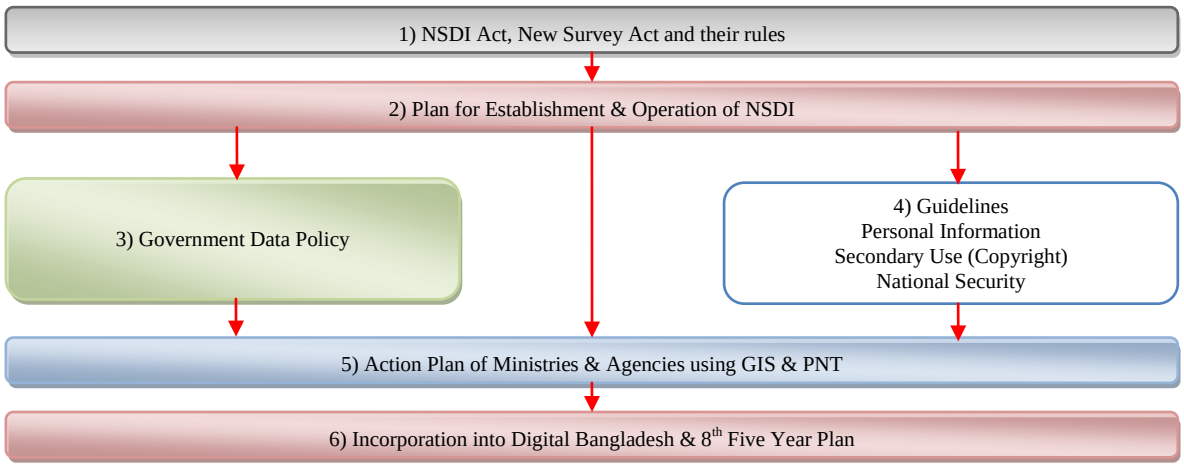


Figure 8.4.1 Relationship of legal framework activities

Source: The Project Team

1) Passage/announcement of NSDI Act/New Survey Act and enactment/ announcement of enforcement orders (Detailed Regulations)
(Activities during preparation period and first half of first period)

The required coordination and discussions with the related ministries and agencies will be implemented with the objective of passing and announcing the NSDI Act and New Survey Act which have already been submitted.

Furthermore, preparation of the ancillary enforcement orders (detailed regulations) will be started, and the enforcement orders (detailed regulations) will be promptly enacted/announced after both acts are passed.

The activities described below will be implemented during the preparation period and first half of first period (Present - December 2019).

a) The required coordination and discussions will be implemented with the related ministries and agencies for the NSDI Act and New Survey Act, and both acts will be submitted to Parliament.

b) Ancillary enforcement orders (detailed regulations) will be prepared for the NSDI Act and New Survey Act, and coordination/discussions will be conducted with the related ministries and agencies.

c) After passage of the NSDI Act and New Survey Act, enforcement orders (detailed regulations) will be announced.

d) Guidelines and explanatory materials will be prepared for the NSDI Act and New Survey Act.

e) Workshops to communicate the NSDI Act and New Survey Act to stakeholders will be held.

2) Formulation of short-term/mid-term/long-term plans for establishment/operation of NSDI (Activities during preparation period and first period)

Short-term/mid-term/long-term plans for establishment/operation of NSDI will be formulated based on the NSDI Act. The target periods for plan formulation (e.g. Short-term: 1 year, Mid-term: 5 years, Long-term: 10 years) will be set, covering basic concept, major objectives, required activities, main implementation agencies, achievement goals and other items.

Furthermore, the basic concept, required activities and other such items will be determined for not only SOB but also the country/government as a whole.

The activities described below will be implemented during the preparation period and first period (Present - June 2021).

a) Study/research will be conducted on cases for establishment/operation of NSDI in other countries.

b) The framework of each plan such as the short-term/mid-term/long-term target periods, basic concept, major objectives, etc. will be formulated.

c) Short-term/Mid-term/Long-term plans will be formulated based on a) and b).

d) The plans will be submitted to the NSDI Committee, and approval obtained.

e) Methods for evaluation/monitoring of the short-term/mid-term/long-term plans will be formulated.

3) Discussion/formulation of data policy at government agencies (Activities during first period)

In order to promote sharing, usage, provision and circulation of geospatial information, the data policy for geospatial information possessed by government agencies will be reviewed, discussed and formulated.

The content will include paid-for/free of charge designation, provision method, promotion of secondary use, related laws and regulations, etc. In particular, considerations will be made to enable users to feel at ease when using geospatial information.

The activities described below will be implemented during the first period (January 2019 - June 2020).

a) Study/research will be conducted on global trends for open data etc. and case studies for data policy in other countries.

b) Study/research will be conducted on copyright law and legal limits concerning the handling of data by related agencies.

c) Review/discussions will be held concerning the data policy that related agencies should have, taking into consideration a) and b).

d) Data policy at government agencies will be formulated in accordance with c).

4) Formulation of guidelines (Personal information protection, secondary use promotion (Handling of copyrights), considerations for safety of country (Including KPI) (Activities during latter half of first period and first half of second period)

Various guidelines will be formulated in order to promote sharing, usage, provision and circulation of geospatial information in a manner that is safe and provides ease of mind.

Priorities will be given to personal information protection, secondary use promotion and considerations for the safety of the country.

In addition, careful consideration will be given to provision and other handling of geospatial information, so as to prevent any inconsistency arising from them between related ministries and agencies and to obtain consensus of the overall government.

The activities described below will be implemented during the latter half of the first period and first half of the second period (July 2020 - June 2023).

a) Study/research will be conducted on cases in other countries on personal information protection, secondary use promotion and considerations for the safety of the country.

b) Study/research will be conducted on personal information protection, copyright law and legal limits concerning the handling of KPI (Key Point Installation) in Bangladesh.

c) Reviews/discussions will be held on the framework for the respective guidelines.

d) The respective guidelines will be formulated.

e) Workshops to communicate the respective guidelines to stakeholders will be held.

5) Formulation and implementation of action plan at each ministry/agency utilizing geospatial information and satellite positioning (Activities during latter half of first period, second period and third period)

An action plan (policy) using geospatial information and satellite positioning at each ministry/agency will be formulated and implemented. Priorities will be given to agriculture, disaster prevention, land management, local autonomy, the environment and statistics.

In the initial stage, it is important to develop geospatial information in each sector by using the basic and other functions of NSDI.

In addition, since each action plan will not be completed in a single year, methods for monitoring over multiple years will be considered.

The activities described below will be implemented during the latter half of the first period, second period and third period (July 2020 - June 2031).

a) Study/research will be conducted on action plans in other countries implemented by using geospatial information and satellite positioning.

b) Technical support will be provided for agencies that do not have adequate experience concerning geospatial information.

c) A common framework for formulation of action plans (policy) will be considered and determined.

d) An action plan will be formulated by each agency.

e) Methods for evaluation/monitoring of action plans will be reviewed and determined.

6) Incorporation into the 8th Five Year Plan, coordination with other policies such as Digital Bangladesh and Open Data (Activities during first period)

The required activities will be implemented together with the related ministries and agencies in order to incorporate establishment/operation of NSDI into the 8th Five Year Plan to contribute to Digital Bangladesh.

In particular, the required policies will be implemented in close coordination with the Prime Minister’s Office and Ministry of Planning.

In addition, activities will also be implemented in order to cooperate with related policies such as GeoDASH, or Open Data.

The activities described below will be implemented during the first period (July 2019 - June 2021).

a) A Digital Bangladesh and the 7th Five Year Plan will be understood, and cooperation between these plans and NSDI will be discussed.

b) Meetings to explain the usefulness of establishing/operating NSDI will be held for the Prime Minister’s Office and Ministry of Planning.

c) An action plan (proposed) to be incorporated into the 8th Five Year Plan will be formulated.

d) The action plan (proposed) will be discussed with the Prime Minister’s Office and Ministry of Planning before its formulation.

e) Activities will be implemented in cooperation with the policies related to NSDI such as GeoDASH, and Open Data.

8.4.2 NSDI Promotion System

An overview of activities concerning NSDI promotion system is described below.

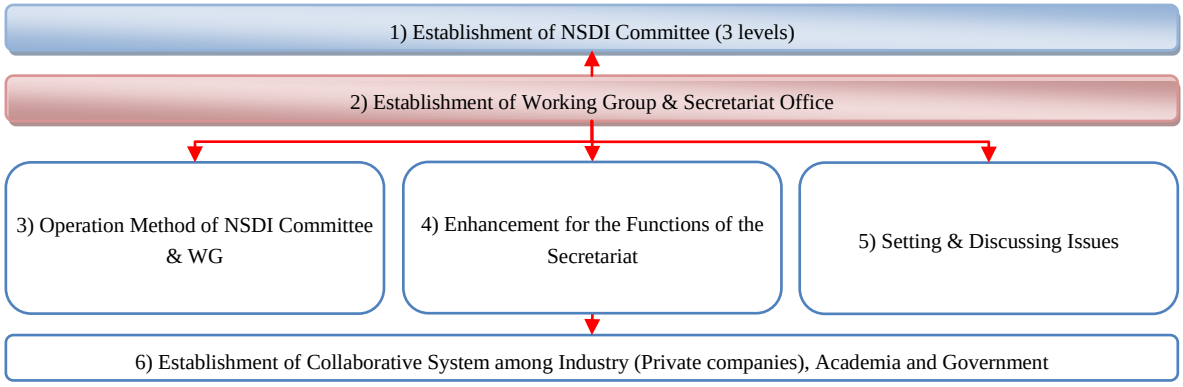


Figure 8.4.2 Relationship of activities in NSDI promotion system

Source: The Project Team

1) Establishment of NSDI committee (3 level hierarchy) and holding of meetings (Once/year) (Activities during latter half of first period, second period and third period)

After passage of the NSDI Act, NSDI Committee (3 level hierarchy) will be established based on this act, and meetings will be held. Since the committee has a 3 level hierarchy consisting of Minister level, Secretary level and Department level, efforts will be made to hold high level meetings once a year, and requests will be made for the approval of activity reports, basic plans and other documents concerning establishment and operation of NSDI.

The activities described below will be implemented during the latter half of the first period (January 2020 - June 2021).

a) Identify Secretariat for NSDI Committee, and formulate rules for holding of meetings.

b) Review agenda, report content and other matters to be considered by NSDI Committee.

c) Select required members and advisers (influential individuals) other than members specified by the NSDI Act.

d) Hold first NSDI Committee meeting in accordance with the NSDI Act.

e) Prepare minutes of NSDI Committee meetings and widely communicate.

NSDI Committee meetings will be periodically held during the second period and after.

2) Establishment of working group/secretariat (SOB + PMO) (Including NSDI working level meetings) (Activities during preparation period and first half of first period)

Working groups that are comprised of division, department and section managers will be established beneath NSDI Committee (3 level hierarchy), and will be provided with functions that enable them to review and discuss individual issues, and make recommendations for proposed conclusions.

A goal of holding working group meetings about once every two months will be established in the initial stage. Furthermore, during the period until the NSDI Act and enforcement orders (detailed regulations) are passed and the working groups are legally formed, the current NSDI contributors meeting will function and operate as a substitute organization for the working groups.

The activities described below will be implemented during the preparation period and first half of the first period (Present - December 2019).

a) For the time being, the current NSDI contributors meeting will function as a substitute organization for the working groups, during which preparations will be made for establishment of the working groups.

b) Issues to be discussed at the initial stage of the establishment/operation of NSDI will be organized.

c) Based on the issues organized in b), the required working groups will be placed and Secretariats determined for these working groups.

d) The members of each working group will be selected.

3) Formulation of operation methods for committee meeting structure (Decision and report methods to be covered) (Activities during first half of first period)

Since NSDI Committee (3 level hierarchy) and working groups have a large structure that covers related ministries and agencies, the operation methods for the meeting structure such as the decision and report methods will be formulated, and consensus will be obtained. In addition, the authority and role of the Secretariat will be determined.

The activities described below will be implemented during the first half of the first period (July - December 2018).

a) The operation methods of the meeting structure for working groups such as decision and report methods will be formulated.

b) The working group chairman and vice chairman will be selected.

c) The authority and role of the organization that is the Secretariat will be determined.

4) Strengthening of secretariat functions (Study/organization/problem solving and proposal abilities for issues to be discussed, meeting operation capabilities, etc.) (Activities during first period)

Strengthening of the capabilities of SOB which is the Secretariat for the NSDI Committee and working groups will be implemented. Specifically, the abilities to study, organize individual issues to be discussed and abilities to make problem-solving proposals will be developed.

In addition, since this is a large structure that covers related ministries and agencies, the meeting operation capabilities will be further strengthened. Cooperation with the Prime Minister's Office will also be strengthened as necessary.

The activities described below will be implemented during the first period (July 2018 - June 2021).

a) A list of the required Secretariat functions will be made.

b) The supervisory agency of the Secretariat will select and appoint the required staff members for the Secretariat.

c) The abilities to study, organize individual issues to be discussed and abilities to make problem-solving proposals will be strengthened.

d) The capabilities for preparation work for holding of meetings and operation will be improved.

5) Setting issues to be discussed within working group and practical discussions (Activities during first period, second period and third period)

Issues to be discussed within working groups will be identified, taking into consideration priority and other matters, and practical considerations/discussions will be made.

Specifically, government's data policies, guidelines, and other technical issues such as projection method and coordinate system, will be discussed.

The activities described below will be implemented during the first period, second period and third period (July 2019 - June 2031).

a) A list will be made of issues to be discussed by each working group, and the priority order will be set.

b) The frequency of meetings to be held by each working group will be about once every two months.

c) Each member will review the opinion, comments etc. concerning each issue.

d) Practical discussions will be held for each issue, and a conclusion will be reached.

There are the following three top priority issues.

a) Unification of height standard

b) Unification of coordinate system

c) Data policy at each agency

6) Building of industrial-academic-government cooperation system and holding of conferences (Once/year) (Activities during second period and third period)

In addition to the central government ministries and agencies, NSDI also plays a role and there is the need for utilization by local governments, universities, research institutes and other academic institutions, and private sector companies.

Therefore, the system to facilitate cooperation between industry, academia and government will be strengthened, and conferences will be held about once a year. It is assumed that SOB will be the Secretariat.

The activities described below will be implemented during the first half of the second period (July 2021 - December 2022).

a) The structure of the industrial-academic-government cooperation will be discussed and determined.

b) The operation method for the partner conference between industry, academia and government will be discussed and determined.

c) The chairman, vice chairman and other officers of the academia-public-private partnership conference and member of the Secretariat will be selected.

d) The program for the industry/academia/government collaboration conference will be reviewed and determined.

e) The first academia-public-private partnership conference will be held.

During the first half of the second period and after, academia-public-private partnership conferences will be periodically held.

8.4.3 Geographic information standards

An overview of activities concerning geographic information standards is described below.

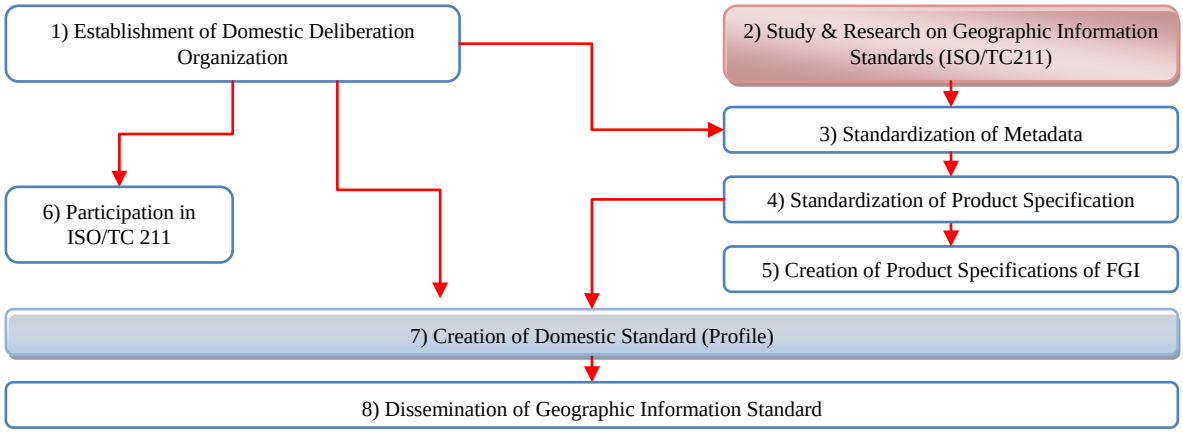


Figure 8.4.3 Relation of activities for geographic information standards

Source: The Project Team

1) Establishment of domestic deliberation organization (Domestic committee) (Compiling of domestic opinions) (Activities during first half of first period)

In order to participate in ISO/TC211 in the future, a domestic deliberation organization which compiles domestic opinions needs to obtain a certification from BSTI, which is the contact point for ISO in Bangladesh.

In addition, the necessity of establishing a domestic deliberation organization and preparing operational regulations which are mandatory when becoming a P member, will be discussed. Furthermore, it is assumed that SOB will be the domestic deliberation organization.

The activities described below will be implemented during the first half of the first period (July 2018 - June 2019).

a) Selection of the domestic deliberation organization for geographic information standards will be discussed, and a decision will be made.

b) The domestic deliberation organization will be established and the operational regulations will be discussed.

c) Members of the domestic deliberation organization will be selected, and the chairman, vice chairman and other members will be selected/appointed.

d) The domestic deliberation organization will be established by making an application to BSTI.

2) Study/research of geographic information standards (Government + private sector + universities, etc.) (Activities during first period)

Due to the fact that dissemination of geographic information standards has not proceeded

adequately in Bangladesh, it is difficult to immediately proceed with formulation of domestic standards.

Therefore, study and research on the existing geographic information standards such as ISO/TC211 will be implemented during which SOB plays a central role, with other government agencies, the private sector, universities, research institutes and other organizations participating.

In addition, since it is necessary to develop specialists in geographic information standards which will be key persons at SOB, human resource development methods need to be adequately considered.

The activities described below will be implemented during the first period (July 2018 - June 2021).

a) Framework (Government + Private Sector + Universities, etc.) for study/research of geographic information standards will be discussed and established.

b) Rules for study/research of geographic information standards will be discussed and formulated.

c) Study/research on ISO/TC211 geographic information standards will be implemented.

d) Research on case studies of profiles for geographic information standards in Japan and other countries will be conducted.

e) Specialists in geographic information standards which will become key persons at SOB will be developed.

3) Formulation of meta data standards, implement preparation/release of domestic Standards (Activities during first half of first period)

Meta data is the first step in order to proceed with the sharing of geospatial information. Therefore, priority will be given to formulation of metadata standards. Metadata will be prepared for the existing geospatial information, and activities to release this data on the Geo Portal website and other locations will be performed.

The activities described below will be implemented during the first half of the first period (July 2018 - June 2020).

a) Technology transfer will be implemented for formulation of metadata standards.

b) Priority will be given to formulation of metadata standards which are part of the geographic information standards.

c) Metadata will be prepared for the existing geospatial information and base map information.

d) Metadata will be released on the Geo Portal and other clearinghouse websites.

4) Formulation of standards for quality evaluation methods, data content, product specifications, etc., and domestic standardization (Activities during latter half of first period)

Priorities will be given to formulation of standards for product specifications including quality evaluation and data content which are important information to promote sharing and usage of geospatial information.

The activities described below will be implemented during the latter half of the first period (January 2020 - June 2021).

a) Technology transfer will be implemented for formulation of standards for product specifications.

b) Among the formation about geographical information standards, priority will be given to the standards for product specifications that include quality evaluation and data content.

5) Preparation of product specifications for fundamental geospatial information (base map) (Activities during latter half of first period)

Product specifications for fundamental geospatial information (base map) will be discussed based on SOB digital topographic maps. These product specifications will be prepared in accordance with the standards for product specifications described in paragraph 4) above.

The activities described below will be implemented during the latter half of the first period (January 2020 - June 2021).

a) Product specifications for fundamental geospatial information (base map) will be discussed based on the digital topographic maps.

b) Product specifications for fundamental geospatial information (base map) will be formulated in accordance with paragraph 4) above.

c) Product specifications for fundamental geospatial information (base map) will be released to the public.

6) Participation in ISO/TC211 and attendance at general meeting (Activities during latter half of first period)

Personnel will formally participate in ISO/TC211 through BSTI, which is the ISO contact point in Bangladesh. For the time being, personnel will participate as an O member, and a goal will be established to attend the ISO/TC211 General Meeting that is held once a year.

The activities described below will be implemented during the latter half of the first period (January

2020 - June 2021).

a) Will participate in ISO/TC211 as an O member through BSTI.

b) Will attend the ISO/TC211 General Meeting that is held once a year.

c) Will share content of ISO/TC211 General Meeting with related agencies.

7) Preparation of domestic standards (Profile) for geographic information standards (Activities during first half of second period)

There are over 50 items (ISO 19100 series) that were standardized with ISO/TC211, but there are 13 standard items (JIS X 7100 series) that were incorporated into JIS in Japan.

The reason for this is the content necessary for the actual use was selected from the ISO/TC211 standards and organized in order to facilitate easy usage of geographic information standards.

Domestic standards (profile) which serve as practical geographic information standards will be formulated in Bangladesh through study/research of various geographic information standards and review by the domestic deliberation organization.

The activities described below will be implemented during the first half of the second period (July 2021 - June 2024).

a) A list will be made of standards required for domestic standards (profile).

b) Standardization of domestic standards (proposed) will be formulated.

c) Review will be performed by the domestic deliberation organization.

d) Domestic standards (profile) which serve as the practical geographic information standards will be formulated.

8) Formulation and implementation of plan to promote dissemination of geographic information standards (Activities during second period)

A plan to promote dissemination of metadata, product specifications and domestic standards (profile) for geographic information standards formulated in paragraph 7) above will be formulated and implemented.

The implementation proposal will include training program curriculum and preparation of training materials.

In addition, target staff members will include all persons involved in geospatial information in Bangladesh, in addition to SOB staff members.

The activities described below will be implemented during the second period (July 2021 - June 2026).

a) Plan to promote dissemination of formulated geographic information standard profile and training program will be formulated.

b) Curriculum, training manual and training materials will be prepared based on training program.

c) Trainers that provide training will be developed.

d) Training program will be implemented.

e) Internet will be utilized to implement public relations activities for geographic information standards.

8.4.4 Geospatial information

An overview of activities concerning geospatial information is described below.

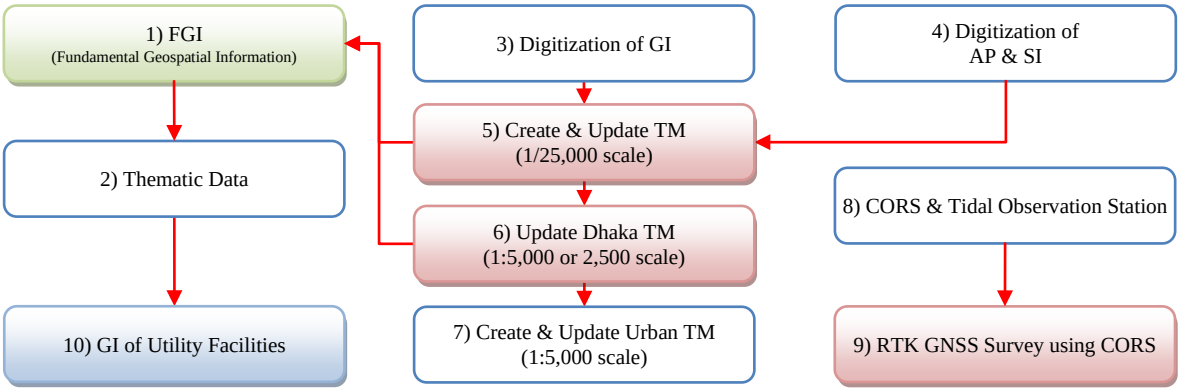


Figure 8.4.4 Activities related to geospatial information

Source: The Project Team

1) Definition of Fundamental geospatial information, formulation of specifications/updating plan (Horizontal position and elevation standards) and verification (Activities during first half of first period)

The fundamental geospatial information at NSDI will be defined, specifications/updating plans will be prepared, and updating/new creation of base map information will be implemented according to the plans.

Currently, an implementation plan to unify the coordinates systems and elevation standards that differ for each agency is being prepared, and the required review work (verification) will be implemented.

The activities described below will be implemented during the first half of the first period (July 2018 - June 2020).

a) Fundamental geospatial information will be defined, and specifications and creation /updating plans will be formulated.

b) Fundamental geospatial information will be prepared from digital topographic maps according to a).

c) Fundamental geospatial information and product specifications will be released to the public, and usage by related agencies will be promoted.

d) An implementation plan to unify coordinate system and elevation standards will be prepared, and work will be implemented.

e) Differences between the fundamental geospatial information and the geospatial information at the respective agencies will be verified.

2) Preparation of thematic data/verification of updating (Including clarification, collection and determination of data) (Activities during latter half of first period)

A creation plan for thematic maps considered to be useful for the various agencies in Bangladesh will be formulated, and creation/updating of thematic maps will be implemented in accordance with the plan.

The creation plan will include the required data content, data collection method, updating period, updating method and other details.

The activities described below will be implemented during the latter half of the first period (July 2019 - June 2021).

a) The normal operation at each agency will be analyzed in order to clarify the required thematic maps.

b) A creation plan for thematic maps considered to be useful for each agency will be formulated.

c) Using the background information described in paragraph 1) above, creation/updating of thematic maps will be implemented in accordance with a).

d) Metadata and product specifications will be prepared for thematic maps.

e) Thematic maps, metadata and product specifications will be released to the public.

3) Promoting digitization of various geospatial information (Including old topographic maps/review and verification of coordinates conversion (Activities during first half of first period)

The latest geospatial information (topographic maps) is important, but old geographic information (topographic maps) is required in order to understand the changes that occur in the geography and features of that region.

Old geographic information is stored in the form of topographic maps (printed maps), and due to the fact that these deteriorate over time, these old topographic maps (printed maps) need to be digitized and stored/managed.

Since the coordinates system for the old topographic maps differs from the coordinates system currently adopted by SOB, review and verification of the coordinates conversion technique needs to be implemented.

These old topographic maps also need to be released on NSDI.

The activities described below will be implemented during the first half of the first period (July 2018 - June 2020).

a) A list of the geospatial information possessed/stored by each agency will be made.

b) The geospatial information stored as printed maps will be digitized.

c) The coordinates system will be verified, and geo-referencing will be performed. In addition, coordinates conversion will be reviewed.

d) Metadata for this geospatial information will be prepared.

4) Collection of aerial photographs/satellite images and promoting digitization (Activities during first half of second period)

In the same manner as for topographic maps, old aerial photographs and satellite images are useful for understanding the changes in the geography and features of that region.

Old aerial photographs stored by SOB are conserved in the form of aerial photograph film, and due to the fact that these deteriorate over time, these old aerial photographs need to be digitized and stored/managed.

The same procedure is also required for satellite images.

The activities described below will be implemented during the first half of the second period (July 2021 - June 2024).

a) A list of the aerial photographs and satellite images possessed/stored by each agency will be

made.

b) The naming rules, specifications and other details when digitizing is performed will be reviewed and determined.

c) Images that are stored in the form of aerial photograph film or other such format will be digitized.

d) Copyrights for aerial photographs and satellite images will be confirmed.

e) Metadata will be prepared for these aerial photographs and satellite images.

5) Creation/updating of national digital topographic maps (1:25,000) (Activities during second period and third period)

1:25,000 scale digital topographic maps that cover the entire country of Bangladesh were created by SOB using aerial photographs taken between 2010 and 2011.

Due to the fact that the features and geography change over time for the topographic map after it was created, the topographic map needs to be modified to reflect changes or a newly updated map needs to be prepared.

Accordingly, a plan for modification over time/creation and updating of 1:25,000 scale digital topographic maps need to be formulated, and the required budgetary measures need to be implemented.

The activities described below will be implemented during the second period and third period (January 2023 - June 2031).

a) An updating plan for SOB 1:25,000 scale topographic maps will be formulated, and budgetary measures will be taken.

b) Satellite imagery will be taken in accordance with the updating plan and changes that occur over time.

c) 1:25,000 scale topographic maps will be updated based on the newly taken satellite imagery.

d) The base map information will be updated based on the updated 1:25,000 scale topographic maps.

e) The updated 1:25,000 scale topographic maps and base map information will be released to the public.

f) Metadata and product specifications for 1:25,000 scale topographic maps will be prepared.

6) Updating of 1:5,000 scale Dhaka City digital topographic maps or creation of 1:2,500 scale topographic maps (Activities during first period, second period and third period)

1:5,000 scale digital topographic maps for Dhaka Metropolitan area were created based on aerial photographs that were taken in 2003. Accordingly, 15 years have already elapsed since the aerial photographs were taken.

Due to the fact that Dhaka Metropolitan area has undergone an extremely large transformation during this period as a result of economic growth in Bangladesh, new 1:5,000 scale digital topographic maps need to be urgently created to replace the existing map.

Accordingly, it is highly desirable that a plan for creation and updating of 1:5,000 scale digital topographic maps of the Dhaka Metropolitan area be formulated as soon as possible, map creation according to the plan be implemented, and newly created 1:5,000 digital topographic maps be released when NSDI is established.

Currently, the scale adopted for a city base maps in Bangladesh is 1:5,000, but in consideration of information that will be required in the future (e.g. information on underground utilities, etc.), limits on the expressing of features due to topographic map scale restrictions and other such details, review of whether or not to create larger scale maps (e.g. 1:2,500 or 1:1,000 scale) than the current city base maps in Bangladesh is required.

The activities described below will be implemented during the first period, second period and third period (July 2018 - December 2027).

a) An updating plan for SOB 1:5,000 scale topographic maps will be formulated, and budgetary measures will be taken.

b) Aerial photographs will be taken in accordance with the updating plan.

c) The specifications for 1:2,500 or 1:5,000 scale topographic maps will be reviewed, and product specifications will be prepared.

d) 1:2,500 or 1:5,000 scale topographic maps will be updated based on the newly taken aerial photographs and product specifications.

e) The fundamental geospatial information will be updated based on the updated 1:2,500 or 1:5,000 scale topographic maps.

f) Updated 1:2,500 or 1:5,000 scale topographic maps and fundamental geospatial information will be released to the public.

g) Metadata and product specifications for 1:2,500 or 1:5,000 scale topographic maps will be prepared.

7) Formulation and implementation of digital topographic maps development plans (1:5,000) for other regional cities (Activities during latter half of first period and first half of second period)

The cities for which 1:5,000 scale digital topographic maps have been developed or are being developed are shown in Table 10.10.5.

If the assumption is made that development of 1:5,000 scale digital topographic maps needs to be implemented in cities with a population of 200 thousand or more, development of 1:5,000 scale digital topographic maps is required in six major regional cities.

1:5,000 scale digital topographic maps creation plan needs to be formulated for these major regional cities, the required budgetary measures implemented, and 1:5,000 scale digital topographic maps need to be developed for these major regional cities.

The activities described below will be implemented during the latter half of the first period and first half of the second period (July 2020 - June 2024).

a) 1:5,000 scale digital topographic maps preparation/updating plan will be formulated for six major regional cities and other regional cities, and budgetary measures will be taken.

b) Aerial photographs will be taken in accordance with the updating plan.

c) Specifications for 1:5,000 scale topographic maps will be reviewed, and product specifications will be prepared.

d) 1:5,000 scale topographic maps will be updated based on the newly taken aerial photographs and product specifications.

e) The fundamental geospatial information will be updated based on the updated 1:5,000 scale topographic maps.

f) Updated 1:5,000 scale topographic maps and fundamental geospatial information will be released to the public.

g) Metadata and product specifications for 1:5,000 scale topographic maps will be prepared.

8) Expansion of CORSs/tidal observation stations (Grant aid), formulation of operation and maintenance (O & M) plan (Activities during preparation period and first half of first period)

Regarding establishment of CORSs and expansion of tidal observation stations for which implementation by JICA is planned, an operation and maintenance (O & M) plan for the facilities after the construction is completed needs to be formulated and the necessary budgetary measures taken.

The activities described below will be implemented during the preparation period and first half of the first period (Present - June 2020).

a) An O & M plan will be formulated for the existing CORSs (6 points) and existing tidal observation station (1 location), and the newly installed CORSs (70 points) and tidal observation stations (2 locations).

b) The necessary budgetary measures will be taken according to the O & M plan formulated in a).

c) A manual and maintenance record book will be prepared that are required for O & M activities.

d) The required training will be implemented according to the manual in c).

e) Maintenance will be implemented according to the O & M plan and manual, and records will be kept.

9) RTK accuracy evaluation in Dhaka City using CORSs (Activities during latter half of first period)

As an integral part of promoting utilization of CORSs (in particular, use for RTK surveying in cadastral surveys), accuracy evaluation of RTK survey needs to be implemented using CORSs, and unified work methods need to be established, such as formulation of work rules.

The activities described below will be implemented during the latter half of the first period (July 2019 - June 2021).

a) A technology transfer manual and teaching materials for RTK survey will be prepared.

b) Technology transfer will be implemented based on the manual and teaching materials in a).

c) OJT for RTK survey will be implemented after implementation of technology transfer.

d) The results of survey implemented with OJT will be verified, and the accuracy will be checked.

e) RTK surveying work rules will be formulated based on the accuracy verification with OJT in d).

f) Seminars to promote dissemination of RTK survey will be implemented for survey organizations including private sector companies.

10) Preparation/verification of geospatial information for utility facilities (Water supply/ sewage, gas, electric power etc.) in Dhaka City

(Activities during first half of second period)

The operation and maintenance of underground utilities (water supply/sewage, gas, electric power, communications, etc.) is a large issue in cities, and for this purpose, information on various underground utilities needs to be provided in unified geospatial information.

Therefore, due to the fact that the scale (1:5,000) of the current SOB city base maps is small, topographic maps with a larger scale (approx. 1:1,000) need to be developed.

Normally, since the main underground objects are buried beneath roads, these topographic maps only need to be created for the area around roads (corresponds to road ledger in Japan).

From this point on, it is necessary that development methods, specifications and other geospatial information details be reviewed with the objective of facilitating operation and maintenance of underground utilities, that verification work be performed, and that development methods, usage and other details be established.

The activities described below will be implemented during the first half of the second period (July 2021 - June 2024).

a) A list will be made of the main underground utilities, and the related agencies (business operators) will be identified.

b) Development methods and specifications for geospatial information on underground utilities will be reviewed and determined. In addition, the areas in which verification experiments are performed will be determined.

c) Geospatial information on underground utilities will be developed in accordance with b).

d) For the time being, the Dhaka City topographic map (1:2,500 or 1:5,000) that was created/ updated will be used as the background map, and a GIS database of underground utilities will be established and verified.

e) Data sharing/exchange methods and other details between the business operators, including the background map, will be verified based on the verification experiments.

8.4.5 IT services/IT system

An overview of activities concerning IT services/IT system is described below.

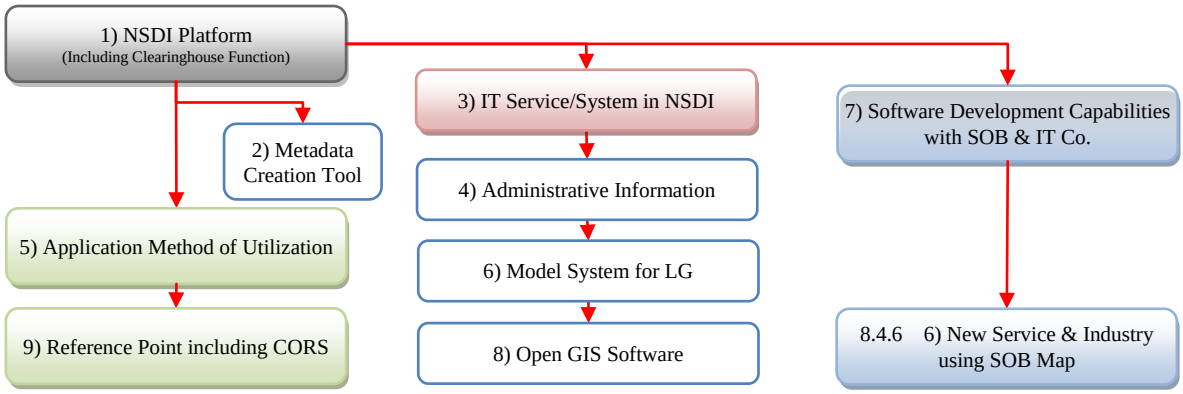


Figure 8.4.5 Relationship of IT service/IT system activities

Source: The Project Team

1) Establishment and development of NSDI platform that includes clearinghouse function (Including SOB Geo-Portal) (Activities during preparation period and first period)

NSDI platform is a system that contributes to the sharing of geospatial information possessed by SOB and related agencies, and to the planning of disaster prevention and post-disaster reconstruction, and urban or regional development plans, etc.

NSDI platform requirements will be defined (outline, objective, scope, work flow, functions, quality, and security), taking into consideration the implementation results of NSDI pilot project, and NSDI platform will be established that includes a clearinghouse function.

The activities described below will be implemented during the preparation period and first period (Present - December 2020).

a) The implementation results of NSDI pilot project will be verified.

b) NSDI platform requirements will be defined, taking into consideration of a).

c) A rough approximation of the establishment cost and the establishment methods will be discussed, taking into consideration the definition of the requirements in b).

d) Tender documents for establishment of NSDI platform will be prepared, and call for tender will be implemented.

e) NSDI platform will be established, and a usage manual will be prepared.

f) NSDI platform will be verified.

g) Workshops will be held to communicate NSDI platform to stakeholders.

h) A permanent help desk for NSDI platform will be established.

2) Development and release of metadata creation tool (Activities during latter half of first period)

A metadata creation tool will be developed based on the formulated metadata standards, and distributed to users that release the geospatial information on NSDI platform in order to facilitate standardization and sharing of metadata.

The activities described below will be implemented during the latter half of the first period (January 2020 - June 2021).

a) The development specifications for the metadata creation tool will be discussed.

b) Tender documents for development of the metadata creation tool will be prepared, and call for tender will be implemented.

c) The metadata creation tool will be developed in accordance with the metadata standards.

d) A usage manual for the metadata creation tool will be prepared.

e) The metadata creation tool will be distributed to users that release the geospatial information data on NSDI platform, and explanatory meetings will be held.

3) Review (Function requirements) and verification of IT services/system to promote sharing, exchange and circulation of geospatial information (Activities during first period)

The scope of geospatial information to be shared on NSDI platform and the information release level will be set, and the work flow for the sharing, exchange and circulation of geospatial information will be organized.

The required IT services/system based on the work flow will be reviewed, and the services/system will be verified using NSDI platform, in cooperation with related agencies.

The activities described below will be implemented during the first period (January 2019 - December 2020).

a) The work flow for the sharing, exchange and circulation of geospatial information will be organized.

b) The required IT services/system based on the work flow will be reviewed.

c) The requirements for the new IT services/system will be defined.

d) A rough approximation of the establishment cost and the establishment methods will be discussed, taking into consideration the definition of the requirements in c).

e) Tender documents for the new IT services/system will be prepared, and call for tender will

be implemented.

f) The new IT services/system will be established.

g) The new IT services/system will be verified.

h) Workshops will be held to communicate the new IT services/system to stakeholders.

4) Establishment/verification of administrative information (statistics, disaster prevention, land, environment, etc.) provision system (Including cooperation with Open Data) (Activities during first half of second period)

In addition to contributing to boosting the efficiency and advancing the level of administrative operations, the conversion of geospatial information into open data and mutual use of this information has the potential to enable private sector companies to create new business models that utilize this information.

In order to promote utilization of geospatial information, a system will be established to provide administrative information related to location, such as statistics, disaster prevention, land and environment, and the system will be verified.

The activities described below will be implemented during the first half of the second period (July 2021 - June 2024).

a) The target fields for the administrative information system will be discussed.

b) The requirements for the administrative information provision system will be defined.

c) A rough approximation of the establishment cost and the establishment methods will be discussed, taking into consideration the definition of the requirements in b).

d) Tender documents for the administrative information provision system will be prepared, and call for tender will be implemented.

e) The administrative information provision system will be established.

f) The administrative information provision system will be verified.

g) Workshops will be held to communicate the administrative information provision system to stakeholders.

5) Improvement of application methods for usage (Procurement) of SOB digital topographic maps (Activities during first half of first period)

In consideration of the current issues with application for usage (procurement) of SOB digital topographic maps, the work flow for the usage of and obtaining digital topographic maps after

NSDI platform is established will be reviewed, efforts will be made to enhance the efficiency and speed of work at SOB, and measures capable of enhancing the convenience for users will be taken.

The activities described below will be implemented during the first half of the first period (July 2018 - December 2019).

a) The application methods for usage (procurement) of SOB digital topographic maps will be studied.

b) An efficient application flow utilizing IT will be reviewed and discussed.

c) The requirements for the topographic map usage (procurement) application system will be defined.

d) A rough approximation of the establishment cost and the establishment methods will be discussed, taking into consideration the definition of the requirements in c).

e) Tender documents for the topographic map usage (procurement) application system will be prepared, and call for tender will be implemented.

f) A topographic map usage (procurement) application system will be established

g) The topographic map usage (procurement) application system will be verified, and operation will be started.

h) Workshops will be held to communicate the topographic map usage (procurement) application system to stakeholders.

6) Development/demonstration of model system for local governments (Cooperation with LGED) (Activities during latter half of second period)

A model system for local governments that use the fundamental geospatial information (base map) distributed/provided on NSDI platform will be developed, and the usefulness of the fundamental geospatial information (base map) at local governments will be demonstrated.

The activities described below will be implemented during the latter half of the second period (July 2023 - June 2026).

a) Information that can be provided by local governments will be studied and organized.

b) The information to be provided will be examined in detail and determined.

c) The requirements for the model system for local governments will be defined.

d) A rough approximation of the establishment cost and the establishment methods will be discussed, taking into consideration the definition of the requirements in c).

e) Tender documents for the model system for local governments will be prepared, and call for tender will be implemented.

f) The model system for local governments will be established.

g) The model system for local governments will be verified.

h) Workshops will be held to communicate the model system for local governments to stakeholders.

7) Upgrading GIS and open source software development capability (Implementation by focusing on private sector companies using the Japan GSI Partner Network as reference) ⇒Creation of new industries (Activities during second period)

An understanding will be obtained of system development in Bangladesh using GIS and open source, as well as the status of Web service establishment, a network in which SOB, related agencies and private sector companies participate will be established in order to promote utilization of geospatial information, and an approach will be implemented to upgrade technology concerning geospatial information.

The activities described below will be implemented during the second period (July 2021 - June 2026).

a) An understanding will be obtained of system development in Bangladesh using GIS and open source, as well as the status of Web service establishment.

b) A network in which SOB, related agencies and private sector companies participate will be established.

c) A technical manual, guidelines and other documents will be prepared for the distribution of SOB geospatial information.

d) Workshops will be held concerning the distribution of SOB geospatial information, and opinions will be exchanged.

e) Technical support will be provided for systems/services developed/established by private sector companies.

f) Wide dissemination of systems/services developed/established by private sector companies will be promoted.

8) Demonstration/promotion of utilization of open GIS software (Activities during latter half of first period and first half of second period)

GIS software is required in order to facilitate the free processing and utilization of geospatial information that is distributed by NSDI platform in a format that permits secondary processing.

In order to promote the utilization of geospatial information, the burden on a user needs to be reduced, and open GIS software is one measure to solve this issue.

Training and workshops will be held by using open GIS software, fundamental geospatial information and the geospatial information that is released on NSDI platform, and an approach will be implemented to promote use of NSDI platform.

The activities described below will be implemented during the latter half of the first period and first half of the second period (July 2019 - June 2023).

a) The dissemination status of open GIS software and group activities will be studied.

b) Simplified manuals and training materials for open GIS software will be prepared.

c) Trainers capable of providing training on open GIS software will be developed.

d) Workshops (training) will be held on the utilization of open GIS software.

e) A permanent help desk for open GIS software will be established.

9) Review of geodetic control points release methods including CORSs, and establishment of observation information distribution system
(Activities during first period)

The data format and content of observation data for CORSs released on NSDI platform, and data release methods to NSDI platform from the GNSS Data Center will be reviewed, and an observation information distribution system will be established.

The activities described below will be implemented during the first period (January 2019 - June 2021).

a) An understanding will be obtained of SOB geodetic control points and CORSs release status.

b) Release policy for SOB geodetic control points and CORSs will be discussed.

c) Requirements for the geodetic control point information and CORSs observation information distribution system will be defined.

d) A rough approximation of the establishment cost and the establishment methods will be discussed, taking into consideration the definition of the requirements in c).

e) Tender documents for the geodetic control point information and CORSs observation information distribution system will be prepared, and call for tender will be implemented.

f) The geodetic control point information and CORSs observation information distribution system will be established.

g) The geodetic control point information and CORSs observation information distribution system will be verified.

h) Workshops will be held to communicate the geodetic control point information and CORSs observation information distribution system to stakeholders.

i) A permanent help desk for the geodetic control point information and CORSs observation information distribution system will be established.

8.4.6 Human resource development/technology development/dissemination promotion/new industry creation

The content of activities concerning human resource development/technology development/ dissemination promotion/new industry creation is described below.

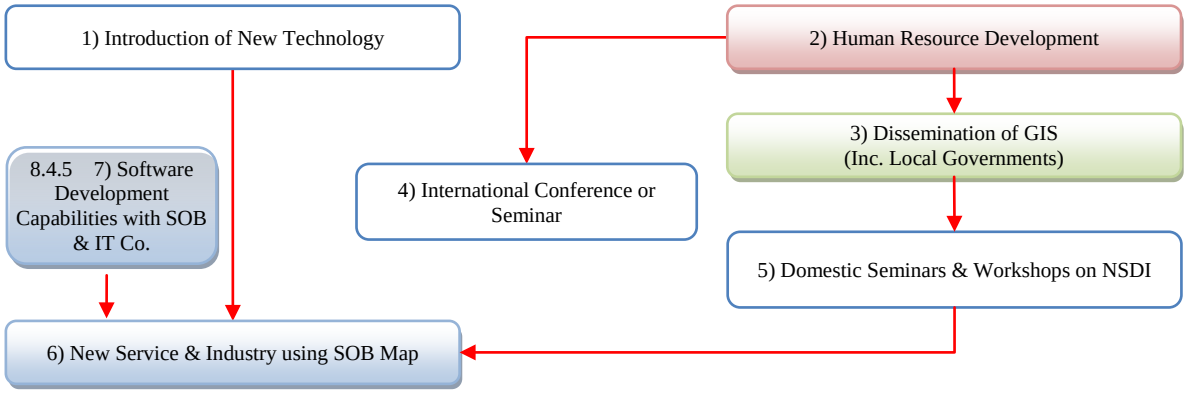


Figure 8.4.6 Relationship of activities for human resource development/technology development/dissemination promotion/new industry creation

Source: The Project Team

1) Introduction of and study/research on new technologies that match needs (3D, satellite positioning, MMS, drone etc.) (Activities during second period and third period)

Study and research of new technologies related to geospatial information will be conducted, and activities to develop and utilize diverse, high-quality, high-accuracy, high-freshness geospatial information will be performed.

The activities described below will be implemented during the second period and third period (July 2021 - June 2031).

a) New technologies related to geospatial information and satellite positioning will be observed

and studied.

b) New technologies with a high level of need will be selected, and priority will be placed on study and research in this area.

c) The potential for application of new technologies to daily operations will be studied.

d) A study/research report concerning new technologies will be prepared.

2) Review and implementation of human resource development for GIS, including other related ministries and agencies (Cooperation with universities, etc.) (Activities during first period)

The scope of use of geospatial information for administration work in such areas as disaster prevention, roads, urban planning, regional planning and welfare planning is diverse, and GIS is indispensable in order to enhance the efficiency and advance the level of this work.

Therefore, human resources with the knowledge and capabilities required to utilize geospatial information will be developed in cooperation with universities and other educational institutions.

The activities described below will be implemented during the first period (January 2019 - December 2020).

a) Methods to develop human resources capable to utilize geospatial information/satellite positioning will be discussed.

b) Training curriculum and training materials will be prepared based on a).

c) Trainers that implement training will be developed.

d) Geospatial information utilization training will be implemented based on the training curriculum.

e) Geospatial information utilization training will be monitored/evaluated, and a review will be conducted.

3) Dissemination of GIS to government agency work (In particular, review of budgetary measures/support for local governments) (Activities during first period)

Fundamental geospatial information consists of the information that is used as the basis for public services such as land management, crisis management and environmental measures provided by the country and local governments, and each entity adds new information according to a specific objective, and uses this as an indispensable platform for implementing individual operations.

For this purpose, budgetary measures and technical support need to be discussed in order to

facilitate achievement.

The activities described below will be implemented during the second period (July 2021 - June 2026).

a) An understanding will be obtained of GIS dissemination status at government agencies.

b) GIS dissemination methods and budgetary measures will be implemented for government agencies, including local governments.

c) Technical support system related to GIS dissemination will be studied.

d) A permanent help desk concerning GIS dissemination will be established.

e) Workshops will be held concerning GIS dissemination.

4) Attendance and presentation at international conference, seminars and other events concerning NSDI or geospatial information (Activities during latter half of first period)

Personnel will participate in international conferences, seminars and other events in order to make activity reports on the approach to NSDI and development status of geospatial information in Bangladesh, and presentations will be made.

The activities described below will be implemented during the latter half of the first period (July 2020 - June 2021).

a) International conferences, seminars and other events concerning NSDI or geospatial information will be studied.

b) Information concerning the approach to NSDI and development status of geospatial information in Bangladesh will be organized.

c) International conferences, seminars and other events concerning NSDI or geospatial information will be attended, and presentations will be made.

d) Information will be shared concerning global trends in NSDI or geospatial information.

5) Holding of domestic seminars, workshops and other events concerning NSDI (Activities during first period)

Seminars, workshops and other events will be held in Bangladesh in order to make reports on the development status of NSDI and promote dissemination/usage of geospatial information.

The activities described below will be implemented during the first period (July 2018 - June 2021).

a) The policy for the holding of domestic seminars and workshops concerning NSDI will be

discussed.

b) A domestic seminar and workshop program concerning NSDI will be prepared.

c) Matters to be communicated and reported concerning NSDI activities will be organized.

d) Domestic seminars or workshops concerning NSDI will be held on a continuous basis once a year.

e) The content of seminars or workshops, and related information will be widely communicated via the internet.

6) Review of creation of new services/industries utilizing GIS or satellite positioning (Activities during first period and second period)

Development of mobile applications utilizing fundamental geospatial information or open data, and the creation of services/industries that utilize position information obtained from satellite positioning will be discussed.

The activities described below will be implemented during the first period and second period (January 2019 - June 2026).

a) Services/industries that utilize global GIS or satellite positioning will be studied/researched.

b) Cases that can be applied in Bangladesh will be reviewed and selected.

c) Seminars and workshops will be held to introduce cases.

d) The role of government agencies to help facilitate the creation of new services/industries will be discussed.

e) Based on the discussion in d), the results will be reflected in the Five Year Plan or action plan.

Table 8.3.1 Roadmap to establish NSDI in Bangladesh (proposed)

1st: January ~ June, 2nd: July ~ December

Classification	No.	Activity Content (Draft)	Central Implement Organization	Digital Bangladesh									Next Digital Bangladesh																				
				Preparation Period				Infrastructure Formation / Dessemination Period					1st Operation Period (8th 5 Years Plan)										2nd Operation Period (9th 5 Years Plan)											
				2017		2018		2019		2020		2021	2022		2023		2024		2025		2026		2027		2028		2029		2030		2031			
				1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd		
Legal Framework	1.1	Establishment & promulgation of NSDI Act & new Survey Act, establishment & promulgation of their rules	MOD SOB	■	■	■	▒	▒	▒																								
	1.2	Short-term, mid-term and long-term planning for NSDI establishment and operation	SOB	■	■		▒	▒	▒	▒	▒	▒								▒	▒									▒	▒		
	1.3	Discussion and formulation of government data policy	SOB					▒	▒	▒																							
	1.4	Formulation of guidelines (protection of personal information, promotion of secondary use <correspondence to copyright>, consideration of national security <inc. KPI> , and so on)	SOB							▒	▒	▒	▒	▒	▒	▒																	
	1.5	Formulation of action plan of ministries and agencies utilizing geospatial information and satellite positioning, and implementation	Each Organization							▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒		
	1.6	Incorporation into the Digital Bangladesh & the eighth five-year plan, cooperation with other policies such as open data and so on	PMO(a2i) MOD SOB						▒	▒	▒	▒																					
NSDI Promotion Structure	2.1	Establishment of NSDI Committee (3 levels) and holding (once a year)	PMO MOD SOB							▒	▒	▲		▲		▲		▲		▲		▲		▲		▲		▲		▲			
	2.2	Establishment of Working group & Secretariat office (SOB + PMO), (Including NSDI Contributor meeting)	SOB WG Members	■	■	■	▒	▒	▒																								
	2.3	Formulation of operation method of committee & working group bodies (covering methods of decision and reporting)	SOB WG Members				▒	▒	▒																								
	2.4	Enhancement of the functions of the secretariat (ability to investigation, organize & solve for issues of discussion, coordination of the committee or working group, and so on)	SOB				▒	▒	▒	▒	▒	▒																					
	2.5	Setting for issues to be considered by the working group, and substantive discussion	WG Members				▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒		
	2.6	Establishment of collaborative system among industry, academia and government, and hold council (once a year)	PMO SOB										▒	▒	▒	▲		▲		▲		▲		▲		▲		▲		▲			
Geographic Information Standards	3.1	Establishment of domestic deliberation organization (national committee) (Summary of national opinion)	BSTI SOB Universities				▒	▒																									
	3.2	Study and research on geographic information standards (government + private + university + etc.)	SOB Universities Other				▒	▒	▒	▒	▒	▒																					
	3.3	Standardization of metadata, domestic standardization, implementation of preparation and publication	SOB Universities Other				▒	▒	▒	▒																							
	3.4	Standardization of method of quality evaluation, data content, product specification, and domestic standardization	SOB Universities Other							▒	▒	▒																					
	3.5	Creation of product specifications of fundamental geospatial information	SOB							▒	▒	▒																					
	3.6	Participation in ISO / TC 211 and attendance at the general meeting	SOB Universities Other								▲																						
	3.7	Creation of domestic standard (profile) of geographic information standard	SOB Universities Other										▒	▒	▒	▒	▒	▒															
	3.8	Formulation and implementation of promotion plan of geographic information standard	SOB Universities Other										▒	▒	▒	▒	▒	▒	▒	▒	▒												
tion	4.1	Definition of the fundamental geospatial information, specifications, formulation of update plan (horizontal position standard, and so on), and demonstration	SOB				▒	▒	▒	▒																							
	4.2	Demonstration of creation / update of thematic data (including data identification, collection and determination)	SOB, LGED, BWDB, Other						▒	▒	▒	▒																					
	4.3	Promotion of digitization of various geospatial information (Including old topographic map), examination of coordinate transformation, and demonstration	SOB Other				▒	▒	▒	▒																							
	4.4	Promotion of collection & digitalization of aerial photographs and satellite images	SOB										▒	▒	▒	▒	▒	▒															

Table 8.3.1 Roadmap to establish NSDI in Bangladesh (proposed)

1st: January ~ June, 2nd: July ~ December

Classification	No.	Activity Content (Draft)	Central Implement Organization	Digital Bangladesh									Next Digital Bangladesh																					
				Preparation Period			Infrastructure Formation / Dessemination Period						1st Operation Period (8th 5 Years Plan)										2nd Operation Period (9th 5 Years Plan)												
				2017		2018		2019		2020		2021	2022		2023		2024		2025		2026		2027		2028		2029		2030		2031				
				1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	
Geospatial Informa	4.5	Create and update the national digital topographic map (1:25,000)	SOB	■	■	■																												
	4.6	Update of Dhaka City Digital Topographic Map (1:5,000), or creating 1:2,500 topographic map	SOB				■	■	■	■												■	■	■										
	4.7	Formulation of digital topographic map development plan (1:5,000) in other local cities, and implementation	SOB LGED								■	■	■	■	■	■	■	■									■	■	■	■	■				
	4.8	Extension of CORS & tidal observation station (grant aid), formulation of maintenance plan	SOB	■	■	■	■	■	■																									
	4.9	Accuracy evaluation of RTK GNSS survey using CORS in Dhaka City	SOB DLRS						■	■	■	■																						
	4.10	Demonstration of creation of geospatial information of utility facilities (Water supply, sewer, gas, electricity and so on) in Dhaka city	SOB WASA Other										■	■	■	■	■	■																
IT Service / IT System	5.1	Construction and organization of NSDI platform including clearing house function (Including SOB Geo-Portal)	BCC SOB Other	■	■	■		■	■	■	■																							
	5.2	Development and publication of metadata creation tool	BCC SOB Other							■	■	■																						
	5.3	Study of IT service / system (function requirement) to promote sharing, exchange, distribution of geospatial information, and demonstration	BCC SOB Other					■	■	■	■																							
	5.4	Construction and demonstration of administrative information (statistics, disaster prevention, land, environmental, and so on) provision system (Cooperation with Open Data)	BBS BCC Other										■	■	■	■	■	■																
	5.5	Improvement of application method of utilization (acquisition) of digital topographic map of SOB	SOB				■	■	■																									
	5.6	Development and demonstration of model system for local government (Cooperation with LGED)	LGED Dhaka City SOB														■	■	■	■	■	■												
	5.7	Improvement of GIS and open source software development capabilities (This refers to "GSI Map Partner Network" and conduct mainly on private enterprises) ⇒ also related to creation of new industries	BCC SOB Other										■	■	■	■	■	■	■	■	■													
	5.8	Demonstration and promotion of utilization of open GIS software	SOB LGED Other						■	■	■	■	■	■	■	■																		
	5.9	Examination of publication method of reference point including CORS and construction of observation information (CORS) distribution system	SOB					■	■	■	■	■																						
Human Resources Development / Technology Development /Promotion/ New Industry Creation	6.1	Introduction of new technology (3 dimensional, satellite positioning, MMS, drone and so on) based with the needs, and study & research	SOB										■	■	■	■	■	■	■	■	■													
	6.2	Examination of human resource development methods including other ministries concerning GIS, and implementation (collaboration with universities, and so on)	SOB Universities Other					■	■	■	■																							
	6.3	Dissemination of GIS into the work of government agencies (especially consideration of budgetary measures and support for local governments)	SOB LGED Other										■	■	■	■	■	■	■	■	■													
	6.4	Attendance and presentation to international conference or seminar on NSDI or geospatial information	SOB								▲																							
	6.5	Holding domestic seminars and workshops on NSDI	SOB				▲		▲			▲																							
	6.6	Consideration of creation of new services and industries using GIS and satellite positioning	SOB Other					■	■	■	■	■	■	■	■	■	■	■	■	■	■													

Chapter 9 NSDI Concept Design (Proposed)

Chapter 9 NSDI Concept Design (Proposed)

The concept design for NSDI (proposed) was formulated in Bangladesh as described below.

9.1 NSDI platform concept

NSDI platform in Bangladesh consists of a system to distribute fundamental geospatial information possessed by SOB, theme and other data developed by related institutions, and various types of geospatial information approved by official organizations in order to contribute to disaster-prevention planning, rebuilding support for disasters, urban planning, rural planning, transportation planning and health and sanitation planning and so on.

The concept for NSDI in Bangladesh is shown in Figure 9.1.1.

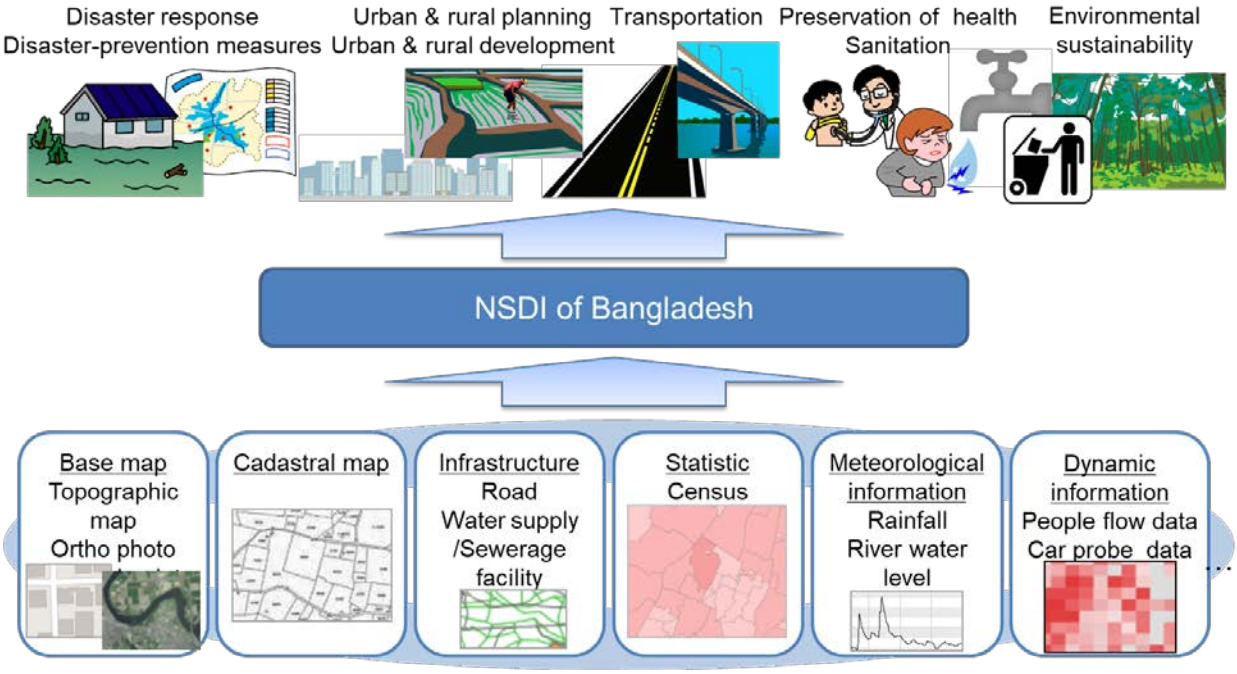


Figure 9.1.1 Bangladesh NSDI concept diagram

Source: The Project Team

The necessary requirements in order to facilitate stable and continuous delivery of various types of geospatial information and achieve efficient maintenance and management when building NSDI Platform were organized into the following items.

Furthermore, the final requirements will need to be reviewed, taking into consideration the test operation results of NSDI Pilot Project that is currently proceeding (Implementation period: August 2017 - June 2018).

9.2 Objectives and goals of building NSDI platform

The objectives of NSDI platform consist of facilitating the wide use of geospatial information by the general public as one component of social infrastructure, thus providing benefit to socioeconomic activities, and contribute to the achievement of Digital Bangladesh.

The objectives and goals are organized in Table 9.2.1.

Table 9.2.1 Objectives and goals of building NSDI platform

Objective		Goal
1	Provide fundamental geospatial information with certified datum reference points, and facilitate shared usage	1) Provide digital topographic maps (1:25,000 and 1:5,000 scale), orthophoto maps (Resolution: 50cm) and elevation data (DEM) possessed by SOB. 2) Provide geodetic control point (GCP) and CORSs information, which are one type of positional information. 3) Use various types of geospatial information published by users in order to facilitate superimposed display on base maps.
2	Publish in format with high level of reusability in order to promote secondary usage	1) Publish fundamental geospatial information with API which allows usage with Web service. 2) Provide fundamental geospatial information in format that easily facilitates secondary processing (Shape, Geodatabase, CSV, TXT, RINEX, TIFF etc.). 3) Provide diverse range of data, including open data and paid-for/free data. 4) Enable paid-for geospatial information to be purchased on the Web.
3	Use geospatial information in order to boost efficiency, sophistication and transparency of administrative work	1) Hold workshops and other events for various administrative organizations in order to disseminate knowledge of the utilization methods as a means to expand usage of geospatial information. 2) Facilitate shared usage of fundamental geospatial information by various administrative organizations, reducing the cost of developing and updating maps by eliminating duplication of efforts. 3) Develop address dictionary and provide geocoding function. 4) Expand spatial information and ledgers with addresses possessed by various administrative organizations onto base maps, creating theme maps that help boost sophistication of civil service.
4	Provide geospatial information to private sector companies in order to help create and develop new businesses	1) Register geospatial information created and possessed by private sector companies, and build delivery platform (showcase) for information. 2) Develop Web applications and mobile applications using fundamental geospatial information. 3) Process and analyze various types of data, including position information, and create new data solutions businesses.
5	Maintain confidentiality and reliability of information, and provide information in safe and appropriate manner	1) Perform operation in stable and continuous manner according to Bangladesh ICT system guidelines. 2) Control access by means of user authentication for information with a high level of confidentiality or sensitivity, preventing fraudulent usage.

Source: The Project Team

9.3 Overview of NSDI platform

An overview of NSDI platform is provided in this section.

9.3.1 System target areas (proposed)

NSDI Platform will distribute fundamental geospatial information that is the benchmark for locations, allow users to superimpose various geospatial information that they possess, and provide a mechanism that enables shared usage (sharing of geospatial information). An image of system usage is shown in Figure 9.3.1, and the system target area (proposed) is shown in Table 9.3.1.

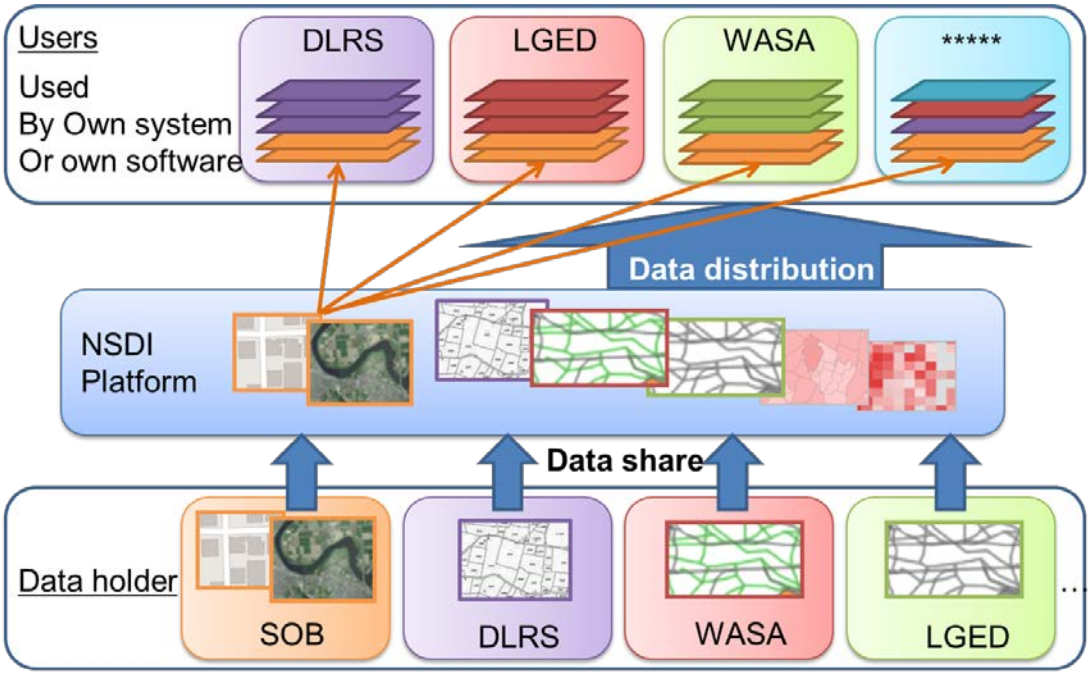


Figure 9.3.1 Image for NSDI platform system usage by related organizations

Source: The Project Team

Table 9.3.1 NSDI Platform target areas (proposed)

Item		Overview
Target Operation	Data Store	Accumulate fundamental geospatial information and various geospatial information. Search for registered geospatial information with desired conditions.
	Data Browsing / Delivery	Use fundamental geospatial information and various geospatial information with a Web browser. Provide API to enable use of background map created with fundamental geospatial information with external Web service. Provide download capability on the Web in a format that that be reused by users.
	Data Processing	Use address dictionary with geo-processing function to enable geocoding, coordinate conversion and space retrieval operations.
	Data Management	Register, update and delete geospatial information. Perform access privilege setting, publish setting and generation control for registered information.
	User Management	Manage system administrators, data administrators and registered system

Item		Overview
		users (register, update and delete users, and set privileges).
	System Management	Manage system to facilitate stable and continuous operation of NSDI Platform.
	Verification Test	Verify with test environment before production delivery system is published by performing updating and other work for base map.
Target Persons	System Administrators	Members who manage overall NSDI platform system.
	Government Agencies (Data Administrators)	Members who belong to Bangladesh Government agencies, possess geospatial information, and use NSDI Platform to publish data.
	Government Agencies (Users)	Members who belong to Bangladesh Government agencies, and use NSDI platform to access geospatial information.
	Publish Users	Persons at private sector companies, universities and members of general public who possess geospatial information and use NSDI platform to publish this information.
	Registered Users	Members who use NSDI platform to create “My-Maps”, use geo-processing, download data and purchase paid-for data.
	General Users	Members of general public who search for and display data registered on NSDI platform with a Web browser.
Excluded Target Operations	Base Map Development /Updating Work	Existing SOB resources will be utilized for base map development and updating work.
	Geospatial Information Development by Related Agencies	Existing resources possessed by each agency will be utilized for geospatial information development by related agencies.
	Charge Work (Online Payment)	An external online payment service will be utilized in order to reduce the security risk for the charging system for paid-for data purchases.

Source: The Project Team

9.3.2 System configuration (proposed)

The system configuration (proposed) for the overall NSDI platform is shown in Figure. 9.3.2.

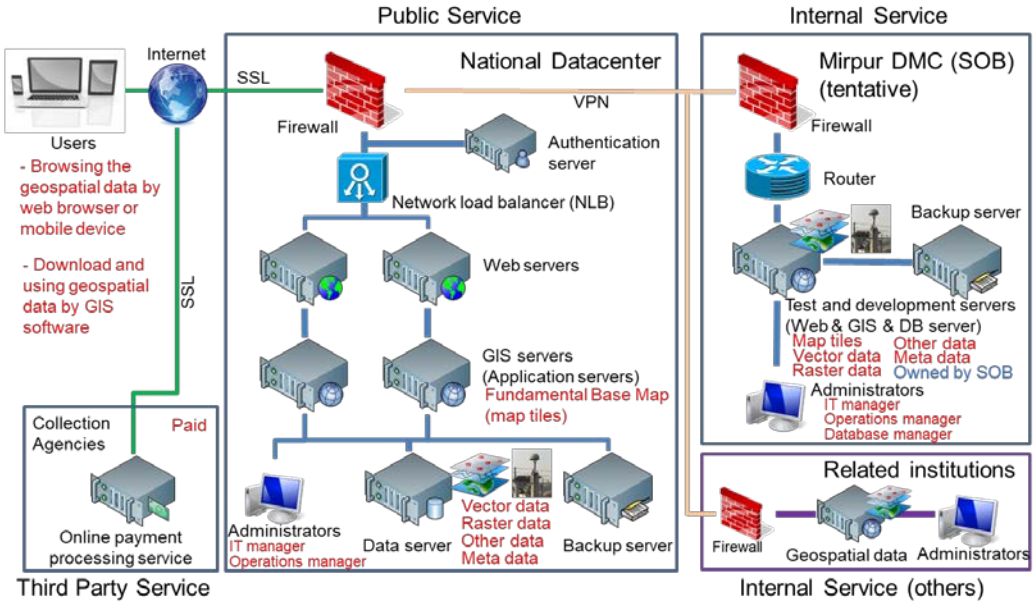


Figure. 9.3.2 NSDI platform system configuration (proposed)

Source: The Project Team

In consideration of ICT guidelines and operational issues, the system used to distribute base maps and various geospatial information will be located at the National Datacenter that is managed by BCC, and users will access the system over the internet.

The system administrators at the National Datacenter will perform monitoring to determine whether or not the overall delivery system is being properly operated.

Updating of fundamental geospatial information and development of various geospatial information possessed by SOB will be performed on a dedicated server in the Datacenter within SOB, and verification will be performed with a test environment before the production environment is published.

The data operation administrators will retain access privileges to the delivery server for updating of fundamental geospatial information.

The system administrators at SOB will perform monitoring as to whether or not the fundamental geospatial information updating system is being properly operated.

Data operations managers who use NSDI platform to publish geospatial information possessed by related institutions retain the privileges for access to the delivery system for data registration and data management.

Users access the delivery system over the internet, and use a Web browser to view published fundamental geospatial information and various geospatial information.

In addition, data can be downloaded from a server in a format allowing secondary usage in order to facilitate use of GIS and other software.

An external online payment service will be utilized in order to reduce the security risk for the charging system for downloading of paid-for data, geocoding functions and other such services.

In order to maintain the stability and availability of the system, redundancy will be provided for the Web servers and GIS servers, and the data will be periodically backed up with a backup server.

9.3.3 Hardware configuration (proposed)

The required hardware configuration (proposed) in order to operate NSDI platform is shown in Table 9.3.2 and Table 9.3.3.

The hardware configuration (proposed) located within the National Datacenter is shown in Table 9.3.2, and the hardware configuration (proposed) located within DMS of SOB at Mirpur is shown in Table 9.3.3.

Server racks to store the servers, network devices, cables, power source equipment and air conditioning systems will be required in addition to the items shown in the configuration.

Table 9.3.2 NSDI platform hardware configuration (proposed) (at National Datacenter)

	Web server	GIS server	Data server	Backup server	Authentication server	Storage	Operations client
CPU	Intel® Xeon® E5-2630 v4 2.2GHz x2	Intel® Xeon® E5-2630 v4 2.2GHz x2	Intel® Xeon® E5-2630 v4 2.2GHz x2	Intel® Xeon® E5-2630 v4 2.2GHz x2	Intel® Xeon® E5-2630 v4 2.2GHz x2	Intel® Xeon® E5-2630 v3 2.4GHz	Intel® Xeon® E5-1620 v4 3.5GHz
Memory	32GB RDIMM x2	32GB RDIMM x4	32GB RDIMM x4	32GB RDIMM x4	32GB RDIMM x2	128GB RDIMM	4GB DDR4 RDIMM x4
Hard Drive	600GB 15K RPM SAS 12Gbps 2.5in x 4	1TB 10K RPM SAS 12Gbps 2.5in x 4	1TB 10K RPM SAS 12Gbps 2.5in x 4	1TB 10K RPM SAS 12Gbps 2.5in x 4	600GB 10K RPM SAS 12Gbps 2.5in x 4	1TB 15K RPM SAS 12Gbps 2.5in x 30	1TB 7.2K RPM SATA HDD 3.5in x 1
RAID	RAID 10	RAID 10	RAID 10	RAID 10	RAID 10	RAID 10	-
Network	1Gb x2	1Gb x2	1Gb	1Gb x2	1Gb x2	FC	1Gb
Other	DVD-ROM	DVD-ROM GPU	DVD-ROM	DVD-ROM	DVD-ROM	DVD-ROM	DVD-ROM Keyboard Mouse Display
OS	Linux	Linux	Linux	Linux	Linux	Storage OS	Linux or Windows
Warranty	7 Year 4Hr On-site Service	7 Year 4Hr On-site Service	7 Year 4Hr On-site Service	7 Year 4Hr On-site Service	7 Year 4Hr On-site Service	7 Year 4Hr On-site Service	5 Year Next Business Day On-site Service
Size	2U	2U	2U	2U	1U	3U	Tower
Quantity	2 more	2 more	1	1	2 more	4 more	1

Source: The Project Team

Table 9.3.3 NSDI platform hardware configuration (proposed) (at SOB Mirpur DMC)

	Test & Development server	Backup server	Operations client	Database client
CPU	Intel® Xeon® E5-2630 v4 2.2GHz x2	Intel® Xeon® E5-2630 v4 2.2GHz x2	Intel® Xeon® E5-1620 v4 3.5GHz	Intel® Xeon® E5-2640 v4 3.4GHz
Memory	32GB RDIMM x4	32GB RDIMM x2	4GB DDR4 RDIMM x4	8GB DDR4 RDIMM x4
Hard Drive	600GB 15K RPM SAS 12Gbps 2.5in x 6	1TB 10K RPM SAS 12Gbps 2.5in x 4	1TB 7.2K RPM SATA HDD 3.5in x 1	1.2TB 10K RPM SAS 12Gbps 2.5in x 4
RAID	RAID 10	RAID 10	-	-
Network	1Gb x2	1Gb x2	1Gb	1Gb x2
Other	DVD-ROM GPU	DVD-ROM	DVD-ROM Keyboard Mouse Display	DVD-ROM Keyboard Mouse Display
OS	Linux	Linux	Linux or Windows	Windows
Warranty	7 Year 4Hr On-site Service	7 Year 4Hr On-site Service	5 Year Next Business Day On-site Service	5 Year Next Business Day On-site Service
Size	2U	2U	Tower	Tower
Quantity	1	1	1	3

Source: The Project Team

9.3.4 Network configuration (proposed)

The NSDI platform network configuration (proposed) is shown in Figure 9.3.3.

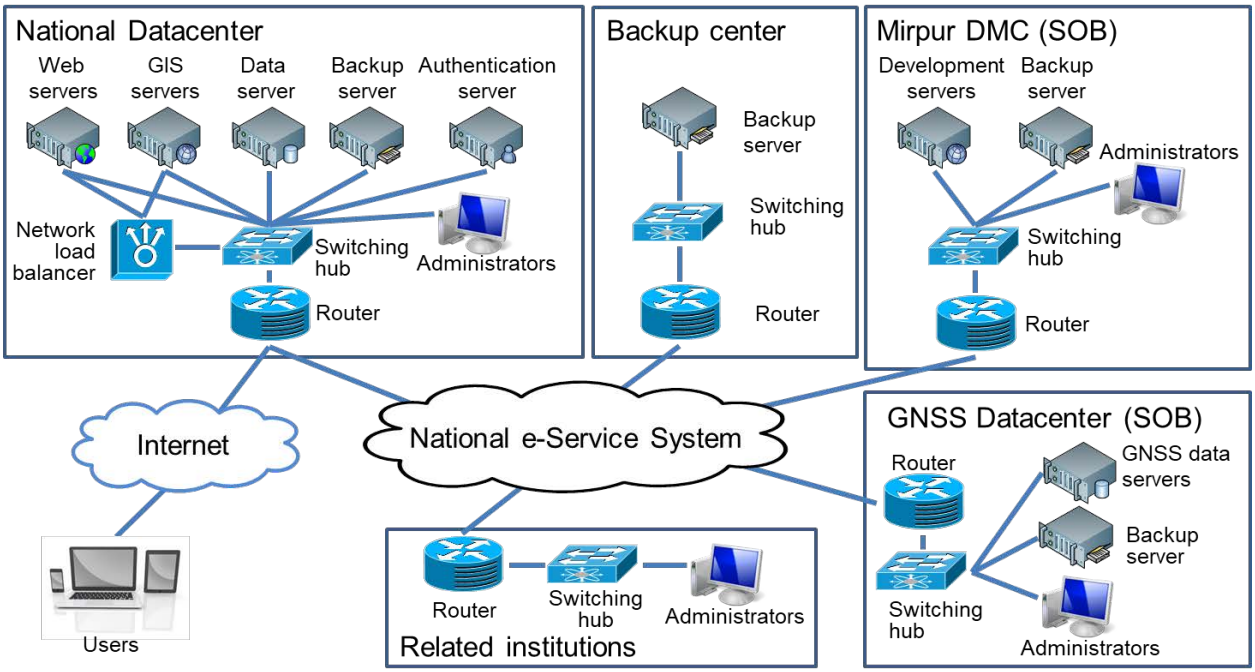


Figure 9.3.3 NSDI platform network configuration (proposed)

Source: The Project Team

Web servers, GIS servers, a data server, backup server and authentication server will be installed at the National Datacenter which will serve as the delivery system which will be the backbone of

NSDI platform, and a network load balancer will be installed in order to disperse the access load from users.

A mechanism will be built to evacuate backup data to a separate location from the National Datacenter to prevent loss of data due to a disaster or system failure.

A development verification server and backup server will be installed at the Mirpur Digital Mapping Center of SOB for the creation, updating and management of fundamental geospatial information and various geospatial information distributed with NSDI Platform.

A GNSS data server will be installed at the GNSS Datacenter of SOB in order to consolidate the observation data for the respective CORSs.

The National e-Service System (NESS) which is being developed by the Government of Bangladesh will be used to access the National Datacenter from the Mirpur Datacenter of SOB, GNSS Datacenter, related institutions and to perform remote backup.

Users will utilize an access system for the Web server at the National Datacenter over the internet.

9.3.5 Software configuration (proposed)

The software configuration (proposed) for NSDI platform is shown in Figure 9.3.4 and Figure 9.3.5. The software configuration at the National Datacenter is shown in Figure 9.3.4, and the software configuration at the Mirpur DMC of SOB is shown in 9.3.5.

Open source software will be used on the servers as a basic rule in order to reduce running costs for software involved with system operation.

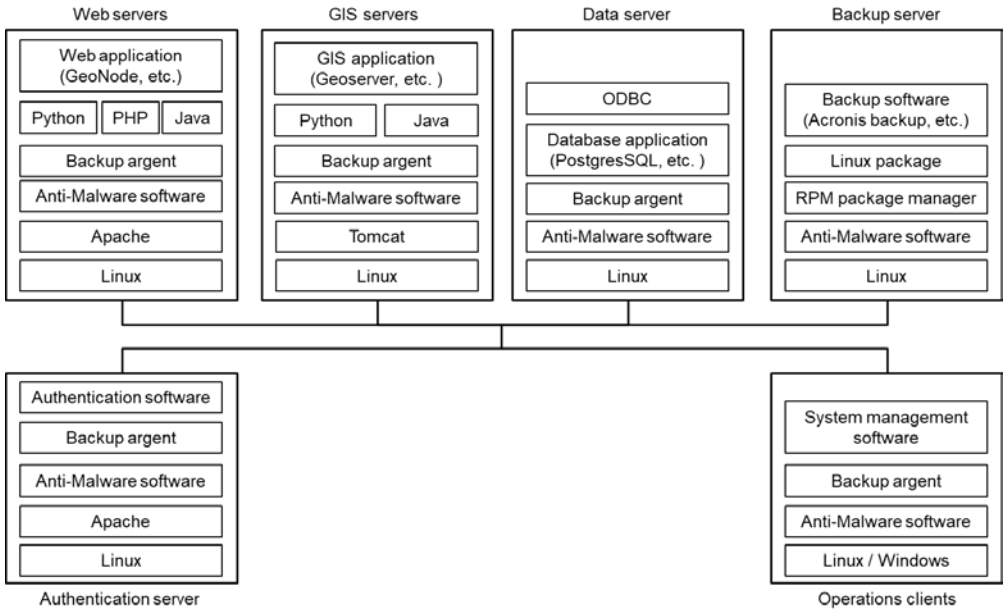


Figure 9.3.4 NSDI platform software configuration (proposed) (at National Datacenter)

Source: The Project Team

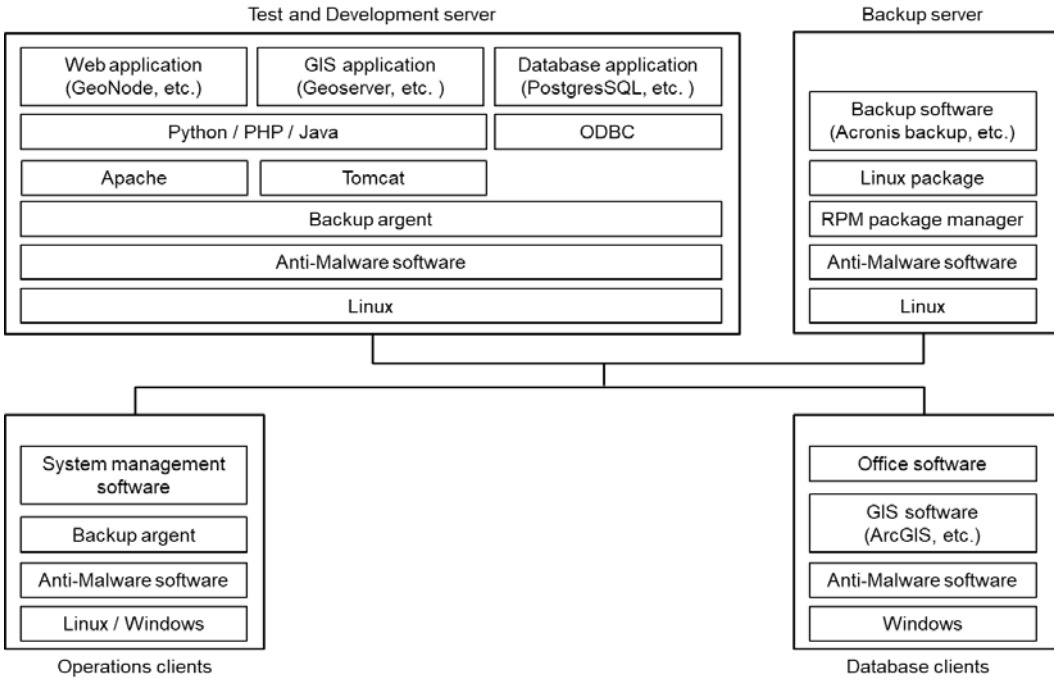


Figure 9.3.5 NSDI platform software configuration (proposed) (at SOB Mirpur DMC)

Source: The Project Team

9.4 Work flow after construction of NSDI platform (proposed)

The work flow after construction of NSDI platform (proposed) is described in this section.

9.4.1 Basic concept for work flow after construction of NSDI platform (proposed)

The work flow after construction of NSDI platform will be organized from both the perspective of the information provider and perspective of users.

The main work flow on the information provider side will be “updating of fundamental geospatial information”, “publishing of geospatial information”, “publishing of observation data for CORSs” by SOB, and “publishing of geospatial information” by related institutions.

The main work flow on the user side will be “user registration”, “downloading of geospatial information”, and “use of geo-processing function".

9.4.2 Work flow on information provider side (proposed)

The work flow on the information provider side (proposed) is described in this section.

1) Work flow for updating of fundamental geospatial information by SOB (proposed)

The work to update the fundamental geospatial information for delivery by SOB is shown in Figure 9.4.1.

The persons in charge of updating fundamental geospatial information store the updated fundamental geospatial information on the verification server, and the data manager verifies that the updated results have been properly processed.

After data verification, the updated data is uploaded to a temporary area, and the data manager confirms that all update target data has been stored.

The update target range of data is backed up after approval by the data manager, and the updated data stored in the temporary area is transferred to the production environment and published.

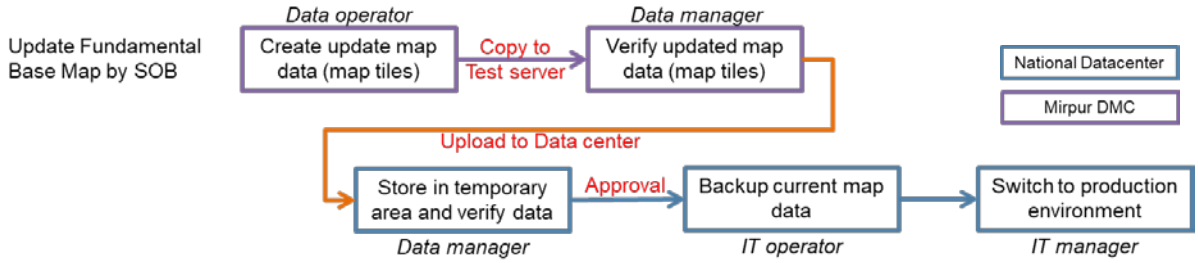


Figure 9.4.1 Flow of delivery base map updating

Source: The Project Team

2) Work flow for publishing of various geospatial information by SOB (proposed)

The work flow for publishing of the existing topographic maps, aerial photos and other archive data, as well as various geospatial information under the jurisdiction of SOB, is shown in Figure 9.4.2.

The persons in charge of creating data (data operators) create geospatial information that is to be published on NSDI platform, and store it on the test server. The data manager verifies the data to be published, and uploads the data to the temporary area at the National Datacenter after verification.

After uploading, the data operator that created the data registers the meta data in the system, the data manager verifies the data, and the data is published after approval.

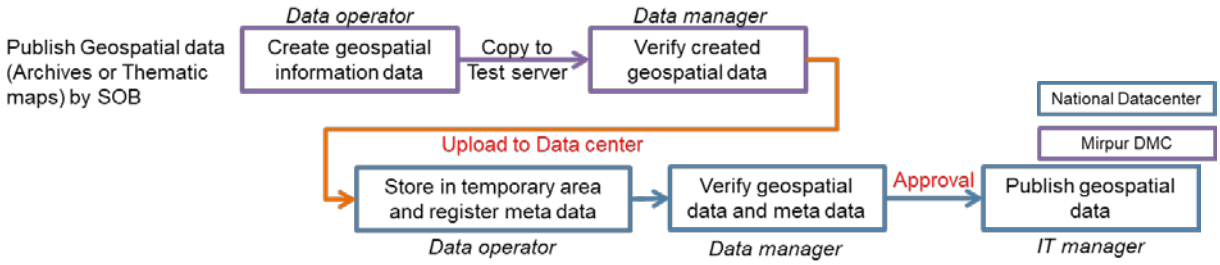


Figure 9.4.2 Flow of publishing of geospatial information under jurisdiction of SOB

Source: The Project Team

3) Work flow for publishing of CORSs observation data by SOB (proposed)

The data flow when CORSs observation data is distributed on NSDI platform is shown in Figure 9.4.3.

The data observed at CORSs is stored on the server at the GNSS datacenter, observation data for delivery is sampled (every 30 seconds), and is converted into RINEX format.

After conversion, the data is uploaded to the National Datacenter and published. All processes are automatically performed by the program.

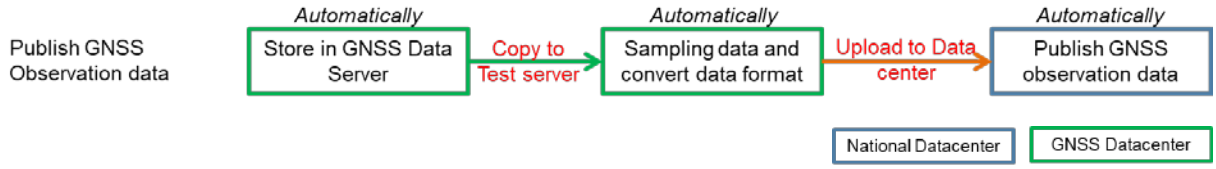


Figure 9.4.3 Flow of CORSs observation data for delivery on NSDI platform

Source: The Project Team

4) Work flow for publishing of geospatial information by related institutions (proposed)

The work flow for publishing of geospatial information possessed by related institutions is shown in Figure 9.4.4.

The persons in charge of creating data (data operators) at each related institution create geospatial information that is to be published on NSDI platform.

The data manager verifies the data to be published, and uploads the data to the temporary area at the National Datacenter after verification.

After uploading, the data operator that created the data registers the meta data in the system, the data manager verifies the data, and the data is published after approval. When data is updated, the

person in charge of system operation backs up the existing data before publishing.

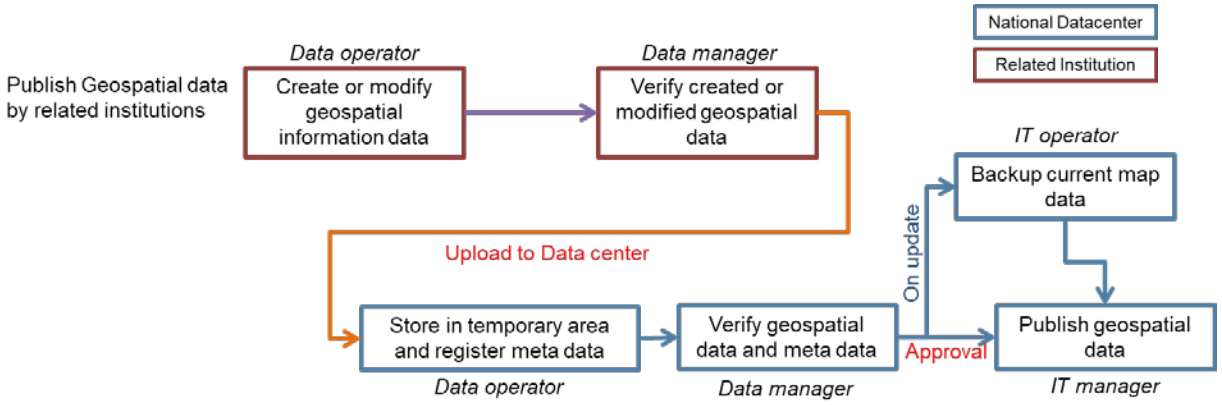


Figure 9.4.4 Flow for publishing of geospatial information by related institutions

Source: The Project Team

9.4.3 Work flow on user side (proposed)

The work flow on the user side (proposed) is described in this section.

1) Work flow for user registration (proposed)

The flow of user registration that is performed to allow usage of data downloading, geo-reference and other functions on NSDI platform is shown in Figure 9.4.5.

Users who wish to use the data downloading and geo-reference functions on NSDI platform enter user information on the User Registration screen on NSDI website in order to apply for registration.

The user is tentatively registered in the system after the application for registration is made, and a formal registration URL (web address) is sent to the e-mail address entered on the User Registration screen. The user accesses the URL (website) from NSDI website to perform formal registration.

Furthermore, it shall be possible to search for and display data on NSDI platform without performing user registration.

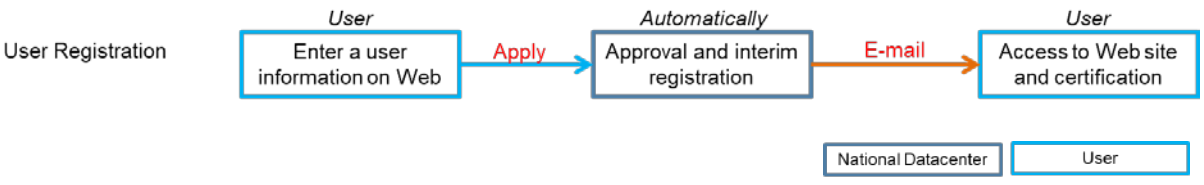


Figure 9.4.5 Flow of user registration

Source: The Project Team

2) Work flow for downloading of geospatial information (proposed)

The flow for downloading of geospatial information from NSDI platform that is allowed for users is described in Figure 9.4.6.

Users access NSDI website and search for registered geospatial information. NSDI website displays the search results on the screen.

When a user executes the download function, the website verifies whether or not the user is registered.

The screen changes to the User Registration screen if the user is not registered. The screen returns to the search result screen after completion of user registration.

After user registration is completed, downloading is executed if the data is free.

When there is a charge for the data (paid-for data), the data to be downloaded is selected, and the screen changes to the online payment service website after the amount is confirmed, and payment is made online.

Downloading is executed after payment is made. Furthermore, NSDI Platform does not retain authentication information concerning online payment.

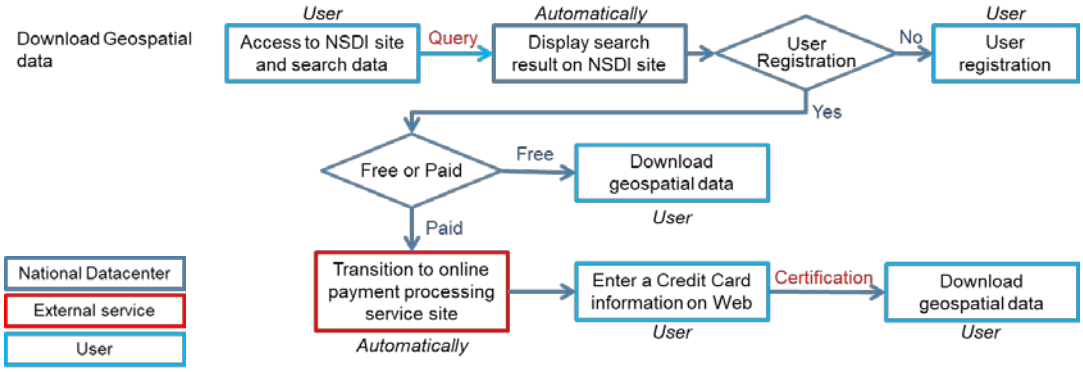


Figure 9.4.6 Flow of data downloading

Source: The Project Team

3) Work flow for geocoding process (proposed)

The work flow for geocoding using the address dictionary which is one type of geo-processing function is shown in Figure 9.4.7.

The user prepares a ledger (data) that includes the address(es), accesses NSDI website, and executes the geocoding function. Confirmation of whether or not the user is registered is performed when the function is executed.

The screen changes to the User Registration screen if the user is not registered.

The prepared data is uploaded to NSDI website after user registration, and geocoding is performed. The number of read items, matching items and other geocoding process results are displayed on the screen, and the user judges the process results.

When there is a problem with the process results, the data is corrected or other data is prepared, and the results are discarded.

When the process results are accepted, the geocoding charge is confirmed on the screen, the screen changes to the online payment service website, and online payment is made.

After payment, the user can use the process results on the Web map or download the data in a format with coordinates.

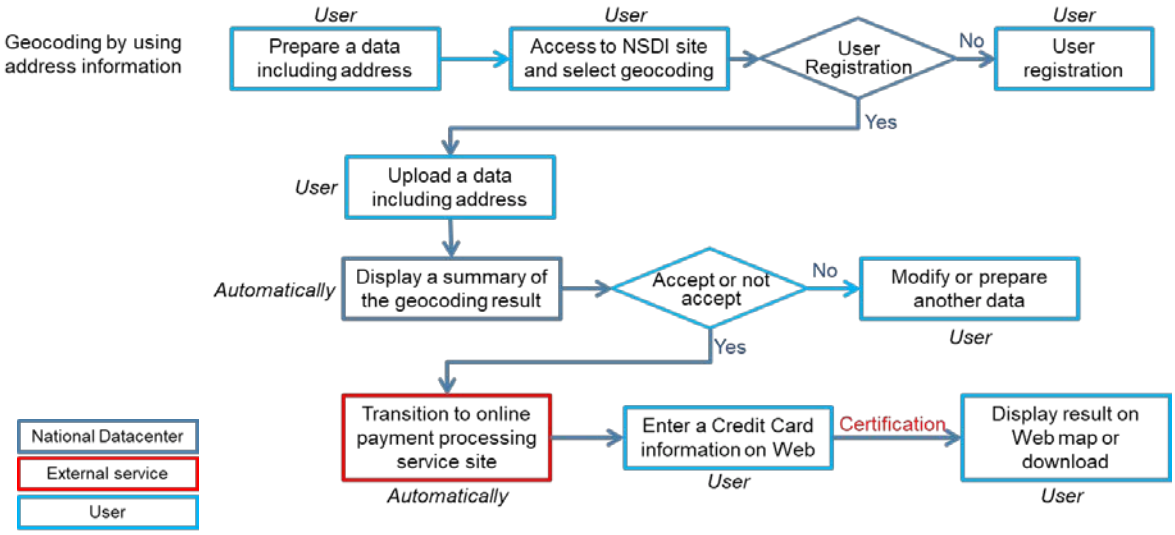


Figure 9.4.7 Flow of geocoding process

Source: The Project Team

9.5 NSDI Platform functions (proposed)

NSDI platform functions (proposed) are described in this section.

9.5.1 NSDI platform function configuration (proposed)

The function configuration (proposed) that can be used on NSDI platform is shown in Figure 9.5.1.

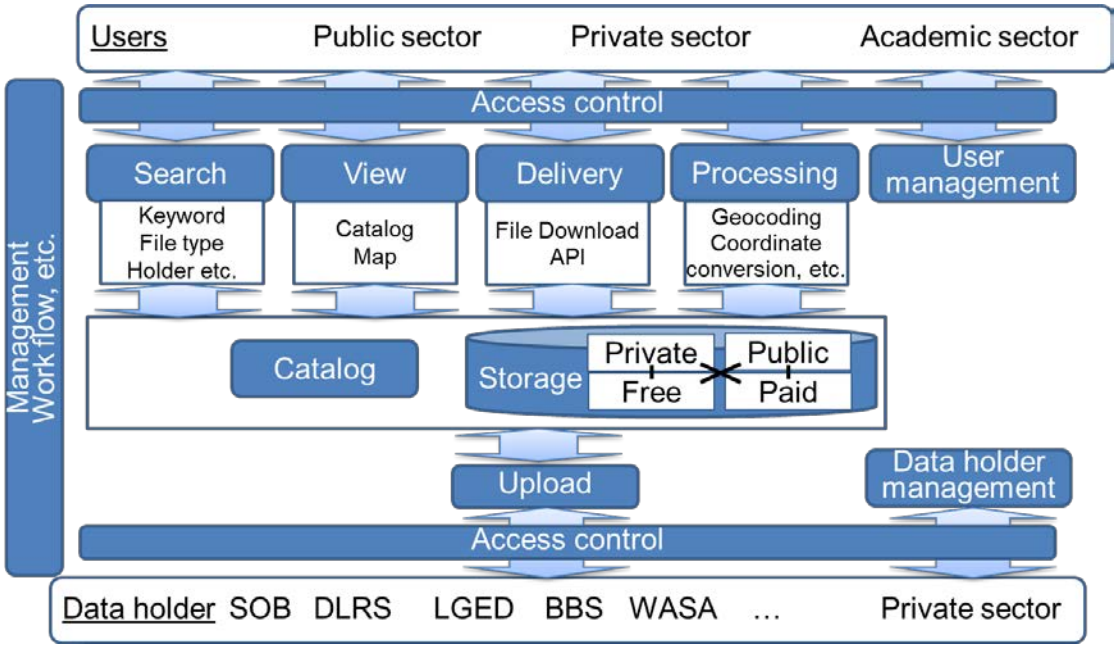


Figure 9.5.1 NSDI platform function configuration (proposed)

Source: The Project Team

The functions that are provided to government institutions, private sector companies, including general users and academic institutions consist of Search, View, Delivery, Geo-processing and User Management. The functions that can be used by users depend upon user privileges and data limitations.

Functions on the Data Holder side consist of functions concerning uploading of data to NSDI platform and data management.

9.5.2 List of NSDI platform functions (proposed)

The functions required for NSDI platform are divided into data provision, data use and system management in Table 9.5.1.

The target year for the 1st stage shall be fiscal 2020, during which the fundamental NSDI platform functions will be built.

Functions to promote utilization of geospatial information and reduce administrator load will be built by fiscal 2025 during the 2nd stage, taking the operational status during the 1st stage into consideration.

Geo-processing functions and paid-for data delivery functions will be developed after fiscal 2026 during the 3rd stage, taking into consideration the operation results until the 2nd stage and changes in the ICT environment.

Table 9.5.1 List of NSDI platform main functions

Class	Item	Function Name	Function Overview	Build Stage
Data Provision	Data Registration	Fundamental geospatial information registration (Map Tiles)	• Function to register fundamental geospatial information (Map Tiles) under jurisdiction of SOB (including meta data)	1st Stage
		Geospatial information registration	• Function to register geospatial information (existing maps, aerial photos and other archives) under jurisdiction of SOB (including meta data) • Function to register geospatial information under jurisdiction of related institutions (including meta data)	
		Fundamental geospatial information info registration (Shape, etc.)	• Function to register fundamental geospatial information (Shape, Geodatabase, Tiff format etc.) under jurisdiction of SOB (including meta data)	2nd Stage
		GNSS observation data acquisition	• Function that enables GNSS Datacenter to acquire CORS observation data	
	Data Updating	Updating (Overwrite)	• Function to allow overwrite updating of registered fundamental geospatial information and geospatial information	1st Stage
		Updating (History)	• Function to retain history and update registered fundamental geospatial information and geospatial information	2nd Stage
		Updating (Auto Processing)	• Auto processing of fundamental geospatial information updating at specified time/date	3rd Stage
	Data Deletion	Deletion	• Function to delete registered data	1st Stage
	Data Management	Access Privilege Setting	• Function to set access privileges for registered geospatial information	1st Stage
		Info View Setting (Layer)	• Function to set info viewing of registered geospatial information in layer unit	1st Stage
		Info View Item Setting	• Function to set info viewing of registered geospatial information in item unit	1st Stage
Data Use	Search	Search All	• Function to search for geospatial information with desired character string	1st Stage
		Condition Specify Search	• Function to search for geospatial information by specifying registered institution name or type	
		Meta Data Display	• Function to display meta data for found geospatial information	
		Search Result Layer	• Function to display found geospatial information on Web map	
		Condition Search	• Function to search, select and display with desired conditions on Web map	
		Save Search Results	• Function to search Web map with desired conditions and register search results on “My Map”	2nd Stage
		Address Search	• Function to search for address based on address dictionary and move display position on Web map	
		Buffer Search	• Function to extract other geospatial information included in range determined by buffer search	
	Display	Fundamental geospatial information Display (Map Tiles)	• Function to display fundamental geospatial information (Map Tiles) on Web map	1st Stage
		Overlay	• Function to perform overlay display of registered geospatial information on fundamental geospatial information	
		Attribute Display	• Function to select feature on Web map and display attributes	

Class	Item	Function Name	Function Overview	Build Stage
		Range Specify Search	• Function to specify range (box, polygon, and circle) on Web map and display attributes of feature	
		Attribute List Display	• Function to display attribute info list for registered geospatial information	
		Print (PDF)	• Function to output content displayed on Web map in PDF format	
	My Map Creation	Map Creation	• Function to enable geospatial information published by registered user to be overlaid as desired and saved as My Map	1st Stage
		Plotting Layer	• Function to enable registered user to create layer that can be plotted as desired to which data can be freely added	2nd Stage
		Plotting Layer Publish Setting	• Function to enable user to make publish or non-publish setting for plotted layer	
		Data Read	• Read function on Web map for geospatial information (Shape, KML, CSV, etc.) possessed by registered user	3rd Stage
	Delivery	API Delivery	• Function to deliver fundamental geospatial information with API.	2nd Stage
		Download (Free)	• Function to download registered free geospatial information in format that allows secondary usage	
		Download (Paid)	• Function to download registered paid-for geospatial information in format that allows secondary usage	3rd Stage
	Analysis	Geocoding	• Function to upload registered user list with addresses and use address dictionary to expand to Web map	3rd Stage
		Coordinate Conversion	• Function to convert geospatial information possessed by registered user to another coordinates system	
		Space Analysis	• Function to space search for multiple layer targets	
System Management	User Registration	Initial Registration	• Function to issue desired ID and password to user, and perform initial registration with e-mail address	1st Stage
		Initial Authentication	• Function to send authentication URL to registered e-mail address after initial registration and change to authentication website to allow formal registration	
		Login	• Function to allow registered users to log into system	
		Modify Registration	• Function to allow registered users to change registered personal information and password	
	Access Management	Dashboard Display	• Function to display data registration status and user registration status as a dashboard	1st Stage
		User Counting	• Function to count number of registered users and usage status	
		Data Counting	• Function to count number of registered data items and number of views	
		Map List	• Function to display list of My Map created content by registered users	2nd Stage
		Map Counting	• Function to count number of My Maps created with registered data	
		Download Counting	• Function to count number of downloads of geospatial information	
		Analyze Process Counting	• Function to count number of geocoding, coordinate conversion and other analyze process events	3rd Stage
	History Management	History Display	• Function to display info on data updating and other history	2nd Stage
	Charging	Online Payment Service Link	• Function to provide link to online payment service website when paid-for data is purchased	3rd Stage

Source: The Project Team

9.6 Overview of NSDI platform (proposed)

Various types of geospatial information that is possessed by related institutions and registered users can be uploaded and handled on NSDI platform in addition to the shared fundamental geospatial information. A list of the main data that is current envisioned is shown in Table 9.6.1.

The types of data include fundamental geospatial information and control points under the jurisdiction of SOB, data concerning the existing maps (archive information) and data possessed by related institutions for which shared usage on NSDI platform is desired or uploaded by registered users.

The data is stored in the optimum format according to the data usage objective, such as Map Tile format for delivery of background maps on Web maps, or download vector format (photos or raster format) for information search and viewing.

The approximate calculated values for the data size of current data per sheet and per point should be treated as reference values, and will need to be reviewed again when the system is actually built.

Table 9.6.1 List of main data handled on NSDI platform

Class	Data	Type	Data Capacity (GB)	Update Interval	Remarks
Fundamental geospatial information	Topographic map (1:25,000 scale)	Map tiles	750	10 years more	Map tiles data, Zoom level =18, PNG format, 998 sheets
	Topographic map (1:5,000 scale)	Map tiles	500	7 years more	Map tiles data, Zoom level =18, PNG format, 998 sheets
	Topographic map (1:25,000 scale)	Vector	100	10 years more	Shape or File geodatabase format, For download service
	Topographic map (1:5,000 scale)	Vector	100	7 years more	Shape or File geodatabase format, For download service
	Orthophoto (2012: 50cm)	Map tiles	4,700	-	Map tiles data, Zoom level =18, PNG format, 998 sheets
	Orthophoto (2012: 50cm)	Tiff	350	-	TIFF (TFW) format, For download service
	DEM	Map tiles	1,000	10 years more	Map tiles data, Zoom level =18, PNG format
	DEM	Text	500	10 years more	Digital elevation model
	Orthophoto (20xx: 20cm)	Map tiles	5,000	-	Dhaka area for updating large scale topographic map
	Orthophoto (20xx: 20cm)	Tiff	1,000	-	Dhaka area for updating large scale topographic map
GCP	GCP index	Vector	0.1	1 year	Coordinate information (X, Y, Z), Bench mark, 3D control point, 2D control point.
	GNSS observation data	Text		Daily	RINEX format (30 sec interval)
Other	Address information	Text	1	1 year	For geocoding
	Existing map	Raster	10	-	Old map, paper map, etc.
	Aerial photo	Raster	1,000	-	Historical aerial photo, JPEG format
Thematic	Hazard map, road	Vector	1,000	1 year	Owned by related institutions

Class	Data	Type	Data Capacity (GB)	Update Interval	Remarks
map	map, facility map, etc.			more	
User map			1,000	often	
Total			17,120.1	-	=16.7TB

Source: The Project Team

9.7 NSDI platform non-functional requirements (proposed)

The non-functional requirements for NSDI platform are shown in Table 9.7.1.

Table 9.7.1 NSDI Platform non-functional requirements

Class	Item	Requirement
Availability	Service Time	Since the geospatial information provided on NSDI platform is mainly online service for external users, the premise will be operational 24 hours a day 365 days a year. However, this excludes planned suspension of operation for device maintenance and other such purposes.
	Service Support	The service support time shall be 9:30 - 16:30 on weekdays, and problems other than emergencies outside of this time frame or on holidays/weekends shall be dealt with on the next business day.
Performance	Simultaneous Traffic	It is envisioned that the number of simultaneous accesses (traffic) of NSDI platform will be 50.
Expandability	Business Processing Volume	The system shall be configured to allow expansion in anticipation of the expected increase in geospatial information stored on NSDI platform and heightening of the need for geospatial information for social activities. The performance target (response time) has not be set at the present time since the communication infrastructure environment has a high level of impact.
Operability	Operation Schedule	The operation schedule will be determined with the premise that NSDI platform is an online service for external users, but planned suspension of service for maintenance or other purposes will be handled by announcing suspension of service in advance.
Usability	User Interface	An interface will be created that allows users without advanced knowledge of geospatial information to search for information that they need. In addition, it shall be possible to use the system with a Web browser without installing specific software.
	Operation Manual	An operation manual for NSDI platform shall be published on the Website. Charts and tables which can be easily understood by novice users shall be used in the operation manual.
	Q & A	A list of Questions & Answers shall be compiled for NSDI platform and geospatial information for which many questions are received, and published on the website.

Source: The Project Team

9.8 NSDI Platform security measures (proposed)

In order to ensure stable operation of NSDI Platform, measures need to be formulated for both the information system and for the geospatial information loaded into the system.

Measures will be formulated according to the security requirements described by the Bangladesh National Enterprise Architecture compiled by the BCC for the information system.

The standards for access privileges and other such settings will be made for the individual information possessed by the respective institutions.

The main security standards for the information system are shown in Table 9.8.1.

Table 9.8.1 NSDI platform main security standards

Item	Security Standards
User Authentication	ID + Password
Communication Protocol	HTTPS communication
Data Integrity Assurance	Data backup Variable data shall be automatically backed up daily, and up to the 5th generation shall be kept. Backup data shall be stored in a remote location to ensure data is retained in the event of a disaster.
Data Recovery	Restored with data from previous backup
Malware Software Pattern File Updating Interval / Method	Automatically updated within 24 hours of release by vendor
OS / Middleware Security Batch Management	Batch test environment created within 3 days from vendor release, and batch test started.
Information Retention Period	5 years

Source: The Project Team

The access privileges for the main geospatial information loaded onto NSDI Platform for the respective types of users are organized in Table 9.8.2.

The types of access privileges consist of data viewing, API use data downloading and data updating, and the types of users consist of data holders, government institution users, registered general users and general users.

Table 9.8.2 List of access privileges to main geospatial information

Class	Data	Function	User			
			Provider	Government Institution	Allowed User	Other User
Fundamental geospatial information	Topographic map (1:25,000/1:5,000 scale)	View	○	○	○	○
		API	○	○	△	×
		Download	○	○	△	×
		Update	○	×	×	×
	Orthophoto	View	○	○	△	△
		API	○	○	△	×
		Download	○	○	△	×
		Update	○	×	×	×
	DEM	View	○	○	○	○
		Download	○	○	△	×

Class	Data	Function	User			
			Provider	Government Institution	Allowed User	Other User
		Update	○	×	×	×
GCP	GCP index	View	○	○	○	○
		Download	○	○	△	×
		Update	○	×	×	×
	GNSS observation data	Download	○	△	△	×
		Update	○	×	×	×
Other	Address information	View	○	○	○	○
		Geocoding	○	△	△	×
		Download	○	△	△	×
		Update	○	△	×	×
	Archive data (Existing map, Aerial photo, etc.)	View	○	○	○	○
		Download	○	○	△	×
		Update	○	×	×	×
Thematic maps	Hazard map, Road map, facility map, etc.	View	○	○	△	△
		Download	○	△	△	×
		Update	○	×	×	×
User maps	Created by authorized user	View	○	△	△	△
		Download	○	△	△	×
		Update	○	△	△	×

Legend: ○=Available △= Restrict ×= Not available

Source: The Project Team

9.9 NSDI platform construction schedule (proposed)

The overall construction schedule (proposed) for NSDI platform is shown in Fig.9.9.1.

The 1st stage shall be the second half of 2018 to the first half of 2021. The requirements for building of NSDI platform will be defined, taking into consideration the results of NSDI Pilot Project that is being implemented by June 2018, and system design and development will be performed. Test operation will be started from the second half of 2020, and full-scale operation will be started from the first half of 2021.

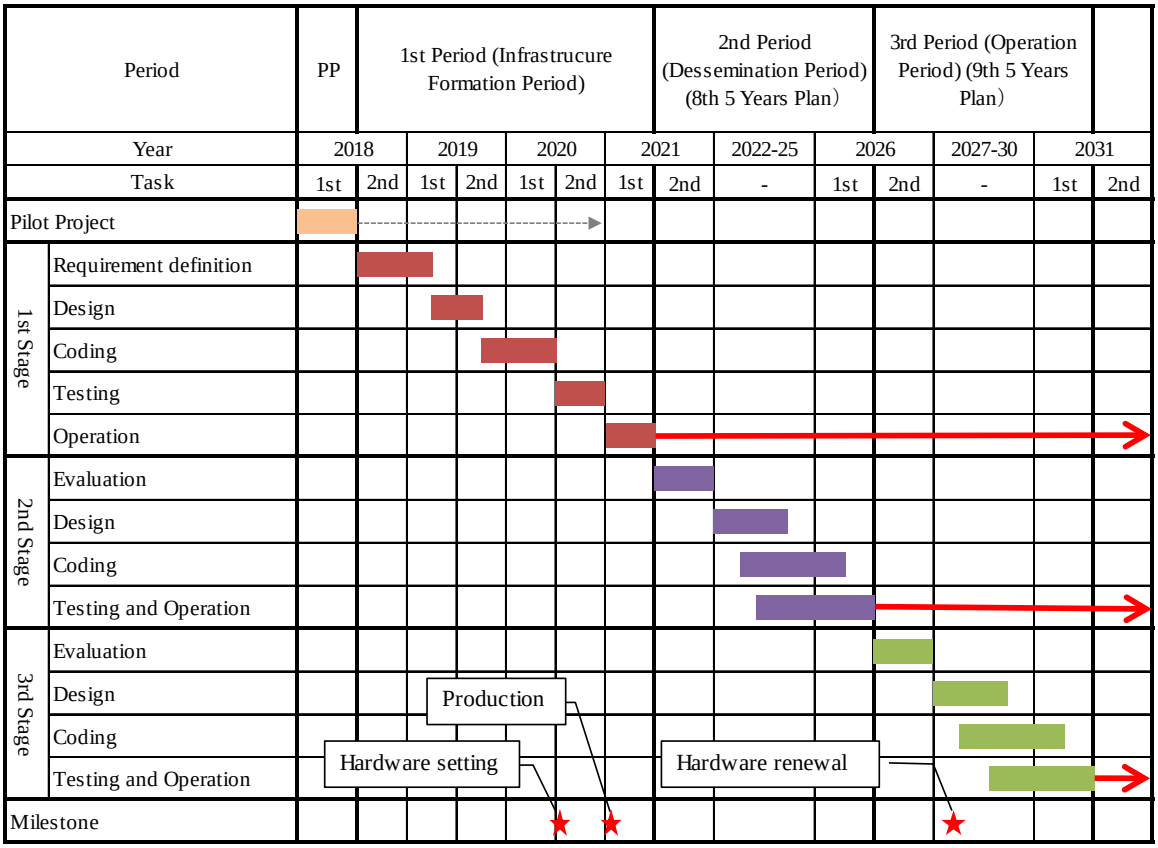
The 2nd stage shall be the second half of 2021 to the first half of 2026. Evaluation analysis of the operation status will be performed from the first half of 2021, and system modification and additional function development will be performed.

System modification will be performed first from items with a high level of importance. Regarding additional function development, the number of man-hours for development and effects after building will be reviewed, and priority will be assigned to determine the order in which work is performed.

The 3rd stage shall be the second half of 2026 to the first half of 2031. The required measures will be implemented, taking into consideration the operation status up to the 2nd stage.

In addition, updating of hardware introduced in the 1st stage will be performed in the second half of

2027 (using 7 years after initial introduction as a rough standard).



*PP: Preparation Period

Fig. 9.9.1 Overall schedule for construction of NSDI platform (proposed)

Source: The Project Team

Chapter 10 Cost and Effect of NSDI in Bangladesh

Chapter 10 Cost and Effect of NSDI in Bangladesh

The estimation of cost and effect of NSDI in Bangladesh is described as bellow.

10.1 Difference of cost and effect between ordinary infrastructure development project and NSDI

At the beginning, it is necessary to understand the difference between ordinary infrastructure development project and NSDI.

The ordinary infrastructure development projects such as highway construction, water supply, gas supply, electric supply, port and harbor development, airport development, etc., the users will pay usage fee (income) at the time of utilization of these infrastructures.

These income will be used for the extinguishment of the construction cost, annual maintenance and operation cost of these infrastructures.

Therefore, the cost and effect of ordinary infrastructure development project will be estimated based on the following two items.

a) Cost Initial investment cost
Maintenance & operation cost
Facility updating cost

b) Income Usage fee by users

However, concerning NSDI, in principle, the users of NSDI can use the information and data on NSDI without charge, except some portion of data. Therefore, it is considered that NSDI has no income or very small income from the users of NSDI.

In a general way, the amount of these kind of data does not include the original data preparation cost such as survey and mapping cost. The amount of these kind of data will be decided based on the cost necessary for printing, data duplication, distribution and so on.

For example, the retail price of 1:25,000 scale digital topographic map (printed map) of SOB is Taka150.-/sheet.

However, it is considered that the actual cost per sheet necessary for the production of 1:25,000 scale digital topographic maps such as aerial photography, ground control point survey, aerial triangulation, digital plotting and compilation and so on is more than several thousand times of this retail price.

The retail price of topographic maps published by Geospatial Information Institute of Japan also does not include the topographic mapping cost and decided by the printing and distribution costs

only.

The preparation of geospatial information data is considered as the fundamental service by the government such as national defence, maintenance of security, justice, diplomacy, preparation of statistic data and so on. The retail price of these kind of data is decided based on the duplication and distribution costs only.

Therefore, it is judged that the income of NSDI is almost as Zero or very small, and it is not impossible to cover the necessary cost for the construction, maintenance and operation of NSDI and data preparation and updating cost.

This is an ultimate difference between the ordinary infrastructure development projects and NSDI. The amount of usage fee by the users of NSDI could not be used for the estimation of effect of NSDI, and it is necessary to use another factor instead of the amount of usage fee by the users for the estimation of effect of NSDI.

Accordingly, for the estimation of cost and effect of NSDI, following two factors were used.

a) Cost — Initial investment cost of NSDI platform
Maintenance and operation cost
Updating cost of NSDI platform
Data preparation and updating cost

b) Effect — Cost reduction effect by the utilization of geospatial information data

10.2 Basic idea for the estimation of cost and effect of NSDI

As already described above, it is necessary to obtain the two values as necessary cost and cost reduction effect for the estimation of cost and effect of NSDI.

The necessary cost of NSDI consists of the following 4 items.

a) Initial investment cost of NSDI platform construction
b) Operation and maintenance of NSDI platform
c) Updating cost of NSDI platform
d) Preparation and updating of geospatial information data which are fundamental information on NSDI

Meanwhile, the cost reduction effect of NSDI can be considered by the following two ideas.

1) Cost reduction effect by mutual data utilization within one organization

Various type of information and data are prepared within one organization and stored and managed by each department individually.

Therefore, the cost reduction in various works of each department in one organization will be available by the utilization of the common data and information shown on the digital topographic maps.

However, the necessary data and information is different organization by organization. Therefore, the cost reduction effect have to be estimated individually, and the amount of cost reduction effect will become different organization by organization.

It will take a long time for the estimation of cost reduction effect of each organization, and it is considered that it is difficult to execute such survey during the short Project period.

Therefore, the estimation method for the cost reduction effect by the mutual utilization of information within one organization is described in this report.

However, this is the cost reduction effect by the mutual utilization of information within one organization, and not the cost reduction effect by the construction of NSDI.

2) Cost reduction effect from the viewpoint of all the country

Meanwhile, it is possible to estimate the cost and effect of NSDI from the view point of all the country.

The effect of NSDI will be estimated based on the cost reduction amount by the utilization of geospatial data on NSDI (mainly utilization for infrastructure development project) by the various organizations relating NSDI, mainly at each stage of utilization for infrastructure development project such as master plan, feasibility study, detail design and construction.

In general, the scale of topographic maps to be used for each stage of infrastructure development project and various study works are as follows:

a) Mater plan stage

Map scale to be used:	1:25,000 - 1:50,000 scale topographic maps 1:25,000 scale topographic maps on NSDI will be able to use for master plan.

b) Feasibility study stage

Map scale to be used:	1:5,000 - 1:10,000 scale topographic maps 1:5,000 scale topographic maps on NSDI will be able to use for feasibility study. However, 1:5,000 scale topographic maps have been prepared only at 6 major cities in Bangladesh. Therefore, it is necessary to prepare new topographic maps for feasibility study at other cities.

c) Detail design stage

Map scale to be used:	1:1,000 - 1:2,000 scale topographic maps It is necessary to prepare new topographic maps for detail design.

d) Construction stage

Map scale to be used:	1:500 - 1:1,000 scale topographic maps Generally, the topographic maps prepared at the detail design stage will be used at the construction stage. The main survey works at the construction stage are engineering survey (ground survey), not topographic mapping.

It is considered that the scale of geospatial information data (digital topographic maps), which will be opened on NSDI in most countries, may be 1:5,000 scale or smaller scale than 1:5,000 scale. Therefore, it is considered that these geospatial information data (digital topographic maps) can be used for master plan study and also feasibility study.

Meanwhile, the necessary scales of digital topographic maps for detail design and construction are more larger than 1:5,000 scale. Therefore, these scale of digital topographic maps for detail design and construction will be prepared project by project.

Based on the above-mentioned matters, the cost reduction effect by NSDI will be estimated from the following three points of view.

a) Difference of the digital topographic map preparation cost by one organization and by many organizations individually

b) Cost reduction by the effective utilization of digital topographic maps by many organizations of the government section

c) Cost reduction by the effective utilization of digital topographic maps by many organizations of private sector

The cost reduction effect of NSDI was calculated based on the above-mentioned method.

10.3 Estimation of cost and effect by mutual data utilization within one organization

The outline of cost and effect by mutual data utilization within one organization are as follows:

10.3.1 Basic idea for the estimation of cost reduction by mutual data utilization within one organization

Various information and data are prepared and managed by each departments or sections within one

organization.

In case that these information and data are plotted and arranged on the digital topographic maps for the mutual data utilization by all departments or sections within one organization, the cost reduction effect in various works within one organization will be available.

The cost reduction effect in this case, it is possible to classify as following three effects, quantitative effect, qualitative effect and synergic effect.

1) Quantitative effect

Quantitative effect has following four effects.

a) Shortening of confirmation time and document preparation
It is possible to reduce the time necessary for the document preparation, confirmation of locations, and so on by the digitalization and visualization of information and data of ledger or ledger sheet on digital topographic maps.

b) Reduction of duplicate works
It is possible to reduce the cost of each department or section by the elimination of similar works among the departments or sections within one organization.

c) Shortening of coordination time
It is possible to reduce the number of meeting time, and time for meeting among the departments or sections within one organization by showing the necessary information and data on one digital topographic maps.

d) Shortening of location map preparation time
It is possible to reduce the data preparation time by providing the geospatial information data possessed by each departments or sections within one organization.

2) Qualitative effect

Qualitative effect has following two effects.

a) Visualization effect
It is possible to grasp the situation or condition easily by showing the necessary information and data on one digital topographic maps.

b) Quality improvement effect
It is possible to find the lack and mistakes of data easily, and also it is possible to grasp the process of works by showing the necessary information and data on one digital topographic maps. Thus, quality improvement will be expected.

3) Synergic effect

Synergic effect is as follow:

a) Creation of new idea, project or business

10.3.2 Cost and effect estimation method by mutual data utilization within one organization

To estimate the cost reduction effect within one organization, it is necessary to set following pre-conditions for above-mentioned four items of quantitative effect.

a) Personnel cost of staff
b) Data format of ledger and ledger sheet (paper or digital data)
c) Data format of topographic maps possessed by each department (paper map or digital data)

For the mutual data utilization, it is necessary to calculated the following costs.

a) Initial investment cost
   - System construction cost
   - Cost for preparation of background maps
   - Cost for preparation of geographic dictionary

b) Maintenance and operation cost
   - Annual maintenance and operation cost
   - Geographic dictionary updating cost

Figure 10.3.1 shows that relation between the necessary cost for mutual data utilization and the cost reduction effect within one organization.

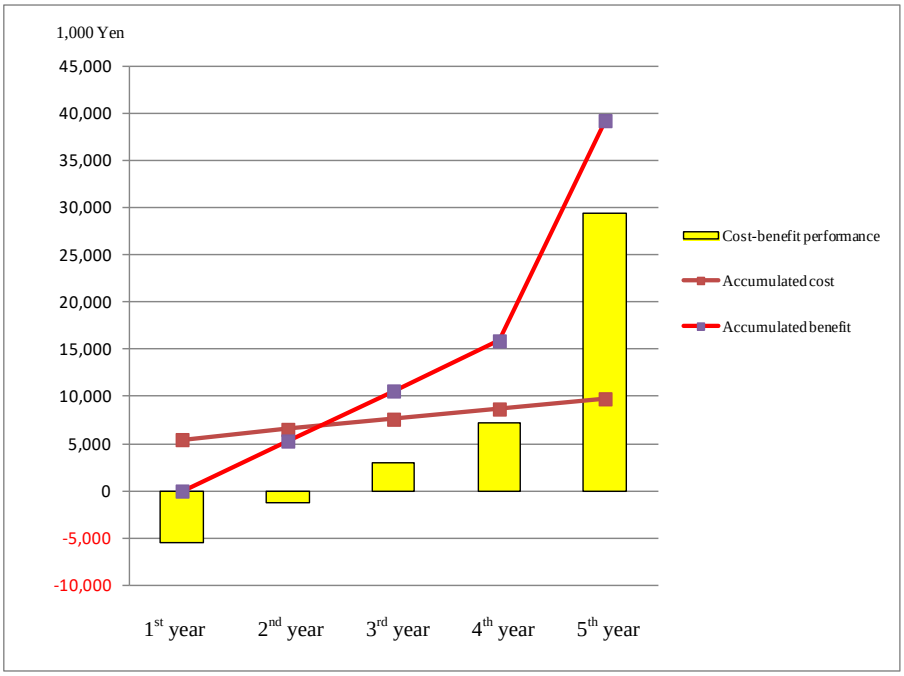


Figure 10.3.1 Cost reduction effect by the mutual data utilization within one organization

Source: Guide line for alignment between central and local governments, Ministry of Land, Infrastructure and Transportation, Japan

At the beginning, the necessary cost for mutual data utilization will exceeds the cost reduction effect. However, several years later, the cost reduction effect will exceed the necessary cost for mutual data utilization.

Qualitative effect and synergic effect do not included in the estimation of cost reduction shown in Figure 10.3.1. due to the difficulty for the estimation of these two effects.

In case that these two effects included in the estimation of cost reduction effect, the time when the cost reduction effect exceed the necessary cost for data mutual utilization will become faster.

10.4 Cost reduction effect from the viewpoint of all the country

The cost and effect of NSDI from the view point of whole country will be able to estimate by the following method.

10.4.1 Difference of digital topographic mapping cost executed by one organization and by respective organizations

The difference of digital topographic mapping cost executed by one organization as a package and by the respective organizations individually is described bellows.

1) Cost reduction of ordering party

For example, in case that 10 local governments prepare digital topographic maps covering their administrative areas individually, the staff of each local governments have to execute planning, cost estimation, tendering, contracting and so on individually for their own works. However, it is considered that these works are similar and duplicated works.

Furthermore, in case that the local government has no knowledge and experience of planning, cost estimation and so on, such works have to be executed by sub-contracting.

Considering above-mentioned points, the total cost of ordering parties will become different by the digital topographic mapping methods, that is digital topographic mapping by each local government individually or digital topographic mapping by one organization in a lot.

In case that the digital topographic maps was prepared by each local government individually, the digital topographic data along the boundary of digital topographic mapping area of each local government may have a discrepancy.

Accordingly, checking and adjustment of digital topographic data along the boundary of digital topographic mapping area of each organization have to be executed after completion of digital topographic mapping by each organization.

In case that the digital topographic maps were prepared by one organization in a lot, this discrepancy along the boundary will not be occurred.

Therefore, it is judged that checking and adjustment of digital topographic data along the boundary of digital topographic mapping area of each organization is an additional work.

The amount of cost reduction by the difference of digital mapping ordering method depends on the shape of the administrative boundary lines (digital topographic mapping area), mapping area and so on.

However, it is considered that the amount of cost reduction by the difference of digital mapping ordering method may be around several percentage of digital topographic mapping cost.

2) Cost reduction of responsible organization

The difference of the necessary cost of ordering parties for the preparation of digital topographic mapping by the difference of ordering method between 1) digital topographic mapping by local government individually and 2) Digital topographic mapping by one local government as a package.

a) Duplicate portion at planning and preparation

As a matter of course, the most planning and preparatory works for digital topographic

mapping are similar and duplicated.

Therefore, total cost of planning and preparatory works for digital topographic mapping can be reduced by the implementation by one organization.

It is considered that an approximately 1/3 - 1/5 (maximum) of the total cost of planning and preparatory works for digital topographic mapping can be reduced.

b) Duplicate area of aerial photography

An aerial photos have to cover the digital topographic mapping area to be able to execute stereoscopic observation.

Therefore, an aerial photography has to be execute to cover little bit outside of digital topographic mapping area.

According to this reason, the total aerial photography area by the order of individual organizations will be more than the total aerial photography area by one organization in one package.

The amount of cost reduction of aerial photography by the one package contract depends on the shape of aerial photography areas. However, it is considered that an approximately 30% (maximum) of total cost of aerial photography will be able to reduce.

c) Duplicate portion of ground control point survey

To execute aerial triangulation, ground control points will be established in around the digital topographic mapping area.

However, the ground control points locating around the boundary of adjacent digital topographic mapping area become duplicated in case of the order of individual organizations.

The amount of cost reduction by one organization in one package depends on the shape of digital topographic mapping. However, it is considered that an approximately 10 - 20% (maximum) of the total amount of ground control point survey may be reduced.

d) Duplicate portion of aerial triangulation

Same as aerial photography, the numbers of aerial triangulation models by the order of individual organizations will become more than the number of aerial triangulation models by on organization in one package.

The amount of cost reduction of aerial triangulation depends on the shape and area of digital topographic mapping area. However, it is considered that an approximately 30% (maximum) of the total amount of aerial triangulation may be reduced.

As already described above, the amount of cost reduction of digital topographic mapping depends on the mapping area, number of organizations, shape of each organization's administrative areas and so on. Therefore, amount of cost reduction has to be estimated case by case.

In general, in Japan, both ordering party and contractor, an approximately 30% (maximum) may be reduced.

In Japan, 1:2,500 scale digital topographic maps are prepared by each local government respectively. Therefore, the cost reduction effect of digital topographic mapping by one block will become large.

However, in Bangladesh, each local government does not execute large scale digital topographic mapping for their own purpose at present, and also, the central organizations which prepare the digital topographic data covering whole country are limited.

Therefore, it is considered that the cost reduction effect of digital topographic mapping by one block is included in the cost reduction effect described in Clause 10.4.2 "Cost reduction effect by mutual utilization of digital topographic data by users".

10.4.2 Cost reduction effect by mutual utilization of digital topographic data by users

The basic information necessary for development planning and so on by the central and local governments are geospatial information (topographic maps) and statistic data.

Due to the dissemination of GIS, the demand of map users was already changed from analogue topographic maps (printed maps) to digital topographic maps.

The cost reduction effect by the utilization of the existing digital topographic maps is considered as follows:

1) Utilization of digital topographic data at master plan stage

In case that each organization can use the existing digital topographic data for master plan study, all necessary cost for the preparation of digital topographic maps will not be necessary.

However, all necessary information and data for each organization may not be shown on the existing 1:25,000 scale topographic maps. Therefore, collection and compilation of additional information and data have to be executed by each organization according to their demands and purpose of the projects.

This cost will be required, even though the existing topographic maps is available.

2) Utilization of digital topographic data at feasibility study stage

In case that each organization can use the existing topographic data for feasibility study, all

necessary cost for the preparation of digital topographic data will not be necessary.

However, at present, the existing 1:5,000 scale digital topographic maps of SOB cover only 6 major cities (Dhaka City, Chittagon City, Sylhet, Khulna, Rajshahi and Barishal). Therefore, in case of other cities, it is necessary to prepare new digital topographic maps for feasibility study.

Also, it is necessary to consider the secular change of the existing topographic maps at the time of utilization. Strictly speaking, the topographic features, land use and other information shown on the topographic maps do not coincide with the real topographic features, land use and other information due to the secular change of the existing topographic maps.

Therefore, it is necessary to execute secular change correction of the existing topographic maps, depending on the degree of secular change of the existing topographic maps.

The cost necessary for the secular change correction of the existing topographic maps will be changed depending on the contents and volume of secular change. However, it is considered that the necessary cost for the secular change correction may be around 10% - 30% of the total amount of new preparation cost of digital topographic maps.

In case that the secular change correction cost exceed the amount of 30% of the total amount of new preparation cost of digital topographic maps, it is recommended that new topographic maps will be made from the view points of cost and working time.

Same as feasibility study, all necessary information and data for each organization may not be shown on the existing 1;5,000 scale topographic maps. Therefore, collection and compilation of additional information and data have to be executed by each organization according to their demands and purpose of the projects.

This cost will be required, even though the existing topographic maps is available.

3) Utilization of digital topographic data at detail design and construction stage

1:500 - 1,1000 scale digital topographic maps will be used at the stage of detail design and construction. Therefore, these scale of digital topographic maps are not including in the category of geospatial information data which will be released on NSDI in Bangladesh at present.

However, 1:5,000 or 1:25,000 scale digital topographic maps will also be used at the stage of detail design and construction.

The main survey method at the stage of detail design and construction is mainly engineering survey by ground survey method.

10.5 Cost reduction effect at each stage of infrastructure development projects

The cost reduction effect at each stage of infrastructure development projects will be able to estimated by the following method.

10.5.1 Cost reduction effect on the financial assistance by the Government of Japan

In case of financial assistance by the Government of Japan, cost reduction effect will be able to estimate as follows:

The amount of financial assistance by the Government of Japan from 2011 to 2015 to Bangladesh is shown in Table 10.5.1.

Table 10.5.1 Amount of financial assistance by the Government of Japan

Year	Loan assistance	Grant aid	Technical cooperation	Total amount
2011	US$ 11,760,000	US$ 23,550,000	US$ 43,090,000	US$ 78,400,000
2012	US$ 248,260,000	US$ 5,550,000	US$ 51,650,000	US$ 305,460,000
2013	US$ 263,750,000	US$ 17,550,000	US$ 45,960,000	US$ 327,260,000
2014	US$ 246,960,000	US$ 17,360,000	US$ 43,370,000	US$ 307,690,000
2015	US$ 331,860,000	US$ 8,930,000	US$ 34,370,000	US$ 375,160,000
Total (5 years)	US$ 1,102,590,000	US$ 72,940,000	US$ 218,440,000	US$ 1,393,970,000
Average amount per year	US$ 220,518,000	US$ 14,588,000	US$ 43,688,000	US$ 278,794,000

Unit: US$

Source: Economic Directory of Bangladesh, August 2014, Embassy of Japan in Bangladesh

To identify the number and amounts of projects, which the geospatial information data (digital topographic maps) are necessary for the implementation of the project, detailed investigation will be necessary. However, it is possible to estimate as follows:

a) The average amount of financial assistance, grant aid and technical cooperation by the Government of Japan from 2011 to 2015 is calculated as US$278,794,000.-/year.

b) Considering the percentage of the total amount of project, that the geospatial information data are necessary for the implementation of the project, as 50% of the total amount, the annual average amount is calculated as US$139,397,000.-/year.

c) It is said that the approximate amount of survey and investigation cost in the infrastructure development project is approximately 3% of the total project cost. To apply this percentage, the amount of survey and investigation cost is calculated as US$4,181,910.-/year.

d) However, this amount includes the following survey and investigation cost.
   - Survey and mapping cost at the stage of master plan study
     1:25,000 - 1:50,000 scale topographic maps
     ⇒Digital topographic data on NSDI is available.
   - Investigation cost at the stage of master plan study

Geological survey, topographic survey, environmental survey and so on
⇒It is necessary to execute at the stage of master plan study.

・Survey and mapping cost at the stage of feasibility study
1:5,000 scale topographic maps
⇒Digital topographic data on NSDI is available only for major cities.

・Investigation cost at the stage of feasibility study
Geological survey, topographic survey, environmental survey and so on
⇒It is necessary to execute at the stage of feasibility study.

・Survey and mapping cost at the stage of detail design
1:500 - 1:1,000 scale topographic mapping, longitudinal and profile survey and so on
⇒It is necessary to execute at the stage of detail design.

・Investigation cost at the stage of detail design
Geological survey, underground utility investigation, environmental survey and so on
⇒It is necessary to execute at the stage of detail design.

・Survey and mapping cost at the stage of construction
Engineering survey and so on
⇒It is necessary to execute at the stage of construction

・Investigation cost at the stage of construction
Environmental survey, underground utility survey and so on
⇒It is necessary to execute at the stage of construction.

As already mentioned above, the digital topographic maps which will be released on NSDI in Bangladesh are 1:25,000 scale digital topographic maps covering whole territory of Bangladesh, and 1:5,000 scale digital topographic maps at the major five cities.

Therefore, The project stages that the existing digital topographic maps on NSDI in Bangladesh are available are as follows:

・All projects at the stage of master plan

・Some project at the stage of feasibility study at the major five cities
(The number of the projects at the major cities is presumed as 1/2 of total number of projects.)

In case that the amounts of above eight survey and mapping, and investigation costs are presumed as same, the amount of cost reduction by the utilization of the existing digital topographic data will be estimated as 1.5/8 of the total survey and mapping, and investigation costs of infrastructure development project.

In case that this ratio is applied to the amount of financial assistance by the Government of

Japan, the amount of cost reduction by the utilization of the existing digital topographic maps will be estimated as US$784,108.-/year.

e) In case that the available period of digital topographic maps without the consideration of secular changes is presumed as 10 years, this cost reduction effect will be able to applied to 10 years after the preparation of digital topographic maps.

In case that the above-mentioned concept is able to applied to the donor countries and international organizations, the cost reduction effect will be estimated as follows:

10.5.2 Cost reduction effect on the financial assistance by the main donor countries excluding Japan

Table 10.5.2 shows the amount of financial assistance by the main donor countries excluding Japan from 2010 to 2014 (5 years) to Bangladesh.

Table 10.5.2 Amount of financial assistance by the main donor countries excluding Japan

Year	Amount of financial assistance by the main donor countries excluding Japan
2010	US$ 890,760,000
2011	US$ 1,046,280,000
2012	US$ 1,044,910,000
2013	US$ 1,144,910,000
2014	US$ 1,109,300,000
Total (5 years)	US$ 5,236,160,000
Average amount per year	US$ 1,047,232,000

Unit: US$

Source: Economic Directory of Bangladesh, August 2014, Embassy of Japan in Bangladesh

The average amount of financial assistance by the main donor countries excluding Japan from 2010 to 2014 (5 years) is calculated as US$1,047,232,000.-/year.

In case that the above mentioned concept is applied to this amount, the cost reduction effect on the financial assistance by the main donor countries excluding Japan is estimated as follows:

a) The average amount of financial assistance by the main donor countries excluding Japan from 2010 to 2014 (5 years) is calculated as US$1,047,232,000.-/year.

b) Considering the percentage of number of projects, that the geospatial information data are necessary for the implementation of the project, as 50% of the total number of the projects, the annual average amount is calculated as US$523,616,000.-/year.

c) Same as above, 3 percentages is applied to calculate the survey and mapping, and investigation cost. The amount of the survey and mapping, and investigation cost is calculated as US$15,708,480.-/year.

d) This amount includes not only the survey and mapping cost but also investigation cost such as soil investigation, environmental survey and so on at the stage of detail survey and construction. Therefore, same as above, the factor of 1.5/8 is applied to calculate the cost reduction effect by the utilization of the existing digital topographic data, and the cost reduction effect is estimated as US$2,945,340.-/year.

e) In case that the available period of digital topographic maps without the consideration of secular changes is presumed as 10 years, this cost reduction effect will be able to applied to 10 years after the preparation of digital topographic maps.

10.5.3 Cost reduction effect on the financial assistance by international organizations

Table 10.5.3 shows the amount of financial assistance by international organizations from 2010 to 2014 (5 years) to Bangladesh.

Table 10.5.3 Amount of financial assistance by the international organizations

Year	Amount of financial assistance by the international organization
2010	US$ 1,052,430,000
2011	US$ 1,012,410,000
2012	US$ 1,480,550,000
2013	US$ 1,831,600,000
2014	US$ 1,675,100,000
Total (5 years)	US$ 7,052,090,000
Average amount per year	US$ 1,410,418,000

Unit: US$

Source: Economic Directory of Bangladesh, August 2014, Embassy of Japan in Bangladesh

The annual average amount of financial assistance by the international organizations from 2010 to 2014 (5 years) to Bangladesh is calculates as US$1,410,418,000.-/year

In case that the above mentioned concept is applied to this amount, the cost reduction effect on the financial assistance by the international organizations to Bangladesh is estimated as follows:

a) The average amount of financial assistance by the international organizations to Bangladesh from 2010 to 2014 (5 years) is calculated as US$1,410,418,000.-/year.

b) Considering the percentage of number of projects, that the geospatial information data are necessary for the implementation of the project, as 50% of the total number of the projects, the annual average amount is calculated as US$705,209,000.-/year.

c) Same as above, 3 percentages is applied to calculate the survey and mapping, and investigation cost. The amount of the survey and mapping, and investigation cost is calculated as US$21,156,270.-/year.

d) This amount includes not only the survey and mapping cost, but also investigation cost such

as soil investigation, environmental survey and so on at the stage of detail survey and construction. Therefore, same as above, the factor of 1.5/8 is applied to calculate the cost reduction effect by the utilization of the existing digital topographic data, and the cost reduction effect is estimated as US$3,966,800.-/year.

e) In case that the available period of digital topographic maps without the consideration of secular changes is presumed as 10 years, this cost reduction effect will be able to applied to 10 years after the preparation of digital topographic maps.

10.5.4 Cost reduction effect on infrastructure development projects by the Government of Bangladesh

Above-mentioned concept is also able to applied to the infrastructure development projects by the Government of Bangladesh.

Table 10.5.4 shows the amount of general revenue and annual expenditure of the Government of Bangladesh in the budget year of 2014 - 2015.

Table 10.5.4 Bangladesh national budget plan in the budget year of 2014 - 2015

Items	Amount (Taka)	Amount (US$)
General revenue	Taka 1,829,540,000,000	US$22,311,463,410
Tax revenue	Taka 1,529,200,000,000	US$18,648,780,490
Nontax revenue	Taka 276,620,000,000	US$3,373,414,634
Annual expenditure	Taka 2,505,060,000,000	US$30,549,512,200
Non-development budgets	Taka 1,282,310,000,000	US$15,637,926,830
Development budgets	Taka 863,450,000,000	US$10,529,878,049

Unit: Taka & US$, US$1.0-=Taka 82.0-

Source: Economic Directory of Bangladesh, August 2014, Embassy of Japan in Bangladesh

In general, the national budget of the developing countries includes the amount of the financial assistance from the donor countries and international organizations.

Therefore, to calculate the actual amount of annual expenditure of the Government of Bangladesh, the total amount of financial assistance by the donor countries and international organizations have to be reduced from the total amount of the annual expenditure of the Government of Bangladesh.

Table 10.5.5 shows the annual revenue amount of development budgets of Bangladesh Government in the budget period of 2014 and 2015.

Table 10.5.5 Annual revenue of development budgets in the budget period of 2014 and 2015

Items	Annual revenue in 2014	Ratio (%)	Annual revenue in 2015	Ratio (%)
Domestic resources	Taka 364,000,000,000	60.7%	Taka 514,500,000,000	64.0%
General income	Taka 406,700,000,000	67.8%	Taka 547,200,000,000	68.1%
Etc.	－Taka 42,700,000,000	－7.1%	－Taka 32,700,000,000	－4.1%
Foreign resources	Taka 236,000,000,000	39.3%	Taka 289,000,000,000	36.0%
Project assistance	Taka 212,000,000,000	35.3%	Taka 277,000,000,000	34.5%
Commodities assistance	0	0.0%	0	0.0%

Items	Annual revenue in 2014	Ratio (%)	Annual revenue in 2015	Ratio (%)
Food assistance	0	0.0%	0	0.0%
Special credit	Taka 24,000,000,000	4.0%	Taka 12,000,000,000	1.5%
Etc.	0	0.0%	0	0.0%
Total amount	Taka 600,000,000,000	100.0%	Taka 803,500,000,000	100.0%

Unit: Taka

Source: Economic Directory of Bangladesh, August 2014, Embassy of Japan in Bangladesh

There is a little difference between the amount of development budget showing in Table 10.5.4 and Table 10.5.5. However, it is considered that this discrepancy was the difference between the amount of budget plan and actual expenditure.

Table 10.5.5 shows that the development budgets of the Government of Bangladesh consists of 62.3% of domestic resources and 37.7% of foreign resources based by the average annual development budget in 2014 and 2015.

The annual expenditure amounts of each sector of the development budget of the Bangladesh Government in 2014 and 2015 are shown in table 10.5.6.

Table 10.5.6 Annual expenditure of development budgets in 2014 and 2015

Items	2014	Ratio (%)	2015	Ratio (%)
Transportation/communication	Taka 108,800,000,000	18.3%	Taka 194,500,000,000	24.2%
Local governing/rural development	Taka 128,900,000,000	21.4%	Taka 151,300,000,000	18.9%
Energy	Taka 98,600,000,000	16.4%	Taka 115,000,000,000	14.3%
Education/technology	Taka 93,100,000,000	15.5%	Taka 126,100,000,000	15.7%
Agriculture	Taka 43,000,000,000	7.1%	Taka 56,300,000,000	7.0%
Insurance	Taka 38,200,000,000	6.4%	Taka 43,500,000,000	5.4%
Social security	Taka 26,100,000,000	4.4%	Taka 37,100,000,000	4.6%
Industry/economic service	Taka 22,800,000,000	3.8%	Taka 22,800,000,000	2.8%
Public administration	Taka 17,600,000,000	2.9%	Taka 38,800,000,000	4.8%
Etc.	Taka 22,900,000,000	3.8%	Taka 18,300,000,000	2.3%
Total amount	Taka 600,000,000,000	100.0%	Taka 803,700,000,000	100.0%

Unit: Taka

Source: Economic Directory of Bangladesh, August 2014, Embassy of Japan in Bangladesh

It is considered that "Transportation/communication" and "Energy" are the main sectors that geospatial information are necessary for the implementation of the project in these sectors and the annual expenditure of these two sectors are 34.7% of the total annual expenditure in 2014 and 43.1 % of the total annual expenditure in 2015, and an average percentage is 38.9%.

In case of the estimation of cost reduction effect on the financial assistance by the Government of Japan, other donor countries and international organizations, the values of 50 percentage is used.

However, in case of the infrastructure development project by the Government of Bangladesh, the value of 38.9 % will be applied for the estimation of cost reduction effect.

Based on the above, the cost reduction effect on the infrastructure development project by the Government of Bangladesh is estimated as follows:

a) The average amount of development budget (domestic resources) in 2014 and 2015 (2 years) is calculated as Taka39,250,000,000.-/year.

b) "Transportation/communication sector" and "Energy sector" are considered as the sectors that geospatial information is necessary for the implementation of their projects. The amount of development budget of "Transportation/communication sector" and "Energy sector" is calculated and Taka170,868,250,000.-/year.

c) Same as above, 3 percentages is applied to calculate the survey and mapping, and investigation cost. The amount of the survey and mapping, and investigation cost is calculated as Taka170,868,250,000.-/year.

d) This amount includes not only the survey and mapping cost but also investigation cost such as soil investigation, environmental survey and so on at the stage of detail survey and construction. Therefore, same as above, the factor of 1.5/8 is applied to calculate the cost reduction effect by the utilization of the existing digital topographic data, and the cost reduction effect is estimated as Taka961,133,906.-/year.

   Based on exchange rate of US$1.0-=Taka82.0-, this amount of Taka is equivalent to US$11,721,145.-/year.

e) In case that the available period of digital topographic maps without the consideration of secular changes is presumed as 10 years, this cost reduction effect will be able to applied to 10 years after the preparation of digital topographic maps.

10.5.5 Cost reduction effect by the direct investment of private sector

Even though it is difficult to estimate it, the cost reduction effect in private sector was estimated as follows:

The direct investment amount from Japan from 2011 to 2015 are shown in Table 10.5.7.

Table 10.5.7 Direct investment amount from Japan

Year	Amount of direct investment from Japan
2011	US$ 46,600,000
2012	US$ 30,100,000
2013	US$ 94,400,000
2014	US$ 96,300,000
2015	US$ 45,400,000
Total (5 years)	US$ 312,800,000
Average amount per year	US$ 62,560,000

Unit: US$

Source: Economic Directory of Bangladesh, August 2014, Embassy of Japan in Bangladesh

The amount of direct investment by major countries to Bangladesh from 2009 - 2013 (5 years) is

shown in Table 10.5.8.

Table 10.5.8 Amount of direct investment by major countries

Country/Year	2009	2010	2011	2012	2013	Total
Malaysia	79.1	40.2	2.0	7.7	337.9	466.9
England	105.6	66.5	144.6	128.2	159.5	604.4
Egypt	309.7	20.0	37.3	146.9	138.1	652.0
Korea	40.9	46.7	73.8	104.9	124.9	391.2
Singapore	14.7	311.8	27.7	15.6	103.6	473.4
Japan	58.5	22.0	35.0	31.4	99.0	245.9
Hong Kong	47.5	72.9	93.5	68.1	86.3	368.3
Holland	62.3	55.9	0	24.4	84.9	227.5
U.S.A.	36.2	34.8	94.1	95.0	71.1	331.2
China	2.5	5.1	18.6	14.4	26.0	66.6
Total	960.6	913.0	779.0	1,195.0	1,731.0	5,578.6
Average						1,115.72

Unit: 1 million US$

Source: Economic Directory of Bangladesh, August 2014, Embassy of Japan in Bangladesh

The Industry-wise amount of direct investment from 2009 to 2013 are shown in Table 10.5.9.

Table 10.5.9 Industry-wise amount of direct investment in Bangladesh

Industry/Year	2009	2010	2011	2012	2013	Total
Transportation/communication	579.6	445.9	54.5	179.0	527.0	1,786.0
Apparel	130.3	157.9	225.1	241.4	412.4	1,167.1
Industry (Excluding apparel)	53.6	75.8	105.2	173.6	300.0	708.2
Trade/Commerce	122.5	128.8	234.8	272.7	295.0	1,053.8
Electricity/Gas	46.9	73.6	127.2	245.0	93.6	586.3
Service	7.7	19.7	20.4	32.6	65.2	145.6
Agriculture	19.1	10.9	11.5	49.5	29.7	120.7
Etc.	0.9	0.4	0.3	1.0	7.1	9.7
Total	960.6	913.0	779.0	1,194.8	1,730.0	5,577.4
Average amount per year						1,115.48

Unit: 1 million US$

Source: Economic Directory of Bangladesh, August 2014, Embassy of Japan in Bangladesh

It is considered that the main sectors, that geospatial information are necessary for their works, are "Transportation/communication sector" and "Electricity/Gas sector" within the 8 sectors shown in Table 10.5.9.

Therefore, based on the direct investment amount of these 2 sectors, the cost reduction effect on the direct investment by the private sector is estimated as follows:

a) The total amount of direct investment of "Transportation and communication sector" and "Electricity and gas sectors" from 2009 to 2013 is US$2,372,300,000.-, and the average amount is US$474,460,000.-/year.

b) Considering the percentage of number of projects, that the geospatial information data are necessary for the implementation of the project, as 50% of the total number of the projects,

the annual average amount is calculated as US$237,230,000.-/year.

c) Same as above, 3 percentages is applied to calculate the survey and mapping, and investigation cost. The amount of the survey and mapping, and investigation cost is calculated as US$7,116,900.-/year.

d) This amount includes not only the survey and mapping cost but also investigation cost such as soil investigation, environmental survey and so on at the stage of detail survey and construction. Therefore, same as above, the factor of 1.5/8 is applied to calculate the cost reduction effect by the utilization of the existing digital topographic data, and the cost reduction effect is estimated as US$1,334,418.-/year.

In case of private sector, it is recommended to evaluate the increase of motivation for direct investment by the effective utilization of the existing geospatial information (digital topographic maps) rather than the cost reduction effect by the utilization of the existing geospatial information.

However, a numeric conversion of this effect is difficult, and this effect was decided not to be considered for the cost and effect of NSDI in Bangladesh.

10.6 Cost reduction amount per a year by the construction of NSDI in Bangladesh

Table 10.6.1 shows the results of cost reduction effect by the construction of NSDI in Bangladesh based on the above-mentioned estimations.

The cost reduction effect per year was estimated as US$20,751,000.-/year.

Table 10.6.1 Estimated cost reduction amount per year by the construction and utilization of NSDI

Items of const reduction	Estimated cost reduction amount per year
1) Cost reduction effect by the preparation of topographic data by one organization	----------
2) Cost reduction effect in the financial assistance of the Government of Japan	US $784,108
3) Cost reduction effect in the financial assistance of main donor countries	US$ 2,945,340
4) Cost reduction effect in the financial assistance of international organization	US$ 3,966,800
5) Cost reduction effect in the infrastructure development project of the Government of Bangladesh	US$ 11,721,145
6) Cost reduction effect in the direct investment of private sector	US$ 1,334,418
7) Cost reduction effect per one year	US$ 20,751,809

Note: 1) will not be considered in case of Bangladesh NSDI (Refer to Clause 10.4.1).

Unit: US$

Source: The Project Team

However, it is necessary to understand clearly that this cost reduction effect will not be developed immediately after the construction of NSDI platform.

The cost reduction effect by the construction of NSDI shown in Table 10.6.1 is estimation based on the under-mentioned conditions.

a) The geospatial information data on NSDI will be utilized by all relating organizations of NSDI effectively.

b) Mutual data utilization among the relating organization will be promoted.

c) The freshness of geospatial information data on NSDI will be kept, and the geospatial information data on NSDI has no significant secular changes of topographic features, land use and so on.

d) The geospatial information data on NSDI will be utilized effectively not only government sector but also academic sector and private sector.

Due to the difference of coordinates system and elevation datum used by the Bangladesh Government organizations, the data possessed by each organization could not be overlapped directly on the digital topographic data of SOB which will be opened on NSDI.

Therefore, without solving these issues, each Bangladesh Government organizations will not be able to use the digital topographic data of SOB, and also, it is difficult to promote the mutual data utilization by the Bangladesh Government organizations.

Due to the difference of geospatial information and GIS utilization capability of each Bangladesh Government organizations, the degree of geospatial information utilization of each Bangladesh Government organization after the construction of NSDI will also be different.

Therefore, the cost reduction effect shown in Table 10.6.1 will be developed gradually after the construction of NSDI, and it will take a time to develop a full cost reduction effect.

10.7 Initial investment cost for the construction of NSDI platform

Based on the concept design of NSDI described in Chapter 9, an approximate initial cost for the construction of NSDI, in case of the construction period is determined from second semester of 2018 to second semester of 2020, was estimated as follows:

The details of NSDI construction cost is shown in Annex-8.

However, the construction cost of NSDI have to be revised based on the results of NSDI Pilot Project which is currently in progress.

The items of initial cost for the construction of NSDI are "System construction cost", "Hardware and software cost" and "Database construction cost", and an approximate amount of each item is shown in Table 10.7.1.

The system construction cost consists of "System design cost", "System coding cost" and "System testing cost" to develop the system described in Clause 9.5.

The hardware and software cost consists of hardware described in Clause 9.3.3 and software

described in Clause 9.3.5.

The database construction cost consists of "Creating database cost" and "Setting database cost" to develop the database described in Clause 9.6.

Table 10.7.1 Estimated initial investment cost for the construction of NSDI platform

Items			Amount (US$)
1	System construction cost		2,820,000
	1-1	System design cost	920,000
	1-2	System coding cost	1,500,000
	1-3	System testing cost	400,000
2	Hardware and software cost		1,600,000
	2-1	Hardware cost	1,250,000
	2-2	Software cost	350,000
3	Database construction cost		1,100,000
	3-1	Creating database cost	1,000,000
	3-2	Setting database cost	100,000
Total			5,520,000

Unit: US$

Source: The Project Team

10.8 Annual maintenance and operation cost of NSDI platform

The approximate annual maintenance and operation cost was estimated as follows: The annual maintenance and operation cost at each year is shown in Annex-9.

a) The starting date of NSDI operation is 2021.

b) The necessary cost for system improvement and functions of NSDI is estimated as 10% of the system construction cost of initial investment (US$282,000.-/year).

c) The maintenance cost for hardware is estimated as 10% of hardware cost of initial investment (US$125,000.-/year).

d) Software usage and maintenance cost for virus and GIS is estimated as 20% of software cost of initial investment (US$70,000.-/year).

e) The maintenance cost for database is estimated as 5% of database construction cost of initial investment (US$55,000.-/year).

The annual maintenance and operation cost of NSDI after 2021 was estimated considering the inflation rate in Bangladesh.

10.9 Updating cost of NSDI platform

The updating cost of NSDI platform was estimated on the condition that the durable years of hardware such as server and so on are 7 years, total US$5,682,000.- was allocated in 2027 as

updating of NSDI platform including updating of hardware.

For system construction cost, design cost, development cost and testing cost for system upgrading were estimated as 80% of the initial investment cost due to the reason of accumulation of knowhow and experience of NSDI operation.

An inflation rate in Bangladesh was considered for the estimation of hardware and software based on the initial investment cost.

Database construction cost was estimated as 70% of database construction cost of the initial investment cost due to the change of system at the time of NSDI updating.

An inflation rate in Bangladesh was considered for the estimation of database construction cost at the time of NSDI updating.

Table 10.9.1 Estimated NSDI platform updating cost

Items			Amount (US$)
1	System construction cost		2,260,000
	1-1	System design	740,000
	1-2	System coding	1,200,000
	1-3	System testing	320,000
2	Hardware and software cost		2,561,000
	2-1	Hardware cost	2,001,000
	2-2	Software cost	560,000
3	Database construction cost		861,000
	3-1	Creating database cost	700,000
	3-2	Setting database cost	161,000
Total			5,682,000

Unit: US$

Source: The Project Team

10.10 Preparation and updating cost of geospatial information data (digital topographic maps)

An approximate amount of preparation and updating of digital topographic data (digital topographic maps), which are the basic information on NSDI, is estimated as follows:

10.10.1 Utilization purpose of the existing digital topographic data of SOB

Table 10.10.1 shows the type, sale and date of preparation of topographic maps to be able to provide on NISD by SOB.

Table 10.10.1 Available topographic maps of SOB for NSIDI (type, scale and year of preparation)

Map	Scale	Location	Area (km^2)	Date of aerial photography	Note
Map	1:1,000,000	Whole country	14,400 km^2	-----	Compiled map
Map	1:500,000	Whole country	14,400 km^2	-----	Compiled map

Map	Scale	Location	Area (km^2)	Date of aerial photography	Note
Map	1:250,000	Whole country	14,400 km^2	-----	Compiled map
Topographic map	1:50,000	Whole country	14,400 km^2	-----	By ground survey method
Topographic map	1:25,000	Whole country	14,400 km^2	Dry season of 2010	By photogrammetric method
Topographic map	1:5,000	Dhaka City	581 km^2	January 2003	By photogrammetric method
Topographic map	1:5,000	Chittagong	574 km^2	Dry season of 2010	By photogrammetric method
Topographic map	1:5,000	Sylhet	178 km^2	Dry season of 2010	By photogrammetric method
Topographic map	1:5,000	Rajshahi	185 km^2	Dry season of 2010	By photogrammetric method
Topographic map	1:5,000	Khulna	329 km^2	Dry season of 2010	By photogrammetric method
Topographic map	1:5,000	Barisal	148 km^2	Dry season of 2010	By photogrammetric method

Source: The Project Team

These topographic maps and maps can be classified into two as shown in Table 10.10.2 from the view points of utilization purpose on NSDI.

Table 10.10.2 Utilization purpose of topographic maps of SOB on NSDI

Utilization purpose	Map scale	Location	Note
Background maps on NSDI	1:1,000,000 scale compiled map	Whole country	
	1:500,000 scale compiled map	Whole country	
	1:250,000 scale compiled map	Whole country	
	1:50,000 scale topographic map	Whole country	
Topographic maps to be used by NSDI users	1:25,000 scale topographic map	Whole country	Already prepared.
	1:5,000 scale topographic map	Main 6 cities	Topographic maps of other major local cities are necessary.

Source: The Project Team

10.10.2 Partial updating and full updating of the digital topographic data

Periodical updating is necessary for topographic maps due to the reason of secular change. Because, in case of photographic mapping using aerial photos and satellite images, secular change of topographic maps start after the date of aerial photography and satellite image data acquisition.

Also, due to economic activation and other reasons, more large scale topographic maps will become necessary for users. At present, generally, 1:5,000 and 1:25,000 scale digital topographic maps will be prepared by photogrammetric method.

However, updating method of these topographic maps will depend on the contents of correction and volume of correction of topographic maps as shown in Table 10.10.3.

Table 10.10.3 Secular change correction method of topographic maps

Method	Area	Implementation method		
Photogrammetric method	Wide area	Aerial photography	New aerial photos	3D data acquisition by photogrammetric method
	Narrow area	Satellite image	Archive data	2D data acquisition using orthophoto image of satellite data
	Wide area		New data (Stereo pair)	3D data acquisition by photogrammetric method
Ground survey method	Narrow area	3D data acquisition by GPS, RTK and so on.		
Utilization of existing data	Narrow area	The data provided by other organizations will be used for the correction of topographic map data.		

Source: The Project Team

Generally, several times of updating (partial correction) of topographic maps will be executed considering the topographic and artificial changes after the preparation of new topographic maps.

However, due to the increase of topographic and artificial changes over time, full updating of topographic maps (preparation of new topographic maps) instead of partial updating of topographic maps will be needed.

In every country, the quality and freshness of topographic maps are maintained by this cycle of topographic maps updating.

In Bangladesh, 1:50,000 scale topographic maps were national base maps covering whole territory of Bangladesh.

However, these 1:50,000 scale topographic maps were prepared at approximately more than 70 years ago, and after preparation of original 1:50,000 scale topographic maps, several times of partial updating were executed by SOB.

However, due to the increase of topographic and artificial changes of 1:50,000 scale topographic maps, new 1:25,000 scale digital topographic maps covering whole territory of Bangladesh were decided to be prepared by IDMS.

Table 10.10.4 shows the standard updating interval of topographic maps in Japan.

Table 10.10.4 Standard updating interval of topographic maps in Japan

Area	Partial updating	Full updating (new preparation)
City area	As necessary	Approximately 5 years interval
Rural area	As necessary	Approximately 10 years interval
Mountain area	As necessary	Approximately 20 years interval

Source: The Project Team

Due to the high economic growth of recent years in Bangladesh, the topographic and artificial features especially, the topographic and artificial features at Dhaka Metropolitan area were changed drastically.

Therefore, in Bangladesh, it is necessary to execute periodical updating of topographic maps taking

into account of standard updating period of topographic maps in Japan shown in Table 10.10.4.

Especially, the existing 1:5,000 scale digital topographic maps covering Dhaka Metropolitan area was prepared at approximately 15 years ago.

The topographic and artificial features in Dhaka Metropolitan area were drastically changed by the large scale housing land development at surrounding parts of Dhaka City, rebuild of buildings in Dhaka City, construction of flyover and so on during the past 15 years.

In advanced countries including Japan, the scale of urban base maps was already changed from 1:5,000 scale to 1:2,500 scale or 1:2,000 scale.

Therefore, also in Bangladesh, it is considered that the scale of urban base maps will be changed from the present 1:5,000 scale to 1:2,500 scale in near future due to the change of utilization purpose of digital topographic maps by users.

10.10.3 Preparation and updating plan (tentative) of geospatial information data

The tentative plan for preparation and updating of digital topographic maps of SOB from 2018 to 2035 (18 years) was prepared as follows:

Figure 10.10.1 shows the schedule of preparation and updating of digital topographic maps by SOB.

The basic idea of preparation and updating of digital topographic maps of SOB are described below.

1) Preparation priority of new digital topographic data

The preparation priority of new digital topographic maps was set up considering the date of preparation of the existing topographic maps (date of aerial photography) as follows:

a) First priority: Preparation of 1:5,000 scale digital topographic maps covering Dhaka Metropolitan Area
This is planned to be commenced from 2018.

b) Second priority: Preparation of 1:5,000 scale digital topographic maps covering remaining major local cities
This is planned to be commenced from last half of 2022, after completion of 1:5,000 scale digital topographic mapping at Dhaka Metropolitan Area (first priority).

c) Third priority: Preparation of 1:5,000 scale digital topographic maps at major 5 cities
This is planned to be commenced from last half of 2026, after completion of 1:5,000 scale digital topographic mapping at remaining

major local cities.

d) Fourth priority — 1:25,000 scale digital topographic mapping
Full updating of 1:25,000 scale digital topographic maps will be planed to commence around half of 2031.

2) Updating of digital topographic data (partial updating)

The updating interval of the existing topographic maps (partial updating) was set up considering the date of preparation of topographic maps (date of aerial photography) and estimated degree of secular changes as follows:

a) 1:25,000 scale digital topographic maps
Partial updating of 1:25,000 scale digital topographic maps is planned at approximately 10 years interval using satellite images.

b) 1:5,000 scale digital topographic maps
Partial updating of 1:5,000 scale digital topographic maps is planned at approximately 7 years interval using satellite images.

c) 1:50,000 scale topographic maps and smaller maps
The data of 1:25,000 and 1:5,000 scale digital topographic data which will be prepared for secular change correction and new preparation will be used for secular change correction of 1:50,000 and more small scale maps, and the secular change correction of these small scale maps will be executed at approximately 4 years interval.

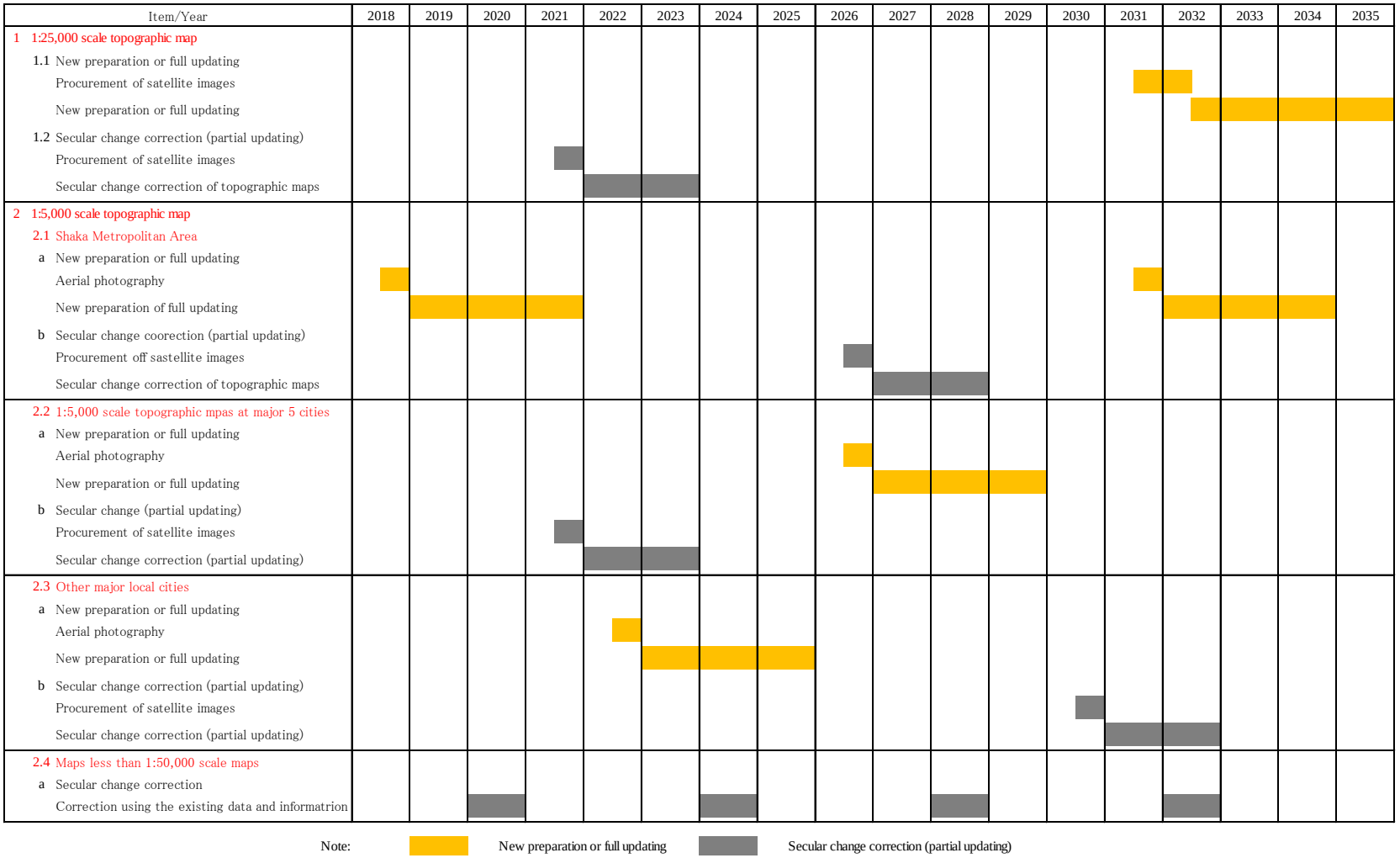


Figure 10.10.1 Preparation and updating plan (tentative) of geospatial information data of SOB

Source: The Project Team

3) 1:25,000 scale digital topographic maps

The aerial photos for 1:25,000 scale digital topographic maps preparation were taken in 2010 and 2011.

Therefore, updating of 1:25,000 scale digital topographic maps (partial updating) using satellite images for the area with large secular change will be planned from the second half of 2021, approximately 10 years after aerial photography.

The work items are as follows:

a) Procurement of satellite images (stereo pair): Last half of 2021

b) Map orientation (ground control point survey will be executed, if necessary)

c) Data acquisition and compilation

d) Field identification

e) Correction of GIS basic data

In 2031, approximately 20 years will be passed after the aerial photography executed in 2010 and 2011.

It is estimated that large scale of secular change for whole area including partial updating area in 2021 will make progress.

Therefore, full updating of 1:25,000 scale digital topographic maps will be planned from the second half of 2031taking new aerial photos.

4) 1:5,000 scale digital topographic maps covering Dhaka Metropolitan Area

An aerial photography for 1:5,000 scale topographic mapping at Dhaka Metropolitan area was executed in January 2003, and approximately 15 years has been already passed after aerial photography.

During past 15 years, the topographic and artificial features around Dhaka Metropolitan area were drastically changed due to the high economic growth in Bangladesh, and the existing 1:5,000 scale digital topographic maps do not show the current topographic and artificial features of Dhaka Metropolitan area.

Therefore, It is planned that new 1:5,000 scale digital topographic maps at Dhaka Metropolitan area will be prepared from 2018 to 2021.

The work items are as follows:

a) Aerial photography

Aerial photography is planned to be executed last half of 2018.

b) Ground control point survey
The existing GSP points and BMs will be used as much as possible, and additional ground control points will be established at the necessary locations.

c) Field identification
The existing data will be used as much as possible to reduce the volume of field identification.

d) Aerial triangulation

e) Digital plotting and compilation

f) Preparation of GIS basic data

From the second half of 2026, approximately 7 years after the new 1:5,000 scale digital topographic mapping at Dhaka Metropolitan area, partial updating of 1:5,000 scale topographic maps at large secular changed area will be planned using satellite images (stereo pair).

In 2031, approximately 13 years will be passed after aerial photography for new 1:5,000 scale digital topographic mapping for Dhaka Metropolitan area.

Considering the large secular change at Dhaka Metropolitan area due to high economic growth in Bangladesh, full updating using new aerial photos will be planned from 2031.

5) 1:5,000 scale digital topographic maps of main 5 cities (Chittagong, Sylhet, Rajshahi, Khulna and Barisal)

An aerial photography for 1:5,000 scale digital topographic mapping at major five cities were executed in 2010 and 2011, and approximately 7 years has been already passed after aerial photography.

It is considered that the degree of secular change at these five major cities may be smaller than the degree of secular change at Dhaka Metropolitan area.

Therefore, from the second half of 2021, approximately 10 years after aerial photography, partial updating for large secular changed area using satellite images (stereo pairs) will be planned.

The work items are as follows:

a) Procurement of satellite images (stereo pair)

b) Map orientation (Ground control point survey will be executed, if necessary.)

c) Digital plotting and compilation

d) Field identification

e) Correction of GIS basic data

From 2026, approximately 15 years later after aerial photography for 1:5,000 scale digital topographic mapping at major five cities, full updating (preparation of new digital topographic maps) of the existing 1:5,000 scale digital topographic maps will be planned using new aerial photos.

6) 1:5,000 scale of digital topographic maps of other local cities

The cities with more than 200,000 population in Bangladesh are shown in Table 10.10.5.

Assuming that the urban base maps should be prepared for the cities with more than 200,000 population in Bangladesh, 1:5,000 scale digital topographic maps showing in Table 10.10.5 should be prepared immediately.

Table 10.10.5 Cities with a population more than 200,000, and 1:5,000 scale topographic maps in Bangladesh

Order	Name of city	Population	District	Division	1:5,000 scale topographic maps
1	Dhaka	12,797,394	Dhaka	Dhaka	Prepared in 2004.
2	Chittagong	3,720,437	Chittagong	Chittagong	Will be published in 2018.
3	Narayanganji	1,572,386	Dhaka	Narayanganji	Prepared in 2004.
4	Khulna	842,995	Khulna	Khulna	Will be published in 2018.
5	Rajshahi	727,083	Rajshahi	Rajshahi	Will be published in 2018.
6	Sylhet	479,837	Sylhet	Shlhet	Will be published in 2018.
7	Tongi	476,350	Dhaka	Gajipur	Prepared in 2004.
8	Comila	407,901	Chittagong	Comila	
9	Mymensingh	407,798	Mymensingh	Mymensingh	
10	Barisal	385,093	Barisal	Barisal	Will be published in 2018.
11	Rangpur	294,265	Rangpur	Rangpur	
12	Bogra	266,930	Rajshahi	Bogra	
13	Cox's Bazar	223,522	Chittagong	Cox's Bazar	
14	Gazipur	213,061	Dhaka	Gazipur	Prepared in 2004.
15	Jessore	201,796	Khulna	Jessore	

Source: Population statistic (2011), Wikipedia

As shown in Table 10.10.5, the cities with more than 200,000 population, which are not covered by the existing 1:5,000 scale digital topographic maps, are Comila, Mymensingh, Rangapure, Bogra, Cox's Bazar and Jessore (total 6 cities).

Preparation of 1:5,000 scale digital topographic maps covering these 6 cities will be planned after completion of new 1:5,000 scale digital topographic mapping at Dhaka Metropolitan Area. The work items for the preparation of 1:5,000 scale of these 6 cities are as follows:

a) Aerial photography
   Aerial photography is planned to be executed at last half of 2022.

b) Target cities
Comila, Mymensingh. Rangapure, Bogra, Cox's Bazar and Jessore

c) Ground control point survey
The existing GPS points, BMs will be used as much as possible, and additional ground control points will be established at the necessary locations.

d) Field identification
The existing data will be used as much as possible to reduce the volume of field identification work.

e) Aerial triangulation

f) Digital plotting and compilation

g) Preparation of GIS basic data

Approximately 8 years after completion of the preparation of 1:5,000 scale digital topographic map at other local cities (around 2030), partial updating will be planned.

Therefore, procurement of satellite images (stereo pair images) will be planned for the secular change correction (partial correction) of the 1:5,000 scale topographic maps.

7) 1:50,000 scale topographic maps and small scale maps

1:50,000 scale topographic maps and more small scale maps will be updated and compiled using the data and information of secular change correction or newly prepared data for 1:25,000 scale and 1:5,000 scale digital topographic maps.

In principle, 1:50,000 scale topographic maps and more small scale maps will be planned every four years or timely.

10.10.4 Necessary cost for the preparation and updating of geospatial information data

The necessary cost for preparation and updating of geospatial information data (digital topographic maps) are estimated as follows:

1) Aerial photography cost (approximately every 5 years)

2018	Aerial photography for 1:5,000 scale digital topographic mapping at Dhaka Metropolitan area will be executed.
2022	Aerial photography for 1:5,000 scale digital topographic mapping at remaining other local cities will be executed.

2026 Aerial photography for full updating of 1:5,000 scale digital topographic maps at major 5 cities will be executed.

2031 Aerial photography for full updating of 1:25,000 scale digital topographic maps covering whole Bangladesh and 1:5,000 scale digital topographic maps at Dhaka Metropolitan Area will be executed.

US$750,000.- is allocated for aerial photography cost in 2018. The aerial photography costs in 2022 and 2026 are calculated considering the inflation rate in Bangladesh.

2) Satellite image data procurement cost (approximately every 5 years)

2021 Satellite images at the heavy secular changed area of 1:25,000 scale digital topographic maps and 1:5,000 scale digital topographic maps at 5 major cities will be procured.

2026 Satellite images at the heavy secular changed area of 1:5,000 scale digital topographic maps of Dhaka Metropolitan Area will be procured.

2030 Satellite images at the heavy secular changed area of 1:5,000 scale digital topographic maps of other local cities will be procured.

US$100,000.- is allocated for the procurement of satellite images in 2021. The amounts of satellite images procurement in 2026 and 2030 are calculated considering the inflation rate in Bangladesh.

3) Digital topographic mapping cost (every year)

The specific amount for ground control point survey, field identification, office works and so on of SOB are allocated every year.

US$300,000.- is allocated in 2018 for the digital topographic mapping cost. The necessary digital topographic mapping costs after 2018 are calculated considering the inflation rate in Bangladesh.

4) Activities cost of all government organizations concerning NSDI (every year)

The specific amount for the activities relating NSDI and data preparation by each organizations in Bangladesh are allocated every year.

US$100,00.- is allocated in 2018 for the activities relating NSDI and data preparation by each organizations respectively (total 43 ministries) in Bangladesh.

The necessary cost after 2018 will be calculated considering the inflation rate in Bangladesh.

The amount of costs allocated at each year are shown in Aannex-10, Annex-11 and Annex-12

respectively.

10.11 Cost and effect of NSDI in Bangladesh

The cost and effect of the construction of NSDI in Bangladesh is as follows:

10.11.1 Condition setting for the estimation of cost and effect of NSDI in Bangladesh

Following two necessary values for the calculation of cost and effect of NSDI in Bangladesh were estimated as mentioned above.

a) Cost for NSDI platform construction, maintenance, operation and updating

b) Cost reduction effect by utilization and mutual utilization of geospatial information on NSDI

However, only these two values are not enough for the calculation of cost and effect of the construction of NSDI in Bangladesh.

Following pre-conditions have to be set for the calculation of cost and effect on NSID in Bangladesh.

1) Setting of commencing time for the estimation of cost and effect of NSDI in Bangladesh

The beginning of 2018 Bangladesh budget year (July 2018) was decided as the starting point for the calculation of cost and effect of NSDI in Bangladesh.

2) Inflation rate in Bangladesh

For the calculation of operation and maintenance cost, platform updating cost, preparation and updating of geospatial information data at each year, it is necessary to consider inflation rate in Bangladesh.

Inflation rate in 2014 (7.35%=1.07) was applied for the calculation of operation and maintenance cost, platform updating cost, preparation and updating of geospatial information data at a year.

3) Increasing rate of Bangladesh government budget

The cost reduction effect of NSDI in Bangladesh is calculated based on the amount of financial cooperation by the donor countries and international organizations, and also the development budget of the Government of Bangladesh.

It is considered that the amount of cost reduction effect on the development project of the Government of Bangladesh will increase according to the increase of budget of the Government of

Bangladesh. Therefore, it is necessary to set up factor for the calculation of Bangladesh Government's budget increase.

The increasing ratio of general expenditure of the Government of Bangladesh between 2014 and 2015 budget year was applied for the calculation of cost reduction effect on the Development budget of the Government of Bangladesh.

4) Factors relating progress of NSDI and GIS utilization of each organizations

As mentioned previously, the coordinates system and elevation datum adopted by the organizations of the Bangladesh Government are different.

At least, without solving these two issues, mutual geospatial information data utilization among the organizations of the Bangladesh Government may be difficult.

Furthermore, utilization of geospatial information data and GIS capability of each Bangladesh Government organization are different. Therefore, cost reduction effect of NSDI will not be developed immediately after the construction of NSDI in Bangladesh.

The cost reduction effect of NSDI in Bangladesh described in Clause 10.6 is calculated on the condition that all relating organizations in Bangladesh are able to utilize the geospatial information data and other data effectively.

Therefore, cost reduction effect described in Clause 10.6 is not able to use for the calculation of cost and effect from the starting period.

To decide this factor, it is necessary to investigate the present situation of geospatial information data utilization and GIS capability of each organizations relating NSDI in Bangladesh.

However, due to the short project period, it is difficult to investigate the present situation of geospatial information data utilization and capability of each organizations relating NSDI in Bangladesh.

Therefore, the progress of geospatial information data utilization on NSDI of each organizations in Bangladesh is presumed as follows:

a) The factor for the utilization of geospatial information data during NSDI construction period is decided as "0" due to the un-availability of NSDI platform.

b) The factor for the utilization of geospatial information data after construction of NSDI platform, following three cases are calculated.

   Case-1
   Utilization of geospatial information data on NSDI by the organizations relating NSDI will increase 10% per year.

Case-2
Utilization of geospatial information data on NSDI by the organizations relating NSDI will increase 15% per year.

Case-3
Utilization of geospatial information data on NSDI by the organizations relating NSDI will increase 20% per year.

5) Annual maintenance and operation cost of NSDI and NSDI platform updating interval

Annual maintenance and operation cost of NSDI and updating interval of NSDI platform were set as follows:

a) The maintenance and operation cost of NSDI platform is shown in Clause 10.8. The maintenance and operation cost of NSDI after 2018 was calculated considering inflation rate.

b) The updating interval of NSDI platform was decided as 7 years (Refer to Clause 10.9). The cost of updating of NSDI platform was calculated considering the inflation rate.

6) Updating interval of CORS

The updating interval of CORS was set as follow.

a) 1/3 of total number of CORS will be necessary to update by the end of next decade.

b) After that time. 1/3 of total number of CORS will be necessary to update at every 5 years.

7) Condition setting of initial investment cost and progress of NSDI utilization

Concerning the cost of NSDI, the cost including the initial investment cost of NSDI platform and CORS, and the cost excluding the initial investment cost of NSDI platform and CORS were calculated.

Furthermore, three cases of 10% up of NSDI utilization per year, 15% up of NSDI utilization per year and 20% up of NSDI utilization per year were estimated for cost reduction effect.

Table 10.11.1 shows the 6 cases of cost and effect estimation of NSDI based on the above-mentioned precondition.

Table 10.11.1 Calculation of cost and effect of NSDI in Bangladesh

Case		Utilization factor of NSDI	Initial investment cost		Maintenance/ operation cost	
			NSDI	CORS	NSDI	CORS
Case-1	Case-A	10% up per year	×	×	○	○
	Case-B		○	○	○	○
Case-2	Case-A	15% up per year	×	×	○	○
	Case-B		○	○	○	○
Case-4	Case-A	20% up per year	×	×	○	○
	Case-B		○	○	○	○

Note: ○：including　　×：Not including

Source: The Project Team

10.11.2 Cost and effect of NSDI in Bangladesh

Considering the above-mentioned precondition, annual necessary cost and cost reduction effect from 2018 to 2032 were calculated. Figure 10.11.1, 10.11.2 and 10.11.3 show the calculation results of annual necessary cost and cost reduction effect of NSDI in Bangladesh.

Figure 10.11.1 shows the cost and effect of NSDI in Bangladesh in case of 10% up of NSDI and GIS utilization per year. Green line on the figure shows the cost and effect of NSDI including the initial investment cost of NSDI platform and CORS. Blue line on the figure shows the cost and effect of NSDI excluding the initial investment cost of NSDI platform and CORS.

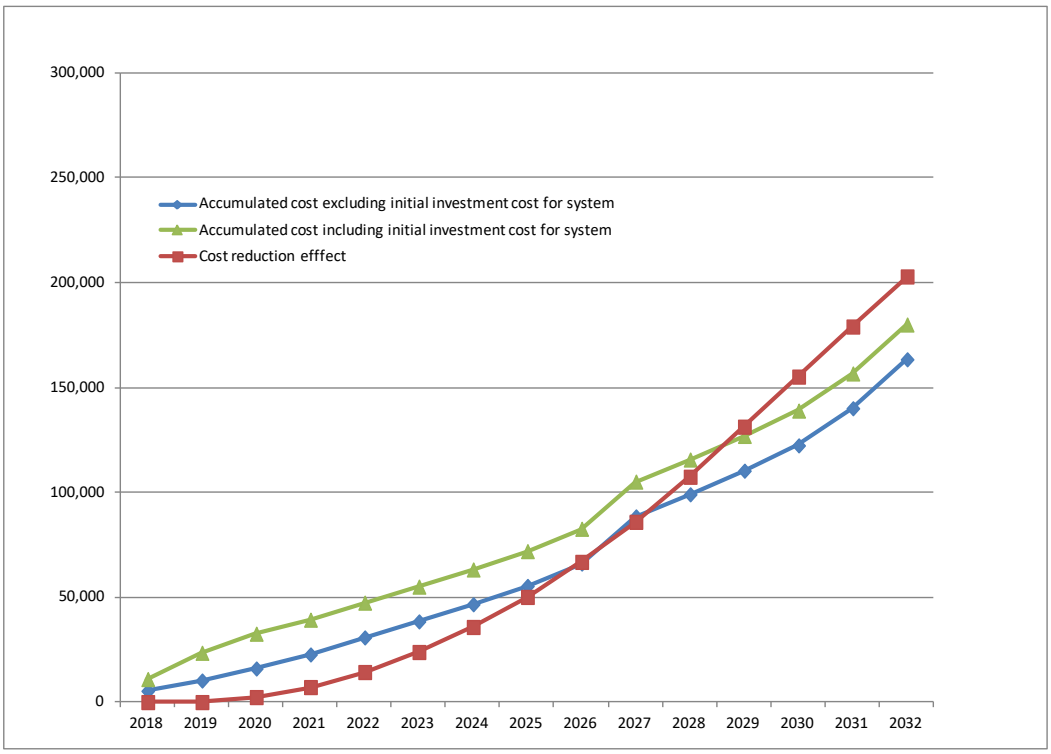


Figure 10.11.1 Cost and effect of NSDI in Bangladesh
(In case of 10% up of NSDI utilization per year)

Source: The Project Team

Figure 10.11.1 shows the following phenomenon.

a) After starting NSDI platform in 2018, the cost reduction effect will not executed the total cost of NSDI platform of construction, maintenance and operation, NSDI platform updating, data preparation and updating for a while.

b) The time when the cost reduction effect exceeds the total cost of NSDI platform construction, maintenance and operation, updating of NSDI platform, data preparation and updating is 2026 (8 years after starting NSDI platform construction in 2018) in case of not including initial cost of NSDI platform construction, and is 2029 (11 years after starting NSDI platform construction in 2018) in case of including initial cost of NSDI platform construction.

c) Once the cost reduction effect exceeds the total cost of NSDI platform construction, maintenance and operation, updating NSDI platform, data preparation and updating, the difference between cost reduction effect and total cost will increase year by year.

d) At the time of NSDI system platform updating, the difference between cost reduction and total cost will become small.

Figure 10.11.2 shows the cost and effect of NSDI in Bangladesh in case of 15% up of NSDI and GIS utilization per year.

Green line on the figure shows the cost and effect of NSDI including the initial investment cost of NSDI platform and CORS. Blue line on the figure shows the cost and effect of NSDI excluding the initial investment cost of NSDI platform and CORS.

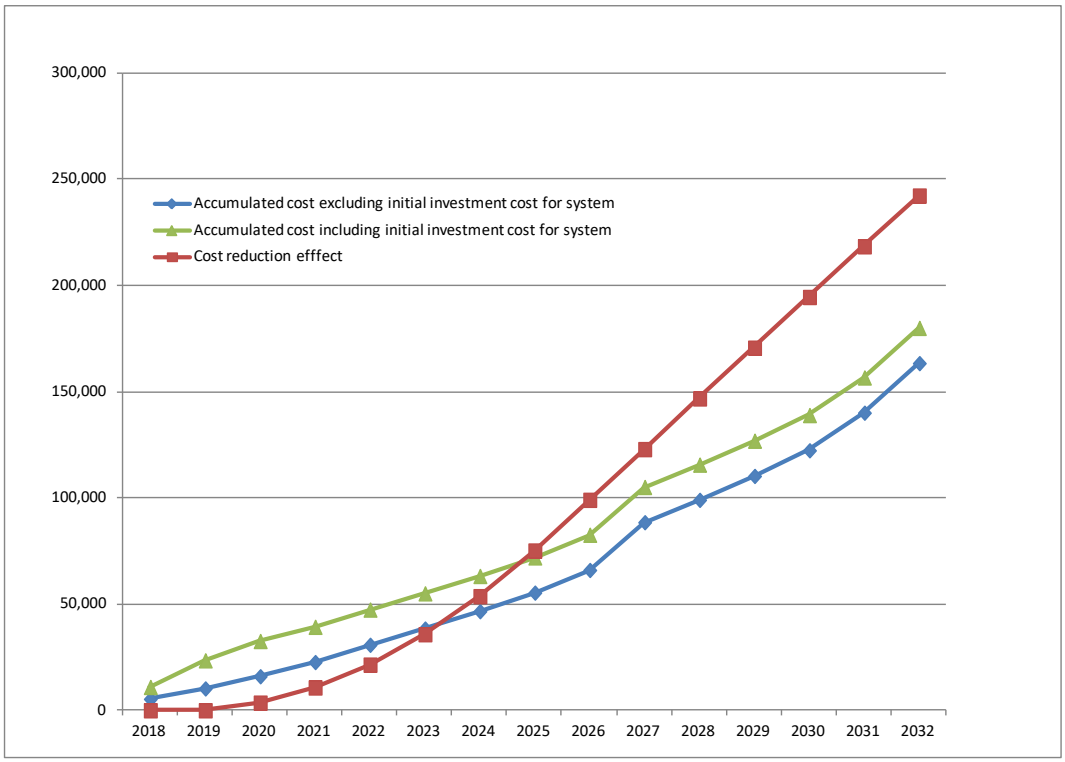


Figure 10.11.2 Cost and effect of NSDI in Bangladesh
(In case of 15% up of NSDI utilization per year)

Source: The Project Team

Figure 10.11.2 shows the following phenomenon.

a) After starting NSDI platform in 2018, the cost reduction effect will not executed the total cost of NSDI platform of construction, maintenance and operation, NSDI platform updating, data preparation and updating for a while.

b) The time when the cost reduction effect exceeds the total cost of NSDI platform construction, maintenance and operation, updating of NSDI platform, data preparation and updating is 2024 (6 years after starting NSDI platform construction in 2018) in case of not including initial cost of NSDI platform construction, and is 2025 (7 years after starting NSDI platform construction in 2018) in case of including initial cost of NSDI platform construction.

c) Once the cost reduction effect exceeds the total cost of NSDI platform construction, maintenance and operation, updating NSDI platform, data preparation and updating, the difference between cost reduction effect and total cost will increase year by year.

d) At the time of NSDI system platform updating, the difference between cost reduction and total cost will become small.

Figure 10.11.3 shows the cost and effect of NSDI in Bangladesh in case of 20% up of NSDI and GIS utilization per year.

Green line on the figure shows the cost and effect of NSDI including the initial investment cost of NSDI platform and CORS. Blue line on the figure shows the cost and effect of NSDI excluding the initial investment cost of NSDI platform and CORS.

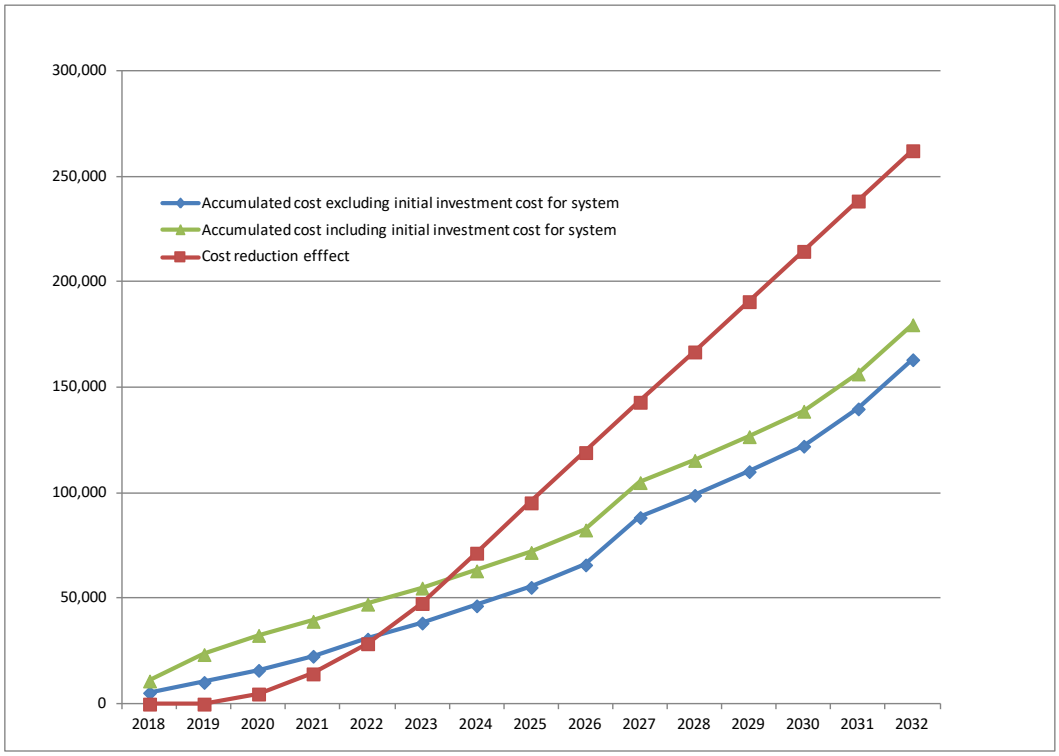


Figure 10.11.3 Cost and effect of NSDI in Bangladesh
(In case of 20% up of NSDI utilization per year)

Source: The Project Team

Figure 10.11.3 shows the following phenomenon.

a) After starting NSDI platform in 2018, the cost reduction effect will not executed the total cost of NSDI platform of construction, maintenance and operation, NSDI platform updating, data preparation and updating for a while.

b) The time when the cost reduction effect exceeds the total cost of NSDI platform construction, maintenance and operation, updating of NSDI platform, data preparation and updating is 2023 (5 years after starting NSDI platform construction in 2018) in case of not including initial cost of NSDI platform construction, and is 2024 (6 years after starting NSDI platform construction in 2018) in case of including initial cost of NSDI platform construction.

c) Once the cost reduction effect exceeds the total cost of NSDI platform construction, maintenance and operation, updating NSDI platform, data preparation and updating, the difference between cost reduction effect and total cost will increase year by year.

d) At the time of NSDI system platform updating, the difference between cost reduction and

total cost will become small.

10.11.3 Important consideration obtained from the estimation of cost and effect of NSDI in Bangladesh

As a result of estimation of cost and effect of NSDI in Bangladesh as shown in Figure 10.11.1, 10.11.2 and 10.11.3, following should be considered for the construction of NSDI in Bangladesh.

a) The effect of NSDI was estimated based on the cost reduction by the utilization of geospatial information on NSDI. Therefore, the time when the cost reduction effect exceed the total cost of construction of NSDI platform, maintenance and operation cost, NSDI platform updating, data preparation and updating will depend on the amount of initial investment for NSDI.

b) The cost of operation, maintenance and updating of NSDI platform will increase according to the cost of initial investment cost, and these cost must be allocated by the Government of Bangladesh.

   Therefore, too much initial investment for the construction of NSDI platform should be avoided, even though NSDI platform is to be constructed by the financial assistance by foreign country or international organization.

   NSDI platform should be upgraded according to the increase of demands for NSDI and also computer and IT technology development.

c) To develop cost reduction effect early, it is necessary to promote the utilization of NSDI and GIS at each organization concerning NSDI.

   Therefore, not only the construction of NSDI platform but also development of legal systems, promotion of NSDI utilization including GIS technology, technical issue resolution, human development and so on are important factors for NSDI.

d) This estimation of cost and effect of NSDI calculated based on the comparison between the total cost of initial investment for NSDI platform, maintenance and operation of NSDI, NDSI platform updating, data preparation and updating and the cost reduction effect by the utilization of geospatial information data on NSDI.

To increase the effect of NSDI, it is necessary to cultivate new business using geospatial information data on NSDI. Because, it is considered that cost reduction effect by the utilization of geospatial information data on NSDI has limitations.

The typical business using geospatial information data on NSDI are as follows:

- Door-to-door delivery business (ex. Amazon)
- Taxi delivery system

- Traffic jam information service
- Car navigation system
- Marketing business using NSDI

Also, in Bangladesh, it is necessary to develop a new business using geospatial information on NSDI by government- academy-business complex.

As a result, new employment will be created, economic activities will be revitalized, and Bangladesh economic growth will be increased, and this is the final target of NSDI.

Chapter 11 NSDI Contributors Meeting and Workshop

Chapter 11 NSDI Contributors Meeting and Workshop

The outline of the contributors meetings and workshop which were held during the Project period are described below.

11.1 The 1st NSDI contributors meeting

The outline of the 1st NSDI contributors meeting are described below.

11.1.1 Date and program of the 1st NSDI contributors meeting

The 1st NSDI contributors meeting was arranged by SOB before staring the Project, and was held on 15 May 2017, immediately after the Project team arrived at Dhaka for the 1st visit to Bangladesh.

The date, place, purpose of meeting and attending organizations of the 1st NSDI contributors meeting are as follows:

Date: 15 May 2017 10:30 - 13:30
Place: Mirpur office of SOB (Digital Mapping Center)
Purpose:

a) Explanation of the purpose of NSDI contributors meeting
b) Explanation of the Project and request for cooperation for the Project
c) Explanation of GeoDASH and capability of cooperation between NSDI and GeoDASH
d) Explanation of case example relating geospatial information and NSDI
e) Exchange of opinions

Program:

a) Opening speech by Surveyor General of SOB
b) Speech by Senior Representative of JICA Bangladesh Office
c) Explanation of NSDI concept and case example of NSDI in foreign country by Mr. Urabe, JICA long-term expert
d) Explanation of outline of GeoDASH by BCC
e) Explanation of the purpose of the Project and request for cooperation for the activities of the Project Team
f) Explanation of case example by Professor Dr. Shibasaki Ryosuke, Tokyo University
g) Exchange of opinions
h) Summary of the discussion by Surveyor General of SOB

11.1.2 Participating organizations of the 1st NSDI contributors meeting

Table 11.1.1 shows the participating organizations of the 1st NSDI contributors meeting. SOB sent

the invitation letter for the 1st NSDI contributors meeting to 18 Bangladesh government organizations, and 14 Bangladesh government organizations participated in the 1st NSDI contributors meeting.

Table 11.1.1 Participating organizations of the 1st contributors meeting

No.	Organizations participated in the 1st NSDI contributors meeting
1	Ministry of Defence (MOD)
2	Bangladesh Bureau of Statistics (BBS)
3	Space Research and Remote Sensing Organization (SPARRSO)
4	Local Government Engineering Department (LGED)
5	Rajshahi Unnayan Kartripakkha (RAJUK)
6	Geological Survey of Bangladesh (GSB)
7	Bangladesh Agricultural Development Cooperation (BADC)
8	Department of Land Records & Surveys (DLRS)
9	Bangladesh Metrological Department (BMD)
10	Department of Disaster Management (DDM)
11	Dhaka North City Corporation (DNCC)
12	Dhaka South City Corporation (DSCC)
13	Bangladesh Computer Council (BCC)
14	World Bank
No.	Organizations not participated in the 1st NSDI contributors meeting
1	Roads and Highways Department (RHD)
2	Bangladesh Water Development Board (BWDB)
3	Water and Sewerage Authority (WASA)
4	Access to Information Programme (a2i)

Source: The Project Team

11.1.3 Opinions and suggestion from the participating organizations

The comments and opinions from the participating organization of the 1st NSDI contributors meeting are as follows:

a) It is agreed the Project Team's opinion that NSDI in Bangladesh should be constructed considering the present situation of Bangladesh. Therefore, NSDI in Bangladesh should not be the same as NSDI in Japan and also NSDI in Indonesia.

b) For the construction and operation of NSDI, strong leadership is necessary. SOB is the national survey and mapping organization in Bangladesh, and the geospatial information is the basic data for NSDI. Therefore, SOB should act as a leader for the construction of NSDI in Bangladesh.

c) GeoDASH already constructed the Geo-Portal, and it is considered that GeoDASH will be able to cooperate the construction and operation of NSDI.

d) The issues caused by the difference of projection and spheroid used by the Bangladesh government organizations, and the necessity of solving these issues are recognized by the many Bangladesh government organizations.

e) It is considered that National Data Center should be involved in the operation of NSDI.

f) Concerning the explanatory text on the system, not only English version, but also Bengali version will be necessary.

11.2 The 2nd NSDI contributors meeting

The outline of the 2nd NSDI contributors meeting are described below.

11.2.1 Date and program of the 2nd NSDI contributors meeting

SOB arranged the 2nd NSDI contributors meeting based on the request from the Project Team to SOB.

The date, place, purpose of meeting and attendants of the 2nd NSDI contributors meeting are as follows:

Date: 9 August 2017 10:30 - 13:30
Place: Mirpur office of SOB (Digital Mapping Center)
Purpose:

a) Explanation and discussion of basic concept for the preparation of NSDI road map to the organizations concerned NSDI in Bangladesh
b) Explanation of the outline of the construction of Geo-Portal (prototype version) of SOB to the organizations concerned NSDI in Bangladesh, and request for their cooperation in this matter
c) Discussion of the basic concept for the preparation of NSDI road map in Bangladesh with the organization concerning NSDI in Bangladesh
d) Opinion exchange

Program:

a) Opening address by Surveyor General of SOB
b) Speech by representative of JICA Bangladesh Office
c) Explanation of basic concept for the preparation of NSDI road map (plan) in Bangladesh, and necessary activities for the construction of NSDI in Bangladesh by the Project Team
d) Explanation of outline and purpose of the construction of Geo-Portal (prototype) of SOB by the Project Team
e) Explanation of the concept of NSDI in Bangladesh by the Project Team
f) Explanation of case example of the utilization of NSDI by Prof. Md. Mafizur Rahman, Department of Civil Engineering, BUET
g) Opinion exchange
h) Summary of the discussion by Joint Secretary of MOD

11.2.2 Participating organizations of the 2nd NSDI contributors meeting

Table 11.2.1 shows the participating organizations of the 2nd NSDI contributors meeting. SOB sent the invitation letter for the 2nd NSDI contributors meeting to 21 Bangladesh government organizations, and 15 Bangladesh government organizations participated in the 2nd NSDI contributors meeting.

Table 11.2.1 Participating organizations of the 2nd NSDI contributors meeting

No.	Organizations participated in the 2nd NSDI contributors meeting
1	Ministry of Defence (MOD)
2	Bangladesh Metrological Department (BMD)
3	Department of Civil Engineering, BUET
4	Local Government Engineering Department (LGED)
5	Rajshahi Unnayan Kartripakkha (RAJUK)
6	Water and Sewerage Authority (WASA)
7	Geological Survey of Bangladesh (GSB)
8	Department of Land Records & Surveys (DLRS)
9	Access to Information Programme (a2i)
10	Dhaka North City Corporation (DNCC)
11	Dhaka South City Corporation (DSCC)
12	Bangladesh Computer Council (BCC)
13	Department of Disaster Management (DDM)
14	World Bank (WB)
15	Institute of Water Modeling (IWM)
16	JICA Bangladesh Office
17	Project Team for Making the Road Map to Establishing NSDI
No.	Organizations not participated in the 2nd NSDI contributors meeting
1	Bangladesh Bureau of Statistics (BBS)
2	Space Research and Remote Sensing Organization (SPARRSO)
3	Roads and Highways Department (RHD)
4	Bangladesh Water Development Board (BWDB)
5	Bangladesh Agricultural Development Cooperation (BADC)
6	Center for Environmental and GIS (CEGIS)

Source: The Project Team

11.2.3 Opinions and suggestion from the participating organizations

The comments and opinions from the participating organization in the 2nd NSDI contributors meeting are as follows:

a) The Project Team emphasized that the construction of NSDI platform is not a final target, this is the first step for the construction of NSDI. Many activities before, during and after the construction of NSDI platform will be necessary for the construction, promotion and utilization of NSDI. The organizations participating the 2nd NSDI contributors meeting agreed it.

b) The Project Team explained that NSDI should be included in the 8th Five Year Plan and Digital Bangladesh, which is the national policy of the Government of Bangladesh, for the

construction, promotion and utilization of NSDI in Bangladesh.

c) The Project Team explained that the geospatial information is the fundamental data on NSDI, and SOB will be requested to release the geospatial information data on NSDI. Therefore, SOB should make a data policy on NSDI, and also SOB should explain the data policy on NSDI to the organizations relating NSDI.

   The opinion that not only SOB but also all organization relating NSDI have to be make a data policy on DSI was suggested from the organization participating in the 2nd NSDI contributors meeting.

d) Concerning the activities necessary for the construction and operation of NSDI, the importance of geospatial information standards was suggested from the organization participating in the 2nd NSDI contributors meeting, and how to make a geospatial information standards in Bangladesh was discussed among the participating organizations.

e) Regarding the difference of projection and ellipsoid used by the Bangladesh government organizations, it is necessary to execute the coordination conversion. However, it is recommended that the coordination conversion should be one time considering the degradation of horizontal accuracy by the many times coordination conversion.

   The Project Team explained that it is not recommended to execute coordination conversion over and over again from the viewpoint of horizontal accuracy.

   However, the necessary horizontal accuracy should be judged from the viewpoint of utilization purpose of geospatial information data. In case that the discrepancy of horizontal data caused by the coordination conversion is less than the required accuracy, it is considered that the discrepancy caused by the coordination conversion may not become a serious issue.

f) It is necessary to solve the issue caused by the difference of elevation datum used by Bangladesh Water Development Board (BWDB) and SOB. Also, there is a issue that the discrepancy of elevations between the benchmarks of BWDM and SOB are not same.

   SOB explained that geodetic network consisting GPS points and benchmarks covering whole Bangladesh was already established. SOB explained that the solution of this issue is to use SOB's geodetic network by all organizations. For the further explanation and discussion of these issues, SOB proposed that the meeting concerning these issues will be organized by SOB after the 2nd NSDI contributors meeting.

g) The Project Team requested the organization participating in the 2nd NSDI contributors meeting to advise the comments concerning the contents and priority of activities necessary for construction and operation of NSDI, and they agreed it.

11.3 NSDI Workshop

The outline of NSDI workshop are described below.

11.3.1 Date and program of NSDI workshop

NSDI workshop was held to explain NSDI roadmap (plan) in Bangladesh to the organizations concerning NSDI in Bangladesh, and to promote the utilization of NSDI in Bangladesh by the SOB and the Project Team.

The date, place, purpose of meeting and attendants of NSDI workshop are as follows:

Date: 12 September 2017 9:30 - 15:00
Place: Pan Pacific Sonargaon Hotel
Purpose:

a) Explanation of NSDI roadmap (plan) in Bangladesh and opinion exchange
b) Explanation of cost and effect of NSDI in Bangladesh, and opinion exchange concerning the promotion of utilization of geospatial information data on NSDI
c) Explanation of outline of Geo-Portal of SOB (prototype), and opinion exchange

Program:

a) Opening address by Surveyor General of SOB
b) Speech by the senior representative of JICA Bangladesh Office
c) Key note presentation by Professor Dr. Shibasaski Ryosuke, Tokyo University
d) Key note presentation by Prof. Md. Mafizur Rahman, Department of Civil Engineering, BUET
e) Explanation of NSDI roadmap (plan) in Bangladesh by the Project Team
   Explanation of cost and effect of NSDI in Bangladesh by the Project Team
f) Opinion exchange concerning above
g) Explanation of Geo-Portal (prototype) of SOB by Mr. Urabe, long-term expert
h) Panel discussion
i) Summary of panel discussion by Prof. Dr. Shibasaki Ryosuke, Tokyo University
j) Closing address by the Additional Secretary of MOD

11.3.2 Participating organizations of NSDI workshop

Table 11.3.1 shows the participating organizations of NSDI workshop. SOB sent the invitation letter for NSDI workshop to 39 organizations, and 24 organizations participated in NSDI workshop.

Table 11.3.1 Participating organizations of NSDI workshop

No.	Organizations participated in NSDI workshop
1	Ministry of Defence (MOD)
2	Bangladesh Metrological Department (BMD)
3	Space Research and Remote Sensing Organization (SPARRSO)
4	Department of Civil Engineering, BUET
5	Local Government Engineering Department (LGED)
6	Rajshahi Unnayan Kartripakkha (RAJUK)
7	Bangladesh Water Development Board (BWDB)
8	Water and Sewerage Authority (WASA)
9	Geological Survey of Bangladesh (GSB)
10	Department of Land Records & Surveys (DLRS)
11	Access to Information Programme (a2i)
12	Dhaka South City Corporation (DSCC)
13	Bangladesh Computer Council (BCC)
14	Department of Disaster Management (DDM)
15	Institute of Water Modeling (IWM)
16	Urban Development Department (UDD)
17	Dhaka Electric Supply Company Limited (DESCO)
18	Bangladesh Power Development Board (BPDB)
19	Dhaka Power Distribution Company Limited (DPDC)
20	Bangladesh Rural Electrification Board (REB)
21	Water Resources Planning Organization (WARPO)
22	Department of Environment
23	Directorate of Primary Education
24	Military Institute of Science and Technology (MIST)
25	JICA Bangladesh Office
26	Project Team for Making the Road Map to Establishing NSDI
No.	Organizations not participated in NSDI workshop
1	Bangladesh Bureau of Statistics (BBS)
2	Roads and Highways Department (RHD)
3	Bangladesh Agricultural Development Cooperation (BADC)
4	Dhaka North City Corporation (DNCC)
5	Center for Environmental and GIS (CEGIS)
6	Bangladesh Road Transport Authority (BRTA)
7	Forest Department
8	Directorate of Secondary and Higher Education
9	Dhaka University
10	Jahanginagar University
11	BRAC University
12	Sher-e-Bangla Agriculture University
13	Bangladesh Inland Water Transport Authority (BIWTA)
14	Bangladesh Energy Regulatory Commission (BERC)
15	Bangladesh Telecommunication Regulatory Commission (BTRC)

Source: The Project Team

11.3.3 Opinions and suggestion from the participating organizations

The comments and opinions from the participating organization in NSDI workshop are as follows:

a) Many organizations recognize that the geospatial information which will be released on NSDI

will be useful for their own works. However, for the mutual utilization of geospatial information by many organizations, the unified standard and the structure for the mutual data utilization are necessary.

b) Several organizations in Bangladesh are already preparing and using the geospatial information by themselves, and BCC already constructed the mutual data utilization system. Therefore, cooperation and discussion among these organizations are essential for the smooth construction and operation of NSDI in Bangladesh.

c) By the mutual utilization of the data, not only the base maps but also the thematic information possessed by the organizations, the work efficiency of organizations will become improved. Therefore, the structure for mutual data utilization of the thematic information possessed by the organizations are necessary.

d) Some organization expressed an opinion to cooperate the construction and operation of NSDI considering the effect by the mutual data utilization and circulation of geospatial information by NSDI.

e) For the construction and operation of NSDI, the discussion and arrangement among many organizations and persons will be necessary. Therefore, it is necessary to hold a high level meeting to build consensus, and also to hold a working level meeting to discuss the specific technical issues.

f) All organizations possessing the geospatial information have to prepare a data policy.

g) NSDI will be able to contribute to the high quality and equitable education and lifelong education.

11.3.4 Questionnaire survey to the participating personnel

To grasp the intelligibility of NSDI and request for NSDI, questionnaire survey to the participants in NSDI workshop was executed. Table 11.3.2 shows the results of questionnaire survey.

Table 11.3.2 Questionnaire survey results to the participating personnel

Question		Strongly agree	Agree	Disagree	Strongly disagree	No answer
a	I understand about the objectives of this workshop.	30	10	0	0	0
b	This workshop lived up to my expectations.	18	20	2	0	0
c.	I recognized important things in order to establish NSDI.					
i.	Legal framework	32	8	0	0	0
ii.	NSDI promotion structure	27	10	2	0	1
iii.	Geographic information standards	31	7	1	0	1
iv.	Sharing geospatial information	33	7	0	0	0
v.	Preparation and updating of geospatial information	31	8	0	0	1
vi.	Human resources development	29	10	1	0	0
vii.	ICT system/service (NSDI platform system)	27	12	0	0	1

Question		Strongly agree	Agree	Disagree	Strongly disagree	No answer
viii.	Protection of personal information	26	11	0	0	3
d.	I recognized the roles of SOB and related institutions for NSDI.	25	13	0	1	1
e.	I understood NSDI would be incorporated into the Digital Bangladesh & the 6th Five Year Plan.	28	10	2	0	0
f.	The work shop enabled me to apply the topic in my work.	13	23	2	0	2
g.	The presenter(s) was knowledgeable about the subject.	25	15	0	0	0
h.	I had a productive discussion in this workshop.	15	19	1	0	5
i.	I would like to share the result of this workshop to others.	25	15	0	0	0
j.	The materials provided me useful information.	25	15	0	0	0

Source: The Project Team

Many participants understood the purpose of this NSDI workshop, and recognized that it is necessary to execute activities of every particular items shown in NSDI roadmap (plan) for the construction of NSDI in Bangladesh.

The Project Team explained that NSDI in Bangladesh should be incorporated in the 8th Five Year Plan in Bangladesh for the smooth construction and promotion of NSDI. However, there is a comment that this is not so important and the necessity is low.


JICA

Annex

Annex

Annex-1 Minutes of Meeting for Inception Report

Minutes of Meeting for Inception Report
of
Project for Strengthen the Capability on Advance Mapping of SOB
for
Building Digital Bangladesh
(Making the Roadmap to Establishing NSDI)

The short term experts project team for "Project for Strengthen the Capacity on Advanced Mapping of SOB for Building Digital Bangladesh (Making the Roadmap to Establishing NSDI) arrived at Dhaka, Bangladesh on 6th May 2017 and submitted 10 copies of Inception Report of this Project to SOB on 7th May 2017.

Inception Report explanation meeting to SOB by the short term experts project team was held on 7th afternoon at SOB office.

The short term experts project team explained the objectives, contents of activities and work schedule and so on to SOB, and also requested SOB to support the activities of short term experts project team and to provide the necessary information and data for this Project and SOB agreed them.

Finally, both parties basically agreed the contents of Inception Report.

The attendants of the Inception Report explanation meeting are shown on the Attachment.

11th May 2017

Mr. Toru Watanabe
Leader of Short Term Experts Team for
Project for Strengthen the Capacity on
Advanced Mapping of SOB for
Building Digital Bangladesh
(Making the Roadmap to Establishing NSDI)

for 11.5.17

Mr. M. A, Rouf Howlader
Director of Defense Survey
Survey of Bangladesh

Attachment

List of Attendants

1. SOB Side

Mr. M. A. Rouf Howlader	Director of Defense Survey, SOB
Mr. Md. Abul Kalam	Director of Development Survey, SOB
Maj. Suja	Deputy Director, Cartography, SOB
Mr. Ganesh Chandra Roy	Assist. Director, Geodesy, SOB
Mr. Md. Mosharaf Hossain	Deputy Director, Administration, SOB
Mr. Bokuro Urabe	JICA Long Term Expert

2. Short Term Experts Side

Mr. Toru Watanabe	Leader/NSDI Planning
Mr. Zenichi Chiba	Legal Framework

3. Date, Time and Location

Date	7th May 2017
Time	14:00～15:00
Location	Office room of Director of Defense Survey

Annex-2 Minutes of Meeting for Progress Report

Minutes of Meeting for Progress Report
of
Project for Strengthen the Capability on Advanced Mapping of SOB
for
Building Digital Bangladesh
(Making the Roadmap to Establishing NSDI)

The short term experts project team for "Project for Strengthen the Capability on Advanced Mapping of SOB for Building Digital Bangladesh (Making the Roadmap to Establishing NSDI)" arrived at Dhaka, Bangladesh on 8th July 2017 and submitted 10 copies of Progress Report of this Project to SOB on 9th July 2017.

Several times discussion concerning the Progress Report between SOB and the Project Team was held after the Project Team submitted the Progress Report to SOB.

Followings are main discussion items on the Progress Report.

1) In SOB, the maps to be opened to the public is called as "Open series maps" and also, the maps to be open to the limited organization is called as "Restricted maps". Therefore, SOB requested to use these words on the Progress Report, and the Project Team agreed this.

2) Generally, in Bangladesh, "mid term" is used instead of "middle term". Therefore, SOB requested the Project Team to correct it, and the Project Team agreed it.

3) There are several spelling mistakes and abbreviation word on the Progress Report. Therefore, SOB requested to correct these mistakes and the Project Team agreed it.

4) Concerning Chapter 4, Clause 4.2 Investigation on status of introduction of geographic information standards and its result, following expression is very strict and few staff of SOB has studied the geographic information standards before.

"No one at SOB understand geographic information standards, either." (Page 4-13)

Therefore, SOB requested the Project Team to change this expression and the Project Team agreed it.

Finally, both parties basically agreed the contents of the Progress Report.

The attendants of the discussion on the Progress Report are shown on the Attachments.

16th July 2017

Mr. Toru Watanabe
Leader of Short Term Experts Team for
Project for Strengthen the Capability on
Advanced Mapping of SOB for
Building Digital Bangladesh
(Making the Roadmap to Establishing NSDI)

16.7.17

Mr. Md. Abul Kalam
Director of Development Survey
Survey of Bangladesh

Attachments

List of Attendants

1. SOB Side

Mr. Md. Abul Kalam	Director of Development Survey, SOB
Mr. Ganesh Chandra Roy	Assist. Director , Geodesy, SOB
Mr. Md. Mosharaf Hossain	Deputy Director, Administration, SOB
Mr. Abdul Hossain	Assist. Director, Director of Development Survey Office
Mr. Bokuro Urabe	JICA Long Term Expert

2. Short Term Experts Side

Mr. Toru Watanabe	Leader/ NSDI Planning
Mr. Zenichi Chiba	Legal framework

Annex-3 Minutes of Meeting for Draft Final Report

Minutes of Meeting for Draft Final Report
of
Project for Strengthen the Capability on Advanced Mapping of SOB
for
Building Digital Bangladesh
(Making the Roadmap to Establishing NSDI)

The short term experts project team for "Project for Strengthen the Capability on Advanced Mapping of SOB for Building Digital Bangladesh (Making the Roadmap to establishing NSDI) arrived at Dhaka on 14 October 2017 and submitted 10 copies of Draft Final Report of this Project to SOB on 16 October 2017.

The explanation meeting for Draft Final Report between SOB and the Project Team was held on 23 October 2017 at SOB DMC office at Mirpur.

The main items discussed between SOB and the short term experts project team are as follows:

1) The short term experts project team explained the outline of Draft Final Report and, both parties basically agreed the contents of Draft Final Report.

2) The short term experts project team explained that not only all the government organizations but also academic and private sectors will be participated in NSDI. This mean that the construction and operation of NSDI is a national project of Bangladesh. Therefore, NSDI should be included in the next 5-years plan for the smooth construction and operation of NSDI.

The Surveyor General requested to the short term experts project team to explain the contents of Draft Final Report to Secretary of MOD, especially the relation between NSDI and 5-years plan in Bangladesh, and the short terms experts project team agreed it.

3) The short term experts project team explained that the specifications and configuration of NSDI platform and estimated cost for the construction of NSDI shown in the Draft Final Report is a tentative idea. The specifications and configuration of NSDI platform (full version) and necessary cost have to be reviewed based on the evaluation of NSDI proto type project.

SOB agreed to review the specifications and configuration of NSDI platform (full version) and necessary cost based on the evaluation of NSDI proto type project.

4) The short term experts project team explained the method for the selection of CORS

location from the view points of single RTK survey available area (30km area from CORS) as a reference. Also the short term project team recommended that it is necessary to minimize the single RTK survey non-available area (over 30km area from CORS) as much as possible.
The short term project team also recommended that CORS station should be arranged to be able to use other CORS for single RTK survey even though one CORS become out of order.

SOB is now executing the point selection of CORSs and the comments of the short term experts project team will be counted for the selection of CORSs.

5) The short term experts project team explained that the working group under the Implementation Committee is necessary for the smooth operation and management of NSDI.

SOB agreed the necessity of working group under the Implementation Committee.

The attendants of the Draft Final Report explanation meeting are shown on the Attachment.

24 October 2017

Mr. Toru Watanabe
Leader of Short Term Experts Team for
Project for Strengthen the Capacity on
Advanced Mapping of SOB for
Building Digital Bangladesh
(Making the Roadmap to Establishing NSDI)

Mr. M. A. Rouf Howlader
Director of Defense Survey
Survey of Bangladesh

Attachment

List of Attendants

1. SOB Side

Brigadier General Zakir Ahmed, psc, Surveyor General
M.A. Rouf Howlader, Director of Defense Survey
Md. Abul Kalam, Director of Development Survey
Md. Mosharaf Hossain, Deputy Director of Administration
Major Pankaj Mallik, ASG, Deputy Director (Survey)
Md. Masudur Rahman, Deputy Director
Md. Shafiqur Rahman, Deputy Director
Mr. Nayon Chandra Sarker, Assist. Director of Geodesy
Major Ahsan Kabir, Project Officer
Major Md. Kamal Uddin, Assistant Director (Survey)
Mr. Syed Mohammad Masum, Assistant Director (Survey)
Mr. Ganesh Chandra Roy, Assistant Director
Md. Ibrahim Khalil, Assistant Director
Md. Shahidul Islam, Consultant for server
Mr. Bokuro Urabe, JICA Long-term Expert, Project for Strengthen the Capability on Advanced Mapping of SOB
Ms. Monoara Tamanna Khan, GIS Specialist, Project for Strengthen the Capability on Advanced Mapping of SOB

2. JICA Side

Mr. Hiroaki Nakatsuka, Representative of JICA Bangladesh Office

3. Short Term Experts Project Team

Mr. Toru Watanabe	Leader/NSDI Planning
Mr. Hiroto Fujita	System Concept Design

Project for Strengthen the Capacity on Advanced Mapping of SOB for Building Digital Bangladesh

- Making the Roadmap to Establishing NSDI -

Draft Final Report

23rd October 2017

Survey of Bangladesh (SOB)
Ministry of Defence
The Government of the People's Republic of Bangladesh

JICA Map Administration Expert
Asia Air Survey Co., Ltd.
Kokusai Kogyo Co., Ltd.
Pasco Corporation

Contents of Draft Final Report

*Red character: Today's main topics

Chapter 6

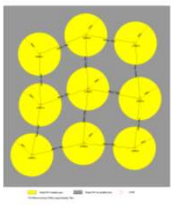
Present status of CORSs and future development policy

Issues to be considered for the establishment of CORSs and datacenter

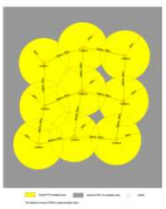
Refer to chapter 6

- Location of CORSs
  - Location plan of CORSs
  - Accessbility around the south delta area, Chittagong hilly area and international border line area
  - Confirmation of land and building ownership for all proposed CORSs
  - Restriction for entering into area
  - Confirmation of building renovation plan
  - Single RTK available area
- Conditions of candidate locations for CORSs
  - Surrounding environment (tree, security, disaster prevention, storm surge, communication, etc.)
- Equipment
  - Moisture proof, lightning surge protect, dust proof
  - Maintenance free/maintenance plan
  - Expansion of existing server, renovation of server room

Single RTK survey available area



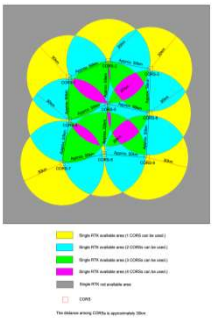
The distance is approx. 70km



The distance is approx. 50km

Single RTK survey available area

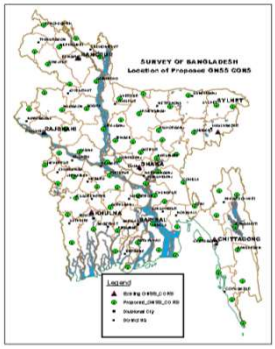
The distance is approx. 30km



It is possible to use other CORS for single RTK survey in case of one CORS is out of order.

Refer to chapter 6

Tentative plan of CORS



Based on this plan, the single RTK survey available area is checked.

Refer to chapter 6

Checking the location of CORS from the view point of single RTK available area

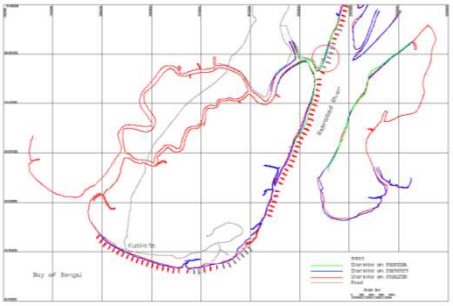
- Some area are not available for single RTK survey
- Around Dhaka Metropolitan Area, it is recommended to arrange the CORSs to be able to use other stations of CODSs for single RTK survey in case of failure of one CORS.

Refer to chapter 6

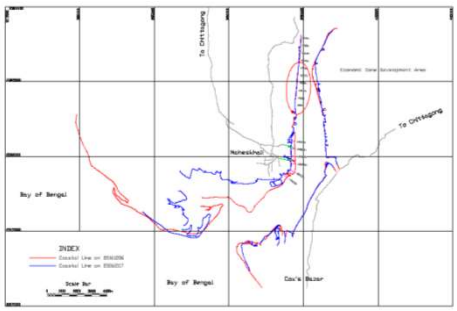
Issues to be considered for the construction of tide observation station

- Location
  - Natural condition (land topography, bathymetric feature, coastal line condition, geology, etc.)
- Natural condition
  - To keep an approximately 1.5m~2.0m water depth at the time of low tide.
  - Not shallow beach
  - No coastal line change
  - No direct influence of ocean weaves
  - Not destroyed by the large ships
  - No influence of water river (river mouth)
- Equipment
  - Float type (in use at Chittagong)
- Coastal line change around the candidate site (proposed)
  - Kuakata
    - Near Payra deep sea port (near by Jetty)
  - Cox's Bazar
    - Opposite shore of economic zone

Candidate site at Kuwakata from the view point of shore line change



Candidate site at Cox's Bazar from the view point of shore line change



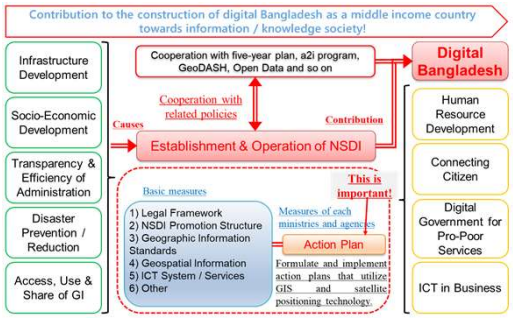
Chapter 8

Roadmap to establish NSDI (proposed)

Refer to chapter 8

Concept of NSDI in Bangladesh (proposed)

- Consistency as national policy



Refer to chapter 8

Points to consider before the formulation of roadmap for establishment of NSDI

- Setting of period for roadmap to construct NSDI
- Review/determination of disclosure range/release method for SOB geospatial information
- Vision for Geo-portal website (Prototype system building)
- NSDI Act (proposed) and NSDI Committee
- Preparation of updated geographic information that matches the demands of NSDI users
- Relationship of NSDI, Digital Bangladesh and five-year plans

Refer to chapter 8

Setting of period for roadmap to construct NSDI

- Preparation : ～June, 2018
- 1st period : July, 2018～June, 2021
- 2nd period : July, 2021～June, 2026 (8th 5-year plan period)
- 3rd period : July, 2026～June, 2031 (9th 5-year plan period)

2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Preparation period	Infrastructure Formation period			Dissemination period					Operation period				
Now - June 2018	July 2018 – June 2021 (3 Years)			July 2021 - June 2026 (8th 5-year plan period)					July 2027 - June 2031 (9th 5-year plan period)				
●Basic Measures ●Formulation of Action Plan				●Implementation of Action Plan					●Implementation of Action Plan				

Refer to chapter 8

Review/determination of disclosure range/release for SOB geospatial information

- Topographic maps prepared/managed by SOB are indispensable for the Geo Portal base map.
- Discussion of to what extent data can be released.
- SOB will clarify the data that can be legally release on NSDI.

Refer to chapter 8

Vision for Geo-portal website (NSDI pilot project)

- NSDI pilot project is;
  - An experimental project of such NSDI using a limited scale of database system powered by GeoDASH platform,
  - To examine the function and performance of NSDI,
  - To research on its benefit,
  - To issues prior to the introduction of full scale NSDI for Bangladesh.
- Evaluation will be scheduled on June, 2018.
- Based on the result of evaluation, it is necessary to define the requirement of NSDI platform.

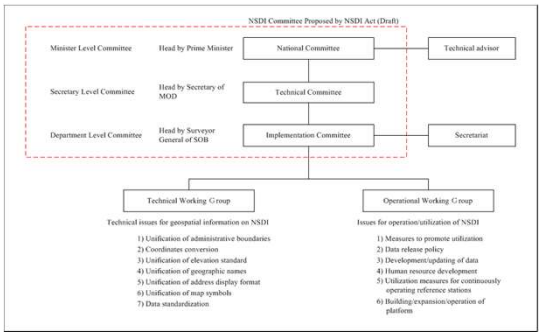
Refer to chapter 8

NSDI Act (proposed) and NSDI Committee

- 3-layer structure level in NSDI Act (proposed)
- High class member on the committee
- In order to build/operate NSDI and promote utilization, many technical and operational issues need to be solved in cooperation with various related agencies.
- 2 Working groups under the Implementation Committee are needed to review the various issues.
  - Technical Working Group
  - Operational Working Group

Refer to chapter 8

Structure of NSDI Committee (proposed)



Refer to chapter 8

Preparation of updated geographic information that matches the demands of NSDI users

- The 1:5,000 scale digital topographic maps that covers Dhaka Metropolitan area is;
  - Prepared and issued in 2004,
  - Aerial photographs are taken in January 2003,
  - 15 years have been already passed.
- Dhaka Metropolitan area has drastically changed during the past 10 years.
- Large portion of the use of NSDI
- In order to match the demands of NSDI users, it is necessary to update the large scale digital topographic map until 2020 which will construct NSDI platform.

Refer to chapter 8

Relationship of NSDI, Digital Bangladesh and five-year plans

- No mention of building, operation and promoting utilization of NSDI in a2i program and 7th 5-year plan.
- Increase in demand for geospatial information required for various types of development planning.
- Indispensable to promote the mutual utilization of geospatial information in NSDI from the point of view of streamlining/speeding up/reducing cost at government agencies.
- It is important that clear rules be established to define building/operation/use promotion of NSDI in which Digital Bangladesh has been set as a policy of the government of the country, and that building/operation/use promotion of NSDI be defined in the next 8th 5-year plan.

Refer to chapter 8

Activity overview of roadmap for establishment of NSDI

No.	Category	1st period	2nd period	3rd period
1	Legal framework	• Passage/announcement of NSD Act/New Survey Act and enactment/announcement of enforcement orders (detailed regulations) • Formulation of short-term/mid-term/long-term plans for establishment/operation of NSDI • Discussion/formulation of data policy at government agencies • Incorporation into 8th 5-year plan, coordination with other policies such as Digital Bangladesh and Open Data	• Formulation of guidelines (personal information protection, secondary use promotion, considerations for safety of country) • Formulation and implementation of action plan at each ministry/agency utilizing geospatial information and satellite positioning	• Formulation and implementation of action plan at each ministry/agency utilizing geospatial information and satellite positioning
2	NSDI promotion system	• Establishment of NSDI Committee (3 level hierarchy) and holding of meetings • Establishment of working group/secretariat • Formulation of operation methods for committee meeting structure • Strengthening of secretariat functions • Setting issues to be discussed within working group and practical discussion	• Holding of meeting of NSDI Committee • Implementation of working group • Building of industrial-academic-government cooperation system and holding of conferences	• Holding of meeting of NSDI Committee • Implementation of working group • Holding of conference of industrial-academic-government cooperation system
3	Geographic information standards	• Establishment of domestic deliberation organization • Study/research of geographic information standards • Formulation of meta data standards, implement preparation/release of domestic standards. • Formulation of standards for quality evaluation methods, data content, product specifications, etc., and domestic standardization • Preparation of product specifications for fundamental base map information • Participation in ISO/TC211 and attendance at general meeting	• Attendance at general meeting in ISO/TC211 • Preparation of domestic standards (profile) for geographic information standards • Formulation and implementation of plan to promote dissemination of geographic information standards	• Attendance at general meeting in ISO/TC211

Refer to chapter 8

Activity overview of roadmap for establishment of NSDI

No.	Category	1st period	2nd period	3rd period
4	Geospatial information	• Definition of fundamental base map information, formulation of information and review/verification of coordinates specifications/updating plan and verification • Preparation of thematic data/verification of updating • Promoting digitization of various geospatial tes conversion • Creation/updating of national digital topographic maps (1:25,000) • Updating of 1:5,000 scale Dhaka City digital topographic maps or creation of 1:2,500 topographic maps • Formulation of digital topographic maps development plans (1:5,000) • Expansion of CORSs/tidal observation stations (Grant aid), formulation of operation and maintenance plan • RTK accuracy evaluation in Dhaka City using CORSs	• Collection of aerial photographs/satellite images and promoting digitization • Updating of national digital topographic maps (1:25,000) • Implementation of digital topographic maps development plans (1:5,000) • Preparation/verification of geospatial information for utility (water supply/sewage, gas, electric power etc.)	• Updating of national digital topographic maps (1:25,000) • Updating of Dhaka City digital topographic maps • Implementation of digital topographic maps development plans (1:5,000)
5	IT service/IT system	• Establishment and development of NSDI platform that includes clearinghouse function • Development and release of metadata creation tool • Review (function requirement) and verification of IT service/system to promote sharing, exchange and circulation of geospatial information • Improvement of application methods for usage (procurement) of SOB digital topographic maps • Demonstration/promotion of utilization of open GIS software • Review of geodetic control points release methods including CORSs, and establishment of observation information distribution system	• Establishment/verification of administrative information (statistics, disaster prevention, land, environment, etc.) provision system (including cooperation with Open Data) • Development/demonstration of model system for local government (cooperation with LGED) • Upgrading GIS and open source software development capability (implementation by focusing on private sector companies using the Japan GSI Partner Network as reference) • Promotion of open GIS software	• Updating NSDI platform

Refer to chapter 8

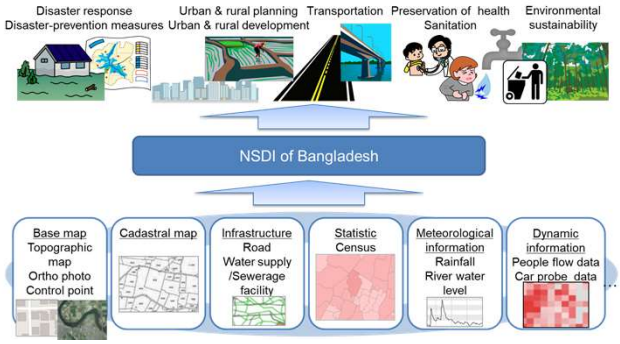
Activity overview of roadmap for establishment of NSDI

No.	Category	1st period	2nd period	3rd period
6	Human resource development/ technology development/ dissemination promotion/ new industry creation	• Review and implementation of human resource development for GIS, including other related ministries and agencies (cooperation with universities, etc.) • Attendance and presentation at international conference, seminars and other events concerning NSDI or geospatial information • Holding of domestic seminars, workshop and other events concerning NSDI • Review of new services/industries utilizing GIS or satellite positioning	• Introduction of and study/research on new technologies that match needs (3D, satellite positioning, MMS, drone etc.) • Dissemination of GI to government agency work (in particular, review of budgetary measures/support for local governments) • Creation of new services/industries utilizing GIS or satellite positioning	• Introduction of and study/research on new technologies that match needs (3D, satellite positioning, MMS, drone etc.)

Chapter 9
Formulation of NSDI concept design (proposed)

Refer to chapter 9

NSDI platform concept



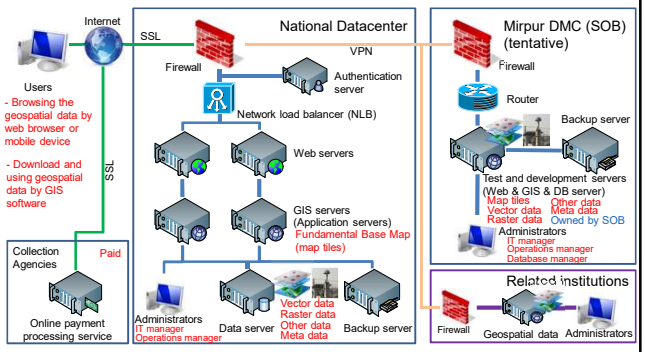
Refer to chapter 9

Objective of building NSDI Platform

- Provide base map information with certified datum reference points, and facilitate shared usage.
- Publish in format with high level of reusability in order to promote secondary usage.
- Use geospatial information in order to boost efficiency, sophistication and transparency of administrative work.
- Provide geospatial information to private sector companies in order to help create and develop new businesses.
- Maintain confidentiality and reliability of information, and provide information in safe and appropriate manner.

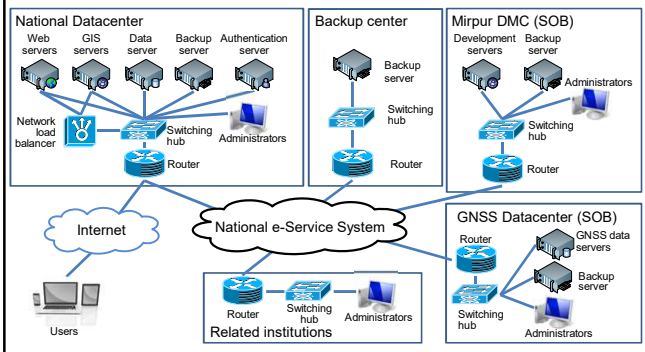
Refer to chapter 9

System configuration



Refer to chapter 9

Network configuration



Refer to chapter 9

Data and data size of NSDI platform

■ Overview of handled on NSDI platform

- Topographic map : Map tiles, Vector
- Orthophoto : Map tiles, Raster
- DEM : Map tiles, Raster
- GCP : Vector, Text
- Address information : Text
- Existing map : Raster
- Aerial photo : Raster
- Thematic map : Vector

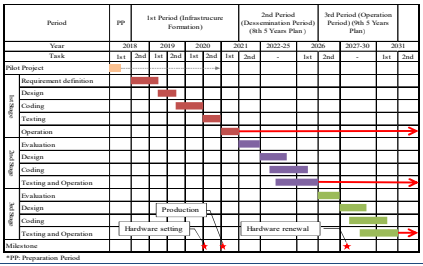
■ Total data size（assumption）

- approximately 16.7TB

Refer to chapter 9

Tentative construction schedule of NSDI

- Tentative construction schedule
  - Requirement definition (After NSDI pilot project)
  - Design and coding (From 2nd Q, 2019 to 3rd Q, 2020)
  - Procurement and Operation test (From 3rd Q 2020)
  - Production (From 1st Q, 2021)



Refer to Annex 8 and 9

Approximate initial investment, operation and maintenance and updating cost

	Item		Initial (US$)	Annual (per year)(US$)	Updating (after 7 years)
1	System		2,820,000	282,000~	2,260,000
	1-1	Design	920,000		740,000
	1-2	Coding	1,500,000	="1" x 10%=282,000	1,200,000
	1-3	Testing	400,000		320,000
2	Hardware and software		1,600,000	195,000~	2,561,000
	2-1	Hardware	1,250,000	="2-1" x 10%=125,000	2,001,000
	2-2	Software	350,000	="2-2" x 20%= 70,000	560,000
3	Database		1,100,000	55,000~	861,000
	3-1	Creating	1,000,000	="3" x 5%= 55,000	700,000
	3-2	Setting	100,000		161,000
Total			5,520,000	532,000~	5,682,000

Chapter10

Cost and effect of NSDI in Bangladesh

Refer to chapter 10

Difference of cost and effect between ordinary infrastructure development project and NSDI

- Ordinary infrastructure (highway construction, water supply/sewage, gas, electric power supply, port and harbor development, airport development, etc.)
  - Users will pay usage fee.
  - Usage fee will be used for the extinguishment of construction cost, maintenance and operation cost.
- NSDI
  - Basically, no income.
  - Some data is paid, but the price is low and it is impossible to cover the necessary cost for maintenance and operation cost.

Refer to chapter 10

Basic idea for the estimation of cost and effect of NSDI

- Cost
  - Initial investment cost of NSDI platform construction
  - Operation and maintenance of NSDI platform
  - Updating cost of NSDI platform
  - Preparation and updating of geospatial information data
- Effect
  - Cost reduction by the utilization of geospatial information data

Cost and effect of NSDI is calculated based on the cost reduction by sharing and mutual utilization of geospatial information among the organizations.

Refer to chapter 10

Estimated cost reduction amount per a year by the construction and utilization of NSDI

Items of cost reduction	Estimated cost reduction amount per year
Preparation of topographic data by one organization	--------
Financial assistance of the Government of Japan	US$ 784,108
Financial assistance of main donor countries	US$ 2,945,340
Financial assistance of international organization	US$ 3,966,800
Development project of the Government of Bangladesh	US$ 11,721,145
Direct investment of private sector	US$ 1,334,418
Total	US$ 20,751,809

Refer to chapter 10

Pre-conditions for estimation of cost and effect on NSDI

- Cost for NSDI platform construction, maintenance, operation and updating
- Reduction cost by mutual utilization of geospatial information on NSDI
- Setting of commencing time for the estimation of cost and effect of NSDI
  - 2018 Bangladesh budget year (July, 2018)
- Inflation rate in Bangladesh
  - 1.07 (Inflation rate in 2014: 7.35%)
- Increasing rate of Bangladesh government budget
  - Increasing ratio of general expenditure of the Government of Bangladesh between 2014 and 2015

Refer to chapter 10

Factors relating progress of NSDI and GIS utilization of each organizations

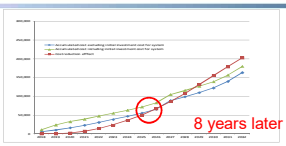
- To utilize the geographic information on NSDI by all organizations
- To share geographic information among related organizations
- To update regularly geographic information on NSDI
- To utilize the geographic information on NSDI by not only government organizations but also academic sectors and private sectors

During NSDI construction period is decided as “0”.
After construction of NSDI platform, 3 case are estimated as “Utilization of NSDI will be 10% up per a year”, “15% up” and “20% up”.

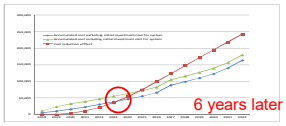
Refer to chapter 10

Cost and effect of NSDI

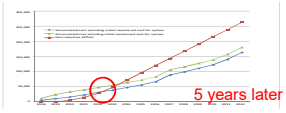
- In case of 10% up of NSDI utilization per a year)



- In case of 15% up of NSDI utilization per a year)



- In case of 20% up of NSDI utilization per a year)



Refer to chapter 10

Important consideration obtained from the estimation of cost and effect of NSDI

- The time when the cost reduction effect exceed the total cost of construction of NSDI platform, maintenance and operation cost, NSDI platform updating, data preparation and updating will depend on the amount of initial investment for NSDI.
- The cost of operation, maintenance and updating of NSDI platform will increase according to the cost of initial investment cost.
- To develop cost reduction effect early, it is necessary to promote the utilization of NSDI and GIS at each organization concerning NSDI.
- Not only the construction of NSDI platform, but also development of legal systems, promotion of NSDI utilization including GIS technology, technical issue resolution, human development and so on are important factors for NSDI.
- To increase the effect of NSDI, it is necessary to cultivate new business using geospatial information data on NSDI.

Thank you very much
for your cooperation and assistance
for our works in Bangladesh

Annex-4 Geographic Information/ Geomatics Standard (ISO/TC211) (As of 30th July, 2017)

List of Geographic information/Geomatics Standard (ISO/TC211) (As of 30th July, 2017)

Document Number	Document Title
ISO 6709:2008	Standard representation of geographic point location by coordinates
ISO 6709:2008/Cor 1:2009	
ISO 19101-1:2014	Geographic information -- Reference model -- Part 1: Fundamentals
ISO/TS 19101-2:2008	Geographic information -- Reference model -- Part 2: Imagery
ISO 19103:2015	Geographic information -- Conceptual schema language
ISO 19104:2016	Geographic information -- Terminology
ISO 19105:2000	Geographic information -- Conformance and testing
ISO 19106:2004	Geographic information -- Profiles
ISO 19107:2003	Geographic information -- Spatial schema
ISO 19108:2002	Geographic information -- Temporal schema
ISO 19108:2002/Cor 1:2006	
ISO 19109:2015	Geographic information -- Rules for application schema
ISO 19110:2016	Geographic information -- Methodology for feature cataloguing
ISO 19111:2007	Geographic information -- Spatial referencing by coordinates
ISO 19111-2:2009	Geographic information -- Spatial referencing by coordinates -- Part 2: Extension for parametric values
ISO 19112:2003	Geographic information -- Spatial referencing by geographic identifiers
ISO 19115-1:2014	Geographic information -- Metadata -- Part 1: Fundamentals
ISO 19115-2:2009	Geographic information -- Metadata -- Part 2: Extensions for imagery and gridded data
ISO/TS 19115-3:2016	Geographic information -- Metadata -- Part 3: XML schema implementation for fundamental concepts
ISO 19116:2004	Geographic information -- Positioning services
ISO 19117:2012	Geographic information -- Portrayal
ISO 19118:2011	Geographic information -- Encoding
ISO 19119:2016	Geographic information -- Services
ISO/TR 19120:2001	Geographic information -- Functional standards
ISO/TR 19121:2000	Geographic information -- Imagery and gridded data
ISO/TR 19122:2004	Geographic information / Geomatics -- Qualification and certification of personnel
ISO 19123:2005	Geographic information -- Schema for coverage geometry and functions
ISO 19125-1:2004	Geographic information -- Simple feature access -- Part 1: Common architecture
ISO 19125-2:2004	Geographic information -- Simple feature access -- Part 2: SQL option
ISO 19126:2009	Geographic information -- Feature concept dictionaries and registers
ISO/TS 19127:2005	Geographic information -- Geodetic codes and parameters
ISO 19128:2005	Geographic information -- Web map server interface
ISO/TS 19129:2009	Geographic information -- Imagery, gridded and coverage data framework
ISO/TS 19130:2010	Geographic information - Imagery sensor models for geopositioning
ISO/TS 19130-2:2014	Geographic information -- Imagery sensor models for geopositioning -- Part 2: SAR, InSAR, lidar and sonar
ISO 19131:2007	Geographic information -- Data product specifications
ISO 19131:2007/Amd 1:2011	Requirements relating to the inclusion of an application schema and feature catalogue and the treatment of coverages in an application schema.
ISO 19132:2007	Geographic information -- Location-based services -- Reference model
ISO 19133:2005	Geographic information -- Location-based services -- Tracking and navigation

Document Number	Document Title
ISO 19134:2007	Geographic information -- Location-based services -- Multimodal routing and navigation
ISO 19135-1:2015	Geographic information -- Procedures for item registration -- Part 1: Fundamentals
ISO/TS 19135-2:2012	Geographic information - Procedures for item registration -- Part 2: XML schema implementation
ISO 19136:2007	Geographic information -- Geography Markup Language (GML)
ISO 19136-2:2015	Geographic information -- Geography Markup Language (GML) -- Part 2: Extended schemas and encoding rules
ISO 19137:2007	Geographic information -- Core profile of the spatial schema
ISO/TS 19139:2007	Geographic information -- Metadata -- XML schema implementation
ISO/TS 19139-2:2012	Geographic information -- Metadata -- XML schema implementation -- Part 2: Extensions for imagery and gridded data
ISO 19141:2008	Geographic information -- Schema for moving features
ISO 19142:2010	Geographic information -- Web Feature Service
ISO 19143:2010	Geographic information -- Filter encoding
ISO 19144-1:2009	Geographic information -- Classification systems -- Part 1: Classification system structure
ISO 19144-1:2009/Cor 1:2012	
ISO 19144-2:2012	Geographic information - Classification systems -- Part 2: Land Cover Meta Language (LCML)
ISO 19145:2013	Geographic information -- Registry of representations of geographic point location
ISO 19146:2010	Geographic information -- Cross-domain vocabularies
ISO 19147:2015	Geographic information -- Transfer Nodes
ISO 19148:2012	Geographic information -- Linear referencing
ISO 19149:2011	Geographic information -- Rights expression language for geographic information -- GeoREL
ISO/TS 19150-1:2012	Geographic information -- Ontology -- Part 1: Framework
ISO 19150-2:2015	Geographic information -- Ontology -- Part 2: Rules for developing ontologies in the Web Ontology Language (OWL)
ISO 19152:2012	Geographic information -- Land Administration Domain Model (LADM)
ISO 19153:2014	Geospatial Digital Rights Management Reference Model (GeoDRM RM)
ISO 19154:2014	Geographic information -- Ubiquitous public access -- Reference model
ISO 19155:2012	Geographic information -- Place Identifier (PI) architecture
ISO 19156:2011	Geographic information -- Observations and measurements
ISO 19157:2013	Geographic information -- Data quality
ISO/TS 19157-2:2016	Geographic information -- Data quality -- Part 2: XML schema implementation
ISO/TS 19158:2012	Geographic information -- Quality assurance of data supply
ISO/TS 19159-1:2014	Geographic information -- Calibration and validation of remote sensing imagery sensors and data -- Part 1: Optical sensors
ISO/TS 19159-2:2016	Geographic information -- Calibration and validation of remote sensing imagery sensors and data -- Part 2: Lidar
ISO 19160-1:2015	Addressing -- Part 1: Conceptual model
ISO 19162:2015	Geographic information -- Well-known text representation of coordinate reference systems
ISO/TS 19163-1:2016	Geographic information -- Content components and encoding rules for imagery and gridded data -- Part 1: Content model

Source：ISO/TC211（https://www.iso.org/committee/54904/x/catalogue/p/1/u/0/w/0/d/0）

Annex-5 OGC Standards (As of 30th July, 2017)

List of OGC Standards (As of 30th July, 2017)

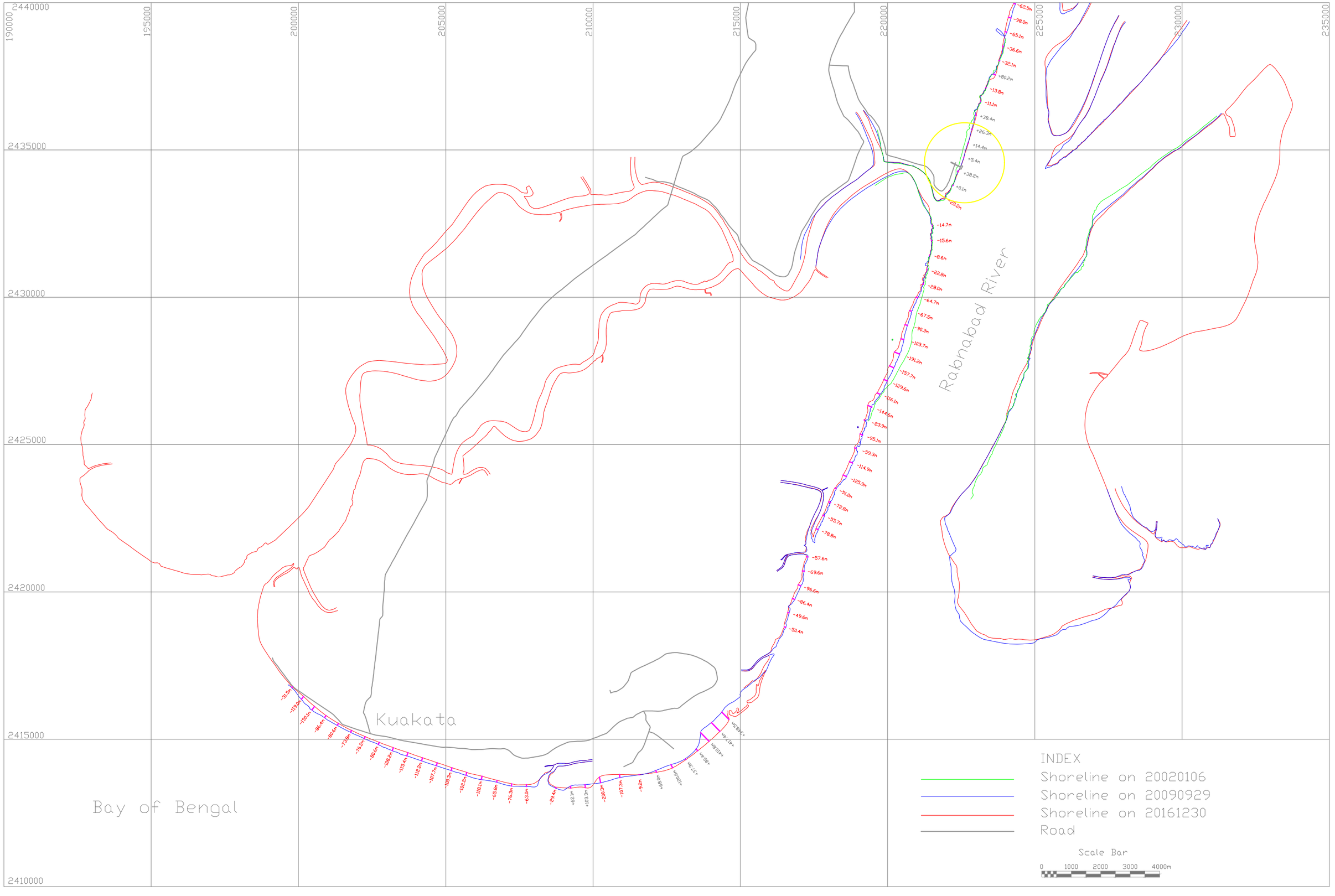
Document Title	Version	Doc.#	Date
CF-netCDF3 Data Model Extension standard netcdf-data-model-ex	3.1	11-165r2	2013/1/3
Corrigendum 1 for OGC Web Services Common Standard v2.0.0 - Multilingual CommonC1		11-157	2011/10/18
Corrigendum 2 for OGC Web Services Common Specification v 1.1.0 - Exception Report CommonC2		11-158	2011/10/18
Corrigendum for OpenGIS Implementation Standard Web Processing Service (WPS) 1.0.0 WPS 1.0 Corr	0.0.8	08-091r6	2009/9/16
CSW-ebRIM Registry Service - Part 1: ebRIM profile of CSW	1.0.1	07-110r4	2009/2/5
CSW-ebRIM Registry Service - Part 2: Basic extension package CAT2 ebRIM part2	1.0.1	07-144r4	2009/2/5
GeoAPI 3.0 Implementation Standard	3.0	09-083r3	2011/4/25
Geographic information — Well known text representation of coordinate reference systems	1.0	12-063r5	2015/5/1
Geospatial eXtensible Access Control Markup Language (GeoXACML) Version 1 Corrigendum	1.0.1	11-017	2011/5/12
GeoXACML Implementation Specification - Extension A (GML2) Encoding GeoXACML extA	1.0	07-098r1	2008/2/23
GeoXACML Implementation Specification - Extension B (GML3) Encoding GeoXACML extB	1.0	07-099r1	2008/2/23
NetCDF Binary Encoding Extension Standard: NetCDF Classic and 64-bit Offset Format netcdf-binary	1.0	10-092r3	2011/4/5
Observations and Measurements - XML Implementation	2.0	10-025r1	2011/3/22
OGC Augmented Reality Markup Language 2.0 (ARML 2.0)	21.0	12-132r4	2015/2/24
OGC City Geography Markup Language (CityGML) Encoding Standard	2.0	12-019	2012/4/4
OGC Coverage Implementation Schema - ReferenceableGridCoverage Extension	1.0	16-083r2	2017/6/15
OGC Filter Encoding 2.0 Encoding Standard - With Corrigendum	2.0.3	09-026r2	2014/8/18
OGC Geoscience Markup Language 4.1 (GeoSciML)	4.1	16-008	2017/1/31
OGC GeoSPARQL - A Geographic Query Language for RDF Data	1.0	11-052r4	2012/6/12
OGC GML in JPEG 2000 (GMLJP2) Encoding StandardPart 1: Core	2.0.1	08-085r5	2016/4/7
OGC I15 (ISO19115 Metadata) Extension Package of CS-W ebRIM Profile 1.0 csw-ebrim-i15	1.0	13-084r2	2014/4/28
OGC KML	2.2.0	07-147r2	2008/4/14
OGC KML 2.3	1.0	12-007r2	2015/8/4
OGC Location Services (OpenLS): Tracking Service Interface Standard	1.0.0	06-024r4	2008/9/8
OGC Moving Features Access	1.0	16-120r3	2017/3/12
OGC Network Common Data Form (NetCDF) Core Encoding Standard version 1.0	1.0	10-090r3	2011/4/5
OGC Network Common Data Form (NetCDF) NetCDF Enhanced Data Model Extension Standard netcdf-enhanced	1.0	11-038R2	2012/10/2
OGC Open Modelling Interface Interface Standard	2.0	11-014r3	2014/5/26
OGC OWS Context Atom Encoding Standard	1.0	12-084r2	2014/1/14
OGC OWS Context Conceptual Model	1.0	12-080r2	2014/1/22
OGC OWS Context GeoJSON Encoding Standard	1.0	14-055r2	2017/4/7
OGC SensorThings API Part 1: Sensing	1.0	15-078r6	2016/7/26
OGC WaterML2.0: part 2 - Ratings, Gaugings and Sections	1.0	15-018r2	2016/2/3
OGC WaterML 2: Part 4 – GroundWaterML 2 (GWML2)	2.2	16-032r2	2017/3/6
OGC Web Coverage Service Interface Standard – Transaction Extension	2.0	13-057r1	2016/11/17
OGC Web Feature Service Implementation Specification with Corrigendum	1.1.3	04-094r1	2016/10/26
OGC Web Service Common Implementation Specification	2.0.0	06-121r9	2010/4/7
OGC®: Open GeoSMS Standard - Core	1.0	11-030r1	2012/1/19
OGC® Catalogue Services 3.0 - General Model	3.0	12-168r6	2016/6/10

Document Title	Version	Doc.#	Date
OGC® Catalogue Services 3.0 Specification - HTTP Protocol Binding	3.0	12-176r7	2016/6/10
OGC® Catalogue Services Standard 2.0 Extension Package for ebRIM Application Profile: Earth Observation Products	1.0.0	06-131r6	2010/2/10
OGC® CF-netCDF 3.0 encoding using GML Coverage Application Schema	2.0	14-100r2	2015/11/18
OGC® Earth Observation Metadata profile of Observations & Measurements	1.1	10-157r4	2016/6/9
OGC® Geography Markup Language (GML) - Extended schemas and encoding rules	3.3	10-129r1	2012/2/7
OGC® GeoPackage Encoding Standard	1.1	12-128r12	2015/8/4
OGC® GeoPackage Encoding Standard	1.0	12-128r10	2014/2/10
OGC® GeoPackage Encoding Standard - With Corrigendum	1.0.1	12-128r12	2015/4/20
OGC® Geospatial User Feedback Standard: Conceptual Model	1.0	15-097r1	2016/12/22
OGC® Geospatial User Feedback Standard: XML Encoding Extension	1.0	15-098r1	2016/12/22
OGC® GML Application Schema - Coverages - GeoTIFF Coverage Encoding Profile wcs_geotiff	1.0	12-100r1	2014/5/28
OGC® GML in JPEG 2000 (GMLJP2) Encoding Standard Part 1: Core	2.0	08-054r4	2014/9/23
OGC® IndoorGML	1.0	14-005r3	2014/12/2
OGC® Land and Infrastructure Conceptual Model Standard (LandInfra)	1.0	15-111r1	2016/12/20
OGC® Moving Features Encoding Extension: Simple Comma Separated Values (CSV)	1.0	14-084r2	2015/2/17
OGC® Moving Features Encoding Part I: XML Core	1.0	14-083r2	2015/2/17
OGC® OpenSearch Extension for Earth Observation	1.0	13-026r8	2016/12/16
OGC® OpenSearch Geo and Time Extensions	1.0	10-032r8	2014/4/14
OGC® Publish/Subscribe Interface Standard 1.0 - Core	1.0	13-131r1	2016/8/22
OGC® Publish/Subscribe Interface Standard 1.0 SOAP Protocol Binding Extension	1.0	13-133r1	2016/8/22
OGC® PUCK Protocol Standard	1.4	09-127r2	2012/1/25
OGC® SensorML: Model and XML Encoding Standard	2.0	12-000	2014/2/4
OGC® Sensor Observation Service Interface Standard	2.0	12-006	2012/4/20
OGC® Sensor Planning Service Implementation Standard	2.0	09-000	2011/3/28
OGC® Sensor Planning Service Interface Standard 2.0 Earth Observation Satellite Tasking ExtensionOGC® Sensor Planning Service SPS EO Tasking Ext	2.0	10-135	2011/3/28
OGC® SWE Common Data Model Encoding Standard	2.0	08-094r1	2011/1/4
OGC® WaterML 2.0: Part 1- Timeseries	2.0.1	10-126r4	2014/2/24
OGC® WCS 2.0 Interface Standard- Core: Corrigendum	2.0.1	09-110r4	2012/7/12
OGC® Web Coverage Service 2.0 Interface Standard - KVP Protocol Binding Extension - Corrigendum	1.0.1	09-147r3	2013/3/26
OGC® Web Coverage Service 2.0 Interface Standard - XML/POST Protocol Binding Extension	1.0.0	09-148r1	2010/10/27
OGC® Web Coverage Service 2.0 Interface Standard - XML/SOAP Protocol Binding Extension WCS XML SOAP ext	2.0	09-149r1	2010/10/27
OGC® Web Coverage Service Interface Standard - CRS Extension WCS-CRS-extension	1.0	11-053r1	2014/3/11
OGC® Web Coverage Service Interface Standard - Interpolation Extension WCS Interopolation	1.0	12-049	2014/2/26
OGC® Web Coverage Service Interface Standard - Range Subsetting Extension WCS range subsetting	1.0	12-040	2014/2/26
OGC® Web Coverage Service Interface Standard - Scaling Extension WCS scaling	1.0	12-039	2014/2/26
OGC® Web Coverage Service WCS Interface Standard - Processing Extension WCS WCPS	2.0	08-059r4	2014/2/26
OGC® Web Feature Service 2.0 Interface Standard - With Corrigendum	2.0.2	09-025r2	2014/7/10
OGC® WPS 2.0 Interface Standard	2.0	14-065	2015/3/5

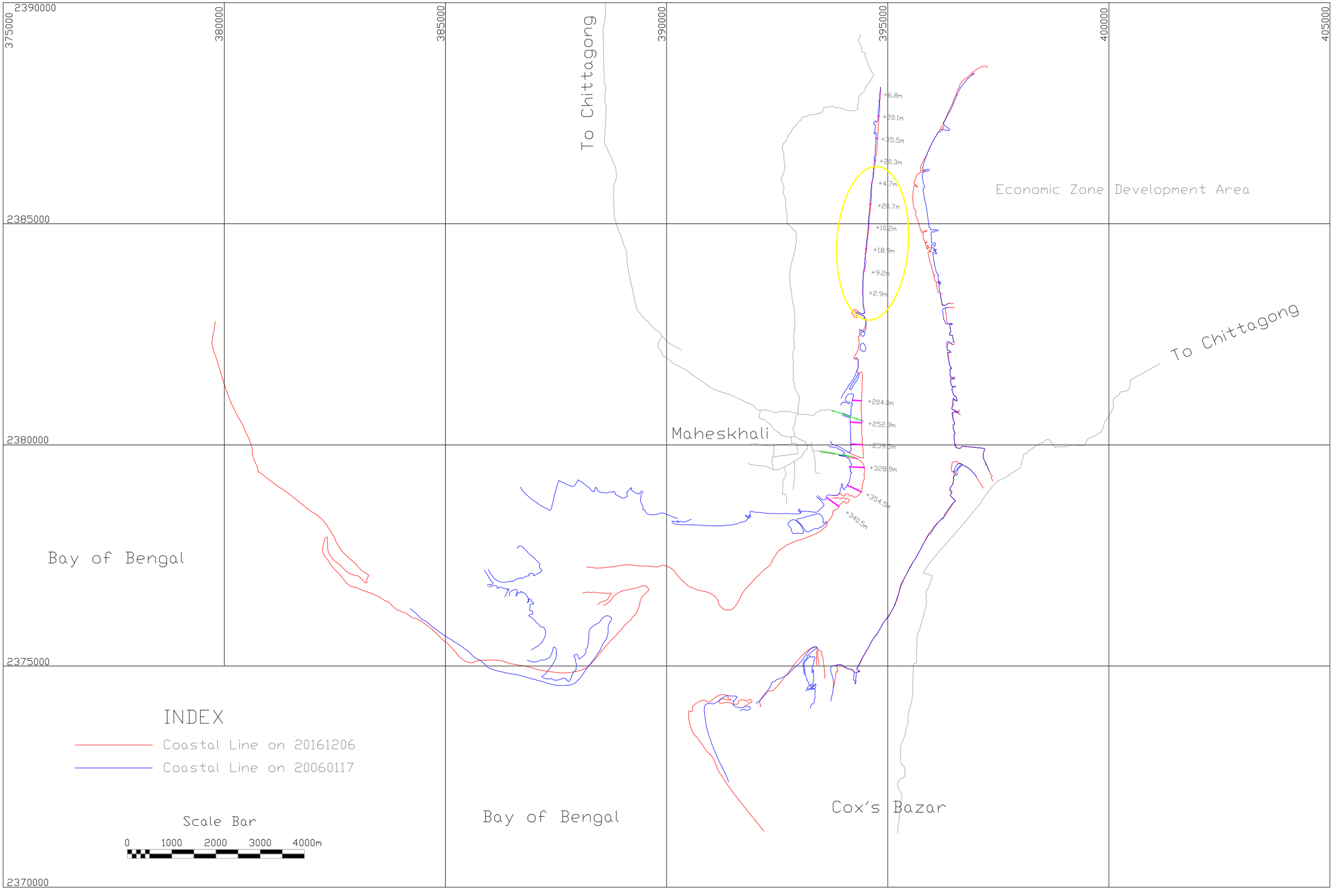
Document Title	Version	Doc.#	Date
OpenGIS Catalogue Service Implementation Specification	2.0.2	07-006r1	2007/4/20
OpenGIS Coordinate Transformation Service Implementation Specification	1.0	01-009	2001/1/12
OpenGIS Filter Encoding 2.0 Encoding Standard	2.0	09-026r1	2010/11/22
OpenGIS Geography Markup Language (GML) Encoding Standard	3.2.1	07-036	2007/10/5
OpenGIS GML in JPEG 2000 for Geographic Imagery Encoding Specification	1.0.0	05-047r3	2006/1/20
OpenGIS Implementation Specification for Geographic information - Simple feature access - Part 1: Common architecture	1.2.1	06-103r4	2011/5/28
OpenGIS Implementation Specification for Geographic information - Simple feature access - Part 2: SQL option	1.2.1	06-104r4	2010/8/4
OpenGIS Location Service (OpenLS) Implementation Specification: Core Services	1.2.0	07-074	2008/9/8
OpenGIS Location Services (OpenLS): Part 6 - Navigation Service OLSNav	1.0.0	08-028r7	2008/9/4
OpenGIS SensorML Encoding Standard v 1.0 Schema Corregendum 1 SensorML Corr 1	1.01	07-122r2	2007/11/12
OpenGIS Sensor Model Language (SensorML)	1.0.0	07-000	2007/7/24
OpenGIS Sensor Observation Service	1.0.0	06-009r6	2008/2/13
OpenGIS Simple Features Implementation Specification for CORBA	1.0	99-054	1999/6/2
OpenGIS Simple Features Implementation Specification for OLE/COM	1.1	99-050	1999/5/18
OpenGIS Styled Layer Descriptor Profile of the Web Map Service Implementation Specification	1.1.0	05-078r4	2007/8/14
OpenGIS Symbology Encoding Implementation Specification	1.1.0	05-077r4	2007/1/18
OpenGIS Web Coverage Processing Service (WCPS) Language Interface Standard	1.0.0	08-068r2	2009/3/25
OpenGIS Web Coverage Service (WCS) - Processing Extension (WCPS) WCS WCPS	1.0.0	08-059r3	2009/3/25
OpenGIS Web Feature Service (WFS) Implementation Specification	1.1.0	04-094	2005/5/3
OpenGIS Web Feature Service (WFS) Implementation Specification (Corrigendum) WFSC	1.0.0	06-027r1	2006/8/22
OpenGIS Web Map Context Documents Corrigendum 1 WMC Corr 1	1.1.0	08-050	2008/5/2
OpenGIS Web Map Context Implementation Specification	1.1	05-005	2005/5/3
OpenGIS Web Map Service (WMS) Implementation Specification	1.3.0	06-042	2006/3/15
OpenGIS Web Map Tile Service Implementation Standard	1.0.0	07-057r7	2010/4/6
OpenGIS Web Service Common Implementation Specification	1.1.0	06-121r3	2007/4/3
OpenGIS® City Geography Markup Language (CityGML) Encoding Standard	1.0	08-007r1	2008/8/20
OpenGIS® Georeferenced Table Joining Service Implementation Standard	1.0	10-070r2	2010/11/22
OpenGIS® SWE Service Model Implementation Standard	2.0	09-001	2011/3/21
Ordering Services Framework for Earth Observation Products Interface Standard	1.0	06-141r6	2012/1/9
Revision Notes for Corrigendum for OpenGIS 07-006: Catalogue Services, Version 2.0.2 cat revision notes	1.0	07-010	2007/6/19
TimeseriesML 1.0 – XML Encoding of the Timeseries Profile of Observations and Measurements	1.0	15-042r3	2016/9/9
Timeseries Profile of Observations and Measurements	1.0	15-043r3	2016/9/9
Volume 1: OGC CDB Core Standard: Model and Physical Data Store Structure	1.0	15-113r3	2017/2/23
Volume 3: OGC CDB Terms and Definitions cdb-terms	1.0	15-112r2	2017/2/23
Volume 11: OGC CDB Core Standard Conceptual Model CDB-core-model	1.0	16-007r3	2017/2/23
Web Coverage Service (WCS) - Transaction operation extension	1.1.4	07-068r4	2009/1/15
Web Processing Service	1.0.0	05-007r7	2007/10/5

Source：Open Geospatial Consortium（http://www.opengeospatial.org/docs/is）

Annex-6 Costal line Change around the Candidate Location of Tide Observation Station at Kuakata Estimated by Google Earth Images


2440000
2435000
2430000
2425000
2420000
2415000
2410000
190000
195000
200000
205000
210000
215000
220000
225000
230000
235000
Rabnabad River
Kuakata
Bay of Bengal
INDEX
Shoreline on 20020106
Shoreline on 20090929
Shoreline on 20161230
Road
Scale Bar
0 1000 2000 3000 4000m

Annex-7 Costal line Change around the Candidate Location of Tide Observation Station at Cox's Bazar Estimated by Google Earth Images


375000
380000
385000
390000
395000
400000
405000
2390000
2385000
2380000
2375000
2370000
To Chittagong
Economic Zone Development Area
+6.8m
+20.1m
+35.5m
+20.3m
+4.7m
+20.7m
+10.2m
+18.9m
+9.2m
+2.9m
+204.0m
+252.9m
+259.5m
+328.9m
+354.5m
+340.5m
Maheskhali
To Chittagong
Bay of Bengal
Bay of Bengal
Cox's Bazar
INDEX
Coastal Line on 20161206
Coastal Line on 20060117
Scale Bar
0 1000 2000 3000 4000m

Annex-8 Initial Investment Cost for the Construction of NSDI Platform

NSDI Platform System initial cost - System

Item	Year	Price(US$)
Design	2018	120,000
Design	2019	800,000
Coding	2019	750,000
Coding	2020	750,000
Testing	2020	400,000
Total (US$)		2,820,000

NSDI Platform System initial cost - Hardware

Server for Data center	Quantity	Unit price	Total price(US$)
Web server	2	40,000	80,000
GIS server	2	50,000	100,000
Data server	1	50,000	50,000
Backup server	1	50,000	50,000
Authentication server	2	30,000	60,000
Storage	4	50,000	200,000
Network equipments	1	120,000	120,000
Server equipment	2	70,000	140,000
Operations client	1	10,000	10,000
Other	1	50,000	50,000
Total			860,000
Server for SOB center	Quantity	Unit price	Total price(US$)
Test & Development server	1	50,000	50,000
Backup server	1	50,000	50,000
Storage	2	50,000	100,000
Network equipment	1	50,000	50,000
Server equipment	1	40,000	40,000
Operation client	1	10,000	10,000
Database client	3	15,000	45,000
Other	1	45,000	45,000
Total			390,000
Ground Total (US$)			1,250,000

NSDI Platform System initial cost - Software

Software for Data center	Quantity	Unit price	Total price(US$)
Backup software	1	50,000	50,000
GIS software	1	35,000	35,000
Anti-malware software	1	5,000	5,000
Other	1	80,000	80,000
Total			170,000
Software for SOB center	Quantity	Unit price	Total price(US$)
Backup software	1	50,000	50,000
GIS software	3	35,000	105,000
Anti-malware software	1	2,000	2,000
Other	1	23,000	23,000
Total			180,000
Ground Total (US$)			350,000

NSDI Platform System initial cost - Database

Item	Year	Price(US$)
Creating database	2019	500,000
Creating database	2020	500,000
Setting database	2020	100,000
Total (US$)		1,100,000

Annex-9 Annual Maintenance, Operation and Updating Cost of NSDI Platform

Estimation of NSDI Platform System

Annex-9

Items			PP	Infrastrucure Formation Period			Dessemination Period (8th 5 Years Plan)					Operation Period (9th 5 Years Plan)					Ground Total (1st Stage)	Ground Total (2nd Stage)	Ground Total (3rd Stage)	Total (USD)
			2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031				
Initial cost and Renewal cost			120,000	2,050,000	3,350,000	0	0	0	0	0	0	5,682,000	0	0	0	0	5,520,000	0	5,682,000	11,202,000
1	System		120,000	1,550,000	1,150,000	0	0	0	0	0	0	2,260,000	0	0	0	0	2,820,000	0	2,260,000	5,080,000
	1-1	System design	120,000	800,000	0	0	0	0	0	0	0	740,000	0	0	0	0	920,000	0	740,000	1,660,000
	1-2	System coding	0	750,000	750,000	0	0	0	0	0	0	1,200,000	0	0	0	0	1,500,000	0	1,200,000	2,700,000
	1-3	System testing	0	0	400,000	0	0	0	0	0	0	320,000	0	0	0	0	400,000	0	320,000	720,000
2	Hardware and software		0	0	1,600,000	0	0	0	0	0	0	2,561,000	0	0	0	0	1,600,000	0	2,561,000	4,161,000
	2-1	Hardware cost	0	0	1,250,000	0	0	0	0	0	0	2,001,000	0	0	0	0	1,250,000	0	2,001,000	3,251,000
	2-2	Software cost	0	0	350,000	0	0	0	0	0	0	560,000	0	0	0	0	350,000	0	560,000	910,000
3	Database		0	500,000	600,000	0	0	0	0	0	0	861,000	0	0	0	0	1,100,000	0	861,000	1,961,000
	3-1	Creating database	0	500,000	500,000	0	0	0	0	0	0	700,000	0	0	0	0	1,000,000	0	700,000	1,700,000
	3-2	Setting database	0	0	100,000	0	0	0	0	0	0	161,000	0	0	0	0	100,000	0	161,000	261,000
Maintenace and operation cost			0	0	0	532,000	570,000	609,000	652,000	698,000	746,000	798,000	664,000	711,000	760,000	813,000	669,000	3,275,000	3,746,000	7,553,000
4	System		0	0	0	282,000	302,000	323,000	346,000	370,000	396,000	424,000	254,000	272,000	291,000	311,000	282,000	1,737,000	1,552,000	3,571,000
	4-1	System maintenance ("1" x 10%)	0	0	0	282,000	302,000	323,000	346,000	370,000	396,000	424,000	254,000	272,000	291,000	311,000	282,000	1,737,000	1,552,000	3,571,000
5	Hardware and software		0	0	0	195,000	209,000	223,000	239,000	256,000	273,000	292,000	312,000	334,000	357,000	382,000	332,000	1,200,000	1,677,000	3,072,000
	5-1	Hardware maintenance ("2-1" x 10%)	0	0	0	125,000	134,000	143,000	153,000	164,000	175,000	187,000	200,000	214,000	229,000	245,000	262,000	769,000	1,075,000	1,969,000
	5-2	Software maintenance ("2-2" x 20%)	0	0	0	70,000	75,000	80,000	86,000	92,000	98,000	105,000	112,000	120,000	128,000	137,000	70,000	431,000	602,000	1,103,000
6	Database		0	0	0	55,000	59,000	63,000	67,000	72,000	77,000	82,000	98,000	105,000	112,000	120,000	55,000	338,000	517,000	910,000
	6-1	Database maintenace ("3" x 5%)	0	0	0	55,000	59,000	63,000	67,000	72,000	77,000	82,000	98,000	105,000	112,000	120,000	55,000	338,000	517,000	910,000
Total - Annual			120,000	2,050,000	3,350,000	532,000	570,000	609,000	652,000	698,000	746,000	6,480,000	664,000	711,000	760,000	813,000	6,189,000	3,275,000	9,428,000	18,755,000
Ground Total - 1st Stage			120,000	2,170,000	5,520,000	6,052,000											6,052,000			6,052,000
Ground Total - 2nd Stage							570,000	1,179,000	1,831,000	2,529,000	3,275,000							3,275,000		3,275,000
Ground Total - 3rd Stage												6,480,000	7,144,000	7,855,000	8,615,000	9,428,000			9,428,000	9,428,000
Ground Total (USD)			120,000	2,170,000	5,520,000	6,052,000	6,622,000	7,231,000	7,883,000	8,581,000	9,327,000	15,807,000	16,471,000	17,182,000	17,942,000	18,755,000	6,052,000	9,327,000	18,755,000	18,755,000

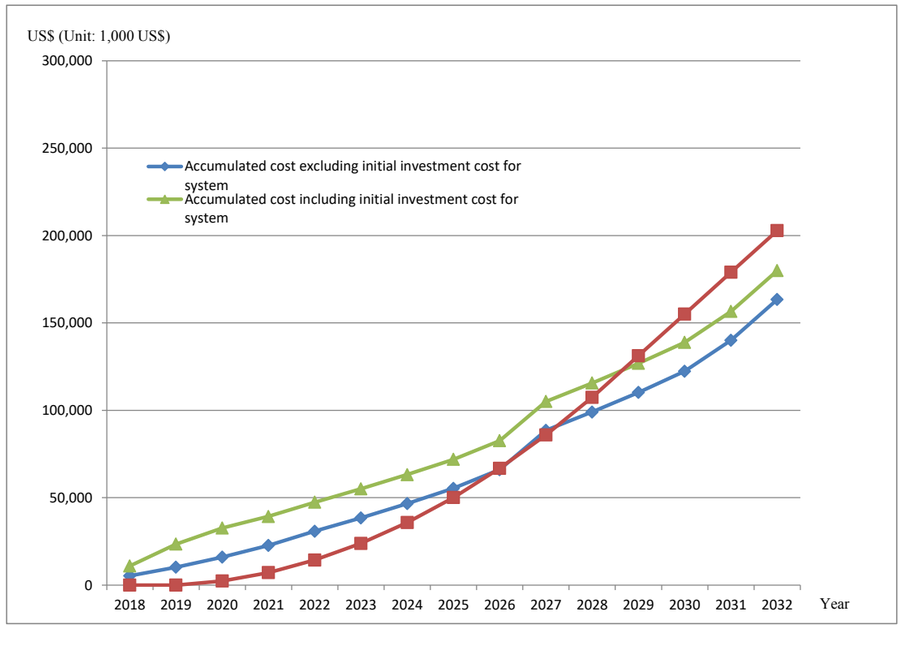
Annual Infration Rate = 7%

Annex-10 Cost and Effect of NSDI (Case-1)

Cost and Effect of NSDI (Case-1) Unit: US$ 1,000.-

Order	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Note
Item/Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
Case-A (Exculding initial investment cost for system)																
NSDI inittial investment cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
NSDI updating cost	0	0	0	0	0	0	0	0	0	5,682	0	0	0	0	0	
NSDI operation/maintenance cost	0	0	0	532	570	609	652	698	746	798	664	711	760	813	894	
Activity cost of each organization	4,300	4,601	4,923	5,268	5,636	6,031	6,453	6,905	7,388	7,905	8,459	9,051	9,684	10,362	11,088	
Map updating cost of SOB	300	321	343	368	393	421	450	482	515	552	590	631	676	723	774	
Satellite image cost	0	0	0	10	0	0	0	0	14	0	0	0	18	0	0	
Aerial photography cost for 1:5,000 mappi	750	0	0	0	983	0	0	0	1,289	0	0	0	0	1,807	0	
Aerial photography cost for 1:25,000 mapp	0	0	0	0	0	0	0	0	0	0	0	0	0	3,000	0	
CORS intial investment cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
CORS updating cost	0	0	0	0	0	0	0	0	0	6,784	0	0	0	0	9,515	
CORS operation/maintenance cost	0	0	470	503	538	576	616	659	705	755	808	864	925	989	1059	
Total amount	5,350	4,922	5,737	6,680	8,121	7,637	8,171	8,744	10,658	22,476	10,520	11,257	12,063	17,695	23,329	Excluding initial investment cost
Accumulated Amount	5,350	10,272	16,009	22,689	30,809	38,446	46,617	55,361	66,019	88,494	99,015	110,272	122,335	140,030	163,359	
Case-B (Including initial investment cost for system)																
NSDI inittial investment cost	120	2,050	3,350	0	0	0	0	0	0	0	0	0	0	0	0	
NSDI updating cost	0	0	0	0	0	0	0	0	0	5,682	0	0	0	0	0	
NSDI operation/maintenance cost	0	0	0	532	570	609	652	698	746	798	664	711	760	813	894	
Activity cost of each organization	4,300	4,601	4,923	5,268	5,636	6,031	6,453	6,905	7,388	7,905	8,459	9,051	9,684	10,362	11,088	
Map updating cost of SOB	300	321	343	368	393	421	450	482	515	552	590	631	676	723	774	
Satellite image cost	0	0	0	10	0	0	0	0	14	0	0	0	18	0	0	
Aerial photography cost for 1:5,000 mappi	750	0	0	0	983	0	0	0	1,289	0	0	0	0	1,807	0	
Aerial photography cost for 1:25,000 mapp	0	0	0	0	0	0	0	0	0	0	0	0	0	3,000	0	
CORS intial investment cost	5,500	5,570	0	0	0	0	0	0	0	0	0	0	0	0	0	
CORS updating cost	0	0	0	0	0	0	0	0	0	6,784	0	0	0	0	9,515	
CORS operation/maintenance cost	0	0	470	503	538	576	616	659	705	755	808	864	925	989	1059	
Total amount	10,970	12,542	9,087	6,680	8,121	7,637	8,171	8,744	10,658	22,476	10,520	11,257	12,063	17,695	23,329	Including initial investment cost
Accumulated Amount	10,970	23,512	32,599	39,279	47,399	55,036	63,207	71,951	82,609	105,084	115,605	126,862	138,925	156,620	179,949	
Cost Reduction Effect	20,751	20,751	20,751	20,751	20,751	20,751	20,751	20,751	20,751	20,751	20,751	20,751	20,751	20,751	20,751	
Factor for utilization	0.0	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.0	1.0	1.0	10% up per year
Acutual cost reduction effect	0	0	2,386	4,773	7,159	9,545	11,932	14,318	16,705	19,091	21,477	23,864	23,864	23,864	23863.65	
Accumulated Cost Reduction Effect	0	0	2,386	7,159	14,318	23,864	35,795	50,114	66,818	85,909	107,386	131,250	155,114	178,977	202,841	

Mainteance cost factor	0.20
Infration rate	1.07
Budget increae rate	1.15
NSDI initial investment cost	
CORS initial investment cost	11,070

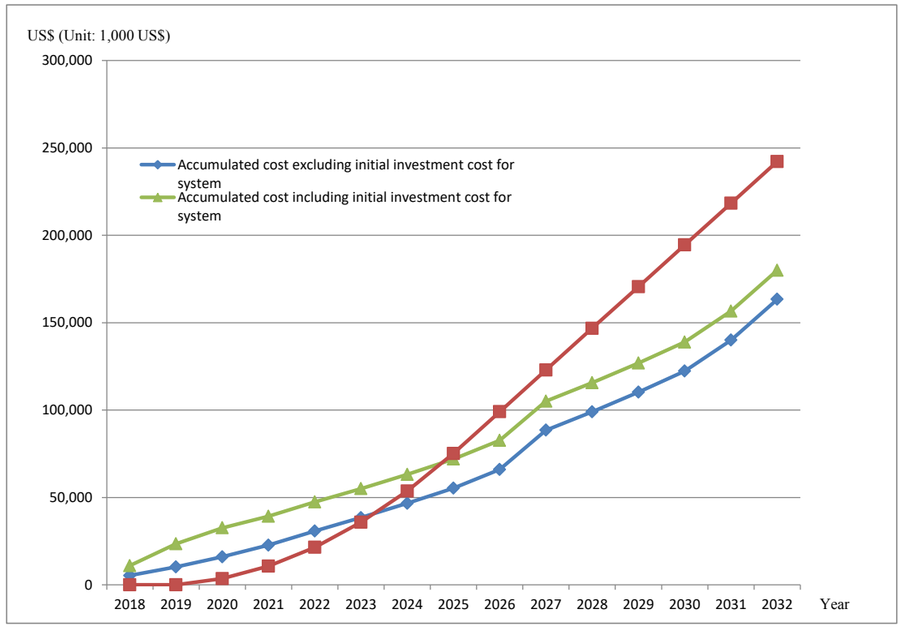


Annex-11 Cost and Effect of NSDI (Case-2)

Cost and Effect of NSDI (Case-2) Unit: US$ 1,000.-

Order	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Note
Item/Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
Case-A (Exculding initial investment cost for system)																
NSDI inittial investment cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
NSDI updating cost	0	0	0	0	0	0	0	0	0	5,682	0	0	0	0	0	
NSDI operation/maintenance cost	0	0	0	532	570	609	652	698	746	798	664	711	760	813	894	
Activity cost of each organization	4,300	4,601	4,923	5,268	5,636	6,031	6,453	6,905	7,388	7,905	8,459	9,051	9,684	10,362	11,088	
Map updating cost of SOB	300	321	343	368	393	421	450	482	515	552	590	631	676	723	774	
Satellite image cost	0	0	0	10	0	0	0	0	14	0	0	0	18	0	0	
Aerial photography cost for 1:5,000 mappi	750	0	0	0	983	0	0	0	1,289	0	0	0	0	1,807	0	
Aerial photography cost for 1:25,000 mapp	0	0	0	0	0	0	0	0	0	0	0	0	0	3,000	0	
CORS intial investment cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
CORS updating cost	0	0	0	0	0	0	0	0	0	6,784	0	0	0	0	9,515	
CORS operation/maintenance cost	0	0	470	503	538	576	616	659	705	755	808	864	925	989	1059	
Total amount	5,350	4,922	5,737	6,680	8,121	7,637	8,171	8,744	10,658	22,476	10,520	11,257	12,063	17,695	23,329	Excluding initial investment cost
Accumulated Amount	5,350	10,272	16,009	22,689	30,809	38,446	46,617	55,361	66,019	88,494	99,015	110,272	122,335	140,030	163,359	
Case-B (Including initial investment cost for system)																
NSDI inittial investment cost	120	2,050	3,350	0	0	0	0	0	0	0	0	0	0	0	0	
NSDI updating cost	0	0	0	0	0	0	0	0	0	5,682	0	0	0	0	0	
NSDI operation/maintenance cost	0	0	0	532	570	609	652	698	746	798	664	711	760	813	894	
Activity cost of each organization	4,300	4,601	4,923	5,268	5,636	6,031	6,453	6,905	7,388	7,905	8,459	9,051	9,684	10,362	11,088	
Map updating cost of SOB	300	321	343	368	393	421	450	482	515	552	590	631	676	723	774	
Satellite image cost	0	0	0	10	0	0	0	0	14	0	0	0	18	0	0	
Aerial photography cost for 1:5,000 mappi	750	0	0	0	983	0	0	0	1,289	0	0	0	0	1,807	0	
Aerial photography cost for 1:25,000 mapp	0	0	0	0	0	0	0	0	0	0	0	0	0	3,000	0	
CORS intial investment cost	5,500	5,570	0	0	0	0	0	0	0	0	0	0	0	0	0	
CORS updating cost	0	0	0	0	0	0	0	0	0	6,784	0	0	0	0	9,515	
CORS operation/maintenance cost	0	0	470	503	538	576	616	659	705	755	808	864	925	989	1059	
Total amount	10,970	12,542	9,087	6,680	8,121	7,637	8,171	8,744	10,658	22,476	10,520	11,257	12,063	17,695	23,329	Including initial investment cost
Accumulated Amount	10,970	23,512	32,599	39,279	47,399	55,036	63,207	71,951	82,609	105,084	115,605	126,862	138,925	156,620	179,949	
Cost Reduction Effect	20,751	20,751	20,751	20,751	20,751	20,751	20,751	20,751	20,751	20,751	20,751	20,751	20,751	20,751	20,751	
Factor for utilization	0.00	0.00	0.15	0.30	0.45	0.60	0.75	0.90	1.00	1.00	1.00	1.00	1.00	1.00	1.00	15% up per year
Acutual cost reduction effect	0	0	3,580	7,159	10,739	14,318	17,898	21,477	23,864	23,864	23,864	23,864	23,864	23,864	23863.65	
Accumulated Cost Reduction Effect	0	0	3,580	10,739	21,477	35,795	53,693	75,170	99,034	122,898	146,761	170,625	194,489	218,352	242,216	

Mainteance cost factor	0.20
Infration rate	1.07
Budget increae rate	1.15
NSDI initial investment cost	
CORS initial investment cost	11,070

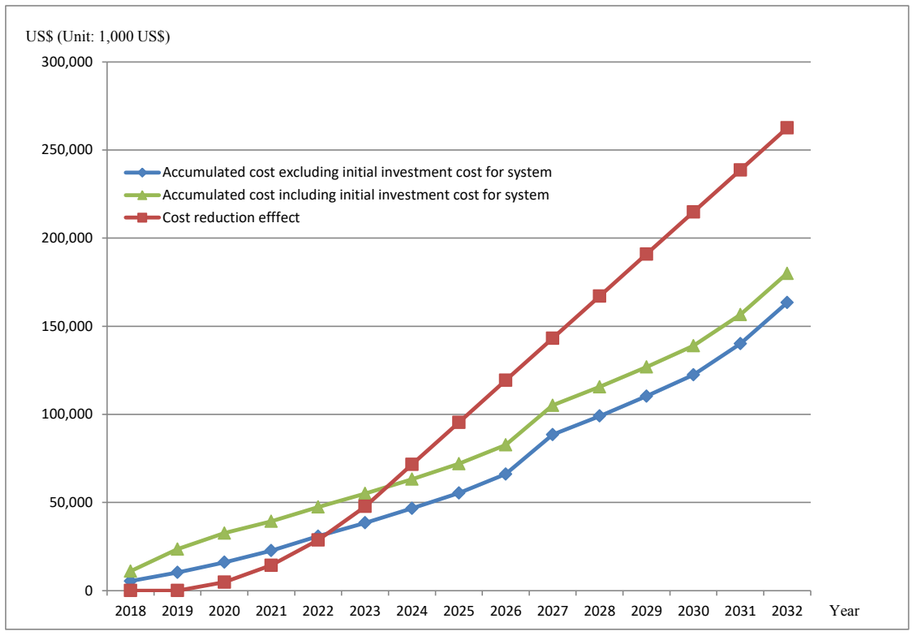


Annex-12 Cost and Effect of NSDI (Case-3)

Cost and Effect of NSDI (Case-3) Unit: US$ 1,000.-

Order	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Note
Item/Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
Case-A (Excluding initial investment cost for system)																
NSDI inittial investment cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
NSDI updating cost	0	0	0	0	0	0	0	0	0	5,682	0	0	0	0	0	
NSDI operation/maintenance cost	0	0	0	532	570	609	652	698	746	798	664	711	760	813	894	
Activity cost of each organization	4,300	4,601	4,923	5,268	5,636	6,031	6,453	6,905	7,388	7,905	8,459	9,051	9,684	10,362	11,088	
Map updating cost of SOB	300	321	343	368	393	421	450	482	515	552	590	631	676	723	774	
Satellite image cost	0	0	0	10	0	0	0	0	14	0	0	0	18	0	0	
Aerial photography cost for 1:5,000 mappi	750	0	0	0	983	0	0	0	1,289	0	0	0	0	1,807	0	
Aerial photography cost for 1:25,000 mapp	0	0	0	0	0	0	0	0	0	0	0	0	0	3,000	0	
CORS intial investment cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
CORS updating cost	0	0	0	0	0	0	0	0	0	6,784	0	0	0	0	9,515	
CORS operation/maintenance cost	0	0	470	503	538	576	616	659	705	755	808	864	925	989	1059	
Total amount	5,350	4,922	5,737	6,680	8,121	7,637	8,171	8,744	10,658	22,476	10,520	11,257	12,063	17,695	23,329	Excluding initial investment cost
Accumulated Amount	5,350	10,272	16,009	22,689	30,809	38,446	46,617	55,361	66,019	88,494	99,015	110,272	122,335	140,030	163,359	
Case-B (Including initial investment cost for system)																
NSDI inittial investment cost	120	2,050	3,350	0	0	0	0	0	0	0	0	0	0	0	0	
NSDI updating cost	0	0	0	0	0	0	0	0	0	5,682	0	0	0	0	0	
NSDI operation/maintenance cost	0	0	0	532	570	609	652	698	746	798	664	711	760	813	894	
Activity cost of each organization	4,300	4,601	4,923	5,268	5,636	6,031	6,453	6,905	7,388	7,905	8,459	9,051	9,684	10,362	11,088	
Map updating cost of SOB	300	321	343	368	393	421	450	482	515	552	590	631	676	723	774	
Satellite image cost	0	0	0	10	0	0	0	0	14	0	0	0	18	0	0	
Aerial photography cost for 1:5,000 mappi	750	0	0	0	983	0	0	0	1,289	0	0	0	0	1,807	0	
Aerial photography cost for 1:25,000 mapp	0	0	0	0	0	0	0	0	0	0	0	0	0	3,000	0	
CORS intial investment cost	5,500	5,570	0	0	0	0	0	0	0	0	0	0	0	0	0	
CORS updating cost	0	0	0	0	0	0	0	0	0	6,784	0	0	0	0	9,515	
CORS operation/maintenance cost	0	0	470	503	538	576	616	659	705	755	808	864	925	989	1059	
Total amount	10,970	12,542	9,087	6,680	8,121	7,637	8,171	8,744	10,658	22,476	10,520	11,257	12,063	17,695	23,329	Including initial investment cosst
Accumulated Amount	10,970	23,512	32,599	39,279	47,399	55,036	63,207	71,951	82,609	105,084	115,605	126,862	138,925	156,620	179,949	
Cost Reduction Effect	20,751	20,751	20,751	20,751	20,751	20,751	20,751	20,751	20,751	20,751	20,751	20,751	20,751	20,751	20,751	
Factor ffor utilization	0.0	0.0	0.2	0.4	0.6	0.8	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	20% up per year
Acutual cost reduction effect	0	0	4,773	9,545	14,318	19,091	23,864	23,864	23,864	23,864	23,864	23,864	23,864	23,864	23863.65	
Accumulated Cost Reduction Effect	0	0	4,773	14,318	28,636	47,727	71,591	95,455	119,318	143,182	167,046	190,909	214,773	238,637	262,500	

Mainteance cost factor	0.20
Infration rate	1.07
Budget increae rate	1.15
NSDI initial investment cost	
CORS initial investment cost	11,070



Annex-13 NSDI 1st Contributors Meeting Materials

SURVEY OF BANGLADESH
SURVEYOR GENERAL OFFICE
TEJGAON, DHAKA - 1208
Phone: 9114191 Fax: 9117463
info@sob.gov.bd,www.sob.gov.bd

SOB/14-C/NSDI Meeting/P- 1362

Date: 02 May 2017

From : Surveyor General of Bangladesh

To : As per the Distribution.

Subject: Invitation to attend the Contributors meeting on "National Spatial Data Infrastructure (NSDI) for Bangladesh" to be held on 15 May 2017

Dear Sir/Madam,

An international Seminar on "National Spatial Data Infrastructure (NSDI) for Bangladesh" organized by Survey of Bangladesh (SOB) of Ministry of Defence (MOD) and assisted by Japan International Cooperation Agency (JICA) was held in the 1st and 2nd June of 2016 at Dhaka. Sheikh Hasina, the Honorable Prime Minister (PM) of Bangladesh, inaugurated and attended the seminar. In two days long seminar, eleven technical sessions took place in which about 130 participants from home and 40 from abroad have keenly participated. Honorable PM, in her speech, gave away the guidelines to create awareness and importance of NSDI among all stakeholders and contributors, to formulate a national committee under the Ministry of Defence to make short, mid and long term strategic plan and provide necessary guidelines for establishing NSDI in Bangladesh and to formulate a law for the implementation of NSDI in Bangladesh. Based on the guidelines both Committee and Laws are in the advance stages of implementation. SOB is also implementing the 'Geo portal' that would be one of the important NSDI components.

With this backdrop, SOB is going to organize a 'Contributors Meeting' between the major contributors of spatial data on 15 May 2017. The meeting would take place at the conference room of Digital Mapping Center of SOB located at Dhamalcoat, Mirpur-14 of Dhaka. It is my pleasure and honor to invite one of your senior representatives to participate in the meeting. We deeply appreciate your long stretched contribution on the Geo spatial activities in Bangladesh. Presence of your resource person will surely enhance and inspire the journey in establishing SDI for our Nation. In this regard, please send us the name of the participant from your organization by 08 May 2017 following the table given below. Apart from the paper copy, you may send the electronic copy of your nomination letter to our official email (info@sob.gov.bd).

Name of the Participants	Position in the office	Name of the Organization	Mobile Number	E-mail ID

The proposed Agenda for the meeting is attached with this letter for your concern. We eagerly look forward of your presence on the meeting.

Sincerely Yours,

Brigadier General Zakir Ahmed, psc
Surveyor General of Bangladesh
Survey of Bangladesh
E-mail: sg@sob.gov.bd

Attachment:

Agenda for "NSDI contributors meeting"

Distribution: (Not as per Seniority)

1. Secretary, Ministry of Defence (MOD)
2. Director General, Bangladesh Bureau of Statistics; (BBS)
3. Chairman, Space Research and Remote Sensing Organization (SPARRSO)
4. Chief Engineer, Local Government Engineering Department (LGED)
5. Chief Engineer, Roads and Highways Department (RHD)
6. Chairman, Rajdhani Unnayan Kartripakkha (RAJUK)
7. Director General, Bangladesh Water Development Board, BWDB
8. Chairman, Water and Sewerage Authority (WASA)
9. Director General, Geological Survey Of Bangladesh
10. Chairman, Bangladesh Agricultural Development Corporation (BADC)
11. Director General, Department of Land Record and Survey (DLRS)
12. Director, Bangladesh Metrological Department (BMD)
13. Director General, Department Of Disaster Management (DDM)
14. Country Representative, WB- World Bank
15. Chief Representative, JICA Bangladesh
16. Mr. Toru Watanabe, Team Leader, JICA NSDI Study Team
17. Project Director, Access to Information (A2I) Programme, PMO's Office
18. Chief Executive Officer, Dhaka North City Corporation (DNCC)
19. Chief Executive Officer, Dhaka South City Corporation (DSCC)
20. Executive Director, Bangladesh Computer Council (BCC)

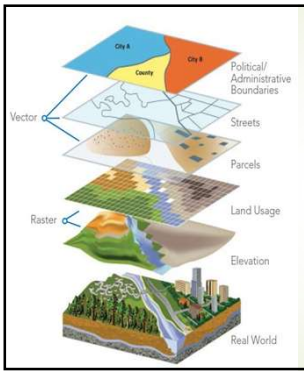
Annexture-1

AGENDA FOR NSDI CONTRIBUTORS MEETING

1. Welcome speech with brief orientation and Updates- Surveyor General.
2. Opening remarks- Joint Secretary, MOD.
3. Opening remarks - JICA representative.
4. Introduction of the Participants.
5. Roles and responsibilities of SOB as national mapping organization.
6. Concept of NSDI and introduction of foreign NSDI (JICA advisor).
7. Review of NSDI seminar and PM's initiative (SOB).
8. Related projects in Bangladesh - Geodash (BCC & WB).
9. One map policy with Basic Framework i.e. a unique coordinate system (BUTM 2010), map projection (Transverse Mercator), unique map datum (WGS84), unique spheroid (WGS84) and unique elevation datum (Mean Sea Level).
10. Discussion on Strategic plan and action plan.
11. Comments from contributors.
12. Open Forum.

WELCOME NOTES ON NSDI CONTRIBUTORS MEETING

Surveyor general of Bangladesh
15 May 2017



WELCOME
to the
NSDI CONTRIBUTORS MEETING

A Way Forward

3

Outline

- Background Aspects
- Importance of NSDI Endeavor in Bangladesh
- Review and output of International Seminar
- Todays Contributors Meeting
- Vote of Thanks

Background Aspects

Background Aspects

Spatial Data:

- Spatial data or Geospatial data **represents the location, size and shape of an object on the Earth** such as a building (Point Spatial data), lake or river (Line data), mountain or township (Polygon data).
- It is usually represented by numerical values in a geographic coordinate system (Latitude and longitude).
- Spatial data may also include attributes (Categorized detail about a particular data) that provide more information about the entity.
- Sources of such data can be the GPS, Aerial photographs, geo-referenced satellite image, field and surveyed data, maps, imagery of both printed and digital copies and open sources like google maps.

Background Aspects

SDI/ NSDI:

- A Spatial data infrastructure (SDI) or National SDI (NSDI) is a data infrastructure or a framework of a nation of Geospatial or Geographic data, Metadata (data or information about the spatial data it belongs to), users (Stakeholders) and tools (server, hub, soft and hardware, policies, standards and web portal) that are interactively connected in order to use spatial data in an efficient and flexible way.
- NSDI is an umbrella under which the Government, the private sector, and the academia are bonded by the common policies, standards, and procedures, interact to foster efficient use and production of spatial data.

Background Aspects

NSDI CONTRIBUTORS:

- NSDI contributors consists of the state and local government, the private sector, and the academia that generate or use geographic or spatial data and the technologies that facilitate the use and transfer of spatial data.
- NSDI's programs and services are made possible through the support of all layers of contributors that includes individuals, corporations and private foundations, combined with City and State efforts.

Background Aspects

Elements of NSDI/ NSDI Components:

- National Spatial Data Standard
- Spatial Data Infrastructure that includes:
  - NSDI Centre/ Organogram
  - Data Network
  - Hardware/ Software
  - Research/ Technical/ Training Institutions
- Spatial Data Protocol/ Policy on Sharing, Metadata and on Operational Mechanism
- Spatial Data Hub/ Centre
- Spatial Data Portal
- NSDI Stakeholders/ Contributors:
  - Data Generators
  - Data Analyzers
  - Data Users

Importance of NSDI Endeavor in Bangladesh

Importance of NSDI Endeavor in Bangladesh

Rationale for establishing NSDI in Bangladesh:

- There is no Center or Hub for the spatial data in Bangladesh. GIS, here, usually exist in the organizations as isolated collections of data, software, and expertise having the parameters different from each other, such as, **different projection system, Spheroid and Datum.**
- Due to practice of different standards often the data produced are incompatible, non-interoperable and non-standardized that severely limits the use of digital GIS data or spatial data among the users.
- There are duplication of efforts in production, collection, processing and utilization of Spatial data that results in waste of time, resources and energy.

Importance of NSDI Endeavor in Bangladesh

Benefits:

- NSDI ensures the spatial data as compatible for all stake holders that is capable of being used with or connected to other devices or components without modification.
- Same standard of Spatial Data that is interoperable, thus, able to exchange and use information without difficulty.
- Standardized data are archived centrally and also disseminated centrally, thus, data can be shared to/collected from all stakeholders with ease.
- Avoid duplication of data that results in waste of time, resources and money. Processed data are also stored for further references/ uses.
- Metadata will accompany with the spatial data that will be highly beneficial for processing and research/development.

Importance of NSDI Endeavor in Bangladesh

Benefits:

- Avoid collision by opposing plans or regulations, harmonize similar development plans, strengthen cooperation among related organizations
- Allow visualization and overlaying of various information to help evaluation and understanding
- A way forward to fulfill the Honorable Prime Minister's strong commitment and keen monitoring to build "Digital Bangladesh."

Review and output of International Seminar

Review and output of International Seminar

Review of International Seminar

- An international Seminar on "National Spatial Data Infrastructure (NSDI) for Bangladesh" organized by Survey of Bangladesh (SOB) of Ministry of Defence (MOD) and assisted by Japan International Cooperation Agency (JICA) was held in the 1st and 2nd June of 2016 at Hotel Sonargaon of Dhaka.
- Sheikh Hasina, the Honorable Prime Minister (PM) of Bangladesh, inaugurated and attended the seminar.
- In two days long seminar, eleven technical sessions took place in which about 130 participants from home and 40 from abroad have keenly participated.

Review and output of International Seminar

Honorable PM's Guideline

Honorable PM, in her speech, gave away the guidelines:

- To create awareness and importance of NSDI among all stakeholders and contributors, to formulate a national committee under the Ministry of Defence.
- To make short, mid and long term strategic plan and provide necessary guidelines for establishing NSDI in Bangladesh.
- To formulate a law for the implementation of NSDI in Bangladesh.

Based on the guidelines:

- Both Committee and Laws are in the advance stages of implementation.
- SOB is also implementing the 'Geo portal' that could be one of the important NSDI components.
- Short, Mid and Long term plan can be presented to the national committee for their consideration and could be brought forward through contributors/ users discussion.

Review and output of International Seminar

Role of SOB and JICA in bringing in the Issue

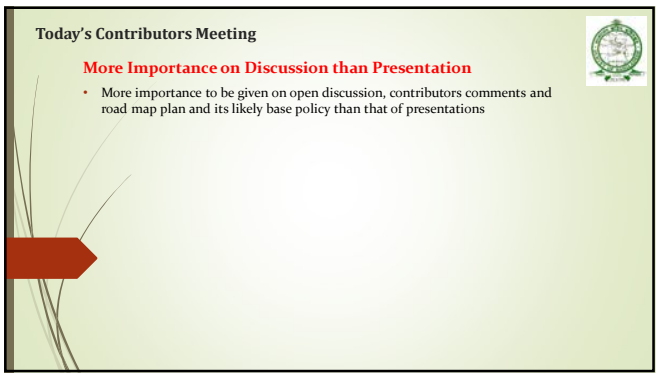
- SOB initiated the concept of NSDI being conceived from JICA objectives on this issue.
- JICA is actively and keenly assisting SOB in bringing the issue forefront with long term expert, short term experts, smaller but continuous project.
- JICA imparted training on NSDI to the Member of SOB, DLRS, LGED and RHD on NSDI and have the plan of continuing such effort.
- SOB under right guidance from MOD and with active assistance from JICA could bring forward the concept of NSDI and could successfully generate among most of the Spatial data contributors.
- NSDI is no more a terminology only, but a possible likelihood.

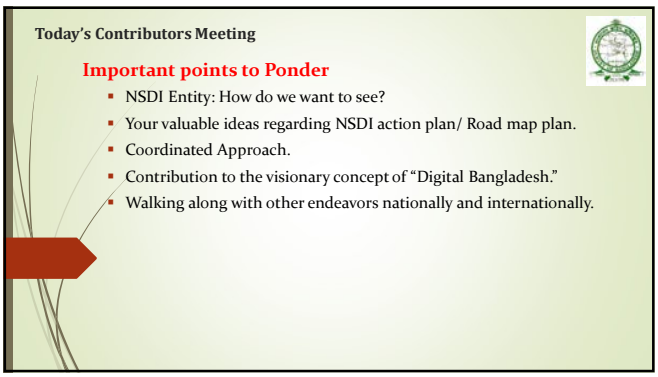
Today's Contributors Meeting

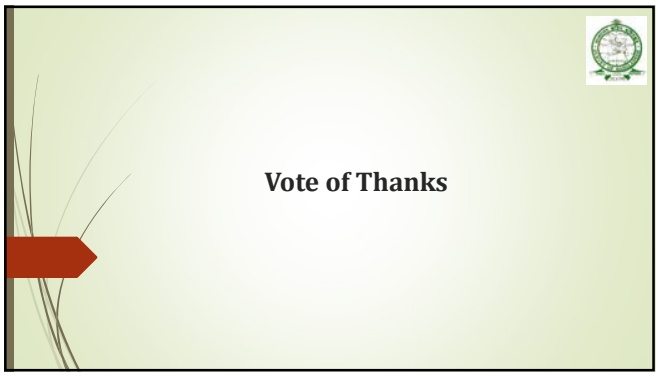
Today's Contributors Meeting

Objective of the Meeting

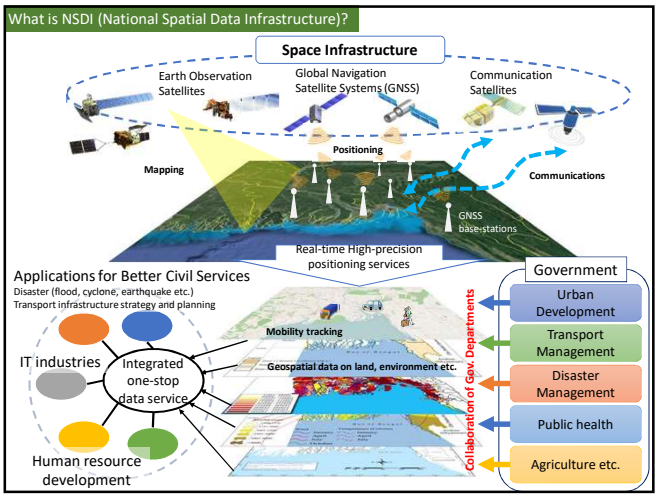
- Principal objective of the meeting is to bring all major contributors now and subsequently all other contributors into a common platform and understanding about the establishment of NSDI.
- To contribute with your valuable idea to formulate basic policy on formulating road map for NSDI construction
- Consensus on the implementation of NSDI components such as Data Hub/Center, operational mechanism, Data sharing and data preparation policy.
- To develop National Spatial data Standard that is compatible within the agencies at home and also compatible to International Organization for Standardization (ISO) and Open Geospatial Consortium (OGC).

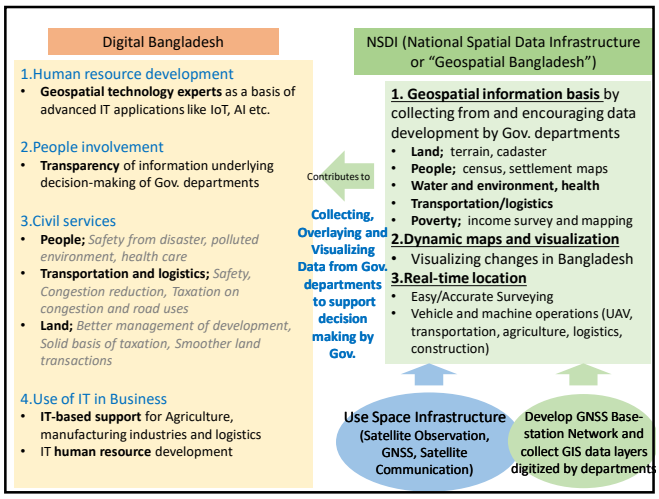

Today's Contributors Meeting
More Importance on Discussion than Presentation
More importance to be given on open discussion, contributors comments and road map plan and its likely base policy than that of presentations

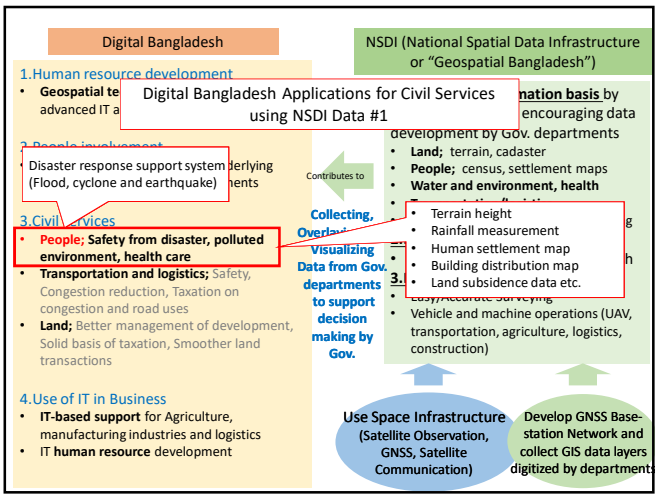

Today's Contributors Meeting
Important points to Ponder
NSDI Entity: How do we want to see?
Your valuable ideas regarding NSDI action plan/ Road map plan.
Coordinated Approach.
Contribution to the visionary concept of "Digital Bangladesh."
Walking along with other endeavors nationally and internationally.

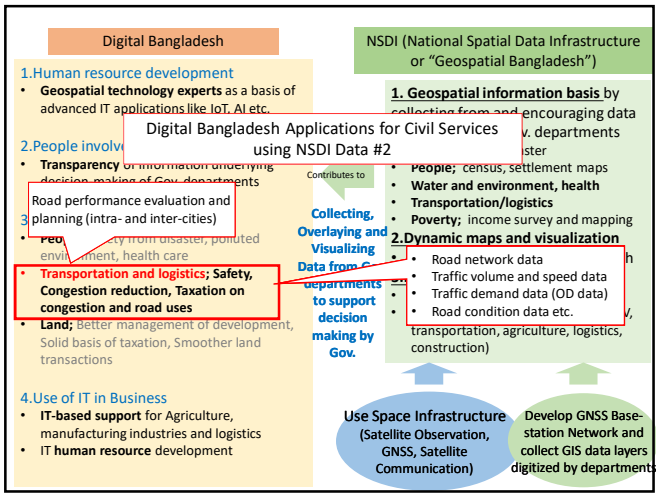

Vote of Thanks

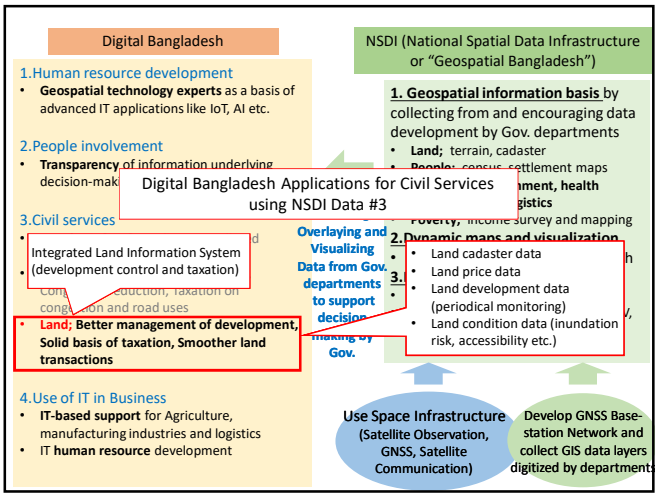
How will NSDI contribute to Digital Bangladesh?











GEODASH.GOV.BD

Tanimul Bari
Technical Specialist
Bangladesh Computer Council

Mohammed Abu Hamid
Consultant, GeoDASH
The World Bank

SUPPORT FROM: GFDRR Global Facility for Disaster Reduction and Recovery

IMPLEMENTED BY: ICT DIVISION

OVERVIEW

GEODASH.GOV.BD

A GEOSPATIAL DATA SHARING PLATFORM FOR BANGLADESH

"The Bangladesh Geospatial Data Sharing Platform (GeoDASH) is a web-based spatial data infrastructure and GIS that empowers government, academia, private enterprise and the public to securely host, manage, share, visualize and analyze geospatial data"

TIMELINE OF KEY DEVELOPMENTS

- ***February 2014:*** GeoDASH roadmap published as an output of the GFDRR-supported Bangladesh Urban Earthquake Resilience Project
- ***May 2014:*** Platform beta launched and data sharing working group established of 11 key government agencies involved in the disaster risk management of Greater Dhaka
- ***March 2015:*** Board approval of IDA $173 million Bangladesh Urban Resilience Project
- ***December 2015:*** Handover of GeoDASH from GFDRR to the Bangladesh Computer Council (BCC), ICT Division, Government of Bangladesh
- ***September 2016:*** GeoDASH highlighted in "Digital World" Bangladesh
- ***March 2017:*** Agreement made for GeoDASH to be integrated into the National Spatial Data Infrastructure Policy, which the Prime Minister is expected to sign by January 2018

PLATFORM CAPABILITIES

GEODASH.GOV.BD

OPERATIONAL DESIGN

GRANULAR PERMISSIONS FOR LAYERS, MAPS AND DOCUMENTS

Organization: Department of Disaster Management
Layer: Cyclonic Storm Surge Risk, 100 Year Return

OVERLAY LAYERS FROM DIFFERENT USERS AND ORGANIZATIONS

How can Dhaka increase its resilience to disasters *and provide better services to its most vulnerable?*

Data Sources

ADDITIONAL FEATURES

- Standard, Facebook, Google+ login
- Upload and download point, line, polygon and raster layers and metadata in all major formats
- Upload and link associated documents
- Dock favorite layers, maps, documents and organizations
- Style and visualize layers (pan, zoom, 3D)
- Analyze layers (centroids and centers, measure length and area, data chart view, buffer search, radius search, map query, cross join, etc.)
- Wiki documentation and full user guide (geodash.gov.bd/wiki)
- Print maps

IMPACT

GEODASH.GOV.BD

IMPROVES EFFICIENCY AND EFFECTIVENESS OF DECISION-MAKING

Geospatial data sharing between GeoDASH stakeholders results in:

- Improved quality of investment decision-making and emergency reaction times
- Reduced paperwork and run around between agencies
- Streamlined government services and reduced transaction times
- Reduced errors and rework
- Value-adding to agency data
- Reduced duplication of effort, resources and infrastructure

IMPACT EXEMPLIFIED

- Department of Disaster Management (DDM) now hosts their geospatial data on GeoDASH (BCC's Tier 3 servers) – previously hosted on an unreliable local server
- Dhaka North and South City Corporations, Capital Development Authority (RAJUK) and Dhaka Water Supply and Sewerage Authority (WASA) have agreed to collaborate in the future on mapping roads, building footprints, and water supply and sewerage
- Local Government Engineering Department (LGED) will use DDM's geospatial layers from the Multi-Hazard Risk and Vulnerability Assessment to inform appraisal of next phase investments in cyclone shelters
- The World Bank Office Dhaka has agreed in principle to include a clause in all relevant TORs that dictates the requirement to upload all non-sensitive data to GeoDASH, ensuring against disappearing data and "PDF only" outputs

FOUNDATION FOR UNLOCKING INVESTMENTS

GeoDASH contributed substantially to unlocking the IDA $173 million Urban Resilience Project by:

- Providing a valuable first engagement with a diverse range of government stakeholders involved in the disaster risk management of Greater Dhaka – data sharing challenges helped to build consensus around the need to coordinate on broader disaster risk management challenges
- Building a catalog of geospatial layers that cumulatively provide the quantitative foundation for effectively understanding urban risks and informing subsequent investment
strategies and design (e.g. risk assessment of critical and lifeline infrastructure required and RAJUK is the best fit as implementing agency)

NEXT STEPS

GEODASH.GOV.BD

TARGETS AND OBJECTIVES

1-year plan:

- Inclusion as primary tool in National Spatial Data Infrastructure Policy
- Continue to improve the platform's utility and user-friendliness based off of feedback from key government stakeholders and working group members
- Inclusion as primary tool in National Spatial Data Infrastructure Policy
- Total of 500 layers, 60 organizations and 400 users

5-year plan:

- Institutionalize GeoDASH in all relevant Government of Bangladesh agencies
- Encourage greater openness of non-sensitive data to all and support broader open data policy reform
- Total of 5,000 layers, 200 organizations and 4,000 users

Annex-14 NSDI 2nd Contributors Meeting Materials

SURVEY OF BANGLADESH
SURVEYOR GENERAL OFFICE
TEJGAON, DHAKA - 1208
Phone: 9114191 Fax: 9117463
info@sob.gov.bd,www.sob.gov.bd

SOB/14-C/NSDI Meeting/P- 2251 Date: 27 July 2017

From

Surveyor General of Bangladesh
Survey of Bangladesh
Shaheed Tajuddin Swarani, Tejgaon, Dhaka-1208

To

As per the Distribution

Subject: Invitation to attend Contributors Meeting on "Draft Road Map Plan and Pilot project for NSDI construction in Bangladesh" to be held on 09 Aug 2017 at 10:30 am

Ref:

1. Survey of Bangladesh letter no SOB/14-C/NSDI Meeting/P-1362 dated 02 May 2017.
2. Record of Discussions between JICA and Authorities Concerned of the People's Republic of Bangladesh (MOD, MOF and SOB) dated 27 August 2013.
3. MOD letter no 23.00.0000.220.25.001.16.639 dated 24 November 2016.

Dear Sir/Madam,

An international Seminar on "National Spatial Data Infrastructure (NSDI) for Bangladesh" organized by Survey of Bangladesh (SOB) of Ministry of Defence (MOD) and assisted by Japan International Cooperation Agency (JICA) was held during 1st and 2nd June of 2016 at Dhaka. Sheikh Hasina, the Honorable Prime Minister (PM) of Bangladesh, inaugurated the seminar and gave away her guidelines to create awareness and importance of NSDI among all contributors. As part of Ref 2 and 3, a contributors meeting was held on 15 May this year where progresses on NSDI construction since the seminar were discussed, importance were re-generated among the stakeholders and the possible role of different contributors for the establishment of NSDI was explained. Large infrastructure like NSDI demands many more numbers of meeting, workshops and seminars.

With this backdrop, SOB with the assistance from JICA, is going to organize the 'Second Contributors Meeting' with the continuation of earlier discussion and the inclusion of new agenda, principally focusing on the 'Draft Road Map for NSDI construction' from the contributors and discussion on 'NSDI Pilot project' as well. The meeting would take place at the **Conference room of Digital Mapping Center of SOB located at Dhamalcoat, Mirpur-14 of Dhaka on 09 Aug 2017 at 10:30 am.** It is my pleasure and honor to invite one of your senior representatives to participate in the meeting. We deeply appreciate your long stretched contribution on the geo-spatial activities in Bangladesh. Presence of your resource person will surely promote the activities in establishing SDI for our Nation. In this regard, please send us the name of the participant from your organization by 03 August 2017 following the table given below. Apart from the paper copy, you may send the electronic copy of your nomination letter to our official email (info@sob.gov.bd).

Name of the Participants	Position in the office	Name of the Organization	Mobile Number	E-mail ID

The proposed Agenda for the meeting is given as an annexure to this letter for your concern. We eagerly look forward to your contribution on this meeting.

Sincerely Yours,

Brigadier General Zakir Ahmed, psc
Surveyor General of Bangladesh

E-mail: sg@sob.gov.bd

Annexure:

Agenda for "NSDI contributors meeting"

Distribution (Not following seniority):

1. Secretary, Ministry of Defence (MOD)
2. Director General, Bangladesh Bureau of Statistics, (BBS)
3. Director, Bangladesh Metrological Department (BMD)
4. Chairman, Space Research and Remote Sensing Organization (SPARRSO)
5. Prof Md. Mafizur Rahman, Department of Civil Engineering, BUET
6. Chief Engineer, Local Government Engineering Department (LGED)
7. Chief Engineer, Roads and Highways Department (RHD)
8. Chairman, Rajdhani Unnayan Kartripakkha (RAJUK)
9. Director General, Bangladesh Water Development Board, BWDB
10. Chairman, Water and Sewerage Authority (WASA)
11. Director General, Geological Survey of Bangladesh (GSB)
12. Chairman, Bangladesh Agricultural Development Corporation (BADC)
13. Director General, Department of Land Record and Survey (DLRS)
14. Project Director, Access to Information (A2I) Programme, PMO's Office
15. Chief Representative, JICA Bangladesh
16. Mr. Toru Watanabe, Team Leader, JICA NSDI Study Team
17. Chief Executive Officer, Dhaka North City Corporation (DNCC)
18. Chief Executive Officer, Dhaka South City Corporation (DSCC)
19. Executive Director, Bangladesh Computer Council (BCC)
20. Director General, Department Of Disaster Management (DDM)
21. Country Representative, World Bank (WB)
22. Executive Director, Center for Environmental and GIS (CEGIS)
23. Executive Director, Institute of Water Modelling (IWM)

Annexure

AGENDA FOR NSDI CONTRIBUTORS MEETING

1. Welcome notes and Summary on the progress of NSDI construction work in Bangladesh– Surveyor General of Bangladesh.
2. Opening remarks – Senior Representative of JICA.
3. Introduction of the Participants.
4. Presentation on the draft Road Map Plan - JICA study team.
5. Discussion on the Agenda 4.
6. Presentation on NSDI pilot Project - Hiroto Fujita and Maj Suja.
7. Valuable remarks from Prof Dr Md Mafizur Rahman, BUET
8. Open Forum
9. Closing remarks by the Joint Secretary, MOD.
10. Lunch

Note: Tea will be served during the Meeting.

WELCOME NOTES
Surveyor General of Bangladesh

WELCOME
TO THE
NSDI CONTRIBUTORS MEETING #2

Ser	Topic	Presenter/ Participants	Time	
			From	To
1.	Welcome notes	Surveyor General of Bangladesh	1030	1040
2.	Opening remarks	Senior Representative of JICA	1040	1050
3.	Introduction of the Participants	All	1050	1100
4.	Presentation on the "Basic vision or idea for the preparation of NSDI road map plan"	JICA study team	1100	1120
5.	Discussion on the Agenda 4	All	1120	1150
6.	Tea	All	1150	1210
7.	Presentation on NSDI pilot Project	Mr Hiroto Fujita & Maj Suja	1210	1220
8.	Case study presentation on NSDI Construction in Japan	Mr Chiba San	1220	1230
8.	Valuable remarks	Prof Md Mafizur Rahman, BUET	1230	1245
9.	Open Forum	All	1245	1315
10.	Closing remarks	Joint Secretary (W&D), MOD	1315	1330
11.	Lunch	All	1330	

- Background
- Role of SOB in the NSDI Construction Work
- Progress of NSDI Construction work in Banglad
- Vote of Thanks

Background

Background:

NSDI Contributors

- NSDI contributors consists of the state and local government, the private sector, and the academia that generate or use geospatial data and the technologies that will facilitate the growth of Bangladesh towards digital transformation.
- It will be possible to initiate the programs and services of NSDI's only through the support of all layers of contributors..

Background:

- An international seminar was held during 1st and 2nd Jun 2016 on "NSDI for Bangladesh" with the assistance from JICA. Honorable PM of People's Republic of Bangladesh attended the seminar and gave her directives and stressed the importance of NSDI in building Digital Bangladesh.
- Now NSDI is well conceived by all contributors.
- Within the NSDI framework stakeholders are to be bounded by the rules and policies and common data standard which is compatible and interoperable.

Background:

- In Bangladesh geospatial data is produced and used by many organizations as isolated works and collection of data, processing, storing and analyzing by various software and expertise having the parameters different from each other. such as, different projection system, spheroid and datum.
- As a result making data produced is incompatible, non-interoperable and non-standardized that severely limits the sharing of geospatial information among the users.
- There are duplication of efforts in collection, processing and storing of data results in waste of time and resources.

Background :

- NSDI will provide technologies and facilities hat generate, use and share geospatial information on a common platform.

Possible Role of SOB in the NSDI as a Contributor

Role of SOB in the NSDI as a Contributor:

- ❑ Establishment of Nation wide Geodetic network to obtain precise location data from anywhere in the country.
- ❑ Nationwide topographic base map at different scales ranging form 1 million to 5,000 or larger.
- ❑ Preparation of geo-portal to support the activates of NSDI so that all stake holders and users can overly their information on to the basic topographic map at different scales or zoom levels.

Progress of NSDI Construction work in Bangladesh

Progress of NSDI Construction work in Bangladesh:

- Initiated by the international seminar held on 1st and 2nd June of 2016 .
- Honorable PM gave away important guidelines to create awareness among all contributors and assigned MOD to formulate necessary laws and national committees.
- Since then, series of bilateral meeting were done within the contributors and mediated by JICA.
- Idea is to bring in all contributors in the common start point.

Progress of NSDI Construction work in Bangladesh:

- First contributors meeting was held on 15 May of this year at this same venue. Rationale of establishing NSDI, number of case studies by JICA study team and possible role along with creating consensus among stakeholders were the major agenda that were discussed last time.
- Since then, bilateral meetings took place again in a numbers within the contributors about the second session and the pilot project to test prototype database system.

Vote of Thanks

Basic Vision for Roadmap (Proposed) to build NSDI in Bangladesh

Project Team for Making the Roadmap to Establishing NSDI

Construction of NSDI system is not final goal.

This is the first step or start point for the construction of NSDI.

Many activities before and after construction of NSDI system are necessary such as:

Legal framework
NSDI promotion structure
Technical issues
Operational issues
Human resources development
Preparation and updating of geospatial information
Etc.

2

Building NSDI in Japan

Preparation Period
Period: 3 years: 1996 - 1998
Main activity: Preparation of rules and long-term plan for NSDI

Dissemination Period
Period: 3 years: 1999 - 2001
Main activity: Development of infrastructure & preparation of basic data

Operation Period
Period: 4 years: 2002 - Present
Main activity: Utilization promotion of NSDI & GIS
(Action plan to enhance quality of life of citizen with GIS)

3

Relation among, Digital Bangladesh, 5 Year Plan in Bangladesh and NSDI

Schedule of 5-year Plan in Bangladesh
7th 5-year Plan in Bangladesh: From July 2016 to June 2021
8th 5-year Plan in Bangladesh: From July 2022 to June 2025
9th 5-Year Plan in Bangladesh: From July 2026 to June 2031

Policies/projects of Bangladesh Government
- Digital Bangladesh ⇒ Core policy of Bangladesh Government
- A2i program⇒ Core project of Digital Bangladesh
- Geodash ⇒ Existing/On going Geo portal

On going JICA project
- Project for strengthen the capacity on advanced mapping of SOB for building digital Bangladesh
- Making the roadmap to establishing NSDI

4

Stages for Building NSDI in Bangladesh (Plan)

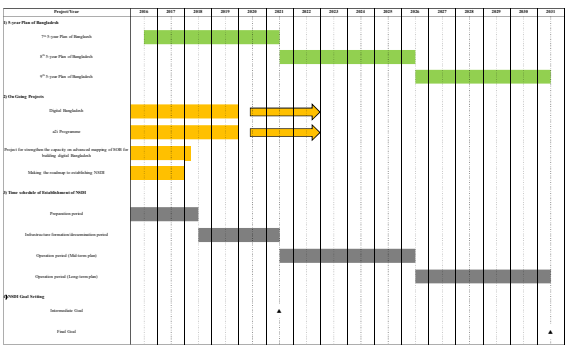
Preparation Period
Period: Now – June 2018
Main work: Preparation work necessary for building NSDI

Infrastructure Formation/Dissemination Period (Short term plan)
Period: July 2018 – June 2021
Main work: Construction of NSDI system framework
Start of operation of NSDI
Solving of various issues

Operation Period (Med-term/Long-term plan)
Period: Med term plan July 2021 – June 2026 (8th 5 year plan period)
Long term plan July 2027 – June 2031 (9th 5year plan period)
Main work: Solving of various issues
Utilization promotion of NSDI
Updating or expansion of system
Updating or creation of geospatial data

5

Time Schedule of Building NSDI (Draft)



6

NSDI Committee and Working Groups

In order to build/operate NSDI and promote utilization, many technical and operational issues need to be solved in cooperation with various related agencies.

To solve these technical and operational issues, it is recommended to organize Working Group (s) under NSDI Committee.

Accordingly, the working group(s) under NSDI Committee need to review the various issues and submit the results and recommended measures to NSDI Committee.

7

Technical Issues for Geospatial Information on NSDI

Technical Working Group

- Unification of administrative boundaries
- Coordinate conversion
- Unification of elevation standard
- Unification of geographic names
- Unification of address display format
- Unification of map symbols
- Data standalization
- Etc.

8

Issues for Operation/Utilization of NSDI

Operational Working Group

- Measures to promote utilization
- Data release policy
- Development/Updating of data policy and schedule
- Human resource development
- Utilization measures for continuously operating reference stations
- Building/expansion/operation of platform
- Etc.

9

Data Release Policy of SOB for NSDI

- Geographic information is the basic data for NSDI, and this is recognized by the various organizations and agencies in Bangladesh.
- SOB is the national survey and mapping agency in Bangladesh, and it is the agency that creates/provide various type of accurate geographic information to the stakeholders.
- It is natural that SOB will be asked to provide and release various type of geographic information on NSDI when NSDI is built in Bangladesh.
- Therefore, it is necessary to decide and explain the data release policy of SOB to the stakeholders when NSDI is build.

10

Necessity of Updating of Topographic Maps

- Secular changes of topographic maps will be started after preparation of topographic maps (Properly say, from the date of aerial photography).
- Therefore, periodic updating of topographic maps is necessary to maintain freshness of data.
- 1:5,000 scale topographic maps covering Dhaka City was prepared on 2004 (Aerial photography was executed January 2003). Therefore, approximately 15 years has been already passed after aerial photography.
- Therefore, immediate updating of 1:5,000 scale topographic maps at Dhaka City is necessary for the basic data on NSDI.

11

Thank you for your cooperation and assistance for construction of NSDI in Bangladesh.

12

Project for Strengthen the Capacity on Advanced Mapping of SOB for Building Digital Bangladesh

- Making the Roadmap to Establishing NSDI -

Contributors Meeting #2

Overview of NSDI Pilot Project

August 2017

Survey of Bangladesh (SOB)
Ministry of Defence
The Government of the People's Republic of Bangladesh

JICA Map Administration Expert
Asia Air Survey Co., Ltd.
Kokusai Kogyo Co., Ltd.
Pasco Corporation

Table of Contents

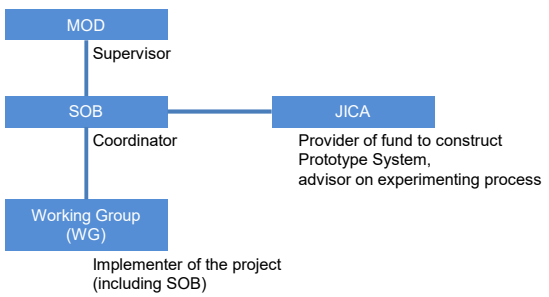
1. INTRODUCTION

1.1 Objective of the NSDI pilot project

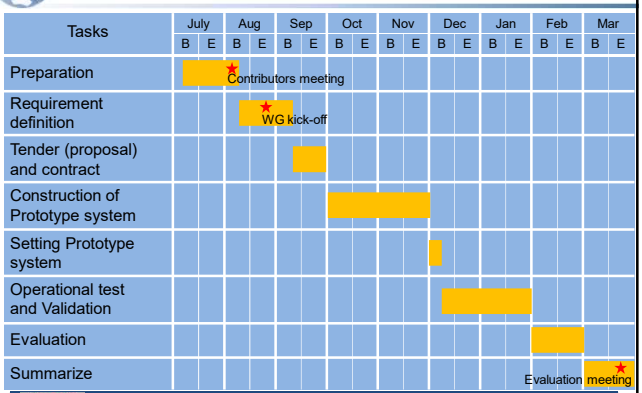
- General objective of the NSDI pilot project is followings:
  - Create a limited scale of database system (Prototype System)
  - Examine the function and performance of NSDI
  - Research on the benefits and issues prior to the introduction of full scale NSDI for Bangladesh
- Purpose and target of the NSDI pilot project
  - Suggest the best specification of NSDI for Bangladesh
  - Propose the rules of operations and roles of participated organizations

1.2 Project members and roles

- Organization of NSDI pilot project



1.3 Schedule



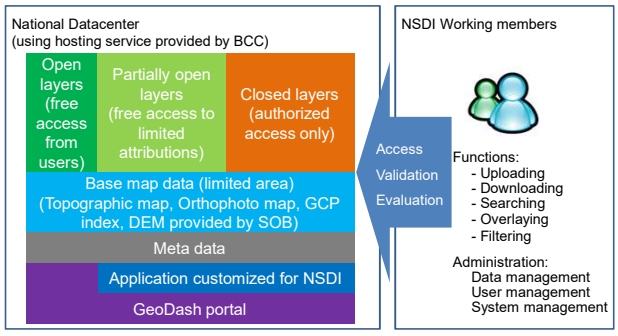
2. OVERVIEW OF THE NSDI PILOT PROJECT

2.1 Structure of the NSDI prototype system (1/2)

- Basic design – NSDI powered by GeoDash
- The reasons for utilizing GeoDash are:
  - To well-designed geo-portal system established with support from WB,
  - To have operational experience to handle and publish various maps and made by public organizations,
  - To be effective in constructing NSDI prototype system.

2.1 Structure of the NSDI prototype system (2/2)

- NSDI prototype system configuration



2.2 Experimental operation (1/2)

- Administration process

Authorization of information	Check the quality and liability of requested maps and information and permit to register.
Registration	Register maps and information layers according to the authorized request.
Access control	Set the rules of access to the registered information.
Unregister and update	Unregister or replace the maps and information with regulated procedures.
Monitoring	Monitor and summarize the accesses from clients.

2.2 Experimental operation (2/2)

- Utilizing process

Checking functions	Check and examine all functions of Geo-portal.
Checking security control	Check security of closed and partially closed layers.
Using system	Check search and download operation of Clearing House.

2.3 Evaluation

- Evaluation items are as follows:
  - Data Quality
    - Change of accuracy or completeness from source data
    - Workload and cost of conversion and registration
    - Consistency and integrity of different maps and information
  - System performance
    - Easiness and secureness of registration
    - Sufficiency of function of geo-portal
    - System resource: capacity, speed
  - Operation bodies
    - Organization of NSDI operation
    - Process of operation
    - Summarization method of user activites

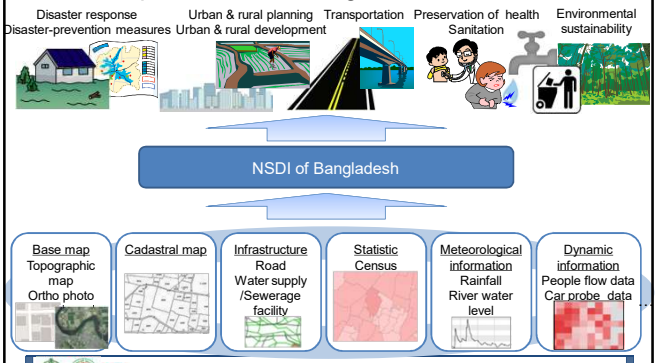
2.4 Final reports

- Final report include the following topics:
  - Benefits and issues in utilizing NSDI on activities of public organizations
  - Issues and necessity in preparation of base maps and geospatial information
  - Examples of activities and organizations in which NSDI is essential or efficient
  - Required specifications for full sized NSDI for Bangladesh

3. FUTURE PLAN

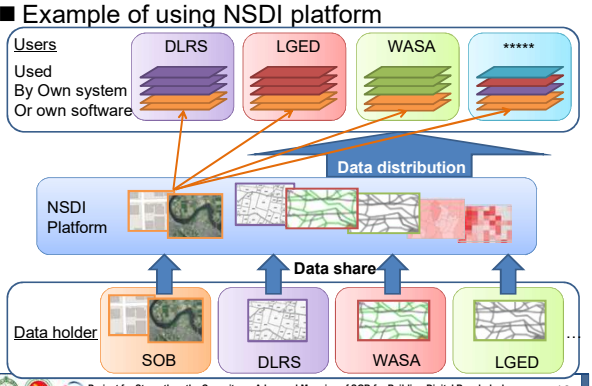
3.1 System Conceptual Design of the Full Scale NSDI for Bangladesh (draft) (1/5)

- Concept of NSDI for Bangladesh



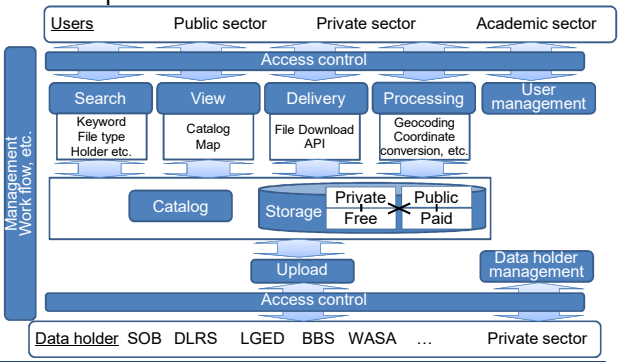
3.1 System Conceptual Design of the Full Scale NSDI for Bangladesh (draft) (2/5)

- Example of using NSDI platform



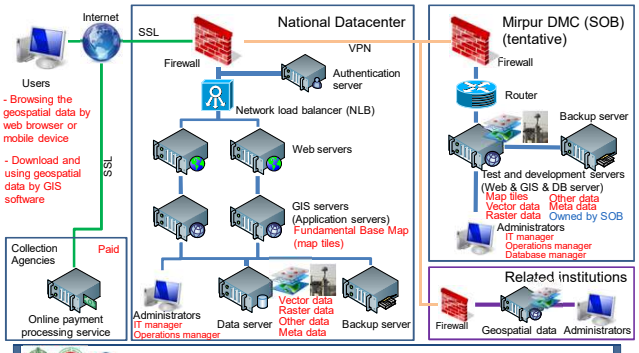
3.1 System Conceptual Design of the Full Scale NSDI for Bangladesh (draft) (3/5)

- NSDI platform architecture



3.1 System Conceptual Design of the Full Scale NSDI for Bangladesh (draft) (4/5)

- NSDI Platform configuration



3.1 System Conceptual Design of the Full Scale NSDI for Bangladesh (draft) (5/5)

■ Required resource for NSDI system

Hardware	Server, Storage, Network device (such as router, road balancer, switch, hub), Network cable, Backup device, UPS, Server rack, Server room, Power supply device, Air-conditioning equipment, Workstation, etc
Software	Web-based application (such as MapServer, GeoServer, GeoNode), GIS (such as ArcGIS), Database (such as PostgreSQL), Programming language (such as Java, Python), Malware software, Network software, Backup software, OS (such as Linux), etc.
Data	Base map data: Topographic map, Orthophoto, GCP index, DEM Archive data: Aerial photo, Historical map, etc. Thematic layer: Cadastral, Road, Water, Sewage, Disaster, Meteorology, etc. Other information: GCP, Address, Road name, Statistics, etc.
Human	IT manager, Operations manager, Database manager, GIS specialist, GIS operator, Surveyor, Mapping operator, Programmer, etc.
Other	Online payment processing service, National e-Service System, Virtual Private Network, etc.

Thank you for your kind attention

Project for Strengthen the Capacity on Advanced Mapping of SOB for Building Digital Bangladesh

- Making the Roadmap to Establishing NSDI -

Contributors Meeting #2

Concept for Establishment and Operation of NSDI

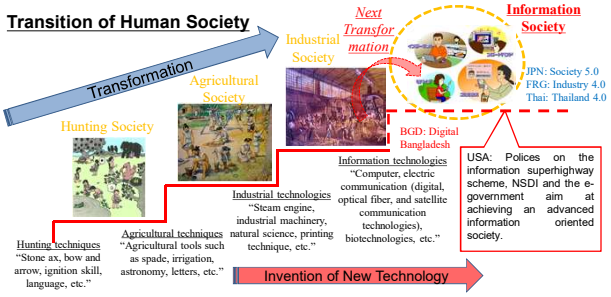
August 2017

Survey of Bangladesh (SOB)
Ministry of Defence
The Government of the People's Republic of Bangladesh

JICA Map Administration Expert
Asia Air Survey Co., Ltd.
Kokusai Kogyo Co., Ltd.
Pasco Corporation

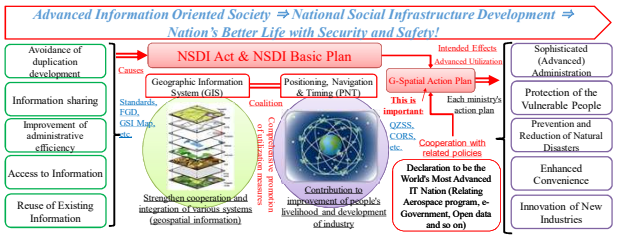
1. Confirmation of Significance and Necessity of Establishment & Operation of NSDI

- GI is a source of innovation and essential to information society.
- GI is closely related to human living activities.
- Cooperation between GI and Satellite PNT produces further effects.



2-1. Concept for Establishment & Operation of NSDI in Japan

The beginning of NSDI: 1995, after the Great Hanshin & Awaji Earthquake
Purpose: 1) Understanding of the disaster situations,
2) Preparing a reconstruction plan



NSDI Promotion Structure: "Liaison Committee of Ministries and Agencies related to GIS" in the Cabinet ⇒ "Council for promotion of geospatial information utilization (Bureau directorial level)"

2-2. Basic Principles concerning Establishment & Operation of NSDI

In 2007, "Basic Act on the Advancement of Utilizing Geospatial Information" that is known as NSDI Act of Japan, was enacted.

And in its Article 3, nine basic principles concerning establishment and operation of NSDI are defined.

I. Implementation of comprehensive and systematic measures that are
   a. development and provision of geospatial information,
   b. promotion of utilize geographic information systems and satellite positioning,
   c. human resource development,
   d. strengthening collaboration with relevant ministries, agencies and institutions
II. Implementing the relationship measures for exerting a synergistic effect for a policy of the promotion of the use of geospatial information
III. Ensuring an environment that will consistently provide highly reliable Satellite Positioning, Navigation and Timing services
IV. Management of effective and efficient public facilities, promotion of disaster prevention measures and utilization, development and conservation of the national land, protection of people's lives, body and property
V. Efficiency and sophistication of public administrative management
VI. Provide a variety of services (⇒ Contribution to improvement of the convenience of citizens)
VII. Creation and development of a variety of business and harmony with the environment
VIII. Utilization of the proposed technology and ingenuity by the private sector
IX. Consideration of infringement to individual rights and interests, and to ensure the country's safety

2.3. Basic Policies of Establishment & Operation of NSDI in the NSDI Basic Plan

In 2008, the 1st Cabinet resolution of the "Basic Plan for the Advancement of Utilizing Geospatial Information" was approved based on the NSDI Act. The NSDI basic plan has been revised for 4 to 5 years, and the following is the transition of these basic policies.

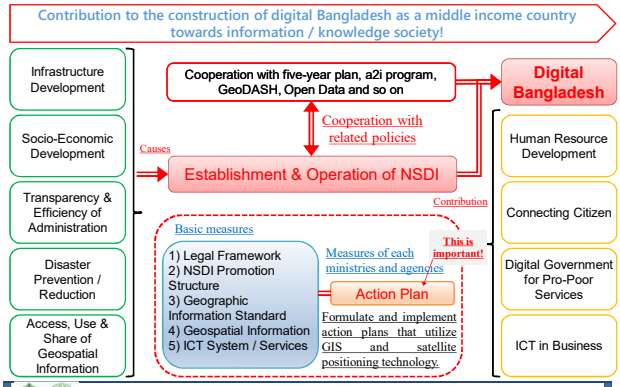
1st Basic Plan April 2008 ~ March 2012	2nd Basic Plan April 2012 ~ March 2017	3rd Basic Plan April 2017 ~ March 2022
① Prepare draft guidelines related to the development, provision and distribution of geospatial information, and promote the provision and distribution of it. ②Promote the development and provision of FGD. ③ Promote the establishment and utilization of a high-tech base for Space-based PNT. ④ Strengthen ties among business, academia and government as they relate to the utilization of geospatial information.	① Developing continuous geospatial information to meet society's needs and applications to new uses ② Domestic and overseas development and utilization of practical quasi-zenith satellite systems ③ Further dissemination and establishment of the geospatial information in society ④Recovery from the Great East Japan Earthquake and contribution to sustainable land-use that is highly resistant to disaster	① Contribution to strong for disasters and sustainable land formation ②Creation of new transportation and logistics services ③ Contribution to high-quality living with safety & security in population declining & elderly society ④ Revitalize local industries, create new industries and new services ⑤ Overseas development of technologies and mechanisms utilizing geospatial information, progress of international contribution

3.1. Digital Bangladesh

The Hashina administration has proposed the "Vision 2021" aiming to become a middle-income country by 2021. And they advocates "Digital Bangladesh" aiming at ICT throughout the country, and work on social and economic development.

Human Resource Development	"Digital Bangladesh" requires human resources with advanced ICT technology, and implements human resources development and development. In addition, education using ICT technology (e-learning) would be implemented.
Connecting Citizen	All citizens ensure access to "Digital Bangladesh" regardless of the gap between rich and poor, literacy abilities, and the place of residence in urban and rural areas. It is intended that citizens continuously obtain benefits from "Digital Bangladesh", and contribute disclosure of information to policies to each layer.
Digital Government for Pro-Poor Services	It consists of two components: electronic civil service tailored to citizen's lifestyles and electronic administration that delivers electronic civil service. Priority is given to services in the fields of education, health, agriculture, social security and others.
ICT in Business	In the business field aims, a) Access to new markets such as e-commerce and electronic bidding, b) Training and promotion of the ICT sector to support "Digital Bangladesh", c) Cultivating ICT sector as the export sector for acquisition of foreign currency.

3.2. Concept for Establishment and Operation of NSDI (Tentative)



3.3. Basic Principles concerning Establishment & Operation of NSDI (Tentative)

Basic principles concerning basic measures and formulation and implementation of action plan of each ministry and agency are suggested as follows:

I. As basic measures for establishment and operation of NSDI, development and provide of geospatial information, promote the use of GIS and satellite positioning technology (CORS), human resource development, research & development, and strengthen cooperation among related organizations.
II. 1) Effective and efficient management of public facilities, 2) Promotion of disaster prevention / reduction measures, 3) Use, maintenance and preservation of the land, 4) Improvement of agricultural productivity, and 5) Protection of the people's lives and property, are applied GIS and satellite positioning technology.
III. Improve the efficiency, sophisticated (advanced) and transparency of administrative management of the central and local governments.
IV. Provide diverse services that contribute to the improvement of convenience for citizens regardless of difference of rich and poor, literacy abilities, place of residence in urban and rural areas.
V. Create and develop diverse businesses utilizing GIS & satellite positioning and harmonize with the environment.
VI. Pay attention to protection of personal information, promotion of secondary use of public data, and consideration of national security.

4. Survey & Mapping Act (Bill) and NSDI Act (Bill)

- Survey & Mapping Act (Bill)
  Article 3 Uses of map and data as per Organization:
  (1) Every Government, Autonomous and Non-Government, Development Planning Organization bound to follow the coordinate method, data, Projection as per Survey of Bangladesh.
  (2) Every Government, Autonomous and Non-Government, Development Planning Organization is permitted to use map and Geo-Information data of SOB as per requirement.

- NSDI Act (Bill)
  Article 23 Open Geospatial data supply and use:
  This Geospatial data will be free of cost for general public.
  Article 24 Storage Geospatial Data supply and use:
  1) Only Government Organizations or agencies can use storage Geospatial Data
  2) Other organization can use Geospatial Data with the permission of Surveyor General.

5. Consideration Points

- Capacity of SOB
  - Correspondence to New Work
    Survey & Mapping Work ⇒ Planning & Coordination Work
  - Capacity Building to New Work
    Technical Level & Number of Staffs
  - Be Required of Training & Implementation (OJT)

- Changing Work Contents of SOB
  - Planning & Coordination of NSDI Legal Framework
  - Coordination of NSDI Promotion
  - Research of Geographic Information Standards
  - Development of ICT System & Service

Thank you very much for your attention!!

Needs, Demands and Value Additions of NSDI: Bangladesh Context

Dr. Md. Mafizur Rahman
Professor of Civil Engineering
BUET
mafizur@gmail.com

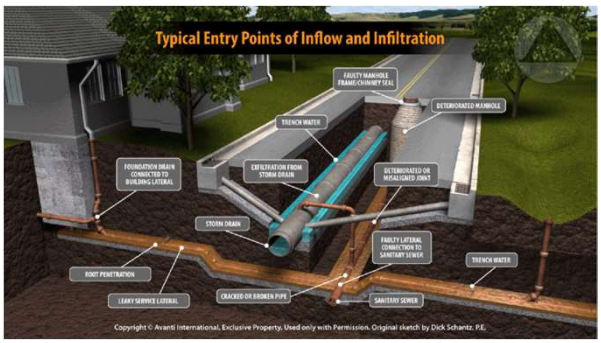
Draft Road Map Plan and Pilot Project for NSDI Construction in Bangladesh
Contributor's Meeting
Digital Mapping Center of SoB, Damalcoat, Mirpur-14, Dhaka
August 9 , 2017

Needs, Demands and Value Additions of NSDI: URBAN AREAS

Various Service Lines

- Water Supply
- Sewerage
- Storm Water
- Gas
- Electricity
- Internet (Fiber Optics)
- Telephone (Land phones)
- Television
- :
- :
- :
- :

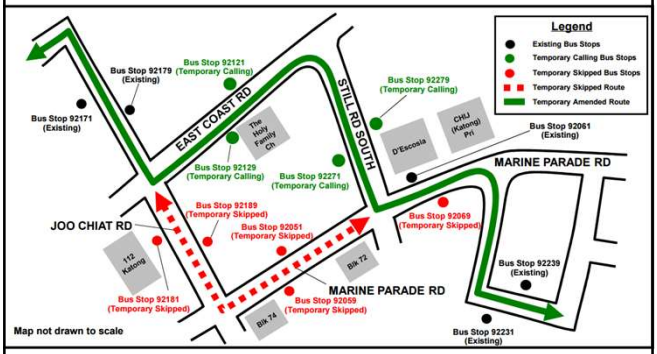
SERVICE LINES ARE NOT SIMPLE: **Have Associated Components**



Purbachol Sector 16

INSTALLATION OF NEW PIPE/ Maintenance of Existing Systems

ALTERNATE TRAFFIC ROUTE : Maintenance and Repair Work



Ref: http://landtransportguru.net/temporary-closure-of-joo-chiat-road/

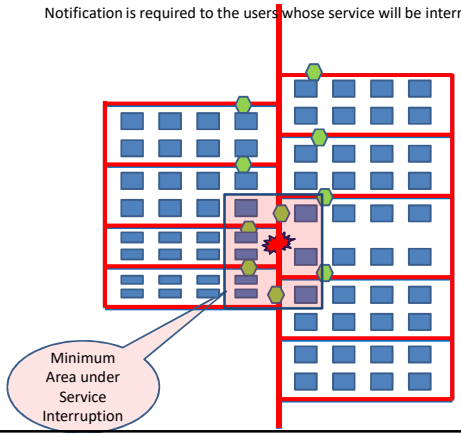
Excavation is difficult in a Densely populated City : Dhaka

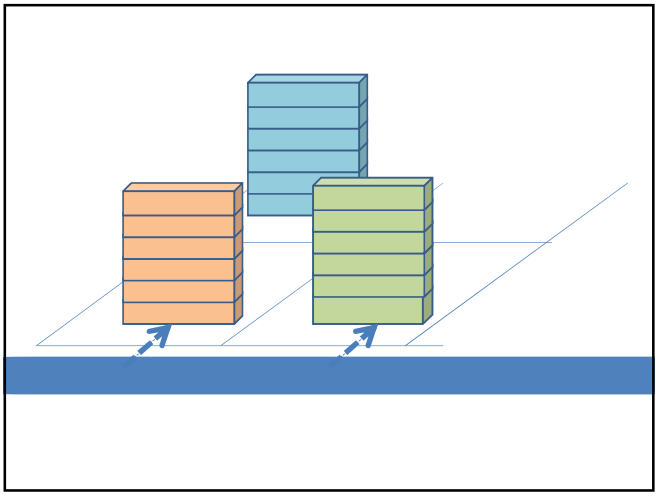
Excavation is difficult in a Densely populated City : Dhaka

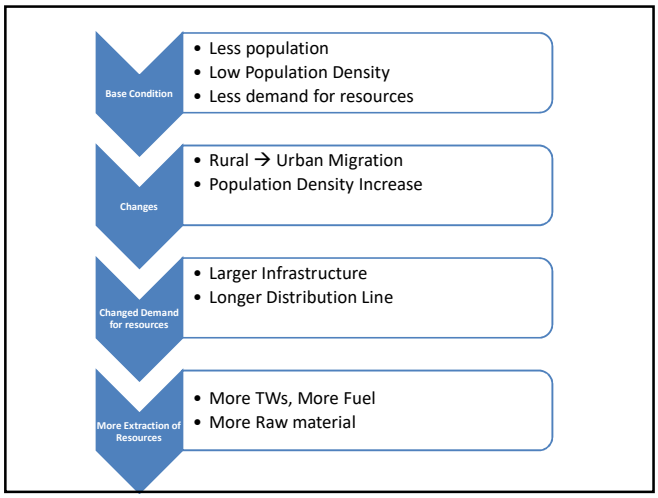
Trouble in one of service lines may need shut off of services of a large area

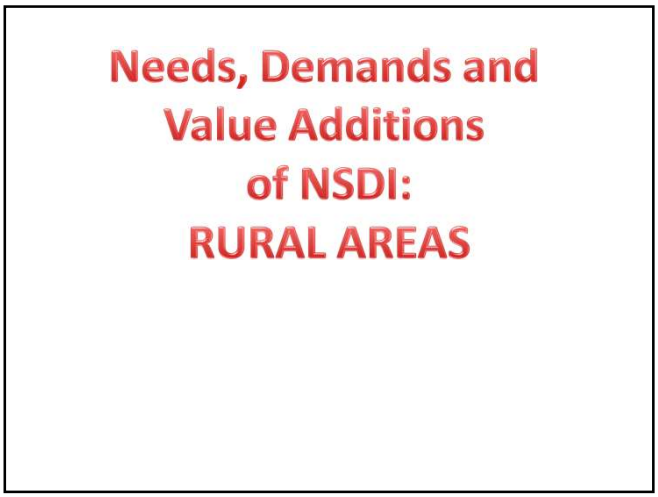
Accident at a specific location may need service interruption of surroundings

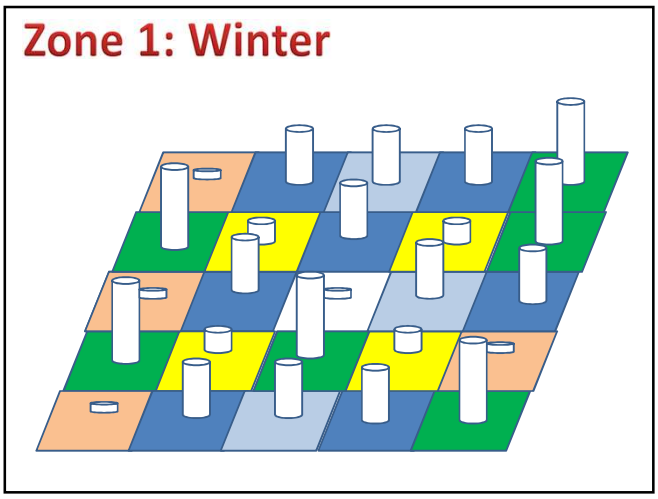
Notification is required to the users whose service will be interrupted

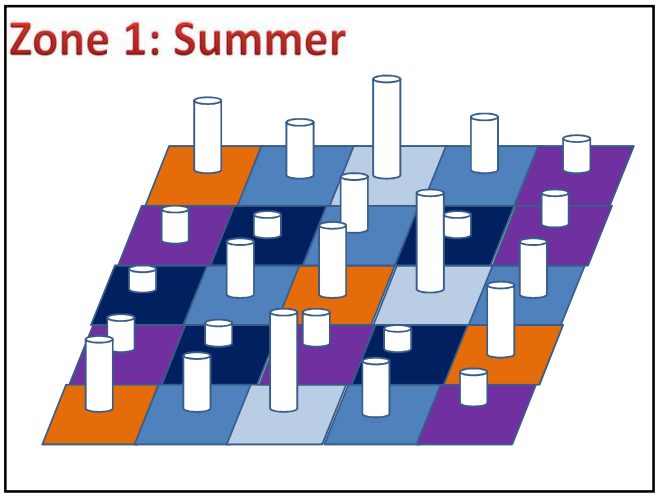


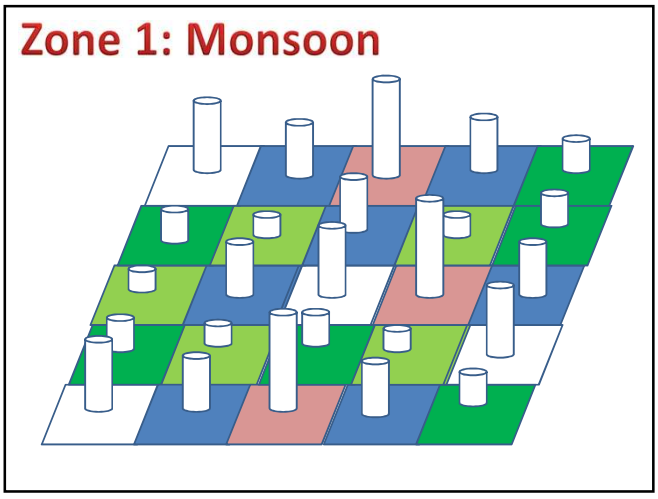



Base Condition
• Less population
• Low Population Density
• Less demand for resources
Changes
• Rural → Urban Migration
• Population Density Increase
Changed Demand for resources
• Larger Infrastructure
• Longer Distribution Line
More Extraction of Resources
• More TWs, More Fuel
• More Raw material


Needs, Demands and Value Additions of NSDI: RURAL AREAS


Zone 1: Winter


Zone 1: Summer


Zone 1: Monsoon

Water Management

- Crop
  - Crop Calendar
  - Zonal Crop Pattern
- Rainfall
  - Rainfall
  - Temperature
  - Climate Change
- Irrigation
  - Water Availability
  - Water Deficit

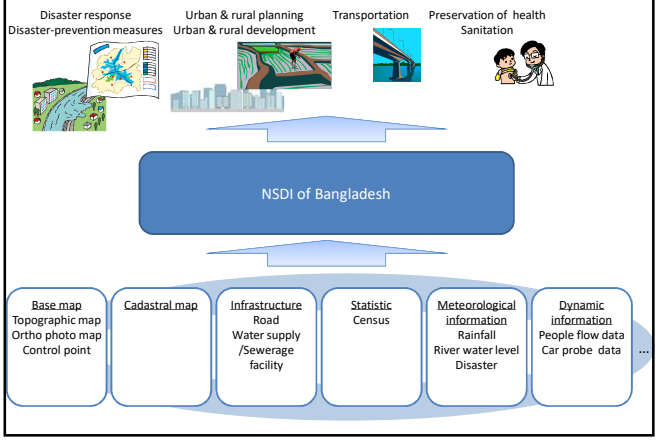
Fertilizer Management

- Crop
  - Crop Calendar
  - Zonal Crop Pattern
- Soil
  - Soil Type
  - Nutrition
- Fertilizer
  - Budget
  - Availability

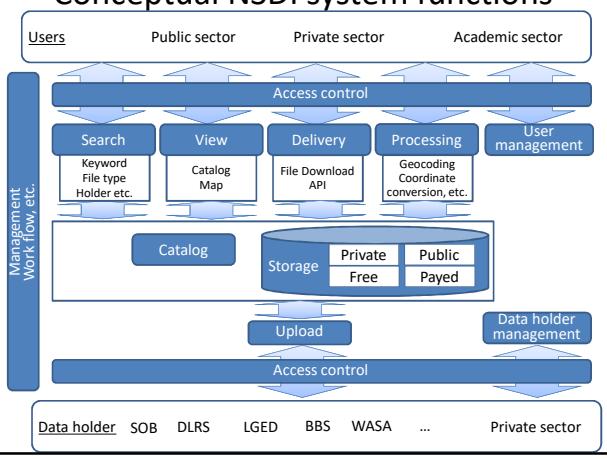
NSDI

- Governance
- Agency Representation
- Information Updating
- **Accumulation of Information**
- **Coordination**
- Decision Making
- Endoresement
- Decision Making
- Dissemination
- Execution

Concept of NSDI in Bangladesh



Conceptual NSDI system functions



Thanks

mafizur@gmail.com

Annex-15 NSDI Workshop Materials

SURVEY OF BANGLADESH
SURVEYOR GENERAL OFFICE
TEJGAON, DHAKA - 1208
Phone: 9114191 Fax: 9117463
info@sob.gov.bd,www.sob.gov.bd

SOB/14-C/NSDI Meeting/P- 2251

Date: 31 August 2017

From

Surveyor General of Bangladesh
Survey of Bangladesh
Shaheed Tajuddin Swarani, Tejgaon, Dhaka-1208

To

As per the Distribution.

Subject: Invitation to attend Workshop on "Pilot project and System Design Concept for NSDI construction in Bangladesh" to be held on 12 September 2017 at 09:30 am

Ref:

1. JICA Letter dated 29 August 2017.
2. Survey of Bangladesh letter no: SOB/14-C/NSDI Meeting/P-2251 dated 27 July 2017.
3. Survey of Bangladesh letter no: SOB/14-C/NSDI Meeting/P-1362 dated 02 May 2017.
4. MOD letter number 23.00.0000.220.25.001.16.639 dated 24 November 2016.
5. Record of Discussion between JICA and Authorities concerned of the People's Republic of Bangladesh (MOD, MOF and SOB) dated 27 August 2013.

Dear Sir/Madam,

An international Seminar on "National Spatial Data Infrastructure (NSDI) for Bangladesh" organized by Survey of Bangladesh (SOB) of Ministry of Defence (MOD) and assisted by Japan International Cooperation Agency (JICA) was held on 1st and 2nd June of 2016 at Dhaka. Sheikh Hasina, the Honorable Prime Minister (PM) of Bangladesh, inaugurated the seminar and gave away her guidelines to create awareness and importance of NSDI among all Contributors. Accordingly two contributors meeting was held on 15 May and 9 August of this year, where so far progresses of NSDI, draft road map plan and NSDI pilot project construction since the seminar were discussed. Large infrastructure like NSDI demands more numbers of meetings, workshops and seminars.

With this backdrop, JICA with the assistance from SOB is going to organize a workshop principally focusing on the 'Pilot project and system design concept for NSDI construction' and discussion on 'Utilization of geo-spatial data and road map plan of NSDI construction' as well. **The workshop would take place in the SURMA Hall of Pan Pacific**

Sonargaon Hotel from morning to afternoon (9.30 am to 3:00 pm) and Respected Secretary, MOD is likely to be the chief guest of the session. It is my pleasure and honor to invite one of your senior representatives (where applicable) to participate in the workshop. We deeply appreciate your long stretched contribution on the geo-spatial activities in Bangladesh. Presence of your resource person will surely promote the activities in establishing SDI for our Nation. In this regard, please send us the name of the participant from your organization by 06 September 2017 following the table given below. Apart from the paper copy, you may also send the electronic copy of your nomination letter to our official email (info@sob.gov.bd).

Name of the Participant	Position in the office	Name of the Organization	Mobile Number	E-mail ID

The proposed Agenda for the meeting is given as an annexure to this letter for your concern. We eagerly look forward to your contribution on this workshop.

Sincerely Yours,

Brigadier General Zakir Ahmed, psc
Surveyor General of Bangladesh

E-mail: sg@sob.gov.bd

Annexure:

Agenda for workshop on 'Pilot project and system design concept for NSDI construction' in Bangladesh

Distribution (Not following seniority):

1. Secretary, Ministry of Defence (MOD)
2. Director General, Bangladesh Bureau of Statistics, (BBS)
3. Director, Bangladesh Metrological Department (BMD)
4. Chairman, Space Research and Remote Sensing Organization (SPARRSO)
5. Prof Md. Mafizur Rahman, Department of Civil Engineering, BUET
6. Chief Engineer, Local Government Engineering Department (LGED)
7. Chief Engineer, Roads and Highways Department (RHD)
8. Chairman, Rajdhani Unnayan Kartripakkha (RAJUK)
9. Director General, Bangladesh Water Development Board (BWDB)
10. Chairman, Water and Sewerage Authority (WASA)
11. Director General, Geological Survey of Bangladesh (GSB)
12. Chairman, Bangladesh Agricultural Development Corporation (BADC)
13. Director General, Department of Land Record and Survey (DLRS)
14. Project Director, Access to Information (A2I) Programme, PMO's Office
15. Chief Representative, JICA Bangladesh
16. Mr. Toru Watanabe, Team Leader, JICA NSDI Study Team

17. Chief Executive Officer, Dhaka North City Corporation (DNCC)
18. Chief Executive Officer, Dhaka South City Corporation (DSCC)
19. Executive Director, Bangladesh Computer Council (BCC)
20. Director General, Department Of Disaster Management (DDM)
21. Executive Director, Center for Environmental and GIS (CEGIS)
22. Executive Director, Institute of Water Modelling (IWM)
23. Director, Urban Development Department (UDD)
24. Chairman, Bangladesh Road Transport Authority (BRTA)
25. Managing Director, Dhaka Electric Supply Company Limited (DESCO)
26. Chairman, Bangladesh Power Development Board (BPDB)
27. Managing Director, Dhaka Power Distribution Company Limited (DPDC)
28. Chairman, Bangladesh Rural Electrification Board (REB)
29. Director General, Water Resources Planning Organization (WARPO)
30. Director General, Department of Environment
31. Chief Conservator of Forest, Forest Department
32. Director General, Directorate of Primary Education
33. Director General, Directorate of Secondary and Higher Education
34. Vice-Chancellor, Dhaka University
35. Vice-Chancellor, Jahangirnagar University
36. Vice-Chancellor, BRAC University
37. Vice-Chancellor, Sher-e-Bangla Agriculture University
38. Chairman, Bangladesh Inland Water Transport Authority (BIWTA)
39. Chairman, Bangladesh Energy Regulatory Commission (BERC)
40. Chairman, Bangladesh Telecommunication Regulatory Commission (BTRC)

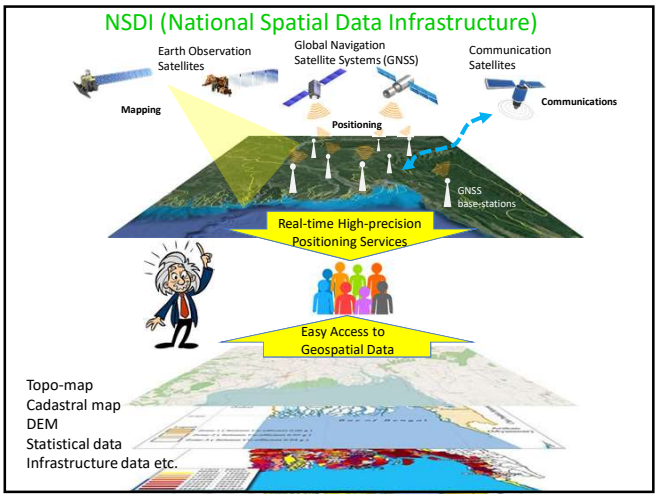
Annexure

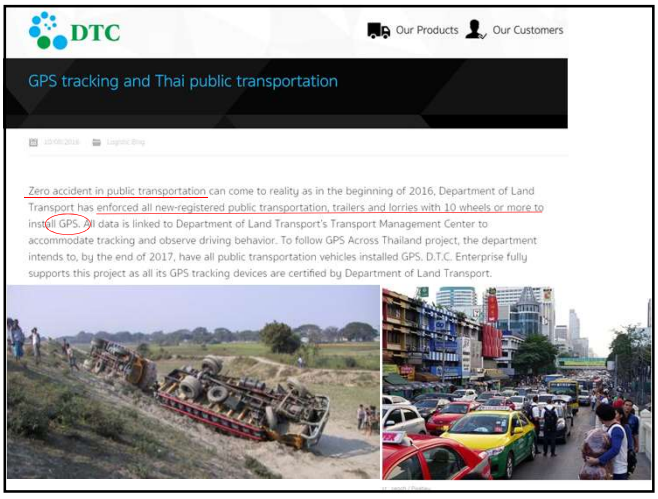
AGENDA FOR WORKSHOP ON 'PILOT PROJECT AND SYSTEM DESIGN CONCEPT FOR NSDI CONSTRUCTION' IN BANGLADESH

Ser No	Topic	Speaker/ Responsibility	Time		Remarks
			From	To	
1.	Opening Speech and Overview	Surveyor General	0930	0940	
2.	Introduction of the Participants	Moderator/Anchor	0940	0950	
3.	Key Note Presentation: Introduction of Advanced examples for constructing NSDI in Bangladesh (Tentative)	Prof. Ryosuke Shibasaki, University of Tokyo	0950	1020	
4.	Key Note Presentation:	Prof. Mafizur Rahman, BUET	1020	1050	
5.	Overview on the "Survey carried out" and Presentation on "Pilot project and System Design Concept"	JICA Study Team	1050	1110	
6.	Discussion on Agenda 5.	All	1110	1140	
7.	TEA	All	1140	1200	Served outside the Hall
8.	Presentation on Road Map Plan for the Construction of NSDI for Bangladesh	Survey of Bangladesh and JICA Study team	1200	1220	
9.	Panel Discussion on the "Utilization of Geo-spatial Data, Road map plan and NSDI Pilot Project"	Moderator – Prof.Shibasaki Working Group Members and other Participants	1220	1310	WG Members may present their speech for 5 to 10 minutes
10.	Summary of the Discussion	Moderator/Anchor	1310	1320	
11.	Closing Address	Secretary, MOD	1320	1335	
12.	LUNCH	All	1335	1500	Served outside the Hall

Introduction for Developing an Advanced NSDI of Bangladesh

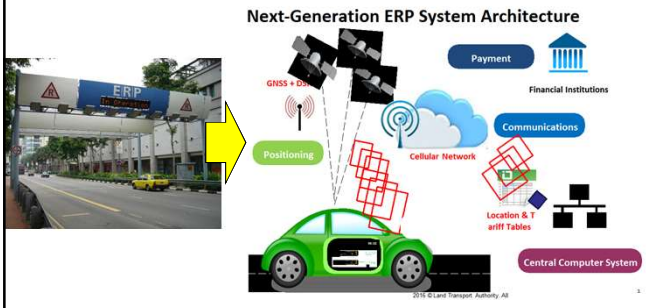
Ryosuke SHIBASAKI
Professor, Center for Spatial Information Science,
The University of Tokyo





Friday, 18 March 2016

Singapore will have world's first GNSS urban congestion pricing scheme by 2020

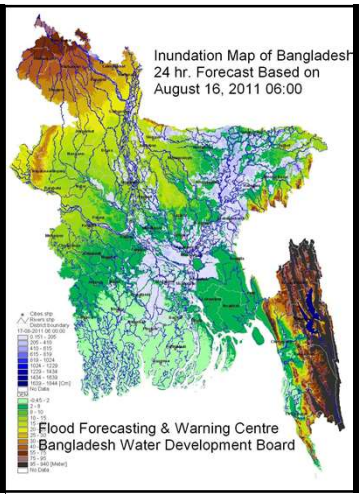


Faster Construction with Better Quality

Very-Cheap RTK GNSS Receiver

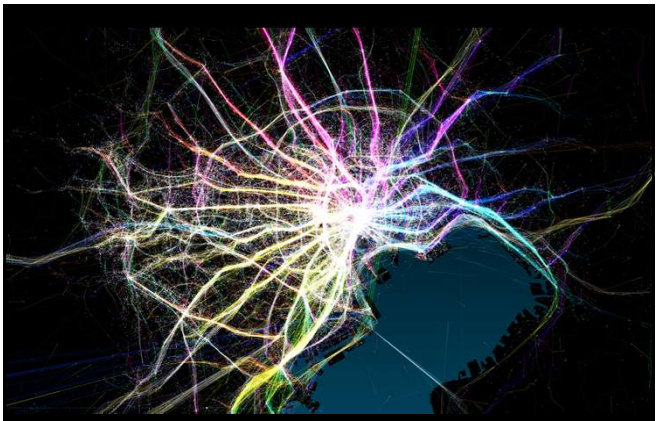
- GNSS Receiver: u-blox M8T US $80
- GNSS Antenna US $30
- RaspberryPi Computer US $50
- Battery Pack US $50
- Data Modem As per use base

US $210

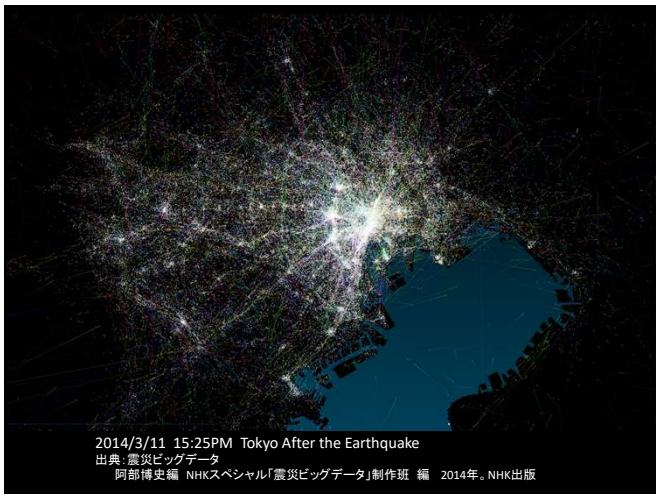


Mar.11 2011, Japan

Mar.11 2011, Japan



2014/3/11 8:00AM Tokyo Before the Earthquake
出典：震災ビッグデータ
阿部博史編 NHKスペシャル「震災ビッグデータ」制作班 編 2014年。NHK出版

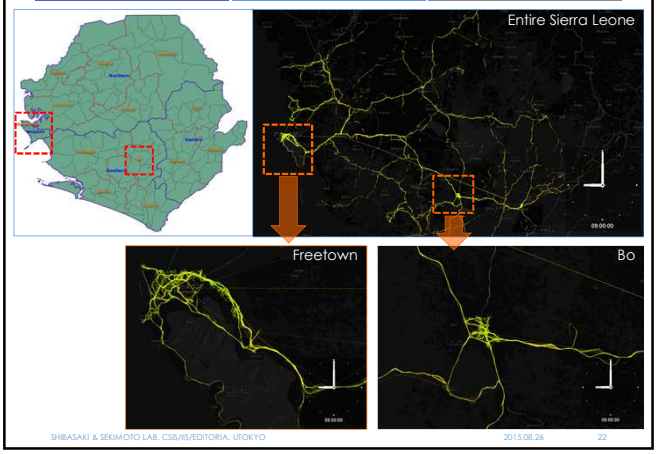


2014/3/11 15:25PM Tokyo After the Earthquake
出典：震災ビッグデータ
阿部博史編 NHKスペシャル「震災ビッグデータ」制作班 編 2014年。NHK出版

People Flow Analysis for Epidemic Control with Mobile Phone Data

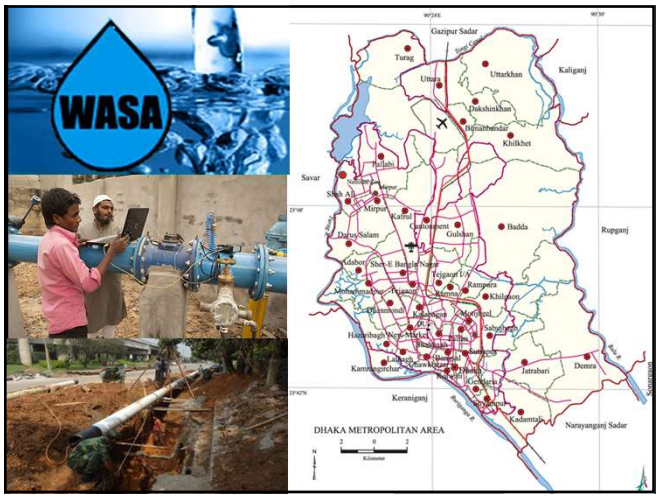
ITU Technical Team for CDAEC
Prof. R. Shibasaki,
Dr. H.Kanasugi,
Dr.A.Watayangkurn and
Dr.W. Ohira

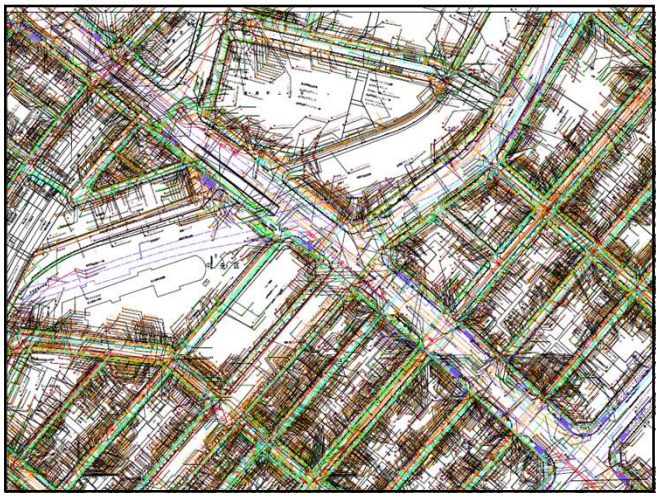
Estimated People Movements (2015.06.07) N=640,504

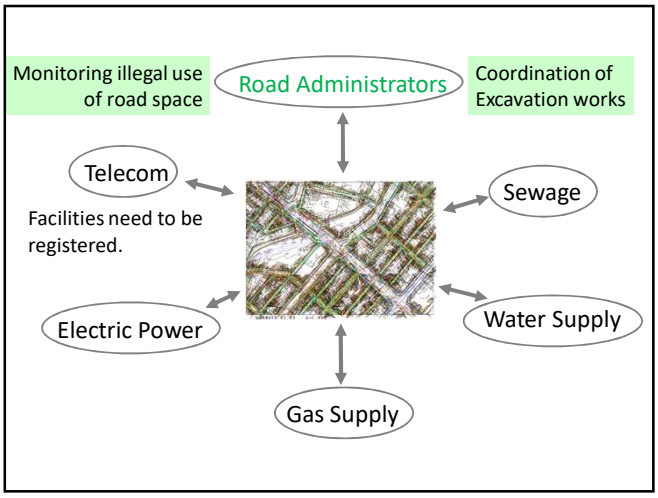


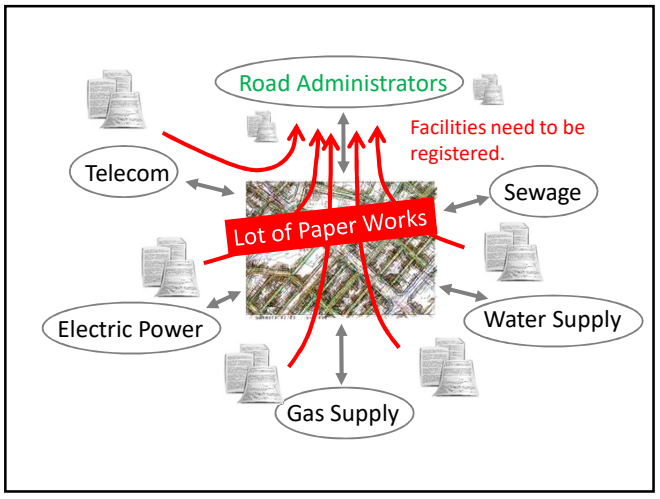
SHIBASAKI & SEKIMOTO LAB. CSIS/IIS/EDITORIA, UTOKYO 2015.08.26 22

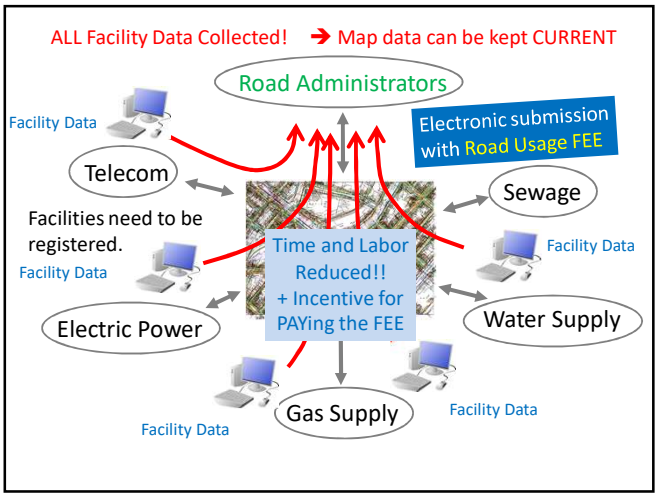
People Flow (7, June 2015) Sierra Leone

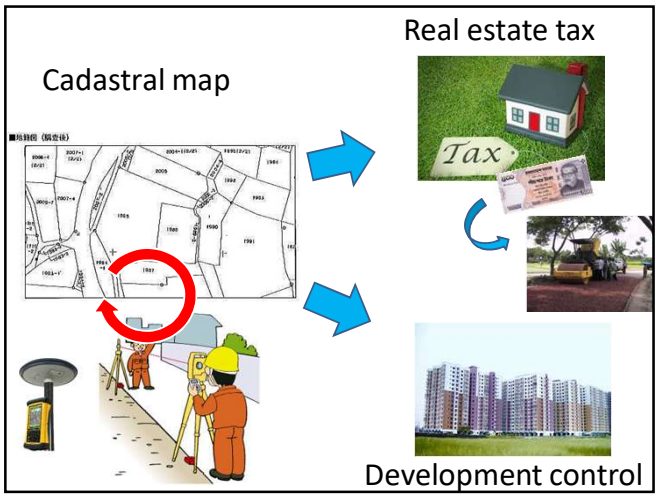

WASA
DHAKA METROPOLITAN AREA




Monitoring illegal use of road space
Road Administrators
Coordination of Excavation works
Telecom
Facilities need to be registered.
Sewage
Electric Power
Water Supply
Gas Supply


Road Administrators
Facilities need to be registered.
Telecom
Sewage
Lot of Paper Works
Electric Power
Water Supply
Gas Supply


ALL Facility Data Collected! → Map data can be kept CURRENT
Road Administrators
Facility Data
Electronic submission with Road Usage FEE
Telecom
Sewage
Facilities need to be registered.
Facility Data
Time and Labor Reduced!! + Incentive for PAYing the FEE
Facility Data
Electric Power
Water Supply
Gas Supply
Facility Data
Facility Data

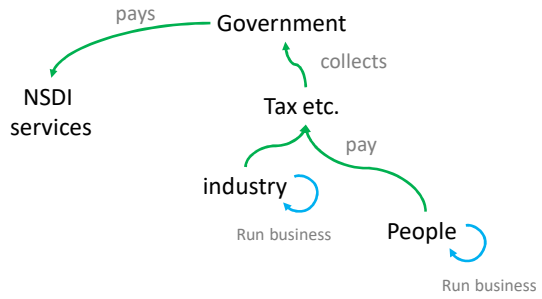


Sustainable NSDI

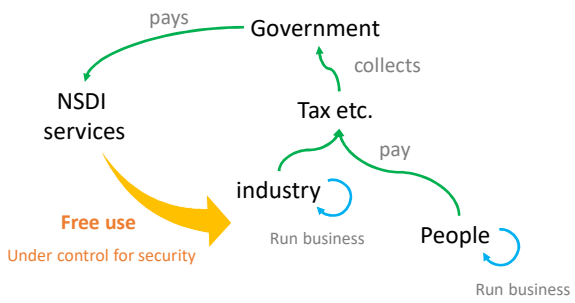
Data Policy?

Finance?

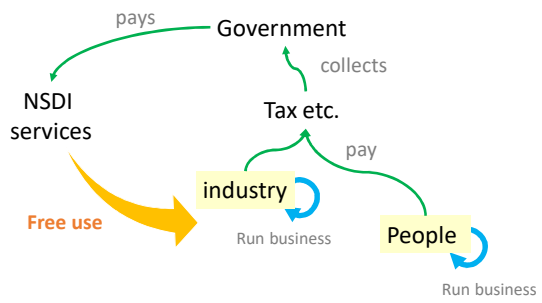
How to finance?



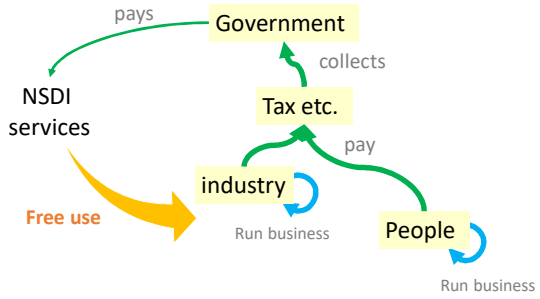
"Free Data" policy



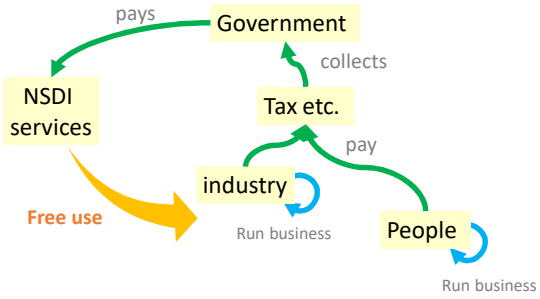
"Free Data" policy



“Free Data” policy

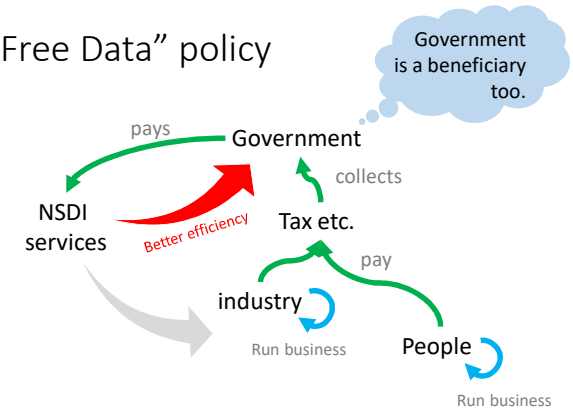


“Free Data” policy

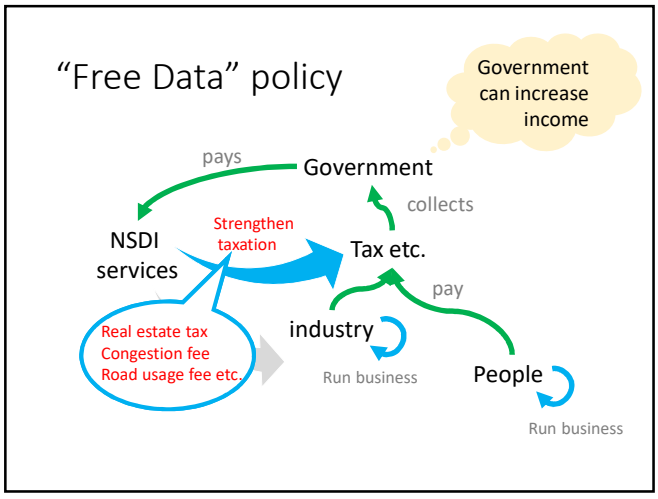


Road network data
POI (point of interest) data

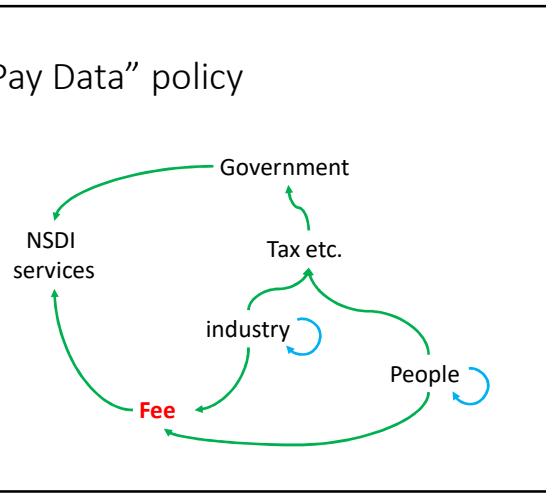
“Free Data” policy



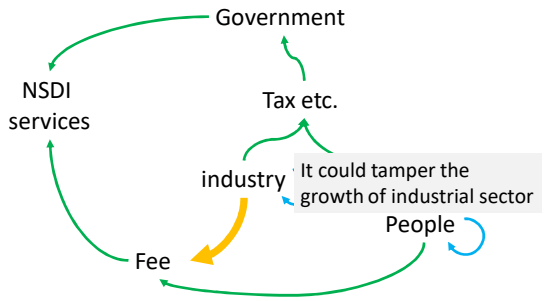
“Free Data” policy



“Pay Data” policy

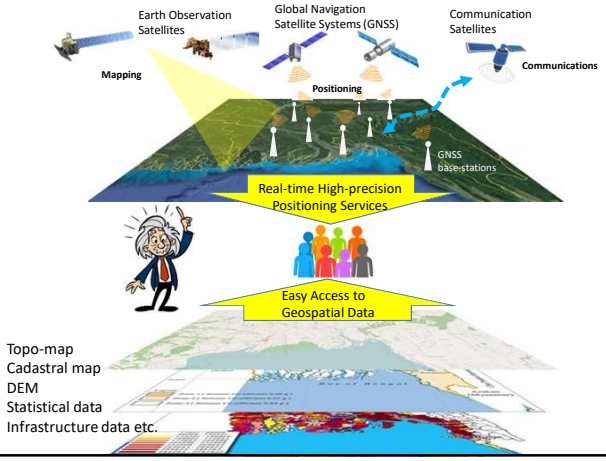


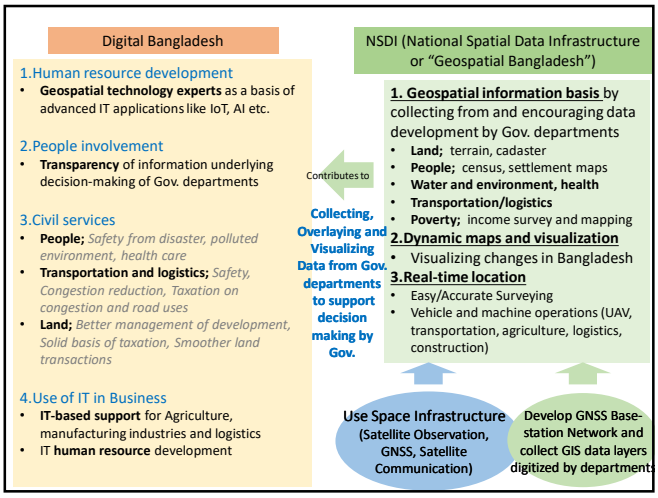
"Pay Data" policy

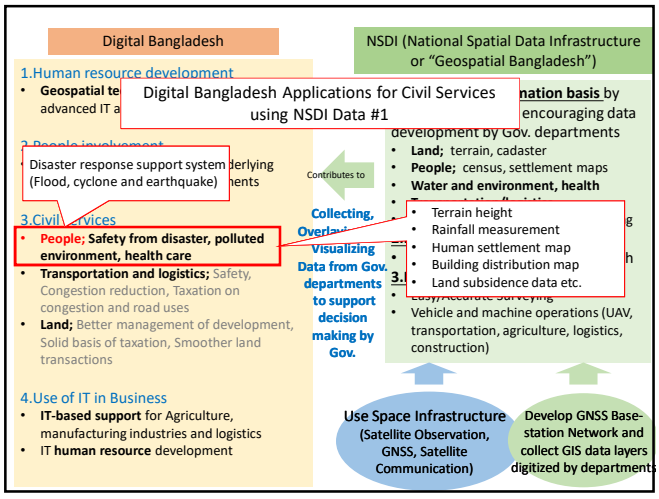


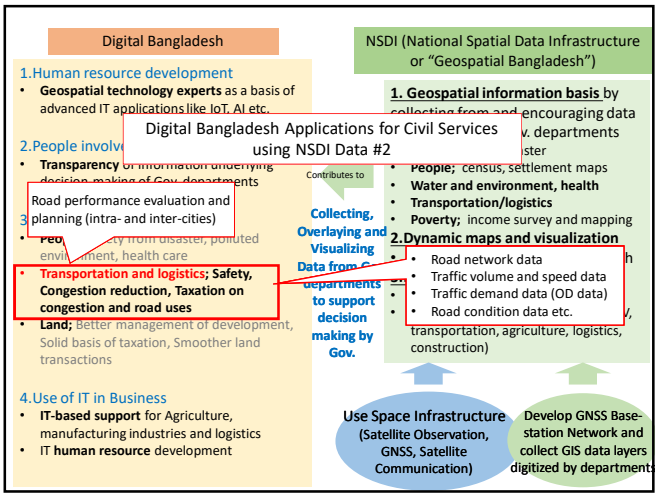
NSDI contribute to Digital Bangladesh!

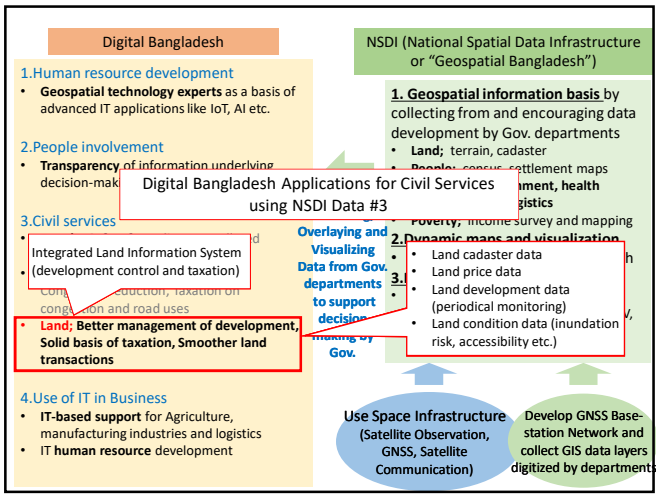
NSDI (National Spatial Data Infrastructure)











Concluding remarks

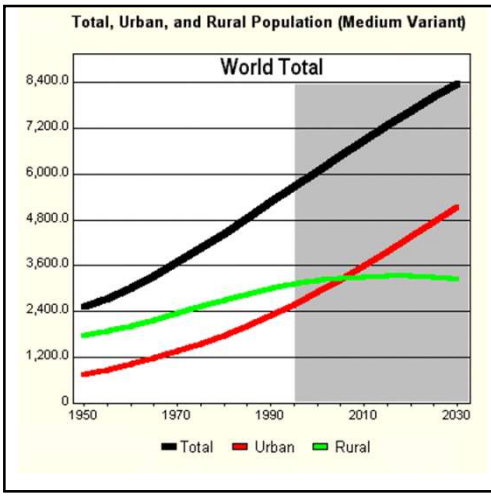
- NSDI should be a mechanism of accelerating Value Creation from Data, beyond a platform of data dissemination.
  - For social benefits, industrial development and the better welfare of People
  - Data policy and financing scheme should be designed based on the above principle.
- It is people or experts that create values from data using NSDI. University or BUET should lead Capacity Building for diverse and innovative users of NSDI.

Needs, Demands and Value Additions of NSDI: Bangladesh Context

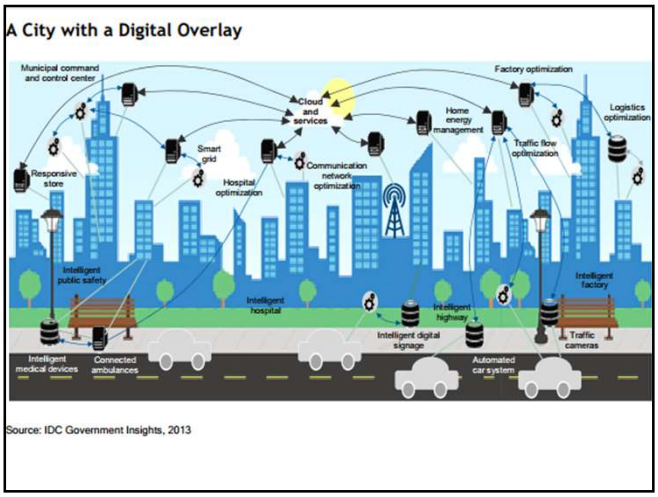
Dr. Md. Mafizur Rahman
Professor of Civil Engineering
BUET
mafizur@gmail.com

Pilot Project and System Design Concept for NSDI Construction in Bangladesh
Hotel Pan Pacific Sonargaon, Dhaka
September 12 , 2017

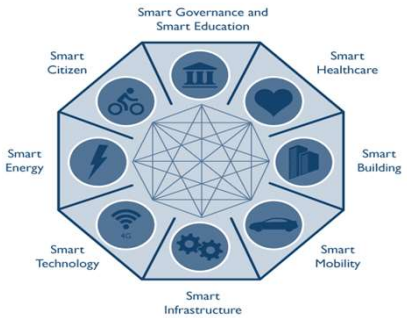
Needs, Demands and Value Additions of NSDI: URBAN AREAS



Japan's Rollout of Smart Cities: What Role for the Citizens, The Asia-Pacific Journal, June 16, 2013
Volume 11 | Issue 24 | Number 2
Andrew DeWit



Smart city concept



features

- ❖Smart parking
- ❖Intelligent transport system
- ❖Tele-care
- ❖Traffic management
- ❖Smart grids
- ❖Smart urban lighting
- ❖Waste management
- ❖Smart city maintenance
- ❖Smart taxi
- ❖Digital-signage.

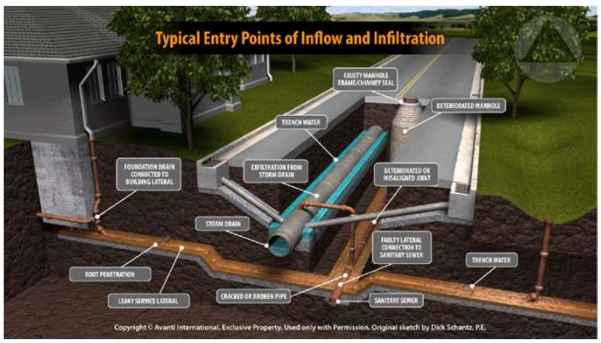
Various Service Lines

- Water Supply
- Sewerage
- Storm Water
- Gas
- Electricity
- Internet (Fiber Optics)
- Telephone (Land phones)
- Television

:
:
:
:

Purbachol Sector 16

SERVICE LINES ARE NOT SIMPLE: Have Associated Components



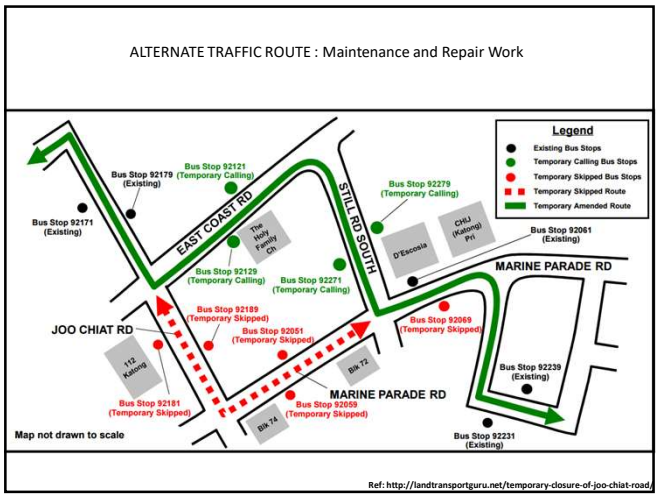
INSTALLATION OF NEW PIPE/ Maintenance of Existing Systems

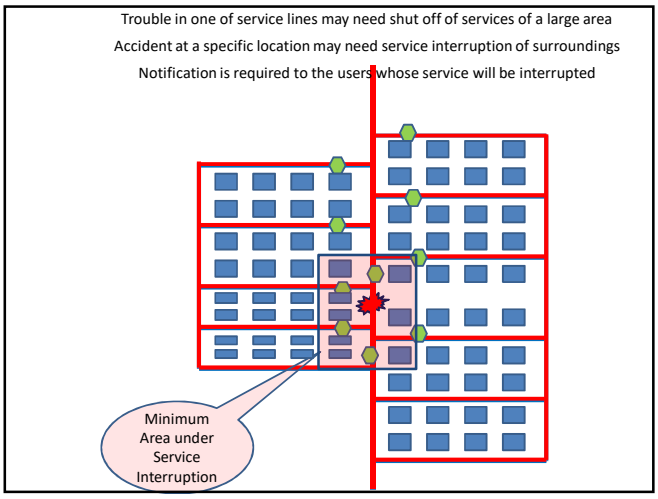
https://www.pulice.com/portfolio/reclaimed-water-lines-greenfield-road-and-queen-creek-road-crnr/

http://foxbrow.com/2017/06/28/15-municipalities-to-split-nearly-14m-for-replacement-of-lead-service-lines/

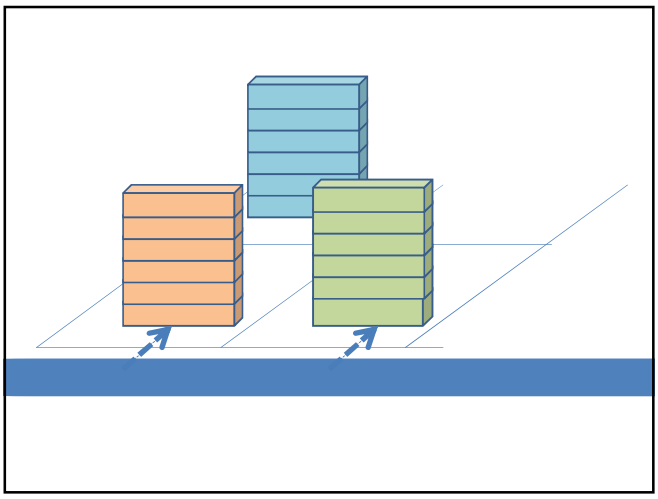
Excavation is difficult in a Densely populated City : Dhaka

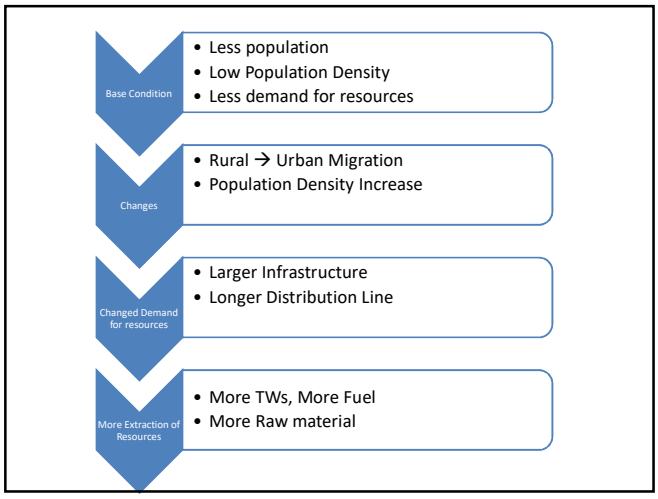
Excavation is difficult in a Densely populated City : Dhaka

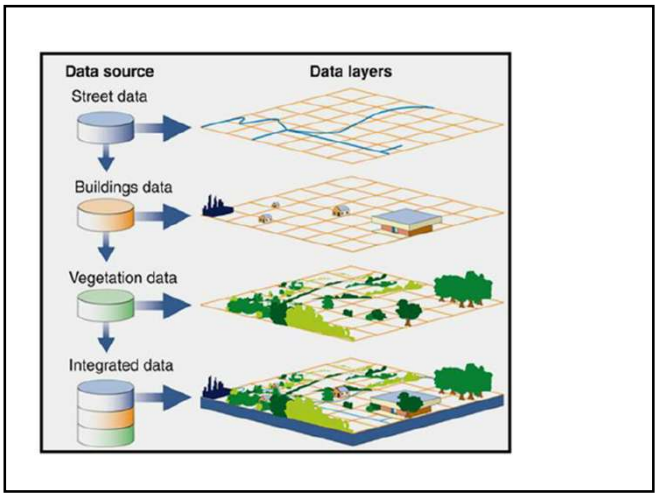

ALTERNATE TRAFFIC ROUTE : Maintenance and Repair Work
Legend
Existing Bus Stops
Temporary Calling Bus Stops
Temporary Skipped Bus Stops
Temporary Skipped Route
Temporary Amended Route
EAST COAST RD
STILL RD SOUTH
MARINE PARADE RD
JOO CHIAT RD
Bus Stop 92179 (Existing)
Bus Stop 92121 (Temporary Calling)
Bus Stop 92171 (Existing)
Bus Stop 92279 (Temporary Calling)
Bus Stop 92061 (Existing)
Bus Stop 92129 (Temporary Calling)
Bus Stop 92271 (Temporary Calling)
Bus Stop 92189 (Temporary Skipped)
Bus Stop 92051 (Temporary Skipped)
Bus Stop 92069 (Temporary Skipped)
Bus Stop 92239 (Existing)
Bus Stop 92181 (Temporary Skipped)
Bus Stop 92059 (Temporary Skipped)
Bus Stop 92231 (Existing)
Map not drawn to scale
Ref: http://landtransportguru.net/temporary-closure-of-joo-chiat-road/

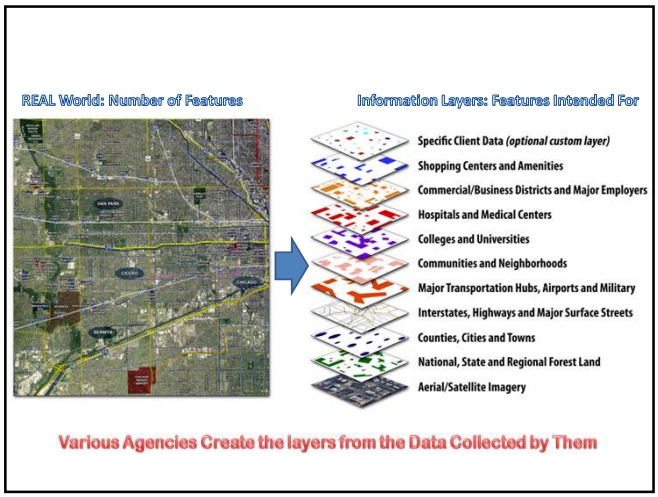

Trouble in one of service lines may need shut off of services of a large area
Accident at a specific location may need service interruption of surroundings
Notification is required to the users whose service will be interrupted
Minimum Area under Service Interruption

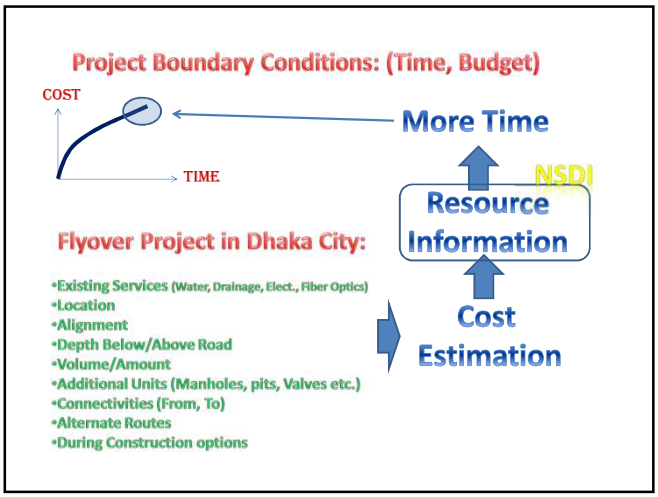

New Service Requirement
Minimum Distance Between two pipes
Width of Road is Adequate ?

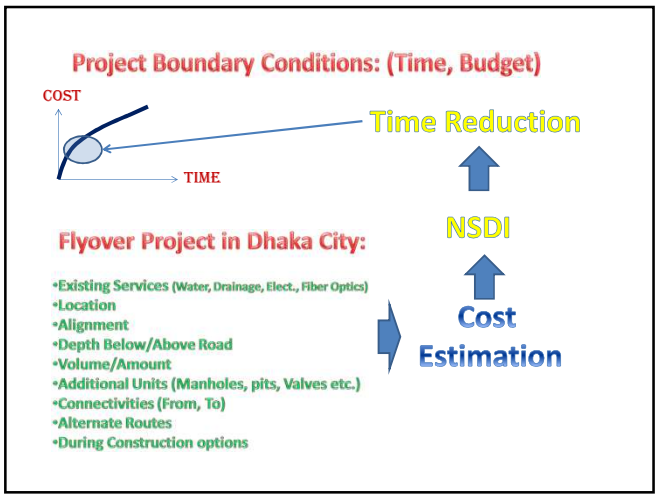


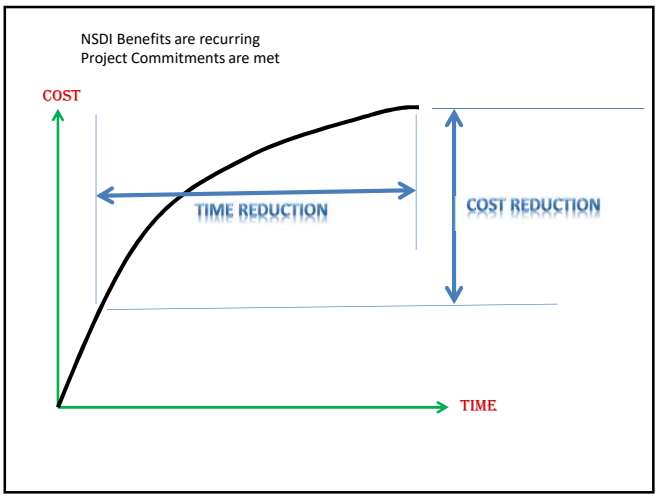

Base Condition
• Less population
• Low Population Density
• Less demand for resources
Changes
• Rural → Urban Migration
• Population Density Increase
Changed Demand for resources
• Larger Infrastructure
• Longer Distribution Line
More Extraction of Resources
• More TWs, More Fuel
• More Raw material

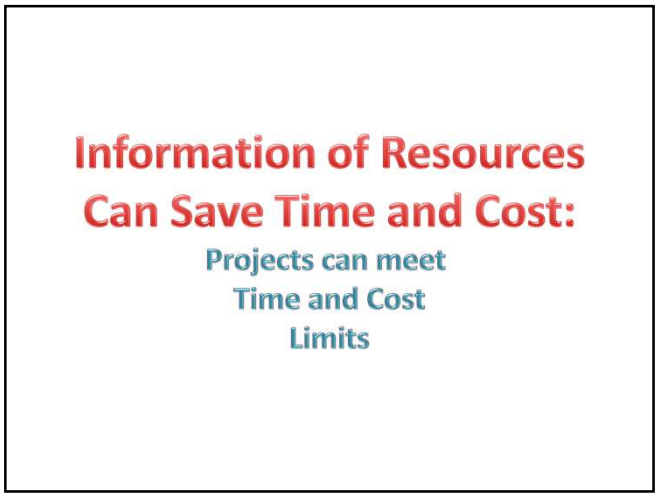

Data source
Data layers
Street data
Buildings data
Vegetation data
Integrated data

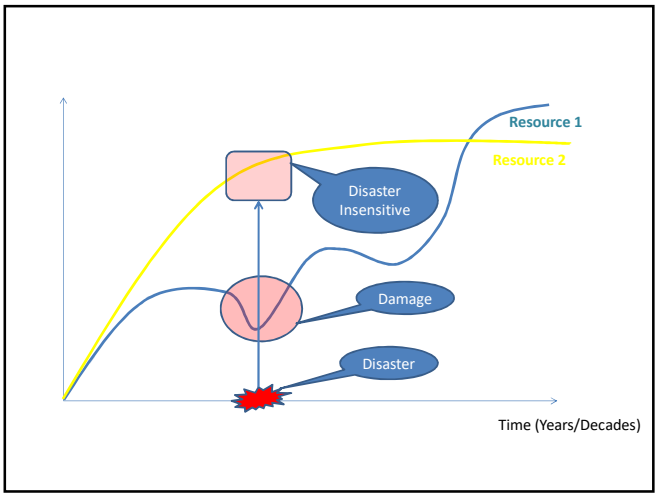

REAL World: Number of Features
Information Layers: Features Intended For
Specific Client Data (optional custom layer)
Shopping Centers and Amenities
Commercial/Business Districts and Major Employers
Hospitals and Medical Centers
Colleges and Universities
Communities and Neighborhoods
Major Transportation Hubs, Airports and Military
Interstates, Highways and Major Surface Streets
Counties, Cities and Towns
National, State and Regional Forest Land
Aerial/Satellite Imagery
Various Agencies Create the layers from the Data Collected by Them


Project Boundary Conditions: (Time, Budget)
COST
TIME
More Time
NSDI
Resource Information
Flyover Project in Dhaka City:
•Existing Services (Water, Drainage, Elect., Fiber Optics)
•Location
•Alignment
•Depth Below/Above Road
•Volume/Amount
•Additional Units (Manholes, pits, Valves etc.)
•Connectivities (From, To)
•Alternate Routes
•During Construction options
Cost Estimation

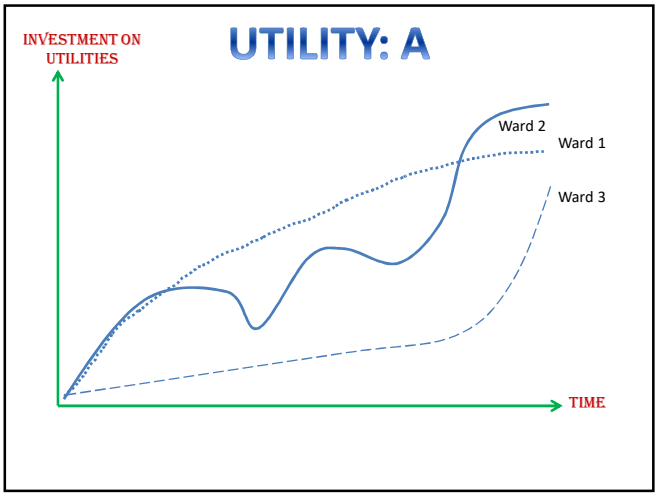

Project Boundary Conditions: (Time, Budget)
COST
TIME
Time Reduction
NSDI
Flyover Project in Dhaka City:
•Existing Services (Water, Drainage, Elect., Fiber Optics)
•Location
•Alignment
•Depth Below/Above Road
•Volume/Amount
•Additional Units (Manholes, pits, Valves etc.)
•Connectivities (From, To)
•Alternate Routes
•During Construction options
Cost Estimation

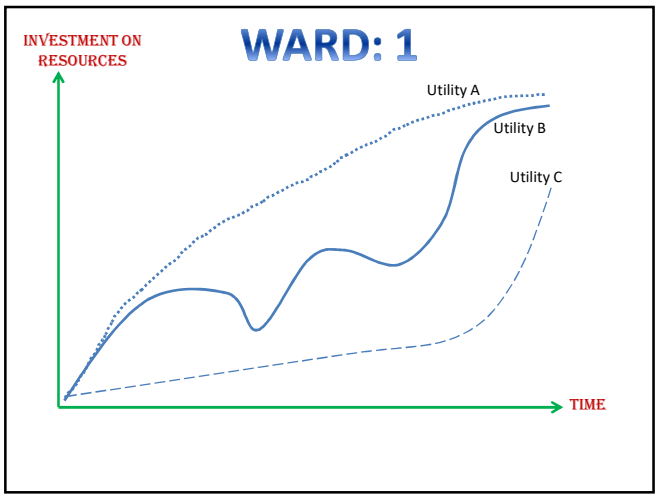

NSDI Benefits are recurring
Project Commitments are met
COST
TIME REDUCTION
COST REDUCTION
TIME


Information of Resources
Can Save Time and Cost:
Projects can meet
Time and Cost
Limits

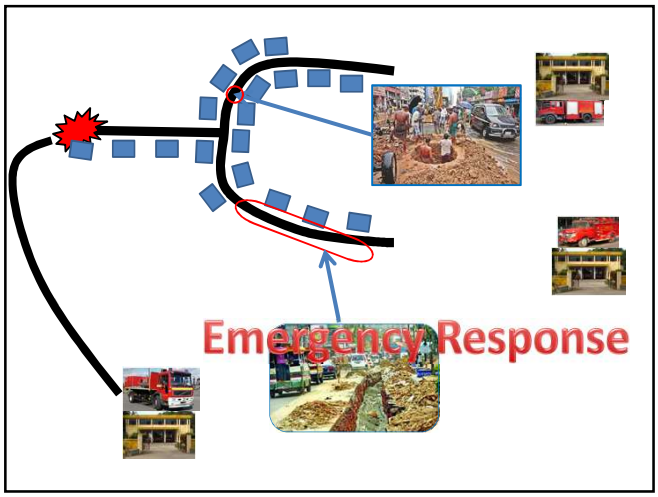

Resource 1
Resource 2
Disaster Insensitive
Damage
Disaster
Time (Years/Decades)

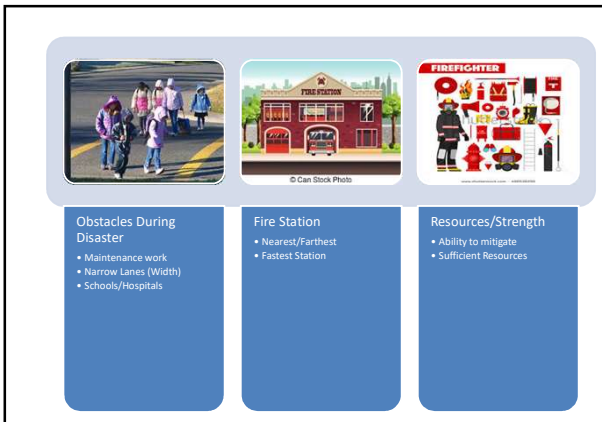
	Resource A	Resource B	Resource C	Resource D	Resource E
LOCATION 3					
LOCATION 2					
LOCATION 1					
Disaster 1	S+	S++	S++	IS	S+
Disaster 2	S++	S++	IS	S+	S+
Disaster 3	IS	S++	S++	S+	S+
S: The Resource is sensitive to the Disaster, ++: The Degree of Sensitivity, IS: Disaster Insensitive Resource					
Disaster 5	S+++	S++	S+++	IS	IS
Disaster 6	S++	S++	S++	S+	S+
Disaster 7	S++	S++	S++		





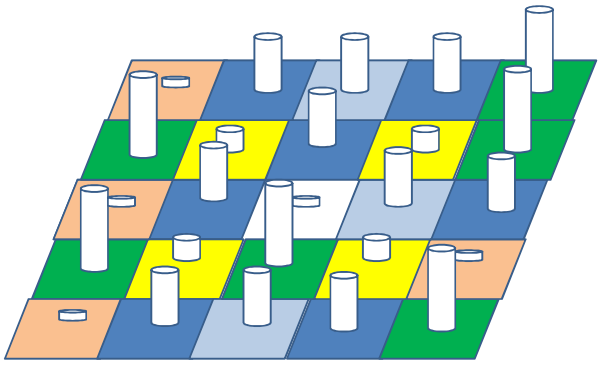
- Additional Demand for resources at the user's end
- Additional Distribution need (Infrastructure Upgradation)
- Additional Demand for resource Extraction at Source (Generating more resource)
- Time and Location (Resource Allocation)



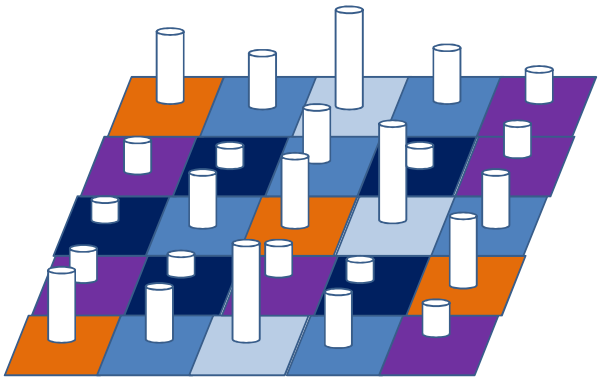


Needs, Demands and Value Additions of NSDI: RURAL AREAS

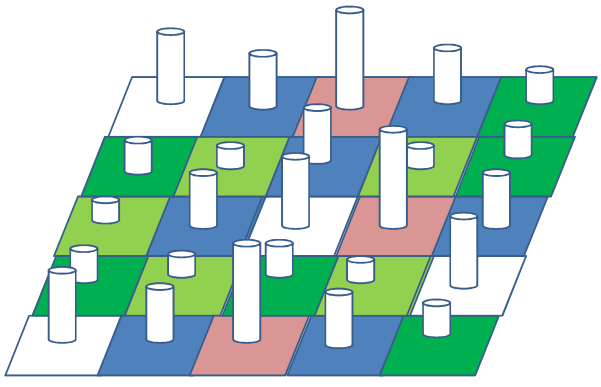
Zone 1: Winter



Zone 1: Summer



Zone 1: Monsoon



Water Management

- Crop
  - Crop Calendar
  - Zonal Crop Pattern
- Rainfall
  - Rainfall
  - Temperature
  - Climate Change
- Irrigation
  - Water Availability
  - Water Deficit

Fertilizer Management

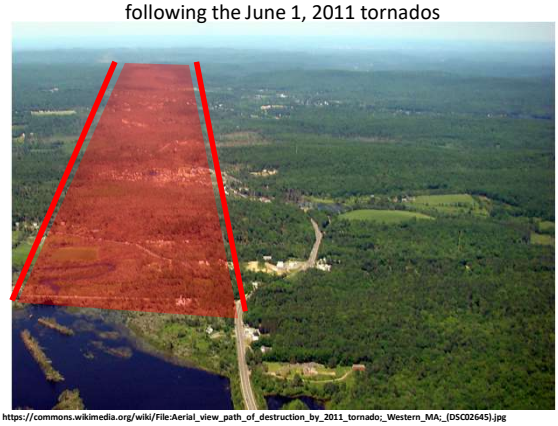
- Crop
  - Crop Calendar
  - Zonal Crop Pattern
- Soil
  - Soil Type
  - Nutrition
- Fertilizer
  - Budget
  - Availability

NSDI

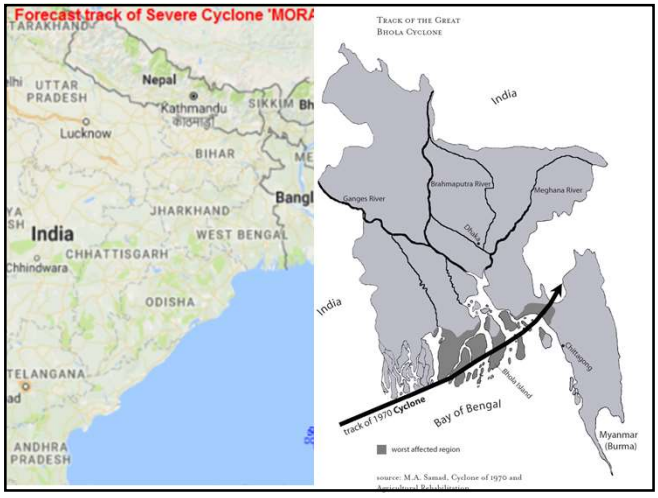
- Governance
- Agency Representation
- Information Updating
- **Accumulation of Information**
- **Coordination**
- Decision Making
- Endoresement
- Decision Making
- Dissemination
- Execution

Disasters: Damage, Loss, Relief Operations for Disaster Recovery and Reconstruction

Aerial views of tornado damage
in Western Massachusetts
following the June 1, 2011 tornados



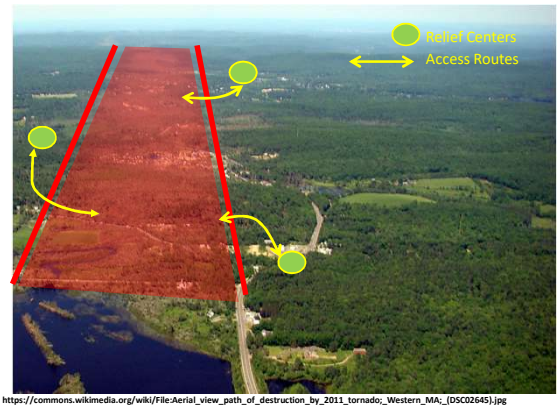
https://commons.wikimedia.org/wiki/File:Aerial_view_path_of_destruction_by_2011_tornado;_Western_MA;_(DSC02645).jpg



Overall Summary of Damage and Losses

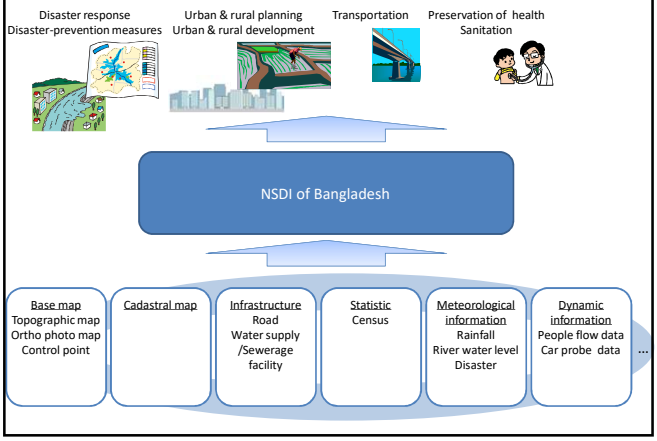
		Disaster Effects, million Ariary			Disaster Effects, USD million		
		Damage	Losses	Total	Damage	Losses	Total
Social Sectors		**212,193.20**	**24,425.60**	**236,618.80**	**128.60**	**14.80**	**143.41**
	Education	5,276.60	1,059.90	6,336.50	3.20	0.64	3.84
	Health	11,230.00	5,690.50	16,920.50	6.81	3.45	10.25
	Nutrition	1,314.30	1,575.70	2,890.00	0.80	0.95	1.75
	Housing and Public Administration buildings	194,372.30	16,099.50	210,471.80	117.80	9.76	127.56
Productive Sectors		**13,974.8**	**212,216.10**	**226,190.80**	**8.47**	**128.62**	**137.09**
	Agriculture, livestock and fisheries	10,461.10	159,564.30	170,025.40	6.34	96.71	103.05
	Industry and Commerce	2,849.5	27,423.8	30,273.2	1.73	16.62	18.35
	Tourism	664.20	25,228.00	25,892.20	0.40	15.29	15.69
Infrastructure		**60,792.10**	**24,954.90**	**85,747.00**	**36.84**	**15.12**	**51.97**
	Electricity	3,502.40	2,957.60	6,460.00	2.12	1.79	3.92
	Water and Sanitation	616.80	1,729.00	2,345.80	0.37	1.05	1.42
	Transport	55,383.60	20,083.60	75,467.20	33.57	12.17	45.74
	Telecommunications	1,289.30	184.70	1,474.00	0.78	0.11	0.89
Cross-Sectoral		**356.60**	**475.80**	**832.40**	**0.22**	**0.29**	**0.50**
	Environment	356.60	475.80	832.40	0.22	0.29	0.50
TOTAL		**287,316.70**	**262,072.40**	**549,389.00**	**174.13**	**158.83**	**333.00**

POST DISASTER RELIEF OPERATIONS

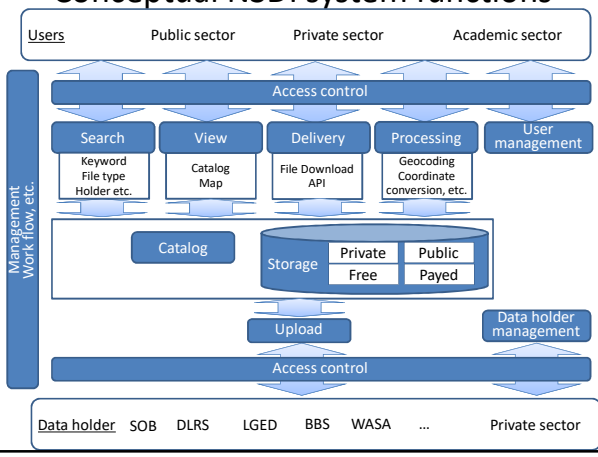


https://commons.wikimedia.org/wiki/File:Aerial_view_path_of_destruction_by_2011_tornado;_Western_MA;_(DSC02645).jpg

Concept of NSDI in Bangladesh



Conceptual NSDI system functions



NSDI Challenges

Accessibility of the data: When any government agency or department collects data, they feel this data is their own and no one has the authority to own them. By this, they forget the benefit of giving this data as they may need some data that are collected by others instead of collecting them again.

-**Availability of digital data**: One of the bases in NSDI implementation is sharing the data and this can be difficult with non-digital data. Also, sharing has become easier with the advancement in the technology which can be done by using the internet.

- **Need of Coordination (Institutional arrangements):** Avoiding the duplication is one of the most important advantages of NSDI. And this advantage cannot be achieved with the lack of coordination and without good arrangements among agencies, particularly among agencies that receive the money from the same resource (i.e. government). The data may be collected by one of the agencies and as a result of absence of the coordination the same data collected again which duplicates the efforts and the money.

Incompatibility of data (lack of standards): Sharing the data is affected greatly by the lack of data sets standards. Collected data can be classified and organized in different ways, especially when using GIS databases, based on each agency needs and requirements. Hence, these data cannot be integrated in order to be shared with other agencies.

-**Lack of experts (knowledge and skills):** NSDI system design and management needs experience and knowledge in order to put the concept of the institutions structure and policy in a network and database. On other words, there is a lack of experts in GIS and IT fields.

-**Absence of technology infrastructure:** In many countries, the problem of deficiency of the technology such the high speed internet, fully constituted WAN and LAN is still present. Sharing the data is affected by this issue as agencies cannot give and take the data easily.

- **Lack of Awareness:** Many non-government agencies, public, and private sectors still have no information on GIS and SDI. These people are not cooperating due to their unawareness of the benefits of disseminating information to the public and the importance of sharing the data.

-**Funding limitation:** Many organizations suffer from the lack of funding in many spatial projects because these projects have big size data which need high processing equipment in addition to big size storage which are too expensive. Also, government agencies have some constraints in funding as they may need to show results to get the required fund. In addition, as mentioned above, the lack of organization may duplicate the money that is spent on different projects for the same area.

-- **Availability of Metadata:** The presence of metadata facilitates the ability of the users to reach its need rapidly and easily. Therefore, collection of a big size of data without metadata describe them would be like a mess. Also, the access to the required data would be time consuming if there is a probability to find these data.

-- **Need of Legal aspects:** NSDI is not only consisting of technical aspect. It is supported by policies and laws, and some of the agencies consider policies as the most important component of NSDI. Policies of many organizations are not suitable for digital data. This usually happens through the process of moving from the use of paper maps to digital data which can be transferred by the networks (internet, intranet). When policies are to manage paper maps and traditional approaches, and they are no longer can be used for digital forms. Also, another issue is the lack of the policies of the multi-field and multi-agency cooperation.

-**Difference in languages**: The provision of a platform with multilingualsupport is important and is not a trivial issue. Many nations consist of more than one language. Thus, data may be entered in a language which is different from some of the users. Therefore, there would be difficulties in searching, querying, and analysing the data.

-- **Weak Cooperation**: The main pillar of NSDI is Cooperation. The more cooperation in an NSDI initiative the more successful will be. Some of NSDI projects may implemented in a multi-stakeholder environment where the partnership has to be enough strong to push the project to the success. A number of NSDI projects experience uncooperative organizations which can affect all the aspects of an NSDI significantly.

-- **Long Term Benefits**: Some of the stakeholders resist an NSDI project in case of there is no evidence on short or medium term benefits because NSDI projects need some time in order to show result or benefits.

NSDI advantages

Throughout the world, many NSDI initiatives have been established and many researchers have studied it from many aspects (Components, Challenges, Advantages, implementation approaches…etc.). In any of these NSDI, there are many challenges must be overcome to move on looking for the success. Therefore, the benefit of NSDI should be strong enough to motivate any government in different levels to start such project. Some of NSDI advantages have been summarized as follow(CGDI, 2003; Cetl & Tomi, 2009; Manisa & Nkwae, 2007; Martirano, Bonazountas, & Gagliardi, 2009; Shariff et al., 2011; The Land Information Council Of Jamaica, 2007):

-Guarantees the availability of the data to the users from different agencies.
-- Prevents the duplication in the spatial data by ensuring the data is collected one time.
-- Removes the redundancy of the spatial data.
-- Supports the economic development at different level: national, provincial, and local by providing platform has all needed maps by investors and private sectors, and promoting geospatial technology for tourism.
-- Links multi-government country by using inter-jurisdictional and intra-jurisdictional linkages.
-- Increases transparency of government and decision-making. - Improves the cooperation among agencies and different departments.
-- Creates and promotes the partnership between public and private sectors.
-- Enhances managing natural and land resource in addition to the actions that affect community.
-- Helps in providing the foundation in a consistent and cost-effective manner for monitoring programs (Environmental, Economic, and social changes).
-- Harmonizes numerous sizes of spatial data.

Thanks

mafizur@gmail.com

Project for Strengthen the Capacity on Advanced Mapping of SOB for Building Digital Bangladesh

- Making the Roadmap to Establishing NSDI -

Workshop

Roadmap for Establishment & Operation of NSDI (Draft)

September 2017

Survey of Bangladesh (SOB)
Ministry of Defence
The Government of the People's Republic of Bangladesh

JICA Map Administration Expert
Asia Air Survey Co., Ltd.
Kokusai Kogyo Co., Ltd.
Pasco Corporation

1. Time Frame

An Expected Process of NSDI Establishment and Operation Plan at the dawn in Japan

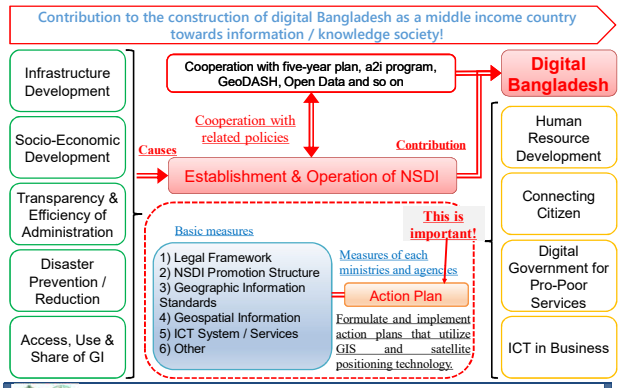
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Great Hanshin & Awaji Earthquake		Infrastructure formation phase [Establishment of a framework and rules]			Expansion phase [Development of the foundation]			Action plan to realize rich & varied life of the people using GIS [Practical dissemination]			
		●Development of NSDI ●Standardization of geospatial information ●Long-term planning for GIS dissemination and promotion			●Development, dissemination and update of NSDI (nationwide development) ●Implementation of various technical assistance			GIS Action Program 2002-2005 ●Promotion of efficiency of administration using GIS ●Support for full-scale dissemination of GIS			

Choice, Concentration & Reduce time

In case of Bangladesh

2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Preparation period	Infrastructure Formation / Dissemination period			Operation period (1)					Operation period (2)				
Now - June 2018	July 2018 – June 2021 (3 Years)			July 2021 - June 2026 (8th 5-year plan period)					July 2027 - June 2031 (9th 5-year plan period)				
●Basic Measures ●Formulation of Action Plan				●Implementation of Action Plan					●Implementation of Action Plan				

2.1. Concept for Roadmap of Establishment & Operation of NSDI in Bangladesh (Tentative)



2.2. Basic Principles concerning Establishment & Operation of NSDI (Tentative)

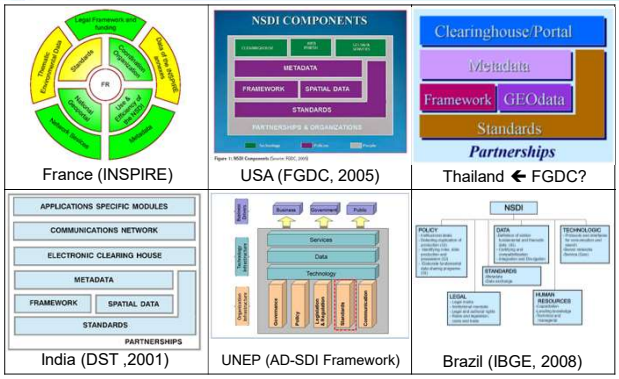
Basic principles concerning basic measures and formulation and implementation of action plan of each ministry and agency are suggested as follows:

I. As basic measures for establishment and operation of NSDI, development and provide of geospatial information, promote the use of GIS and satellite positioning technology (CORS), human resource development, research & development, and strengthen cooperation among related organizations.
II. 1) Effective and efficient management of public facilities, 2) Promotion of disaster prevention / reduction measures, 3) Use, maintenance and preservation of the land, 4) Improvement of agricultural productivity, and 5) Protection of the people's lives and property, are applied GIS and satellite positioning technology.
III. Improve the efficiency, sophisticated (advanced) and transparency of administrative management of the central and local governments.
IV. Provide diverse services that contribute to the improvement of convenience for citizens regardless of difference of rich and poor, literacy abilities, place of residence in urban and rural areas.
V. Create and develop diverse businesses utilizing GIS & satellite positioning and harmonize with the environment.
VI. Pay attention to protection of personal information, promotion of secondary use of public data, and consideration of national security.

3. Roadmap for Establishment & Operation of NSDI

- Legal Framework
- NSDI Promotion Structure
- Geographic Information Standards (ISO/TC211)
- Geospatial Information
- IT Service / IT System
- Other
  Human Resources Development / Technology Development / Promotion / New Industry Creation

3.0.1 Example of Components of NSDI



France (INSPIRE) | USA (FGDC, 2005) | Thailand ← FGDC?

India (DST ,2001) | UNEP (AD-SDI Framework) | Brazil (IBGE, 2008)

3.1. Legal Framework

1.1 NSDI Act, new Survey & Mapping Act and their rules

1.2 Plan for Establishment & Operation of NSDI

1.3 Government Data Policy

1.4 Guidelines
(1) Personal Information
(2) Secondary Use (Copyright)
(3) National Security

1.5 Action Plan of Ministries & Agencies using GIS & PNT

1.6 Incorporation into Digital Bangladesh & 8th five-year plan

3.1.1 Examples of G-Spatial Action Plan in Japan (1)

Source: Cabinet Secretariat (Geospatial Information Utilization Promotion Committee)

G-Spatial Action Plan of Each Ministry for NSDI in 2015

No.	Name of Ministry & Agency	# of Plan	Remarks
1	Council for promotion of geospatial information utilization	8	
2	Cabinet Office	9	Including NPA
3	Ministry of Internal Affairs and Communications	10	
4	Ministry of Justice	3	
5	Ministry of Finance	1	
6	Ministry of Foreign Affaires	2	With Cabinet Office
7	Ministry of Education, Culture, Sports, Science and Technology	15	
8	Ministry of Agriculture, Forestry and Fisheries	25	
9	Ministry of Economy, Trade and Industry	12	
10	Ministry of Land, Infrastructure, Transport and Tourism	**76**	**GSI: 33**
11	Ministry of the Environment	10	
12	Ministry of Defense	1	
13	National Police Agency (NPA)	11	
14	Other	4	
Total		187	

3.1.2 Examples of G-Spatial Action Plan in Japan (2)

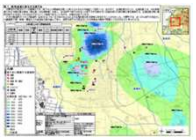
Source: Cabinet Secretariat (Geospatial Information Utilization Promotion Committee)

Promotion of the Utilization of Practical Quasi-Zenith Satellite System (GNSS)

The Emergency Call System (with Position Information) by the Japan Coast Guard

Development & Operation of the Environmental GIS

Promotion of Cadastral Survey by MLIT



Basic Research of Water

Basic Research of Land Classification (Land History)

3.1.3 Legal Framework of NSDI in Japan

Basic Act on the Advancement of Utilizing Geospatial Information (NSDI Act of Japan)

By the Minister of MLIT

By the National Diet

Ministerial ordinance on fundamental geospatial data (FGD)

Public Notice: Technical standards for fundamental geospatial data (FGD)

An underlying vision

Basic Plan on the Advancement of Utilizing Geospatial Information (Updated in 4 to 5 years)

Items & Specification of FGD is defined out of NASI Act. Detailed specification of FGD is decided by GSI.

Linkage of the Basic Act

By the Cabinet

Cooperative framework

By S/C, each ministry & agency

Guidelines for Management of Personal Information in Using Geospatial Information

Guidelines for Promotion of Secondary Use of Geospatial Information

Formulation of Action Plan

Review and follow-up every year at the S/C

<Budget Request Procedures>

Submission of Budget

Budget Request

The National Diet ← Cabinet ← Ministry of Finance ← Each Ministry & Agency

3.2. NSDI Promotion Structure

2.1 Establishment of NSDI Committee (3 levels)

2.2 Establishment of Working Group & Secretariat Office

2.3 Operation Method of NSDI Committee & WG

2.4 Enhancement for the Functions of the Secretariat

2.5 Setting & Discussing Issues

2.6 Establishment of Collaborative System among Industry (Private companies), Academia and Government

3.2.1 NSDI Promotion Structure in Japan

Source: Cabinet Secretariat (Geospatial Information Utilization Promotion Committee)

Council for promotion of geospatial information utilization (Bureau Director Level)

Cooperation

Academic society

Council for a partnership among industry, government and academia on geospatial information

Director meeting for the council for promotion of geospatial information utilization (Section Director Level)

W/G for Geographic Information System

W/G for Satellite Positioning

W/G for G-spatial Project Promotion

W/G for Research & Development on Common Infrastructure Technologies

W/G for G-Spatial EXPO

●S/G on Privacy Protection and Intellectual Property
●S/G on National Security
●S/G on Development and Update of Fundamental Geospatial Data

●S/G on Utilization Promotion of the G-spatial Information Center
●S/G on Advancement Promotion for the Disaster Prevention System
●S/G on IT Agriculture, Forestry and Fisheries Promotion Team
●S/G on Regional / Small & Medium Business Promotion
●S/G on Overseas Development Promotion

W/G for Infrastructure Development for Promotion of Geospatial Information Utilization in Disaster Prevention

●Task Force for Data Standardization
●Task Force for Systematization

Municipalities

Industrial Sector

Central Government

This council was decided by the Chief Cabinet Secretary.

3.3. Geographic Information Standards

- 3.1 Establishment of Domestic Deliberation Organization
- 3.2 Study & Research on Geographic Information Standards (ISO/TC211)
- 3.3 Standardization of Metadata
- 3.4 Standardization of Product Specification
- 3.5 Creation of Product Specifications of FGI
- 3.6 Participation in ISO / TC 211
- 3.7 Creation of Domestic Standard (Profile)
- 3.8 Dissemination of Geographic Information Standard

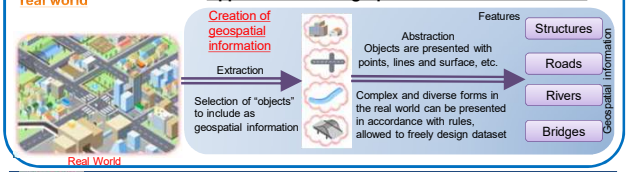
3.3.1 Significance of Standardizing Geospatial Information

Significance of Standardizing Geospatial Information

- Enhanced cross-operability of data
- Reduced cost by eliminating duplication of data
- Enhanced accuracy and promptness in data use
- Enhanced reusability of data

Conception of and Approach to Features, and Standardization of the Data

Application of Geographic Information Standards

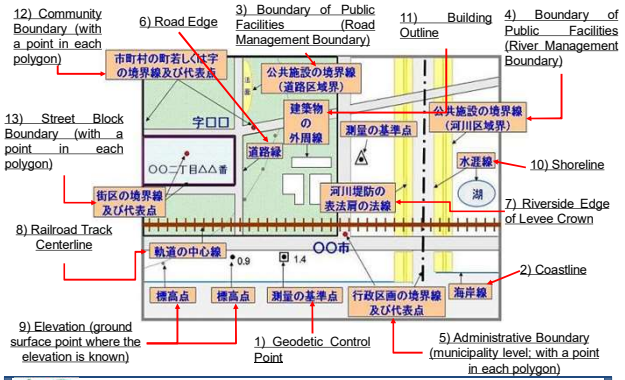


3.4. Geospatial Information

- 4.1 FGI (Fundamental Geospatial Information)
- 4.3 Digitization of GI
- 4.4 Digitization of AP & SI
- 4.5 Create & Update TM (1/25,000)
- 4.6 Update Dhaka TM (1/5,000 or 2,500)
- 4.7 Create & Update Urban TM (1/5,000)
- Grant Aid
- 4.8 CORS & Tidal Observation Station
- 4.9 RTK GNSS Survey using CORS
- 4.2 Thematic Data
- 4.10 GI of Utility Facilities

3.4.1 Fundamental Geospatial Data in Japan

Source: Geospatial Information Authority of Japan



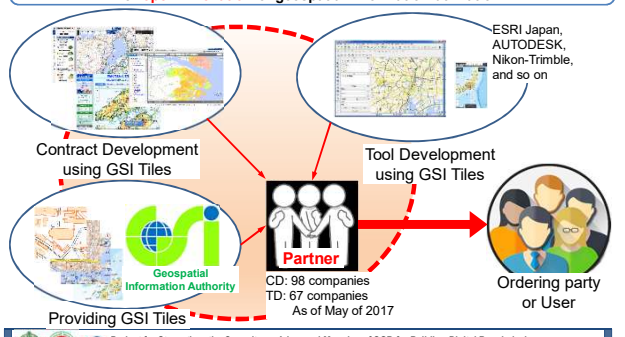
3.5. IT Service / IT System

- 5.1 NSDI Platform (Including Clearinghouse Function)
- 5.2 Metadata Creation Tool
- 5.3 IT Service / System in NSDI
- 5.4 Administrative Information
- 5.5 Application Method of Utilization
- 5.6 Model System for LG
- 5.7 Software Development Capabilities with SOB & IT Co.
- 5.8 Open GIS Software
- 5.9 Reference Point including CORS
- 6.6 New Service & Industry using SOB Map

3.5.1 GSI Maps Partner Network

Source: Geospatial Information Authority of Japan

An external engineers (contract developers, tool providers) with the utilization power of GSI tiles are as the partner, and making information sharing and opinion exchange place **aiming for open innovation of geospatial information utilization.**



3.6. Other

6.1 Introduction of New Technology

6.2 Human Resource Development

6.3 Dissemination of GIS (Inc. Local Governments)

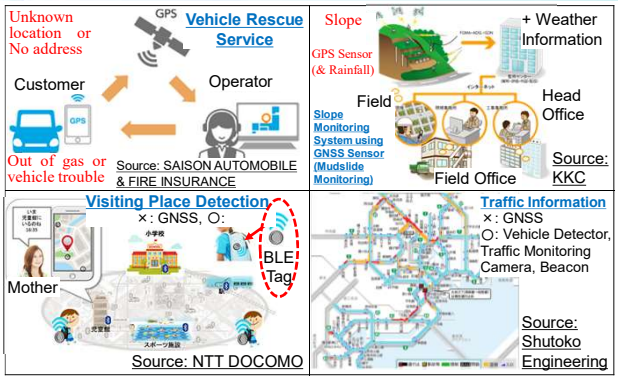
5.7 Software Development Capabilities with SOB & IT Co.

6.4 International Conference or Seminar

6.5 Domestic Seminars & Workshops on NSDI

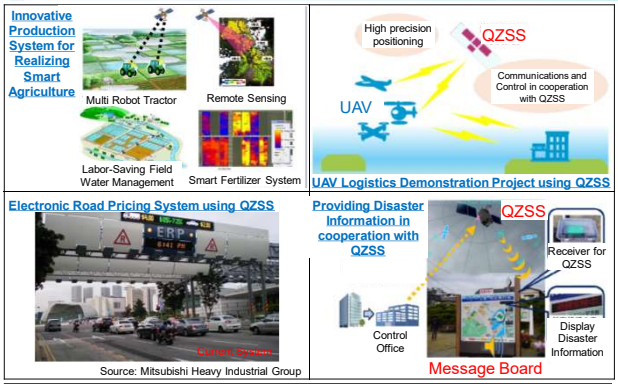
6.6 New Services & Industries utilizing GIS & PNT

3.6.1 Examples of New Service & Industry in Japan



3.6.2 Examples of Demonstration Project in Japan

Source: Cabinet Secretariat (Geospatial Information Utilization Promotion Committee)



Thank you very much for your attention!!

Project for Strengthen the Capacity on Advanced Mapping of SOB for Building Digital Bangladesh

- Making the Roadmap to Establishing NSDI -

Workshop

Presentation on "Cost and Effect of NSDI in Bangladesh"

September 2017

Survey of Bangladesh (SOB)
Ministry of Defence
The Government of the People's Republic of Bangladesh

JICA Map Administration Expert
Asia Air Survey Co., Ltd.
Kokusai Kogyo Co., Ltd.
Pasco Corporation

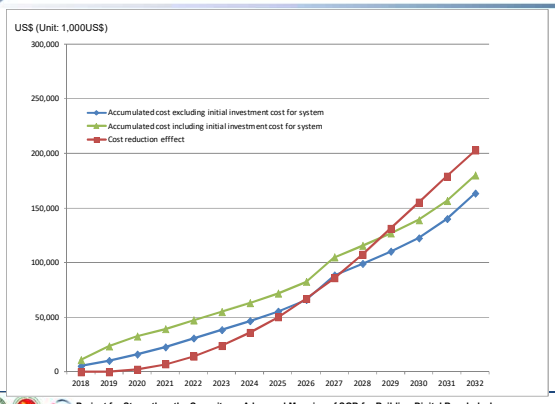
1.1 Difference of cost and effect of ordinary infrastructure development project and NSDI

- Ordinary Infrastructure Development Project (Highway, Water, Gas, Electricity, Harbor, MRT, etc.).
  - Users will pay usage fee.
  - Project earns an income.
  - An income will be used for the maintenance and operation
  - cost, updating cost and extinguishment of initial investment cost.
- NSDI
  - Basically, users will not pay usage fee.
  - Therefore, project earns no income or very small income.

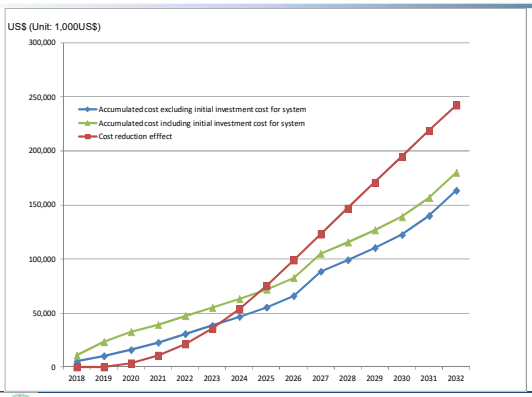
1.2 Cost and income of infrastructure development project

- Ordinary Infrastructure Development Project
  - Cost:
    - Initial investment cost
    - Operation and maintenance cost
    - Updating cost
  - Income:
    - Usage fee paid by users
- NSDI
  - Cost:
    - Initial investment cost for NSDI platform
    - Operation and maintenance cost
    - Updating cost of NSDI platform
    - Data preparation and updating cost
  - Income:
    - Cost reduction by the utilization of geospatial information by NSDI users.

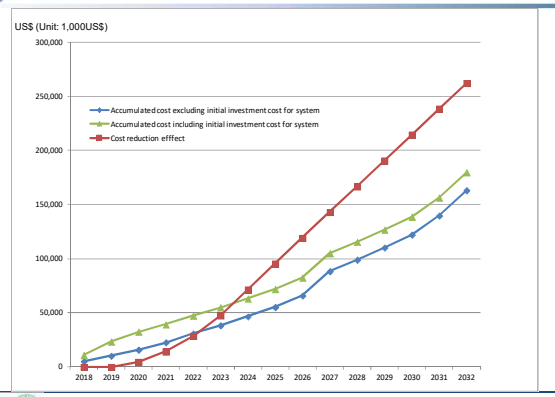
2.1 In case of 10% up of NSDI utilization per year



2.2 In case of 15% up of NSDI utilization per year



2.3 In case of 20% up of NSDI utilization per year



3. Conclusion

- From the viewpoint of cost and effect of NSDI, it is necessary to promote the utilization of NSDI, especially mutual data utilization among the organizations.
- Assuming that utilization of NSDI will increase 20% per year, it is estimated that at the end of 4th year after the construction of NSDI platform, the cost reduction effect will exceed the total cost of initial investment cost, maintenance and operation cost, platform updating cost and data preparation and updating cost.

Thank you for your cooperation for the establishment of NSDI in Bangladesh.

Project for Strengthen the Capacity on Advanced Mapping of SOB for Building Digital Bangladesh

- Making the Roadmap to Establishing NSDI -

Workshop

Overview of NSDI Pilot Project

September 2017

Survey of Bangladesh (SOB)
Ministry of Defence
The Government of the People's Republic of Bangladesh

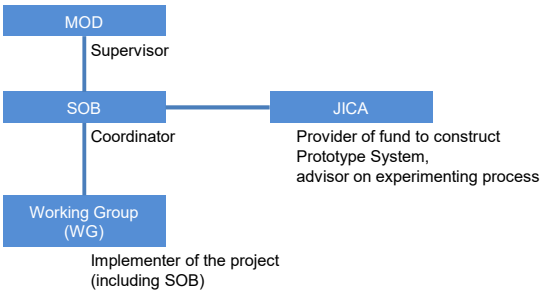
JICA Map Administration Expert
Asia Air Survey Co., Ltd.
Kokusai Kogyo Co., Ltd.
Pasco Corporation

1.1 Objective of the NSDI pilot project

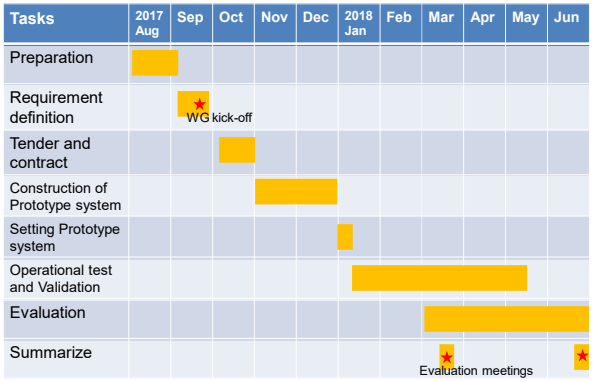
- General objective of the NSDI pilot project is followings:
  - Create a limited scale of database system (Prototype System)
  - Examine the function and performance of NSDI
  - Research on the benefits and issues prior to the introduction of full scale NSDI for Bangladesh
- Purpose and target of the NSDI pilot project
  - Suggest the best specification of NSDI for Bangladesh
  - Propose the rules of operations and roles of participated organizations

1.2 Project members and roles

- Organization of NSDI pilot project



1.3 Schedule



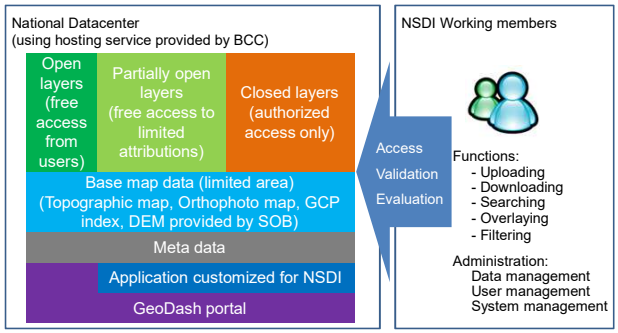
2. OVERVIEW OF THE NSDI PILOT PROJECT

2.1 Structure of the NSDI prototype system (1/2)

- Basic design – NSDI powered by GeoDash
- The reasons for utilizing GeoDash are:
  - To well-designed geo-portal system established with support from WB,
  - To have operational experience to handle and publish various maps and made by public organizations,
  - To be effective in constructing NSDI prototype system.

2.1 Structure of the NSDI prototype system (2/2)

■ NSDI prototype system configuration



2.2 Experimental operation (1/2)

■ Administration process

Authorization of information	Check the quality and liability of requested maps and information and permit to register.
Registration	Register maps and information layers according to the authorized request.
Access control	Set the rules of access to the registered information.
Unregister and update	Unregister or replace the maps and information with regulated procedures.
Monitoring	Monitor and summarize the accesses from clients.

2.2 Experimental operation (2/2)

■ Utilizing process

Checking functions	Check and examine all functions of Geo-portal.
Checking security control	Check security of closed and partially closed layers.
Using system	Check search and download operation of Clearing House.

2.3 Evaluation

■ Evaluation items are as follows:

- ☐ Data Quality
  - Change of accuracy or completeness from source data
  - Workload and cost of conversion and registration
  - Consistency and integrity of different maps and information
- ☐ System performance
  - Easiness and secureness of registration
  - Sufficiency of function of geo-portal
  - System resource: capacity, speed
- ☐ Operation bodies
  - Organization of NSDI operation
  - Process of operation
  - Summarization method of user activites

2.4 Final reports

■ Final report include the following topics:

- ☐ Benefits and issues in utilizing NSDI on activities of public organizations
- ☐ Issues and necessity in preparation of base maps and geospatial information
- ☐ Examples of activities and organizations in which NSDI is essential or efficient
- ☐ Required specifications for full scale NSDI for Bangladesh

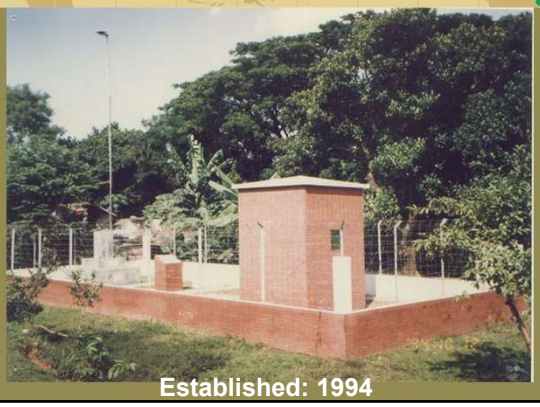
NSDI for Bangladesh

Geodetic Products & Services for NSDI

Nayon Chandra Sarker
Assistant Director (Survey)
Incharge, Geodetic Detachment
Survey of Bangladesh

Survey of Bangladesh establishes and maintains the Geodetic Control Network of Bangladesh

National Datum Yard, Gulshan, Dhaka



Established: 1994

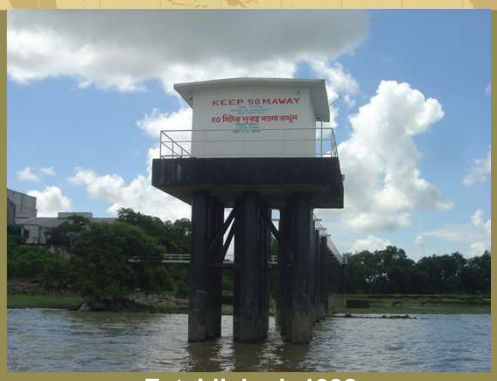
National Horizontal Datum, Gulshan, Dhaka

Horizontal Datum Fixation

Horizontal Control Point Network

National Vertical Datum, Gulshan, Dhaka

Tidal Station, Rangadia, Chittagong

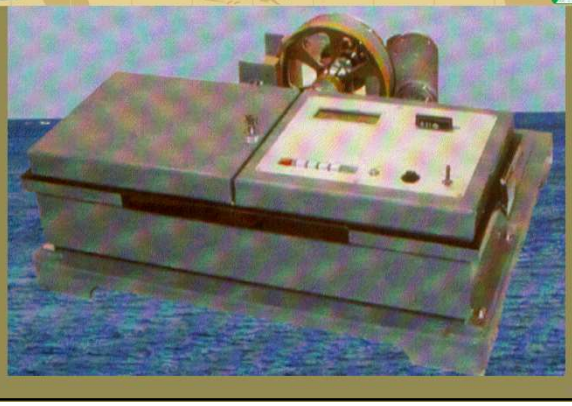


Established: 1992

Tidal Station, Rangadia, Chittagong

Tidal Bench Mark

Digital Tide Recorder



Vertical Control Point Network

Total number of Geodetic Survey Pillars established covering the whole country - 2495

- 1D Geodetic Survey pillars (height above MSL value only) – 1418
- 2D Geodetic Survey pillars (horizontal coordinates only) – 289
- 3D Geodetic Survey pillars (height above MSL value & horizontal coordinates) – 788

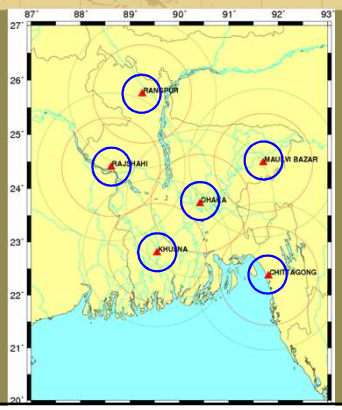
SOB GNSS CORS

Established: 2011

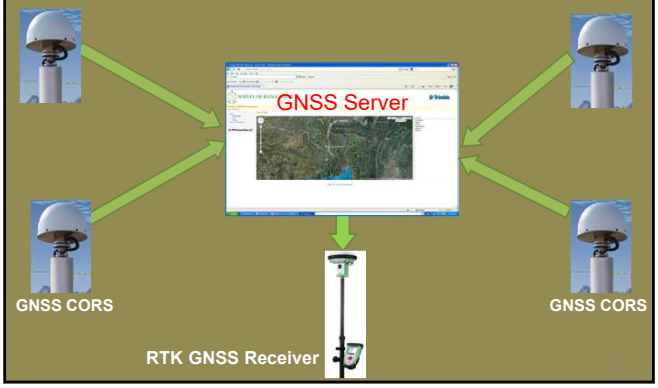
GNSS CORS (Continuously Operating Reference Station)

IGS Stations Around Bangladesh

Six GNSS CORS



SOB GNSS CORS Service for RTK Survey



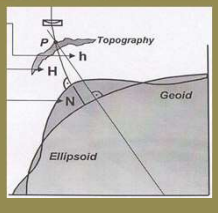
- Link for SOB Geodetic Survey Pillars → SOB → Website: www.sob.gov.bd → Important Links → SOB Geodetic Control Points
- Link for SOB GNSS CORS → SOB Website: www.sob.gov.bd → Important Links → SOB Continuously Operating Reference Station

Next plan of SOB in the field of Geodetic Survey

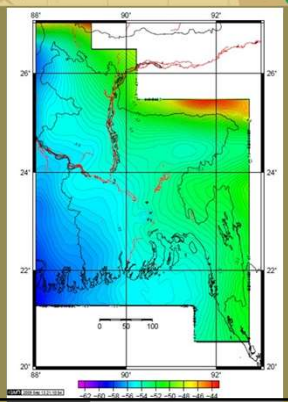
To densify the GNSS CORS Network to cover the whole country establishing additional 60 CORS with the cooperation of JICA

To prepare an accurate Geoid Model for Bangladesh

Geoid Model of Bangladesh

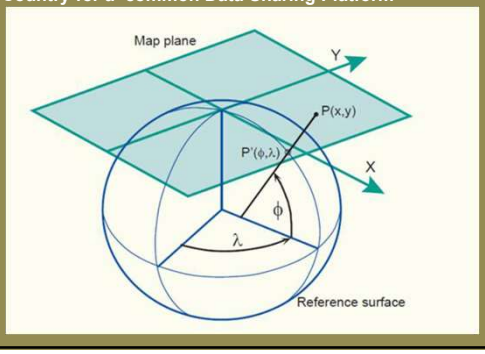


P: Point on Earth Surface
H: Elevation from MSL
h: : Elevation from Ellipsoid
N: Geoidal Seperation
H=h-N



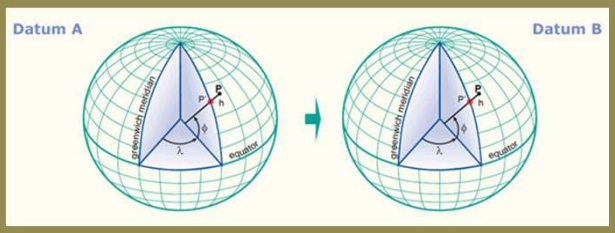
Probable Contribution for NSDI

Defining Best Possible Geographic and Projected Coordinate System for the Country for a common Data Sharing Platform



Probable Contribution for NSDI

Determining the Parameters for Coordinate Transformation



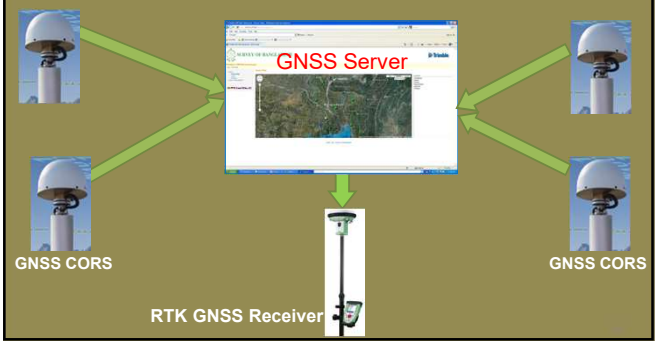
Dx = xx.xx, dy = yy.yy, dz = zz.zz

Probable Contribution for NSDI

Determining accurate 3D Coordinate at any place

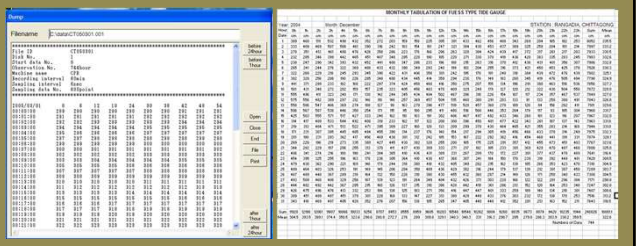
Probable Contribution for NSDI

Providing GNSS CORS Service for RTK Survey to get quick & accurate position in Real Time



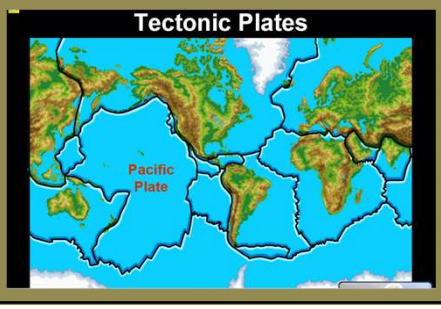
Probable Contribution for NSDI

Providing Tidal Data for Disaster Management, Drainage System Designing, Mangrove Forest Management, Maritime and other research etc



Probable Contribution for NSDI

Assisting Monitoring of Tectonic Plate Movement by providing GNSS CORS Data



Probable Contribution for NSDI

Providing Coordinates & Heights of Geodetic Control Points for determining Coordinates & Heights of unknown places

Lat: 23° 52' 12.364"
Long: 90° 25' 27.421"
Height: 8.142 m

Probable Contribution for NSDI

Assessing Spatial Standard for other Organization Data

Error Ellipse

THANKS

Instruments used for Geodetic Survey

GNSS CORS Receiver

Instruments used for Geodetic Survey

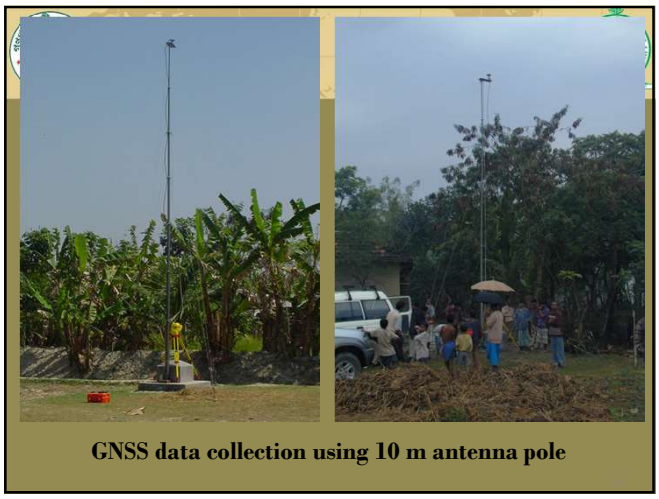
GNSS Receiver

Instruments used for Geodetic Survey

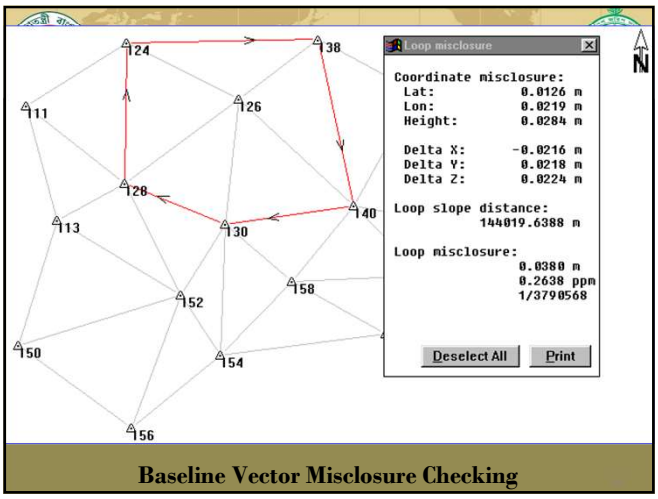
Total Station

Instruments used for Geodetic Survey

Digital Level

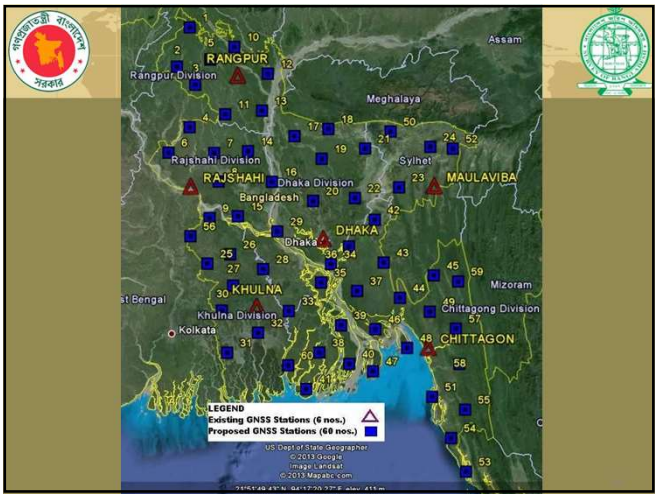


GNSS data collection using 10 m antenna pole



Baseline Vector Misclosure Checking

GNSS Survey team & Army members at Bangalhalia, Bandarban




THANKS