[*Final Report*]

By WeGO, Seoul Metropolitan Government
For Overseas City e-Government Application Feasibility Study Project

Feasibility Study on Spatial Data Infrastructure (SDI)

In terms of underground facilities such as network, pipelines and electricity in urban area

January, 2013

City Government of Ulaanbaatar
Seoul Metropolitan Government
WeGO (World e-Government Organization of Cities and Local Governments)

Preface

The "Feasibility Study on Spatial Data Infrastructure' has been produced by the Feasibility Study Project Team under the supervision of Ulaanbaatar city government and Seoul Metropolitan Government. Seoul Metropolitan Government, Ulaanbaatar city government and the team have the ownership on the modification and revision on this report.

For the further information or additional modification, please contact the Feasibility Study Project Team at following e-mail address;

<Feasibility Study Project Team>

- Project Coordinator and Manager

Ulaanbaatar				Seoul Metropolitan Government			
Title	Name	Email	Tel	Title	Name	Email	Tel
Project Coordinator	Mr. Bat-Ulzii	Bat.ulzii@ulaanbaatar.mn	+976 11330822	Project Manager	Ms. SUN MI KANG	smi729@seoul.go.kr	+82 2 6361 3116
Project Manager	Mr. E. Davaajargal	Saikhnaa0612@yahoo.com	+976 11330822	Project Manager	Ms. JUNG AH KIM	gim1018@seougl.go.kr	+82 6361 3116
				Project Manager	Ms. SUN YOUNG JUNG	hymns97@seoul.go.kr	+82 6361 3116

- Project Consultants

Seoul Metropolitan Consulting Team (Korea)			
Title	Name	Email	Tel
Project Manager	Mr. Hak-Jin LIM	consulting@hyundai-uni.com	+82 2 2072 6029
Senior Consultant	Mr. Tae-Hee YOON	consulting@hyundai-uni.com	+82 2 2072 6029
Senior Consultant	Miss. Tae-Hyee KIM	consulting@hyundai-uni.com	+82 2 2072 6029
Junior Consultant	Miss. Ji-Eun CHOI	consulting@hyundai-uni.com	+82 2 2072 6029
Director(IT specialist)	Mr. Sang Yong Kim	consulting@hyundai-uni.com	+82 2 2072 6029
Director(IT specialist)	Mr. Kwang-Soo LEE	consulting@hyundai-uni.com	+82 2 2072 6029

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Abbreviations

ADB	Asia Development Bank
C/S	Client/Sever
CPU	Central Processing Unit
DBMS	Database Management System
EA	Environmental Analysis
e-Gov	e-Government
e-Signature	Digital signature scheme for providing the authenticity of a digital message or document
e-GMP	e-Government Master Plan
F/S	Feasibility study
H/W	Hard Ware
ICT	Information and Communication Technology
ICTPA	Information Communication Technology and Post Authority
IDC	Integrated Data Center
ISO	International Standardization Organization
KEXIM	Export Import Bank of Korea
KISDI	Korea Information Society Development Institute
KOICA	Korea International Cooperation Agency
MPRP	Mongolian People's Revolutionary Party
MNDP	Mongolian National Democratic Party
MNT	Mongolian National Tugrik
Mom	Minutes of Meeting
NIPA	National Industry Promotion Agency
LA	Legislation & Regulation Analysis
LOI	Letter of intent
LBS	Location Based Service
ODA	Official Development Assistance
OGC	Open Geo-spatial Consortium
OS	Operating System
PC	Personal Computer
R&R	Roles and Responsibilities
SMG	Seoul Metropolitan Government
SDW	Spatial Data Warehouse
S/W	Soft Ware
SWOT	Strength, Weakness, Opportunities, Threats
TA	Technical Analysis

TFT	Task Force Team
UB	Ulaanbaatar City Government
USD	US dollars
UNDP	United Nations Development Program
WB	World Bank
WeGO	World e-Government Organization

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Executive Summary

As the final report for the feasibility study on Spatial Data Infrastructure(SDI) –in terms of underground facilities- of Ulaanbaatar city government, this project has been supervised by WeGO and collaborated with World Bank. This project, so called the informatization feasibility study, has been conducted focusing on the prevention of unexpected accidents by utilizing correct and sharing information. Moreover it is promoted to improve the civil service, especially in the construction sector, in Ulaanbaatar.

The final report consists of issues & problems which are derived from the current operating status of underground facility management, IT and public administration management status, definition of informatization directive, derivation of improvement issues, and finally implementation plan for establishment of SDI for underground facilities.

Furthermore, through the analysis of financial capability and possibility, the final report has provided a more specific feasibility such as NPV, IRR based on estimated cash flow.

Through the first and second site investigation, issues of Ulaanbaatar city and To Be model have been addressed and shared with Ulaanbaatar city government. In order to design To-Be model, the implementation plan was established and then the final report in Ulaanbaatar was conducted on Jan. 2013.

The current level of e-government implementation of UB is in the diffusion phases. For last many years, UB has used systems such as transportation, lands from central and local government and tried to implement e-government through international collaborations.

Due to rapid economic growth, Ulaanbaatar city has lots of problems such as air pollution, traffic jam which are caused by urbanization. This is the typical phenomenon generated by rapid population influx. Thus, UB has been considering various solutions against those negative effects of urbanization, and one of the solutions is the investment of e-Government like median exclusive bus lane system, construction IDC in & out of city, establishment of digital map, etc.
Also, central and local government of Mongolia is going to eliminate the detrimental effects of disharmony between classes and regions.

Therefore, this target project is one of the most important e-Government items for its sustainable development and public safety.

According to the results during the investigation, there are numbers of unexpected accidents in urban underground. Those accidents have significant effects on factories (no electricity), hospitals (no water) and all citizens. It is an issue exactly against the stable development and citizen's safety right. All citizens could be potential victims by non-efficiency management for underground facilities.

As a consequence, the feasibility study project team will analyze current situation and introduce best practice of other cities in the final report. Also, it will provide recommendations on the right direction for underground facility management.

I. Overview

1. Introduction

The capital city of Mongolia, Ulaanbaatar has grown as economic, cultural, social hub of Mongolia with rapid urbanization and population increase during the last decade.

However, Ulaanbaatar City Government currently recognized the importance of systemized urban development planning in accordance with the issue of population distribution in terms of concentration of overpopulation phenomena in specific districts, which is considered as one of the biggest problems for balanced urban development in Ulaanbaatar.

Therefore, Ulaanbaatar is now in progress of restructuring urban development plan with information technology utilization as the solution for the balanced city development.

Following this, Feasibility study on Spatial Data Infrastructure (SDI) is focused on the establishment of systemized urban development and the enhancement of work efficiency for city administration tasks through integration of Ulaanbaatar underground facilities information and systemized management.

2. Project Background

The role of city government has strengthened in recent years. Urbanization is an indispensable trend in modern times. The population in urban areas has steadily increased, particularly in developing countries. By 2025, it is projected that about two-thirds of the global population will live in urban areas, and by 2030, the urban population is expected to reach 5 billion.[1] Meanwhile, the urbanization of developing countries has been proceeding more and more rapidly.

However, many cities in developing countries have limitations in terms of their capacity for urbanization due to a lack of infrastructure, a lack of vision, limited financial resources, etc.

To address these various limitations, the establishment of e-Government is another solution.

Thus, city government requires the adoption of an advanced e-Government model with the object of efficient and sustainable city development to address the problems caused by the lack of systematic urbanization.

SMG[2] is one of the most advanced city governments in terms of e-Government. Since 1990, SMG has built on its e-Government knowledge and operational expertise in various areas to develop a city where e-Government is fully implemented. Also, as a president city of WeGO[3], SMG has a strong interest in the spread of e-Government, and has been making efforts to build an inter-city cooperation model. As a part of this effort, SMG is opening a project F/S[4] project called "Feasibility Study for Overseas Cities e-Government Application" for three city governments.

According to the LOI[5] from the city government of Ulaanbaatar, the city has finished developing a joint state high-speed internet network spanning 90 km, through a combination of underground

[1] UN(2012) World Urbanization Prospects, The 2011 Revision
[2] SMG: Seoul Metropolitan Government
[3] WeGO: World e-Government Organization
[4] F/S: Feasibility study
[5] LOI: Letter of intent

wiring and airwaves, which connects every city administrative department. The city is currently working on necessary applications based on this network. To offer public services online, the city must first have the necessary infrastructure, such as applications, databases, etc.

To address the needs of Ulaanbaatar city government, the city was willing to join in the project named "Development of an e-Government toolkit for cities in developing countries: a joint project of WeGO and the World Bank."

As a part of global co-prosperity, both city governments are exploring ways to optimize their cooperation. SMG, on the basis of its experience of building e-Government, is willing to deliver its successful expertise to UB[6].

3. Project Objectives

The key objectives of this project can be summarized as follows:

- Feasibility study on Spatial Data Infrastructure in terms of SDI for underground utilities such as networks, pipelines and electricity in urban area.
  - Report concept : Practical, Creative, Effective immediately and Sustainable
  - Objective study utilizing best practices and survey for e-Government environments
  - Derivation of a practical benefit(s) from e-Government for city government and the citizen

- Proposed development of future e-Government model
  - Development of To-Be Model according to requirement(s)
  - Creation of an e-Government roadmap suitable for target item(s)

- Promote e-Government best practices to WeGO members
  - Case study on e-Government implementation by Seoul Metropolitan Government
  - Presentation about e-Government at the second General Assembly 2012, in Spain (November/2012)

- Cooperation with World Bank Toolkit Project
  - Improving executive ability and reliability of World Bank Toolkit through output generated in this project

4. Project Scope

- Requirement Analysis and Preliminary Study
  - Detailed analysis of requirement(s)
  - Analysis of problem(s) currently faced
  - Survey of applicable model based on secondary data
  - Preparation of pre-interview questionnaire and others

- Research and Site Survey
  - Undertake onsite kick-off meeting and review the inception report
  - Conduct interviews and collect primary data for analysis (See 'Table 4-1' below)
  - Field trip (if necessary)
  - Report the initial result(s) of onsite investigation

Table I-1 *Investigation & analysis items*

[6] UB: Ulaanbaatar City Government, member of WeGO

Category	Descriptions
EA (Environmental Analysis)	Overview Overall policies and strategies Stakeholders analysis Constraints and issues to address
TA (Technical Analysis)	Current ICT status ICT situation & request for the project Technical design & approach SWOT analysis
LA (Legislation & Regulation Analysis)	Legal & regulatory analysis Institutional analysis Suggestions regarding the legal, regulatory & institutional framework for the project
RC (Recommendations)	Project overview & components Priority of the projects Budget planning Schedule Monitoring & evaluation
FA (Feasibility Assessment & Economic Analysis)	Demand analysis Project rationale Valuation of benefits & costs Monitoring & Evaluation Linkages to World Bank Toolkit Development Project

- Establishment of Strategy
  - Vision and goal setting
  - Development of the informatization strategy in detail for e-Government
  - Calculation of benefits by scenario (if necessary)
  - R&R[7] setting by each organizer and other stakeholders
  - Briefing implementation plan
  - Budgeting plan (if necessary)

- Consensus and Future planning
  - Reach a consensus during (or after) the release of an Interim report
  - Reconfiguration of the strategy, or modification of the strategy (if necessary)
  - After mutual consensus, plan as detailed an implementation as possible
  - Final report

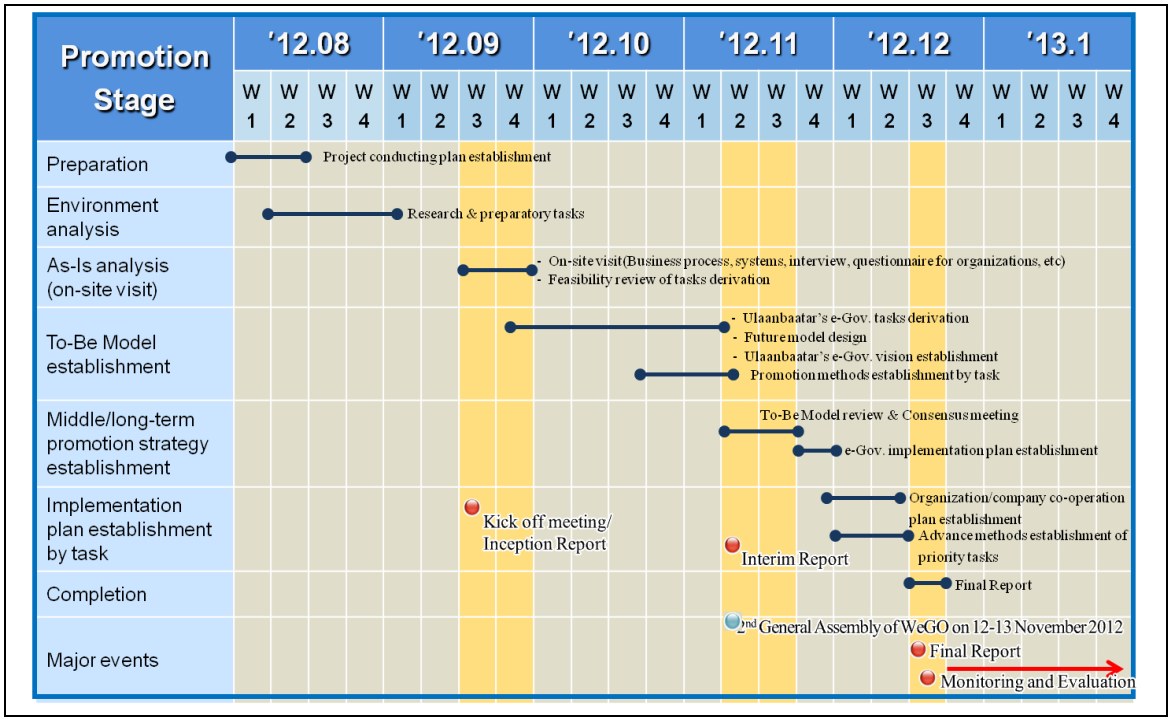
- Other
  - Cooperation with World Bank Toolkit Project team

5. Project Schedule

Project timescales will be no more than (five) months, commencing in August 2012. This is the extensive project schedule, and the overall schedule of the F/S project is as follows:

Figure I-1 Project schedule

[7] R&R: Roles and Responsibilities



6. Project Organization

The project is initially organized by both SMG and UB, as follows:

Table I-2 *Project Organization*

Seoul Metropolitan Government (SMG)	
Title	Name
Senior officer	Ms. Sun-Mi Kang
Officer	Ms. Jung-Ah Kim
Officer	Ms. Sun-young Jung

Ulaanbaatar City Government (UL)	
Title	Name
Head of IT	Mr. Bat-Ulzii
Senior officer	Mr. E. Davaajargal
To be confirmed	To be confirmed

Seoul Metropolitan Government FSCT			
Title	Name	E-mail	Area of expertise
Project director	Mr. Junghoe Koo	kiddy98@h[8]	Project manager, IT Specialist (15)[9]
Project manager	Mr. Frederic Lim	hjlim@h	Business & investment consulting (10)
Senior consultant	Mr. Taehee Yoon	thyoon@i[10]	IT consultant, IT analysis specialist (5)
Junior consultant	Ms. Jieun Choi	pealike@h	IT consultant (2)
IT specialist	Mr. Kwangsoo Lee	kwangsoo@h	IT specialist, e-Gov.: GIS (10)
IT specialist	Mr.Sangyong Kim	dpsykl@h	IT specialist, e-Gov.: Administration (10)

- Project Roles and Responsibilities

[8] @h: hyundai-uni.com
[9] (number) years of experience
[10] @i: intergen.co.kr

Table I-3 *Project Roles and Responsibilities*

Classification	Activities
SMG	Project Management Preparation of the 2nd General Assembly of WeGO
Roles & Responsibilities	
Overall management & supervision of the F/S Offer & Sharing of e-Government experience and expertise	

Classification	Activities
City Government of Ulaanbaatar	Planning & Coordination Project Execution
Roles & Responsibilities	
F/S project coordination Offer of Ulaanbaatar's ICT current status information Identification of the project scope Project execution	

Classification	Activities
FSCT	Project Management Project Consulting
Roles & Responsibilities	
Project management (i.e., scope, schedule, etc.) Review of project deliverables Project monitoring	

II. Environmental Analysis (EA)

1. Country/ City Overview

Environmental Analysis (EA) aims to look into Ulaanbaatar city's general environment to make better understanding of current status in Ulaanbaatar through the research in order to collect and analyze geographical, political, economical, and socio-cultural information.

1.1 Overview of Mongolia

1.1.1 Overview

Mongolia is a landlocked country, located between Russia and China, and sized more than seven times of Korea. It is one of the highest countries in the world with an average elevation of 1,580 meters. Ulaanbaatar lies at 1,351 meters above the sea level. Geographically the country encompasses six distinct zones: high mountains, steppe, forest steppe, dessert steppe, taiga (forest) and desert. The southern third of Mongolia is dominated by the Gobi desert.

Approximately 95% of total population is composed of Mongol ethnic who mainly believe Buddhist Lamaism, Shamanism and Muslim.

Since the independence from china with the Soviet Union's support in 1921, Mongolia established Mongolian People's Revolutionary Party (MPRP) by the first assembly in 1924. During the socialist time, MPRP coordinated all external, internal affairs as sole political party. However, after the Soviet Union collapsed, Mongolia transformed the market economy into Democratic parliamentary Republic in 1992.

The traditional main industry of Mongolia is stock farming due to the topographical condition because Mongolia is mainly consisted of desert, steppe and mountains. However, according to the rapid increase of international raw-material cost, mining industry becomes one of the main industries in Mongolia currently.

Table II-1 *Mongolia country overview*

General	
Location	Northern Asia, between China and Russia (46 00 N, 105 00 E)
Area	1,564,116 km^2
Climate	desert; continental (large daily and seasonal temperature ranges)
Population	2,754,685 (July 2012 est.)
Capital	Ulaanbaatar
Ethnic groups	Mongol (mostly Khalkha) 94.9%, Turkic (mostly Kazakh) 5%, other (including Chinese and Russian) 0.1% (2000)
Languages	Khalkha Mongol 90% (official)
Religions	Buddhist Lamaism 50%, Shamanist and Christian 6%, Muslim 4%, none 40%
Politics	
Government type	Parliamentary
Chief of state	President Tsakhia Elbegdorj (Since 18 June 2009)
Legislative branch	unicameral State Great Khural (76 seats)
Political parties	Democratic Party (DP), Mongolian People's Party (MPP), Justice Coalition from the Mongolian People's Revolutionary Party (MPRP) and the Mongolian National Democratic Party (MNDP), Civil Will-Green Party (CWGP)
International Organization participation	ADB, ARF, CD, CICA, CP, EBRD, FAO, G-77, IAEA, IBRD, ICAO, ICRM, IDA, IFAD, IFC, IFRCS, ILO, IMF, IMO, IMSO, Interpol, IOC, IOM, IPU, ISO, ITSO, ITU, ITUC, MIGA, MINURSO, MONUSCO, NAM, OPCW, OSCE (partner), SCO (observer), UN, UNAMID, UNCTAD, UNESCO, UNIDO, UNMISS, UNWTO, UPU, WCO, WHO, WIPO, WMO, WTO
Economy	
GDP (PPP)	13.264 billion USD
GDP per capita	4,743 USD
GDP growth rate	17.3% (2011 est.)
Currency	Mongolian Tugrik(MNT)
Fiscal year	Calendar year (1. 1. ~ 12. 31.)
Main Industry	Agriculture, herding, mining
Exports commodities	Floor, Copper, apparel, livestock, animal products, cashmere, wool, hides, fluorspar, other nonferrous materials, coal, crude oil
Imports commodities	Sugar, Machinery and equipment, fuel, cars, food products, industrial consumer goods, chemicals, all things expect for rice
Natural Resources	Oil, coal, copper, molybdenum, tungsten, phosphates, tin, nickel, fluorspar, gold, silver, iron

*Source: CIA, World fact book (https://www.cia.gov/library/publications/the-world-factbook/geos/mg.html)

1.1.2 Geography

1.1.2.1 Area/Location

Mongolia is located in Central Asia with the area of 1,565,000 km^2 at north latitude 46 00 and east longitude 105 00. Total length of the border is 8,158 km and out of that Mongolia shares 3,485 km border with the Russian Federation to the north and 4,673 km with the People's Republic of China to the south. From the westernmost point to the easternmost point is 2,392 km, and from the northernmost point to the southernmost point is 1,259 km.

Figure II-1 Mongolia Map

*Source: Google map (http://maps.google.com)

1.1.2.2 Topography

Mongolia is elevated on average about 1,580 m above the sea level. In the north and west lie Altai, Khentii mountain ranges. Gobi and desert regions spread throughout the east and south of the country. Much of the country consists of steppe. The highest point in Mongolia is the Khuiten Peak in the Tavan Bogd mountain range in the far west at 4,374 m above the sea level. From the north to the south, the country is divided into 4 major regions differing in natural and geographical features. Further, Mongolia is divided into six natural zones, such as high mountain zone, taiga (forest) zone, forest steppe zone, steppe zone, desert steppe zone and desert zone.

1.1.2.3 Climate

Mongolia has extremely continental seasons, hot summer and very cold winter, because it is located in the heart of the central Asian continental. The average temperature is 20 ^oC in summer and -24 ^oC in winter. Also, under the influence of surrounding high mountains, the dry weather continues over the year and leads to a huge daily temperature change.

1.1.2.4 Natural Resources

Mongolia has abundant resources, such as oil, coal, copper, uranium, molybdenum, tungsten, phosphates, tin, nickel, fluorspar, gold, silver, iron, etc.

1.1.3 Society

1.1.3.1 Population and Ethnicity

According to CIA world fact book in 2012, the estimated population in Mongolia is 3,179,997

(2012 est.). Mongolia, in the population comparison to the world, was ranked 135 within 239 countries. Population growth rate is 1.469 %, which was ranked 81 among the world (2012 est.).

In the case of ethnicity, ethnic groups are composed of 94.9 % of Mongol (mostly Khalkha), 5 % of Turkic (mostly Kazakh) and others (including Chinese and Russian).

1.1.3.2 Languages and Religions

The official language of Mongolia is Khalkha Mongol (90%). However, some part of Mongolia often uses English.

In the case of religion, about 50% of total population believes in Buddhist Lamaism. Other religions are composed of Shamanism, Christian, Muslim, according to the CIA world fact book (2004). Especially, Shamanism is still the most powerful religion in Mongolia.

1.1.3.3 Politics form and standard

According to the research sourced by United Kingdom Foreign & Commonwealth Office (FCO), the type of government in Mongolia is parliamentary. Supreme legislative power is vested in the unicameral parliament, the Great state Khural. The 76 members are elected by universal adult suffrage for four years. They recognize the President and appoint the Prime Minister and members of the Cabinet, which is the highest execution body. The President is the Head of State and Commander in Chief of the Armed Forces, and is directly elected for a term of four years. The Cabinet is nominated by the President in consultation with the Prime Minister and confirmed by the Great Khural.

In the case of Administrative units, Mongolia is divided into 21 provinces (Arkhangai, Bayan-Ölgii, Bayankhongor, Bulgan, Darkhan-Uul, Dornod ,Dornogovi ,Dundgovi, Govi-Altai ,Govisümber, Khentii , Khovd, Khövsgöl, Ömnögovi ,Orkhon, Övörkhangai, Selenge, Sükhbaatar, Töv, Uvs, Zavkhan) and 1 municipality (Ulaanbaatar).

1.1.4 Economy

Mongolia is considered one of the world's fastest-growing economies in the world. It is reported a 17% growth rate in 2011, and a 16.7% growth rate in the first quarter of 2012. Mongolia is also trying to develop the national economy to reach out beyond Russia. In spite of the extensive development of mineral deposit such as cooper, coal, molybdenum, etc., the main economic activities are still agriculture and herding. As of 2011, the mining industry occupies 21.8% of GDP and the agriculture occupies 16% of GDP. GDP per capita in 2011 was $3,100.

Originally, the main industrial activity in Mongolian is the mining sector. Currently, in Mongolian, the economic structure is being taken under restructuring. Although the rate of exportation was increasing in 2011, approximately 90 percent of exportation was from mineral resources. Hence, the government reports that an economic structure relies much on mineral resources.

Thus, Mongolian economic situation will become independent of the mining sector; the economic structure will be changed. Under the economy development plan, Mongolian government states that agriculture and plantation have important roles to develop an economy area, independent of the mining sector.

1.2 Overview of Ulaanbaatar

1.2.1 Overview

Ulaanbaatar, the capital city of Mongolia is located in the Tuul River and elevated at 1,300m above the sea level. By 2011 statistics, the population of the city was counted about 1,300,000 people, which accounts for almost 50% of the total Mongolian population. Ulaanbaatar is the cultural, political, and financial heart of the country.

Table II-2 *Ulaanbaatar General Information*

Contents	Data	Description
Number of districts	9	Total
Number of khoroos (sub-districts)	144	Total
Population	1,287,100	By 2011
Territory	4,704.4	Km^2
Time zone	GMT + 8	Add 8 hours Greenwich mean Time
Area code	+976-11 (21, 51)	976 –country code 11, 21, 51 – area code
Vehicle registration code	(УЪ), (УН) 00-00 (sample)	“УЪ”, “УН” stands for Ulaanbaatar

*Source: Ulaanbaatar City Group, Statistics for economies based on natural resources (http://web.nso.mn/ub_city_group/ablout-ulaanbaatar), project team revised

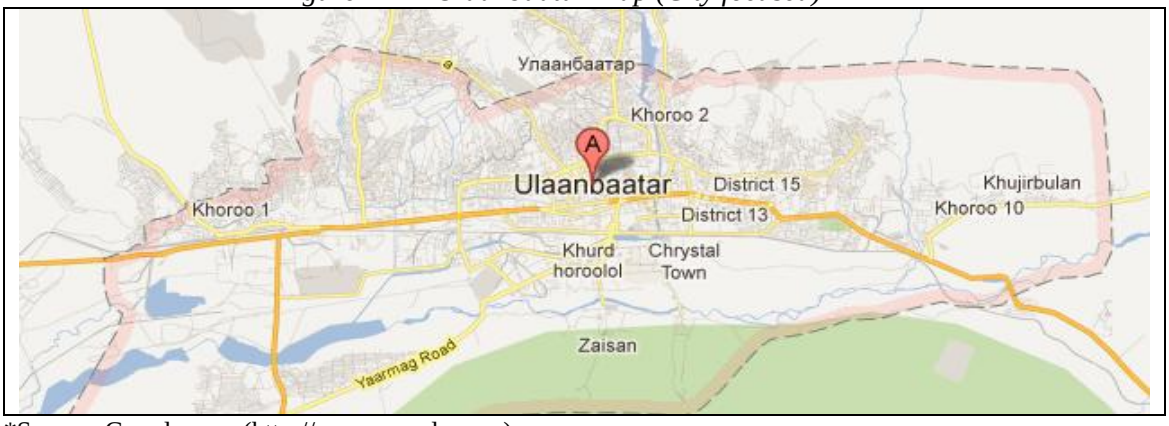
1.2.2 Geography

1.2.2.1 Area/Location

Ulaanbaatar city is located in the basin often southwestern edge of the Hentiynn Mts. Range. It is surrounded by 4 mountains which protect the city from the heavy winds of the plains in the past. However, nowadays 4 mountains have become a big problem. The smog covers the downtown areas of Ulaanbaatar by blocking the air circulation of those four mountains, especially in winter season. Among the world’s capital cities, Ulaanbaatar is notable for being located at the highest altitude (1350m) with the coldest climatic conditions.

Total administrative area of Ulaanbaatar is 4700 km^2, which consisted of 9 districts and the city area is 3257 km^2 excluding remote three districts. However, urbanized area is only 225.6 km^2, which is 4.8% of total administrative area in Ulaanbaatar.

Figure II-2 Ulaanbaatar Map (City focused)



*Source: Google map (http://maps.google.com)

1.2.2.2 Climate

Ulaanbaatar city has a monsoon-influenced, cold semi-arid climate that closely borders a

subarctic climate. Therefore, the weather is severely harsh with a long, bitterly cold and dry winter with the minimum temperature of -49 ^{o}C in the country side, and of -35 ^{o}C in the city. The city features brief, warm summers with the maximum temperature of 39^{o}C. The temperature deviance between winter and summer is 88 ^{o}C. Thus Ulaanbaatar is the coldest capital city in the world.

The annual average air temperature is -3 ^{o}C. The coldest month of the year is January with the average temperature of -26 ^{o}C and the number of days with below -30 ^{o}C can be counted about 40. The city lies under snow cover for about 130 days between November 10th and March 20th with about 18cm depth on average.

In summer, the number of the days with temperature +30 ^{o}C or above is about 10 and the number of days with temperature +10 ^{o}C is about 80, which are usually occurs between June 6th and August 25th. Most of the annual precipitation of 216 mm falls from June to September.

Ulaanbaatar city is considered to be one of the places with the least amount of wind in the country. The average wind speed is 3 to 5 m/sec. The highest ever recorded wind speed was 40 m/sec. The wind is milder in winter times whereas the spring is the windiest season. The warmest month is July with the average temperature of 17 ^{o}C at night, 28 ^{o}C to 32 ^{o}C in the afternoon.

1.2.3 Ulaanbaatar Politics

Ulaanbaatar city is governed by the Citizen's Representative City Council (Khural) with four years in term. It has 45 delegates and 9 chiefs. The mayor of Ulaanbaatar is appointed by the Prime Minister and serves for a term of four years. The mayor reports his work progress to Citizen's Representative City Council (Khural).

The Ulaanbaatar City Citizen's Representatives, Khural, comprise 45 seats, from which 30 seats are elected upon the Majority System from 9 districts of the Capital city, and the remaining 15 seats are elected upon the Proportional Representation System, in other words, from the candidates nominated in the Party list.

In July 2012, new Citizen's Representatives were elected by the Majority System and the Proportional Representation System. 20 candidates were elected from the Democratic Party (DP) and 10 candidates from Mongolian People's Party (MPP) by the Majority System. The remaining 15 seats were elected by Proportional Representation System as follows:

- Democratic Party (6 seats)
- Mongolian People's Party (4 seats)
- "Justice Coalition" from MPRP[11] and MNDP[12] (4 seats)
- Civil Will Green Party (1 seat)

Ulaanbaatar city government is composed of governor's office divisions and implementing agencies under the control of the nominated mayor and Citizen's Representatives, Khural, which is shown as follows:

Table II-3 *Implementation Agencies of the Governor's office of Ulaanbaatar city*

Presidium

[11] MPRP: Mongolian People's Revolutionary Party
[12] MNDP: Mongolian National Democratic Party

Capital City Council/ Office of the City Council	
Governor	
Governor of the Capital City and Mayor of Ulaanbaatar	
Deputy Governor	
Leader Deputy of Governor (Economy and City Finance)	
Deputy Governor (Urban Planning & City Construction, Infrastructure)	
Deputy Governor (Ecology and Manufacturing Policy)	
Deputy Governor (Social Development Policy)	
City manager	
City Development Policy Planning	Public Administration Management
Social Development Policy	Monitoring & Evaluation
Manufacturing Policy	Legal Affairs
Economy, Finance & Treasurer	Military Affairs
International Relation & Cooperation	Public Relation & Media
Division of the Mayor's Office	
Administration Management	Food and Commerce, Services
Engineering Facilities	Environmental Pollutions & Waste Management
Urban Community Services	
Implementing Agencies of the Governor Capital City and Mayor of Ulaanbaatar	
Air Quality Agency	Labor Department
Agricultural Department	Land Agency
Archives Department	Police Department
Art & Culture Department	Professional Supervision Department
Children's Department	Property Relations Department
Communal Services for Agencies Department	Public Relations Department
Construction, Urban Development and Planning Department	Registration Department
Court decisions Enforcement Department	Road Department
Court analysis Agency	Social Insurance Department
Disaster management Department	Social Welfare Department
Education Department	Sports Department
Environment Protection Department	Statistics Department
Health Department	Taxation Department
Heating stoves Utilization Department	Tourisms Department
Housing & Communal Service Department	Veterinary Service Department
Information Technology Department	Water supply & Canalization Department

*Source: IT department, Ulaanbaatar City Government

In 1924, People's Republic of Mongolia was officially declared and the Niislel Khuree was renamed as the city of Ulaanbaatar. The name of Ulaanbaatar means "Red Hero".

Ulaanbaatar was divided into administrative divisions in 1924, for the first time. New constitution was adopted in 1992, and new "Administrative and Territorial Units of Mongolia and their Governing Bodies Law" was also adopted according to its 18th order of August 19, 1992.

Sukhbaatar district used to be divided into three districts, Chingeltei, Sukhbaatar, and Oktyabri, and now three more districts are added. Currently, the Ulaanbaatar city is divided into 9 districts. Districts are divided into Khroos, the smallest unit of administrative division of Ulaanbaatar. There are total of 144 Khroos in the city as of 2011

1.2.4 Society

1.2.4.1 Population

Population size of Ulaanbaatar was 43.2% of the total population of Mongolia. Population of Ulaanbaatar city has been increasing constantly within a scope of urbanization process. The population of Ulaanbaatar was 14.0% of total population in 1956 and such percentage reached 22.3% in 1969 and 43.6% in 2010, out of the total population of Mongolia.

According to the data from statistics department as of January 2012, 1,206,610 people, 45.8% of the Mongolian total population, live in Ulaanbaatar and 571,192 of them are male while 635,418 of them are female.

Table II-4 *Population of Capital City, 2006-2011*

(Unit: thousand persons)

	2006	2007	2008	2009	2010	2011
Population of Mongolia	2,583.3	2,620.4	2,666.0	2,716.3	2,761.0	2,811.7
Population of Capital	1,053.5	1,098.8	1,147.7	1,196.8	1,244.4	1,287.1
Residents in Capital	987.2	1,025.2	1,067.5	1,106.7	1,161.8	1,206.6
Percentage in total population	40.8	41.9	43.0	44.1	45.1	45.8

*Source: Statistic Department of Ulaanbaatar, Population and economic activities of Ulaanbaatar, 2012

1.2.4.2 Language

Official language of Mongolia is Mongolian. Most Mongols speak Russian as a second language, but many also speak a third language. English, Korean, Chinese, and Japanese, are widely spoken in the Ulaanbaatar.

1.2.5 Economy

According to the Ulaanbaatar statistics department report, the role of Ulaanbaatar to the economy of Mongolia is massive in accordance with the concentration of health, education, production, financial activities and people with high income sources. 88.5% of total universities of Mongolia are located in Ulaanbaatar city and 95.3% of total students of the country also study in the city.

The size of Ulaanbaatar city's economy was MNT[13] 6,991.3 billion as of 2011, which was 33.8% of year-over-year growth. Ulaanbaatar city created 64.6% of GDP of Mongolia in 2011. According to the total GDP of Mongolia by regions, GDP performance of western areas is higher by 19.4%, mountainous areas by 14.8%, central areas by 31.8%, eastern areas by 16.8% and Ulaanbaatar city by 33.8% in 2011, compared to 2010.

[13] MNT : Mongolia National Tugrik

Economy of Ulaanbaatar city consists of services (68.8%), industry and construction (30.7%) and the agriculture sector (0.4%). Weight of retail and whole sales, manufacturing, mining and quarrying, transportation and storing services is massive in economy of Ulaanbaatar city.

In the case of employment, 1,124,700 people, which are 34.0% of the total population of Mongolia, are economically active, and 34.8% of these people live in Ulaanbaatar city as of 2011 according to "Work force survey" which has been conducted since 2006 by Mongolian law on statistics

Table II-5 *Number of Employees in all types of economic sectors*

Year	2006	2007	2008	2009	2010	2011
Number of employees	359,400	368,700	391,900	333,800	360,900	361,400

*Source: Statistic Department of Ulaanbaatar, Population and economic activities of Ulaanbaatar, 2012

Average family income of each family of Ulaanbaatar city reached MNT 697,554 in 2011, which was 31.8% growth, compared to 2010. The average family income of each family was higher than the average income of overall country by MNT 61,700 in 2008 and was increased to MNT 124,000, approximately doubled, in 2011.

Table II-6 *Monthly average income per household, at current prices*

Unit: MNT

Types of income	2007	2008	2009	2010	2011
Average income per household of UB	290,755	425,327	487,093	529,302	697,554
1. Monetary income – Total	284,981	416,015	475,803	514,069	676,392
Wages and salaries	*171,299*	*255,089*	*292,858*	*325,901*	*428,609*
Pensions and allowances	*41,606*	*68,761*	*74,915*	*70,061*	*122,679*
Income from household businesses	*49,411*	*53,068*	*66,051*	*62,059*	*63,841*
Other	*22,665*	*39,097*	*41,979*	*56,048*	*61,264*
2. Received from others free of charge	5,276	8,962	11,187	13,895	19,724
3. Foodstuff, which consumed from private farm or enterprise	498	350	103	1,338	1,437
National average income per household	263,681	363,594	402,525	448,027	573,541
Difference of National and UB average income per household	27,074	61,733	84,568	81,275	124,013

*Source: Statistic Department of Ulaanbaatar, Population and economic activities of Ulaanbaatar, 2012

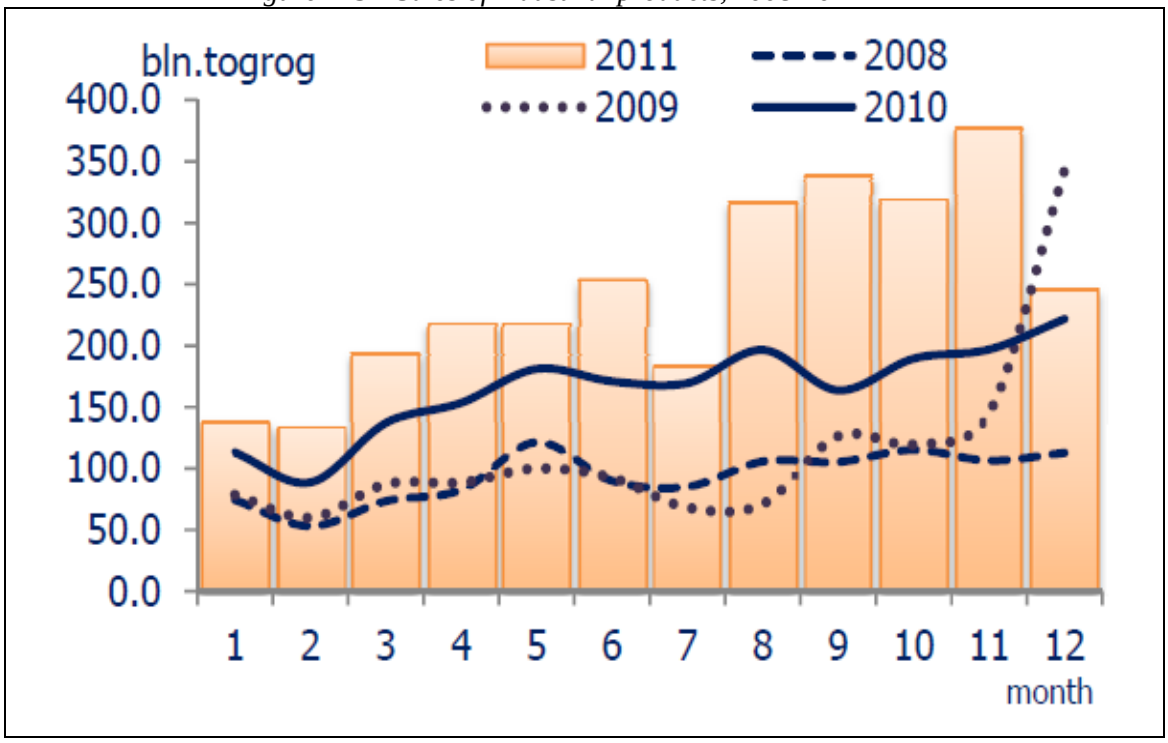
Per capita of GDP of Mongolia reached to MNT 3.8 million in 2011, with the increase of MNT 813,500 compared to 2010. Value added to per person of Ulaanbaatar city is MNT 5.5 million in 2011, with the increase of MNT 1.2 million compared to last year and it is higher than the average amount of the country by MNT 1.6 million.

Total investment of MNT 3,874.6 billion was made to economy of Ulaanbaatar city. The amount of investment was increased by MNT 2,095.3 billion, which was 2.2 times more, compared to 2010. Majority of state investment was made to Ulaanbaatar due to concentration of infrastructure, market capacity and professional work force. On the contrary, the development of infrastructure is insufficient; market is small and isolated, and most of citizens are dependent on livestock husbandry. Therefore, compared to the amount of investment made to Ulaanbaatar, the investment made to Mongolia is much less.

Gross industrial output of Ulaanbaatar reached to MNT 2,433.1 billion and their sales reached to

MNT 2,924.3 billion in 2011. Compared to 2010, the amount of total production has increased up to 27.1%, and the amount of sales has increased up to 33.7%.

Figure II-3 Sales of industrial products, 2008-2011



*Source: Statistic Department of Ulaanbaatar, Population and economic activities of Ulaanbaatar, 2012

According to *Figure II-3*, the amount of monthly production and sales between 2008 and 2011 was on an increasing trend.

2. Policies and Strategies

2.1 Mongolia National Policies and Strategies

2.1.1 National Development Plan

In 2008, the Millennium Development Goals (MDGs) - based Comprehensive National Development Strategy (NDS) of Mongolia was approved by the State Great Khural (the parliament).

The MDGs-based Comprehensive NDS of Mongolia shall be defined in/as a comprehensive development plan for the next fourteen years, which focuses on developing human resources for establishing humane, civil and democratic society, and actively encouraging the development of the country's society, economy, science, and technology in accordance with the global and regional development, by promoting economic growth.

The objective of MDG-based NDS is to strengthen and protect Mongolia's sovereignty while fostering national pride, and to grow into one of the middle income countries by achieving MDGs through strengthening human capacity and intellect.

Priorities of MDG-based NDS; private sector-led dynamic economic growth and Mongolian

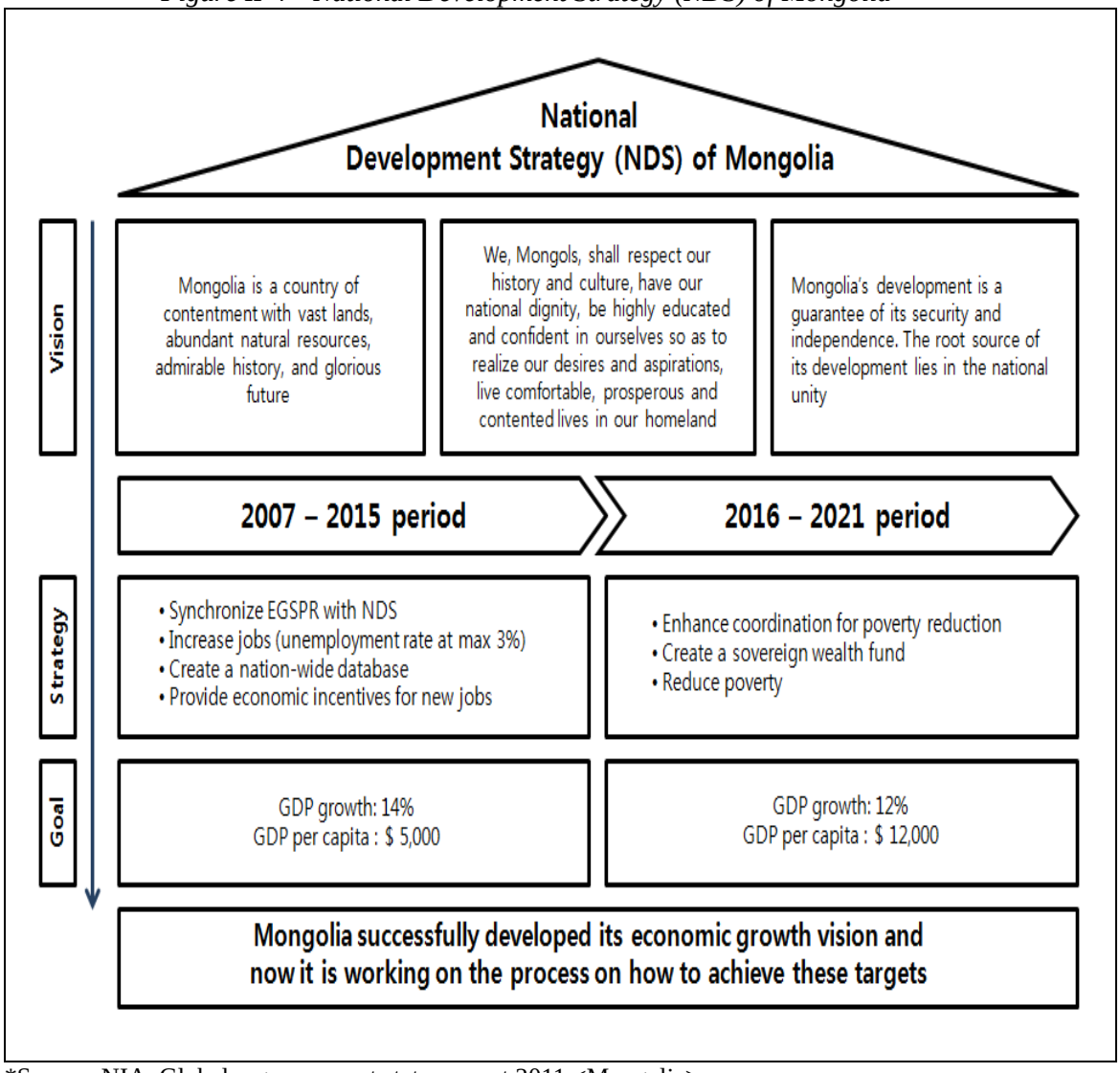
human development, including sustainable educational, healthcare, scientific, technological, and environmental development; creating a knowledge-based economy whose growth is ensured through high-technology-based, environment-friendly production and services; fostering a democratic system of governance, which serves its citizens, protects human rights and freedoms, and is free from corruption and red tape.

Mongolia government aims to reach up to 14% GDP growth and $5,000 GDP per capita in the 1st phase (2008-2015), 12% GDP growth and $12,000 GDP per capita in the 2nd phase (2016-2021) through the National development Strategy (NDS) of Mongolia.

In order to achieve national economic goals, Mongolia government has established the poverty eradication and economic development strategies for reducing the unemployment rate down to 3% at max, implementing nation-wide data base, and creating the sovereign wealth fund.

Strategic priorities are defined in the order of human & social development, economic & infrastructure development, community development & environmental protection, and legal development.

Figure II-4 National Development Strategy (NDS) of Mongolia



*Source: NIA, Global e-government status report 2011 <Mongolia>

2.1.2 National ICT Policies and Strategies

Mongolia government defined ICT as the part of economic development in National Development Strategy of Mongolia (section 5.3.4 of NDS).

ICT sector is recognized as the most important momentum for Mongolia's economic development. Thus, Mongolia government seeks national development opportunities focused on the ICT based socio-economic life through investment for ICT sector such as software technology, legal framework, technology, organization, finance, human resource, etc. As detailed strategies related to ICT, NDS proposed vitalization of medical IT industry, internet banking, e-Commerce and establishment software industry foundation through implementation of broadband infrastructure, high tech, IT park and Industry-University-Institute collaboration complex.

Following these detailed strategies, NDS aims to have over 70% of total population in Mongolia enjoy the informatization society.

In order to realize NDS, Mongolia government announced the detailed implementation plan for 2008-2012 named as 'Government Action Plan (GAP)'. In addition, as an action plan for National Development Plan for Mongolia, 26 core tasks were also announced by National Development and Innovation Committee (NDIC) in September, 2009.

Among the Government Action Plan (GAP), the infrastructure and urban development policy sector planned to promote people's lives, informatization of various documents and efficiency of government administration such as informatization of resident registration, corporation registration and property registration through development of IT infrastructure, software, GIS, broadcasting communication, etc.

The announced 26 core tasks from National Development and Innovation Committee (NDIC) include 3 IT related projects such as construction of cutting-edge technology industrial complex, information technology education center, university Science Park, etc.

Table II-7 *National Development and Innovation Committee (NDIC)*

Project	Description	Budget (estimated)	Period
Cutting-edge technology industrial complex, science and industrial complex	Construction of bio technology utilizing industrial complex	US $ 4 million	2010~2015
Information Technology education center	Developing human resources in information technology, production of IT products and establishment of outsourcing service centers	US $ 1 million	
University science park	Construction of Industry-University-Institute collaboration complex with the capacity of 20,000-25,000 people	US $ 3 million	

* Source: NIA, Global e-government status report 2011 <Mongolia>

2.2 Ulaanbaatar Policies and Strategies

As a part of city development, urban planning in Ulaanbaatar started in the 1950s. The first urban development master plan for the capital city was approved in 1954 and revised in 1960.

The latest master plan of Ulaanbaatar city was revised and approved in 2002 and is current to

Year 2020, although it is now under revision again. The revision process started in 2007 and has the aim of creating a master plan for the city's development until the year of 2030.

According to the World Bank report, the sustainable development of GER areas in Ulaanbaatar (UB) is one of the critical development issues that the country is facing. The "MDG-based Comprehensive National Development Strategy," adopted by the Parliament in 2007, suggested the spatial expansion of UB.

In addition, the "2008 UB City Urban Development Master plan," which was developed with the assistance of the Japanese Government, advocated a "Compact City" concept through suggesting more efficient use of land.

Based on this guidance, technical assistance has been offered by bilateral donors for the introduction of effective zoning regulations and as a result, the government has been taking on large scale development of apartment residences for Ulaanbaatar.

2.2.1 Ulaanbaatar Vision 2020

Ulaanbaatar vision 2020 was established by World Bank City Development Strategy (CDS) exercise in 2001. The city vision was formulated through the series of meetings and seminars, focusing on deriving the city's potentials and constraints in development and addressing priority issues.

Table II-8 *Potentials, Constraints and Priority issues of Ulaanbaatar city development*

Potentials		• A center of industry, trade and commerce, education and health service in Mongolia • Proximity to two big markets : China and Russia • Abundant labor force with advanced skill and education • Presence of an international airport, international railway, and Asian Highway • Potential for tourism development with rich Mongolian heritage and culture • Having relatively better living condition, business opportunities and infrastructure
Constraints		• Lack of infrastructure in "GER" area and outdated infrastructure in urbanized area • Weak urban planning and land management system, and insufficient organizational structure and fiscal power • Rapid population growth causing pressure on infrastructure • Lack of knowledge, training and technology on market oriented economy • Severe climate condition (causing high living cost and lack of year-round attractions for tourists.)
Priority Issues	Urban Development	• To improve "GER" area with provision of basic infrastructure such as water supply, sewerage, drainage, road, etc • To improve infrastructure to meet with rapid population growth and to increase efficiency of services in the urbanized area • To develop efficient Urban Planning System and Land Management System • To increase the density of the urbanized area • To develop satellite towns to decrease the concentration of the urban population

	Urban Environment	• To improve and protect environment, especially air and water pollution and soil contamination caused from "GER" area • To protect water resource and to prevent soil erosion by controlling development of northern area of the city • To improve solid waste management • To establish green facilities (e.g. parks, gardens, street lined with trees) in the urbanized area

*Source: The Ulaanbaatar city urban planning policy and UB city "master plan" up to 2020 presentation

According to these derived potentials, constraints and priority issues mentioned above, five city visions are as follows:

- ***Vision 1*:** The city to have vibrant economy, as a world class business center, having a competitive position in the areas of education, information, science and technology.

- ***Vision 2*:** The city to have a well-developed urban design with appropriate and adequate infrastructure facilities, coupled with well-defined land and housing policies for all citizens, including those living in "GER" areas.

- ***Vision 3*:** The city to be healthy, safe and environmentally friendly, having a well-knit social life and a progressive legal framework

- ***Vision 4*:** The city to have a responsive and efficient public administration, having a participatory approach in order to involve local communities and private sectors in civic services

- ***Vision 5*:** The city to be an attractive destination for tourists in the Asian Region, aiming for promotion of Mongolian art, culture and heritage

In order to formulate development policy for "GER" area, Ulaanbaatar Vision 2020 shows a guideline or standards for non-apartment area development such as provision of basic infrastructure: water supply, drainage and sewerage, road, health and education service with appropriate land use policy

To maximize land use efficiency and promote housing development in urbanized area with improvement of existing infrastructure, the regulatory frameworks for urban development and tenure land use were established.

Development strategies for Ulaanbaatar Vision 2020 are described as follow:

- To extend sewerage and drainage, and introduce a septic tank to "GER" area settlement.

- To improve solid waste management by introducing the recycling and sorting garbage system through community activities or NGOs.

- To alleviate poverty and increase living standard of people by securing basic human needs for all citizens.

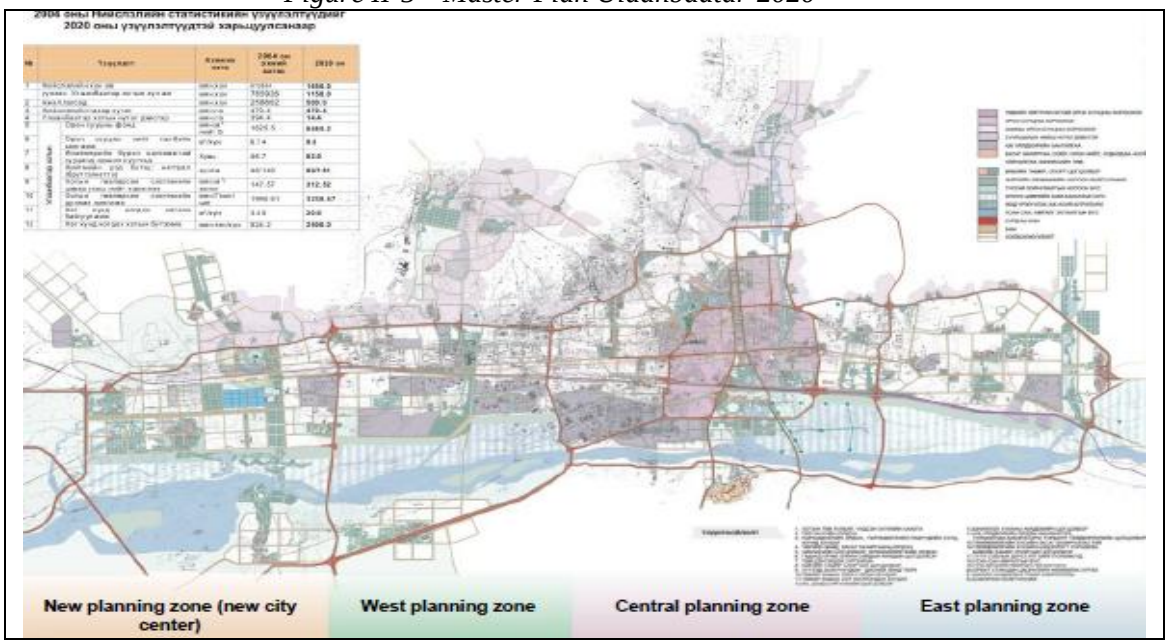
- To improve peace and order by reducing crime.

2.2.2 Ulaanbaatar City Master plan

Based on the Ulaanbaatar Vision 2020, the city's 'master plan,' targeted for year 2020, is confirmed by Government of Mongolia in 2002.

According to the Master Plan UB-2020, the city is designed to be divided into 4 different zones for more effective development: New planning zone, west planning zone, Central planning zone, and east planning zone.

Figure II-5 Master Plan Ulaanbaatar-2020



*Source: The Ulaanbaatar city urban planning policy and UB city "master plan" up to 2020 presentation

- ***New planning zone (new city center)***: The eastern area of Mt. Songino Hairhan, the basin of the Tahilt River, and the Bayangol area are reserved urban areas in the case of overpopulation of Ulaanbaatar in term of planning after 2020. The new city center will be built under composition of "New century – New city."***West planning zone***: The western area is to be improved in the engineering network and infrastructure system, as well as to be restructured and converted to an ecological sector by removing factories and construction materials which pollute air, discharge explosive gas and dust, and damage soil. ***Central Planning zone***: Three rivers in this zone, the Selbe River, the Hailaast River, and the Chingeltei River, will be stabilized through horticulture. The Selbe basin will be recreated as an eco-friendly complex including ponds, local parks, and a sports complex.

- ***East planning zone:*** This zone is aimed for population settlement. Cultural and commercial complexes, as well as comfortable and affordable housing complexes will be constructed for residents.

However, According to the Ulaanbaatar city development plan report in 2012, concentration of overpopulation phenomena in specific districts is currently becoming one of the serious problems in Ulaanbaatar.

94.6% of Ulaanbaatar population is concentrated in 6 districts, located in the center of the city. It is mainly generated from the developmental gap of urbanization between the city center and the suburban area.

In addition, during the promotion of Ulaanbaatar Master Plan 2020, various obstacles are derived as follows:

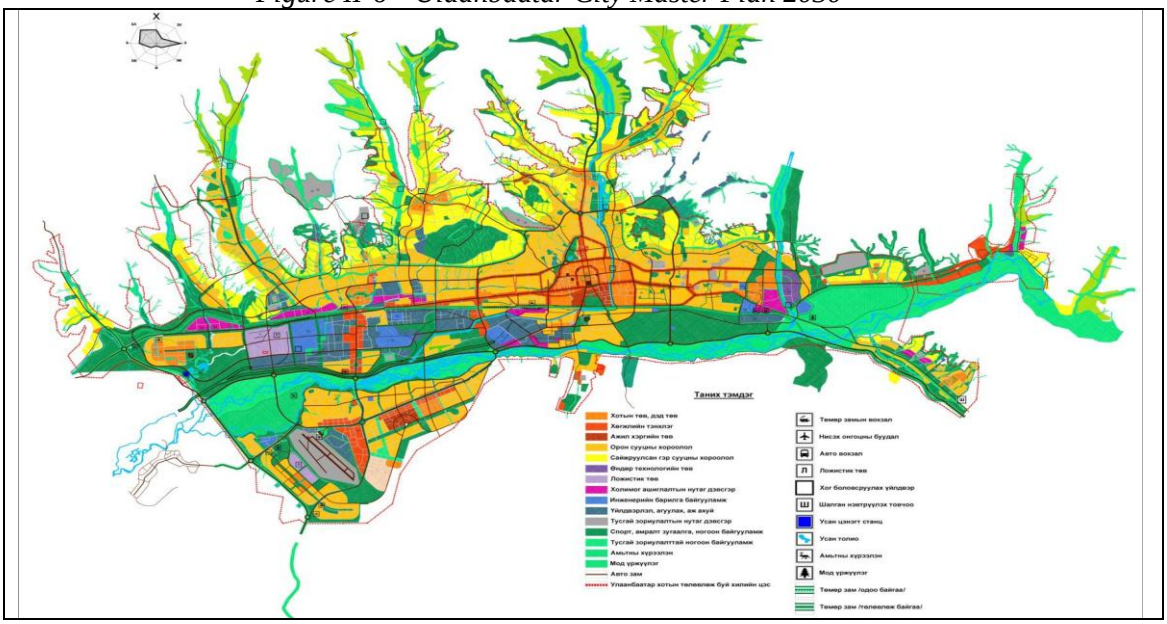
- No solution for concentration of overpopulation
- Absence of laws and regulations related to the urban development
- Limitation of exclusive organization for urban development
- Absence of framework to conduct urban development plan (i.e., improvement of working process, development stage, standards, etc.)
- Lack of necessary investment support

In order to improve city development master plan 2020, Ulaanbaatar city government newly establishes and conducts Ulaanbaatar city development master plan up to 2030 by mayor's approval in August, 2012.

The vision of Ulaanbaatar city development master plan up to 2030 is described as follow:

- Realization of the citizen-based city
- Development of various special zones
- Realization of the eco-friendly green city
- Advanced technology based on knowledge arrangement
- Development of internally competitive enterprises, products, and services.
- World-class city development

Figure II-6 Ulaanbaatar City Master Plan 2030



*Source: Ulaanbaatar City Government, Ulaanbaatar city master plan toward 2030 report, 2012

City development priorities are divided into 6 objectives as follow:

- Sustainable, stable and healthy green city in order to overcome climate change and future natural disasters
- Improvement of convenience for citizen's life environment through exclusive group organization, land planning, apartment zone establishment, etc.
- Implementation of clear and efficient administrative system through citizen-enterprises connected public service realization
- Establishment and amendment of legal framework for urban development
- Satellite town development in order to resolve concentration of overpopulation through the exclusive group organization and active regional development promotion

Realization of becoming an internationally competitive business hub by developing cities equivalent to those of developed countries.

3. ICT Environmental Analysis relate to the Project

3.1 Ulaanbaatar ICT Policies and Strategies

Ulaanbaatar ICT Policies and Strategies are in accordance with the National ICT Policies. The mission of Mongolia ICT policies is to develop a society based on knowledge and intellectual potential and to improve the quality of people's lives. Accordingly, the parliaments adopted the 'Concept on information and Communications Technology Development of Mongolia up to 2010 years' in February 2000.

Before the establishment of the National ICT polices, there were several facing problems on ICT environment in Mongolia as below.

- The lack of information on laws associated with ICT
- Low salaries for ICT experts in government departments
- Absence of laws/registrations for providing stable information
- A lot of duplication data

Thus, E-Mongolia national program was approved by the Government of Mongolia on October 14, 2005 by degree No. 216, developed from the Information and Communications Technology Authority of Mongolia (now ICTPA[14]) to solve these problems.

The vision of e-Mongolia national program is to establish the information society and to found the knowledge-based society in Mongolia by enhancing extensive applications of ICT in all sectors of society. Also, Mongolia aims to be one of the top ten ICT developed countries in Asia by 2020.

3.1.1 E-Mongolia National Program

[14] ICTPA : Information Communication Technology and Post Authority

E-Mongolia National Program, an extensive number of projects, programs and activities, implemented successfully. In October 2005-2009, the ICTPA reviewed accomplishments of "E-Mongolia National Program" and redefined priorities of ICT sector.

There were 18 major objectives in the priorities of e-Mongolia National Program by 2012 as follows.

Table II-9 *Major objectives of e-Mongolia National Program*

No.	Major objectives of e-Mongolia National Program
1	From 3G technology to 4G
2	Development of mobile content
3	Information technology in Postal Services
4	National Radio and Television Multi Channel Broadcasting
5	E-document exchange
6	Digital Archiving
7	Outsourcing
8	*E-government*
9	Unified registration and information system
10	PC for every household, universal Internet access, mobile phone to every herder, post to every household
11	Free and open source software for government and business
12	E-security
13	E-health
14	E-school
15	E-knowledge
16	Robot industry
17	Fiber optical network
18	Silicon valley

*Source: Information, Communication Technology and Post Authority (ICTPA)

Regarding the relations between South Korea and Mongolia since the establishment of e-Mongolia national program and e-GMP[15] in 2005, the government of Korea has been supporting Mongolia by providing a lot of consultation and project execution for Mongolia ICT. The master plan and the feasibility study were done under the support of the NIPA[16], and the follow-up of this project was supported by KOICA[17]. Especially, KOICA in Mongolia office has adopted many business-related e-government projects as a top priority since 2009.

Table II-10 *The support status of South of Korea to e-Mongolia project (2010)*

Sector	Name of Project	Year (complete)	Sponsor	Competent authorities
Consulting	E-Government Master Plan (MP)	2005	NIPA	ICTPA
	NID FS	2005	NIPA	ICTPA

[15] e-GMP : e-Government Master Plan
[16] NIPA : National Industry Promotion Agency
[17] KOICA : Korea International Cooperation Agency

	Customs FS	2006	NIPA	ICTPA
	E-Government Enterprise Architecture	2006	KOICA	ICTPA
	Procurement, Post-office FS	2007	NIPA	ICTPA
	Patent FS	2008	NIPA	ICTPA
	Patented module pilot	2009	NIPA	ICTPA
	Customs Single Window FS	2010	NIPA	ICTPA
	NID module pilot applies	2010	NIPA	ICTPA
	Support broadband master plan	2010	KISDI[18]	ICTPA
	GIS, NID, the immigration system FS	2010	KOICA	ICTPA
Project	Optical backbone networks (some fat)	2000	KEXIM[19]	State-based unit
	National IT park	2004	KOICA	ICTPA
	Mongolia National Data Center	*2009*	*KOICA*	*ICTPA*
	Digital information (e-Archiving)	2009	KOICA	Ministry of Foreign Affairs
	Tariff customs	2010	KOICA / ADB[20]	Customs
	Digital information (e-Archiving)	2010	KOICA	Congress
	Patent	2010	KOICA	Patent office
	Disaster management systems (EIN)	2010	KEXIM	Police
	Intelligent Traffic Control System (ITS)	2010	KEXIM	Police
	E-procurement	2010	KOICA	Treasury

* Source: NIA, Global e-government status report 2011 <Mongolia>

3.1.2 Mongolia National Data Center (MNDC)

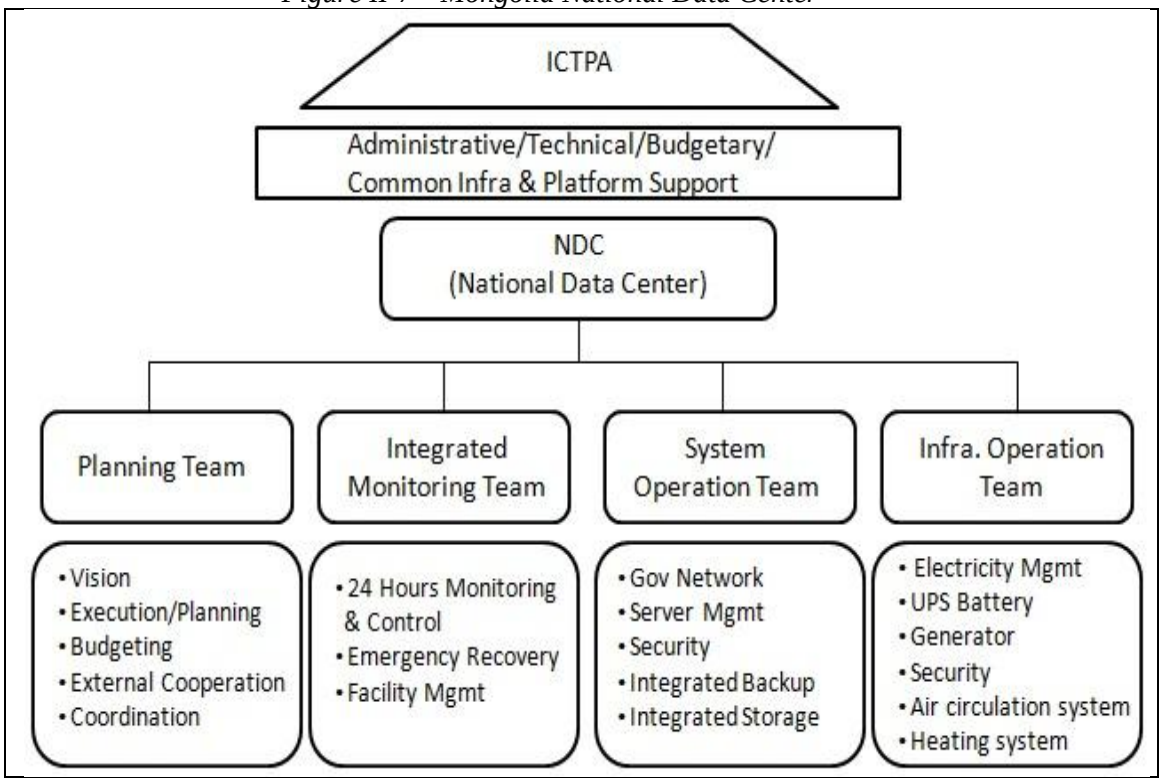
Mongolia National Data Center (MNDC) was established by decree No.183 on June 24, 2009. This project was implemented by ICTPA and Korean International Cooperation Agency (KOICA), as a result of the joint project. The data centre is located in the Songinokhairkhan district in Ulaanbaatar. Construction actually began in 2006. The National Data center is recognized as a collocation of national information database and information security in information technology sector.

The main mission is to provide operative, secure and accessible services for data and information of government organizations of Mongolia.

Mongolia National Data Center (MNDC) implemented several projects related to establishment of infrastructure for special ICT, such as development of document registration and online e-archiving system, supply of online Mongolian language translator and online commerce system, applying for license and monitoring over approval process, upgrade of Mongolian Internet Exchange point (MIX), establishment of infrastructure for interconnecting of government organizations, and supply and installation of digital information security warning information system.

[18] KISDI : Korea Information Society Development Institute
[19] KEXIM : Export Import Bank of Korea
[20] ADB : Asia Development Bank

Figure II-7 Mongolia National Data Center



* Source: NIA, Global e-government status report 2011 <Mongolia>

In order to integrate data resources in National Data Center, there are still facing problems as following.

- It has to move distributed server and hardware equipments from each department to IDC[21].
- There is the absence of law related to data sharing between departments(IT law is still draft)
- Due to the absence of the agreement concerning sharing information between departments, IDC utilization rate is relatively low.
- There are empty racks with few customers.

3.2 Ulaanbaatar ICT Project plan related to the SDI Project

In the case of the Ulaanbaatar ICT project plan, project expenses are funded by international organizations such as World Bank and ADB as below.

Table II-11 *The support status of international organizations to Ulaanbaatar project*

Project Tillie	Year	Sponsor
Ulaanbaatar Clean Air Project	2012	WB[22]
Improving Disaster Risk Management in Mongolia	2011	WB

[21] IDC : Integrated Data Center
[22] WB : World Bank

Community-led Infrastructure Development for the Urban Poor in Ulaanbaatar Phase 2	2011	WB
Solid Waste Management Demonstration Project for the Urban Poor in Ulaanbaatar	2010	WB
MN-Energy Sector Additional Financing	2010	WB
MN-Sustainable Livelihoods II	2007	WB
MN- Renewable Energy for Rural Access - GEF	2006	WB
Renewable Energy for Rural Access Project (REAP)	2006	WB
Information and Communications Infrastructure Development Project	2006	WB
Second Ulaanbaatar Services Improvement Project	2004	WB
Energy Sector Project	2001	WB
Ulaanbaatar Services Improvement Project	1997	WB
Ulaanbaatar Clean Air	Drop	WB
Third Ulaanbaatar Urban Services Improvement Project	2011	ADB
Urban Transport Development Investment Program	2012	ADB
Establishment of Climate-Resilient Rural Livelihoods	2012	ADB
Logistics Capacity Development Project	2012	ADB
Ulaanbaatar Urban Service and GER Areas Development	2011	ADB
Western Regional Road Corridor Investment Program	2011	ADB
Ulaanbaatar City Geo-database system	2010	ADB

* Source: World Bank, ADB project list, project team reconstituted

According to place-based information management for economic growth report 2012, One of Ulaanbaatar ICT Project plans related to the SDI Projects is UB city Geo-database system.

The UB city geo-database system was built in 2010. The lead agency was Information and Technology Division of the Urban Development, Construction and Planning Department (Ulaanbaatar city Government's Implementing Agency), in cooperation with Asian Development Bank. In this system, there are sub databases, consisting of administrative unit boundaries, Government organizations, Environmental, Social, Infrastructure, Works financed by government budget.

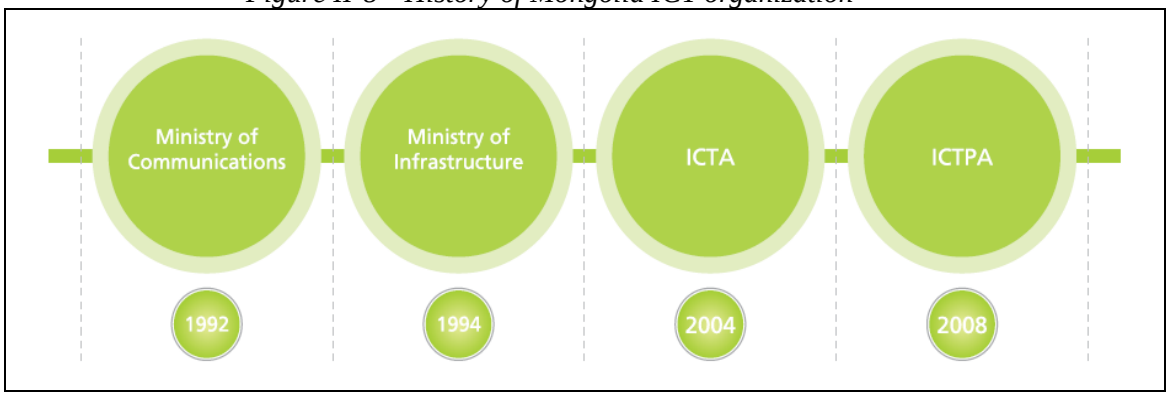
The project aimed to develop a poverty-environment mapping tool and a Web GIS application in the context of Ulaanbaatar city in order to enhance the accessibility of urban infrastructure and service conditions of the city based environmental and social indicators.

The subproject aimed to integrate poverty-environment indicators into city policies for environmental management and urban development, and developed a database based on open source software for the Web GIS application that distributes spatial data to various users through a web browser.

3.3 Ulaanbaatar ICT Organization and Business Process

The contemporary ICT history of the policy level organizations on ICT Mongolia started in 1992, when the Government of Mongolia decided to separate policymaking and operating services. According to this policy, the Ministry of Communications of Mongolia was established in 1992. The following graph represents developmental stages of policy level organizations of Mongolia.

Figure II-8 History of Mongolia ICT organization



* Source: ICTPA, White paper: Information and communications Technology development of Mongolia 2010

Following implementation of decree No. 05 related to e-government on January 19, 2005, Metropolitan department of information technology in UB city was issued by Prime Minister of Mongolia, and was established by Ulaanbaatar major's command on January 26, 2005. Ulaanbaatar city is not only to reinforce the e-Government policies, but also to start the front IT service, such as extending homepages on January 19th in 2005.

Metropolitan department of information technology is responsible for the technical issues related to ICT area. The goal of Metropolitan department of information technology of Ulaanbaatar city in 2011 was to establish the community networks in all Ulaanbaatar area.

Metropolitan department of information technology is divided into 3 divisions; their role is as in the following

- ***Organization division***: Organization division is responsible for international cooperation, Web news updates and advertisement (www.mayor.mn/UB.mn), training ICT, Secretary, Human resources and legality, Software monitoring of internet cafés in UB.

- ***Planning and policy implementation division***: Planning and policy implementation division is responsible for establishment of strategies, implementation related to ICT information, programs implementation, research, Web online programming, Communications and network, Automation, E-information security , and Soft ware planning in Ulaanbaatar.

- ***Operation and service division***: Operation and service division is responsible for phones for public sectors, Computers, hardware repair, Communications, single supervision system, information network, single network, program providers, checking the status of technical issues with companies, and updating information in ICT area.

The front service of Metropolitan department of information technology of Ulaanbaatar city is to provide the useful information through the website. Nowadays, Metropolitan department of information technology is going to regulate and monitor the internet cafés in Ulaanbaatar.

3.4 Ulaanbaatar ICT Infrastructure

Ulaanbaatar ICT infrastructure is in the process of gradually improving over the years under the National ICT policies. In 2000, the new communication cable was constructed by Ulaanbaatar city. The cable for public service was 213km and the cable for private service was 1697km. The total cable length was 1910km, which was connected to almost all Ulaanbaatar area.

In Mongolia, Internet service was introduced in 1994. Currently, twenty companies (almost 90%) in Mongolia operate the business. Up to 60 percent of the companies in Ulaanbaatar have their own web-site. They use the internet speed from 512Kbit/sec to 10Mbit/sec. And, statistically, the number of the household of using the internet service is 95.000.

Table II-12 *ICT status in Ulaanbaatar city*

	2006	2007	2008	2009	2010
Internet use in households	4,837	7,625	14,581	23,889	-
Computer use in households	29,633	40,855	55,447	73,045	-
Landline phone use in households	67,611	66,275	67,774	63,839	65,327
Landline phone	93,043	91,380	95,397	94,885	96,408
ATC Wed	7	22	20	269	309
Public phone	427	426	392	353	340
Mobile phone users	580,308	930,011	1,364,323	1,798,566	2,102,864
Pre-paid mobile phone users	532,397	849,867	1,215,019	1,605,777	1,851,823
Post-paid mobile phone users	47,911	80,144	149,304	192,789	251,041

*Source: metropolitan department of information technology

However, in the case of local area in Mongolia, there is still a lack of the ICT infrastructures. For years, Mongolia government has been trying to minimize the ICT gap between cities and villages through implementing the national ICT infrastructure program. The following is a list of some issues concerning the Ulaanbaatar ICT:

- Expand the national network system to provide citizens with real-time information
- Implement the backup line in national network
- Supply PCs and high-speed internet connections to citizens to make e-Government active

3.5 Implications

Derived implications for ICT environment in Ulaanbaatar are illustrated as in below.

- Ulaanbaatar ICT Policies and Strategies are in accordance with the National ICT Policies, which is to develop a society based on knowledge and intellectual potential and to improve the quality of people's lives in Ulaanbaatar.
- Although various ICT projects are conducted with support by international organizations, SDI related projects are not considered as the first priority due to the gap of ICT infrastructure between cities and villages.

4. Stakeholders Analysis

4.1 Stakeholders Analysis Overview

Stakeholder Analysis is a methodology used to facilitate institutional and policy reform processes by accounting for and often incorporating with the needs of those who have a 'stake' of an interest in the reforms under consideration. With information on stakeholders, their advocates can choose how to best accommodate them, and thus, assuring policies are politically realistic and sustainable.

Although Stakeholder Analysis originated from the business sciences, it has a field that now incorporates with economics, political science, game and decision theory, and environmental sciences. Current models of Stakeholder Analysis are applied to a variety of tools on both qualitative and quantitative data to understand stakeholders, their positions, their influence with other groups, and their interest in a particular reform.

In addition, it provides an idea of the impact of reform on political and social forces, illuminates the divergent viewpoints towards proposed reforms and the potential power struggles among groups and individuals, and helps indentifying potential strategies for negotiating with opposing stakeholders.

According to the World Bank Stakeholder Analysis guideline, Stakeholder analysis is divided into Four-Step Processes which are illustrated as follows:

- Identify Key Stakeholders
- Assess Stakeholder Interests and the Potential Impact of the Project
- Assess Stakeholder Influence and Importance
- Outline a Stakeholder Participation Strategy

Based on this World Bank Guidelines, the project team customizes stakeholder analysis tool focused on the derivation of key stakeholders for Ulaanbaatar SDI system implementation. Thus, stakeholder analysis is divided into 2 categories as to stakeholder classification and assessment phase.

Furthermore, customized stakeholder analysis adds implications phase which will describe detailed way forward to implement SDI system in Ulaanbaatar City by each selected stakeholder group.

Table II-13 *Comparison of Stakeholder Analysis*

Division	Steps
World Bank Stakeholder Analysis	Identify Key Stakeholders
	Assess Stakeholder Interests and Potential Impact of the Project
	Assess Stakeholder Influence and Importance
	Outline a Stakeholder Participation Strategy
Customized Stakeholder Analysis	Classification of Stakeholders
	Stakeholder Assessment through customized evaluation indicators

	Implications

4.2 Classification of Stakeholders

The first step of stakeholder analysis is to classify stakeholder groups through the process of stakeholder identification who are involved in SDI system implementation for Ulaanbaatar City.

According to the process of World Bank Guideline, key stakeholders should be selected by following considerations.

Table II-14 *Considerations for the stakeholder identification by World Bank*

• Who are potential beneficiaries? • Who might be adversely impacted? • Have vulnerable groups been identified? • Have supporters and opponents been identified? • What are the relationships among the stakeholders?

*Sources: World Bank, Stakeholder Analysis Module II

Through the defined considerations mentioned above, stakeholders for Ulaanbaatar city SDI system implementation project are selected as follow:

Table II-15 *Selected stakeholder list*

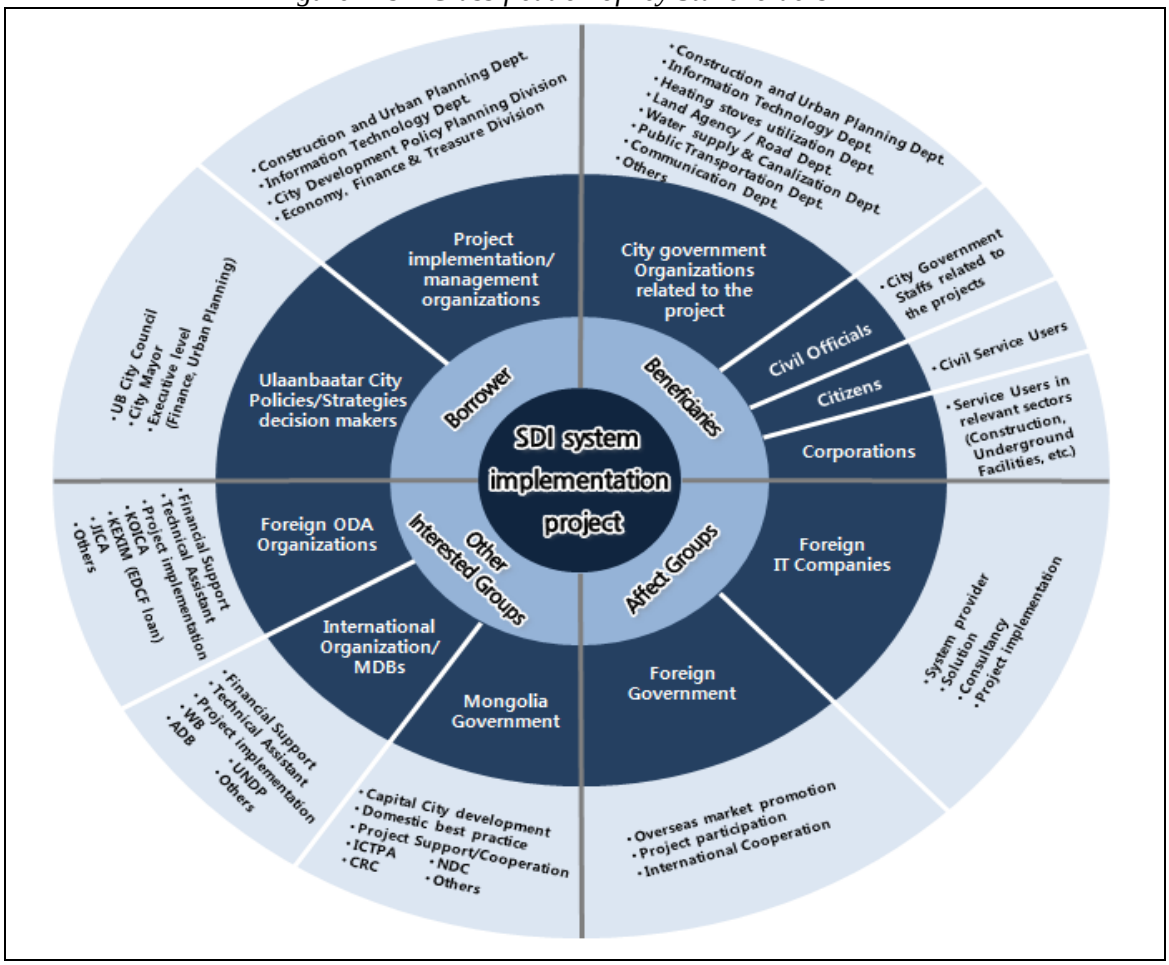
No.	Stakeholders	Detailed Stakeholders
A	Ulaanbaatar City Policies/Strategies Decision Makers	• Ulaanbaatar City Council • Ulaanbaatar City Mayor • Leader Deputy of Government (Economy and City finance) • Deputy Governor (Urban planning & City construction, Infrastructure)
B	Project Implementation/ Management Organizations	• Construction, Urban Development and Planning Department • Information Technology Department • City Development Policy Planning Division • Economy, Finance & Treasure division
C	City Government Organizations related to the project	• Construction, Urban Development and Planning Department • Information Technology Department • Heating Stoves Utilization Department • Land Agency • Property Relations Department • Public Transportation Department • Road Department • Water supply & Canalization Department • Electricity relevant Department/Agency • Communication relevant Department/Agency • Other Underground facilities relevant Department/Agency
D	Civil Officials	• City government officials or Staffs who are using SDI relevant system
E	Citizens	• Public service users
F	Corporations	• Service users in relevant working fields (construction, water supply, transportation, electricity, communications, etc.)

G	Foreign IT Companies	• System provider • Solution • Consultancy • Project implementation
H	Foreign Government	• Project relevant Ministries or Organizations (e-Government/ICT)
I	Mongolia Government	• Information, Communications Technology and Post Authority (ICTPA) • Communication Regulatory Commission (CRC) • National Data Center (NDC) • Other Project relevant Ministries or Organizations (e-Government/ICT)
J	International Organization/ MDBs	• World Bank (WB) • Asian Development Bank (ADB) • United Nations Development Program (UNDP) • Others
K	Foreign ODA Organizations	• KOICA • KEXIM (EDCF loan) • JICA • Others

When key stakeholders are selected, stakeholder groups are classified into 4 different groups which compose a large array of institutions and individuals that could potentially affect or be affected by the proposed intervention for the Ulaanbaatar City SDI system implementation.

Classified stakeholder groups are described in accordance with the level of interests and affects as follow:

Figure II-9 Classification of key Stakeholders



- **(Group 1) Borrower:** Borrowers stand for the subject of project, management and execution related principal organization/institution to conduct Ulaanbaatar City SDI system implementation project.

  - E-Government / ICT projects order initiatives; Ulaanbaatar City Council, mayor or executive level officials who are influential in driving project decisions for the SDI system implementation project.
  - Organization/institution of project planning and support for the project; City Development policy planning division, Economy, Finance & Treasure division
  - Project management and implementation organization/institution; Construction and Urban planning Department, Information Technology Department

- **(Group 2) Beneficiaries:** Beneficiaries stand for organization/institution or individuals who obtain benefits through the Ulaanbaatar City SDI system implementation project

  - SDI system service providing and using major city government organization/institution; Construction and Urban planning Department, Information Technology Department, and other relevant departments or agencies in Ulaanbaatar City government. (In detail, please refer to *Table II-3.)*

- Working environmental beneficiaries; City Government officials and staffs who use SDI relevant system or working tasks.
- Service beneficiaries; citizens, corporations, etc.

- **(Group 3) Affect groups:** Affect groups stand for organizations/institutions or individuals who obtain benefits through activities of project promotion or service provision, etc.

  - Foreign IT companies, which pursue interests through the market development and project implementation.
  - Foreign governments, which pursue national interests through the strategic support and exchange

- **(Group 4) Other interested groups:** Other interested groups stand for cooperation or support organization/institution for the Ulaanbaatar City SDI system implementation project.

  - Cooperation support for funding, labor force and technical assistance; international organization, MDBs and foreign ODA organizations.

4.3 Stakeholders Assessment

Stakeholder assessment is reflected by the result of environmental and documentary survey, the opinion of local companies and relevant agencies' staff, interview result from city government departments and agencies related to the implementation of SDI system in Ulaanbaatar to assess the key stakeholders.

Stakeholder assessment is composed of two stages; Assessment of each stakeholder based on the analysis basis utilized by World Bank and customized Stakeholder evaluation for the SDI system implementation project.

In order to derive key stakeholders through these stages, utilized assessment resources and materials are described as follow:

Table II-16 *Assessment resources and materials for stakeholder analysis*

<table>
<tr><th>Stage</th><th colspan="2">Evaluation basis</th><th>Resources and materials</th></tr>
<tr><td rowspan="2">First Stage (World Bank Basis)</td><td colspan="2">Interest & Potential Impact</td><td rowspan="8">• Pre-documentary survey (reports, web site, etc)
• Interview result in each department/agency
• Corporations/city government staff's opinion
• Collected documents in UB (survey sheet, report, statistics, city policy, etc.)</td></tr>
<tr><td colspan="2">Influence & Importance</td></tr>
<tr><td rowspan="6">Second Stage (Customized basis)</td><td rowspan="3">Possibility of project realization</td><td>Promotion influence</td></tr>
<tr><td>Project readiness</td></tr>
<tr><td>Awareness of the project</td></tr>
<tr><td rowspan="3">Intent of project promotion</td><td>Political intent</td></tr>
<tr><td>Activeness of cooperation request</td></tr>
<tr><td>Funding/budget Retention</td></tr>
</table>

4.3.1 First Stage: Stakeholder Assessment based on the World Bank basis

The first Stage of stakeholder assessment aims to define each stakeholder's interest, impact, importance and influence for Ulaanbaatar SDI system implementation project through utilization

of verified analysis basis.

For the assessment of each stakeholder, evaluation basis are divided into two categories; Interests & Potential Impact and Influence & Importance which based on the World Bank stakeholder analysis basis.

Table II-17 *Evaluation basis for the first stage of Stakeholder assessment*

Evaluation basis	Detailed basis
Interests & Potential Impact	• What is the stakeholder's expectation of the project? • What benefits are there likely to be for the stakeholders? • What resources might the stakeholder be able and willing to mobilize? • What stakeholder interests conflict with project goals?
Influence & Importance	• Power and status (political, social, and economic) • Degree of organization • Control of strategic resources • Informal influence (e.g. personal connections) • Power relations with other stakeholders • Importance to the success of the project

*Sources: World Bank, Stakeholder Analysis Module II

As a preparation step of the first stakeholder assessment, stakeholder's roles and interests based on the classified stakeholders are defined through the consideration of evaluation basis as mentioned above.

Table II-18 *Stakeholders' Roles and Interests*

Groups	No.	Stakeholders	Roles	Interests
Borrowers	A	Ulaanbaatar City Policies/ Strategies decision makers	• Key decision making subjects for the e-Government relevant projects and SDI system implementation project that instruct project strategies, planning and execution • Budgetary and legal issues decision makers for the city development and operation	• Development of Social economy and sustainable city development • ICT sector development for the conversion of Information society for the City • Urban development through the introduction of advanced ICT technologies
	B	Project implementation/management Organizations	• Establishment of Urban planning and e-Government / ICT relevant project plan for city government • Suggestion of project execution to SDI system implementation project related agencies or departments • SDI system implementation project management and implementation	• Provision of Spatial data relevant services for city government, citizens and corporations • Enhancement of work efficiency and business process by the introduction of advanced technologies • Improvement of existing spatial data and GIS based information in order to have sufficient IT system for Urban development planning
Beneficiaries	C	City Government Organizations related to the project	• The subject of Spatial data service provision and utilization • System utilization subjects to improve business process and working tasks	• Introduction of advanced technologies and system • Improvement of work efficiency and data accuracy

	D	Civil Officials	• The subject of SDI system operation, management and utilization	• Improvement of work efficiency • Reduction of working time and business process
	E	Citizens	• The subject of Spatial Data service utilization	• Application of real-time information
	F	Corporations	• The subject of Spatial Data service utilization	• Business ease improvement • Application of real-time information
Affected groups	G	Foreign IT Companies	• The execution and implementation subject of SDI system implementation project • Projects are normally carried out through the relationship with the city government department such as Construction and Urban planning Department, Information Technology Department, etc.	• Making profits through the project order obtainment • Pioneering new overseas markets
	H	Foreign Government	• Supporting domestic IT companies through the consultation between countries • Strategic exchange and cooperation to pursuit beneficial rights; resource development, etc.	• Supporting to pioneer new overseas markets for domestic companies • Securing national concessions through the exchange and cooperation
Other Interested groups	I	Mongolia Government	• Financial Support for the implementation of SDI system as development of the capital city of Mongolia • The exertion of influence through e-Government relevant projects support and cooperation	• Applicable case obtainment for urban development through the support of city government project • National development policies and strategies direction establishment • Sustainable economic and social development in the nation
	J	International Organization/ MDBs	• Supporting national / city development strategies • Setting the project direction through the strategy establishment of SDI system implementation project • Promotion vitalization for relevant projects through the participation inducement of fund, expertise, foreign governments and IT companies • The exertion of influence through e-Government relevant projects support and cooperation	• International economic development and support • Resolving social gap • ICT industry development
	K	Foreign ODA Organizations	• Financing for the implementation of SDI	• Pioneering new overseas markets

			system • Promotion vitalization for the e-Government project through the participation inducement of funds, expertise, foreign governments and IT companies • The exertion of influence through the e-Government relevant project support and cooperation	• Resolving information gap • Enhancing the national prestige through the foreign exchange • Exporting support for the national IT companies

When stakeholder's roles and interests are identified, each stakeholder's importance and influence degree are evaluated through the qualitative stakeholder assessment based on World Bank's evaluation basis

Importance and influence level of each stakeholder is divided into 6 different levels considered by each stakeholder's interests at stake in relation to SDI implementation project through the evaluation of each stakeholder's effects.

Table II-19 *Stakeholder assessment based on World Bank evaluation basis*

Stakeholders		Interest(s) at Stake in Relation to Project	Effect of Project on Interest(s) + 0 -	Importance of Stakeholder for Success of Project U = Unknown 1= Little/No Importance 2= Some Importance 3= Moderate Importance 4= Very Importance 5= Critical Player	Degree of Influence of Stakeholder over Project U = Unknown 1= Little/No Influence 2= Some Influence 3= Moderate Influence 4= Significant Influence 5= Very Influence
A	Ulaanbaatar City Policies/Strategies decision makers	Social economy and sustainable city development	0	(4) Very Importance: Making policies and strategies in order to archive sustainable city development	(5) Very Influence: Project should be conducted under the provision of city policies and strategies
		ICT sector development	+		
		Urban development through the introduction of advanced ICT technologies	+		
B	Project implementation/ management Organizations	Provision of Spatial data relevant services	+	(5) Critical Player: As an execution group of the project, all relevant tasks are to be conducted under the city policy and plan	(5) Very Influence: As the project execution group, project's success depends on their intent
		Enhancement of work efficiency and business process	+		
		Improvement of existing spatial data and GIS based information system	+		
C	City Government Organizations related to the project	Introduction of advanced technologies and system	+	(4) Very Importance: Understanding of current status of relevant system, work process, etc.	(4) Significant Influence : Enhancement of work efficiency and time saving, etc.
		Improvement of work efficiency and data accuracy	+		
D	Civil Officials	Improvement of work efficiency	+	(4) Very Importance: Understanding of current status of relevant system, work process, etc.	(3) Moderates Influence : To achieve work efficiency and resolving working
		Reduction of working time and	+		

		business process			time through the introduction of the relevant system
E	Citizens	Application of real-time information services	+	(1) Little/No Importance: Depends on the project scope	(1) Little/No Influence: Depends on the project scope
F	Corporations	Business ease improvement	?	(2) Some Importance: Consideration of relevant service user (Construction, underground facilities, etc.)	(1) Little/No Influence: Depends on the project scope
		Application of real-time information services	+		
G	Foreign IT Companies	Making profits through the project order obtainment	+	(3) Moderate Importance: Understanding level of Project implementation, technology skills, etc	(2) Some Influence: System Implementation, service provision
		Pioneering new overseas markets	+		
H	Foreign Government	Supporting to pioneer new overseas markets for domestic companies	+	(2) Some Importance: Depends on the cooperation level with Ulaanbaatar city Government	(3) Moderate Influence: Knowledge exchange, International cooperation and Technical Assistance
		Securing national concessions through the exchange and cooperation	+		
I	Mongolia Government	Applicable case obtainment for urban development	?	(3) Moderate Importance: All national policies and strategies involve with city government's policies and strategies	(5) Very Influence: Financial, Legal and political project supports
		National development policies and strategies direction establishment	?		
		Sustainable economic and social development	+		
J	International Organizations/ Multilateral Development Banks (MDBs)	International economic development and support	+	(3) Moderate Importance: Cooperation opportunity and Financial/Technical support	(4) Significant Influence: International cooperation, Financial support and Technical Assistance
		Resolving social gap	0		
		ICT industry development	+		
K	Foreign ODA Organizations	Pioneering new overseas markets	+	(2) Some Importance: Secure funding sources, technical support	(4) Significant Influence: International cooperation, Financial support and Technical Assistance
		Resolving information gap	0		
		Enhancing the national prestige through the foreign exchange	+		
		Exporting support for the national IT companies	?		

Based on the analysis of each stakeholder's influence and importance, each stakeholder is disposed on their position as follows:

Table II-20 *Mapping stakeholders' Relative Influence and Importance*

Influence of	Importance of Activity to Stakeholder

Stakeholder	Unknown	Little/No Importance	Some Importance	Moderate Importance	Very Importance	Critical Player
Unknown						
Little/No Influence		Citizens	Corporations			
Some Influence				Foreign IT Companies		
Moderate Influence			Foreign Government		Civil Officials	
Significant Influence			Foreign ODA Organizations	International Organizations/ MDBs	City Government Organizations related to the Project	
Very Influence				Mongolia Government	Ulaanbaatar City Policies/ Strategies decision makers	Project implementation/ management Organizations

4.3.2 Second Stage: Stakeholder assessment based on the customized basis

When the first stage is completed, the second evaluation of stakeholder is considered in two assessment basis; possibility of project promotion and intent of project promotion in order for the implementation of SDI system to derive key stakeholders in Ulaanbaatar city government.

According to the result of the first assessment, the second assessment is to be remarked as 3 levels (High, Medium, and Low) following calculated score based on customized evaluation basis with weighting rates as follow:

Table II-21 *Evaluation basis for the second stage of Stakeholder assessment*

Evaluation basis	Criteria	Weighting	Detailed basis
Possibility of project realization	Promotion Influence	50	• Degree of organization • Level of power relations with other stakeholders
	Project readiness	25	• Technical understanding level • Consideration level of informal influence
	Awareness of the project	25	• Awareness level of project importance • Awareness level of project necessity
Intent of project promotion	Political intent	50	• Level of promotion intent • Consideration level of political issue
	Activeness of cooperation request	25	• Level of resource mobilization for the project • Level of MOU or feasibility study promotion intent
	Funding/budget Retention	25	• Authority of economic situation (Budget, Funding) • Access possibility for funding channels (International Organizations, MDBs, Foreign ODA, etc.)

In case of evaluation basis of the second stakeholder assessment, two main evaluation bases have 3 criteria in each. The score is calculated by 5 level measures (very low – 1, low – 2, medium -3,

high – 4, very high -5) giving weight to each criterion.

The first evaluation basis, Possibility of project realization, is divided into 3 criteria: promotion influence, project readiness and awareness of the project. Among the criteria, promotion influence is given weight 50 due to the importance of project realization. Other 2 criteria, project readiness and awareness of the project are weight 25 in each.

Table II-22 *Evaluation for Possibility of project realization*

Stakeholders		Possibility of project realization						Total (100)	
		Promotion influence (50)		Project readiness (25)		Awareness of the project (25)			
		level	score	level	score	level	score	level	score
Ulaanbaatar City Policies/Strategies decision makers	A	5	50	3	15	4	20	4.25	85
Project implementation/ management Organizations	B	4	40	5	25	5	25	4.5	90
City Government Organizations related to the project	C	3	30	5	25	4	20	3.75	75
Civil Officials	D	2	20	3	15	5	25	3	60
Citizens	E	1	10	1	5	1	5	1	20
Corporations	F	1	10	2	10	4	20	2	40
Foreign IT Companies	G	2	20	4	20	3	15	2.75	55
Foreign Government	H	3	30	3	15	4	20	3.25	65
Mongolia Government	I	5	50	2	10	4	20	4	80
International Organizations/ Multilateral Development Banks (MDBs)	J	4	40	3	15	3	15	3.5	70
Foreign ODA Organizations	K	3	30	3	15	3	15	3	60

The Second evaluation basis, Intent of project promotion is also divided into 3 criteria: political intent, activeness of cooperation request and funding/budget retention. Among the criteria, political intent is given weight 50 due to the importance of intent to conduct project. Other 2 criteria, activeness of cooperation and funding/budget retention are given weight 25 in each.

Table II-23 *Evaluation for Intent of Project promotion*

Stakeholders		Intent of project promotion						Total (100)	
		Political intent (50)		Activeness of cooperation request (25)		Funding/budget retention (25)			
		level	score	level	Score	level	score	level	score
Ulaanbaatar City Policies/Strategies decision makers	A	4	40	4	20	5	25	4.25	85

Project implementation/ management Organizations	B	5	50	5	25	4	20	4.75	95
City Government Organizations related to the project	C	3	30	3	15	2	10	2.75	55
Civil Officials	D	3	30	2	10	2	10	2.5	50
Citizens	E	1	10	1	5	1	5	1	20
Corporations	F	2	20	1	5	2	10	1.75	35
Foreign IT Companies	G	4	40	2	10	3	15	3.25	65
Foreign Government	H	3	30	4	20	3	15	3.25	65
Mongolia Government	I	2	20	1	5	4	20	2.25	45
International Organizations/ Multilateral Development Banks (MDBs)	J	3	30	2	10	5	25	3.25	65
Foreign ODA Organizations	K	2	20	3	15	4	20	2.75	55

According to the result of first and second evaluation basis, overall result of the second stakeholder assessment based on the derived scores are described as follow:

Table II-24 *Result of the second stakeholder assessment*

(Unit: High ●, Medium ◐, Low ◯)

Stakeholders		The second stakeholder assessment				Total (100 avr.)	Remark
		Possibility of Project realization		Intent of Project promotion			
		Score (100)	Remark	Score (100)	Remark		
Ulaanbaatar City Policies/Strategies decision makers	A	85	●	85	●	85	●
Project implementation/ management Organizations	B	90	●	95	●	92.5	●
City Government Organizations related to the project	C	75	●	55	◐	65	◐
Civil Officials	D	60	◐	50	◐	55	◐
Citizens	E	20	◯	20	◯	20	◯
Corporations	F	40	◯	35	◯	37.5	◯
Foreign IT Companies	G	55	◐	65	◐	60	◐
Foreign Government	H	65	◐	65	◐	65	◐
Mongolia Government	I	80	●	45	◐	62.5	◐
International Organizations/ Multilateral	J	70	◐	65	◐	67.5	◐

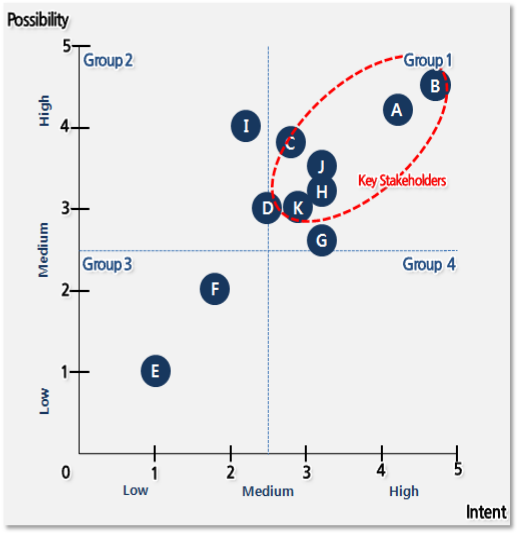
Development Banks (MDBs)							
Foreign ODA Organizations	K	60	◐	55	◐	57.5	◐

Based on the assessment result, each stakeholder is classified into 4 groups utilized by possibility and intent index which refers to *figure II-10*. Classified 4 groups are described as follows:

Figure II-10 Identification of key stakeholders

(Unit: High ●, Medium ◐, Low ○)

Stakeholders		The second stakeholder assessment				Total (100 avr.)	Remark
		Possibility of Project realization		Intent of Project promotion			
		Score (100)	Remark	Score (100)	Remark		
Ulaanbaatar City Policies/Strategies decision makers	A	85	●	85	●	85	●
Project implementation/ management Organizations	B	90	●	95	●	92.5	●
City Government Organizations related to the project	C	75	●	55	◐	65	◐
Civil Officials	D	60	◐	50	◐	55	◐
Citizens	E	20	○	20	○	20	○
Corporations	F	40	○	35	○	37.5	○
Foreign IT Companies	G	55	◐	65	◐	60	◐
Foreign Government	H	65	◐	65	◐	65	◐
Mongolia Government	I	80	●	45	◐	62.5	◐
International Organizations/ Multilateral Development Banks (MDBs)	J	70	◐	65	◐	67.5	◐
Foreign ODA Organizations	K	60	◐	55	◐	57.5	◐



- ***Group 1***: Strategically important stakeholders. Group 1 has not only high decision making authority but also high influence and expectation level featured as a decision maker or powerful implementation department or agency

- ***Group 2***: Potential key stakeholders. Group 2 has high possibility and authorities. However, intent level is relatively low. This group will be featured as a key decision maker or powerful competitor and collaborator if SDI system project is visualized

- ***Group 3***: Group 3 has both low possibility and intent with restricted interest.

- ***Group 4***: Group 4 has low possibility. But, intent level is high. This group is going to need important partnership in the implementation stage of project due to high understanding level of the project

4.4 Implications

According to the first and second stakeholder assessment, derived key stakeholders are identified in each assessment result

- First stakeholder assessment: Key stakeholders are selected who are positioned between moderate importance/influence and Critical Player/very influence in accordance with stakeholder mapping which refers to *Table II-18.*

- Second stakeholder assessment: Key stakeholders are selected according to the classified assessment Group 1which refers to *Figure II-9.*

Table II-25 *Identification Result from the first and second assessment*

The 1st Stakeholder assessment	• Project implementation/management organizations • Ulaanbaatar City policies/strategies decision makers • City government organizations related to the project • Civil Officials • Mongolia Government • International organizations/MDBs
The 2nd Stakeholder assessment	• Project implementation/management organizations • Ulaanbaatar City policies/strategies decision makers • International organizations/MDBs • Foreign government • City government organizations related to the project • Foreign ODA[23] organizations

Based on the result from the first and second stakeholder assessment, common key stakeholders are derived as follow:

Table II-26 *Common key stakeholders resulting from the first and second stakeholder assessment*

• Project implementation/management organizations • Ulaanbaatar City policies/strategies decision makers • City government organizations related to the project • International organizations/MDBs

Resulting from the stakeholder assessment, SDI system implementation project is necessary to take key stakeholders who have high influence and importance with high possibility of project realization and promotion intent into consideration for project implementation/management organizations, decision makers, system application department/agency and international organizations/MDBs.

- Based on the point of stakeholder assessment, consideration of project realization and promotion intent with high awareness of importance and influence are required in order for SDI system to conduct successful project implementation supported by appropriate organizations/agencies in Ulaanbaatar city government.

- SDI system implementation project should be promoted through the cooperation support with international organizations/MDBs like World Bank and ADB to secure promotion and execution budget for advanced SDI system introduction and operation.

5. Constraints and Addressing Issues

5.1 Constraints

- Limitation of city development construction period due to the climatic, geographical features
  - Ulaanbaatar is located in a basin surrounded by high mountains and has comparatively cold climate during the winter. It makes period limitation for the city development construction.
  - In order to progress efficient city development, specific city development guideline is required.

[23] ODA : Official Development Assistance

- Regional gap of ICT and social infrastructure due to the concentration of overpopulation in some district/area of Ulaanbaatar
  - Over the 90% of Ulaanbaatar population live in specific district/area due to the high urbanization gap between specific city center and rural area.
  - It is necessary to make social, ICT infrastructure base for rural districts/areas through the establishment of urban development plan for rural districts/areas.

5.2 Addressing Issues

- Balanced urban development for the population dispersion in Ulaanbaatar
  - The city puts efforts on successful urban development to disperse city population from city center through restructured city development master plan by mayor's approval
  - In order to achieve successful urban development, spatial data management is one of the priorities to make better urban planning and management.

- Financing and investment promotion for Urban development
  - For the successful urban development, financing support and investment promotion is required, such as financing support by Multilateral Development Banks and International organizations, and foreign investment promotion.

III. Technical Analysis (TA)

1. Overview

Technical Analysis (TA) consists of 4 parts in order for Ulaanbaatar city's SDI system to understand current ICT status and requirement for each city departments through results of interviews and survey during the insight survey.

Detailed information in each part described as follow:

- Requirement Analysis
  - Derivation of addressing issues and requirements for each department related to the SDI system implementation.

- Current ICT Status Analysis
  - Understanding of current SDI system components in Ulaanbaatar city
  - H/W, S/W, N/W environmental Analysis
  - Business process analysis for SDI relevant system
  - Organization analysis related to the SDI system

- SWOT Analysis
  - Analysis of internal and external factors for SDI system implementation in Ulaanbaatar city through the verified SWOT methodology

- Constraints and Addressing Issues
  - Derivation of facing issues and implications in order for the SDI system implementation to resolve current obstacles and problems

2. Requirement Analysis

Based on the interview result and survey sheet obtained from insight survey, requirements in each department related to the SDI system implementation project are derived as follow:

Table III-1 *Issues and Requirements in each department (to be updated)*

Department	Issues and Requirements
Construction, Urban Development and Planning Department (CUDPD)	• Lots of spatial and non-spatial data are distributed over a number of organizations and sections • no joint regulations on geospatial information fund creation, processing, and usage or cooperation of organizations on this issue • As knowledge and usage of metadata has not been introduced yet, every organization has a certain data; however, they have not had information on time, subject, and details of establishment of the data. • Data format, system, details, and classification are different. Thereby, it limits information exchange between organizations
Water supply and sewerage Authority	• Overlapped underground facility data location • Lack of knowledge for existing SDI system (ArcGIS)
Ulaanbaatar Electricity Distribution network company	• There are no information of accurate electricity spatial data • Implementation cost for electricity spatial data is now facing problem • Lack of awareness of spatial data standards
Ulaanbaatar District Heating Company	• No sharing information due to the money problem (CUDPD request?) • Government has a strong cost policy, many types of tariffs, heating and

	electricity production costs, which are higher than apartment user fee • Underground engineering department does not share information • Transferring pipe capacity becomes insufficient • Users bundles are not fully automated
Facility management department "Batbayan burd government owned industrial department" (public/private)	• Currently, 21 departments are public owned department which covered 40 districts (khoroos) in Ulaanbaatar and other districts are managed by private branch. • In the case of public department, each department is in charge of minimum 2 districts and maximum 6 to 7 districts for small scale facility installation and management. • Most officials have more than 8 years experience to conduct their work; however, most work is progressed manually. • As the future planning, SDI system is recognized as one of the important issues for new employees

*Sources: Interview / Questionnaire

3. Current ICT Status Analysis

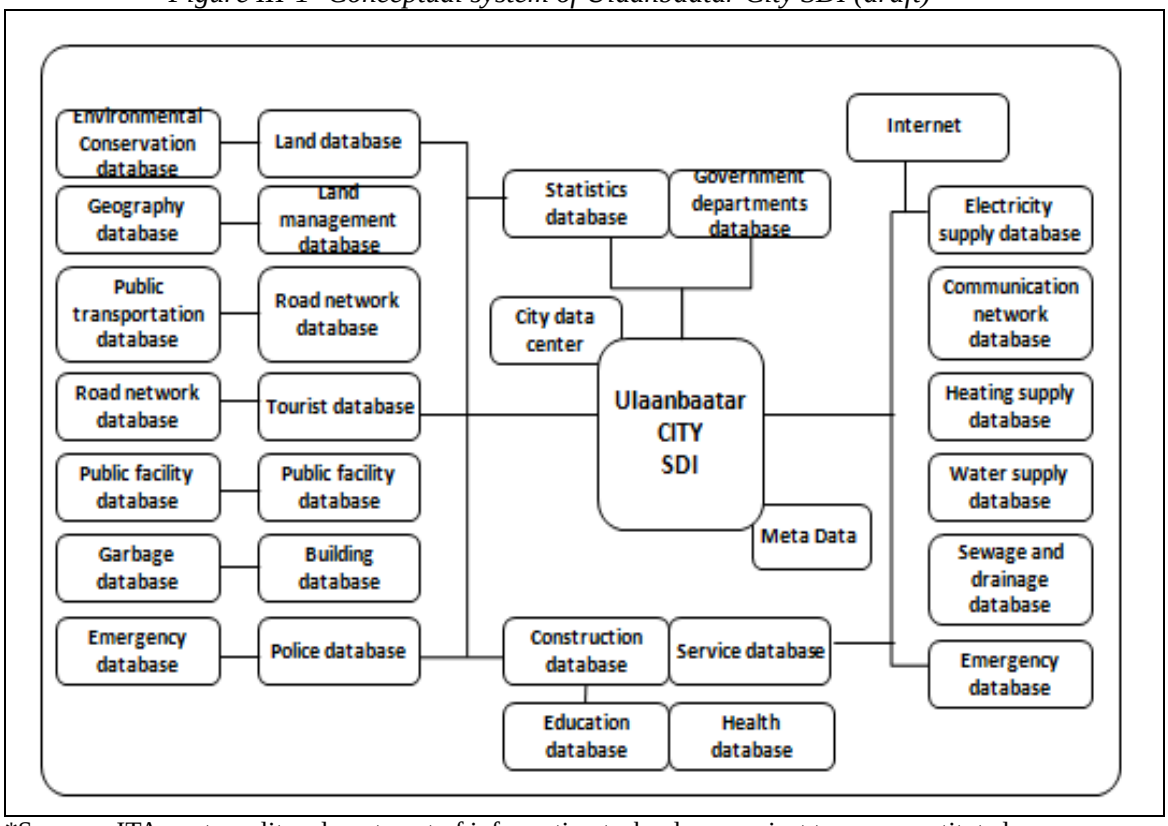
3.1 System Configuration

Spatial data center implementation project, now on progress by Ulaanbaatar city government, is planned to complete in 2012. However, underground utilities data-water supply, sewage, electric supply, gas pipelines, etc are shown as insufficient in our pre-survey.

A spatial data infrastructure (SDI) is a data infrastructure implementing framework of geographic data, metadata, users and tools that are interactively connected in order to use spatial data in an efficient and flexible way.

To optimize and to rationalize the use of data, national and regional users, public as well as private, will demand nationwide homogeneous and updated data sets. In a few years spatial data will be integrated in all kinds of information systems.

Figure III-1 Conceptual system of Ulaanbaatar City SDI (draft)



*Sources: ITA, metropolitan department of information technology, project team reconstituted

The expected effectiveness of Spatial Data Infrastructure (SDI) implementation project is defined as in below.

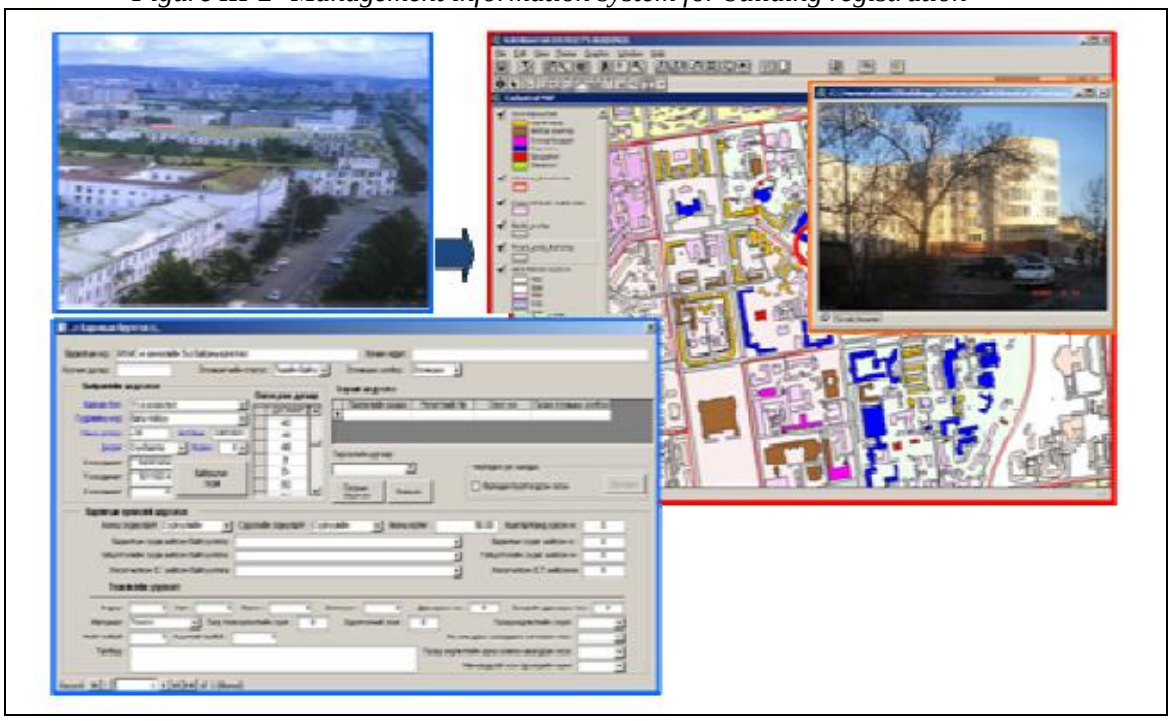
- To simplify business process between the departments
- To reduce the redundant information & repetitious work done by different departments
- To share necessary information between the departments
- To improve the information storage and stability

- To cut the cost of paying a database system management

According to the result of interview from CUDPD, Ulaanbaatar city has several IT systems related to the GIS based system including management information system for building registration which was introduced in 2006.

As one of the divisions of the department, the information technology division has established Ulaanbaatar basic digital maps, thematic maps and data sources of underneath construction engineering line. A management information system of building registry has also been established which includes several location and registration information of state and private buildings and related attributes.

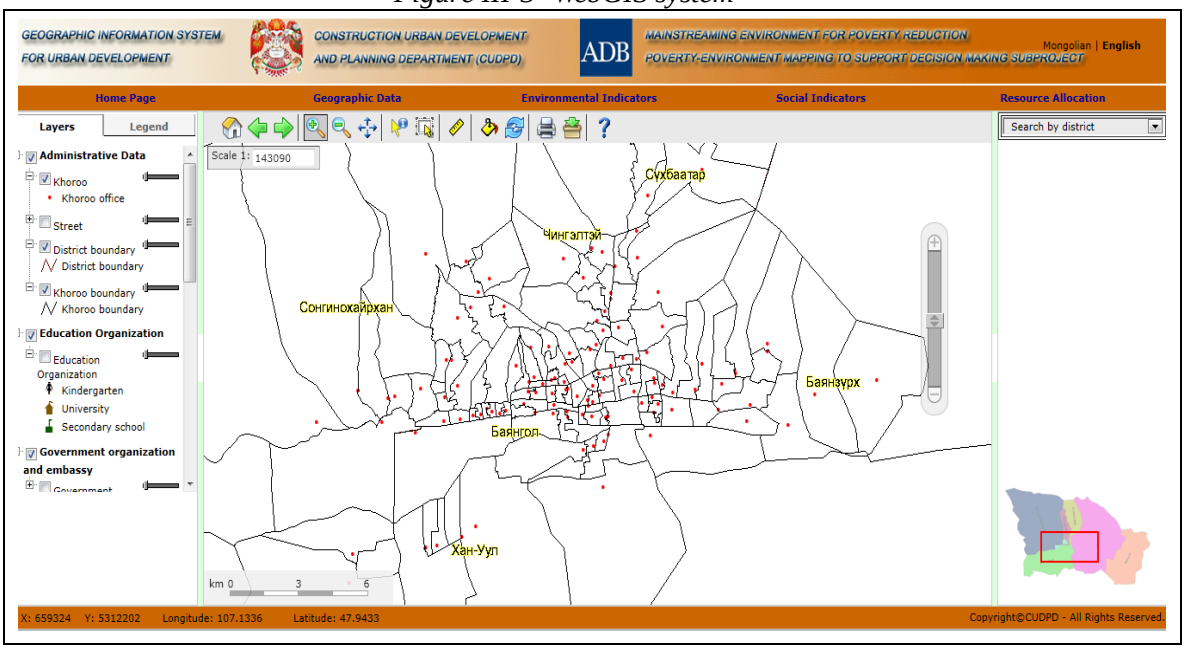
Figure III-2 Management information system for building registration



*Source: Construction, Urban Development and Planning Department (CUDPD)

In addition, information technology division of the CUDPD also has established WebGIS system in collaboration with Asian Development Bank (ADB), which contains urban development, socio-economic and environment information of the city of Ulaanbaatar.

Figure III-3 WebGIS system



*Source: WebGIS system website (http://ubgeodata.mn/geocity/)

WebGIS system is divided into 4 parts, which are Geographic Data, Environmental Indicators, Social Indicators, and Resource Allocation. Detailed data layers in each part are illustrated as follow:

Table III-2 *WebGIS data layer in Geographic data*

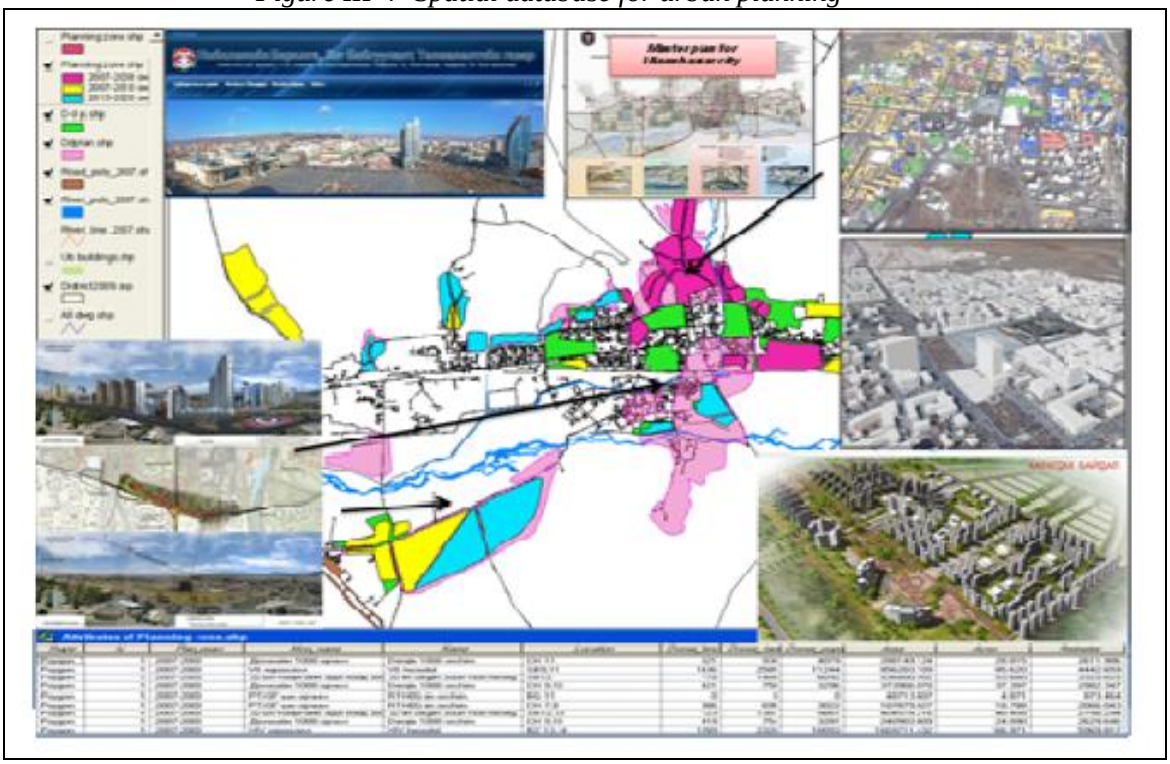
Part	Data layer		
Geographic Data	Administrative data	Khoroo	Khoroo office
		Street	Street
		District boundary	District boundary
		Khoroo boundary	Khoroo boundary
	Education organization	Education organization	Kindergarten
			University
			Secondary school
	Government organization and embassy	Government organization	Government office
			Embassy
	Health organization	Health organization	Hospital
			Family hospital
			Private hospital
	Commercial organization	Service organization	Bank
			Store
			Restaurant
			Hotel
			Auto service

		Industrial	Industrial
	Culture and arts data	Culture organization	Culture organization
			Culture palace
			Culture centre
			Museum
			Library
			Cinema
		Statue	Statue
	Parcel and building data	Building	Building
	Road information	Public transportation	Minibus station
			Bus station
		Bridge	Bridge
		Bus route	Bus route
		Road	Auto road
	Contour	Contour	Contour, Relief
	Aerial photographs	Aerial photographs	-

* Note: detailed all data layers for WebGIS system by part is refer to <Appendix 1>

CUDPD has several spatial databases such as urban planning, education, health and infrastructure which maintain urban planning and housing information either on paper map or spatial databases.

Figure III-4 Spatial database for urban planning



*Source: Construction and Urban Development Planning Department (CUDPD)

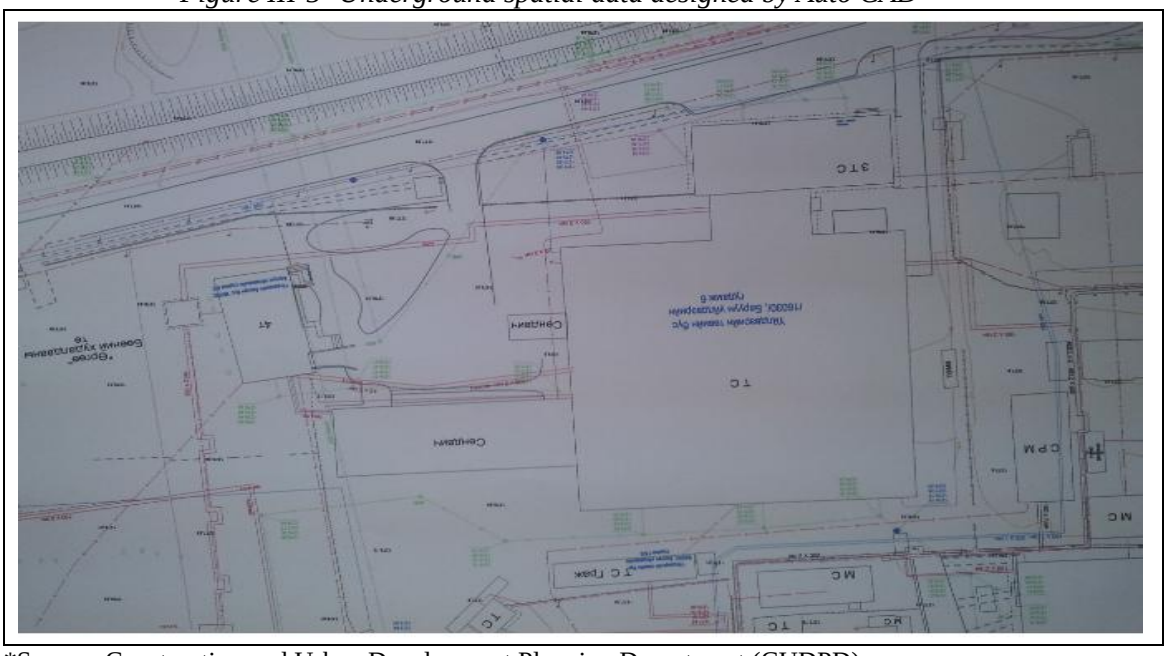
At present, some of the city government agencies such as administration office, meteorology agency and road department are currently using GIS tools for their operation separately. Even though CUDPD attempts to update the data and information in collaboration with other relevant agencies continuously, data sharing and system integration have many challenges due to the facing problems as follow:

- No joint regulation on geospatial information fund creation, processing, usage, etc.
- Lack of knowledge and usage of metadata
- Absence of united standard and coding system

In the case of the spatial data for underground facilities, CUDPD managed all relevant spatial data in collaboration with relevant agencies and companies who are in charge of underground facility supply such as water supply, sewerage pipeline, electricity distribution, heating distribution, telecommunication cable, and other facilities as the exclusive department in Ulaanbaatar.

All underground facilities related to spatial information are created or modified through Auto CAD based data by CUDPD under the data confirmation with relevant agencies and public owned companies.

Figure III-5 Underground spatial data designed by Auto CAD



*Source: Construction and Urban Development Planning Department (CUDPD)

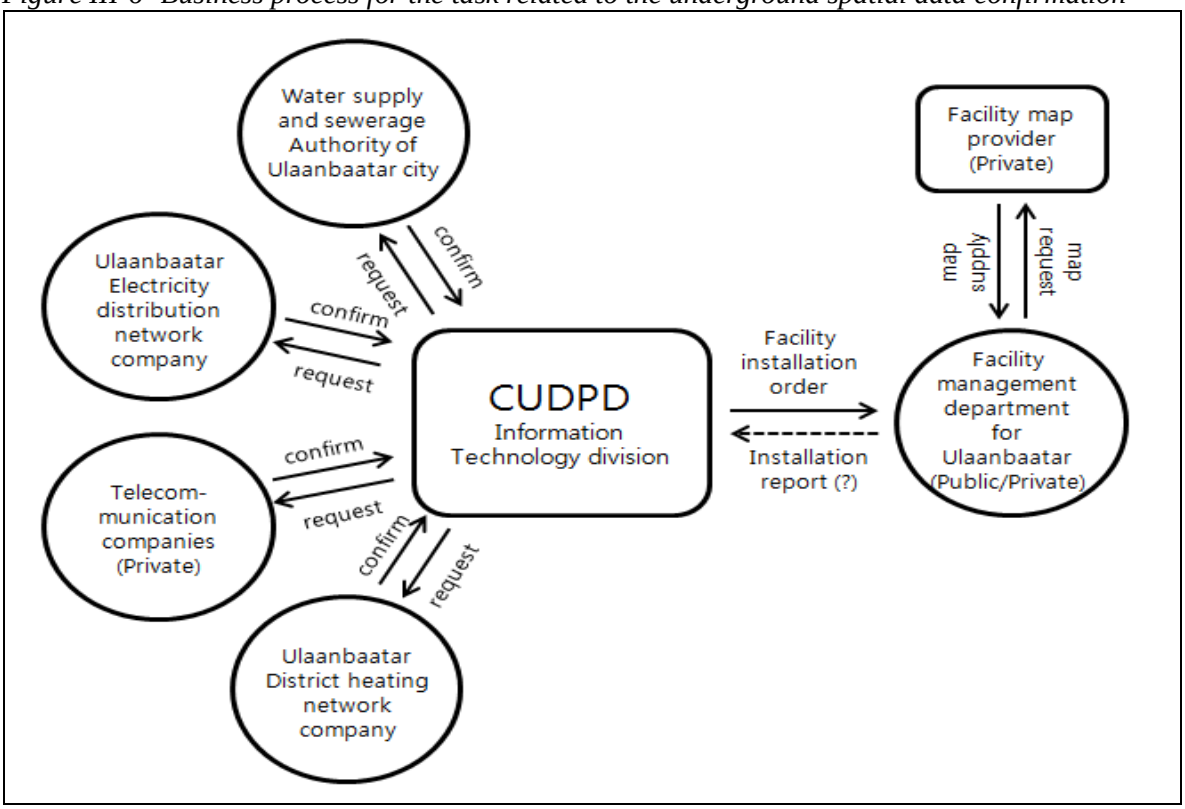
3.2 Business Process

Construction, Urban Development and Planning Department (CUDPD) is in charge of all spatial data management and maintenance work for urban development planning in Ulaanbaatar.

Tasks related to underground spatial data and information is managed by CUDPD, information technology division. However, underground facility management and operation tasks are processed separately by each relevant agency or public owned companies due to the absence of information sharing law.

Therefore, in order to confirm the specific information of underground spatial data such as water supply and sewerage pipeline, electricity distribution cable, heating distribution pipeline, telecommunication network maps, etc., information technology division of CUDPD requests data confirmation to each relevant agency and public owned company officially under the information agreement between CUDPD and each relevant agency or public owned company.

Figure III-6 Business process for the task related to the underground spatial data confirmation



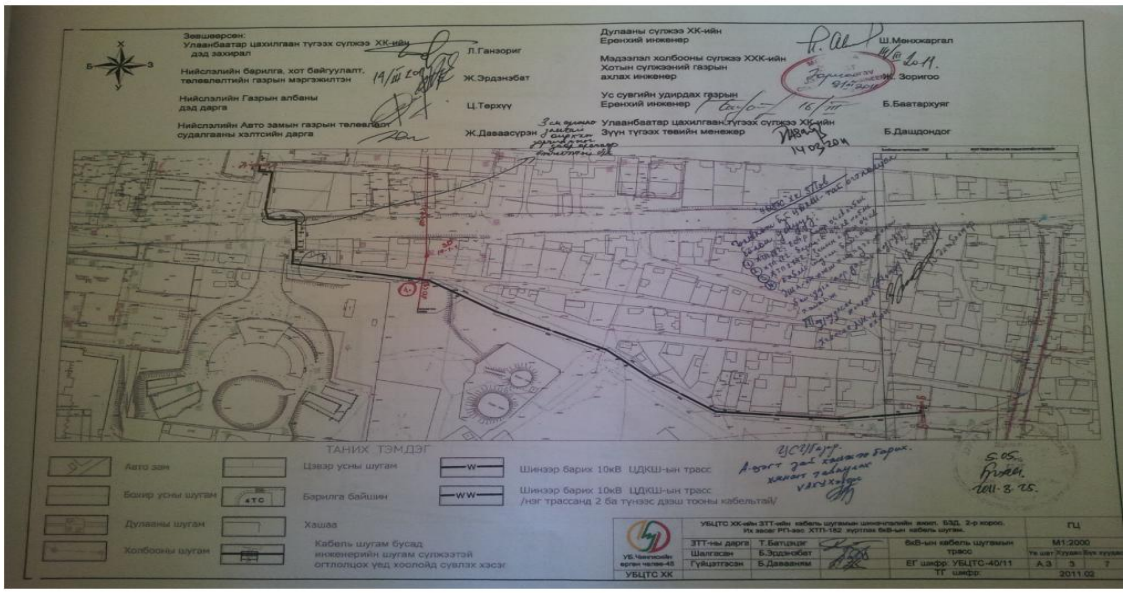
Relevant agencies and public owned companies are in charge of the construction or management issues of large scale underground facilities, such as water supply main pipeline, sewage main pipeline, heating distribution facility, electricity distribution facility, etc.

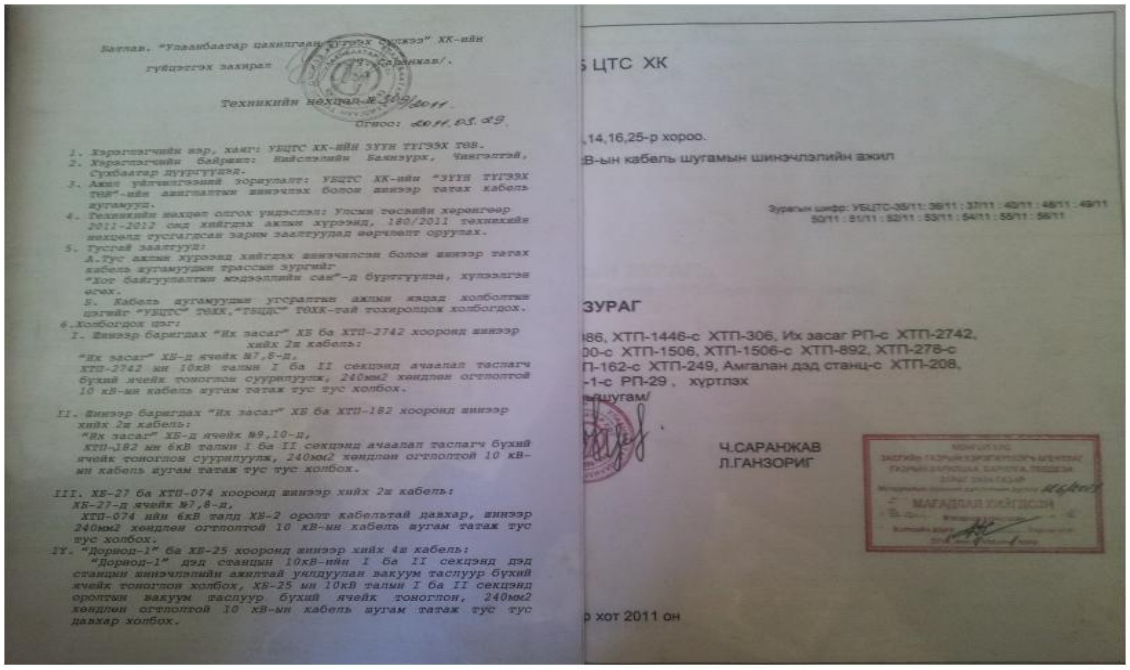
Information of underground facilities is combined with spatial data and non-spatial data. Most relevant tasks are progressed manually.

In the case of large scale spatial data, it is mostly designed by Auto-CAD and managed by each agency and public owned company as a desktop-based environment.

All relevant spatial data are updated as manually through the paperwork. When spatial data have updated, new information document has to be confirmed by person with stamp. In addition, modified or updated information are noted as in writing due to the lack of spatial data format.

Figure III-7 Documents for spatial data design (electricity distribution network company)





*Source: Ulaanbaatar Electricity Distribution Network Company

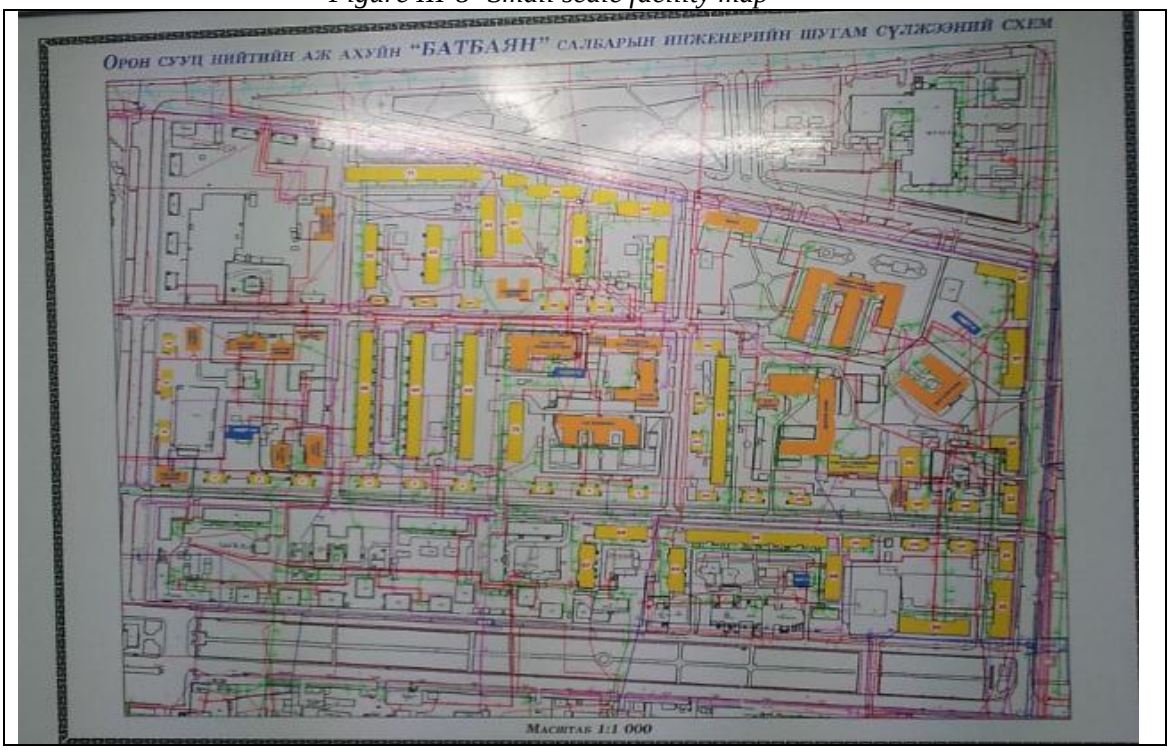
However, in the case of small scale facility installation such as water pipe connection, electricity distribution, heating pipe connection and other relevant installation and maintenance for buildings, it is progressed separately.

Small facility installation and maintenance are managed by facility management department which consists of public owned and private companies (e.g. Batbayan burd government owned industrial department, etc).

According to the interview with 'Batbayan burd government owned industrial department,' installation and maintenance of small underground facilities are progressed manually based on the information of small facility spatial data which are provided from private city facility map

provider called MONGBIT[24].

Figure III-8 Small scale facility map



*Source: Batbayan burd government owned industrial department

Small scale underground facilities are normally buried in land directly in Ulaanbaatar. In the case of tasks for small facility installation or maintenance, personnel in charge of facility installation are tracking pipeline or cable manually due to the insufficient data map.

Figure III-9 Small facility pipeline in Ulaanbaatar

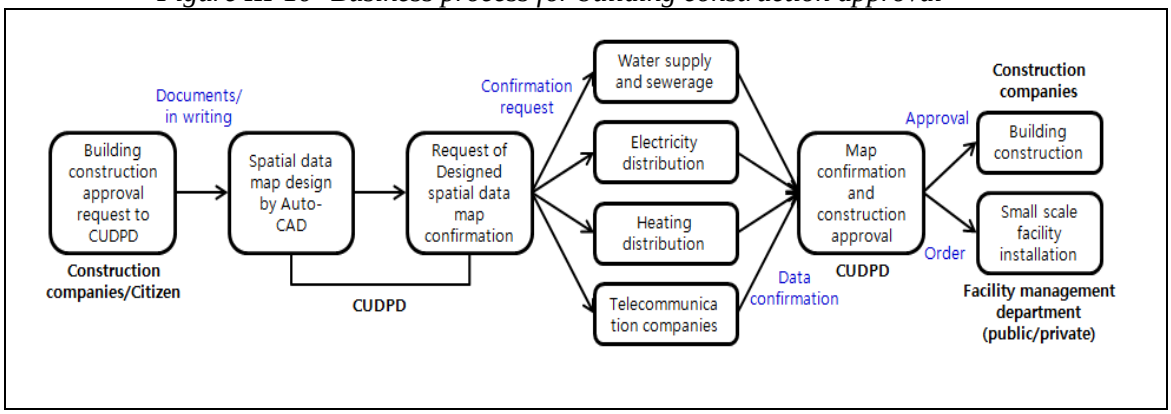
*Source: Batbayan burd government owned industrial department

[24] MONGBIT : Private company in Mongolia

The issue of building construction and registration is approved by CUDPD; therefore, in order to request approvals on building construction or registration issues, construction companies or citizens are to submit documents as in writing.

Approval issues of building construction or registration are progressed as follows:

Figure III-10 Business process for building construction approval



When construction companies or citizens request approvals for building construction or registration, CUDPD designs spatial data based on the documents submitted by construction companies or citizens.

In order to confirm the accuracy of spatial information, designed spatial data is sent to each relevant agency and public owned company.

After the confirmation of the spatial data, CUDPD approves building construction or registration and order the installation or maintenance work to the facility management department which is in charge of specific district in Ulaanbaatar.

3.3 H/W, S/W, N/W Analysis

CUDPD operates the underground facilities information by utilizing Auto-Cad based.

The information sharing on underground facilities between underground facilities management agencies and operating agencies are held on a regular basis 1 or 2 times once a year. The H/W, S/W, N/W information of these management & operating agencies related to SDI is shown below.

Table III-3 *The information of H/W, S/W, N/W*

Management department	H/W	S/W	N/W
Construction Urban Planning	2 Data sever 1 Web sever Desktop based	Auto-CAD Auto-CAD Map Arc-GIS	-
Water supply Canalization	Desktop based	Auto-CAD Auto-CAD Map Arc-GIS	-
Heating Stoves Utilization	Desktop based	Auto-CAD SKADA	-
Electric Power Corporation	Desktop based	Auto-CAD	-
Metropolitan department of information technology	Desktop based	-	-

*Source: Interview / Questionnaire

3.3.1 H/W

Regarding to H/W information, Construction Urban Development Planning Department has 2 Data servers and 1 Web server. More detailed information is as follows.

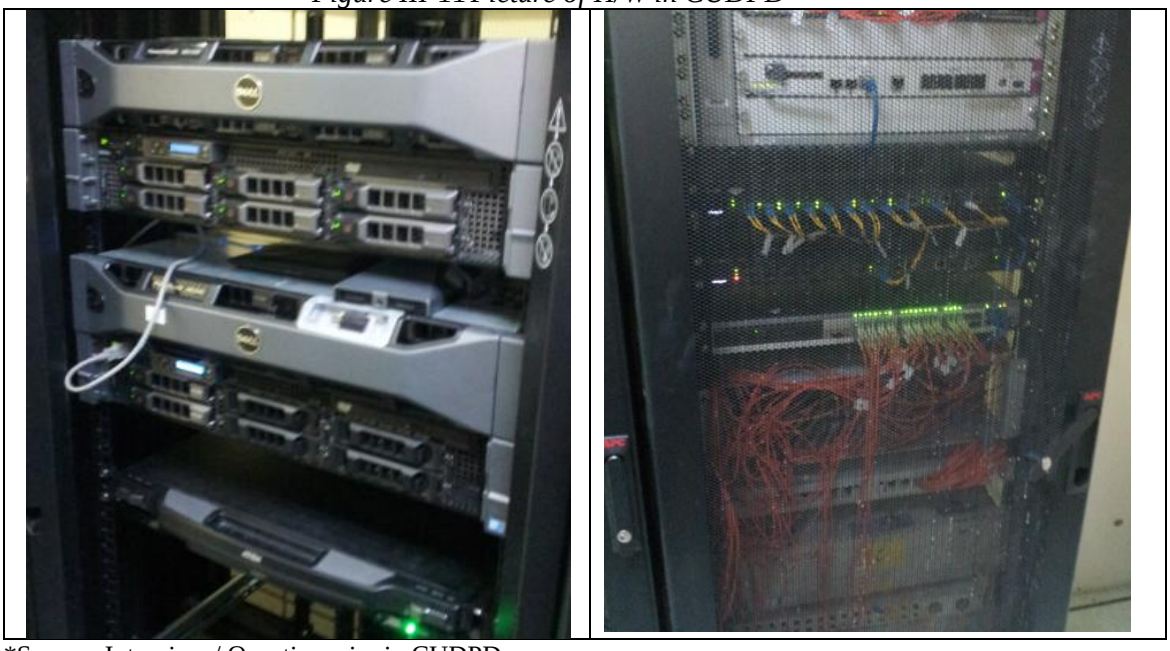
Table III-4 *H/W specification of CUDPD*

Model	H/W	Intro
Data Server	CPU: Intel Quad Core Xeon HDD: 8 TB memory: 8GB O/S: Windows server 2008	2011
Data Server	CPU: Intel (R) Xeon(R) HDD: 600GB memory: 8GB O/S: Windows server 2008	2008
Web Server	CPU: Intel Quad Core Xeon HDD: 5*500GB memory: 8GB O/S: Linux Fedora	2011

*Source: Interview / Questionnaire in CUDPD

CUDPD operates the following three servers; 1.Data server, 2.Solution-processing server, 3.Backup server.

Figure III-11 Picture of H/W in CUDPD



*Source: Interview / Questionnaire in CUDPD

In the case of H/W of the other management departments such as Water supply, Heating Stoves Utilization, Electric Power Corporation, Information Technology department, it is managed by their own Desktop.

3.3.2 S/W

CUDPD software uses AutoCAD, AutoCAD MAP, and Arc-GIS, which were introduced in 2009 and in 2011. The function of AutoCAD is Data input and creating map. The Arc-GIS's function is Data input, Creating map, Data analysis of functions.

The S/W for underground facilities management is mainly using Auto-CAD, AutoCAD MAP.

In the case of Water supply, AutoCAD, AutoCAD MAP, Arc-GIS are being used. Electricity and Heating part are using only AutoCAD.

3.3.3 N/W

N/W related to underground facilities information system has its own network by each agency for CUDPD. CUDPD agencies use a single network. In the case of Metropolitan government of Information Technology department, although it is not under underground facilities system, it is in charge of the general network in Ulaanbaatar City Hall.

Table III-5 *N/W specification in Ulaanbaatar City hall*

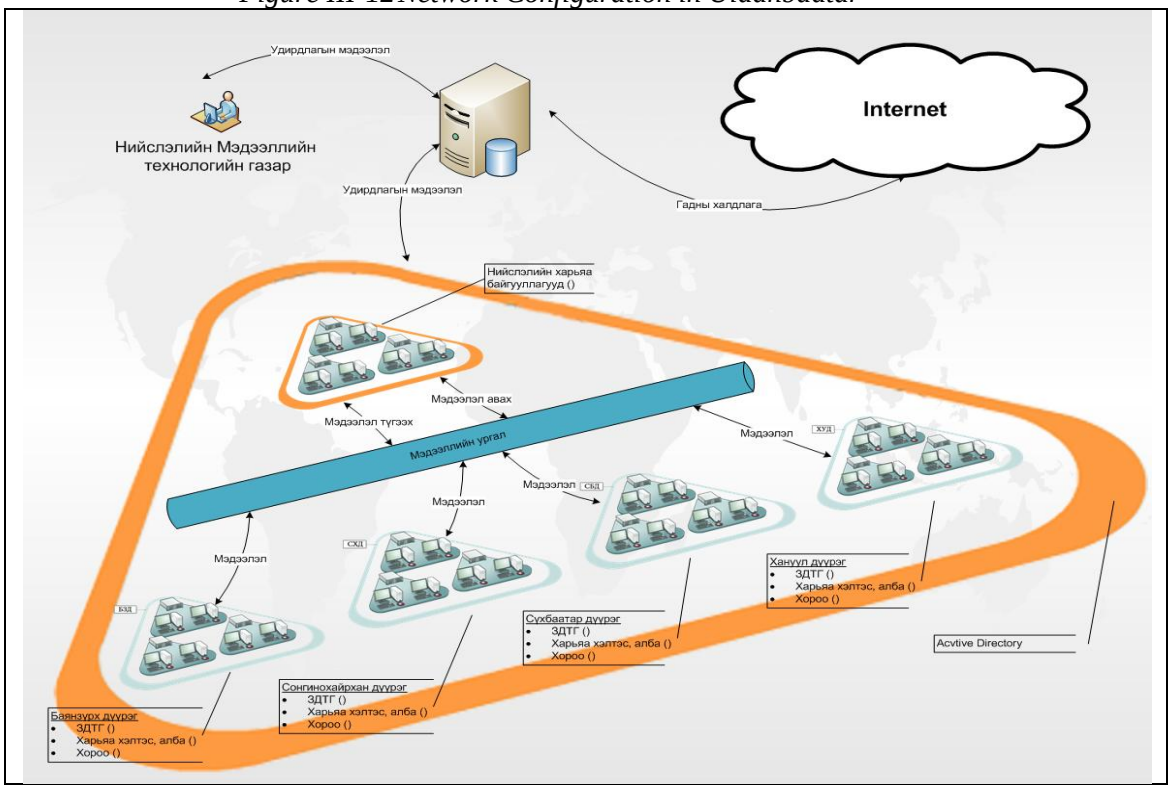
Model	Description
Chassis Selection	Inter Modular Server System MFSYS35
Compute Module	Sever Compute Module (MFS5000SI) 1 : Processors 2 X Intel Xeon E5450 Processor, 2x6M Cache, 3.00 GHz, 1333 Memory 8 X 4GB Registered, ECC, DDR2-667 FB-DIMM Module I/O Mezzanine Card 1 X Dual Channel Gigabit Ethernet I/O Mezzanine Card 2 : Processors 2 X Intel Xeon E5450 Processor, 2X6M Cache, 3.0 GHz, 1333 Memory 8 X 4GB Registered, ECC, DDR2-667 FB-DIMM Module I/O Mezzanine Card 3 : Processors 2 X Intel Xeon E5450 Processor, 2x6M Cache, 3.00 GHz, 1333 Memory 8 X 4GB Registered, ECC, DDR2-667 FB-DIMM Module I/O Mezzanine Card 1 X Dual Channel Gigabit Ethernet I/O Mezzanine Card 4 : Processors 2 X Intel Xeon E5450 Processor, 2x6M Cache, 3.00 GHz, 1333 Memory 8 X 4GB Registered, ECC, DDR2-667 FB-DIMM Module I/O Mezzanine Card 1 X Dual Channel Gigabit Ethernet I/O Mezzanine Card 5 : Processors 2 X Intel Xeon E5450 Processor, 2x6M Cache, 3.00 GHz, 1333 Memory 8 X 4GB Registered, ECC, DDR2-667 FB-DIMM Module I/O Mezzanine Card 1 X Dual Channel Gigabit Ethernet I/O Mezzanine Card 6 : Processors 2 X Intel Xeon E5450 Processor, 2x6M Cache, 3.00 GHz, 1333 Memory 8 X 4GB Registered, ECC, DDR2-667 FB-DIMM Module I/O Mezzanine Card 1 X Dual Channel Gigabit Ethernet I/O Mezzanine Card
Hard Drives	73GB 3.5” SAS Hard Drive (73GB 3.5” SAS Hard Drive) 146GB 3.5” SAS Hard Drive (146GB 3.5” SAS Hard Drive) 300GB 3.5” SAS Hard Drive (300GB 3.5” SAS Hard Drive) 450GB 3.5” SAS Hard Drive (450GB 3.5” SAS Hard Drive) 500GB 3.5” SATA Hard Drive(500GB 3.5” SATA Hard Drive) 750GB 3.5” SAS Hard Drive (750GB 3.5” Hard Drive)

	1TB 3.5” SAS Hard Drive (1TB 3.5” SAS Hard Drive)
Power Supply	Modular Server Power Supply (AXXPSU)
Accessories	Modular Server Storage Module (AXXSCM35) Modular Server Gigabit Ethernet Switch (ACCSW
Spares	Too-less Sliding Rail kit

*Source: Interview / Questionnaire in MGIT

System configuration of the network status of the Ulaanbaatar city is as follows:

Figure III-12 Network Configuration in Ulaanbaatar



*Source: Interview / Questionnaire in MGIT

3.4 Organization Process

In Construction, Urban Development and Planning Department of Ulaanbaatar city (CUDPD), in term of the organization for underground facilities, there is Information technology division which manages underground facilities in Ulaanbaatar City. The detail of the organization related to underground facilities within CUDPD is as below.

Table III-6 *Composition of CUDPD*

Task	The number of staff	Total Number
Planning & documentation	1 Administration division, 3 Urban development divisions	4
Regal and regulation	1 Administration division, 3 Urban development divisions	4
IT part	3 Information technology divisions	3
Citizen Service	3 Urban development divisions, 2 Information technology divisions	5

Underground utilities database creating and updating	6 Information technology divisions	6

*Source: Interview / Questionnaire in CUDPD

Regarding the organization process related to spatial information on the basis of interviews and questionnaires, CUDPD as the center role of the geospatial data management exchanges the spatial data with other departments such as Ulaanbaatar District Heating Company, Electricity Distribution Network Company, Water Supply and Sewerage Authority. For example, Water Supply and Sewerage Authority sends geospatial data to CUDPD in order to confirm data accuracy only 1 to 2 times per year.

This organization process indicates that the different, but relevant departments hardly share the spatial data due to the lack of the standard related to the common spatial data sharing between relevant departments.

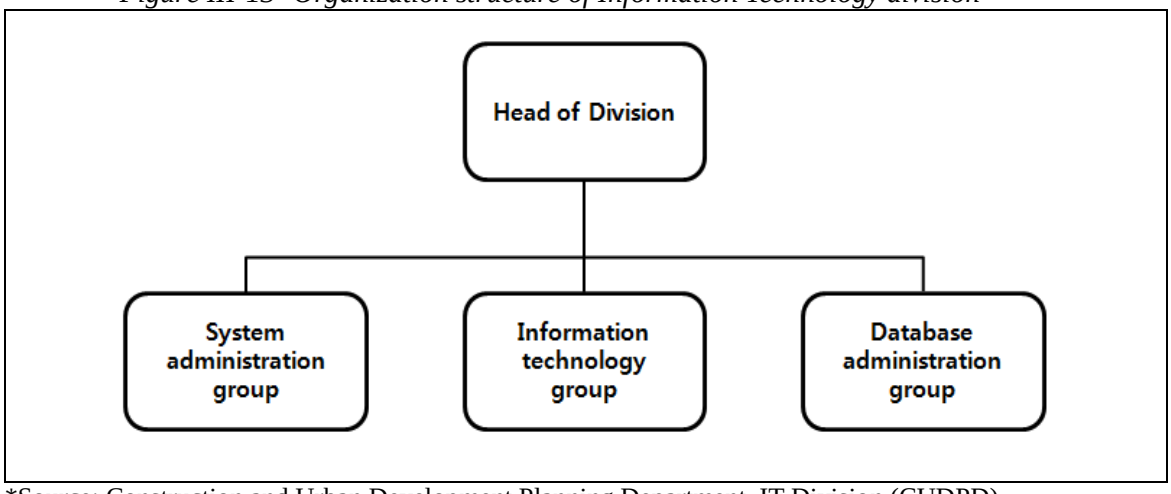
As the exclusive division of spatial data management, Information Technology division is composed of 3 groups controlled by head of division as follow:

- System administration group (3)
  - Senior officer (1)
  - System engineer (1)
  - Programmer (1)

- Information technology group (4)
  - Specialist of GIS (3)
  - Planning Architect (1)

- Database administration group (4)
  - Geodetic engineer (3)
  - Specialist of GIS (1)

Figure III-13 Organization structure of Information Technology division



*Source: Construction and Urban Development Planning Department, IT Division (CUDPD)

In the case of the underground facility related agencies and public owned companies, only one person is disposed to be in charge of spatial data information management in each agency and company.

There are 3 underground facility management agencies and public owned companies in Ulaanbaatar; Water supply and sewerage authority, Electric distribution Network Company, and

Ulaanbaatar District Heating Company.

Telecommunication network and cable are in charge of private telecommunication companies in Ulaanbaatar.

Exclusive officers for spatial data information management in each agency and company normally confirm spatial data information accuracy which is designed by CUDPD.

3.5 Implications

Derived implications for ICT status of underground spatial data and information in Ulaanbaatar illustrated as in below.

- Ulaanbaatar does not have common standards and coding system related to geospatial data. Furthermore, the geospatial data does not have united policy, standard, and detailed formats.

- Underground facility data, such as spatial data information for water pipe line, heating pipeline, electricity distribution cable, and etc., are managed by in each relevant facility department as combined type of database and paper documents.

- In order to progress administrative task for underground facility management, CUDPD manage all spatial data as the type of Auto-CAD format. However, data accuracy is unclear due to the limitation of interagency data exchange.

4. SWOT Analysis

4.1 SWOT Analysis Overview

SWOT analysis is a structured planning method used to evaluate the Strengths, Weaknesses, Opportunities, and Threats involved in a project. In order to establish promotion strategy for SDI system implementation project, internal and external factors are derived through using SWOT analysis.

The aim of SWOT analysis is to identify the key internal and external factors that are important for achieving the objective. These come from within the relevant organization's unique value chain. SWOT analysis key pieces of information are classified into two main categories:

- Internal factors – The internal Strengths and Weaknesses to the organization.

- External factors – The Opportunities and Threats presented by the external environment to the organization.

4.2 Classification of SWOT

According to the result from internal, external environmental analysis, derived factors for SDI system implementation project are illustrated as follow.

- *Strength*
  - Strong promotion intent of Ulaanbaatar city Government
  - High awareness of SDI system introduction in order to conduct urban development
  - Possession of exclusive organization and GIS related specialists
  - Operation and implementation experience of Spatial data related system

- *Weakness*
  - Lack of Technical understanding for SID system operation and management in each relevant organization except exclusive department
  - Unclear data accuracy of existing spatial data
  - Legal limitation of information exchange and absence of spatial data related laws and regulations
  - Absence of basic data and common standard regarding spatial information

- *Opportunity*
  - Easy access to overseas cities' e-Government information as the member of city in WeGO
  - Sufficient intent on introducing and developing of national level ICT for urban development
  - Constantly increasing economic growth rate and demand for IT
  - Easy to secure financing and funding source through utilization of international organizations and MDBs

- *Threat*
  - Difficulties in providing education to city officials regarding new system and the resistance of the existing staffs to the change of business process
  - Substantial time taking for improvement of legal framework related to the SDI system implementation
  - High dependence on foreign organizations and companies regarding advanced technology introduction
  - Possibility of being excluded from the first priority of investment regarding ICT project promotion by international organization and MDBs.

Table III-7 *SWOT analysis for underground facility SDI system implementation*

Strength	Weakness
• Strong promotion intent of Ulaanbaatar city Government • High awareness of SDI system introduction in order to conduct urban development • Possession of exclusive organization and GIS related specialist • Operation and implementation experience of Spatial data related system	• Lack of Technical understanding for SID system operation and management in each relevant organization except exclusive department • Unclear data accuracy of existing spatial data • Legal limitation of information exchange and absence of spatial data related laws and regulations • Absence of basic data and common standard regarding spatial information
Opportunity	Threats
• Easy access to overseas cities' e-Government information as the member of a city in WeGO • Sufficient intent on introducing and developing ICT for urban development • Constantly increasing economic growth rate and demand of IT • Easy to secure financing and funding source through utilization of international organizations and MDBs	• Difficulties in providing education to city officials regarding new system and the resistance of existing staffs to the change of business process • Substantial time taking for improvement of legal framework related to the SDI system implementation • High dependence on foreign organizations and companies regarding advanced technology introduction • Possibility of being excluded from the first priority of investment regarding ICT project promotion by international organization and

	MDBs

4.3 Implications

In order to overcome internal and external environment issues, derived promotion strategies are summarized as follow:

- *Strength improvement- Opportunity catch Strategy (SO Strategy)*
  - Design of SDI system implementation guideline in order to progress appropriate project for Ulaanbaatar City Government through the advanced case review in cooperation with WeGO
  - Establishment of national-wide Spatial Data Infrastructure base through the systemized implementation of SDI system in Ulaanbaatar City Government
  - Sacrament of the system implementation budget utilized by international organizations and MDBs
  - Enhancement of sustainable economic development through introducing advanced IT technologies

- *Weakness overcome – Opportunity utilization Strategy (WO Strategy)*

  - Enactment or revision of appropriate laws and regulations for spatial data related issues in Mongolia through the advanced case review
  - Improvement of existing spatial data accuracy and common standards development through the introduction of the advanced system
  - Secure of the system implementation budget utilized by international organizations and MDBs
  - Development of various IT technology training programs in order to make sufficient human resources for IT development

- *Strength Improvement – Threat overcome Strategy (ST Strategy)*
  - Prompt legal framework establishment based on the powerful intent of City Government
  - Civil officials' capacity improvement through utilization of experienced exclusive department and GIS specialists
  - Boost decision-makers' promotional intent in order to make informatization project as the first priority of investment in Ulaanbaatar by the support from international organizations and MDBs

- *Weakness supplementation – Threat evasion Strategy (WT Strategy)*
  - Enhancement of training for city officials in order to overcome resistance to working process change
  - Legal consideration on special resolutions approved by city mayors in order for information sharing on spatial data between relevant agencies
  - Retention fiscal self-reliance ratio and increase of city IT budget
  - Promotion of domestic IT companies for national IT technology enhancement

Table III-8 *Strategy derivation by SWOT analysis*

Internal	Strength	Weakness
	• Strong promotional intent of Ulaanbaatar city Government • High awareness of SDI system introduction in order	• Lack of Technical understanding for SID system operation and management in each relevant

External	to conduct urban development • Possession of exclusive organizations and GIS related specialists • Operation and implementation experience of Spatial data related system	organization except exclusive departments • Unclear data accuracy of existing spatial data • Legal limitation of information exchange and the absence of spatial data related laws and regulations • Absence of basic data and common standard regarding spatial information
Opportunity	SO – strategy	WO - strategy
• Easy access to overseas cities' e-Government information as the member of city in WeGO • Sufficient intent for introducing and developing national level ICT for urban development • Constantly increasing economic growth rate and demand for IT • Easy to secure financing and funding source through utilization of international organizations and MDBs	• Design of SDI system implementation guideline in order to progress appropriate project for Ulaanbaatar City Government through the advanced case review in cooperation with WeGO • Establishment of national-wide Spatial Data Infrastructure base through the systemized implementation of SDI system in Ulaanbaatar City Government • Securement of the system implementation budget utilized by international organizations and MDBs • Enhancement of sustainable economic development through the introduction of advanced IT technologies	• Enactment or revision of appropriate laws and regulations for spatial data related issues in Mongolia through the advanced case review • Improvement of existing spatial data accuracy and common standards development through the introduction of advanced system • Securement of the system implementation budget utilized by international organizations and MDBs • Development of various IT technology training programs in order to make sufficient human resources for IT development
Threats	ST - strategy	WT – strategy
• Difficulties in providing training for new system introduction and resistance to the change of business process • Substantial time taking for improvement of legal framework related to the SDI system implementation • High dependence on foreign organizations and companies regarding advanced technology introduction • Possibility of being excluded from the first priority of investment regarding ICT project promotion by international organization and MDBs	• Prompt legal framework establishment based on the powerful intent of City Government • Civil official training through the utilization of exclusive department and experts who have relevant IT system operation/management experiences • Boost decision-makers' promotion intent for informatization project implementation as to be the first priority of investment project based on the importance of urban development	• Enhancement of training for city officials in order to overcome resistance to working process change • Legal consideration on special resolutions approved by city mayor in order for information sharing on spatial data between relevant agencies • Retention of fiscal self-reliance ratio and increase of city IT budget • Promotion of domestic IT companies for national IT technology enhancement

5. Constraints and Addressing Issues

5.1 Constraints

- Limited information exchange on underground spatial data between relevant city departments and facility management agencies/companies
  - Due to the lack of data exchange between data management department and facility management department, information of existing spatial data accuracy is unclear
  - Systemized data exchange framework should be introduced

- Absence of common standard for underground spatial data
  - Integrated data standard establishment is required

5.2 Addressing Issues

- Advanced facility introduction for integrated spatial data management system
  - As the exclusive department for urban development, CUDPD has its own server room in order to manage all spatial data for Ulaanbaatar urban development. However, the scale of facility should be extended for more detailed information management and a huge data storage should be secured to achieve efficient spatial data management

- Design of common standard for spatial data
  - In order to make better communication between spatial data relevant departments, common data standards and formats based on international standards should be introduced

IV. Legislation and Regulation Analysis (LA)

1. Overview

According to White Paper 2011 (ICT), the parliament (the National Assembly) adopted "Mongolia's IT development until 2010" in 2000, and in 2002, "IT development medium-term strategies and action plan" was enacted by the parliament in communication, post office, a propagating radio wave, patents, technology transfer, science and technology.

Thus, for the development of ICT, Mongolia Parliament and Government have been trying to broaden the range of legislation and regulation.

There are a number of sector specific key legal and policy documents, which govern ICT sector of Mongolia ratified by the Parliament of Mongolia as follows:

Table IV-1 *Mongolia Laws related to the ICT sector*

Legal	Year
Law on Communication	Approved in 1995 and amended in 2001 and in 2008
Law on Radio wave	Approved in 1999
Law on Post	Approved in 2003 and amended in 2007
Law on Licensing Business Activities	Approved in 2001
Law on Government's Special Fund	Approved in 2006

* Source: ICTPA

2. Legal/Regulatory Analysis

2.1 Legal/Regulatory Context

Legal/Regulatory Framework was established by the communications regulatory council under the Ministry of Infrastructure (MOI) in 1995. The law on Information Technology is still draft in Mongolia. Thus, currently there is no laws or regulations related to general ICT field.

The following extract is taken form 'Law of Mongolia in general law on information technology' (Draft)

Table IV-2 *The law on Information Technology (Draft)*

Article 1. Purpose of the Law

The purpose of this Law is to regulate relations related to the use of information technology.

Article 2. Legislation of Information technology

2.1 The legislation of Information technology consists of the Constitution of Mongolia, this Law, subsidiary laws on E-Transactions, E-Signature and E-Governance; and other acts enacted in conformity with the aforementioned.

2.2 If the international treaties to which Mongolia is a party stipulate other than this Law, the priority is given to the International treaties

Article 3. Legal definitions in this Law

3.1 For the purposes of this Law, the following terms shall have the meanings defined below:

3.1.1 "Information" is imaginations or news on individuals, things, occurrences, events, acts and activities which are not dependent on forms or manners in which they are expressed.

3.1.2 "Electronic form" is an expression of information in a digital form.

3.1.3 "Electronic document" is a document processed in an electronic form.

3.1.4 "Electronic hardware" is equipment or hardware to originate/create, store, send, receive or process the electronic information.

3.1.5 "Electronic data" is data and information which are originated, stored, sent, transmitted, received or processed by using the electronic hardware.

3.1.6 "Database " is a complex set of data, information or software which are originated, gathered, processed or stored in accordance with the integrated classification, codes, standards, methodologies or requirements of equitable documents.

3.1.7 "Information system" is a complex set of electronic hardware, database or software to originate, send, receive or process the data or information.

3.1.8 "Information technology" is a complex system of media, hardware and software to execute correlated activities of science, engineering and management that are oriented to generate, store, exchange or process any of data, information or electronic documents in a electronic form.

3.1.9 "Electronic signature" is any letters, characters or numbers in electronic form attached to or logically associated with an electronic document which may be used to identify the signatory in relation to the electronic document and to indicate the signatory's intention of authenticating or approving the information contained in the electronic document.

* Source: Mongolia law on Information Technology (Draft)

Regarding the laws and regulations of spatial data infrastructure for underground facilities, Mongolia still has no applicable laws on sharing information between departments or agencies. Thus, now each agency has a certain limit on sharing information by State Secrecy Law, State Secrecy List Approval Law. (The April 1995 Law on State Secrets and the January 2004 List of State Secrets)

In Mongolia, there are in fact two laws under State Secrets. Law on State Secrets and the List on State Secrets were enacted in 1995, and last updated in January 2004. The List on State Secrets repeats and expands upon Article 5 of the Law on State Secrets.

Table IV-3 *The Law on State Secret*

Article 5: Scopes of state secrets

1. within scope of the national security of Mongolia:

1) The concept of the national security of Mongolia and confidential parts of information, documents and other matters for ensuring economic security as appropriate.

2) Vital information related to foreign policy and official opinion of Mongolia and agreements or their drafts of Mongolia, established with other foreign countries, which are appropriate to classify as confidential.

4. within scope of intelligence, counterintelligence and secret operations:

1) Intelligence and counterintelligence proceedings, and information on methods, types, tools and facility, sources of information, number of staff, organizational structure, documents, archive, database and financing used for secret operations.

2) Codified system of the government communication, and other relevant documents to this system, its encryption, method and proceeding to use them.

3) Information on supply and reserve of arms and special equipment to police, intelligence agencies, detention units, plans for operation during public disorder by police, intelligence agencies, and internal military units, information on tools and facility to protect vital important objects, plans for operation by detention units during war and within war period, and other relevant documents.

4) Actions taken by state competent institutions in order to safeguard national security of Mongolia.

*Source: Mongolia law on state secrets

When amendments are introduced to the List of State Secrets, Article 5 of the Law on State Secrets may also have to be (and has been) amended to reflect the changes introduced to the List.

These contents can be misinterpreted as all the information are to be classified as "secret" and therefore, restrictions on the access to government records in Mongolia are required.

Especially, under the influence of scope of the law on State Secrets and the List of State Secrets, secrecy of maps with a scale more detailed than 1:100000 should be repealed because geospatial maps with a scale more detailed than 1:100000 are included in state secrecy. Therefore, those data have limited possibilities to be obtained and used.

Ulaanbaatar city geo-database system was built in 2010 when there were no laws/regulations related to GIS system. Thus, Asian Development Bank and Information and Technology Division of the construction came to an agreement by the settlement agreement for the project.

Currently, In regard to sharing information of underground facility, Construction, Urban Development and Planning Department and other departments still exchange the agreement, which is not under any regulation/law.

2.2 Current Policies and Plans

Currently, no laws/regulations related to spatial data infrastructure exist, and furthermore, no further plans and policies are planned at this point. On the other hand, Ulaanbaatar City development Master Plan up to 2030 is in progress, approved by the mayor of Ulaanbaatar in accordance with rationales in below.

- "Ulaanbaatar city development plan" order 13, enacted in January 2010
- "Ulaanbaatar city development foundation design" order 41, ordered by the minister of department of economic development on February 24, 2010 "Ulaanbaatar city development master plan toward 2020" order 350, ordered on May 26, 2010

2.3 Implications

The law on ICT sector in Mongolia is still drafts. Currently, the enactment of the comprehensive ICT law becomes a priority for the ICT field development in Mongolia.

In terms of sharing information, no law/regulation/command and conducting business progress between agencies, especially in the current GIS system related projects, they done after consultation through an agreement between institutions.

There are difficulties in sharing information that each agency must protect information under influence of Laws on State Secrets. Main problem is that the scope of the Law on State Secrets and the List of State Secrets is too broad, and that anything can be classified as "state secret".

3. Institutional Analysis

3.1 Institutional Structure

According to the data from national statistical office of Mongolia, Ulaanbaatar is divided into 9 districts and 144 sub districts (khoroos) as of 2011.

Key decision making organization of Ulaanbaatar city is the City Council. The mayor of Ulaanbaatar reports all administrative issues to city council.

Construction, Urban development and planning Department (CUDPD) controls all operation and management tasks related to underground facility spatial data and information.

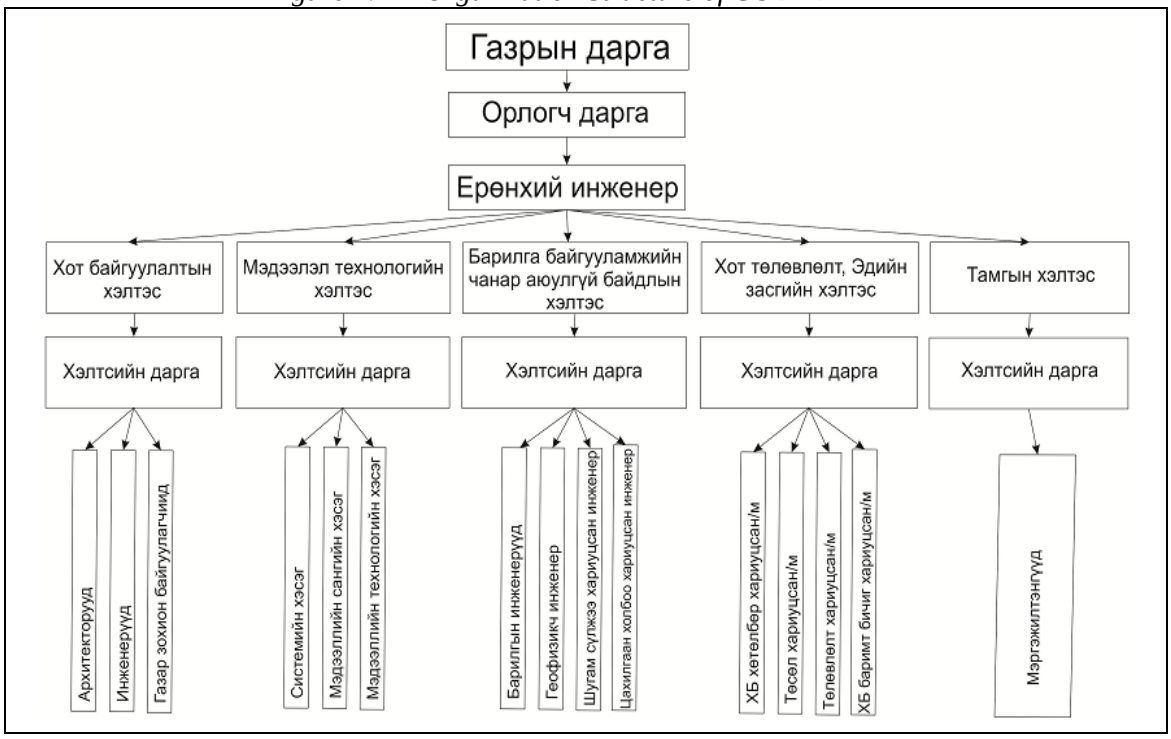
In addition, Water supply and Sewerage Authority, Electricity Distribution Network Company, and District Heating Company are in charge of underground facility operation and management in each field as underground facility exclusive organization.

3.1.1 Construction, Urban Development and Planning Department (CUDPD)

As an implementing agency under Ulaanbaatar city mayor, CUDPD manages to make rational policies on city development, land administration and infrastructure, to prepare master and detailed development plans for Ulaanbaatar city, to develop urban development database, and to monitor newly constructed buildings in the city.

Organization structure of CUDPD is as follows:

Figure IV-1 Organization Structure of CUDPD



*Source: Construction and Urban Development Planning Department (CUDPD)

3.1.2 Water supply and Sewerage Authority (USUG)

The Water Supply and Sewerage Authority of Ulaanbaatar City (USUG) is responsible for drinking water provision and wastewater treatment in Ulaanbaatar, Mongolia. Established in 1959, USUG is a municipally owned organization, whose assets belong to the City Property Department of the Municipality of Ulaanbaatar City.

It draws groundwater from pumping stations in four well fields and chlorinates water supplies before distribution. The current extraction rate is within safe yield limits.

The Water Supply and Sewerage Authority of Ulaanbaatar City serves about 90% of Ulaanbaatar total population, approximately 1.03 million people: 40% by piped water supplied mostly to apartments, 20% through pipeline-connected kiosks, and 30% through truck-supplied kiosks where residents buy and fill containers. The kiosks mostly serve people in Ger areas. Private vendors or non-governmental organizations (NGOs) serve the remaining 10% of the city population.

3.1.3 Ulaanbaatar District Heating Distribution Network Company (UBDHDN)

Ulaanbaatar District Heating Company was established in 1959 in the name of Ulaanbaatar District heating Network (UB DHN) by the Resolution No.367 of Council of Ministries of MPR on September 09, 1959. After 42 year of operation, UB DHN was restructured as Ulaanbaatar District Heating State-Owned Company by the Resolution No.164 of Government of Mongolia, on July 09, 2001.

Ulaanbaatar District Heating Company conducts heat supply, installation and maintenance of heat distributing pipelines and manufacturing of spare parts. There are about 325 employees in

the company, of which more than 50 engineers have pursued postgraduate degrees. Highly qualified workers account for 70% of the total staff.

3.2 Core Activities

Ulaanbaatar City Council is in charge of City Government coordination and decision making for all administrative issues which will affect entire city through the adjustment.

Detailed roles of Ulaanbaatar City council are described as follow:

- CUDPD is responsible for all relevant issues of urban development and infrastructure establishment as an exclusive implementation department in Ulaanbaatar

- Water supply and Sewerage Authority controls water supply facility management in Ulaanbaatar, such as water pipeline installation, maintenance work, water distribution management, etc.

- Ulaanbaatar Electricity Distribution Network Company is responsible for sustainable and stable electricity distribution management in Ulaanbaatar through the establishment of electricity policies for stable electricity supply and efficient power management.

Detailed objectives of Ulaanbaatar Electricity Distribution Network Company are described as follow:

- Reinforcement of power facility maintenance through the advanced technology training related to the electricity distribution

- Establishment of working process improvement policy to supply stable electricity in Ulaanbaatar

- System operation and development for electricity related accident management

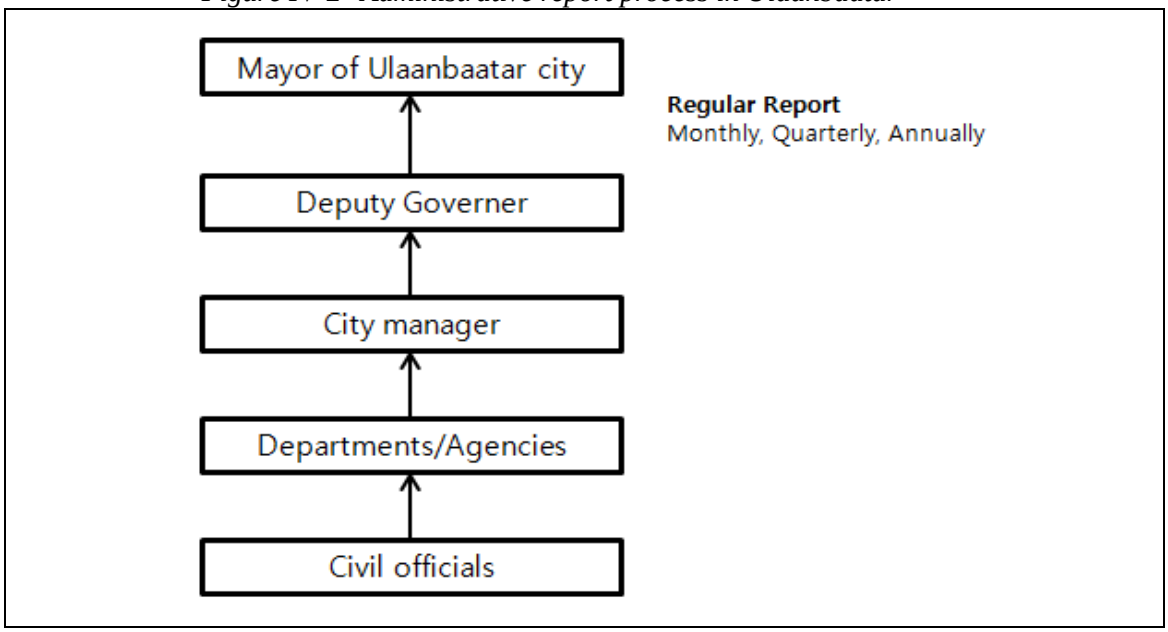
- Improvement of power facility and electricity management technology to reduce electricity related accident

- Ulaanbaatar District Heating Company is in charge of heating facility management in Ulaanbaatar such as heating pipe construction and maintenance, heating facility provision and installation, etc.

3.3 Communication

The mayor of Ulaanbaatar has all authority to determine Ulaanbaatar city plan, policy making, and project promotion as a key decision maker. All business reports of Ulaanbaatar city government are progressed regularly (Month, Quarter, and Year).

Figure IV-2 Administrative report process in Ulaanbaatar



The main agencies related to underground facilities exchange information with CUDPD 1 or 2 times a year on a regular basis. When CUDPD has an additional information request from main agencies besides this regular information exchange, the personnel in the charge of underground facilities information will check the request at any given moment and provide the corresponding information to CUDPD.

3.4 Challenges

According to the result from the institutional analysis, Ulaanbaatar has difficulties in information sharing for underground spatial data between spatial data management departments and underground facility operation departments due to the influence of legal restriction.

3.5 Implication

From the result of institutional analysis, derived implications are as follow:

- Ulaanbaatar city mayor has the authority to make decisions for all administrative issues in the city government. Each department and agency of city government regularly reports their achievements to upper level.

- In the case of interagency spatial information exchange, there is no existing structured report system. All spatial information follows the confirmation process by the information exchange agreement between CUDPD and each relevant agency or company.

- Actual spatial information sharing between spatial data exclusive agencies and underground facility relevant agencies or companies is not available due to the legal limitation regarding the information protection.

4. Constraints and Addressing Issues

4.1 Constraints

- Absence of spatial data related laws and regulations
  - In order to systemize SDI system, relevant laws and regulations should be enacted through the sufficient consideration for SDI system establishment

- Limitation of information sharing by the law
  - In the case of data exchange between departments and agencies, all information must be protected by the influence on Law on State Secrets.
  - In order to improve working productivity related to spatial data management, the laws on State Secrets should be revised.

4.2 Addressing Issues

- Consideration of law/Regulation enactment or revision for Spatial data information
  - Law enactment or revision for information sharing should be considered to develop advanced spatial data management
  - Draft laws and regulations related to the integrated spatial data system should be considered as appropriate clauses for Ulaanbaatar and Mongolia

V. Benchmarking

1. Overview

Bench Marking (BA) consists of 2 case studies (Seoul, Abu Dhabi) in order for Ulaanbaatar city's SDI system to provide current best practices for leading a successful project. First case study focuses on the all overall process such as stages, purposes and tasks, system configuration of Spatial Data Warehouse of Metropolitan Government. Second case study focuses on how to settle the standard of Spatial Data Infrastructure in Abu Dhabi.

Detailed information in each part is described as follow:

- Case Study 1 –Spatial Data Warehouse(SDW) of Seoul
  - The history of Spatial Data Warehouse
  - The Purpose, Vision, Tasks of Spatial Data Warehouse
  - The system configuration of Spatial Data Warehouse

- Case study 2- Spatial Data Infrastructure Standard of Abu Dhabi
  - The Purpose, Vision, Tasks of Spatial Data Infrastructure
  - The history of Spatial Data Infrastructure
  - The process for the standard development SDI

2. Case Study

2.1 Case Study 1. (SMG integrated GIS)

Most of GIS System in Korea has been completed under supervision of National Geography Institute, in order to prevent the accident caused by the absence of comprehensive information of underground facilities.

According to the National Geographic Information System implementation plan in 1995, SMG firstly made GIS implementation master plan and then produced a digital map based on a scale of 1:1,000 and developed various GIS applications over a period of several years. SMG's GIS implementation master plan is divided into four stages as in below.

Table V-1 *SMG's GIS implementation master plan*

First stage	Second stage	Third stage	Fourth stage
Growth period 1996-2006	Stabilized period 2002-2006	Completion period 2007-2011	Practical Period 2012-2016

*Source: Seoul Metropolitan Government homage (http://gov.seoul.go.kr/archives/1945)

First stage is Growth period in 1996~2006; the main subject of this stage was establishment of GIS Data and implementation of pilot project. Various GIS systems related to road management, water management and urban planning information management were produced using the digital maps on a 1:1,000 scale.

Second Stage in 2002~2006 is Stabilization stage; this stage was modification and expansion of GIS data. At this stage, GIS Portal was opened by SMG. Spatial data warehouse based on the conceptual GIS was established for public service and the sharing of data for multiple business systems. In the second stage, SMG also obtained the following outcomes.

Third stage in 2007~2011 is Completion period; this stage focused on connection and system integration. In this stage, the outcomes were realization of EA, enhanced application system,

integration with new technology such as mobile, LBS, telemetric, etc.

Fourth stage is Practical period in 2012~2016; in this stage, a paradigm shift on spatial data services happens in the domain of public participation. The citizen can access open GIS data such as administration spatial data though web-site or mobile application.

The following steps; the major GIS projects were completed in 2001 such as road management system, sewerage management computerized system, water supply management computerized system, GIS management system under SMG's implementation master plan. Also underground facilities data which is managed by external agencies (electricity, gas, telecommunication, heating and etc.) was integrated in 2001 with the major cities of Seoul-based facilities.

Thus, SMG was establishment of utilization systems such as urban plan information, road management, water & sewage management, etc. Especially, in second stage in SMG's GIS, Spatial Data Warehouse (SDW) was established in 2005-2006. SDW basically was integrated data sources based on underground facilities, administrative data for information exchange and smooth business cooperation between agencies.

Table V-2 *Vision, Goals and related tasks for Spatial Data Warehouse*

Vision	Goal	Tasks
Spatial data for citizen communication	Life spatial data infrastructure development for citizen communication	• Establishment of community mapping center for citizen communication • Construction of mobile GIS infrastructure • Establishment of the accuracy of high-quality spatial data
	Vitalization of spatial data communication for sovereign realization of citizen information	• Build efficient distribution system • Provide convenient spatial information through the data marts in Seoul
	High-class spatial data service provision for citizen	• Operate mobile service based on spatial data • Provide spatial data service • Provide the service supporting scientific decision

*Source: Seoul Metropolitan Government homage (http://gov.seoul.go.kr/archives/1945)

The purposes of establishment of SDW from a back office point of view are to reduce duplication data, unify operational process, and establish standardization. Also, the purposes from the front office perspective are to strengthen the civil services, distribute GIS system to citizens, and provide the GIS information to citizens anytime through various applications.

Table V-3 *Spatial Data Warehouse (SDW) of Seoul Metropolitan Government*

Project title	Spatial data warehouse of Seoul Metropolitan Government (SDW)
Period	2005-2006
Definition	- SDW built from integrated data sources based on the spatial and administrative data of SMG is an integrated system.
Purpose	- Prevent duplication of data, Increase use of data - Access data, Unify operational processes, Ensure preciseness of Data, Establish standardization - Share data, Expand business application - Support decision-making, Strengthen the civil service,

	- Participate in the diffusion of NGIS
Development environment	- O/S : Windows2003 - DB : Oracle9i - Language: ASP, XML, JavaScript - GIS Server : ArcIMS 9.2
Details	- Build sharing-based data - Establishment & design of common spatial data - Establishment & design of online spatial data renewal plan - Establishment & design of meta data
Connection scope	- Underground facilities management system - Aerial photograph web search system - Road management system (84 layers, land register, building register, etc. –in charge of road management action office) - Urban plan intranet (location-based services urban management-in charge of urban plan department) - Transport safety facility document management system (in charge of road and transport facility action office) - Waterworks management system - (in charge of waterworks business division) - Sewage management computer system - (in charge of water re-use plan department) - 119 general emergency management - (in charge of emergency center in Seoul) - River management system (in charge of river management department)

*Source: Seoul Metropolitan Government homage (http://gov.seoul.go.kr/archives/1945)

Spatial Data Warehouse (SDW) is stored on a central sever and a number of business systems and different classes of users can have access to and share spatial data warehouse structures. The data in SDW which includes frame work data, topographic map, and common property data can be updated and deleted up to the users.

Figure V-1 Configuration of Spatial Data Warehouse

*Source: Seoul Metropolitan Government homage (http://gov.seoul.go.kr/archives/1945)

According to the report of spatial data warehouse of Seoul, Spatial Data Management Framework was developed to properly maintain the on-line data sharing framework between the common spatial data bases. This framework was implemented by developing the ETT module that maintains the correspondence between spatial data and the metadata management program. The common spatial data originally constructed in each individual GIS system, and is acquired and archived to the SSDW servers. Users or other system's users can access the Meta data in Spatial Data Warehouse through Web server. Web server saved Meta data connects Web server in National Spatial data and access Spatial Data Warehouse in SMG. Thus, the data collected from the Spatial Data Warehouse are sent to each business systems for the system utilization.

As below the table shows common GIS data components. The GIS data is classified as line, dot, and face in Spatial Data Warehouse data format.

Table V-4 *Common GIS Data components*

Division		type	Attribute data
	water pipe	line	identification number, title, caliber, length, depth, material symbol, installation date, opening status (closed pipe or opened pipe), water supply use, cause of restoration (construction)
	deformed fittings	dot	-

Water supply	stand pipe	dot	installation date, caliber, material symbol, altitude
	end pipe	dot	-
	taper pipe	dot	-
	water supply manhole	dot	shape of structure (shape of water supply manhole), manhole type
	catchment area	dot	title (name of catchment area), installation date, area (basin area), water storage capacity, water level (normal water level)
	water intake tower	dot	installation date, facility type (water intake tower), intake height, height (water intake tower), shape of structure (channel shape)
	water intake pump station	dot	identification number, title (name of intake pump station), installation date, capacity (each pump), in taking water volume, number of lane/path (number of pumps)
	filtration plant	face	identification number, title (name of filtration plant), installation date, drainage capacity
	distribution reservoir	dot	identification number, title (name of distribution reservoir), installation date, drainage capacity
	distribution reservoir tower	dot	identification number, installation date, shape of structure, shape of structure, material symbol, capacity (distribution reservoir tower)
	balancing reservoir	dot	identification number, title (name of balancing reservoir), installation date, altitude
	flow meter	dot	identification number, installation date, facility type (flow meter), width length (flow meter caliber)
	water supply tower	dot	identification number, installation date, caliber (water supply tower)
	fire hydrant	dot	identification number, installation date, caliber (fire hydrant), facility type(fire hydrant type)
	water tank	dot	title (owned organization), installation date, water tank use, water tank capacity, material symbol (water tank), classification between ground and underground (overpass/underpass)
	water-pressure gauge	dot	identification number, installation date, caliber (water-pressure observation caliber)
	water meter	dot	identification number (paddy field number), installation date (approval date), caliber, business type(customer division), facility type(water meter type)
	observation balloon	dot	-
	exclusive hydrant	dot	title (owned organization), installation date (approval date), capacity (facility capacity), water supply capacity
	water control valve	dot	identification number, title, length, shape of structure, installation date, facility type, caliber, material symbol, sense of rotation
	check valve	dot	installation date, facility type, caliber, material symbol
	mud valve	dot	identification number, length, installation date, facility type, caliber, material symbol
	exhaust valve	dot	identification number, title, length, shape of structure, installation date, facility type, caliber, material symbol

	reducing valve	dot	installation date, facility type, caliber, material symbol, set pressure
	safety valve	dot	installation date, facility type, caliber, material symbol, set pressure
	booster station	dot	identification number, title(name of booster station), installation date, altitude(boater station), classification of booster station, booster beneficiary household
	water leak point	dot	-
	distributing area boundary		-
	water supply area boundary (by filtration plant)		identification number, title (water supply boundary by filtration plant)
sewerage	sewer pipe (under drain)	line	identification number, title, slope, depth, starting, depth, ending depth, shape of structure, caliber, width length, vertical length, material symbol, installation date, opening status, number of lane/path, sewage pipe use, starting point manhole identification number, ending point manhole identification number, rainfall drainage area, waste water drainage area, rainfall velocity, fine weather velocity
	sewer pipe (open sewer)	line	installation date, shape of structure, length, slope, sewage pipe use, width length, vertical length, structure, starting point manhole identification number, ending point manhole identification number, staring depth, ending depth, rain water drainage area, waste water drainage area, rainfall velocity, fine weather velocity
	sewage joint pipe	line	installation date, shape of structure, material symbol, width length, vertical length, number of lane/path, length, slope, sewage pipe use
	lateral ditch	line	installation date, lateral ditch division, material, symbol, width length, vertical length, number of lane/path, length
	facility planning pipe conduit	line	material symbol, width length, vertical length, slope, sewage use, discharge capacity, allowance, rain water drainage area, waste water drainage area, rainfall velocity, fine weather velocity
	end pipe	dot	-
	inversed siphon	line	installation date, facility type, material symbol, width length, vertical length, number of lane/path, length, slope, sewage use
	sewage manhole	dot	identification number, installation date, manhole type, shape of structure, elevation, opening status, cover quality of material
	receiver	dot	identification number, installation date, shape of structure, receiver division
	rainwater collector	dot	installation date, shape of structure
	outfall	dot	installation date, altitude, water level, outfall use, receiver division
	sewage disposal office	dot	identification number, title, installation date, opening status, area(disposal area), shape of structure, disposal capacity, type of sewage disposal, quality of design inflow water, quality of

			design outflow water
	pump station	dot	identification number, title, installation date, opening status, shape of structure, altitude, water level, disposal capacity, capacity of water storage, drainage capacity, use of pump station
	retarding basin	dot	identification number, title, installation date, water level, capacity of water storage, type of retarding basin
	disposal area	face	identification number, title, extent of disposal area
	disposal division	face	identification number, title, extent of disposal division, residential area, commercial area, industrial area, sewage flow rate, disposal planning population
	drainage area	face	identification number, title, extent of drainage area, direction angle
	drainage division	face	identification number, title, extent of drainage division, residential area, project area, industrial area and green belt, 5 years frequency rainfall strength, 10 years frequency rainfall strength
	prearranged drainage area boundary	line	title, extent of prearranged drainage area
	drainage equipments	line	title, material symbol
	sewage area division (drainage area)	face	-
	separate system area boundary	face	-
	construction maintenance boundary	face	-
	observation balloon (underground water volume)	dot	title, installation date, caliber, type of business
	sewage vent	dot	installation date, facility type, caliber
	restoration point	dot	installation date, material symbol, width length, restoration cause
	relay pump	dot	number, title, installation date, area, disposal capacity
Electricity	power distribution-aerial substation	face	title, substation voltage
	power distribution-aerial electric pole	dot	installation date, identification number, types of electric pole, height, district code, lot number
	power distribution-high voltage aerial conductor wire	line	types of high voltage wire, caliber, length
	power distribution-low voltage aerial conductor wire	line	types of low voltage wire, caliber, length
	power distribution-aerial protection net line	line	types of protection net line, caliber, length
	power distribution-underground manhole	dot	installation date, identification number, power manhole type, width length, vertical length, district code, lot number
	power distribution-underground switch	dot	installation date, identification number, classification between ground and underground, district code, lot number
	power distribution-underground power tunnel	line	installation date, title, facility type, length, depth

	power distribution-underground pipe conduit	line	installation date, length, number of lane/path, depth
	power distribution-underground buried cable	line	installation date, length, number of lane/path, depth
	power distribution-underground transformer	dot	installation date, identification number, district area, lot number, classification between ground and underground
	power distribution-underground vent	face	installation date, identification number, vent type
	power transmission-aerial transmission support	line	installation date, identification number, type of electric pole, height, district code, lot number
	power transmission-aerial conductor wire	line	type of power transmission wire, length, substation voltage
	power transmission-overhead ground wire	line	type of power transmission wire, length, substation voltage
	power transmission-underground manhole	dot	installation date, identification number, district code, lot number, width length, vertical length, depth
	power transmission-underground cable head	dot	installation date, identification number, district code, lot number, cable head type, height
	power transmission-underground pipe conduit	line	installation date, material symbol, length, number of lane/path, depth
	power transmission-underground power tunnel	line	installation date, title, facility type, number of lane/path, length, depth, width length, vertical length
	power transmission-underground buried cable	line	-
	power transmission-underground vent	face	installation date, identification number, vent type
communication	city communication underground pipe conduit	line	installation date, number of lane/path, material symbol, caliber, width length, depth, area, operating office code, telephone company code, data input date, name of trunk line, communication pipe conduit starting point, communication pipe conduit ending point, name of cross-sectional diagram
	intercity communication underground pipe conduit	dot	installation date, number of lane/path, material symbol, caliber, width length, depth, area, network management office code, relay center code, data input date, communication pipe conduit starting point, communication pipe conduit ending point, intercity communication pipe conduit big section, intercity communication pipe conduit medium section, intercity communication pipe conduit small section, name of cross-sectional diagram
	city communication manhole	dot	identification number, installation date, operating office code, telephone company code, data input date, name of trunk line, standard, road division, name of cross-sectional diagram, degree of noxious gas, manhole type
	intercity communication manhole	dot	identification number, installation date, network management office code, relay center code, data input date, standard, road division, name of cross-sectional diagram, degree of noxious gas, manhole type, intercity communication pipe conduit small section

	cable tunnel	dot	title, installation date, width length, depth, area, operating office code, telephone company code, data input date, object type, name of cross-sectional diagram
	telephone company	dot	title, installation date, area(exclusive area), operating office code, telephone company code, data input date
	network management office	dot	title, installation date, area(exclusive area), network management office code, relay center code, data input date
	RSS, Remote Subscriber System	dot	title, installation date, operating office code, telephone company code, data input date
	public phone booth	dot	identification number, installation date, telephone company code, data input date, communication management type, object type
	city communication owner	dot	identification number, installation date, length, structure, operating office code, telephone company code, data input date, name of trunk line, installation location by topography, communication management type
	intercity communication owner	dot	identification number, installation date, length, structure, network management office code, relay center code, data input date
	buried terminal box	dot	identification number, installation date, operating office code, telephone company code, data input date, name of trunk line, standard
	CATV power supply box	dot	identification number, installation date, network management office code, relay center code, data input date, name of CATV amplifier
	grounding facilities	dot	identification number, installation date, operating office code, telephone company code, data input date, object type, length
	Intermediate switching	dot	identification number, installation date, operating office code, telephone company code, data input date, name of trunk line, standard
	intercity communication station pole	dot	identification number, installation date, network management office code, relay center code, data input date, owner
	freeway emergency call	dot	identification number, installation date, network management office code, relay center code, data input date, owner
heating	heating pipe	line	identification number, title, installation date, caliber, length, number of lane/path, depth, width, material symbol, open condition
	heating manhole	dot	-
	Air Vent	dot	-
	Hand Hall	dot	-
	grounding box for signal transmission	dot	-
	water leak sensor equipment box	dot	-

*Source: Seoul Metropolitan Government homage (http://gov.seoul.go.kr/archives/1945)

The SMG's Spatial Data Warehouse offers several benefits to the community.

First of all, it is grasping at a glance all the information related to underground facilities including road and road facilities. Second, it is adjusting road excavation period effectively between the organizations of underground facilities. Third, SDW can improve the durability of road pavement and prevent redundant digging for road and underground facilities. Lastly, it is providing basic information to rapidly cope with accidents.

2.2 Case Study 2. (United Arab Emirates –Abu Dhabi)

Abu Dhabi, the capital of the United Arab Emirates (UAE), lies on a T-shaped island jutting into the Persian Gulf. The Abu Dhabi in United Arab Emirates is not only one of the members of WeGO, but also one of the best practices cities in Spatial Data Infrastructure Standard establishment.

According to the Abu Dhabi system and information centre report in June 2007, AD-SIC launched the AD-SDI initiative to provide a framework of standards, policies, data, procedures, technology, and capable staff to facilitate and support the effective use and sharing of geospatial information in Abu Dhabi. AD-SDI is a data clearinghouse, geospatial portal, and Web site, as well as an extensive program for community engagement, organization, coordination, and establishment of formal agreements for data provision and sharing.

AD-SDI was mobilized by the Executive Council under ADSIC Charter GO-R-026 Geographic Information Infrastructure. This AD-SDI Strategic Plan is one of the several latest ADSIC accomplishments in the pursuit of improved delivery of e-Government services and knowledge and information infrastructure in Abu Dhabi. It aims to achieve synergies, avoid duplication, and support increased coordination and data sharing across the government GIS user community.

The vision of AD-SDI is empowering government and society with convenient, open access to highly qualified and up-to-date geographic information and spatially enabled e-government services.
The mission is to promote, facilitate, coordinate and support the development of a dynamic and flexible geospatial environment that will:

- Provide an online access to a wide range of geographic information and services
- Facilitate information sharing across boundaries
- Facilitate and support the adoption of standards to ensure compatibility and interoperability through the government systems
- Promote government transparency and public rights to information access

The development roadmap of AD-SDI for the phased development of the standards is presented in the accompanying diagram.

Table V-5 *AD-SDI development roadmap*

First stage	Second stage	Third stage	Fourth stage
Institutionalization Nov 2008	Communication Jul 2009	Enforcement Jan 2010	Refinement Jan 2011

*source: Abu Dhabi Spatial Data Infrastructure (http://sdi.abudhabi.ae/Sites/SDI)

The institutionalization phase started in November 2008 and lasting eight months, produced the two general documents Reference Manual and Base Document, which are common to all Standards. Content Standards for metadata, five base map data sets, and seven utility data sets

were developed during this phase.

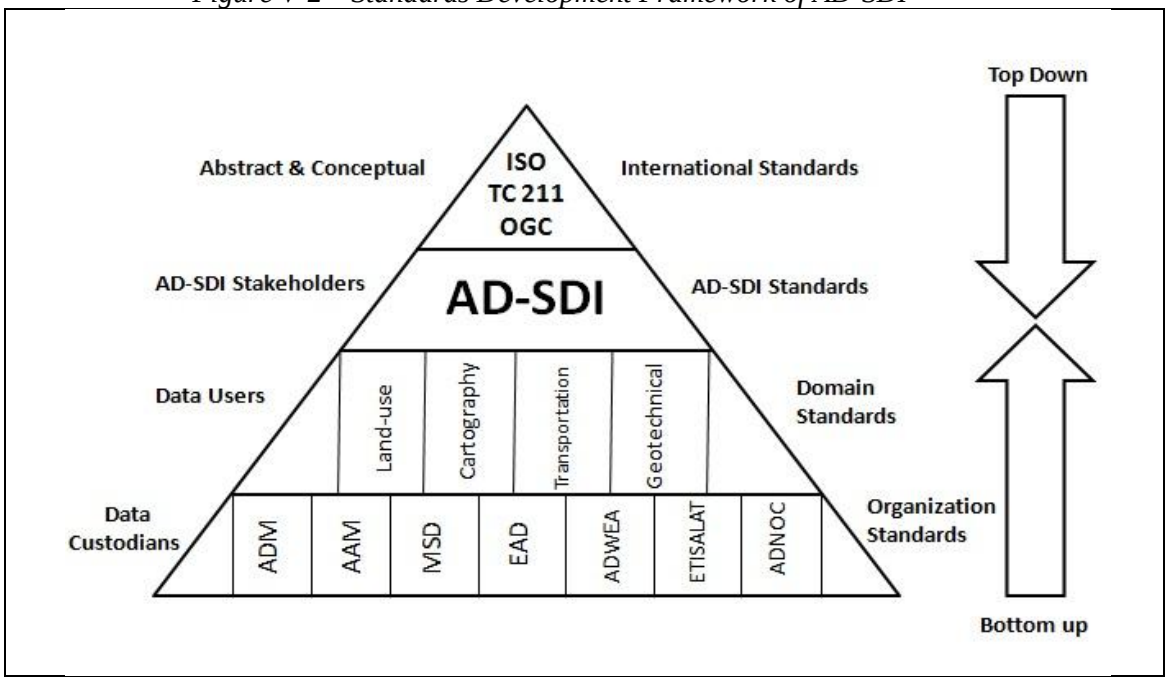
The communication of standards to all the AD-SDI stakeholders was the main emphasis of the second phase lasting six months. During this second wave of Standards development another six standards were finalized, including the symbolic standard for Community Facilities.

The focus of the third stage for the calendar year 2010 is the publication of standards documents through the print media and the web portal to reach out to the AD-SDI community and the public, with the main objective of enforcing the standards by the data custodians. Another twenty standard documents are expected to be developed during this period.

The refinement was made in 2011 with the adoption and wider use of the geospatial standards by the stakeholders. It is anticipated that many of the developed standards need refinement, a task that shall be taken up during the year 2011.

According to Abu Dhabi Spatial Data Standards Development Framework, different stakeholder organizations or government entities, which are responsible for producing different types of geospatial data, have developed in-house data standards and specifications. Apart from this, there are domain standards for data sets such as land use, land cover, transportation, geotechnical, etc. Then, there are also standards development organizations such as OGC and ISO at international level, and SDI bodies at various national and regional levels, which develop standards for geospatial data of various types.

Figure V-2 Standards Development Framework of AD-SDI

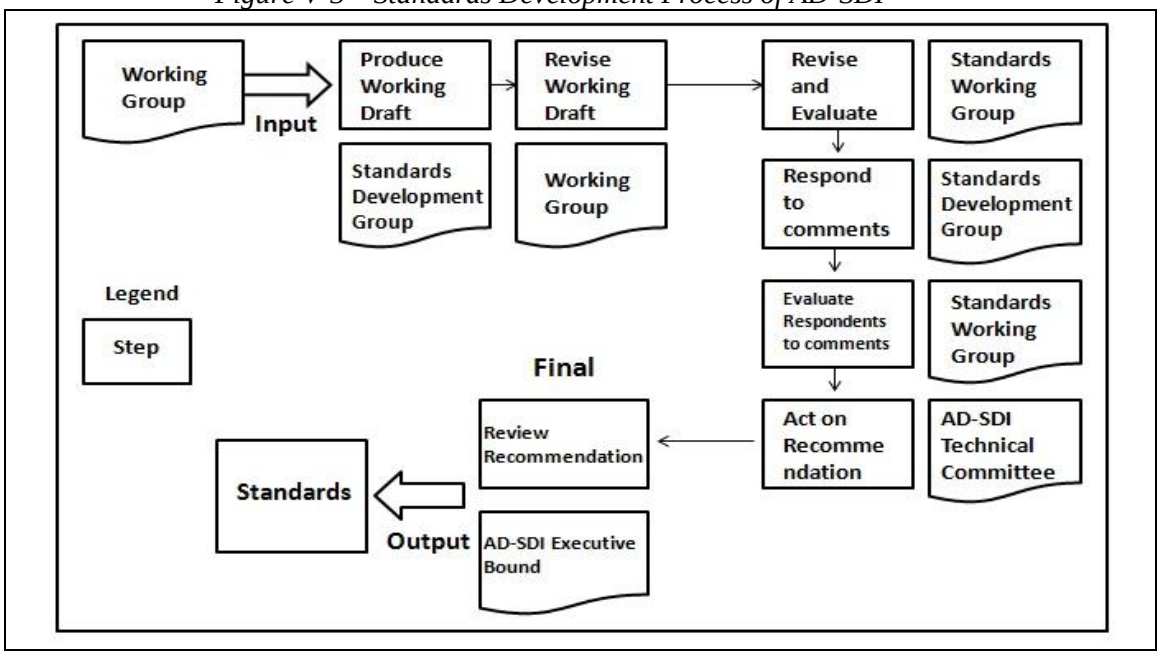


*Source: Abu Dhabi Spatial Data Infrastructure (http://sdi.abudhabi.ae/Sites/SDI)

All these standards, specifications, and best practices are reviewed and assessed by the AD-SDI Standards Development Group in the development of FGDS data content standards for the Emirate of Abu Dhabi. The top-down and bottom-up approaches adopted by AD-SDI for harmonizing the abstract ISO and OGS standards specifications with the various existing standards are illustrated in the diagram.

Regarding standard development process, the Working Groups provide the necessary input for the data content of each FGDS data set and also recommend any specific international standard to be followed. There are seven steps from initial Draft through the Standards publication and adoption as depicted in the diagram.

Figure V-3 Standards Development Process of AD-SDI



*Source: Abu Dhabi Spatial Data Infrastructure (http://sdi.abudhabi.ae/Sites/SDI)

These steps are organized into three stages: Draft, Review, and final

First stage is Draft step 1-2. This stage is to collect inputs from the stakeholders as working groups and discuss the standard form. Second stage is steps 3-6. In this stage, the standard form is evaluated and test-operated to get ready for AD-SDI approval. Final stage is step 7, the last stage, which becomes an officially recognized AD-SDI standard.

The Abu Dhabi Spatial Data Infrastructure offers several benefits to the community.

First of all, removal of barriers: Standards enhance geospatial data exchange and sharing. The exchange mechanisms for the transfer of geospatial data between dissimilar systems are addressed by standards.

Second, Integration of systems: Standards enable the use of data across a wide spectrum of applications, thus maximizing effective use of systems. Third, Data collection: Standards reduce duplication and overall costs of geospatial data collections.

Lastly, Increase data sharing among government entities: Spatial data users are aware of the availability of various types of existing data. They are able to find and access existing data sources and services with minimum impediments. Users are also able to easily ascertain the quality of existing spatial data and its fitness to meet their needs.

3. Constraints and Addressing Issues

3.1 Constraints

- Systematic preparation and planning are required for the establishment of spatial data system in Ulaanbaatar

  When comparing the stage of preparation of Spatial Data Warehouse of Seoul with Ulaanbaatar, Ulaanbaatar is not systematically ready to implement the spatial data system at each agency.
  - Most agencies in Ulaanbaatar don’t have any infrastructures (H/W, S/W, N/W) for spatial data system

- There are no standards/ regulations/laws related to geo-spatial data system.
  - In the case of Spatial Data Warehouse (SDW) of Seoul, before the implementing stage of the project, there existed the GIS law related to SDW such as National Spatial Data Infrastructure Act, Act on Land survey, Waterway survey, Cadastral records, etc.
  - Abu-Dhabi also has the standard group from each agency for making the agreement & standard process in order for the information sharing.

3.2 Addressing Issues

- Need to establish the GIS master plan as a Mongolia national program.
  - For the successful Spatial data infrastructure project, it is required to make the national GIS program like Mongolia GIS master plan

- To make the standard for spatial data infrastructure, it needs to gather the opinions of hands-on workers

- In the case of Abu-Dhabi, in order to make the standard for spatial data, they composed the standard group. Likewise, a broad variety of ideas have to be taken into consideration from the stakeholders in Ulaanbaatar.

VI. Recommendation (RC)

1. To-Be model strategy and direction

The recommendation section is divided into five stages based on the existing Analysis information and best practices survey data for future models promoted as a way to establish a future model strategy.

- Step 1: Currently, the main cause of the problem related to underground facility management system in Ulaanbaatar is drawn from environmental, business, legal and institutional, financial, and technological sectors based on the status of the existing such as environment, technical analysis, and institutional analysis.

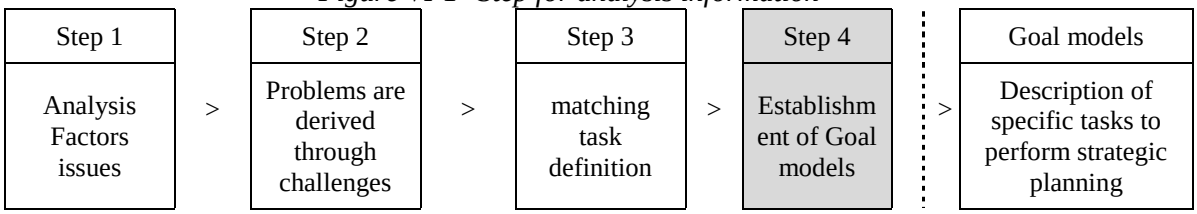
- Step2: Through the derived cause of problems, corresponding challenges which can resolve problems are derived.

- Step3: The corresponding challenges are subsided into preceding assignments, short-term responses, and mid and long-term responses as to establish Underground Facilities Management system.

- Step 4: Goal models are established based on the long-term blueprint model.

- Step 5: Performing strategies of each project are described.

Figure VI-1 Step for analysis information



1.1 To derive the main cause via analysis of the current status

According to the environmental analysis, technical analysis, and legal analysis, currently (as of December 2012), the derived problems of underground facility management in Ulaanbaatar is divided into 5 parts (environmental, business, legal, financial and technical sector) for as shown in the table.

Table VI-1 *Main causes by sector*

Division	Main causes
Environmental sector	• The diversity of management authority • Due to rapid urbanization, a lot of the construction in public / private sector • The oldness of the existing facilities • A lack of infrastructure of the burying system • Inaccuracy of the underground facilities information by each agency (surveying)
Work sector	• The absence of a consultative group (TF) between management authorities • Centralization of business processes

	• The absence of systems utilization • System-oriented business systems (the absence of services for civil members and civil construction companies)
Legal and regulatory sector	• Weakness of Legal (information sharing and utilization) and federal security laws • Weakness of Institutional systems to make agreements among related agencies for information sharing and approval request • A time-consuming process of enactment of new legislations and security • No relevant laws related to Spatial information • Limitation of legislations enacted by the city hall
Financial sector	• Financing limits
Technical sector	• Dispersion of IT systems (CUDPD, MDIT) • Limit in sharing schemes (CAD) • Lack of education on SDI (each agency) • Non-authorized products used (CAD)

Five immediate problems resulting from the phenomenon are as follows: the challenges are defined as

Table VI-2 *Effectiveness*

Division	Main causes	Effectiveness
Environmental sector	A Rapid urbanization	• There are numbers of buildings being built in both urban and suburban areas and numbers of on-going constructions all over the city to reinforce the existing road network and infrastructures. • Population is rapidly increasing by the incoming people from outside the city. They mainly reside in a hill area of the northern part of the city in a particular housing type of a tent (Gar) where public services such as water, sewage, heating, electrical configuration, etc are extremely limited. Especially, if heated in winter, it becomes a major cause of air pollution due to its fueling materials such as coal and wood.
	Inaccurate underground facilities information	• Resource investment is needed to make connections between existing facilities and to continue building new facilities. • The inaccurate information of underground facilities may cause damages to underground facilities during the construction period
	Falling behind of the existing facilities	• Accidents such as blackout, or suspension of water supply may occur due to old pipelines, cables, etc.
	The diversity of management authorities	• Management authorities are differentiated according to the individual department such as sewer and hot water supply, heating supply, electricity supply and communication, and therefore, the information sharing regarding mutual underground facilities is extremely limited and insufficient.
	A lack of basic infrastructures of burying way	• Due to the direct burial of electrical (high pressure and low pressure) line to the ground, the protective function is limited. • The absence of management facilities for integrated

		manholes and underground facilities (tunnels)
Work sector	Absence of the consultative group between the principal facilities managements council members	• Due to the absence of the consultative group, it is limited on sharing information between CUDPD, Water supply and sewerage authority, heating company, etc. • Currently, sharing information for underground facilities has been limited by the CUDPD
	Task concentration on a specific department	• Excessive work related to spatial data system is loaded on CUDPD. • It contains limitations on work productivity and expertise in GIS
	Systems (GIS) lack of leverage	• Even if CUDPD and Water supply and sewage authority inputs information into GIS system, it is still insufficient
	Back-office-oriented systems	• It is difficult to update the information in real-time due to the absence of the information registration system
Legal and institutional sector	Weakness of Legal cause	• The act of sharing & utilization of Information is still pending as a draft • No e-government laws • No spatial data laws
	Weakness of institutional maintenance	• The content of the agreement between the relevant agencies is limited.
	Limitations on legislation under local governments	• It is difficult to enact the legislation under local government in the near-term • A national level cooperation is required to enact GIS laws related to sharing & utilization of information
	Time-taking processes for new legislation and amendments to existing laws	• When new laws and institutions are introduced, it is expected to take a substantial amount of time to proceed
Financial sector	Financing limits	• The local government has no budgetary appropriation for spatial data infrastructure for most of the budget is invested to resolve the facing problems (social infrastructure) of the undeveloped area. • It is difficult to keep the project progressing in term of spatial data system management, because the project of underground facility management combined with IT technologies is not recognized as a priority project when compared with the construction of underground facility project including physical construction.
Technical sector	Dispersion of IT infrastructure	• The benefits are low because CUDPD and MDIT manage their own IT infrastructure, separately. • Each department has a limited information on existing system, and correspondingly, the actual utilization of base materials and various systems are limited • The physical security is relatively weak, due to the decentralization of the IT infrastructure.
	The limitations of a shared approach (CAD)	• The form of information shared between CUDPD and its relevant agencies is CAD (Computer aided Design) oriented, not object-oriented, in which modification and maintenance of information as well as information sharing are highly limited.
	Lack of education on SDI	• Except CUDPD, only Water supply and sewerage authority is using the GIS-based information

		management system for underground facilities. • If used without systematic training, the Spatial Data system can collect inaccurate and unnecessary information, which may harm the system itself. • Prior to or during the introduction of the system, it is necessary to introduce the GIS-based educational environment
	Non-authorized products used (CAD)	• Due to the current usage of numbers of unauthorized (no license) products in each agency, maintenance of S/W is highly limited.

1.2 The challenges derived from the main causes

The table of matching tasks based on the main causes of the specific status of each part is as below.

Table VI-3 *Matched key tasks*

Division	Main cause	Matching tasks
Environmental sector	Rapid urbanization	• Systematic Urban Development master plan through new spatial data system efficiency • Conduct surveying for underground facilities • life cycle management for existing facilities • Establishment of Information sharing system between main agencies • Construction of Pipeline facilities • Establishment of the automatically-updated spatial data system • Introduction to the Spatial data education system • Strengthening the public service through the establishment of the management system integrated with underground facilities • Examination of the decision-making process of Mongolian ICT law • Strengthening institutional maintenance • (Agreements on information sharing between the agencies and the introduction of information standardization)Promoting a pilot project in connection with ODA and MDB projects or in utilization of a part of their own budget • Centralization of IT infrastructure • Object-oriented information integration • Performing sustainable maintenance through the introduction of low-cost S / W • Establishment of Road Spot excavation system • Establishment of Web Facility Management System
	The inaccuracy of information regarding underground facilities	
	The oldness of existing facilities	
	The diversity of management authorities	
	A lack of infrastructure of the burying system	
Work sector	The absence of consultative group (TF) between management authorities	
	Centralization of business processes	
	The absence of frequent systems utilization	
	Back-office oriented systems	
Legal and institutional sector	Weakness of Legal (information sharing and utilization) and federal laws	
	Time-taking processes for new legislation	
	No relevant laws related to Spatial information	
	Limitation of legislation enacted by the city hall	
Financial sector	Limited fund	
Technical sector	Decentralization of IT infrastructure	
	The limitations of a shared approach (CAD)	
	Lack of education on SDI	

	Use of Non-authorized products (CAD)	

1.3 The definition of matching tasks by stage

The preceding problems are resolved through the corresponding challenges which are categorized into the short-term challenges and the mid/long-term challenges.

Table VI-4 *The stage of matching tasks*

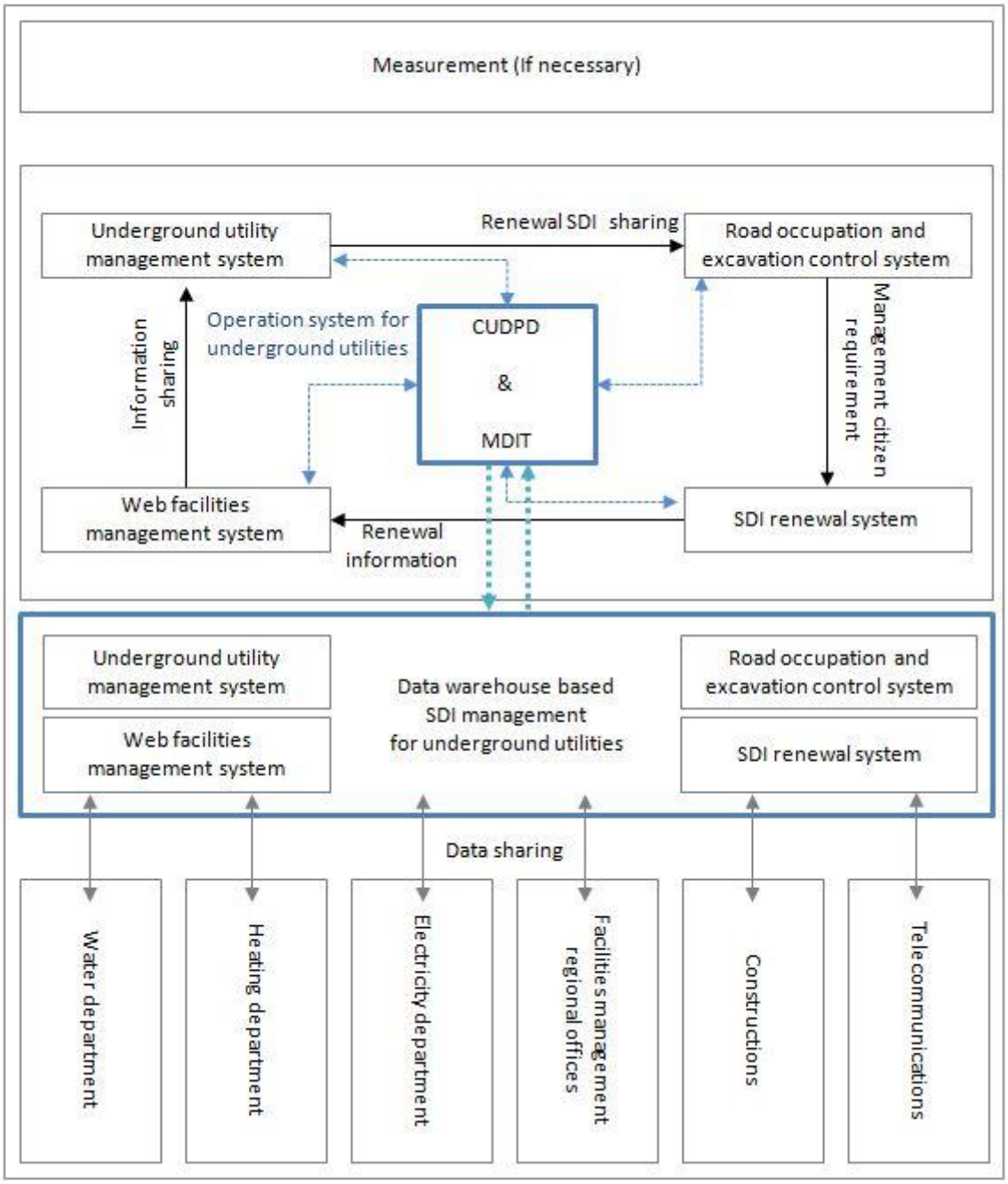
Division	Apply challenges
Preceding challenges	• Development of Systematic Urban Development master plan through enhancing the efficiency of spatial data system • Conducting surveys for underground facilities • Establishment of Information sharing system between main agencies • Examination of the decision-making process of Mongolian ICT law • Strengthening Institutional maintenance • (Agreements on information sharing between the agencies and the introduction of information standardization) Centralization of IT infrastructure • Object-oriented information integration
Short-term challenges	• life cycle management for existing facilities • Introduction of Spatial data education system • Promoting a pilot project in connection with ODA and MDB projects or in utilization of a part of their own budget • Object-oriented information integration • Performing sustainable maintenance through the introduction of low-cost S / W
Middle, long-term challenges	• Construction of Pipeline facilities • Establishment of the automatically updated spatial data system • Strengthening the public service through the establishment of the management system integrated with underground facilities • Construction of Road Spot excavation system • Construction of Web Facility Management System

2. To-Be Model Design

2.1 To-Be Model

The future model of underground facilities management system based on short-term and mid/long-term challenges is as follows.

Figure VI-2 To-Be Model



2.2 Total Underground facility management system architecture

2.2.1 Operation environment(H/W)

The h/w specifications of underground facilities integrated management system consist of metadata gateway/nod 1 for Ulaanbaatar city hall, operation PC 1, and spatial data node 5 for the relevant agencies. The relevant agencies use distributed operating system under GIS database operation environment of integrated management system.

Table VI-5 *Operating environment of H/W*

Category	Product Specifications	Q`tity	Location
Metadata Gateway	CPU : 2.0GHz Quad Core * 2 RAM : 4GB	1	Ulaanbaatar City Hall IDC(1st floor)

Sever(DB Server)	HDD : 500GB*2 ODD : DVD R/W N/W : 100MB Ethernet 1EA HBA : 4GB FC 1EA OS : Windows 2008 Server STD Virus vaccine, 19" including monitor		
Data storage	DISK : usable space 10TB RAID : 0,1,0+1,5 Array supporting	1	Ulaanbaatar City Hall IDC(1st floor)
Metadata Node/Spatial data node sever	CPU : 2.0GHz Quad Core * 2 RAM : 4GB HDD : 500GB*2 ODD : DVD R/W N/W : 100MB Ethernet 1EA HBA : 4GB FC 1EA OS : Windows 2008 Server STD Virus vaccine, 19" including monitor	5	Ulaanbaatar City Hall Water Supply and Sewage authority Ulaanbaatar District Heating Company Ulaanbaatar Electricity Distribution Network Company Facility management department "Batbayan burd government owned industrial department" (public/private)
Operating PC	CPU : i7 3 version 3.0G RAM : 4GB HDD : 500GB Graphic : G/F GTX types 1GB OS : Windows 7 pro N/W : Ethernet 10/100/1000 1 EA Virus vaccine, 19" including monitor	1	Ulaanbaatar City Hall IDC(1st floor)

2.2.2 Operation environment(N/W)

The network specifications of underground facilities integrated system are shown below.

Table VI-6 *Operating environment of N/W*

Category	Product Specifications	Quantity	Location
DBMS	ANSI Standard SQL Stored Procedure support minimum 5user Recommended MS SQL 2008 Server Ent	1	Ulaanbaatar City Hall IDC(1st floor)
OS	Windows 2008 Server Ent	8	Ulaanbaatar City Hall IDC(1st floor)
GIS Server	Recommended ArcGIS Server 10.1 GIS DB handling for SDE(Spatial Database Engine) support Linked Web Server for Web-adapter support API support for system development and web-based services (JavaScript, Flex, Silverlight)	1	Ulaanbaatar City Hall IDC(1st floor)
GIS Tool	Arc GIS Info recommended for editing GIS Data Linked to the GIS Server based on Tool Production and editing of the map, Data In/Out Required to be compatible CAD data Tool Used in complex and sophisticated editing (Ex: coordinate system conversion, analysis, etc.)	5	User PC

GIS Object	It overcomes the system limitations based on web-service (UI, Speed) for the development of new management system based on Arc Object and CS(Client/Server)	5	User PC
Web Server	Recommended MS IIS by considering the environment of Windows-based OS	8	Ulaanbaatar City Hall IDC(1st floor)
WAS Server	Web Application Server is suitable when considering the developmental environment and the compatibility with the web-server. When developing programs based on Java, it can be utilizing Tomcat, BEA Web Logic, and IBM Web Sphere. Tomcat is eligible to be used when less than a hundred people use the system simultaneously. When more than a hundred people use the system simultaneously, web-logic and web-sphere are recommended.	1	Ulaanbaatar City Hall IDC(1st floor)

2.2.3 Operation environment(S/W)

The software specifications of underground facilities integrated system are as below.

Table VI-7 *Operating environment of S/W*

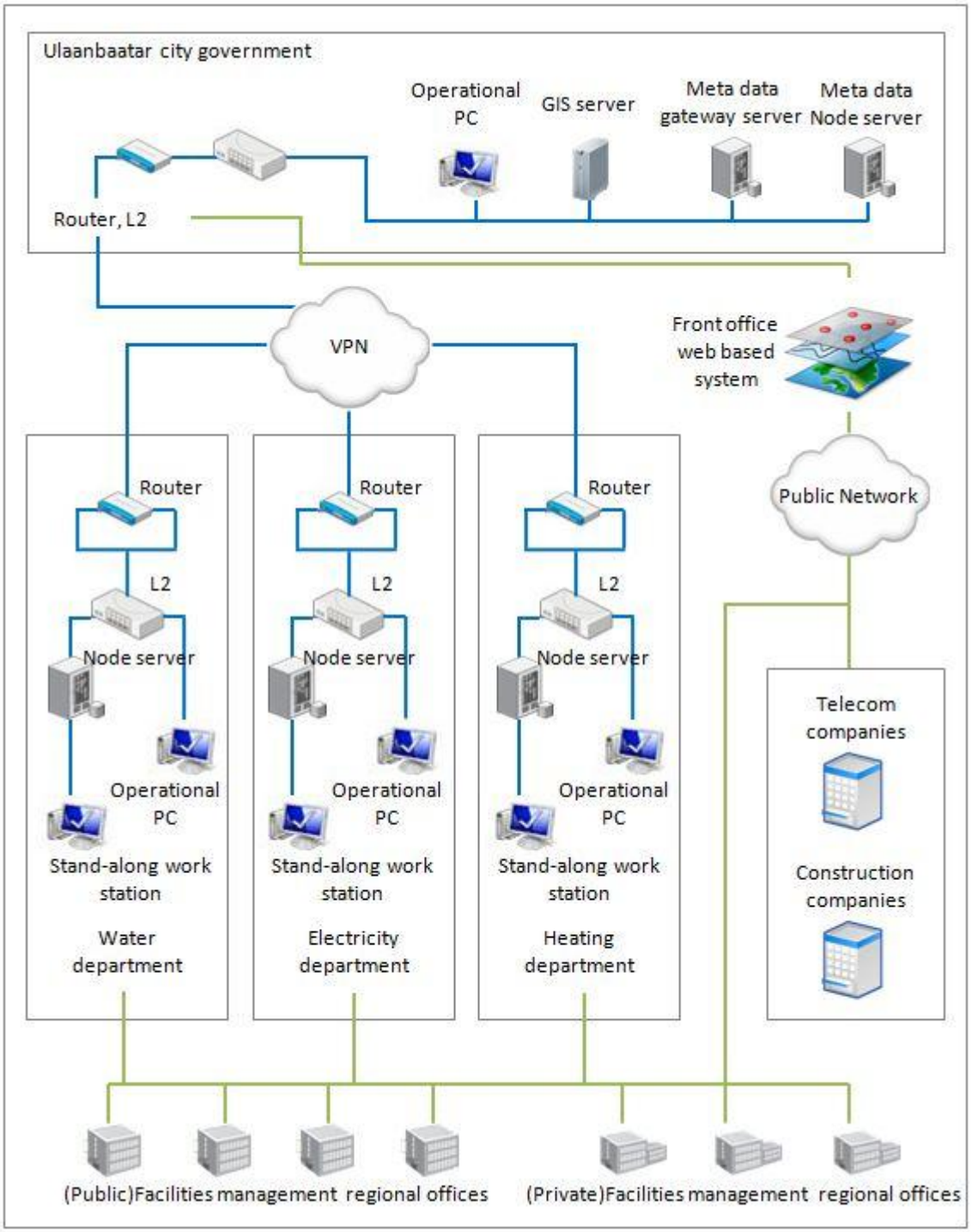
Category	Product Specifications	Quantity	Location
DBMS	ANSI Standard SQL Stored Procedure support minimum 5user Recommended MS SQL 2008 Server Ent	1	Ulaanbaatar City Hall IDC(1st floor)
OS	Windows 2008 Server Ent	8	Ulaanbaatar City Hall IDC(1st floor)
GIS Server	Recommended ArcGIS Server 10.1 GIS DB handling for SDE(Spatial Database Engine) support Linked Web Server for Web-adapter support API support for system development and web-based services (JavaScript, Flex, Silverlight)	1	Ulaanbaatar City Hall IDC(1st floor)
GIS Tool	Arc GIS Info recommended for editing GIS Data Linked to the GIS Server, production and editing of maps based on Tool, Data In/Out, Required to be compatible with CAD data Tool Used in complex and sophisticated editing (Ex: coordinate system conversion, analysis, etc.)	5	User PC
GIS Object	It overcomes the system limitations based on web-service (UI, Speed) for the development of new management system based on Arc Object and CS(Client/Server)	5	User PC
Web Server	Recommended MS IIS when considering the environment of Windows-based OS	8	Ulaanbaatar City Hall IDC(1st floor)

WAS Server	Web Application Server is suitable when considering the developmental environment and the compatibility with the web-server. When the development program is based on Java, it can be utilizing Tomcat, BEA Web Logic, and IBM Web Sphere. Tomcat is eligible to be used when less than a hundred people use the system simultaneously. When more than a hundred people use the system simultaneously, web-logic and web-sphere are recommended.	1	Ulaanbaatar City Hall IDC(1st floor)

2.2.4 Visualization environment

It is for the city of Ulaanbaatar to integrate the underground facilities (Water/Sewage, Electricity, Communication, and Heating) with the urban infrastructure (load) based on the current digital map, and to share the underground facilities information in real-time with other relevant agencies through web GIS technology on the internet environment.

Figure VI-3 Thy system configuration



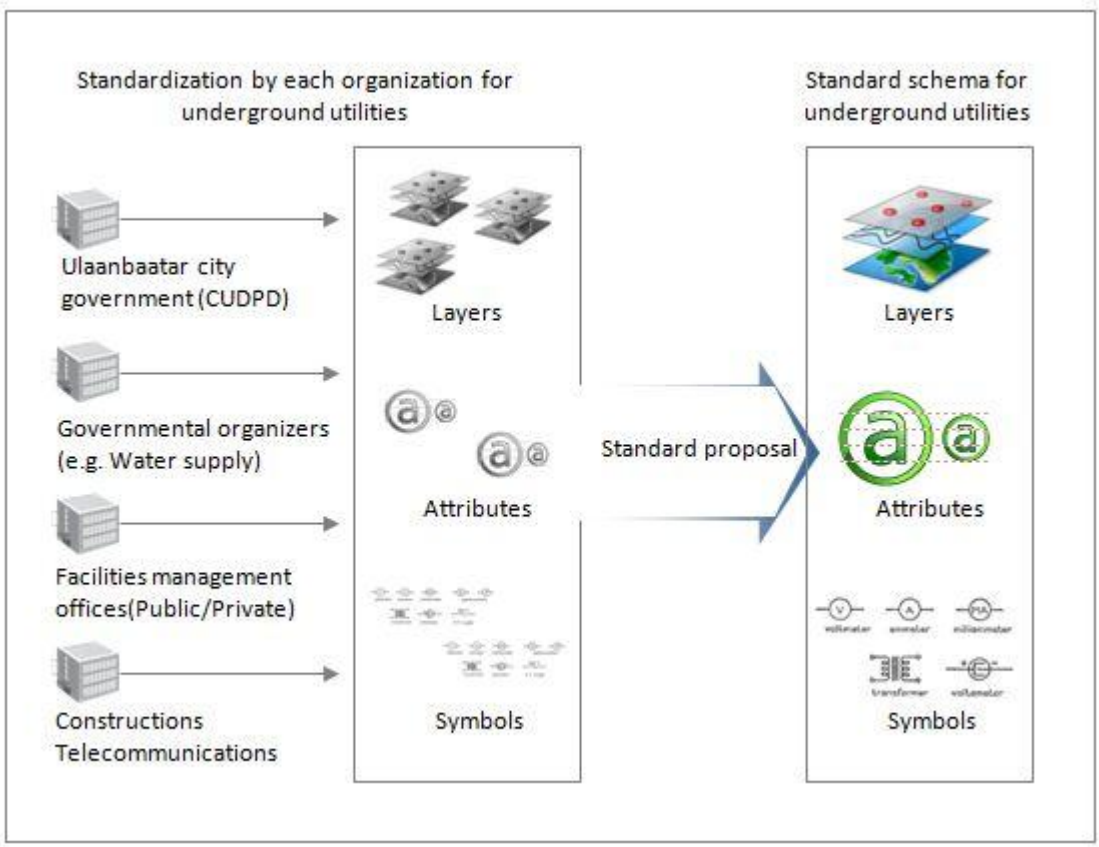
2.3 Data base construction plan

It is necessary to conduct an analysis on underground management system and database between management agencies and relevant agencies for the cross-references of underground facilities information since each agency has different GIS S/W and DB types for underground facilities management. Therefore, it has to be converted into 'integration schema' by using 'spatial data converting tool' in order to share information between agencies through sharing the source data base which is maintained by each facilities agency.

2.3.1 Spatial Data infrastructure design

It is necessary that each facility should develop the integrated schema standard in order to manage the integrated underground facilities from relevant agencies. Thus, this report emphasizes the necessity of underground integrated schema standard through the introduction of the best practices (case study) and the promotion conference for standardization underground facilities.

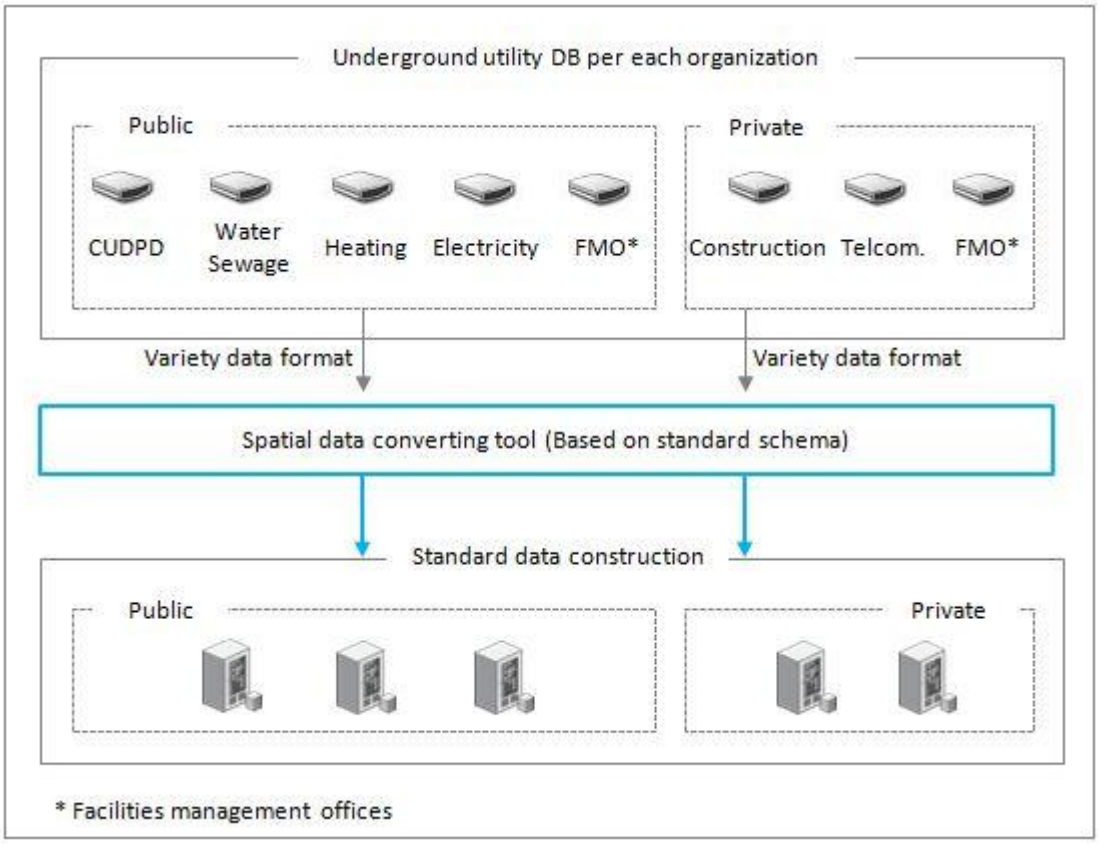
Figure VI-4 Underground integrated schema(draft) Design



Also, each agency has different types of GIS data& database schema. So they have been using separate maintenance management system for underground facility for many years.

However, the integrated schema standard (draft) is defined as shown above for the construction of underground facilities integrated system. The source database needs to be converted and stored into standard database using the spatial data converting tool in accordance with the integrated schema.

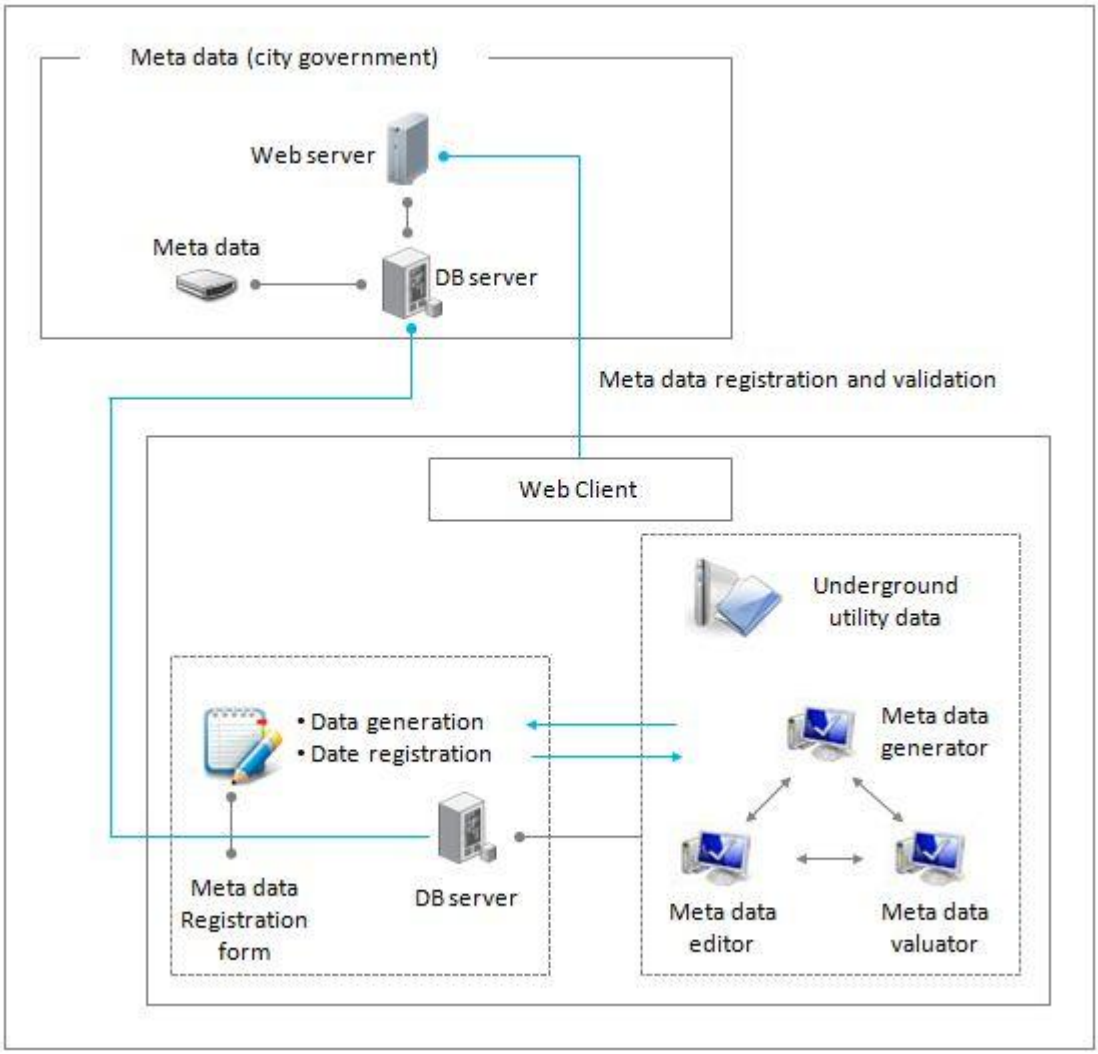
Figure VI-5 Spatial data tools


Underground utility DB per each organization
Public
CUDPD
Water Sewage
Heating
Electricity
FMO*
Private
Construction
Telcom.
FMO*
Variety data format
Variety data format
Spatial data converting tool (Based on standard schema)
Standard data construction
Public
Private
* Facilities management offices

2.3.2 Meta data base design

Underground facilities metadata items in this project should be based on the core items of international metadata standard using the metadata editor. Also it needs to construct and design the common data in reference to the integrated underground facilities information. Currently, some of relevant agencies have been trying to construct spatial data infrastructure whereas the system which is updating & revising metadata for information sharing is absent in Ulaanbaatar. Thus, it is essential to construct the metadata DB for the effective use. The metadata system configuration is shown in the figure below.

Figure VI-6 Metadata concept construction



Meta data base is coded, modified, and deleted by the metadata editor. The underground facilities data sever are to acquire a certification of the possibility of editing by connecting metadata node. After obtaining the certification, the underground facilities data sever inputs the details of the metadata items by using the metadata editor, and then, acquires the validation of suitability by using the metadata evaluator. Finally, the Meta data base is registered and edited.

2.4 Underground facilities measurement

2.4.1 Measurement method

2.4.1.1 The exploration method

This approach is the measurement method of underground facilities by exploration. When the electricity flows through conductive objects, a cylinder-shaped magnetic field is formed, centering on the direction of the flow of electricity. Correspondingly, when the electricity flows through tubular, conductive objects buried underground, the magnetic field is formed around the tubular objects. At that moment, the horizontal component of the magnetic field is maximized, and if measured from the surface of the earth, the location of underground facilities is able to be detected. This method has advantages in grasping the location and the condition of, and the connections between underground facilities, but is difficult to detect non-metallic underground facilities.
The direct exploration method is as below.

Table VI-8 *The measurement method of underground facilities by exploration*

Category	Description
Electromagnetic Induction Method	Direct mode If the buried pipe is electrical conductor, one of transmission electrodes directly connects a pipe and other electrodes are put to be on the ground in order to form a concentric circular magnetic field by sending the electric current
	External coil mode Although the buried pipe is an electrical conductor, it cannot be connected directly if the buried pipe is coated. In this case, the buried pipe should be wrapped with a coil using the clamp, and then a constant frequency should be applied to the buried pipe in order to make an induced current. Then, the induced current is able to form a concentric circular magnetic field. .
	Indirect mode If impossible to access the tube directly, a magnetic field is sent to the expected points by transmission loop, and then it causes induced electricity. So a magnetic field is formed around a pipe.
Sonde/Probe Method	In the case of nonconductive pipe, the pipe can be detected along the pipeline by inserting a probe into a pipe.
Ground Penetration Rader Method	GPR uses radar pulses to image the subsurface. This nondestructive method uses electromagnetic radiation in the microwave band of the radio spectrum, and detects the reflected signals from subsurface structures.
Passive method	If a diameter of a pipe is relatively small, and the pipe itself produces distinct electromagnetic field (e.g. communication pipes), the cable location and the depth of buried pipe can be found through communication frequency without the need of a transmission source

2.4.1.1 Real-time measurement method

Real-time measurement method is applied to the construction of new underground facilities excavation work. It is to measure the exposed underground facilities after the excavation work. The merit of this method is that it has better accuracy than the exploration method and that it has less exploration error, and location and depth error as a mean of finding the exposed underground facilities.

The measurement methods are below.

- Direct measurement

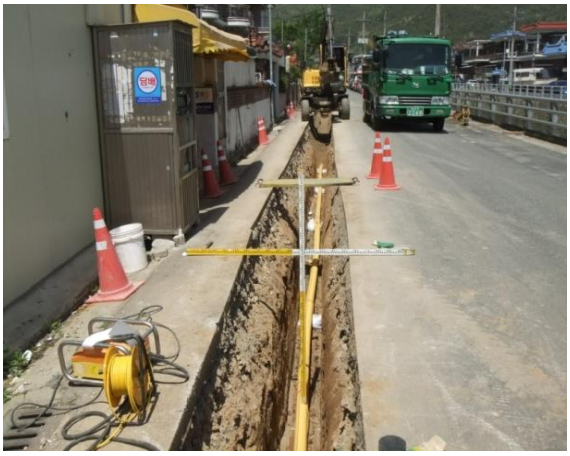
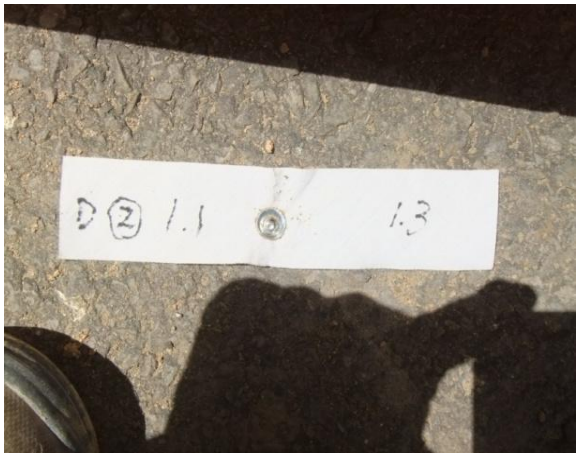
In such cases as building development districts where no standard exist, this method can be used as a way to measure the top of the exposed pipeline as described in the table.

Figure VI-7 Direct measurement picture by step

<table>
<tr><td>  </td><td> 
</td></tr>
<tr><td>A field of construction work photo shoot</td><td>(kind of pipe /pipe diameter/
depth/measuring-point name recode)</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>The measurement of the top of
the pipeline location photo shoot</td><td>After construction photo shoot</td></tr>
</table>

- Indirect measurement

Figure VI-8 Indirect measurement picture by step

	
A field of construction work photo shoot	Laying status foot plate spaced anchor points foot plate Lay the tube on top of photo shoot (kind of pipe /pipe diameter/ depth/measuring-point name recode)
	
After recording separation point measurement point /separation distance/depth photo shoot	It measures the exact distance on the road from separation point photo shoot

2.4.2 Measurement equipment

Depending on the underground facilities measurement methods, the necessary equipments are varied as below.

Table VI-9 *Major exploration equipment*

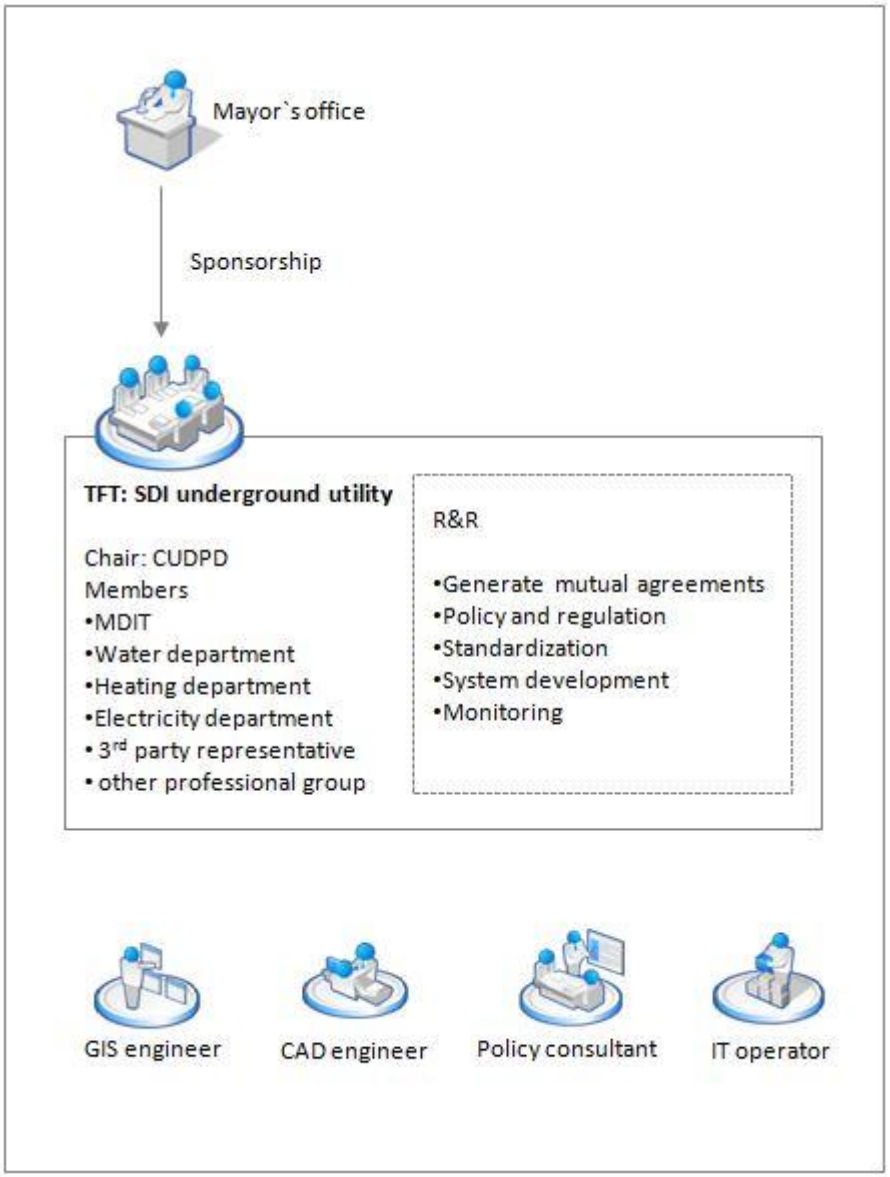
Name of equipment	Related images	Remark

MPL-H10S		Under ground facilities measuremen t equipment
GPS instrument	 	
Total station	 	
level	 	

2.5 The establish of underground facilities integrated management process

The main agencies managing the underground facilities consist of Construction, Urban Development and Planning Department, Water supply and Sewage Authority, Ulaanbaatar District Heating Company, Ulaanbaatar Electricity Distribution Network Company and private companies having the communication cable. Thus, the management authority of underground facilities in Ulaanbaatar is diversified. There is lack of unity among the agencies because of the absence of the related laws & regulations. As mentioned above, the underground facilities integrated management system shown as below is required.

Figure VI-9 Process structure



3. Project budget

Although more detailed issues related to developing a master plan of underground facilities should be considered in order for the efficient use of the spatial data information of the entire Ulaanbaatar city, this report, based on some assumptions of the underground facilities integrated management system, describes the necessary budget for promoting the project.

According to the interview with the person in charge of spatial data in Ulaanbaatar city hall,
The officer addressed that there is no need to do the measurement work for underground facilities because the existing spatial data is high in accuracy.
On the other hand, according to the opinion of the person in charge of spatial data as in working level, it needs to conduct a survey on underground facilities because the existing spatial data is low in accuracy. Thus, the measurement costs are briefly described.

The total budget consists of personnel expenses, H/W, S/W and N/W

3.1 The measurement and the development costs of DB

The measurement cost of the underground facilities is variable depending on the work condition. Referring to the company specialized in the measurement; normally the cost estimates 1 km units for approximately US $ 70,000

It takes 7~8 days for measurement of 1km/GIS DB construction

Table VI-10 *Total length for measurement by organization*

Category	Details	The length	Surveying costs	Remark
Water Supply and Sewage Authority	Water	350.3	US $ 2,452,100	Exploration and DB construction costs
	Sewage	151,7	US $ 1,061,900	
Ulaanbaatar District Heating Company	-	1,200,0	US $ 8,400,000	
Ulaanbaatar Electricity Distribution Network	-	337,4	US $ 2,361,800	

3.2 H/W budget

H / W equipment is essential for establishing the DB. Data Server, Work station, work PC, and color scanners for existing Hard copy drawings can be classified into the data building equipment and the data storing equipment.

US $ 85,000 was estimated for the total budget of H / W for the initial year, and the depreciation term of four years was formulated.

3.3 S/W budget

Software objects were taken into consideration including DBMS, OS and GIS tool and a total budget of US $ 223,000 was determined. Web server and WAS server are priced to be held by the existing City Hall.

3.4 IT System development budget

Each system cost of establishing underground facilities integrated management systems, roads Spot excavation systems and underground facilities automatic updating system and the systems associated with this project are shown in the table below.

Table VI-11 *System construction budget*

Category	Cost (USD)	Remark
Underground integrated management system	US $ 552,000	
Load occupation/excavation system	US $ 294,000	
Underground utilities automatic information	US $ 339,000	
Total	US $ 1,185,000	

VII.Feasibility Analysis (FA)

1. Cost item set

In term of feasibility study, if the cost of the entire project is simplified to an overall cost, it is difficult to track the cash flow for the feasibility analysis. Especially, it is difficult to check the reinvestment for equipment in the future. Thus, categories need to be subdivided and analyzed separately for feasibility analysis

This is the detailed analysis for the cost of the item as follows:

- Exploration and DB building costs
- H/W costs of introduction
- S/W costs of introduction
- System development costs
- System updating costs
- System management costs
- System operating costs

1.2 Exploration and DB building costs

Though the cost of exploration and database construction is varied depending on the working environment and other conditions, according to the interview with the specialty GIS Company, it is possible to build the spatial data infrastructure DB for the average of US $ 7,000.00 and the average duration of 7-8 working days.

1.3 H/W Purchase cost

H/W equipment is essential to build up the database.
As mentioned in the recommendation part, the configuration of the equipment is storage devices, operating devices, network devices, etc. The cost of these equipments is shown in the table below

Table VII-1 *H/W purchase cost*

Category	Unit Price (USD)	Quantity	Total
Metadata gateway server (DB server)	US $ 10,500	1	US $ 10,500
Data Storage	US $ 9,000	1	US $ 9,000
Metadata Node/Spatial Data Server	US $ 10,000	5	US $ 50,000
Operating PC	US $ 3,000	1	US $ 3,000
Route(L3)	US $ 2,000	5	US $ 10,000
Switch(L2)	US $ 500	5	US $ 2,500
VPN Client	-	5	-
VPN Server	-	1	-
Total			US $ 85,000

In addition, the equipment needs to be replaced by new one due to the depreciation over time.

Especially, due to the advancements of information technology, these equipments may have to be replaced earlier than we expect. It can be assuming that the duration of the each piece of the equipment is every 4 years, reflected by the estimation of the equipment life expectancy.

1.4 S/W Purchase cost

S/W, as a tool, operates the purchased the H/W or Database. For more information of S/W, it is already mentioned in the Recommendation, and S/W Purchase costs are shown in the table below.

Table VII-2 *S/W Purchase cost*

Category	United Price (USD)	Quantity	Total
DBMS	US $ 5,000	1	US $ 5,000
OS	US $ 2,000	5	US $ 10,000
GIS server	US $ 78,000	1	US $ 78,000
GIS Tool	US $ 55,000	1	US $ 55,000
GIS Object	US $ 5,000	5	US $ 25,000
Web server	US $ 50,000	1	US $ 50,000
Was Server			
Total			US $ 223,000

1.5 IT system development cost

The costs of underground facilities integrated management system, load occupation excavation system, and underground facilities information automatic updating system are to be calculated by manpower input as follow.

Table VII-3 *Manpower input underground utilities integrated management system*

Costs of input payroll	Price (Month)	M/M	Number	Rate of Input	Total
Expert	12,000	9	1	50%	US $ 54,000
Advanced	10,000	9	1	100%	US $ 90,000
Middle	8,000	12	2	100%	US $ 192,000
Beginner	6,000	12	3	100%	US $ 216,000
The total number					US $ 552,000

Table VII-4 *Road occupation exaction system*

Costs of input payroll	Price (Month)	M/M	Number	Rate of Input	Total
Expert	12,000	9	1	50%	US $ 54,000
Advanced	10,000	9	0	0%	-
Middle	8,000	12	1	100%	US $ 96,000
Beginner	6,000	12	2	100%	US $ 144,000
The total number					US $ 294,000

Table VII-5 *Underground utilities information automatic system*

Costs of input payroll	Price (month)	M/M	Number	Rate of Input	Total
Expert	12,000	9	1	50%	US $ 54,000
Advanced	10,000	9	1	50%	US $ 45,000
Middle	8,000	12	1	100%	US $ 96,000
Beginner	6,000	12	2	100%	US $ 144,000
The total number					US $ 339,000

Table VII-6 *System Development costs*

Category	Cost of building (USD)	Remark
Underground facility integrated management system	US $ 552,000	Construction standard 2013
Road occupation & excavation system	US $ 294,000	Construction standard 2014
Underground facility information automatic renewal system	US $ 339,000	Construction standard 2015

1.6 The cost of system renewal

The cost of system update is based on 4 year of H/W life expectancy. The renewal of an existing system is inevitable due to the introduction of new technologies for efficient H/W equipment. However, the cost of the system renewal has set on 30% of the initial construction cost in consideration of the possibility of using the existing system.

1.7 The cost of system management

The cost of system management is for maintaining and repairing the established system and S/W, and 10% of the purchase price of each S/W is calculated for this.

1.8 The cost of system operation

The costs of system operation mean the costs of purchasing supplies for the operating system in Ulaanbaatar city. The costs of system operation are about US $ 10,000 based on Kwangju, which is the most similar to Ulaanbaatar city.

2. Benefit item set

The general meaning of benefit is to obtain services and goods through the enterprise performance process. In the case of the national project, different from private companies, it is desirable to measure benefits including both direct and indirect benefits. Thus, in the case of the public project, benefits might be estimated relatively low if calculated excluding the direct benefits as well as the indirect benefits such as disaster prevention, increased efficiency, and convenience. Especially, there are growing numbers of private/public facilities constructions in Ulaanbaatar due to the rapid urbanization, and accordingly, numbers of construction accidents happen, which may cause damages on underground facilities, traffic jams, cutting off from social infrastructure (e.g. water, power outage), etc. Thus, overall benefits would be larger than the quantifiable amount, but in this report, benefit items are set on the basis of the quantitative analysis.

The setting of benefit items in this report is as below.

- The cost saving of the official payroll cost
- The cost saving of the civil standby time
- The cost saving of accident prevention
- The cost saving of updated drawing

2.1 The cost saving of administrative and onsite official payroll

According to the introduction of underground integrated management system, the unnecessary business process can be reduced and the overall working efficiency can be improved. Ulaanbaatar City Hall and the relevant agencies in the average wage is based on the number of civil servants involved in activities related to the work related to underground utilities and 50% is assumed.

Table VII-7 *Number of labor cost for underground facilities*

Category	Workers (M/M)	Average wage(year)	Saving (50%)	Remark
Construction, Urban Development and Planning Department	21	US $ 5,400	US $ 56,700	
Water supply and sewage authority	71	US $ 5,400	US $ 191,700	
Ulaanbaatar District Heating company	53	US $ 5,400	US $ 143,100	
Ulaanbaatar Electricity Distribution Network	100	US $ 5,400	US $ 270,000	
Total	245		US $ 661,500	

2.2 The cost saving of civil waiting time

In the case of Kwangju city, the most similar city of Korea to Ulaanbaatar city, the number of cases that underground facility maps have been issued are approximately 4,300 cases. When applied to the case of Mongolia, and calculated based on Mongolia`s per capita income, the cost saving of civil waiting time of Mongolia is estimated to be US $18,962 in 2013.

Main assumption is that the number of issuances of civil documents will be increasing 10% by each year; in the condition that the civil income will grow by 10% per first 4 years and by 5% until 2022.

2.3 The cost saving of accident prevention

The cost saving of accident prevention is concerned with the unpredictable accidents by other organization. Each organization which manages underground facilities has been damaged by other organization during constructions due to lack of accurate information and information sharing. Thus, these cost saving items are one of the main saving items of underground facility management.

All information below is collected by each organization.

Table VII-8 *Total amount of prevention accident benefit*

Category	The annual average number of accidents	Accident average cost	Total

Water supply and sewage authority	18	US $ 13,000	US $ 234,000
Ulaanbaatar District Heating company	24	US $ 12,000	US $ 288,000
Ulaanbaatar Electricity Distribution Network	40	US $ 5,000	US $ 200,000
Total	82	US $ 30,000	US $ 722,000

2.4 The cost saving of updating drawing

The cost saving of updating drawing is estimated based on the case of Kwangju, the most similar city of Korea to Ulaanbaatar city. In the case of Kwangju, they saved $507,343 in 2012 under the main assumption of 5% growth in each year.

3. Feasibility Analysis

3.1 The setting of precondition

3.1.1 The setting of discount rate

The definition of discount rate is the interest rate that an eligible depository institution is charged to borrow short-term funds directly from a Federal Reserve Bank. Different types of loans are available from Federal Reserve Banks and each corresponding type of credit has its own discount rate.

The interest rate is used in discounted cash flow analysis to determine the present value of future cash flows. The discount rate takes into account the time value of money (the idea that money available now is worth more than the same amount of money available in the future because it could be earning interest) and the risk or uncertainty of the anticipated future cash flows (which might be less than expected).

However, the monetary value is possible to change under influence on over time. In this point, it defines monetary values (or the purchasing power of money) as the purchase of any goods of monetary values

$$\text{The nominal interest rate} = (1+\text{real interest rate})*(1+\text{inflation rate})-1$$

$$\text{The real interest rate} = \frac{1+\text{the nominal interest rate}}{1+\text{the inflitation rate}} -1$$

3.1.2 Cash flow statements

Cash flow statement can be divided into nominal cash flows and real cash flows. Nominal cash flow is cash flow in absolute terms without adjusting for inflation. In the short term, nominal cash flow equates to real cash flow, but if a cash flow remains the same in a period of high inflation, these results in a real loss for the person or company receiving a cash flow and a real gain for the one giving it. When applying the cash flow and the discount rate in the feasibility analysis, nominal cash flow should be accurate by nominal discount; real cash flow should be discounted by real discount rate. And then it can determine exactly the current value.

Table VII-9 *The real discount rate*

Category	The rate of inflation (%)	Nominal discount rate	Real discount rate (%)

		(%)	
Discount rate	6	10	3.8
		12	5.7
		14	7.5
	8	10	1.9
		12	3.7
		14	5.6
	10	10	0
		12	1.8
		14	3.6

3.2 Estimated cash flow

Based on 1. Costs of setting 2. Benefits of setting of this feasibility study, the estimated cash flows are as below.

Table VII-10 *Estimated Cash flow(1) (including the surveying and DB, construction cost)*

Unit: `000 USD

Category	2013	2014	2015	2016	2017
Benefit					
The cost saving of official payroll cost	-	793	865	942	1,027
The cost saving of Civil waiting time	-	-	24	30	37
The cost saving of accident prevention	-	858	935	1,019	1,111
The cost saving of updated drawing	-	-	-	617	648
Total	-	1,651	1,823	2,608	2,823
Cost					
Exploration and cost of DB building	14,276	-	-	-	-
H/W purchase costs	85	-	-	-	85
S/W purchase costs	223	-	-	-	-
System development costs	552	294	339	-	-
System renewal costs	-	-	-	-	166
System management costs	-	85	119	119	119
System operating costs	-	20	30	30	30
Total	15,136	399	488	149	399
Cash flow (year)	-15,136	1,831	1,923	2,459	2,424
Cash flow (Accumulation)		-13,883	-12,548	- 10,088	- 7,664

Table VII-11 *Estimated Cash flow(2) (including the surveying and DB, construction cost)*

Category	2018	2019	2020	2021	2022
Benefit					
The cost saving of official payroll cost	1,120	1,220	1,330	1,450	1,580

The cost saving of Civil waiting time	45	54	64	77	92
The cost saving of accident prevention	1,211	1,320	1,439	1,568	1,709
The cost saving of updated drawing	680	714	750	787	826
Total	3,055	3,308	3,582	3,882	4,208
Cost					
Exploration and cost of DB building	-	-	-	-	-
H/W purchase costs	-	-	-	85	-
S/W purchase costs	-	-	-	-	-
System development costs	-	-	-	-	-
System renewal costs	88	102	-	166	88
System management costs	119	119	119	119	119
System operating costs	30	30	30	30	30
Total	237	250	149	399	237
Cash flow (year)	2,818	3,057	3,434	3,483	3,971
Cash flow (Accumulation)	- 4,846	- 1.789	1,645	5,128	9,099

According to the opinion of the person in charge of the spatial data in Construction, Urban Development and planning department in Ulaanbaatar city hall, if not necessary to survey underground, the estimated cash flow is as follow.

Table VII-12 *Estimated cash flow(3) (not included surveying and DB construction cost)*

Unit: `000 USD

Category	2013	2014	2015	2016	2017
Benefit					
The cost saving of the official payroll cost	-	793	865	942	1,027
The cost saving of Civil waiting time	-	-	24	30	37
The cost saving of accident prevention	-	858	935	1,019	1,111
The cost saving of updated drawing	-	-	-	617	648
Total	-	1,651	1,823	2,608	2,823
Cost					
H/W purchase costs	85	-	-	-	85
S/W purchase costs	223	-	-	-	-
System development costs	552	294	339	-	-
System renewal costs	-	-	-	-	166
System management costs	-	85	119	119	119
System operating costs	-	20	30	30	30
Total	860	399	488	149	399
Cash flow (year)	- 860	1,831	1,923	2,459	2,424
Cash flow (Accumulation)		392	1,728	4,188	6,611

Table VII-13 *Estimated cash flow(4) (not included surveying and DB construction cost)*

Category	2018	2019	2020	2021	2022
Benefit					
The cost saving of the official payroll cost	1,120	1,220	1,330	1,450	1,580
The cost saving of Civil waiting time	45	54	64	77	92
The cost saving of accident prevention	1,211	1,320	1,439	1,568	1,709
The cost saving of updated drawing	680	714	750	787	826
Total	3,055	3,308	3,582	3,882	4,208
Cost					
H/W purchase costs	-	-	-	85	-
S/W purchase costs	-	-	-	-	-
System development costs	-	-	-	-	-
System renewal costs	88	102	-	166	88
System management costs	119	119	119	119	119
System operating costs	30	30	30	30	30
Total	237	250	149	399	237
Cash flow (year)	2,818	3,057	3,434	3,483	3,971
Cash flow (Accumulation)	9,430	12,487	15,921	19,404	23,375

If the construction of the spatial data system is started in 2013, the estimated cash flow reflected on surveying and Database construction costs presents that the accumulated cash flow converts into + in 2020. In case of excluding the costs of surveying and database construction costs, the accumulated cash flow converts into + in 2014.

3.3 Feasibility analysis

This analysis is to verify the feasibility of this project based on the net present value, and to confirm the feasibility of this project through B/C analysis in order to find the discount rate matching the costs and benefits of the internal revenue law as a secondary means of the analysis of the above to use.

3.3.1 The net present value method (NPV)

In finance, the net present value (NPV) or net present worth (NPW) [1] of a time series of cash flows, both incoming and outgoing, is defined as the sum of the present values (PVs) of the individual cash flows of the same entity.

In the case when all future cash flows are incoming (such as coupons and principal of a bond) and the only outflow of cash is the purchase price, the NPV is simply the PV of future cash flows minus the purchase price (which is its own PV). NPV is a central tool in discounted cash flow (DCF) analysis and is a standard method for using the time value of money to appraise long-term projects. Used for capital budgeting and widely used throughout economics, finance, and accounting, it measures the excess or shortfall of cash flows, in present value terms, once financing charges are met.

NPV can be described as the "difference amount" between the sums of discounted: cash inflows and cash outflows. It compares the present value of money today to the present value of money in future, taking inflation and returns into account.

The NPV of a sequence of cash flows takes as inputs of the cash flows and a discount rate or discount curve and outputs of a price; the converse process in DCF analysis — taking a sequence of cash flows and a price as input and inferring as output a discount rate (the discount rate which would yield the given price as NPV) — is called the yield and is more widely used in bond trading.

$$NPV = \sum_{n=1}^{n} \left(\frac{Bi - Ci}{1(1+d)i} \right), \qquad \text{i} = 1,2, \ldots \ldots, \text{n}$$

Table VII-14 *According to the change of the discount rate, current value*
(Including the cost of surveying and database construction)

Unit: %, `000 USD

category	The rate of inflation	Nominal discount rate	Real discount rate	The net present value
Discount rate	0	10%	0%	$ -843
		12%	0%	$ -2,122
		14%	0%	$ -3,243
	6	10%	3.8%	$ 4,448
		12%	5.7%	$ 2,573
		14%	7.5%	$ 1,018
	8	10%	1.9%	$ 6,606
		12%	3.7%	$ 4,555
		14%	5.6%	$ 2,666
	10	10%	0.0%	$ 9,099
		12%	1.8%	$ 6,728
		14%	3.6%	$ 4,661

Table VII-15 *Depending on the change of the discount rate, the net present value changes*
(Not including surveying and Database construction)

Unit: %, `000 USD

category	The rate of inflation	Nominal discount rate	Real discount rate	The net present value
Discount rate	0	10%	0%	$ 13,432
		12%	0%	$ 12,154
		14%	0%	$ 39,354
	6	10%	3.8%	$ 72,601
		12%	5.7%	$ 64,308
		14%	7.5%	$ 57,510
	8	10%	1.9%	$ 82,255
		12%	3.7%	$ 73,073

		14%	5.6%	$ 64,715
	10	10%	0.0%	$ 93,536
		12%	1.8%	$ 82,806
		14%	3.6%	$ 73,549

In conclusion of NPV analysis, all the results are acceptable for investment only except two cases like 12% and 14% of nominal discount rate. In principle, the feasibility is very high because the interest rate will not be 12% and 14% in the real market.

3.3.2 Internal Rate of Return(IRR)

The internal rate of return on an investment or a project is the "annualized effective compounded return rate" or "rate of return" that makes the net present value (NPV as NET*1/ (1+IRR) ^year) of all cash flows (both positive and negative) from a particular investment equal to zero.
In more specific terms, the IRR of an investment is the discount rate at which the net present value of costs (negative cash flows) of the investment equals the net present value of the benefits (positive cash flows) of the investment.
IRR calculations are commonly used to evaluate the desirability of investments or projects. The higher a project's IRR, the more desirable it is to undertake the project. Assuming all projects require the same amount of up-front investment, the project with the highest IRR would be considered the best and undertaken first.
A firm (or individual) should, in theory, undertake all projects or investments available with IRRs that exceed the cost of capital. Investment may be limited by availability of funds to the firm and/or by the firm's capacity or ability to manage numerous projects.

$$IRR = \sum_{n=1}^{n} \left(\frac{Bi - Ci}{(1+d)i} \right) = 0, \qquad \text{i} = 1,2, \ldots \ldots, \text{n}$$

During the IRR analysis, the result of internal rate of return showed 10.2%. It means that borrowing rate of interest will not be 10.2%, which means this project will be appropriated.

4. Final conclusions

According to the change of inflation rate, the feasibility study analysis is as below. To sum up, IRR 8.8% was appraised by applying a conservative situation and reflected on surveying and database construction costs.

Table VII-16 *Feasibility study (Not reflect on the inflation)*

Unit: %. `000 UDS

Inflation rate	0%		
Nominal discount rate	10%	12%	14%
Real discount rate	10%	12%	14%
The net present value	US $ 168	US $ -1,137	US $ -2,284

Table VII-17 *Feasibility study (reflect on the inflation 6%)*

Unit: %. `000 UDS

Inflation rate	6%

Nominal discount rate	10%	12%	14%
Real discount rate	3.8%	5.7%	7.5%
The net present value	US $ 5,551	US $ 3,646	US $ 2,064

Table VII-18 *Feasibility study (reflect on the inflation 8%)*

Unit: %. `000 UDS

Inflation rate	8%		
Nominal discount rate	10%	12%	14%
Real discount rate	1.9%	3.7%	5.6%
The net present value	US $ 5,551	US $ 3,646	US $ 2,064

Table VII-19 *Feasibility study (reflect on the inflation 10%)*

Unit: %. `000 UDS

Inflation rate	10%		
Nominal discount rate	10%	12%	14%
Real discount rate	0.0%	1.8%	3.6%
The net present value	US $ 10,264	US $ 7,863	US $ 5,767

Therefore, if done under the discount rate of 8.8%, or borrowing rate under the same funding, the project can be assessed doable based on the feasibility analysis. In this analysis, the actual cost of the expected investment is reflected in the cost section; however, in the benefits section, it needs attention that it only reflects the expected effect, not the actual effect.

Since one of the important purposes of the public informatization project is the employment of the unemployment or the jobless, the analysis on the employment effects is inevitable; however, this analysis has limitations due to the absence o**f** a developed or proper method which enables the quantitative analysis. The expected but unquantifiable effects can be listed as follows: the security of the construction workers and the prevention of water leakage, power/water failure, and electric shock caused by underground facilities constructions.

In addition, considering other quantifiable effects such as the informatization promotion effect and the disaster prevention effect, it is possible to conclude that this project has sufficient feasibility to be regarded as a national project.

Appendix

<Appendix 1> WebGIS data layers by part

Part	Data layer		
Geographic Data	Administrative data	Khoroo	Khoroo office
		Street	Street
		District boundary	District boundary
		Khoroo boundary	Khoroo boundary
	Education organization	Education organization	Kindergarten
			University
			Secondary school
	Government organization and embassy	Government organization	Government office
			Embassy
	Health organization	Health organization	Hospital
			Family hospital
			Private hospital
	Commercial organization	Service organization	Bank
			Store
			Restaurant
			Hotel
			Auto service
		Industrial	Industrial
	Culture and arts data	Culture organization	Culture organization
			Culture palace
			Culture centre
			Museum
			Library
			Cinema
		Statue	Statue
	Parcel and building data	Building	Building
	Road information	Public transportation	Minibus station
			Bus station
		Bridge	Bridge
		Bus route	Bus route
		Road	Auto road
	Contour	Contour	Contour, Relief
	Aerial photographs	Aerial photographs	-
Environmental Indicators	Administrative data	Khoroo	Khoroo office
		District boundary	District boundary
		Khoroo boundary	Khoroo boundary
	Parcel and building data	Building	Building
	Surface water	River	River
		Main river	Main river
	Nature-spatial Data	Forest	Forest
		Earthquake disaster	Treason

		magnitude	Hazardous
			Average
		Air pollution	No data
			Small
			Medium
			Polluted
			High
		Slope map	More suitable (<5)
			Suitable (5-10)
			Restrictive suitable (10-15)
			Unsuitable (15-25)
			More unsuitable (25<)
Social Indicators	Administrative data	Khoroo	Khoroo office
		Street	Street
		District boundary	District boundary
		Khoroo boundary	Khoroo boundary
	Parcel and building data	Building	Building
	Social indicators	Access to health care facilities	Up to 500m
			500m to 1000m
			1000m to 2000m
			2000m to 3000m
			More than 3000m
		Adult tertiary education achievement level (2010)	Up to 20%
			20% - 40%
			40% - 60%
			60% - 80%
			More than 80%
			No data
		Access to safe drinking water	Up to 300m
			300m to 700m
			700m to 1.5km
			1.5km to 3km
			More than 3km
		Number of recorded crimes (2010)	Up to 14
			15 – 35
			35 – 53
			54 – 78
			79 – 149
		Unemployment rate (2010)	Up to 6.7%
			6.8% - 12.8%
			12.9% - 21.2%
			21.3% - 32.2%
			32.3% - 62.7%
		Heating distribution	Up to 300m
			More than 300m
		Percentage of disabled	Up to 10%

		population (2010)	10% - 20%
			20% - 30%
			30% - 40%
			40% - 53%
			No data
		Access to kindergarten	Up to 500m
			500m to 1km
			1km to 2km
			2km to 3km
			More than 3km
		Distance from power-source	Up to 1km
			1km – 2km
			2km to 2km
			2km – 3km
			Away from 3km
		Family income rate (2010)	1% - 5%
			6% - 10%
			11% - 20%
			21% - 30%
			31% - 40%
			No data
		Population rate per sq.km area	Up to 5000
			5001 – 10000
			10001 – 15000
			15001 – 20000
			More than 20001
		Social and environmental vulnerability	Very vulnerable
			Vulnerable
			Measurable
			Complacent
			Very complacent
		Access to public transport	Up to 600m
			600m – 1200m
			1200m – 1800m
			1800m – 2400m
			2.4km – 5km
			More than 5km
		Sewage line connection	1km – 2km
			Parcels without sewage system
		Housing condition	No data
			More than 75% of all families living in apartment
			50% to 75% of all families living in apartment
			25% of all families living in Ger and 75% are in small house

			25% to 50% of all families living in Ger
			More than 50% of all families living in Ger
Resource Allocation	Administrative data	Khoroo	Khoroo office
		Street	Street
		District boundary	District boundary
		Khoroo boundary	Khoroo boundary
	Parcel and building data	Building	Building
	Resource Allocation	Resource allocated for kindergarten repair (2011)	1.0
			2.5
			5.0
			10.0
		Resource allocated for green belt construction (2011)	No data
			24,9
			25,0
			49,6
			50,0
			110,0
			149,5
			183,4
			407,9
		Resource allocated from city budget for urban upgrading (2011)	No data
			22 – 3000
			3000 – 5000
			5000 – 8000
			8000 – 11000
			11000 – 14000
		Resource allocated from state budget for urban upgrading (2011)	No data
			10 – 250
			250 – 500
			500 – 800
			800 – 1000
			1000 – 1400