WeGO Feasiblity Study 2016

Establishment of Street Lamp & Traffic Light Monitoring System of Seberang Perai

FINAL REPORT

World e-Governments Organization of Cities and Local Governments

Abbreviation

Abbreviation	Full name
ADB	Asian Development Bank
ADSL	Asymmetric Digital Subscriber Line
AIIB	Asia Infrastructure Investment Bank
ASEAN	Association of Southeast Asian Nations
ATMI	Akademi Teknik Mesin Industri
BDA	Big Data Analytics
BEP	Break Even Point
BTO	Build-Transfer-Operate
CAT	Citizen Action Technology
CDM	Clean Development Mechanism
CSF	Critical Success Factor
EGDI	E-Government Development Index
ELX	Electronic Labor Exchange
EP	Electronic Procurement
EPI	E-Participation Index
ESCO	Energy Service Company
EXIM	Export – Import Bank
FS	Feasibility Study
G-77	The Group of 77
GDP	Gross Domestic Product
GHG	Green House Gas
GIS	Geographic Information System
GOE	Generic Office Environment
GSM	Global System for Mobile Communications
HPS	High Pressure Sodium
HRMIS	Human Resources Management Information System
ICCTF	Indonesia Climate Change Trust Fund

Abbreviation	Full name
ICED	Indonesia Clean Energy Development Project
ICT	Information & Communication Technology
IDI	The ICT Development Index
IoT	Internet of Things
IRR	Internal Rate of Return
JICA	Japan International Cooperation Agency
LED	Light Emitting Diode
LTE	Long-Term Evolution
M2M	Machine to Machine
MAMPU	Malaysian Administrative Modernization, and Management Planning Unit
MCMC	Malaysian Communications and Multimedia Commission
MDEC	Malaysia Digital Economy Corporation
MPSP	Majlis Perbandaran Seberang Perai
MSC	The Multimedia Super Corridor
NAM	National Archives of Malaysia
NITA	National IT Agenda
NITC	National IT Council
NPV	Net Present Value
ODA	Official Development Assistance
PIC	Person in Charge
PMS	Project Monitoring System
PSISP	Public Sector ICT Strategic Plan
SDGs	Sustainable Development Goals
SL/TL	Street Lamp/Traffic Light
SPICEC	Seberang Perai International Conference on Ecotourism and Conservation Efforts
SSLI	Smart Street Lighting Initiative
STMS	Street Lamps and Traffic Lights Monitoring System
SWOT	Strengths Weaknesses Opportunities Threats
TCO	Total Cost of Ownership

Abbreviation	Full name
TII	Telecommunications Infrastructure Components
TNB	Tenaga Nasional Berhad
U-SIM	Universal Subscriber Identity Module
USAID	United States Agency for International Development
WCDMA	Wideband Code Division Multiple Access
WeGO	The World e-Governments Organization of Cities and Local Governments

Table of Content

List of Figures

List of Tables

I Introduction

1. Overview & Background of Project

1.1. Project Title

The title of this project is: Feasibility Study for the Establishment of Street Lamp & Traffic Light Monitoring System of Seberang Perai.

1.2. Project Period

The project starts on September 22, 2016, and ends on December 31, 2016.

1.3. Background of the Project

To share knowledge and experience in e-Government, the World e-Governments Organization of Cities and Local Governments (WeGO) provides consulting services to member cities through feasibility studies every year. Seberang Perai, Malaysia was selected as the beneficiary city of the 2016 FS project.

As an important task to achieve the national development plan of Malaysia VISION 2020, the Malaysian government has been trying to introduce e-Government systems to local governments. The Seberang Perai Municipal Council (MPSP) also recognizes the importance of ICT to improve quality and efficiency of work. The MPSP also has a plan to promote Internet of Things (IOT) and big data analytics (BDA) to improve the quality of their citizens' lives.

Managing thousands of street lamps and traffic lights is a crucial issue to secure public safety. The MPSP considers this project as the most important task in Seberang Perai's safe city program. To resolve their safety concerns, establishing a new monitoring system based on ICT and therefore improving the operation of street lamps and traffic lights was proposed as a solution.

1.4. Project Objectives

The main purpose of implementing e-Government in the MPSP is to improve the quality of citizen lives. E-Government is also expected to reduce paperwork in public services by using ICT to enhance the flow of information through all levels of public organizations in Seberang Perai. By implementing a "smart system" using ICT for street lamps and traffic lights, Seberang Perai will be able to have the foundation for better e-Government services and safety of citizens.

1.5. Project Scope

- **As-Is Status Analysis**

  Analyzing the current situation of MPSP

  - Current situation and action plan for e-Government Services of MPSP

- Operation management system and related infrastructure for street lamps and traffic lights
- Data utilization plans related to big data analytics, street lamps, and traffic lights
- Related laws and regulations
- Main issues and requirements from stakeholders

- **Case Study**

  Analyzing best practices

  - Cases of Korea and other countries which have already successfully established and operated m-Government and street lamps & traffic lights system
  - Gap analysis between advanced cases and MPSP

- **To-Be Model**

  Establishing To-Be model based on gap analysis

  - Basic structure and service model of monitoring street lamps & traffic lights system

- **Feasibility Study**

  Analyzing feasibility of To-Be model

  - Economic and Technical Feasibility Analysis

- **Prototype Service**

  Simulating pilot system

  - Smart control system using big data approach: Checking control history, statistics, detailed location and location-based information via maps, information from distribution boxes, number of lights, reference power, flasher, daily (monthly) electronic meter graph, etc.

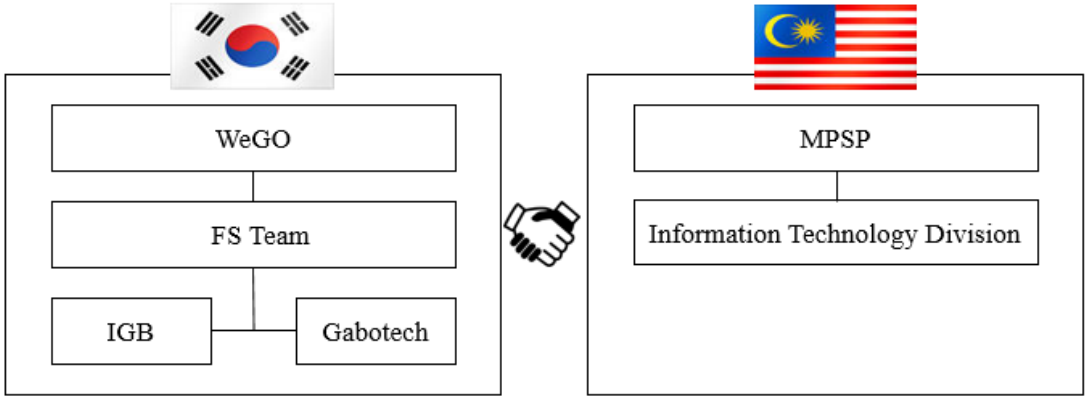
2. Target City & Recipient

The target city and the beneficiary of this project is the city government of Seberang Perai, Malaysia.

3. Structure of Project Implementation

The project organization was set up both in Korea and Malaysia.

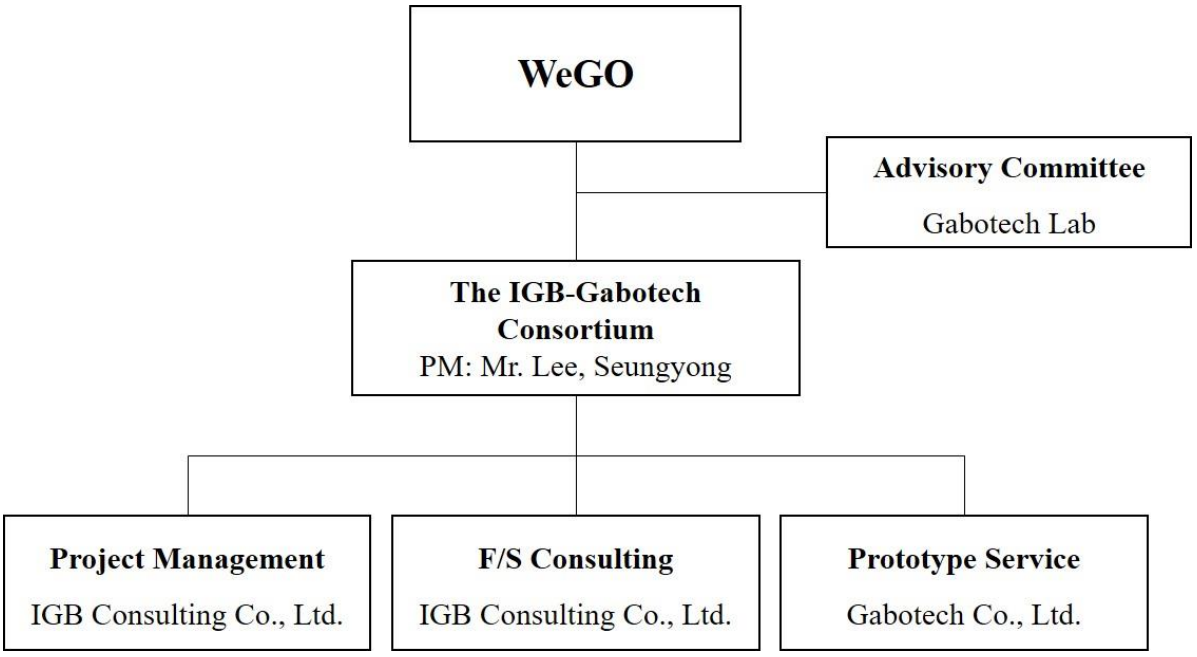
< Figure 1. Structure of Project Implementation >



4. Project Organization

IGB and Gabotech formed the FS team for the project which consists of professionals who have specialties in ICT consulting, feasibility study, and SL/TL operating system with the latest IoT technologies.

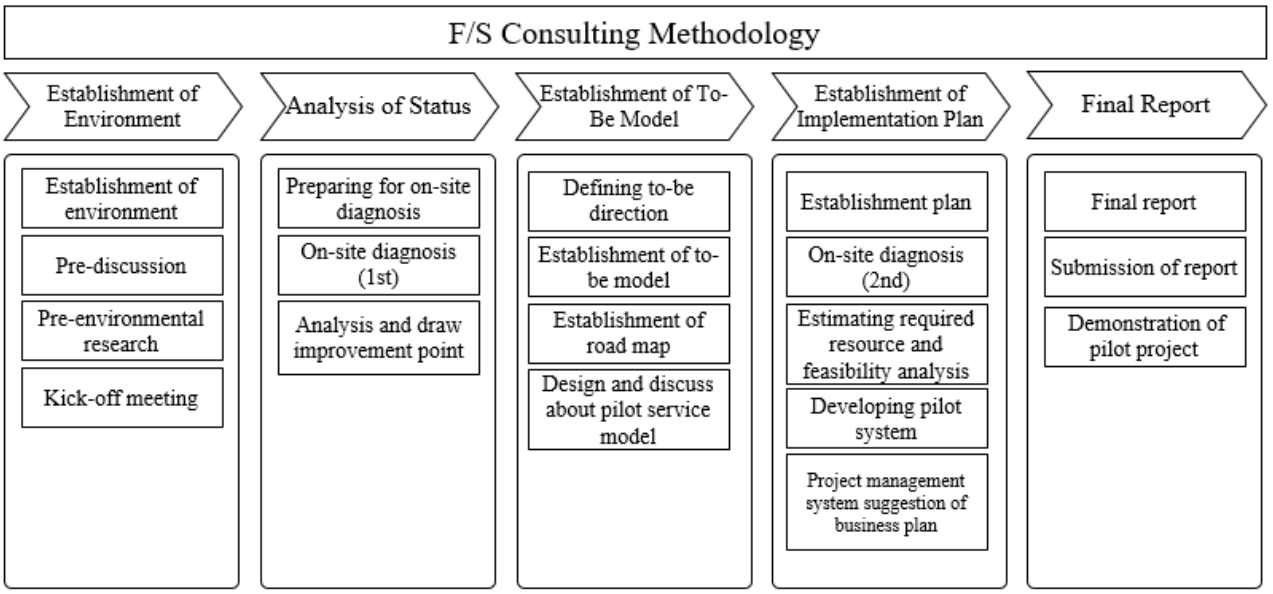
< Figure 2. Project Organization >



5. Project Approach

The FS project was approached and conducted with the following methodologies:

< Figure 3. Project Approach >



6. Project Schedule & Conducted Activities

- Project period: Sep. 22, 2016 – Dec. 31, 2016
- Project Schedule:
  - The main work process of the project has been progressed from October 2016 onwards under the following schedule

< Table 1. Project Schedule >

Stage		Tasks	Working Period							
			Sep		Oct		Nov		Dec	
Project Initiation	Preparation	Working Group Formation		■						
		Pre-Research / Study		■						
	Kick-Off Meeting	Onsite Kick-off Meeting		■						
Current Status Analysis	1st On-Site Inspection	Environmental Research			■					
		Surveys of ICT / e-Gov State			■					
		Interviews with Officials			■					

	Activities in Korea	Analysis of the 1ST Inspection Results									
		Analysis on the Developed Systems									
To-Be Model Design	2nd On-Site Inspection	Additional / Supplemental Research at Malaysia									
	A Study on Future Direction	Discussion with Officials									
	Establishing a Service Model	The Implantation of a Trial Service Model									
	Consultation	Review and Confirm the Range of Service Model									
		Domestic/International System Benchmarking									
Feasibility Analysis	Action Plan Design	Establish a Budget and Action Plan									
		Confirm the Action Plan									
	Feasibility Analysis	Economical FS									
		Technical FS									
	Completion Report	Write the Final Report									
		Review and Approve the Report									
	Pilot system	Development of Pilot System									
Project Completion	Final Report	Report the Results (WeGO)									
		Final Workshop									
		Demonstration of Pilot System									
Reporting Schedule				Inception			Interim			Final	

II City & Country Profile

1. General

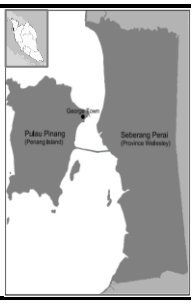
< Table 2. City Profile >

Name	Seberang Perai		
Chief Town	Butterworth		
Government	Seberang Perai Municipal Council		
Area	Total 755 km^2	Population	906,077
State	Penang State		

(WIKIPEDIA 2016)

< Table 3. State Profile >

Name	Penang State		
Capital	George Town		
Government	Penang Island City Council / Seberang Perai Municipal Council		
Area	Total 1,031 km^2	Population	1,902,116
GDP	$ 50,144 billion (2016)	GDP per capita	$ 16,426 (2014)



(WIKIPEDIA 2016)

< Table 4. Country Profile >

Name	Federation of Malaysia				
Capital	Kuala Lumpur / Putrajaya (administrative)				
Government	Federal parliamentary democracy under an elective constitutional monarchy				
Official languages	Bahasa Malaysia		Currency	Ringgit (MYR)	
Area	Total 220.802 km^2		Population	30,331,007 (2015)	
GDP	$ 296.218 billion (2015)		GDP per capita	$ 9,766.2 (2015)	
Religion	61.3%	Sunni Islam	Ethnic groups	50.1%	Malay
	19.8%	Buddhist		22.6%	Chinese
	11.8%	Indigenous		11.8%	Indigenous
	6.7%	Indian		6.7%	Indian
	8.8%	Other		8.8%	other

(BBC MONITORING 2016)

< Figure 4. Map of Malaysia >

2. Geography

The target city of this project, Seberang Perai, is in Penang which is located on the northwest coast of Peninsular Malaysia. Penang can be divided into two parts, Penang Island, home to the capital city of George Town, and Seberang Perai. Seberang Perai is connected to Penang island by the Penang bridge and by ferry services as well. Seberang Perai is divided into three districts—North, South, and Central Seberang Perai.

- Geography: Penang Island is an island of 293 km^2 located in the Straits of Malacca, and Seberang Perai is a narrow hinterland of 653km^2 on the peninsula across a narrow channel whose smallest width is 4 km.

- Climate: Like the rest of Malaysia, Penang has a tropical climate, specifically a tropical rainforest climate. It is slightly drier from December to February, but hot and humid throughout the year.

3. History

Malaysia has its origins in the Malay kingdom Malacca Sultanate established in 1402. There was another old sultanate named Kedah when Malacca was established. Before Penang state got its own government, Penang was previously part of the Sultanate of Kedah until it became a British possession in 1786. It later became part of the Federation of Malaya in 1957. For a long time, the island of Penang has had an important role of influence and trade, the main shipping channel between the Indian Ocean and the Pacific Ocean, linking major Asian economies.

In 1896, the first municipal ordinance was introduced to regulate the local authorities in Penang. Then in 1973, the Rural Board of Province Wellesley was established, and in 1952, Butterworth Municipal Council and the three rural authorities North, Central and South District Council were established. Under the Local Government Act in 1976, the four local authorities were merged to form the Seberang Perai Municipal Council.

4. Economy

Malaysia is the fourth largest economy in Southeast Asia and the 35th largest in the world. Malaysia, once heavily dependent on the export of raw materials such as tin and rubber even as recently as the 1970s, has now become a multi-sector economy and a leading exporter of electrical appliances, electronic parts and components, palm oil, and natural gas.

Penang is the third-largest economy amongst the states of Malaysia after Selangor and Johor and it is the state with the highest GDP per capita in Malaysia. It is well known as the "Silicon Valley of the East", and manufacturing is the most important component of the economy, contributing 45.9% of the state's GDP. Other important sectors are tourism, finance, shipping, and other services.

Seberang Perai, in particular, is located near industrial estates like the Bayan Lepas Free Industrial Zone and Kulim High Tech Park which are highly industrialized with high-tech electronic plants. Thanks to the industrial base, Seberang Perai has become an important industrial and commercial hub. Seberang Perai is also renowned for shopping complexes such as Megamall Pinang, Carrefour Seberang Jaya, and Makro.

The Penang Development Corporation (PDC) is a self-funding statutory body that helps to plan, implement, and promote most of the development projects on behalf of the state government of Penang. Invest Penang is a non-profit entity of the state government with the sole purpose of promoting investments in Penang.

5. People & Society

Malaysia is a multi-ethnic, multi-religious federation of 13 states and three federal territories. The society is multiracial with 50% of Malays, 22% of Chinese, 11% of indigenous people and 6% of Indians. Around 61% of the population is Muslim, 19% is Buddhist, and 6.7% is Hindu. The national capital, the largest city in Malaysia, is Kuala Lumpur.

The population of Penang is 1,902,116 and Seberang Perai is populated by 906,077 people in the 2016 Census. The state has the highest population density in Malaysia with 1,450.5 people per square kilometer. Penang hosts an estimated 50,000 to 60,000 migrant workers, especially from Indonesia, Myanmar, Vietnam, Thailand, and South Asian nations who are mostly involved in domestic help, services, manufacturing, construction, plantations, and agriculture.

< Table 5. Ethnic Groups in Penang 2015 >

Ethnicity	Population	Percentage
Chinese	689,600	41.5%
Bumiputra	693,100	41.7%
Indian	166,000	10.0%
Others	4,700	0.3%
Non-Malaysian	103,300	6.2%

Spoken languages are Malay (official), English, Tamil, and Chinese (Cantonese), and literacy rate, the percentage of people aged 15 or over who can read and write, is 94.6%.

6. Government & Administration

The politics of Malaysia is based on a federal constitutional monarchy in which the King is the head of state and the Prime Minister is the head of government under the Westminster parliamentary system, and is categorized as a representative democracy. The federal government of Malaysia adheres to and is created by the supreme law of the land Federal Constitution of Malaysia. Each of the 13 states has its own constitution which must be compatible with the federal constitution.

The state of Penang also has its own state legislature and executive, but they have very limited powers in comparison with those of the Malaysian federal authorities. Since independence, the head of state of Penang Yang di-Pertua Negeri (also known as Governor) has been appointed by the Yang di-Pertuan Agong (King of Malaysia).

There are currently two local authorities in Penang, the Penang Island City Council (Majlis Bandaraya Pulau Pinang) in charge of Penang Island and the Seberang Perai Municipal Council (Majlis Perbandaran Seberang Perai) in charge of Seberang Perai. The city council consists of a mayor, a secretary and 24 councilors while the municipal council is made up of a president, a municipal secretary and 24 councilors.

7. International Relationship

7.1. Participation in International Organizations

Malaysia has actively established diplomatic relations with countries in Americas, Europe, the Middle East, and other parts of Asia. Under the national policy, Penang State has international relations with other cities, known as sister cities, mostly in Australia and other parts of Asia. It is also a member of international organizations like WeGO, CityNet and an active participant of global summits like World Cities Summit and Asia Smart City Conference.

< Table 6. Sister Cities of Penang State >

George Town	Seberang Perai
• City of Adelaide, Australia • Xiamen, China • Yokohama, Japan • Medan, Indonesia • Taipei, Taiwan • Bangkok, Thailand • Phuket City, Thailand • Changwon, South Korea	• Manila, Philippines • City of Fremantle, Australia • City of Armadale, Australia • Gwangju, Korea

7.2. Relationship with Korea

The relationship between Korea and Malaysia started in 1960. Malaysia has an embassy in Seoul and Korea has an embassy in Kuala Lumpur (KOTRA 2016).

< Table 7. Relationship with Korea >

Agreements between South Korea and Malaysia	• Trade Agreement (1962) • Cultural Agreement (1965) • Aeronautical Agreement (1967) • Double Tax Avoidance Agreement (1983) • Visa Waiver Agreement (1983) • Science and Technology Cooperation Agreement (1985) • Investment Promotion and Protection Agreement (1988) • Shipping Agreement (1988) • Cooperation of Resources Agreement (1995) • Extradition Treaty (2013)

III ICT & e-Government Development Analysis

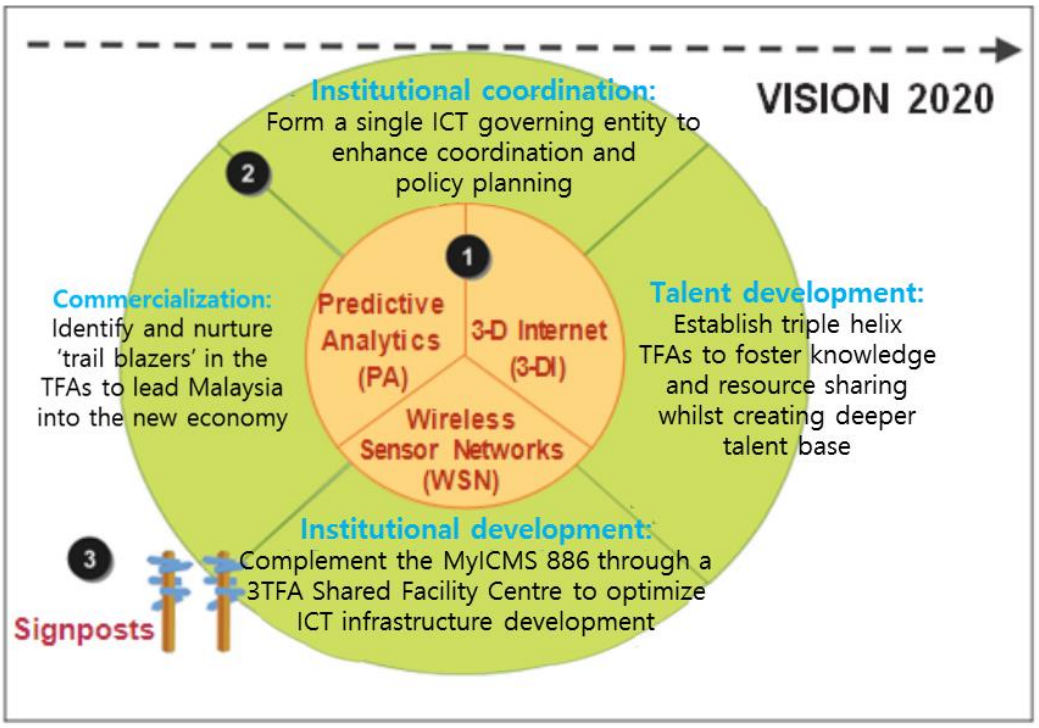
1. Literature & Progress Review

1.1. Malaysia ICT Roadmap

The key recommendations of the *National Strategic ICT Roadmap* are inputs for the formulation of strategic policies, programs and plans to intensify Malaysia's transformation into a knowledge-based economy. There are three strategies for Malaysia to pursue:

- **Strategy 1: Be a global leader in Three Technology Focus Areas (3TFAs)**
- **Strategy 2: Rationalize institutional arrangement and accelerate K-Based Ecosystem**
- **Strategy 3: Use Signposts and Vision Areas to manage opportunities and risks**

< Figure 5. Key Strategies of the National Strategic ICT Roadmap >

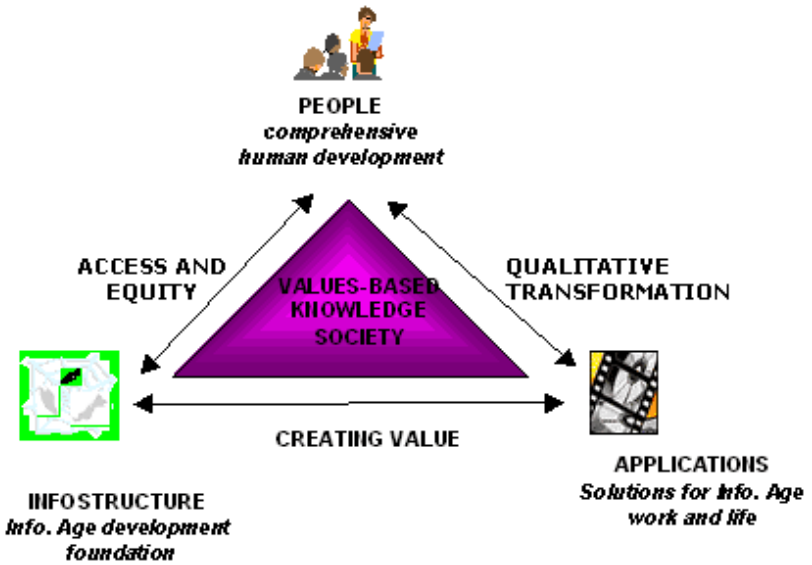


(NATIONAL STRATEGIC ICT ROADMAP 2011)

1.2. National IT Agenda – NITA

The National IT Agenda (NITA), launched in December 1996 by the National IT Council (NITC), provides the foundation and framework for the utilization of information and communications technologies (ICT) to transform Malaysia into a developed nation under the Vision 2020 (NITC Malaysia 2014).

< Figure 6. The Heart of NITA >



The NITA vision is to utilize ICT to transform all Malaysian society into an information society, then to a knowledge society and finally to a values-based knowledge society. With the theme "Turning Ripples into Tidal Waves," NITA focuses on the development of people, info-structure, and applications to create value, to provide equity and access to all Malaysians, and to qualitatively transform society into a values-based knowledge society by the year 2020 (NITC Malaysia 2014).

The "ripples" are focused initiatives led by the government to create the necessary environment and empower the people so that they can bring about the tidal wave of change required to achieve the NITA vision. The Multimedia Super Corridor (MSC), the earliest strategic initiative of the NITC, is one of such "ripples" (NITC Malaysia 2014).

The NITC promotes the notion that knowledge and information will be the most valuable assets in the economy of the new millennium. For Malaysia to be competitive, it must embrace the knowledge-based economy (k-economy) and create world-class Malaysian enterprises that can compete globally with their competitive edge in price, quality, delivery, and costs. NITA holds the key to empowering the nation and enabling the emergence of this new breed of entrepreneurs. NITA is the foundation for Malaysia's success in the information age and beyond (NITC Malaysia 2014).

1.3. UN e-Government Survey

1.3.1. General

The e-Government Survey is issued when countries are starting to implement the 2030 Agenda for Sustainable Development. It provides new evidence and new analysis about the potential of e-Government in supporting the implementation of the Agenda and the 17 Sustainable Development Goals (SDGs) that are at its core (UNITED NATIONS E-GOVERNMENT SURVEY 2016).

- **Facilitating integrated policies and services through e-Government**
- **Open Government Data for promoting effective, accountable, and transparent institutions**
- **E-participation to promote participatory decision-making and service delivery**
- **Advanced online services and bridging divides**

In the UN E-Government Survey announced in October 2016, Malaysia ranked 60th among 193 UN member states, down from 52$_{nd}$ in the previous survey in 2014.

< Table 8. UN e-Government Survey Results of Malaysia>

Ranking		EGDI		Online Service Index		Telecom Infra Index		Human Capital Index	
2014	2016	2014	2016	2014	2016	2014	2016	2014	2016
52	60	0.6115	0.6175	0.6772	0.7174	0.4455	0.4397	0.7119	0.6953

(UNITED NATIONS E-GOVERNMENT SURVEY 2016)

1.3.2. e-Government Development Index

Malaysia is ranked second among 11 ASEAN countries following Singapore.

< Table 9. Sub-regional Comparison among ASEAN Countries >

Rank	Country	EGDI	Online Service Component	Telecom Infra Component	Human Capital Component	GNI Per Capita (USD)	Income Level
4	Singapore	0.8828	0.971	0.8414	0.836	55,150	High
60	Malaysia	0.6175	0.7174	0.4397	0.6953	10,760	Upper Middle
71	Philippines	0.5765	0.6667	0.3791	0.6839	3,470	Lower Middle
77	Thailand	0.5522	0.5507	0.4117	0.6942	5,370	Upper Middle
83	Brunei	0.5298	0.5072	0.3512	0.731	37,320	High
89	Viet Nam	0.5143	0.5725	0.3715	0.5989	1,890	Lower Middle
116	Indonesia	0.4478	0.3623	0.3016	0.6796	3,630	Lower Middle
148	Laos	0.309	0.2826	0.1537	0.4907	1,650	Lower Middle
158	Cambodia	0.2593	0.0507	0.2486	0.4785	1,020	Low
169	Myanmar	0.2362	0.1594	0.0655	0.4837	1,270	Lower Middle
Reference Group	High Income	0.498	0.4678	0.3789	0.6471		High
	Upper Mid-Income	0.4964	0.4658	0.3759	0.6476		Upper Middle
	Lower Mid-Income	0.3861	0.3719	0.2292	0.5573		Lower Middle
	Low Income	0.2303	0.2101	0.1062	0.3746		Low
	Global Average	0.4922	0.4623	0.3711	0.6433		

(UNITED NATIONS E-GOVERNMENT SURVEY 2016)

1.3.3. Telecommunications Infrastructure Components, TII

The Table shows that Malaysia's TII is in the second-place following Singapore as in other indicators.

< Table 10. Telecommunications Infrastructure Index of UN e-Government Survey 2016 >

Rank	Country	TII	% of Indiv. Using Internet	Subscriptions per 100 Inhabitants			
				Fixed Telephone	Mobile Cellular Telephone	Fixed B/B Internet	Wireless B/B Internet
3	Singapore	0.8414	82	35.52	158.13	27.79	136.6
70	Malaysia	0.4397	67.5	14.61	148.83	10.14	14.1
77	Thailand	0.4117	34.89	8.46	144.44	8.21	52.5
87	Philippines	0.3791	39.69	3.09	111.22	23.22	27.2
90	Viet Nam	0.3715	48.31	6.01	147.11	6.48	21.8
97	Brunei	0.3512	68.77	11.4	110.06	7.15	6.5
109	Indonesia	0.3016	17.14	11.72	126.18	1.19	36
118	Cambodia	0.2486	9	2.84	155.11	0.21	10.1
149	Laos	0.1537	14.26	13.36	66.99	0.16	2.4
183	Myanmar	0.0655	2.1	0.98	49.47	0.27	1
Reference Group	High Income	0.6607	78.77	36.51	126.97	26.78	64.02
	Upper Mid-Income	0.3734	44.54	16.42	115.59	9.63	25.99
	Lower Mid-Income	0.2292	27.21	8.32	89.71	3.34	14.03
	Low Income	0.1062	7.98	1.08	65.27	0.19	5.08

(UNITED NATIONS E-GOVERNMENT SURVEY 2016)

1.3.4. E-Participation Component

As analyzed in the EGDI above, the EPI (E-Participation Index) of Malaysia (0.678) falls far behind that of Vietnam (0.6949) with the marked difference in the percentage of Stage-3 service (Malaysia: 0, Vietnam: 1).

< Table 11. E-Participation Index in e-Government Development Survey 2016 >

Rank	Country	EPI	Total (%)	Stage-1(%)	Stage-2 (%)	Stage-3 (%)	EGDI
8	Singapore	0.9153	0.917	0.941	1	0.571	0.8828
43	Vietnam	0.6949	0.7	0.647	0.684	1	0.6175
47	Malaysia	0.678	0.683	0.794	0.737	0	0.5143
67	Philippines	0.5932	0.6	0.676	0.579	0.286	0.5765
67	Thailand	0.5932	0.6	0.735	0.579	0	0.5522
114	Brunei	0.3729	0.383	0.5	0.316	0	0.5298

114	Indonesia	0.3729	0.383	0.412	0.474	0	0.4478
133	Laos	0.2712	0.283	0.353	0.263	0	0.309
170	Myanmar	0.1017	0.117	0.118	0.158	0	0.2593
179	Cambodia	0.0678	0.083	0.147	0	0	0.2362
Reference Group	Global Average	0.4625	0.471	0.564	0.431	0.129	0.4922
	High Income	0.6952	0.7	0.794	0.675	0.317	0.498
	Upper Mid-Income	0.444	0.453	0.556	0.411	0.069	0.4964
	Lower Mid-Income	0.3943	0.404	0.493	0.368	0.071	0.3861
	Low Income	0.2227	0.236	0.319	0.171	0.008	0.2303

(UNITED NATIONS E-GOVERNMENT SURVEY 2016)

2. ICT Environment

2.1. ICT Development Index (2015)

The ICT Development Index (IDI), which has been published annually since 2009, is a composite index that combines 11 indicators to monitor and compare developments in Information and Communications Technology (ICT) between countries (The ICT Development Index 2016).

The IDI is divided into the following three sub-indices: Access sub-index, Use sub-index, and Skills sub-index. Access sub-index is related to the infrastructure for Internet access. Use sub-index is related to the rates of Internet use. Skills sub-index is associated with the citizens' capabilities of using ICT. Each of the indices includes three to five indicators to measure basic elements for enabling ICT development.

Malaysia ranks 64th in the world and eighth in the Asia-Pacific region. It is a relatively high ranking compared to other developing countries.

< Table 12. ICT Development Index >

Rank	Economy	Value
1	Korea (Rep.)	8.93
19	Singapore	8.08
24	Macao, China	7.73
64	Malaysia	5.9
71	Brunei	5.53
74	Thailand	5.36
98	Philippines	4.57
102	Viet Nam	4.28
108	Indonesia	3.94

ICT Development Index	Malaysia	Developing
IDI ACCESS SUB-INDEX	6.61	4.66
Fixed-telephone subscriptions per 100 inhabitants	14.61	10.01
Mobile-cellular telephone subscriptions per 100	148.83	91.07
International Internet bandwidth per internet user(Bit/s)	27,173	28,499
Percentage of households with computer	66.48	31.02
Percentage of households with Internet access	65.5	31.55
IDI USE SUB-INDEX	4.76	2.63
Percentage of individuals using the Internet	67.5	32.41
Fixed (wired)-broadband subscriptions per 100 inhabitants	10.14	6.58

115	Sri Lanka	3.64	Active mobile-broadband subscriptions per 100 inhabitants	58.34	27.86
130	Cambodia	2.74	IDI SKILLS SUB-INDEX	6.75	6.06
131	India	2.69	Adult literacy rate	94.64	83.87
136	Nepal	2.59	Secondary gross enrolment ratio	70.8	73.16
142	Myanmar	2.27	Tertiary gross enrolment ratio	37.2	25.64
144	Bangladesh	2.22	Total	4.13	5.90

(MEASURING THE INFORMATION SOCIETY REPORT 2015)

2.2. Telecommunications

< Table 13. Overview of Telecommunication Service in Malaysia >

2015	Telephone lines per 100 people	Mobile cellular subscriptions per 100 people
Malaysia	14.34	148.83
Korea, Rep	58.06	118.46
East Asia & Pacific	17.3	104.22
World	14.34	98.62

(MEASURING THE INFORMATION SOCIETY REPORT 2015)

The provision of telephony services was considered a public monopoly in Malaysia until the mid-1980s. However, the number of providers increased to seven by mid-1990s following the liberalization policy with the need to open the economy to foreign investment and technologies. Now, the primary regulator of telecommunications in Malaysia is the Malaysian Communications and Multimedia Commission (MCMC) that issues licenses.

Now there are three major service providers Maxis, Celcom, and Digi. The rest are small operators with less coverage across Malaysia. Digi leads in subscriber market share and Maxis leads in service revenue. Celcom appears to be the last among the big three. The table below shows the number of subscribers and the market share of the big three companies.

< Table 14. The Market Share of Big 3 >

	Q1 2016	Q1 2015
Digi	12.34 million (33.6%)	11.69 million (31.4%)
Maxis	12.31 million (33.5%)	13.26 million (35.6%)
Celcom	12.08 million (32.9%)	12.28 million (33%)
Total	36.73 million	37.23 million

(MEASURING THE INFORMATION SOCIETY REPORT 2015)

2.3. Internet Service Providers

< Table 15. Overview of Internet Service in Malaysia >

2015	Broadband Internet Subscriptions per 100 population	Internet users (including mobile phone) per 100 population
Malaysia	8.95	71.06
Korea, Rep	40.25	89.9
East Asia & Pacific	15.76	49.82
World	11.34	44

(MEASURING THE INFORMATION SOCIETY REPORT 2015)

While Internet technology in Malaysia is advanced, the connection to broadband services outside the major cities is still developing. Broadband Internet access (ADSL) and wireless Internet services are accessible everywhere in and around Kuala Lumpur and other major cities of Malaysia. The main broadband service provider is TMNet's Streamyx which belongs to Telecom Malaysia. Other providers are Celcom and Maxis.

3. E-Government Development

3.1. E-Government Promotion Organization

The National Information Technology Council of Malaysia (NITC Malaysia) is the country's premier organization that strategically manages ICT in the interest of the nation. The Council serves as the primary advisor and consultant to the Government on matters pertaining to ICT in Malaysia's national development.

To facilitate the realization of the national transformation agenda, nine expert groups in the following figure have been established under the NITC.

< Figure 7. Expert Groups under NITC >

(NITC Expert Groups 2016)

3.2. List of e-Government System /Applications

Among the nine expert groups, the Malaysia Digital Economy Corporation (MDEC) is the government agency responsible for overseeing Multimedia Super Corridor (MSC), the national ICT development initiative and implementation. e-Government was initiated by the introduction of the MSC in 1996. The Malaysian government launched electronic government as one of the MSC flagship applications, and seven projects have been launched under the e-Government flagship application since 1997.

The summary of the projects and their functions are as follows:

< Table 16. E-Government Application >

E-government Application	Function	Agency
Human Resources Management Information System (HRMIS)	Provides a single interface for government employees to perform human resources department functions effectively and efficiently in an integrated environment	Public Service Department
Generic Office Environment (GOE)	Provides a new paradigm of working in a collaborative environment where government agencies communicate, interact, and share information	Prime Minister's Office
Project Monitoring System (PMS)	Provides a new mechanism for monitoring implementation of development projects, incorporating operational and managerial functions, and knowledge repository	Implementation Coordination Unit at the Prime Minister's Office
Electronic Labor Exchange (ELX)	A one-stop-center for labor market information, accessible to government agencies, the business sector, and the citizens	Ministry of Human Resources
Electric Services	Enables direct, online transactions between the public, the government and large service providers via electronic means	Road Transport Department
Electric Procurement (EP)	Links the government and suppliers in an online environment. Government agencies as buyers procure goods/services by browsing catalogues advertised by suppliers. Aimed at best value for money, timely and accurate payment	Ministry of Finance
E-syariah	Introduces administrative reforms that upgrade the quality of services in Syariah Courts to enhance the Islamic Affairs Department's effectiveness, better monitoring and coordination of its agencies and 102 Syariah Courts	Islamic Justice Department at the Prime Minister's Office

(Norshita and Mohammad 2010)

Another government agency, Malaysian Administrative Modernization and Management Planning Unit (MAMPU), has developed the Public ICT Strategic Plan to ensure the quality and efficiency of service for the Malaysian citizens. Following this plan, the e-Government website was launched. The myGovernment Portal (www.malaysia.gov.my) acts as the one-stop source of Malaysian government information and services for the citizens.

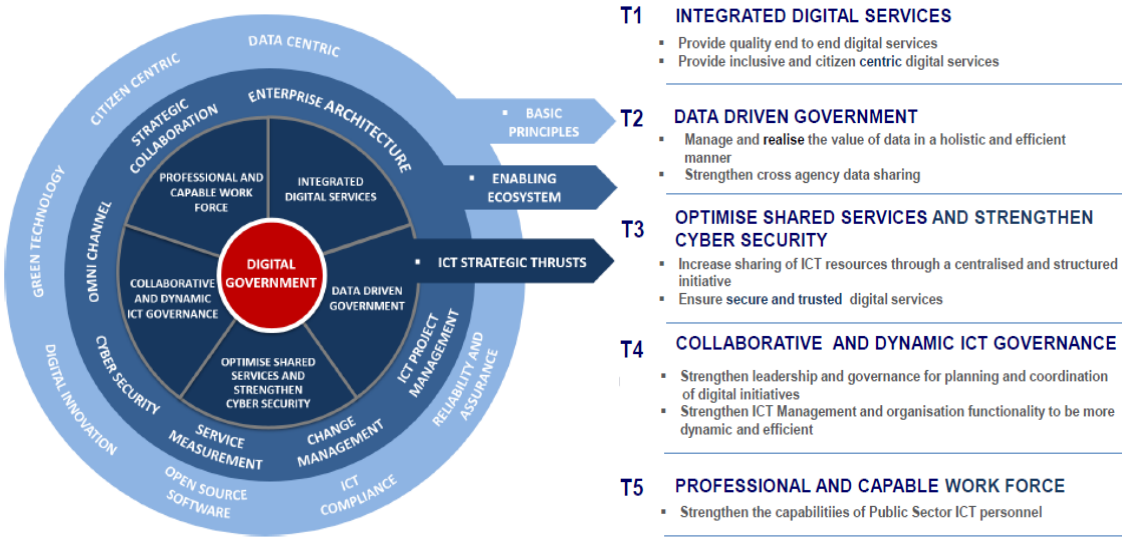
3.3. e- Government Services in Plan

3.3.1. Public Sector ICT Strategic Plan 2016 - 2020

The Malaysian government launched the Public-Sector ICT Strategic Plan (PSISP) 2016-2020 to ensure that the various ICT initiatives are undertaken by all ministries and public agencies in line with the Government Transformation Plan to make Malaysia a developed nation by 2020.

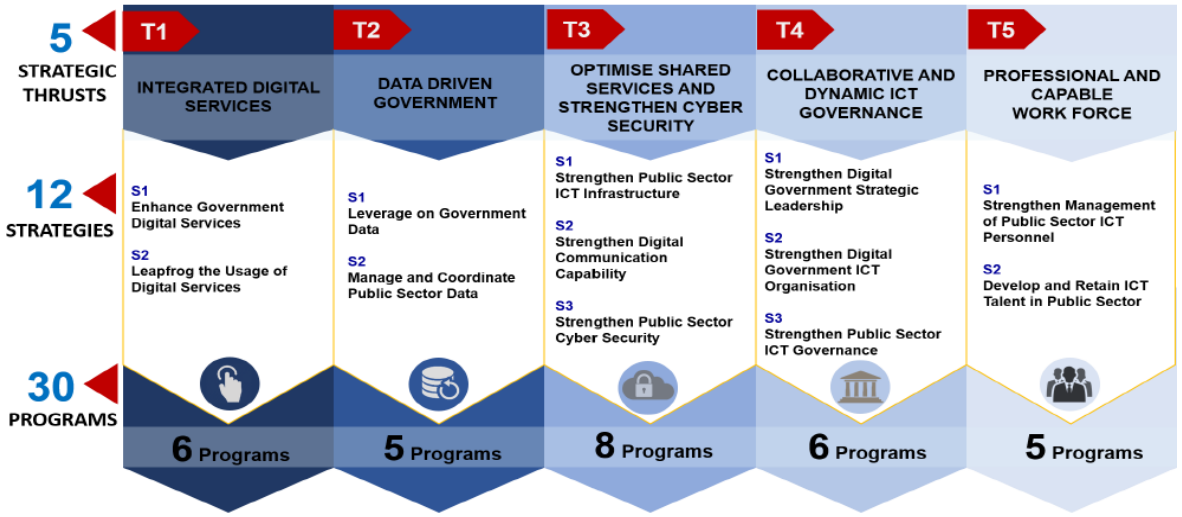
The ICT Framework consists of four main components: ICT Vision, Five Strategic Thrusts, Enabling Ecosystem, and Seven Basic Principles.

< Figure 8. ICT Strategic Plan 2016-2020 >



(MAMPU 2016)

< Figure 9. ICT Strategic Plan 2016-2020 >



(MAMPU 2016)

There are 12 strategies and 30 programs in total under the Five Strategic Thrusts.

4. Implication of ICT & e-Government Development

4.1. e-Government

Malaysia is ranked at 60th and 2nd on UN- e-Government Survey in the world and among the ASEAN countries respectively; however, Malaysia has slipped down 8 ranking from 2014 ranking, which was 52nd in the world. This shows that Malaysia's e-Government performance fell behind other similar ranked countries.

Among ASEAN countries, Malaysia has been performing better in E-Government Development Index (EGDI) compared to Thailand which has the same income level, Upper High. Malaysia is 17 ranks higher than Thailand in overall EGDI as well as in Telecommunications Infrastructure Components (TII) by 7 ranks.

However, Malaysia has shown areas for improvement in e-Participation Index by ranking 3rd after Vietnam among ASEAN countries. Perhaps it is because of not having nationwide complaint handling system but not limited to this cause alone.

4.2. ICT Infrastructure

In terms of ICT Development Index (IDI), Malaysia is ranked 64th in the world and 4th in Asia-Pacific region. Most of the index is higher than the average of developing countries; however, the score of international Internet bandwidth per Internet user is lower than the average of developing countries. This means Malaysians use lower speed of Internet than average developing countries.

Malaysia has a low Broadband Internet Subscriptions rate. It is almost half of East Asia & Pacific score (Malaysia: 8.95, East Asia & Pacific: 15.76). This shows that less Malaysians have high-speed Internet access.

4.3. Telecommunication

Malaysia has much higher score on Mobile Cellular Subscriptions per 100 People than Republic of Korea and other countries, and active mobile-broadband subscriptions per 100 people are more than double comparing to average developing countries. This shows Malaysians use their mobile phone more often to communicate and access the Internet instead of landlines.

Therefore, mobile applications or mobile-centered services and systems would appeal more to Malaysian citizens to participate in e-Government platform and services.

IV As-Is Status Analysis

1. Stakeholder Analysis

1.1. Internal Stakeholders

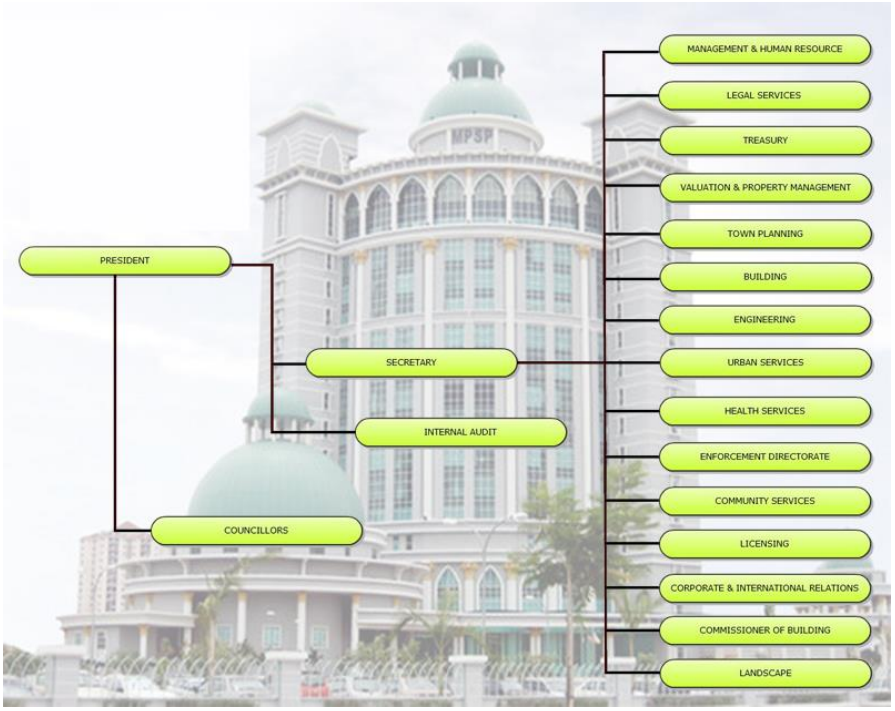
Majlis Perbandaran Seberang Perai (MPSP) is a local authority which administers Seberang Perai and other areas. This agency is under the Penang state government. The MPSP is responsible for public health and sanitation, waste removal and management, town planning, environmental protection and building control, social and economic development, and general maintenance functions of urban infrastructure. The MPSP main headquarters is located at Bandar Perda, Bukit Mertajam (QUALITY STATEMENTS 2000).

< Figure 10. MPSP Goals, Vision, and Mission >

(QUALITY STATEMENTS 2000)

The MPSP consists of 15 departments—Municipal Secretary Office, Internal Audit Office, and councilors. Departments that are directly involved in the SL/TL Monitoring System are the Engineering Department and the IT Department.

< Figure 11. MPSP Organization Chart >



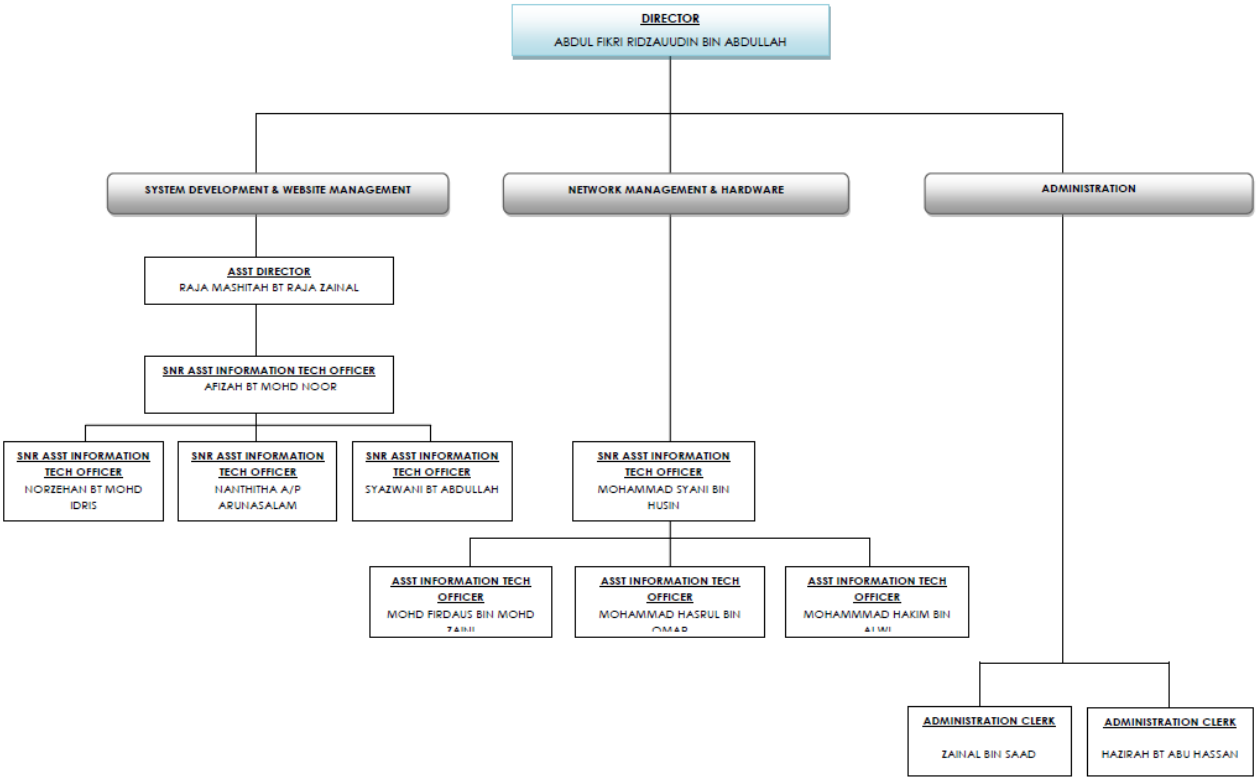
The IT department is in charge of managing all IT systems in the MPSP. There are more than 100 IT systems in the MPSP including stand-alone systems. However, the MPSP currently does not have an IT system for SL/TL Monitoring. This undermines the MPSP's ability to analyze the current IT system situation.

- **IT Department**

The IT Department is responsible for managing all IT systems, network, and other matters related to information. The Director of IT department Abdul Fikri Ridzauudin bin Abdullah was the chief collaborator for this feasibility study.

- Currently, there is no IT system for managing SL/TL in MPSP
- Around 100 IT systems are up and running in MPSP
- There is no comprehensive IT master plan for MPSP (yearly plan exists)
- MPSP is using Hadoop for BDA
- ArcGIS is being used for GIS system for efficient territory development
- Several IoT systems are up and running - Fleet Management System, TL control box monitoring system (pilot)

< Figure 12. Organization Chart of IT Department >



The MPSP's IT Department is in charge of managing more than 100 IT systems of the MPSP. The IT Department will be the main department in charge of operating a pilot system at the end of this feasibility study and will manage the system when the MPSP introduces the complete SL/TL monitoring system.

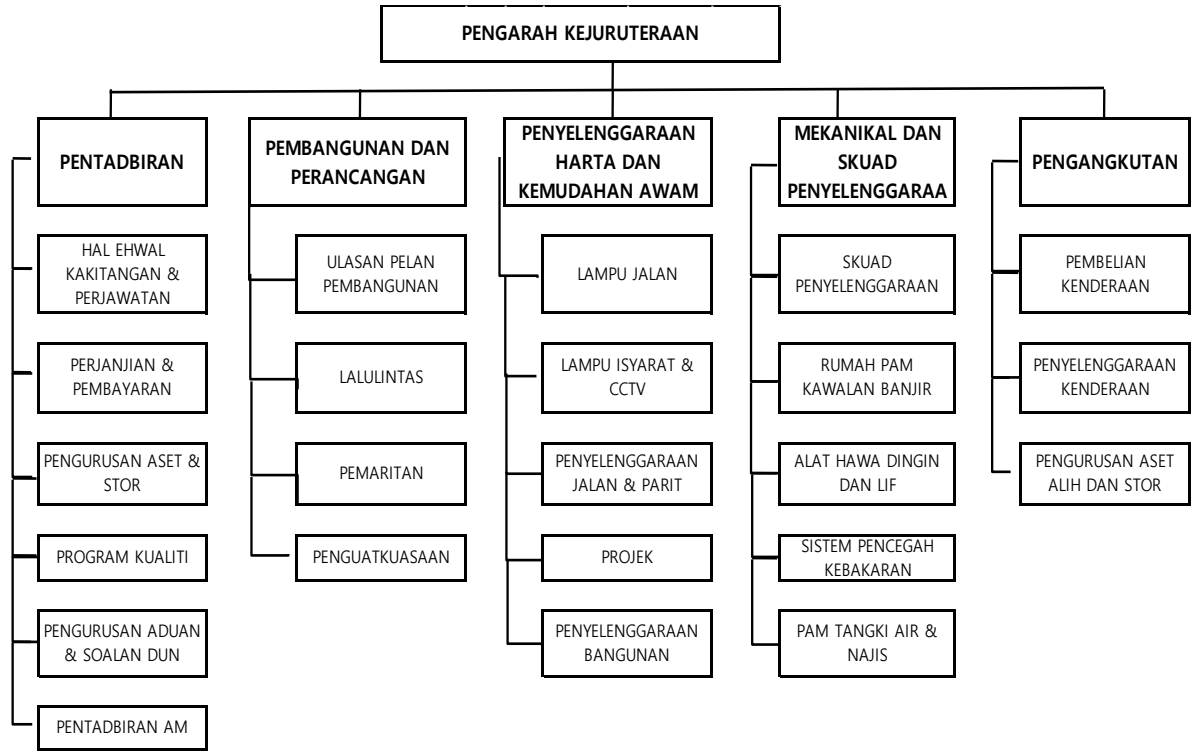
In addition to the SL/TL monitoring system, the IT Department is interested in big data analytics (BDA) to utilize the databases gathered from the IT systems of the MPSP. However, the IT department is currently developing DBs only from the complaint handling systems such as Aduan System and Smart Monitoring System.

That is why the possibility of using big data is important to the pilot system. By having pilot SL/TL Monitoring System, the MPSP can have more DBs to conduct BDA to improve the efficiency of city management, which will help increase citizen's satisfaction.

- **Engineering Department**

The Engineering Department is responsible for managing SL/TL. The Assistant Director of Engineering Department Nadia Faradila binti Jalawl is the main collaborator from the Engineering Department for this FS project.

< Figure 13. Organization Chart of Engineering Department >



The MPSP's Engineering Department is in charge of managing street lamps with galvanized poles and all traffic lights in Seberang Perai. Officials of the Engineering Department are maintaining and patrolling SL/TL with five private contractors.

- Engineering Dept. regularly tests and patrols SL/TL with contractors
- Engineering Dept. works with five contractors
- Complaints about SL/TL are mostly sent to contractors via WhatsApp
- PIC of complaint in Engineering Department checks System Aduan and Smart Monitoring System

- **Community Affairs Department**

The Community Affairs Department's main role includes administration & public relations, culture, social and sports activities, and the department is also in charge of one of two complaint handling systems, Aduan System. The system is the main complaint handling system of the MPSP. Aduan System started to be operated from 2004, and it is operated only in Intranet of MPSP. Complaints only related to MPSP are registered in the system, and complaints that are irrelevant to MPSP are distributed to related agencies. After the register of complaints, a feedback letter will be sent in 5 days. Aduan System also has statistics function that shows charts on the monitor. Aduan System originally has only back-office for MPSP officers

to handle complaints, but now it also has front-office where Seberang Perai citizens can submit complaints through a webpage, eAduan. Aduan System will be explained later in this report.

The complaint handling system is a crucial component in the STMS because citizen's complaint is one of two measures to notice malfunctions of street lamps and traffic lights. In addition, the complaint handling system can be a good source of data for the MPSP's BDA utilization. Therefore, the Community Affairs Department has been chosen as an important internal stakeholder.

The department's main functions are as follows:

- Supervising and maintaining sports complex
- Designing and implementing sports and cultural programs
- Improving quality of sport and culture
- Managing cooperation with government agencies, private sector and other organizations for social events, sports, and culture
- Improving image of MPSP through achievements in the field of sports or culture
- Operating Public Complaints Bureau
- Publishing annual report, newsletters, and brochures

- **Corporate & International Affairs Department**

The Corporate & International Affairs Department's main role includes acting as the secretariat of the Office of President and Municipal Secretary, providing information and data to the President and the Municipal Secretary and managing corporate responsibility development. The department is also in charge of meetings related to complaints and feedback from citizens and other stakeholders.

This department is also responsible for managing one of the two complaint handling systems, Smart Monitoring System, which deals with complaints received from Facebook and mobile applications. Smart Monitoring System is integrated with Citizen Action Technology (CAT) managed by an NGO. Smart Monitoring System will be elaborated later in this report.

In addition to the Community Affairs Department, the Corporate & International Affairs Department has been chosen as an important internal stakeholder. Integration of these two complaint handling systems is an important issue to enhance efficiency in operation and BDA.

- **Town Planning Department**

As the MPSP has enacted the Act 172 and the Town and Country Planning Act, the Town Planning Department has started its operation. The Town Planning Department is in charge of developing Eco-City, which is an important project for the STMS because of the following reasons.

- Newly developed area can be good target for implementation of STMS
- STMS can play important role in saving energy and reducing GHG emissions, which are important factors for Eco-City

< Figure 14. Concept of Eco-City >

- Street Lamp & Traffic Light Monitoring System can be designated as standard system in development regulation by MPSP's Engineering Department
- Eco-City is divided into seven areas, each of which can be developed by different developers
- Once system is designated as standard system by MPSP, all developers must adopt it

1.2. External Stakeholders

- **Citizen**

The population of Seberang Perai is 906,077 in the 2016 Census, and Penang state has the highest population density in Malaysia with 1,450.5 people per square kilometer. Penang hosts an estimated 50,000 to 60,000 of migrant workers, primarily from Indonesia, Myanmar, Vietnam, Thailand, and South Asian nations who are mostly involved in domestic help, services, manufacturing, construction, plantations, and agriculture.

- **SL/TL Operating Contractors**

Contractors and MPSP officials of the Engineering Department regularly perform Megger Test and Earth Test following the maintenance manual. Every traffic light in Seberang Perai is inspected once a day and street lamps are inspected three times a week. Considering the regular inspections and patrols, a full recovery of malfunction will take at least 24 to 48 hours and even 72 to 96 hours.

- SL contractors – one for central area and one for southern and northern areas
- TL contractors – two for northern and central areas and one for southern area
- Contractors' main tasks are Megger Test, Earth Test and SL/TL patrol
- All TL is checked every day and SL is checked three times a week
- Minor issues are supposed to be resolved within 24 hours, and major issues are supposed to be resolved in two weeks
- Malfunctions of lamps and wires are most common issues

< Table 17. SL/TL Contractors >

	Contractor	Area
Street Lamp	Contractor1	Central
	Contractor2	Southern & Northern
Traffic Light	Contractor3	Northern & Central
	Contractor4	
	Contractor5	Southern

- **Telecommunication Companies**

Celcom and Maxis, two biggest wireless service providers are expected to utilize the wireless network for the pilot system and the To-Be Model.

- **Celcom**
  - Celcom is one of the largest wireless providers in Malaysia
  - Celcom has both GSM and WCDMA bandwidth
  - Celcom is participating in smart traffic light controlling system in Malaysia
  - Celcom provides price table for M2M package

- **Maxis**
  - Maxis has GSM, LTE and WCDMA bandwidth
  - Maxis provides IoT services for water company
  - Maxis provides price table for M2M package

- **Tenaga Nasional Berhad (TNB)**

Tenaga Nasional Berhad (TNB) is the only electric utility company in Peninsular Malaysia and also the largest power company in Southeast Asia. It serves over 8.4 million customers throughout Peninsular Malaysia and the eastern state of Sabah through Sabah Electricity Sdn Bhd. The TNB's core activities are electricity generation, transmission, and distribution.

The TNB manages 42,856 concrete street light poles in Seberang Perai. Concrete street light poles are powered by overhead cable unlike the galvanized ones. The MPSP only pays electricity bills for lighting those street lamps.

< Table 18. Concrete Poled Street Lamp >

Area	Numbers of Street Lamp
Northern	8,726
Central	25,238
Southern	8,892
Total	**42,856**

2. Law & Regulation Analysis

2.1. E-Government Law

In 1997, the Malaysian Government launched the Electronic Government initiative, generally known as e-Government, to reinvent itself to lead the country into the Information Age. As far as Malaysia is concerned, the implementation of e-Government was initiated with the introduction of the Multimedia Super Corridor (MSC) in 1996. E-government is one of the seven flagship applications introduced in the MSC. The objectives of these flagship applications are to start and accelerate the growth of the MSC, to enhance national competitiveness, to create high-value jobs and increase export, to help reduce digital divide, and to make the MSC a regional hub and a test bed.

- **Communications and Multimedia Act 1998**

This act is the main pillar of cyber laws in Malaysia. It explains the roles and responsibilities of Internet service providers. It also states that there should not be barriers to accessing the Internet in Malaysia. The Communication and Multimedia Commission, a specialized government body in information and communications technology (ICT) has been established under this Act. The Act has been enforced by the government since Apr. 1, 1999 (Multimedia Development Corporation 1996-2012).

- **The National Archives Act 2003**

The National Archives of Malaysia (NAM) amended the National Archives Act 1966 to recognize all forms of electronically created records as public records. The new National Archives Act was passed in 2003. With this new law, the National Archives of Malaysia has to assume a leading role in governing the management of electronic records from their creation to disposal in the public sector. It has to take several measures and initiatives to start this new initiative.

- **Electronic Government Activities Act 2007**

Malaysian Government has enforced the act to facilitate the delivery of electronic government services to the public. It came into force on Jan. 1, 2008 (Multimedia Development Corporation 1996-2012).

2.2. Street Lamp & Traffic Light Law

- **STREET, DRAINAGE, AND BUILDING ACT 1974 (Act 133)**

An Act to amend and consolidate the laws relating to street, drainage, and building in local authority areas in West Malaysia, and for purposes connected therewith.

Maintenance and repair of public streets 4. (1) The local authority shall, so far as the funds at its disposal will admit, cause all public streets together with the footways thereof, whether covered by arcades or not, to be maintained and repaired and may provide street lighting.

Precautions against accident. Bars to be erected across streets during repairs and lights placed at night 41. (1) The local authority, any person, or any other authority, shall, while carrying out the construction or repair of any street, back-lane, sewer or drain take proper precaution against accident by shoring up and protecting the adjoining houses and causing such bars, chains or posts to be fixed across or in any street or road to prevent the passage of carriages, carts or other vehicles, while such works are carried on as to it seems proper and causing the works to be sufficiently lighted and guarded during the night.

- **ROAD TRANSPORT ACT 1987 (Act 333)**

The Road Transport Act 1987 (Malay: Akta Pengangkutan Jalan 1987) is a Malaysian law which enacted to make provision for the regulation of motor vehicles and of traffic on roads and other matters with respect to roads and vehicles thereon; to make provision for the protection of third parties against risks arising out of the use of motor vehicles; to make provision for the co-ordination and control of means of and facilities for

transport; to make provision for the co-ordination and control of means of and facilities for construction and adaptation of motor vehicles; and to make provision for connected purposes.

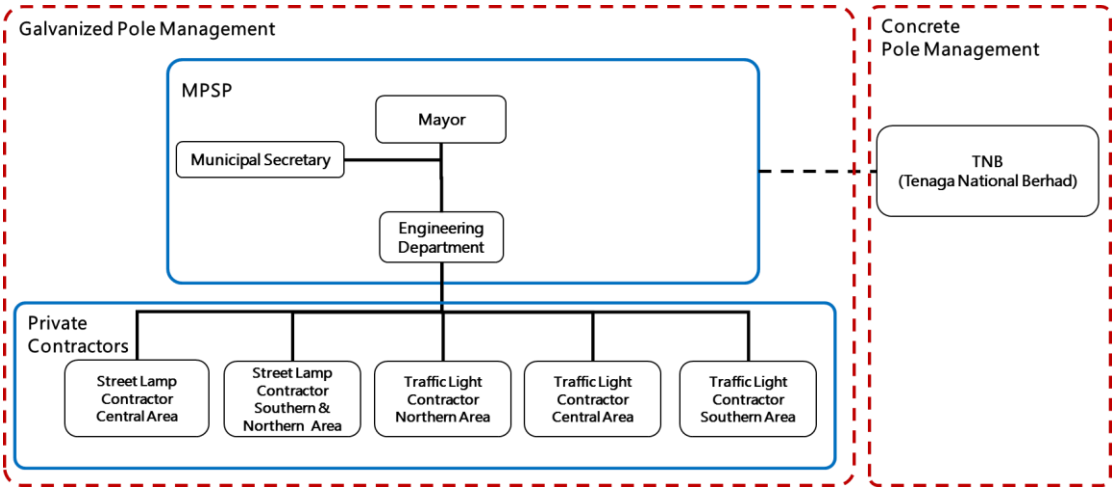
Erection of traffic signs 77. (1) The Minister charged with the responsibility for works (in this section hereinafter referred to as the "Minister") in relation to any Federal road, and the appropriate authority in relation to any other road, within the area of such authority, may cause or permit traffic signs to be placed on or near such road and may from time to time repair, alter, change, or remove the same.

3. Street Light & Traffic Light Management Analysis

The MPSP manages and operates SL/TL manually with the Engineering Department and private contractors without an IT system. Therefore, our analysis is focused on organizations that operate SL/TL and its complaint handling process.

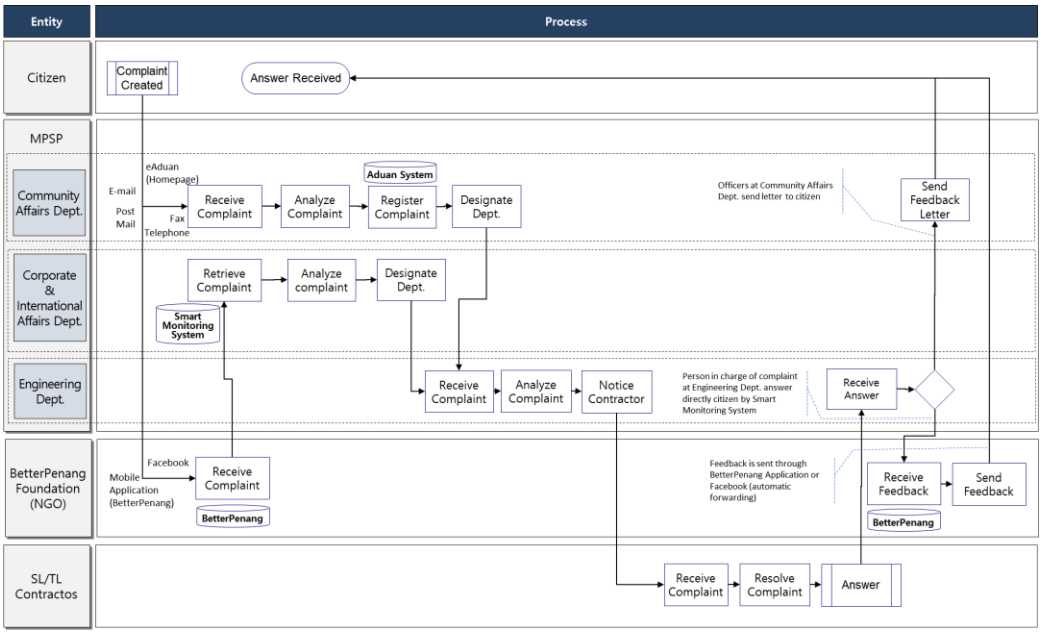
The MPSP's street lamps are managed mainly by two organizations, Engineering Department of the MPSP and Tenaga Nasional Berhad (TNB). Galvanized poles are managed by the Engineering Department of the MPSP while concrete poles are managed by the TNB.

< Figure 15. SL/TL Management Organizational Chart >



Currently, the MPSP is operating its street lamps and traffic lights manually without an IT system. Although citizen complaints about SL/TL are received via the MPSP's complaint handling systems (Aduan System and Smart Monitoring System), the process of managing complaints is executed by phone call, text message or paper.

< Figure 16. SL/TL Complaint Handling Process >



To increase the efficiency of SL/TL complaint handling process, the MPSP must put in place the SL/TL monitoring and controlling system.

4. IT Status Analysis

The IT infrastructure of the MPSP is relatively sufficient compared to other cities. The MPSP currently utilizes about 100 IT systems. Some of the major IT systems among them are introduced below.

< Table 19. Major IT Systems of MPSP >

IT System	Function
E-Recruitment System	Hiring new staff
Assessment Tax System	Printing and checking information related to tax
E-License system	Registering new applications for license and checking license details
e-Court	Accelerating the process of registration of cases MPSP for the prosecution to Court
e-Building	Signing up and processing building plans
GIS system MPSP	Map Browser based on GIS
Integrated Financial Accounting System	Preparation of annual budget allocations, account payable, accounts receivable, general ledger, general costs and so on
OSC ONLINE	Receiving land development application
Smart Monitoring System	Processing public complaint with Facebook and mobile application
Aduan System	Processing public complaint

As much as 100 IT systems the MPSP operates for its citizens are relatively advanced. Specifications of major equipment and infrastructures are described below.

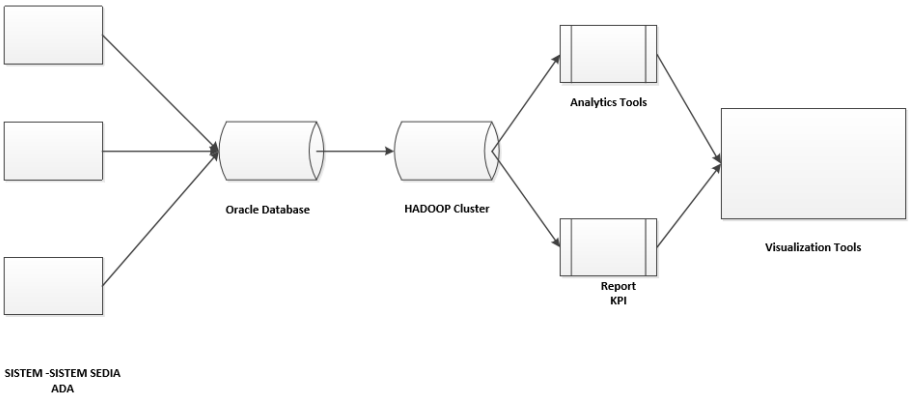
< Table 20. IT Infrastructure of MPSP >

IT Components	
Core Switch	Cisco Catalyst 4500 X 2 unit
Internet connection bandwidth	Lease line Metro-E 12mbps, Unifi 50mbps X 2
Virtual Server	HP Converged System 250HC Store Virtual
Physical Server	20 Units (HP and Dell)
Database Server	Oracle 10 G / HP RX2620 Oracle 12 C / HP Integrity RX2800 i4
Numbers of Computers	PCs: 20, Laptops: 6
Numbers of Human Resources	IT Technicians: 3 IT Department Officials: 12

4.1. Big Data Analytics

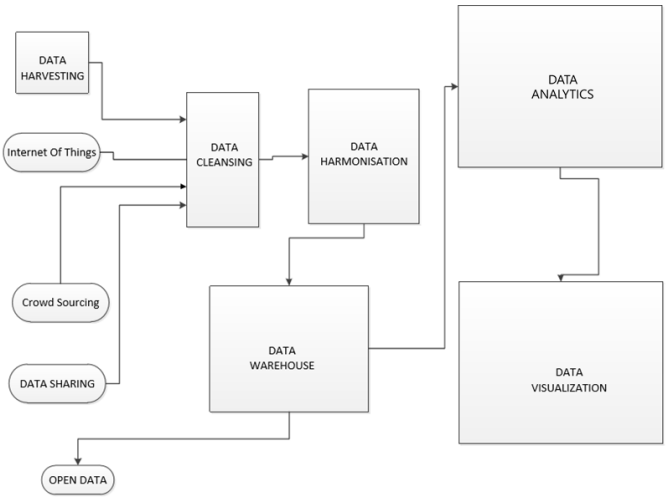
The MPSP is aiming to become a Smart City with its advanced ICT infrastructure. Big data analytics using IoT are essential to achieve that goal. The MPSP has endeavored to gather useful information through its two complaint handling systems. However, now the MPSP needs to start gathering information using IoT technology for BDA.

< Figure 17. BDA using Hadoop >

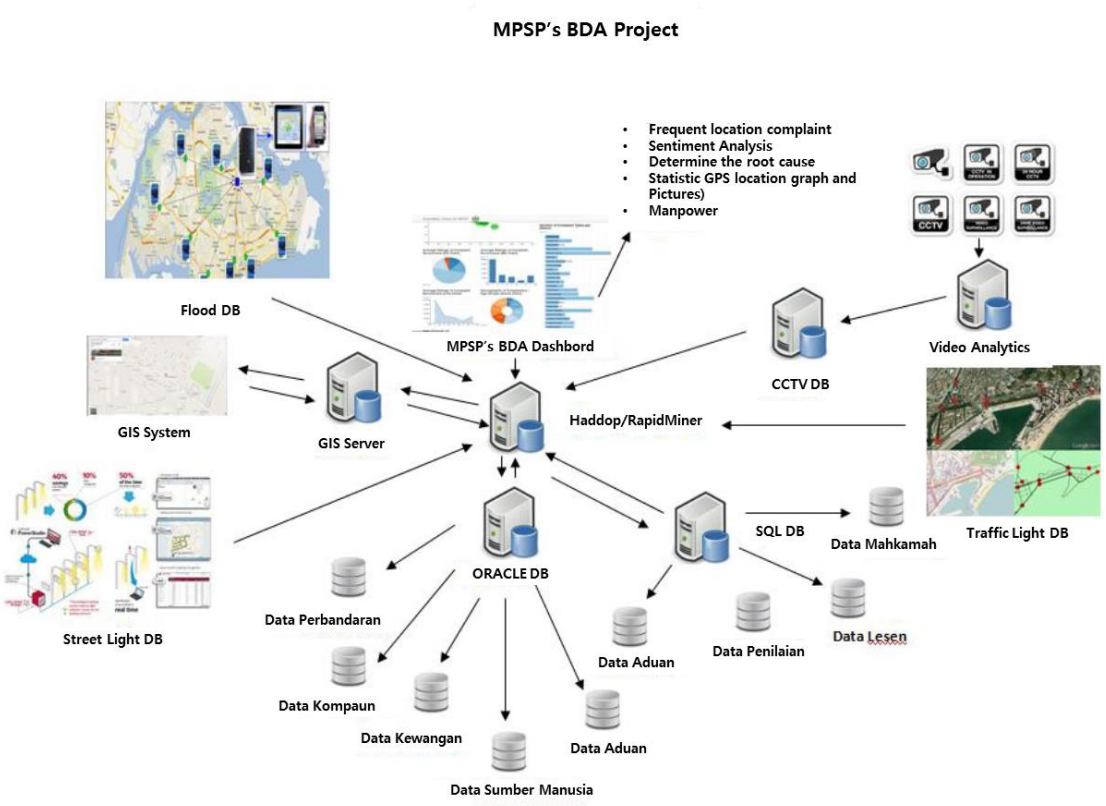


The MPSP has already been using Hadoop for BDA but there is not enough information for analytics. That is why the MPSP is focusing on implementing IoT infrastructure. The STMS is part of a plan for adequate utilization of BDA.

< Figure 18. Road Map for BDA >



< Figure 19. MPSP's Expected Future BDA Projects >

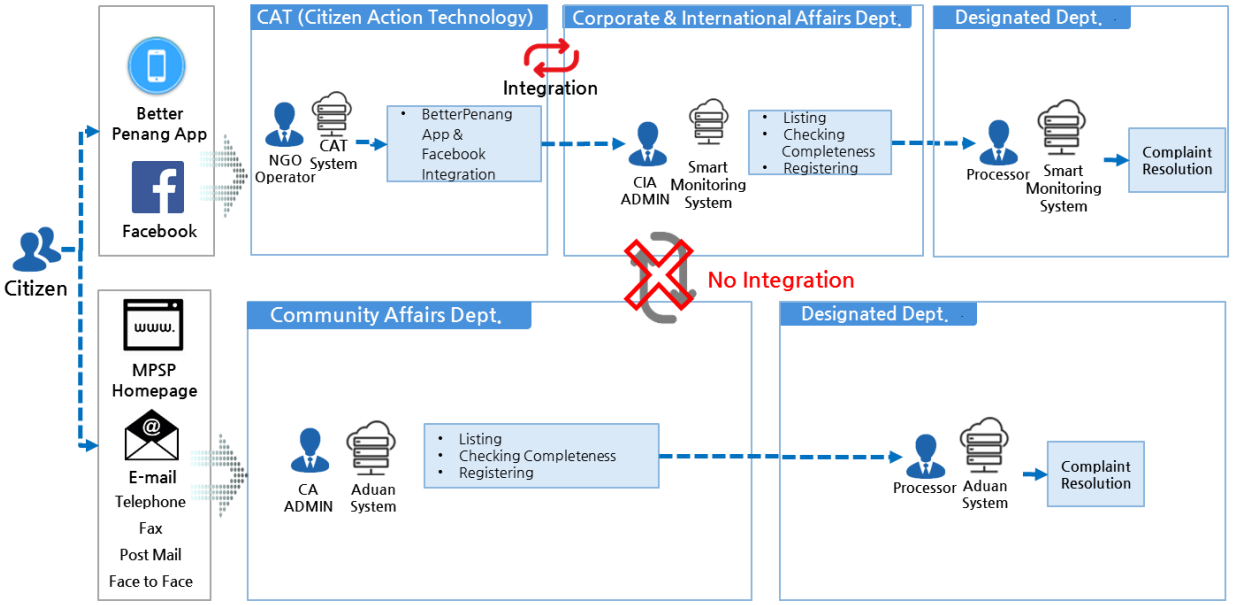


4.2. Complaint Handling System

The MPSP has two separate complaint handling systems, Smart Monitoring System for complaints submitted through Facebook/Better Penang Application and Aduan System for complaints submitted via the MPSP homepage and other channels.

Since Smart Monitoring System does not have its own front-office, NGO-operated Citizen Action Technology (CAT) provides Better Penang mobile application and webpage to receive complaints from citizens. Smart Monitoring System and CAT are integrated to transfer complaints gathered from Better Penang application to Smart Monitoring System, and CAT can receive complaints from Facebook as well. This complicated architecture of Smart Monitoring System makes it even harder for it to be integrated with Aduan System.

< Figure 20. Separate Complaint Handling Process >



- System Aduan is a main complaint handling system that receives complaints via phone, e-mail, and e-Aduan run by Community Affairs Dept.

- Complaints collected through Facebook and Better Penang mobile application are managed with Smart Monitoring System by Corporate International Affairs Dept.

- Each department normally has two IDs for its officials (PIC and head of the department) to connect to the system

5. Implication of As-Is Analysis

The Municipal Council of Seberang Perai (MPSP) has been an innovative and progressive local council in Malaysia that promotes ICT as a tool to enhance the quality and efficiency of work. In this context, Seberang Perai is currently working to utilize big data analytics solutions with the Internet of Things (IoT) technology. One of the proposed solutions is for monitoring street lamps and traffic lights.

Street lamps and traffic lights are important components of public facilities managed by Seberang Perai. Keeping street lamps and traffic lights working properly is crucial because citizen's security and safety issues such as crimes and traffic accidents are directly associated with these infrastructures.

Currently the MPSP does not operate an SL/TL monitoring system. All management processes are based on a manual system except the process of receiving complaints from Aduan System and Smart Monitoring System. However, the MPSP is using a messaging platform such as WhatsApp and SMS to give information about malfunctions of SL/TL to the MPSP engineers and contractors who are in charge of maintenance. Therefore, introducing and implementing an SL/TL system is an urgent matter for the MPSP to increase its efficiency and citizen's satisfaction.

Important implications from major stakeholders are as follows:

- **IT Department**

The MPSP is utilizing IT technologies and systems relatively well. However, the absence of a comprehensive IT master plan causes some inefficiency in IT system operation.

- Sufficient IT infrastructure and human resources for operating SL/TL Monitoring
- Comprehensive IT master plan should be created for efficient e-Government development

- **Engineering Department**

The absence of a real-time monitoring system for SL/TL operation causes delay in fixing malfunction of SL/TL. Street lamps are checked only three times a week, which means it can take two to three days to fix malfunctions of street lamps.

- Delay in repairing malfunctions of SL/TL due to the absence of real-time monitoring system
- Improvement of SL/TL management process is necessary

- **Corporate & International Affairs and Community Affairs Departments**

The MPSP provides good complaint systems to its citizens, but the integration of the two separate systems, Smart Monitoring System and Aduan System, will provide even better services to the citizens and MPSP officials.

- MPSP is currently providing good complaint systems to citizen, but integrated system will better serve citizens and MPSP officials
- Voices of citizens can be major source of big data

- **Town Planning Department**

The MPSP considers Eco-City project a crucial stepping stone to proceed to the next level. Currently the MPSP is promoting Eco-Tourism as an important development strategy in which Eco-City is an essential part. The SL/TL controlling system will contribute to reducing light pollution, energy waste, and GHG emissions.

- Implementing STMS in newly developed areas such as Eco-City is recommended
- Effect of STMS can meet goals and vision of Eco-City

- **Telecommunication Companies**

Celcom and Maxis both provide advanced wireless network service such as 4G LTE. In addition, they provide not only GSM-based service but also WCDMA-based network service, which Gabotech uses for its solutions in Korea. This makes it easier to customize pilot projects and other possible projects in the future.

V Case Study

1. Best Practice

Transforming into a smart city using the Internet-of-Things technology has been a major issue in many nations for the past few years. There have been many attempts, at the regional or city level, to build a smart management system for public services. A few of them are recognized as a transformational change and become a role model of innovation for other cities and countries.

Best practices of Seoul, Korea and other cities were analyzed for this FS project. The range of research is limited to cases of implementing smart lighting systems. The cases of other advanced cities will show how the integration of lights and IoT can make a city smarter.

1.1. Korea

1.1.1. Seoul, Korea

- **Pilot project - Smart LED Street Lighting Management System**

< Figure 21. Before & After Implementing a Smart LED Lighting System >

(Kim Moon goo 2014)

Since 2014, Seoul City has established a smart lighting management system in certain areas including Mugyo-ro, Sejong-ro, and Namdaemun-ro. Each lamp pole has a sensor to detect the movement of people and objects. It connects to the main server and the system can automatically adjust the brightness of the lamp based on its surrounding lighting conditions. Dozens of street lights were replaced and have been operating as a pilot.

In the case of driveways, when a vehicle approaching is detected, the streetlight illuminates up to a distance of 100 meters ahead. The streetlight slowly dims after the vehicle passes and when there is no following vehicle. When it comes to sidewalks, the streetlights illuminate the path for pedestrians.

As a result, there is no significant inconvenience caused by heavy traffic at night in Seoul, and the power saving effect of the smart system is estimated to be more than 30%. The figure is expected to rise to 60% when street lights are controlled more efficiently. The city plans to replace all the street lamps with LEDs by 2018 and aims to expand the areas controlled by the smart system to 50% by 2020.

The city's total use of electricity, before implementing smart LED lighting system, was about 145 GWh and the cost was 22.6 million won. After expanding the system to the entirety of Seoul, the cost is expected to decrease by more than 30%. Seoul will then be marked as the first city in Asia to use a smart system to control the entire city's lighting.

< Table 21. The Number of Outdoor Lights >

Total	Streetlight		Security Light	Park Lamp
	Streetlight	Distribution Box		
599,640	339,945	6,898	225,292	34,403

(LUCI AGM Seoul Conference Book 2016)

- **Laws and Rules of Smart Street Lights**

  - Lighting Policy for Exterior Illumination

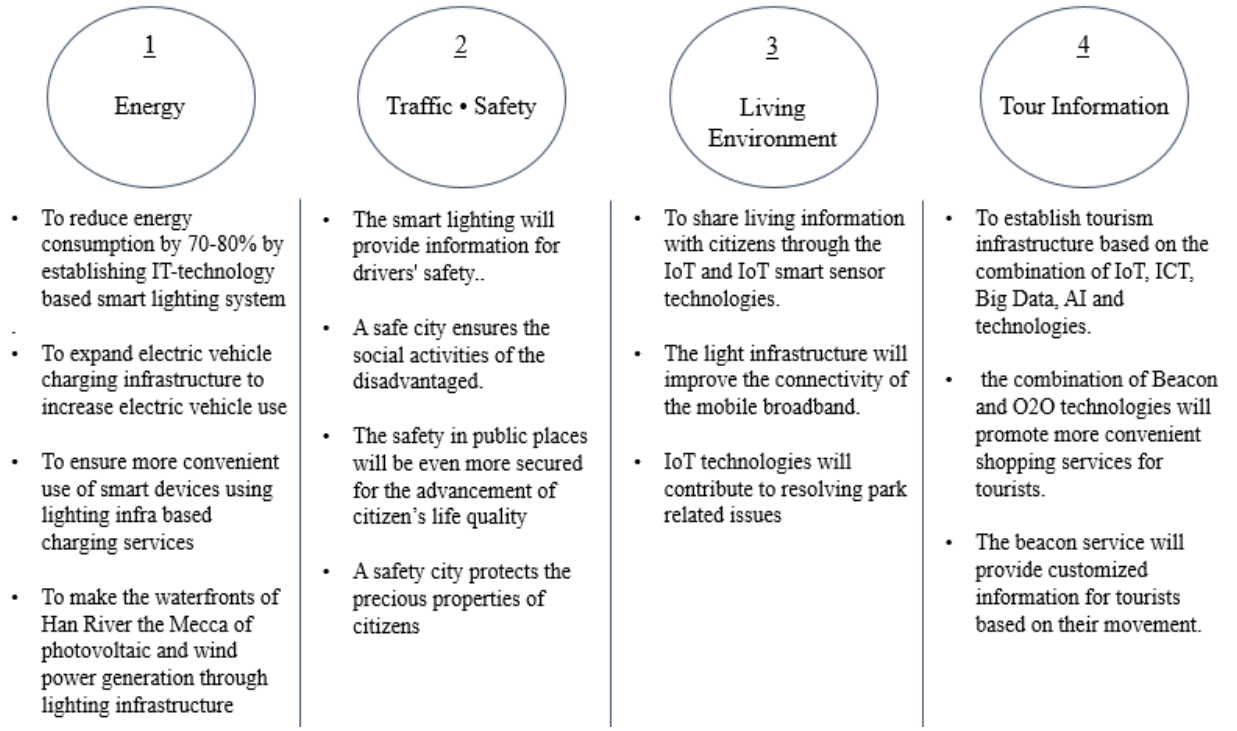
In 2010, the Seoul Metropolitan Government established an ordinance for exterior illumination titled, "Seoul Metropolitan City Ordinance for the Prevention of Light Pollution, and Management of Urban Lighting". It was enacted for the systematic management of lighting and the minimization of light pollution. It was two years earlier than the legislation by the Ministry of Environment.

In 2014, the Ministry of Environment announced its comprehensive plan to prevent light pollution and decrease it by 50 percent in 5 years. Under this plan, the Seoul Metropolitan Government has designated light, noise, and odor pollution as the three major causes of discomfort. It has pursued policies to better the urban environment.

The Seoul Metropolitan Government also has recognized the importance of lighting, not only to ensure the citizen's comfort and safety but to enable urban regeneration by encouraging tourism and leisure in the city.

The Seoul Metropolitan Government has been pursuing four strategies to have the world's best urban lighting infrastructure.

< Figure 22. The 4 Main Strategies of Seoul >



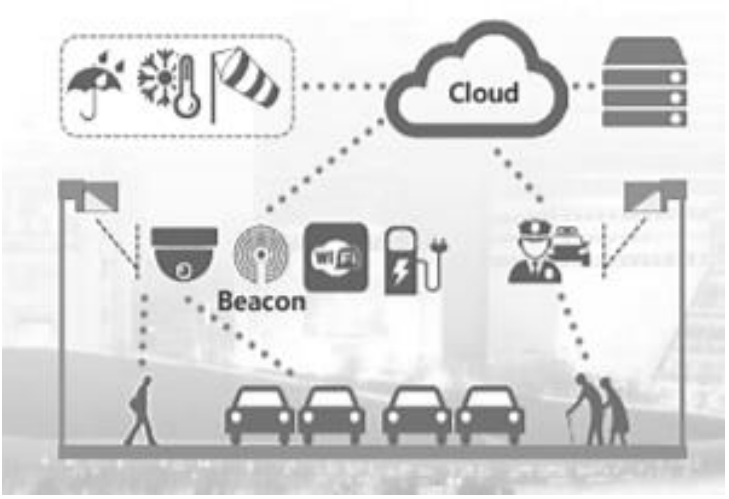
(LUCI AGM Seoul Conference Book 2016)

- Seoul Digital Foundation Plan 2020

On Feb. 23, this year, the Seoul Metropolitan Government has announced "Seoul Digital Foundation plan 2020", a road map for the five-year plan for digital policies (Seoul Press Releases, 2016). The digital plan of Seoul is to be renewed every five years under the "Seoul Information Basic Ordinance". The Seoul Metropolitan Government has formed and enhanced the plan in light of a changing digital environment.

Under the vision "New Connections, New Experience of Global digital Seoul 2020", the Seoul Metropolitan Government is now pushing forward four strategies (Social Capital, Diginomics, Innovation through Digital Society, Global Digital Leader) and 54 action plans. One of the city's major goals is to construct an ICT network that covers the entire city, including the GIS data gathered from smart street lights, traffic lights, and CCTVs.

< Figure 23. To-Be Model of Smart Lighting System in Seoul >



(LUCI AGM Seoul Conference Book 2016)

1.1.2. Gwangju, Korea

Gwangju has led the way in introducing new energy technologies, improving energy efficiency, and saving energy from 2008. As a way to reduce its energy consumption, the Gwangju government has gradually upgraded its street lights, starting from replacing the bulbs with LEDs to building an integrated management system. Taking it a step further, the Gwangju government has made its own independent system for street lights.

- **Replacing with LED bulbs**

In 2010, the Gwangju government started to replace the street lights with LEDs after years of testing. A 350-watt metal light was replaced with a 150-watt LED light, starting from those on the main highways which consume an enormous amount of power to those on other types of roads. Now, this project is about 20 percent complete and is still in progress.

Gwangju city's initiative is different from that of other cities in several ways.

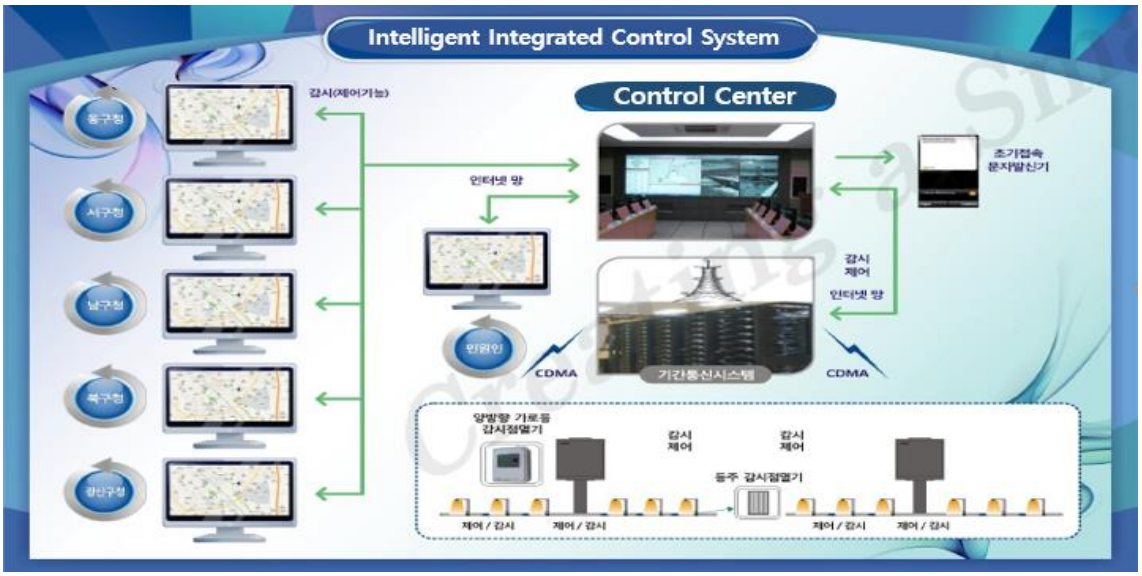
- It is the first case where the local government made its own standards of LED street lights and conducted conformance tests on its own. The standard defines the specifications of its LED module, power supply, size, and capacity. It dramatically reduces the cost of the system by making maintenance easier, and new opportunities are created for small local firms to participate in the public projects.

- It is also the first case in the world to be approved as a CDM (Clean Development Mechanism) business in LED street lighting. The CDM is a global effort to reduce greenhouse gas emissions. A registered CDM business can sell its emission rights in return for the emissions reductions. In 2011, Gwangju city won the approval to sell the emission rights for 28 years.

- It is a successful case of public private partnership. About 40 percent of the 2015 budget came from private capital invested in the name of ESCO (Energy Service Company). The investment made by ESCO can be paid back for years with the revenues from the energy saving efforts.

- **Implementing Intelligent management system**

< Figure 24. Intelligent Integrated Control System >



(Kim Byeong Cheol 2014)

After several studies, the Gwangju government decided to install a Gabotech Solution in which a control center monitors every street light and security light based on real-time information, and prevents power loss by blocking circuit immediately in case of trouble. Every street light and security light could send and receive data in both directions using CDMA networks.

What is different here is as follows:

- The Gwangju government bought the solution from Gabotech and modified this solution to meet their needs. They developed a communication protocol which can be used by any product not only from Gabotech but from others as well. Their active efforts to establish standards and guarantee the quality of procurement enhanced citizen's convenience.

- The Gwangju government registered this integrated management system as an intellectual property and they sold their solution to other cities such as Sejong city, Naju city, and Nepo city. The extra income from these sales covers ten percent of development costs.

- **Installing and managing Smart Street light**

The Gwangju government also developed two types of smart street lights; one has a built-in black box (video recording) and the other features Beacon (Bluetooth). These smart street lights can replace CCTVs in small alleys and remote areas that are difficult to be connected to the city control center.

< Table 22. The Number of Smart Street Lights >

Year / Unit	Black Box	Beacon
2015	70	1000
2016	220	2150

(Gwangju Best Practice Book 2016)

The Gwangju government has started to install smart street lights from 2015. The ones with the black box video can record footage and save it for ten days. The other with the Beacon technology can automatically ask for help in case of emergency. The motion sensor reads the rescue signal of mobile phones within a radius of 50 meters, provided that the application, "City of Light," is installed in his/her smartphone.

These new functions were actively promoted and well received by women, children, and older people. A test operation has proved that smart street lights is particularly helpful in preventing minor crimes like school violence, trash dumping, and urinating in public. Around 15 real crime cases have been solved by using the data gathered from the street lights.

< Figure 25. The Pictures of Installation Sites in Gwangju >

(Gwangju Best Practice Book 2016)

1.2. Other countries

1.2.1. Indonesia

The Smart Street Lighting Initiative (SSLI) of Indonesia is a program of policies and measures coordinated by the Ministry of Energy and Mineral Resources with the objective to increase the energy efficiency of street lighting by substituting conventional street lighting systems with more efficient street lighting technologies in cities and urban areas.

In 2009, the Government of Indonesia made a commitment to reduce 26% of its GHG emissions through domestic efforts and up to 41% with international support. In 2011, the National and Local Action Plans on GHG Emission Reduction (RAN/RAD-GRK) were launched to formulate action to achieve these reduction targets.

The SSLI NAMA provides the framework in order to increase the efficiency of national energy management, expand the grid infrastructure in a stable and energy-efficient manner, attract investors and involve all relevant stakeholders, and facilitate access to financial, technical, and capacity building support. To overcome economic and structural barriers, the SSLI focuses on the following activities:

< Figure 26. SSLI Activities >

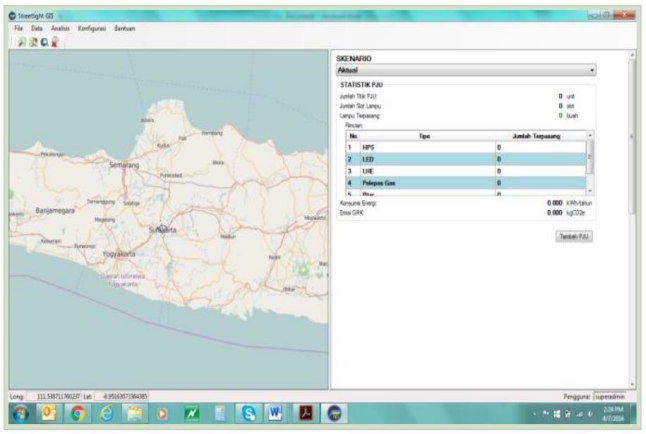
(SSLI 2016)

The city of Surakarta with 16,700 street light units, of which 70% is unmetered, spends an average of IDR 28.8 billion annually to pay street light electricity bill, much more than the neighbouring cities Yogyakarta (IDR 7.2 billion/year), Pekalongan (IDR 10.3 billion/year), and Salatiga (IDR 3.2 billion/year).

The SSLI supported the implementation of a pilot project in Surakarta from June to December 2014. It included the computer-based street light information system and the master plan for energy efficiency of street lights. The information system displays ten types of information, including alert system, reporting, pole, wiring, street lights, Surakarta administrative map, street light location map, master data, and simulation.

The project is funded by the Indonesia Climate Change Trust Fund (ICCTF) and implemented by Akademi Teknik Mesin Industri (ATMI) Surakarta.

< Figure 27. The Screenshot of Street Light Information System >



(SSLI 2016)

Another pilot project was carried out in Makassar over the same period. Around 77 units of High Pressure Sodium (HPS) lamps were replaced with LED lamps as a trial to test the feasibility of LED replacements. The LED lamps saved 130 watts per unit while showing better lighting performance. This project was conducted with the grant from USAid-Indonesia Clean Energy Development Project (ICED).

< Figure 28. Changes of Energy Consumption after Replacement with LED >

Average Energy Consumption (kWh) Before Replacement

	Street Light Panel #50	Street Light Panel #51	Street Light Panel #52	Total
Unit	20	32	25	77
kWh/day/lamp	5.5	3.9	4.5	
kWh/day	110	125	223	347

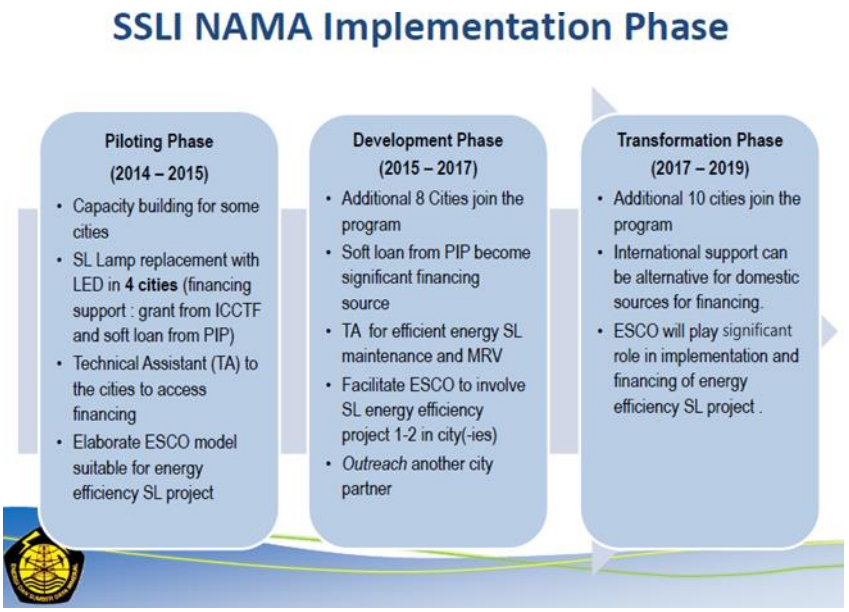
Average Energy Consumption (kWh) After Replacement

	Street Light Panel #50	Street Light Panel #51	Street Light Panel #52	Total
Unit	20	32	25	77
kWh/day/lamp	1.65	1.5	1.5	
kWh/day	**33**	**48**	**37**	**118**

(SSLI 2016)

The SSLI NAMA implementation plan describes the necessary measures to be taken in order to improve Indonesia's street lighting system in urban areas by 2020. The SSLI NAMA implementation plan has been developed in partnership with the German government.

< Figure 29. SSLI NAMA Implementation Plan >



(SSLI 2016)

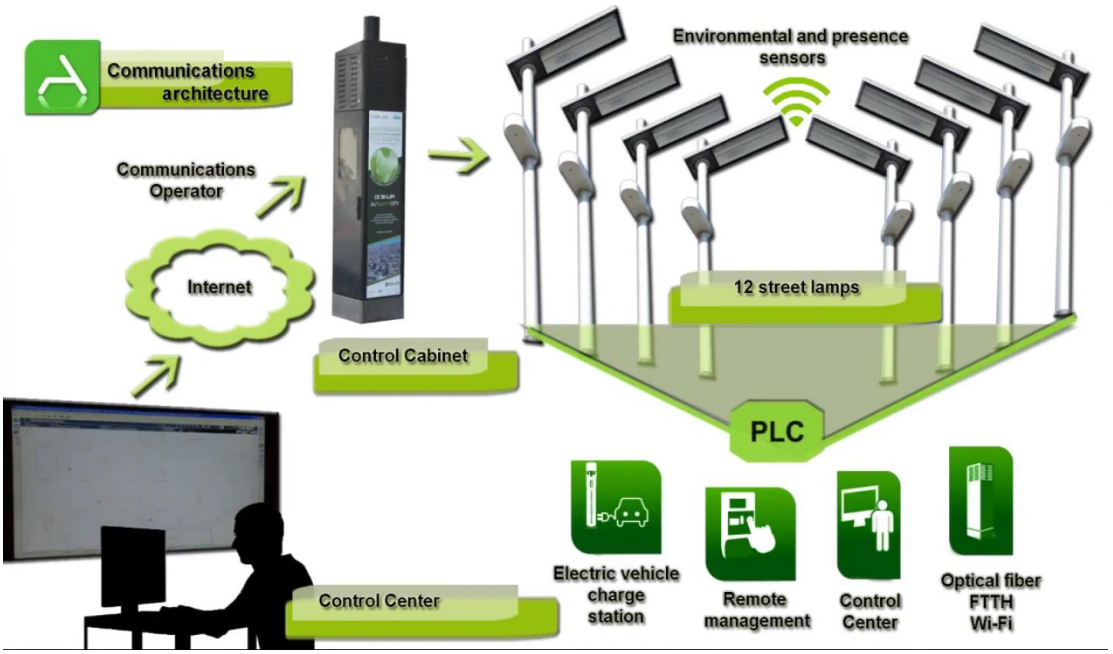
1.2.2. Barcelona, Spain

Barcelona has a strong willingness to develop digital infrastructure and to apply new technologies for a smarter city management (Barcelona Smart City Tour 2011). The city launched the 22@Urban Lab project to foster the city as an urban laboratory and a testing ground for innovative solutions. The aim of the project was to provide companies that are developing innovative solutions at a pre-commercialization stage with the opportunities to test them within the district through pilot trials.

The SIIUR project (Integral Solution for Urban Infrastructures) is an example of innovative urban living labs. It is a very innovative project focusing on urban lighting as part of a smart city. The SIIUR project involved Barcelona Digital Technology Center and the consortium of more than 12 companies involved in public lighting, automation, control, and communication networks (ESOLI Newsletter 2010).

Street lamps in the SIIUR project are equipped with LED technologies to reduce cost and pollution. The lamps include sensors that process environmental information and detect movement, temperature, humidity, noise and pollution. These lights are connected to a Street Lighting Cabinet that centralizes all communications and services, and send the information to a central control center.

< Figure 30. The Communications Architecture of 22@Barcelona >



This new lighting system is located in Passate Mas de Roda, with two main objectives of testing new and efficient lighting systems and integrating technological features to develop a true smart city environment. The development of an efficient public lighting solution contributes to a better strategic position of Barcelona given the current global trend of sustainable development.

SIIUR was awarded in the Living Labs Global Award 2011 out of more than 245 proposals, and was also proposed to be implemented in Eindhoven to develop intelligent and sustainable lighting solutions in Eindhoven.

With the implementation of 22@ Barcelona project, more than 4,500 companies have moved in Barcelona, and 56,000 jobs have been created with the growth of the knowledge-based industry. Various sensors which can generate power themselves have been installed throughout the city. Smart bus stops that provide information on traffic and tourism, smart streetlights that measure the pollution level, and smart trash cans that weigh waste have all been installed to realize a smart city. This project is truly transforming the lives of urban residents.

1.2.3. Comparison of Best Practices and Its Implications

The following table gives brief information about each project and compares the four aforementioned projects.

< Table 23. Comparison of Four Projects >

City	Seoul, Korea	Gwangju, Korea	Barcelona, Spain	Indonesia
Objective	- Create world's most advanced infrastructure based on IT technology - Search new growth engines for city	- Expand social safety networks to ensure the citizen's security - Enhance manageability and optimize performance of light	- Transform old industrial district into innovative cluster - Improve citizen's quality of life and stimulate new Smart City economy	- Reduce electricity cost of Street Lamps and GHG emissions - Ensure citizen's safety and security, particularly at night
Key Features	- Smart lighting infrastructure incorporating IoT, ICT, Big Data and AI analysis will be introduced all over city	- Real example of building and developing smart SL control system by using Gabotech Solution	- Sensors that can capture vital information for smart water, smart lighting and smart energy were installed in 22@ Barcelona district	- Project is now at very early stage and will be implemented with Foreign ODA Funds
Impact	- 30 – 60% of cost savings are expected	- 37 - 63% of cost savings are expected	- 40% of cost savings were realized	- 34% of cost savings were derived from the pilot

There are common elements among the four cases:

1. Replacing streetlights with LEDs
2. Establishing a management system using wireless networks

However, the reason why the smart lighting was first introduced is totally different. There is an ultimate goal of transforming the city into a smart city in the case of Barcelona and Seoul, whereas Indonesia focuses on cutting electricity cost. Gwangju pledged to adopt smart lighting as a way to ensure women's safety and to keep an election promise.

Barcelona took an active approach using the system to promote the city's international standing and reputation. However, only a few areas are controlled by the smart lighting system in a true sense, and there is no specific plan to extend it all over the city.

In case of Seoul, thanks to its well-established IT infrastructure, chances are high that it builds a smart lighting infrastructure that covers the entire city. However, it is premature to tell the outcome.

The Gwangju case can be a useful reference to the MPSP because the city used Gabotech's solution and modified it as needed. The city has done a series of productive trials and has now started to make a profit by selling its own solution to other cities.

Indonesia just completed two pilot projects and has been under discussion about their outcomes. They developed their own Street Light Information System and has begun to distribute the software for free to Indonesian cities that are willing to use it. After this FS project, when the MPSP will enter the actualization stage, the case of Indonesia will serve as a useful reference. The case of Indonesia may have structural similarities with that of the Malaysia because both projects were supported by international development funds at the beginning.

VI To-Be Model

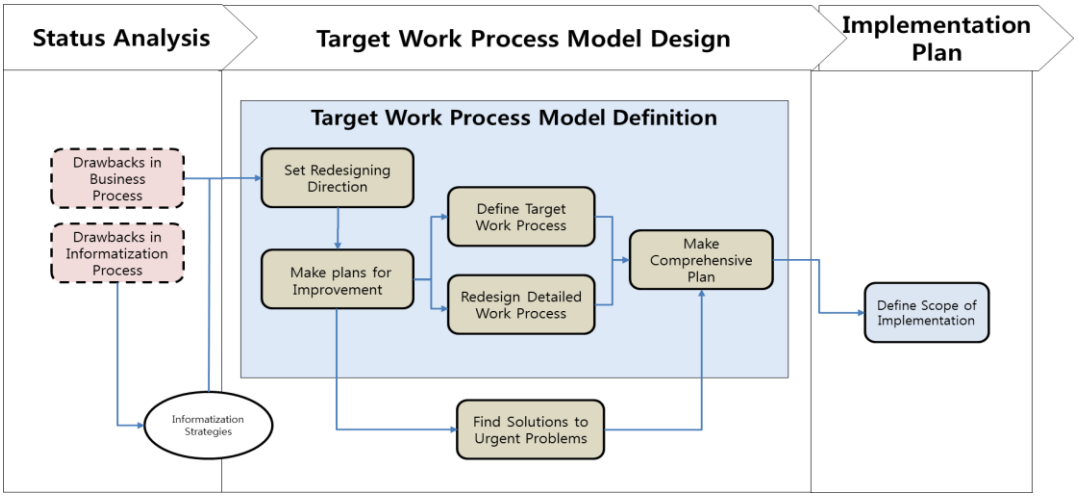
The As-Is analysis looked into some major implications and identified the most crucial issue as the absence of real-time SL/TL monitoring system in the MPSP. Therefore, the To-Be model will include conceptual real-time monitoring system process and IT architecture.

In addition to the real-time SL/TL monitoring system, the complaint handling system of the MPSP, which is important in SL/TL monitoring system, has room for improvement. Its two complaint handling systems should be integrated or replaced by a single system to increase administrative efficiency, citizens' satisfaction and utilization of BDA. A conceptual To-Be model of complaint handling system will be introduced in this chapter to advise the MPSP.

1. Approach for To-Be Model

In the phase of defining a target work process, the direction for redesigning is set based on the different redesigning models of each plans for improvement. The outcome of improvement efforts feeds into the detailed redesigning process while completing the work process.

< Figure 31. Approaches to Designing Target Work Process >



Seven redesigning models are identified for the improvement of business through status analysis:

1. Reducing Processing Time
   - Minimizing the time spent on processing petitions, thereby boosting efficiency

2. Removing Redundant/Overlapping Work
   - Streamlining the work process by removing redundant or overlapping work caused by inefficient processing procedure or methods

3. Work process at Front Line of Service
   - The department where data is created processes it and the data is processed only once where it is created

4. Enhancing Accuracy of Result
   - Improving work processes in a way that enhances the integration of data regardless of whoever may enter on any standards of processing

5. Digitalizing and Disposing of Written Documents
   - Boosting efficiency of the process by digitalizing written documents

6. Designing Petitioner-Friendly Process
   - Improving process by finding the needs of the petitioners by thinking from their perspective and needs

7. Introducing and Utilizing Information System
   - Enhancing the quality of work by introducing and utilizing information systems

To redesign the current manual SL/TL monitoring system, an integrated control center is built to control all SL/TL-related matters. In addition to the existing two monitoring processes (detected by PIC and received complaints from citizens), SL/TL monitoring system detects malfunctions of street lamps and traffic lights

in real time. For street lamps, the detection includes control box door opening, electricity shutdown and malfunction on lamps, whereas for traffic lights, the detection includes control box door opening and electricity shutdown. The integrated control center can then send contractors or MPSP engineers to resolve the problem. As soon as the malfunction is addressed, the PIC can directly reply to the citizen through the integrated complaint handling system in case of a complaint-initiated issue.

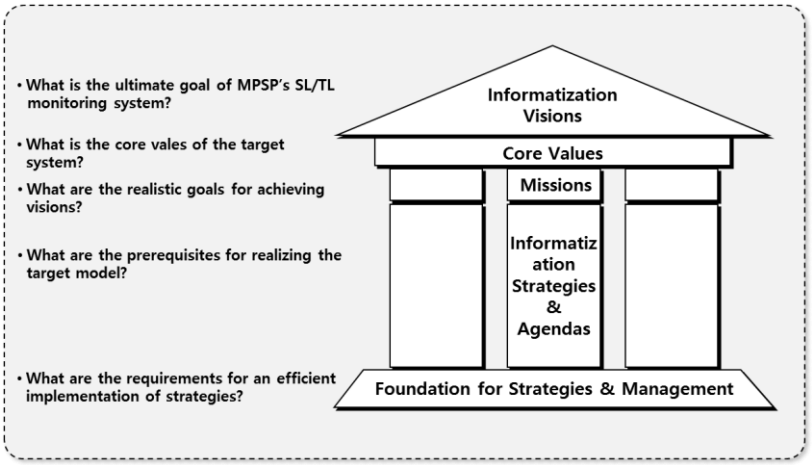
Moreover, the accumulated database of information gathered from the SL/TL monitoring system can be an excellent source for big data analysis to improve efficiency of SL/TL management and handling of other issues such as traffic, illegal dumping and citizen satisfaction. Finally, a decision maker can synthesize directions for short and mid-to long-term plan.

2. Information Vision & Strategy

- **Vision Framework**

Setting visions and goals, drawing informatization strategies and agendas based on the areas of improvement identified through status analysis.

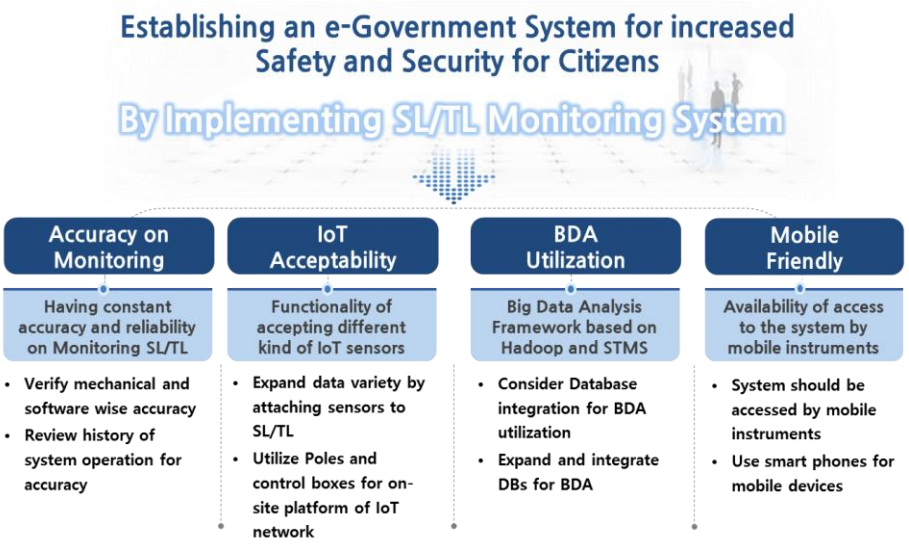
< Figure 32. Vision Framework >



- Informatization Vision: Target model and ideals
- Core Values: Values and principles that underlie the STMS
- Mission: Specific short, mid and long-term goals to achieve the vision
- Informatization Strategies and Agendas: Major considerations to reach the goals
- Foundation for Strategies and Management: Legal, institutional, and organizational foundation for strategies and agendas

- **MPSP SL/TL Monitoring System Informatization Vision**

< Figure 33. MPSP SL/TL Monitoring System Informatization Vision >

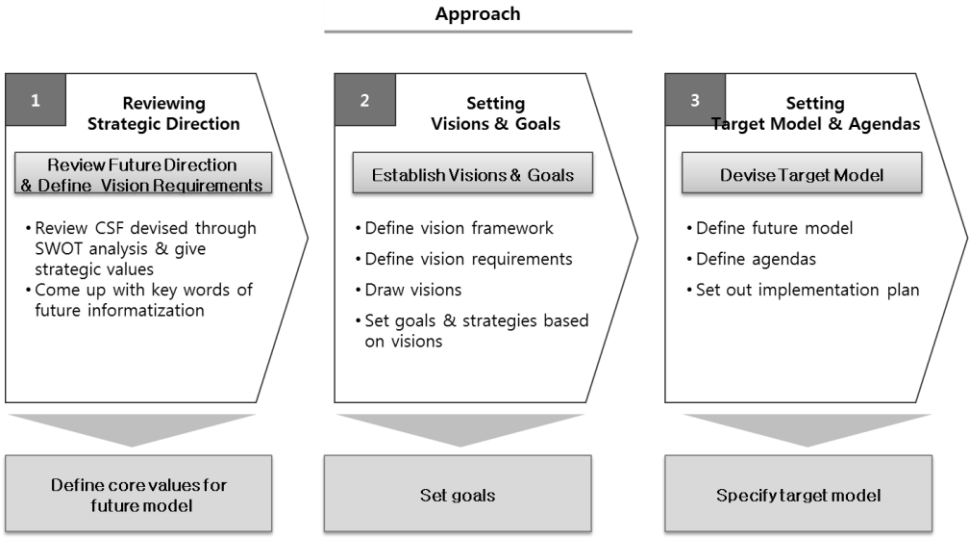


3. Critical Success Factors

3.1. Setting Strategic Direction

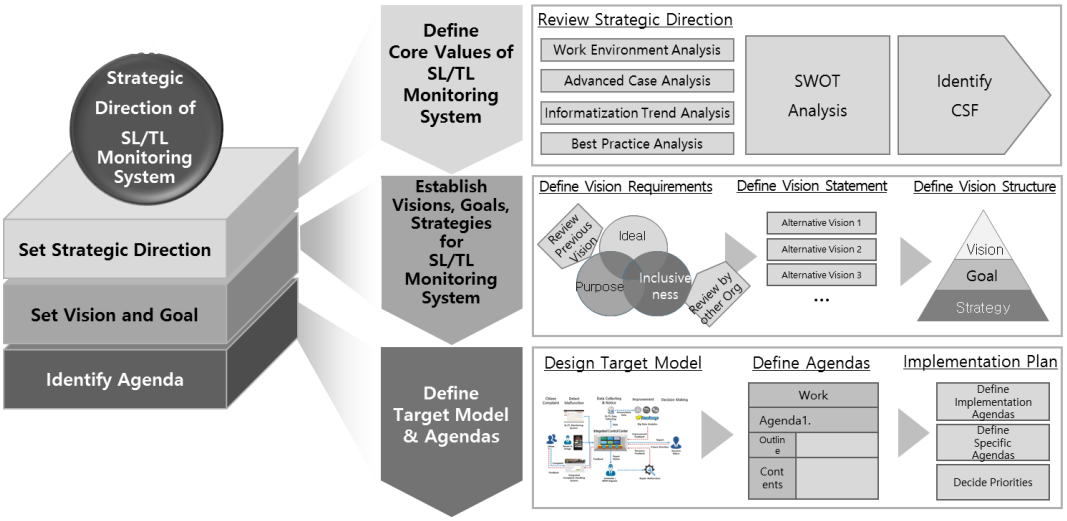
Establishing visions and objectives of the SL/TL monitoring system based on the direction of the redesigned SL/TL monitoring process that is devised through environment/status analyses, and identifying major agendas.

< Figure 34. Process of Setting Strategic Directions >



These are the three approaches to design a target model based on specific analysis methods and the definition of vision requirements. The outcome of such analysis and definitions feeds into a target model and ultimately contributes to coming up with specific agendas for each area.

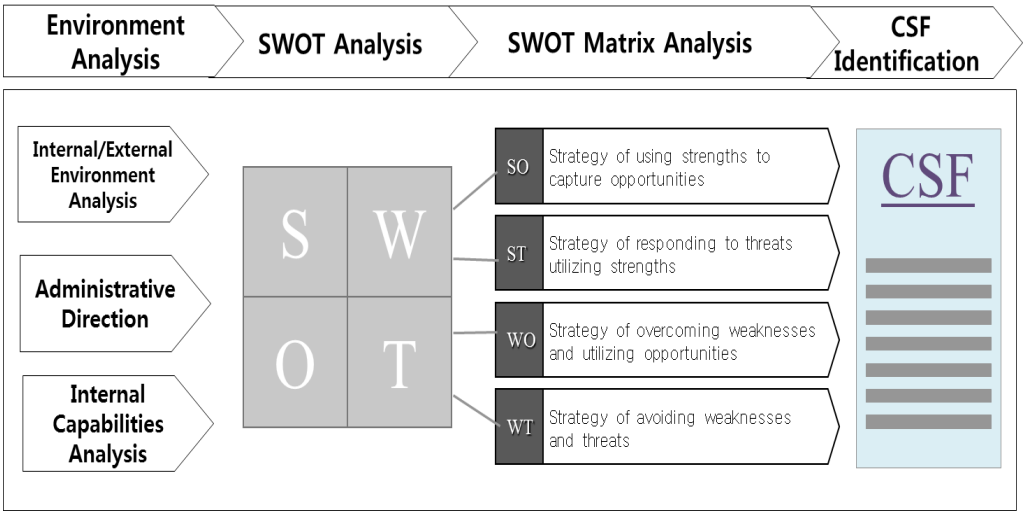
< Figure 35. Procedure for Establishing Informatization Vision and Goals >



- **Review strategic direction**

SWOT analysis is an analysis tool for developing strategies by identifying an organization's strengths, weaknesses, opportunities and threats through internal capabilities analysis.

< Figure 36. Procedure of Identifying Success Factors through SWOT Analysis >



- **SWOT Analysis from As-Is Analysis**

< Table 24. SWOT Analysis from As-Is Analysis >

Strength	Weakness
1. Strong will to implement SL/TL monitoring system 2. Sufficient IT and Engineering human resources 3. Sufficient IT infrastructures such as Internet broadband 4. SL and TL managed by one department 5. High mobile penetration rate and use of the mobile devices by officials and contractors	1. Insufficient experience of operating SL/TL IT system 2. Insufficient storage for Database 3. No control center for managing SL/TL monitoring system 4. Separated Complaint Handling Systems 5. Insufficient utilization of BDA
Opportunity	**Threat**
1. Good quality of wireless network 2. High mobile penetration rate and use of the mobile devices of officials and contractors 3. Newly developed area (Eco-City) suitable for STMS 4. Existing DB of complaints related to SL/TL	1. Working with several contractors (five contractors) 2. Concrete street light poles managed by other organization (TNB)

- **SWOT Matrix Analysis**

  - SO Strategy : Use strengths to capture opportunities (STRENGTH/OPPORTUNITY)

    (S1:O3) Implement second pilot system in Eco-City area as stepping stone for complete implemention

    (S2:O4) Analyze complaint and SL/TL DB to develop more efficient work process for IT and Engineering human resources

  - ST Strategy : Respond to threats by tapping into strengths (STRENGTH/THREAT)

    (S1:T1) Reduce the number of contractors and outsourcing rate by using SL/TL monitoring system

    (S2:T2) Spread SL/TL monitoring system to TNB by capitalizing on sufficient IT and Engineering human resources

    (S5:T2) Merge separate organizations for managing galvanized and concrete street light poles into one single organization by using SL/TL monitoring system

  - WO Strategy: Overcome weaknesses by utilizing opportunities (WEAKNESS/OPPORTUNITY)

(W4:O4) Integrate separate complaint handling systems or develop single complaint handling system to replace two separate systems

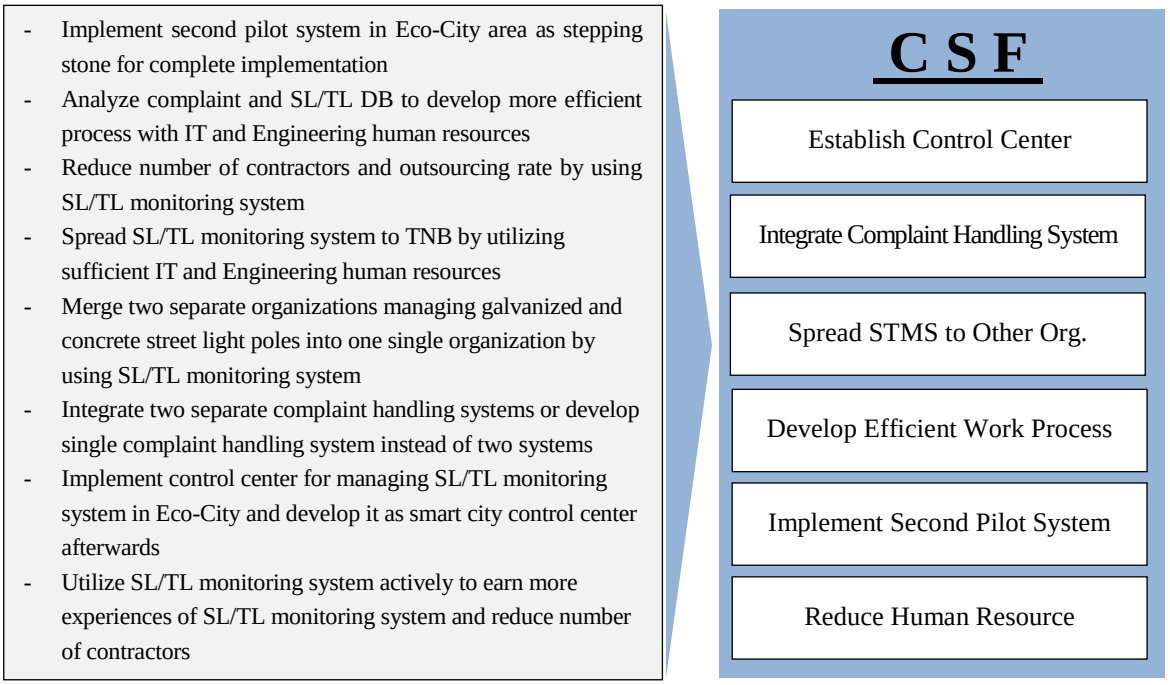
(W3:O3) Establish control center for managing SL/TL monitoring system in Eco-City and develop it as smart city control center afterwards

- WT Strategy : overcome weaknesses and threats

(W1:T1) Utilize SL/TL monitoring system actively to earn more experiences of SL/TL monitoring system and reduce the number of contractors

- **CSF Identification based on SWOT Analysis**

< Figure 37. CSF Identification based on SWOT Analysis >



4. To-Be Direction

Based on the critical success factors identified above, the To-Be Direction is further developed into a successful To-Be Model. Important targets that are defined as To-Be directions for the MPSP are as follows:

- Implementing second pilot System in Eco-City area
- Creating Smart City Control Center
- Developing big data analytics system with IoT
- Developing integrated complaint handling system

These four To-Be directions are critical to implement a target system and maximize the full potential of the target system. The To-Be directions are drawn based on the MPSP's goal to become a Smart City in the near future.

- **Implementing Second Pilot System in Eco-City area**

The pilot system of this project consists of five street lamps and one junction of traffic lights. The size of the pilot system is too small to verify the positive and negative effects of the STML. One of the most important aspects of the STML is acquiring citizens' opinion, but it is almost impossible for the citizens to understand its effect with the current size of the pilot system, Therefore, a second pilot system is necessary before the complete implementation of the system in the entire Seberang Perai. Eco-City is a valuable site for the second pilot system.

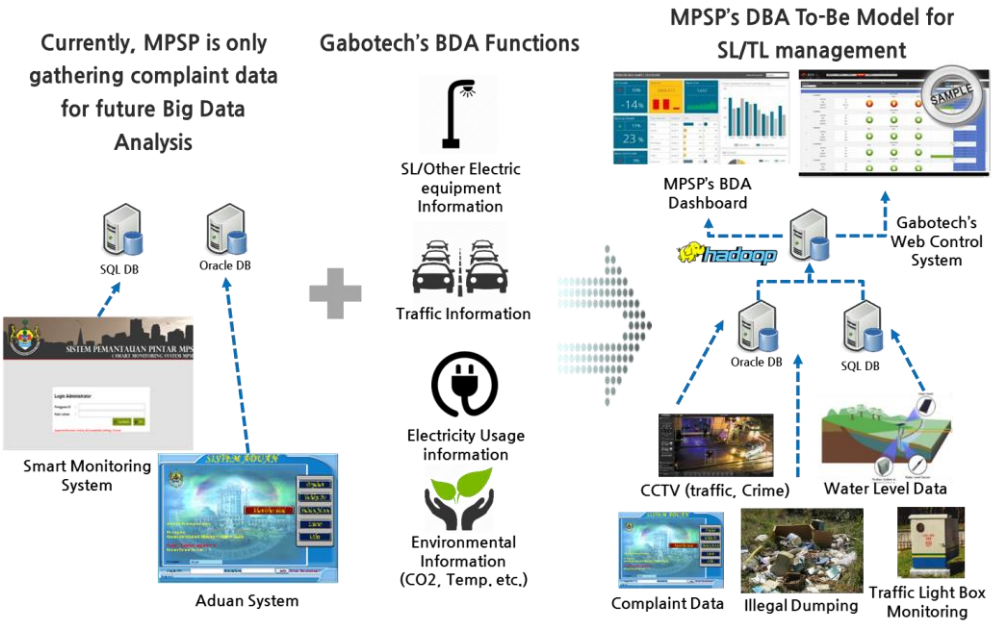
- **Creating Smart City Control Center**

The integrated control center is fundamental to Smart City or Eco-City since the city's large number of IT systems, sensors, equipment and facilities should be controlled and managed in a single place. The MPSP faces a good opportunity to create the control center by implementing the STMS control center. By the time the second pilot system is implemented, the MPSP can create a control center for Eco-City because the STMS can provide a good opportunity to connect IoT sensors and other systems.

- **Developing Big Data Analytics System with IoT**

BDA is a crucial component for the MPSP to become a Smart City. According to the MPSP's BDA plan, the MPSP has five target BDA models: 1. Smart Monitoring System, 2. Flood Mitigation, 3. Health Check Monitoring, 4. CCTV solution, 5. Illegal Dumping. These models are closely linked with IoT solutions that can utilize the STMS. To achieve all these goals, the MPSP needs to develop a mid- to long-term BDA master plan.

< Figure 38. To-Be Direction of BDA with IoT >



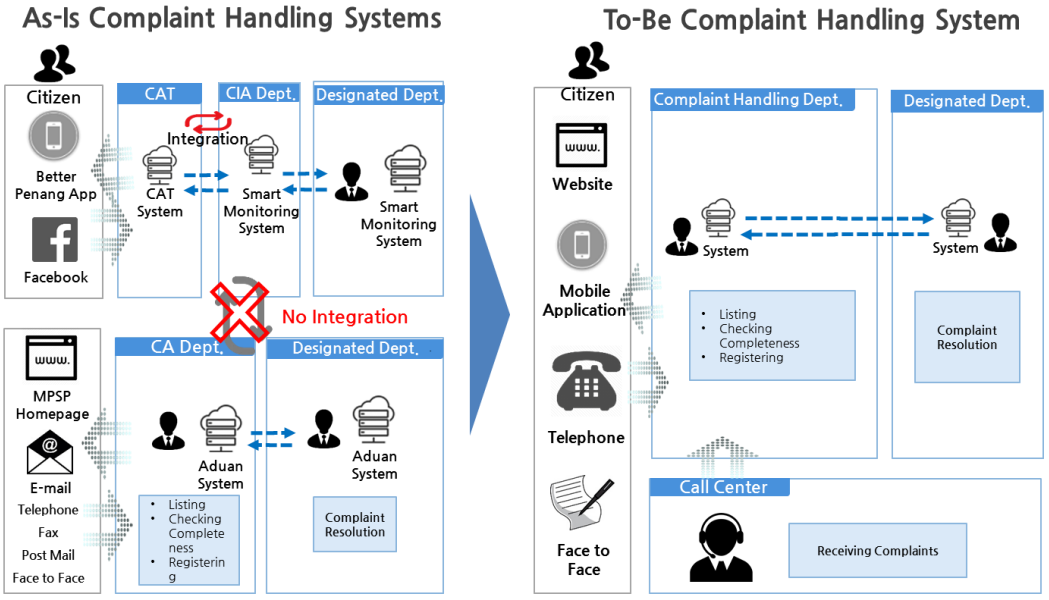
- **Developing Integrated Complaint Handling System**

As was mentioned in the As-Is analysis, the MPSP is operating two complaint handling systems, Aduan System and Smart Monitoring System. Aduan System was developed earlier, and it is a more traditional model. On the other hand, Smart Monitoring System was developed later for the purpose of listening to citizens' voices from Facebook and mobile applications.

The two systems are operated and managed by two different departments in the MPSP, and they have separated database and system architecture. Furthermore, Smart Monitoring System was integrated with an external system that is developed and operated by an NGO. This complicated situation should be resolved to better utilize complaint information and increase efficiency in managing the complaint handling system.

Complaint information is a crucial resource for BDA because it provides information about citizens that are not obtainable by public servants. In addition, the external system operated by an NGO can be problematic the MPSP cannot make sure that the external system properly protects sensitive information about its citizens. Furthermore, there is possibility of data loss.

< Figure 39. To-Be Direction of Complaint Handling System >



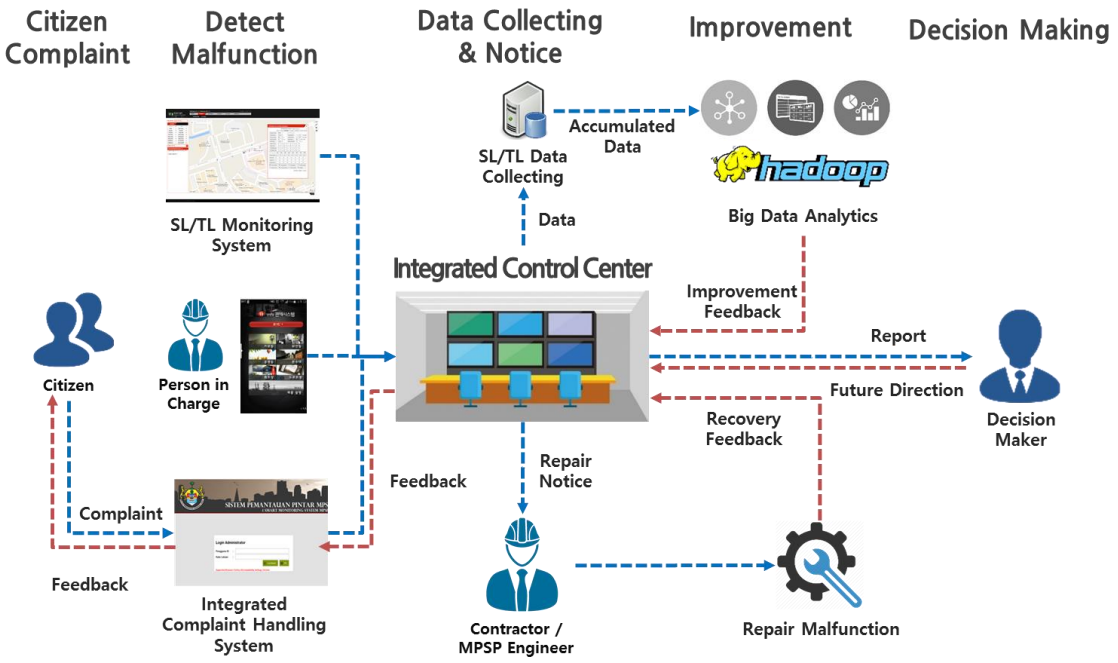
Therefore, introducing a single complaint handling system is recommendable for the MPSP for the three following reasons.

- Integration of two complaint handling system is difficult and time-consuming
- If the two systems are integrated, NGO can access Aduan system as well, which is not preferable for MPSP
- Integration of two systems will require more input in the future such as upgrades and issues between two systems

5. To-Be Model

The MPSP is facing three issues in SL/TL management: No real-time monitoring system for SL/TL, insufficient big data analytics solutions, insufficient integrated complaint handling system. To satisfy citizens and increase the efficiency of SL/TL management, the MPSP needs to resolve these three issues by implementing an integrated control center for SL/TL monitoring system and integrated complaint handling system as well as developing databases for big data analytics using IoT.

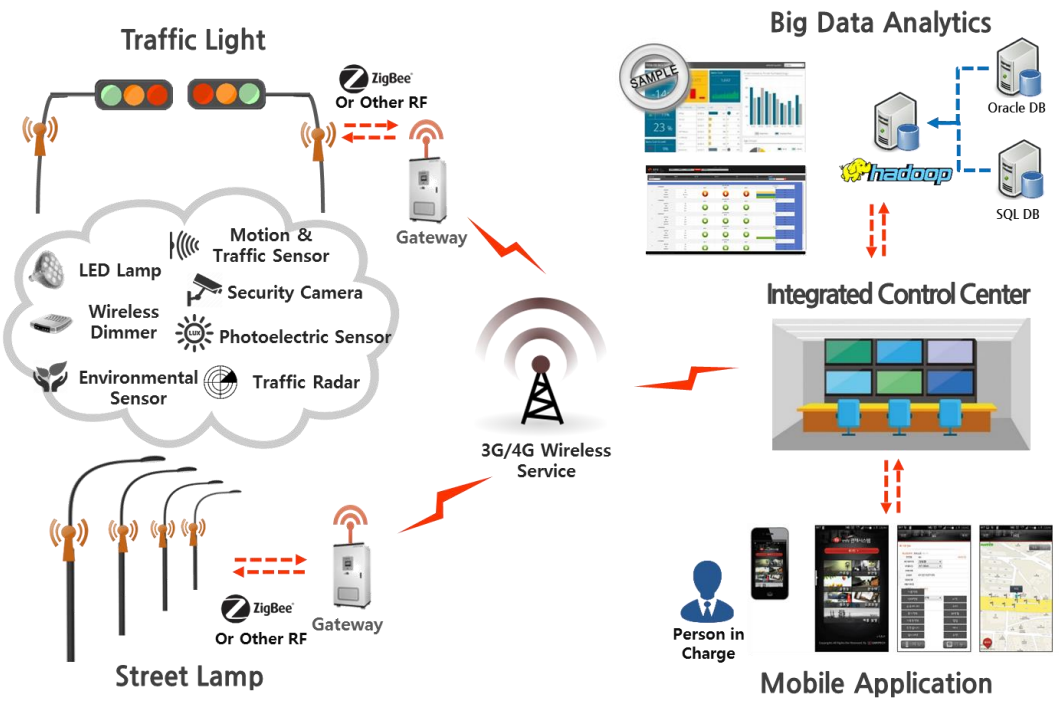
< Figure 40. Conceptual To-Be Model >



5.1. Integrated Control Center for SL/TL Monitoring System

Having an integrated control center is essential to manage SL/TL monitoring system and databases for BDA because there will be a massive inflow of different data and information from IoT sensors to the databases and the control center. To utilize these data, specialized officials are necessary to handle the integrated control center to immediately respond to any contingencies. The integrated control center will also be in charge of IT systems to operate a Smart City or Eco-City that will be built in the near future.

< Figure 41. Integrated Control Center for SL/TL Monitoring System >

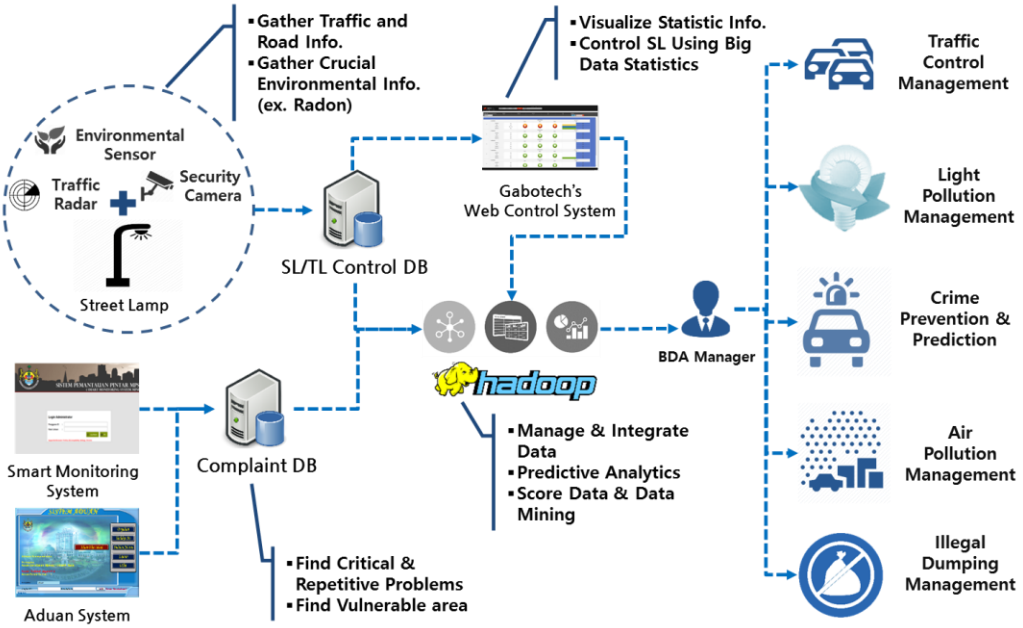


The Integrated Control Center will receive information through SL/TL monitoring system from its sensors. Related data will be saved in the servers of the MPSP and accumulated as useful databases for BDA. BDA managers will utilize these databases to make decisions more efficiently. In addition, when Integrated Control Center is informed of malfunctions of SL/TL by the monitoring system, the complaints handling system, the PIC, and the center will send a notification to the SL/TL maintenance PIC to resolve the malfunction.

5.2. Developing Database for Big Data Analytics by IoT

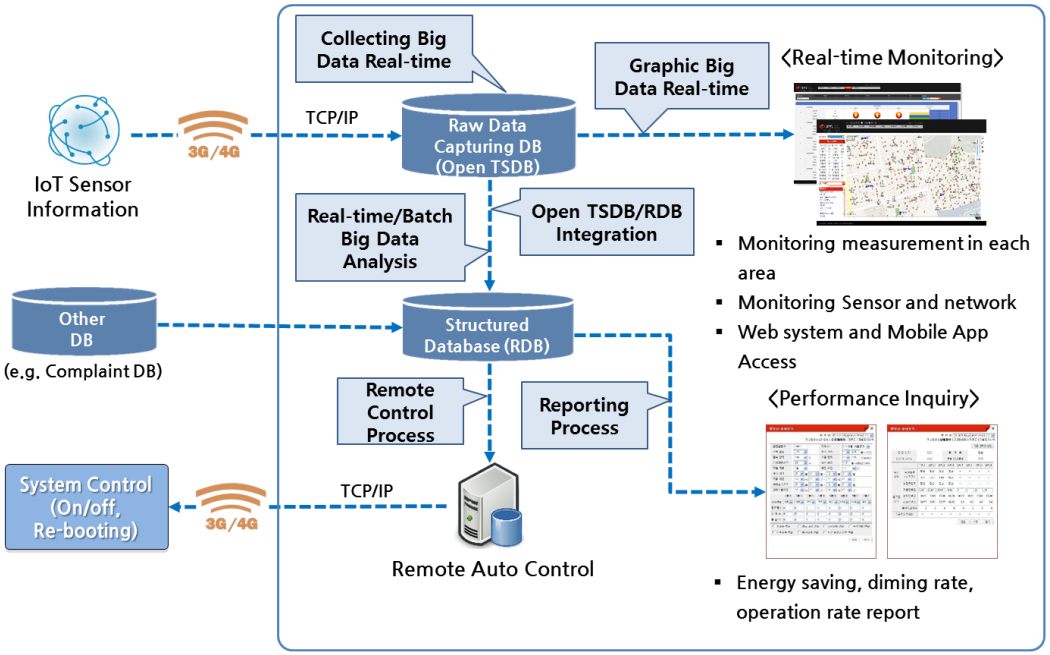
One of the MPSP's priorities is accelerating BDA to increase the efficiency of operating the municipality. With SL/TL monitoring system, the MPSP will be able to incorporate various IT technologies such as traffic radar, security camera, and environment sensors into SL/TL poles to gather information in its databases, and these databases will be utilized in addition to the complaint database that the MPSP has developed. The MPSP will analyze these databases focusing on citizen complaints and make resolutions in various fields such as traffic control and light pollution management, crime prevention & prediction, air pollution and illegal dumping management.

< Figure 42. Database for Big Data Analytics by IoT >



Currently, the MPSP is planning to use Hadoop for BDA because it is an open source and capable of storing and processing large amount of data in all form. Since a large amount of data is derived from social media and IoT, managing a huge volume of data in many different forms is crucial. Therefore, the MPSP's successful development of databases using IoT with SL/TL monitoring system will provide the MPSP with a big opportunity to increase efficiency with BDA.

< Figure 43. Application of Big Data Analytics >



< Figure 44. Application of Big Data Analytics >

IoT Sensor/Data recorded	Database	BDA Application
Street Lamp Controller	On/Off Record	Forecast and modify SL usage by on/off Analysis
	Number of Malfunction	Forecast and prevent malfunction of SL by cause analysis
	Cause of Malfunction	
	Electricity Consumption	Forecast electricity usage and develop strategy for reducing electricity usage
	Dimming Control Record	Forecast and adjust light requirement by dimming DB
Traffic/ Motion Sensor	Vehicle Traffic	Control traffic by analyzing traffic DB
	Pedestrian Traffic	Design road facility by analyzing traffic DB
	Animal Traffic	Control lamp dimming by analyzing traffic
CDS Sensor (Light Sensor)	Amount of Light	Adjust on/off time table by analyzing amount of light
		Control the brightness of SL if needed
		Reduce light pollution by analyzing amount of light
Environmental Sensor	Radon content in Air	Prevent health damage by analyzing air quality
	Temp/Humidity/Wind/Noise	Deal with environment change by analyzing environmental element
Surveillance Camera	Dumping/Crime/Accident/ Parking/Damage	Prevention on Illegal dumping, crime, accident, parking, public damage

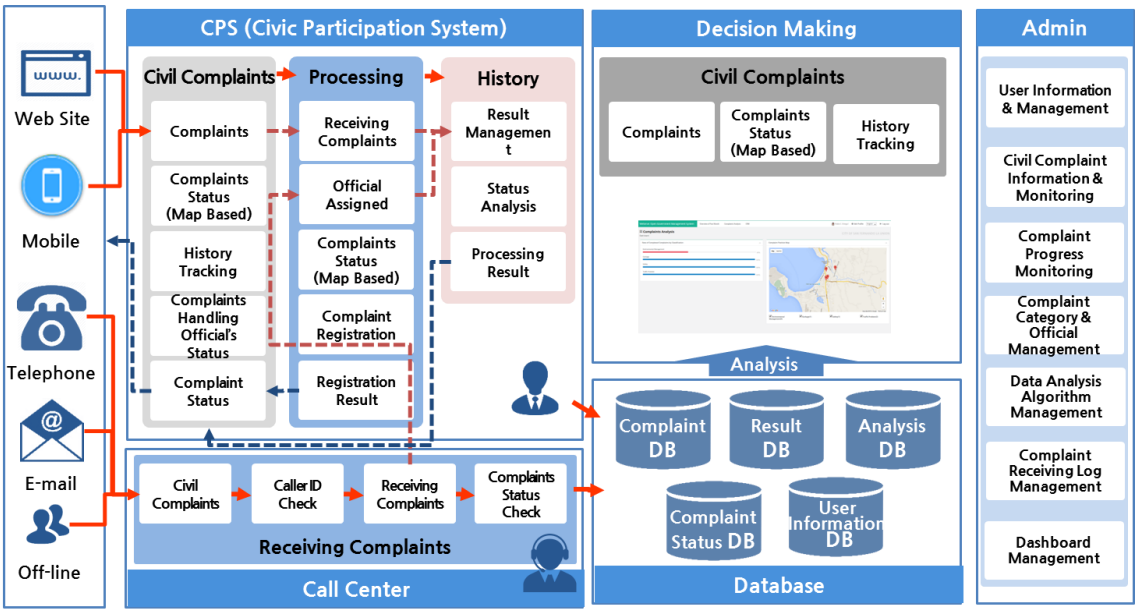
5.3. Implementing Integrated Complaint Handling System

One of the recent trends of e-Government service for citizens is increasing interest in e-participating among citizens. It is important to hear citizens' voices and reflect them on the municipality policies to increase the level of democracy and the quality of citizen life. In terms of complaint handling systems, the MPSP has been operating two comparably advanced systems, Aduan System and Smart Monitoring System. However, these two different systems run independently, causing difficulties for the MPSP in utilizing statistics and making decisions and resulting in an inefficient complaint handling system operation.

< Table 25. Advantages of Integrated Complaint Handling System >

Increased Operation Efficiency	• One department managing complaint handling operation instead of two departments • Reduced number of officials to manage complaint handling system • Less time consuming for integrating data for reporting • Less cost for operating IT systems
Resource for BDA	• Valuable source of BDA for improving citizen satisfaction and preventing negative incident

< Figure 45. Integrated Complaint Handling System >



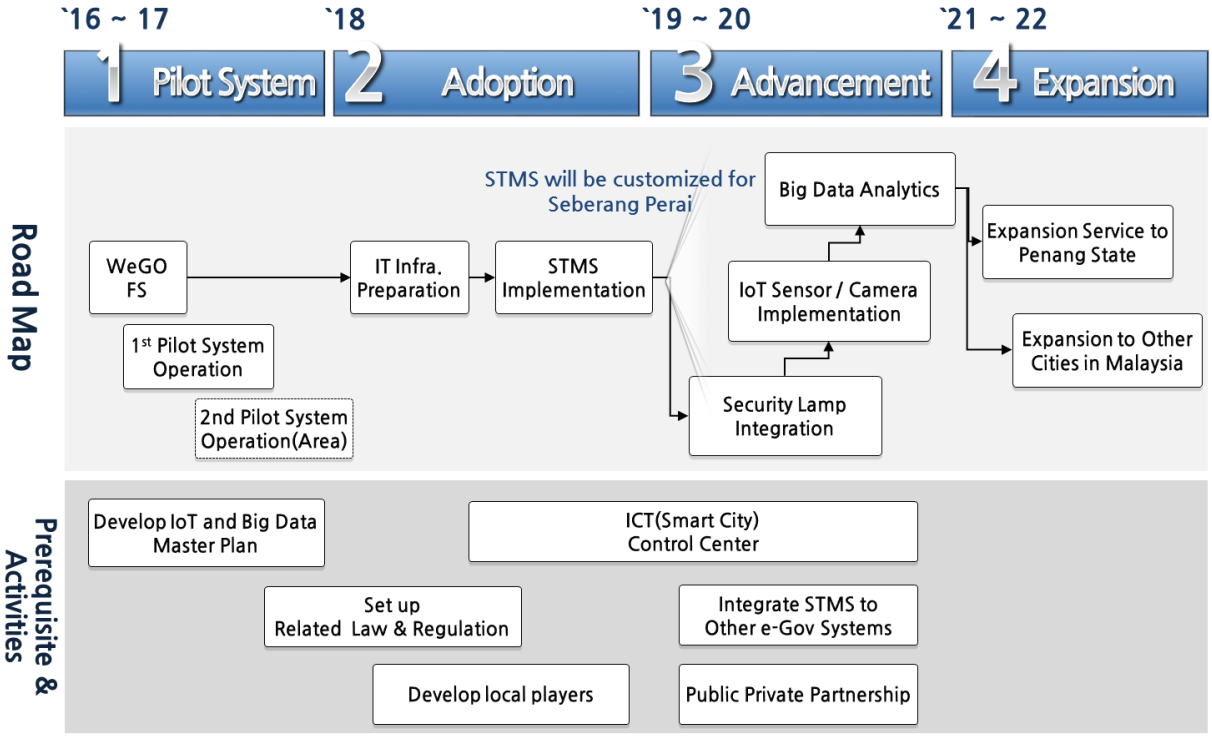
There are two options to overcome this challenge; integrating the two systems into one system or introducing a new complaint handling system. Introducing a new system is recommended instead of integrating the two systems into one because the integration will cost more and will make the whole system more complicated.

The new complaint handling system will provide various channels to receive complaints including mobile application, webpage, telephone, visits etc. This system will provide both front-office and back-office, decision making tool, administration tool in a single system.

6. Road Map

Through this FS project, the MPSP implements a pilot SL/TL monitoring system starting from Dec. 2016. After running the pilot system for about six months, it is highly recommended to move onto a second pilot system in the Batu Kawan Eco-City area. The scale of the first pilot system is too small (only confined to five street lamps and one junction of traffic lights), so it will be difficult to see evident outcomes; the Batu Kawan Eco-city area is optimal for a second pilot system because an SL/TL monitoring system is not only necessary for economic efficiency and citizen satisfaction but also for eco-friendliness. After the second pilot system, the MPSP should adopt SL/TL monitoring system in all the areas of Seberang Perai. SL/TL monitoring system's integrated control center will evolve into Smart-City Control Center in 2020.

< Figure 46. Road Map >



6.1. Second Pilot System

To have a test bed for customizing the SL/TL monitoring system and to see if the STMS is a good fit for the Eco-City at Batu Kawan, a second pilot system needs to be carried out in Eco-City. There are two reasons:

1. It is cost-effective because SL/TL will be newly constructed
2. SL/TL monitoring system is necessary for the eco-friendly theme of Eco-City

- **Cost-Effectiveness**
  - Construction work can be done when the street lamps and traffic lights are newly constructed
  - Lamps with automatic brightness adjustments and SL/TL monitoring system can cut electricity and labor costs

- **Eco-Friendliness**
  - Reduced electricity consumption leads to decrease in GHG emissions
  - Use of sensors and lamps with automatic brightness adjustment reduces light pollution

The scale of the second pilot system should be bigger than the first one (bigger than two to three blocks). And the period of the system should be between six months and a year to verify the effects and outcomes of the pilot system.

6.2. Adoption Period

After implementing the second pilot system, the project can begin with coming up with related laws and regulations. For public service, related laws and regulations are the most important factor. At the same time, IT infrastructure for smart city (Eco-City) control center that operates the STMS should be prepared, and local players who can maintain the STMS should be developed.

Implementing the STMS in the whole city of Seberang Perai will not be completed in a short period of time. The STMS control center should be established and used as the smart city (Eco-City) control center before spreading it to the whole city. After putting in place the control center, the MPSP can expand its boundary by adding controllers, considering priorities such as crime rate and accident rate.

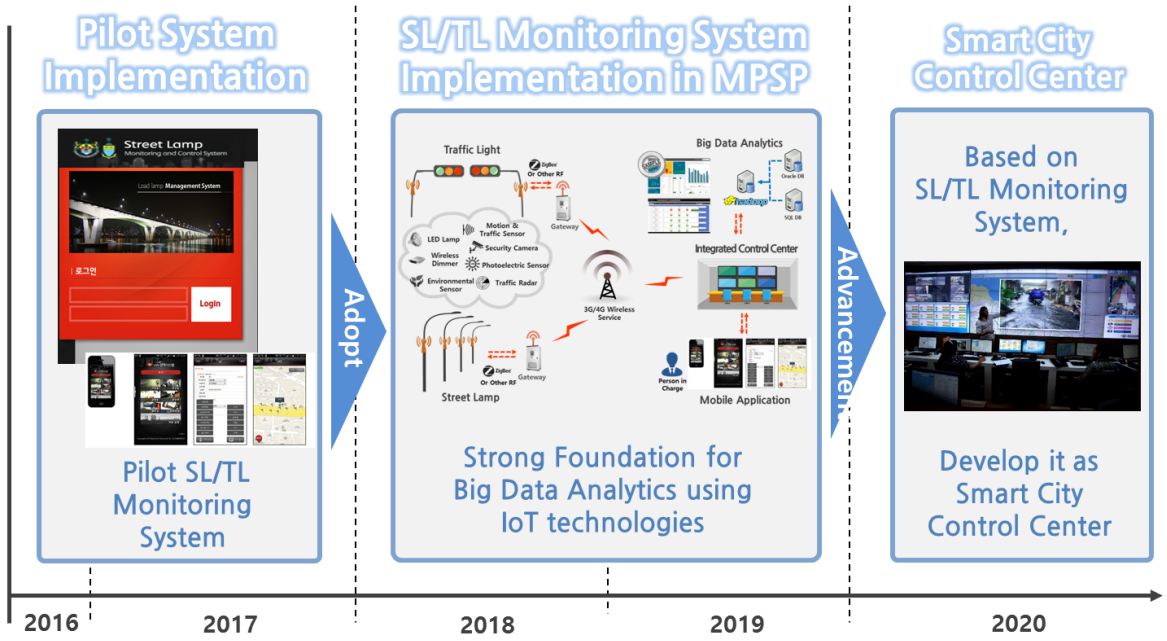
6.3. Advancement Period

The STMS is an important IT infrastructure for the MPSP to become a Smart City (Eco-City). Various IoT sensors can be attached on street lamps and traffic light poles to gather information for BDA. The cost will be much lower integrating IoT sensors into the poles than deploying them elsewhere. With the IoT sensors on street lamp and traffic light poles, the MPSP will be able to accelerate BDA application for higher citizen's satisfaction and efficiency in city management.

In addition to the BDA, the STMS can be integrated with e-Government platform so that information sharing and efficiency of IT systems operation can be dramatically improved. MPSP can develop STMS Integrated Control Center as Smart City (Eco-City) Control Center in 2020, which is essential for MPSP operating successful Smart City (Eco-City). Financing methods are as follows:

- **Public Private Partnership (PPP)**
  - PPP is a cooperative arrangement between one or more public and private sectors, typically of a long-term nature such as BTO (Build-Transfer-Operate)
  - Investment in the SL/TL monitoring system together with the MPSP and private companies, and the private companies can generate revenue from the saved electricity
- **Receive Aids from MDBs or Official Development Assistance (ODA) from Other Countries**
  - World Bank, Asian Development Bank (ADB) and Asia Infrastructure Investment Bank (AIIB)
  - Reach out to international originations such as EXIM bank and KOICA (South Korea), JICA (Japan) and USAID (U.S.A.)

< Figure 47. Adoption & Advancement >



6.4. Expansion Period

With the successful operation of the STMS, the MPSP will be able to introduce the system to other cities and states in Malaysia. Following the case of City of Gwangju, the MPSP should make the system as a package (by customizing and developing Gabotech's system as optimized Malaysian model of STMS) and get royalties or fees from other cities and states for using the MPSP's solution.

7. Budget

The target of SL/TL monitoring system is limited to galvanized street light poles and traffic lights in Seberang Perai. The number of galvanized street light poles is 12,376, and that of traffic lights is 285. Each street lamp and traffic light is required to have sub-controller, and one smart controller is required to be put in place in approximately every 20 street lamps and traffic lights.

To control a total of 12,661 street lamps and traffic lights, the MPSP needs the equipment, web control system, and an integrated control center. Figure 48 shows SL/TL monitoring system implementation costs.

< Figure 48. SL/TL Monitoring System Budget >

Depth 1	Depth 2	Depth 3	Quantity	Cost (USD)
System Implementation	Integrated Control Center	1. H/W - Bidirectional Control System - Personal Computer (3) - Monitor (3) - SMS Transmitter - Other equipment	1	34,000
		2. S/W - Main Control Program - OS - Other software	1	25,000
		3. Installation	1	12,500
	Smart Controller	4. H/W	633	822,900
		5. Installation	633	34,815
	Sub Controller	4. H/W	12,661	2,152,370
		5. Installation	12,661	506,440
	LED Lamp	6. H/W	12,376	990,080
		7. Installation	12,376	185,640
Wireless Network	Monthly Fee	For 10 years	633	420,000
Maintenance	-		10	20,000
Total (USD)				5,203,745

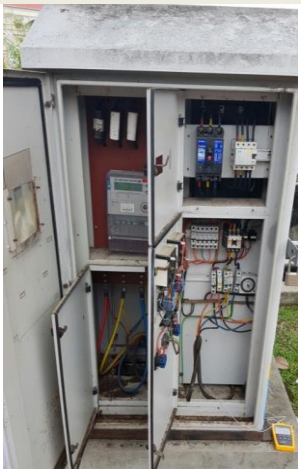
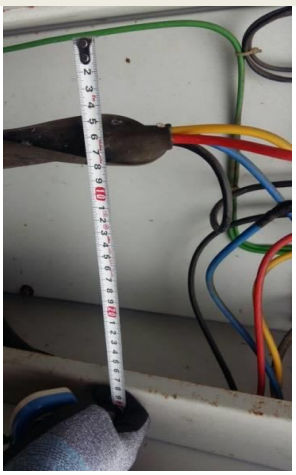
VII Pilot System Implementation

1. As-Is Analysis

- **Street Lamp Distribution Box**

Street lamp distribution box supplies power to 15 street lamp poles through three-phase transformer with four-wire output (R, S, T, N), which is the same as in Korea, at 240 V/+-10% and a frequency of 50 Hz.

< Table 26. Street Lamp Distribution Box >

Distribution Box	Wires	Power Supply
		• 3P4W (3 Phases 4 Wires) • 240V/+-10% / 50Hz • N(union), R, S, T (connection) • Supplying power to 12 poles
• Distribution box is equipped with stabilizer • Distribution box is built and set up by Malaysian local company • Main malfunction reasons – lightning, cable disorder		

- **Street Lamp Pole**

Total five galvanized street poles will be subject to the SL/TL monitoring system. As mentioned above, the country uses 240V/+-10% and a frequency of 50Hz, and adopts a three-phased, four-wire (R, S, T, N) system which is the same in Korea.

< Table 27. Street Lamp Pole >

Pole	Wires	Power Supply
		• 3P4W (3 Phases 4 Wires) • 240V/+-10%/ • Galvanized Pole • Sodium Lamp (150W)
• Street Lamps are operated between 7pm to 7am – 12 hours		

2. System Development

- **Street Lamp Distribution Box**

Street lamp distribution box will be a gateway to communicate with the integrated control center of the MPSP through a wireless network such as 3G and 4G LTE. A smart controller will be installed inside the distribution box using a bracket to make sure it is firmly fixed.

The smart controller was customized to be used in Malaysia since it was originally developed to be used in Korea. The Gabotech team translated the product information into English and customized the network key and power supply (from 220V/60Hz to 250V/50Hz) in accordance with the Malaysian standard.

< Table 28. Street Lamp Distribution Box >

Smart Controller	Bracket	Specification
		**Specifications** Frequency ranges : ~~(key network) 800~2,200MHz~~ (Wireless street lamp monitoring and switching controllers) ~~424.7125~424.9500MHz~~ Malaysia CDMA/GSM Key network : ~~TDMA or CDMA~~ Receiving sensitivity : (key network) -111 dBm or less (Wireless street lamp monitoring and switching controllers) -117 dBm or less Oscillation type : PLL synthesizer Output power : Nominal 0.6 Watts Antenna impedance : 50Ω Antenna : Dipole antenna and Helical antenna Display : Graphic LCD Fuse capacity : ~~AC 220V/1A~~ 250V/50Hz Power supply : ~~AC 220V±10%, 60Hz~~ Operating temperature : -20°C ~ +50°C Dimensions(W×H×D) : 150mm X 220mm X 105mm

Main Functions

- Data reception, modification and check through key network
- Monitoring status of street lamps & distribution boxes and reporting to control center
- Double secured control by wireless remote control and switching time table
- Sequential control of magnet switches
- Divided regional control
- Input connection control
- Switching time and period control of every other lamps
- Daily and monthly changeover for every other lamp switching
- Displaying the status of Key network modem
- Modification of switching time deviation

- Last operation data preservation even in case of power failure
- LCD display and manual operation by keys available
- Manual setup of switching duration time available in case of maual control
- Built-in backup rechargeable battery
- Monitoring and dispaying of power distribution box and door opening
- Individual magnet control and setup of control time
- Reservation available

- **Street Lamp Pole**

A sub-controller which includes ZigBee to communicate with the gateway without external wireless network service is installed in an external box attached on the galvanized pole.

The sub-controller is also customized to be used in Malaysia because the controller was originally developed to be used in Korea. The Gabotech team translated the product information into English and customized power supply (220V/60Hz to 250V/50Hz) in accordance with Malaysian standard.

< Table 29. Street Lamp Pole >

External Box	Sub Controller	Specification
		Specifications 250V/50Hz Power supply : ~~AC 220V±10%, 60Hz~~ Operating temperature : -20°C ~ +50°C CPU : 1 chip microprocessor Frequency range : ~~424.7125MHz ~ 424.9500MHz~~ Zigbee Channel space : 12.5 KHz Oscillation type : PLL Synthesizer Modulation mode : FM Modulation Reception type : Super Heterodyne Data modulation : GFSK Transmission mode : Half duplex mode Transmission type : F1D Receiving sensitivity : -118 dBm and less Power Output : 10mW and less Antenna : Helical(built-in) Display : Matrix LCD Fuse : 250V / 10A Power switch : ELB(built-in) Dimension s W×H×D) : 141mm X 206mm X 92mm

Main Functions
• Individual street lamp monitoring and switching control • Monitoring the status of light failures, electric leakages of security lights and reporting to the central control center • Displaying the status of lighting fixtures with LED lamps (output power, failures) • Determination of lamp and ballast failures • Dimming control while used with ballast which has dimming control function (optional) • Switching control and status monitoring on the spot by means of PDA

- **LED Lamps**

LED lamps will be installed on five galvanized light poles in order to utilize automatic brightness adjustment and reduce electricity consumption.

< Table 30. LED Lamp >

LED Lamp & Housing

Specification
• Electronic power of lamp : 100W • Dodual : LG 25W * 4 • Weight : 9KG • Cover : Aluminum alloy for diecastings • Power supply : AC 240V±10%, 50Hz • Dimensions(W×H×D) : 900mm X 340mm X 216mm

- **Traffic Light Distribution Box**

In the traffic light distribution box, a smart controller will be installed as a gateway to communicate with the integrated control center. The smart controller has the same specifications with the one for the street lamp distribution box.

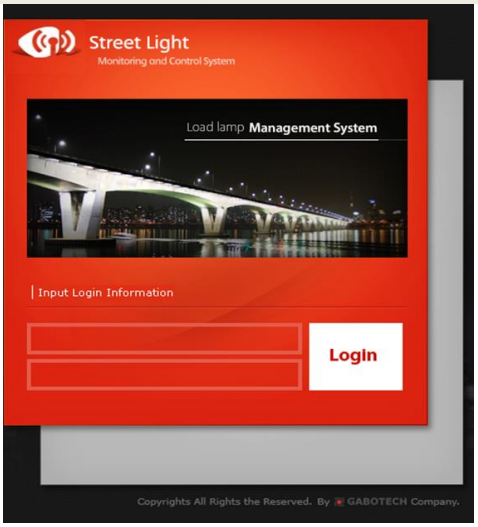
< Table 31. Traffic Light Distribution Box >

Smart Controller	Specification
	**Specifications** Frequency ranges : ~~(key network) 800~2,200MHz~~ (Wireless street lamp monitoring and switching controllers) ~~424.7125~424.9500MHz~~ Malaysia CDMA/GSM Key network : ~~TDMA or CDMA~~ Receiving sensitivity : (key network) -111 dBm or less (Wireless street lamp monitoring and switching controllers) -117 dBm or less Oscillation type : PLL synthesizer Output power : Nominal 0.6 Watts Antenna impedance : 50Ω Antenna : Dipole antenna and Helical antenna Display : Graphic LCD Fuse capacity : ~~AC 220V/1A~~ 250V/50Hz Power supply : ~~AC 220V±10%, 60Hz~~ Operating temperature : -20°C ~ +50°C Dimensions(W×H×D) : 150mm X 220mm X 105mm

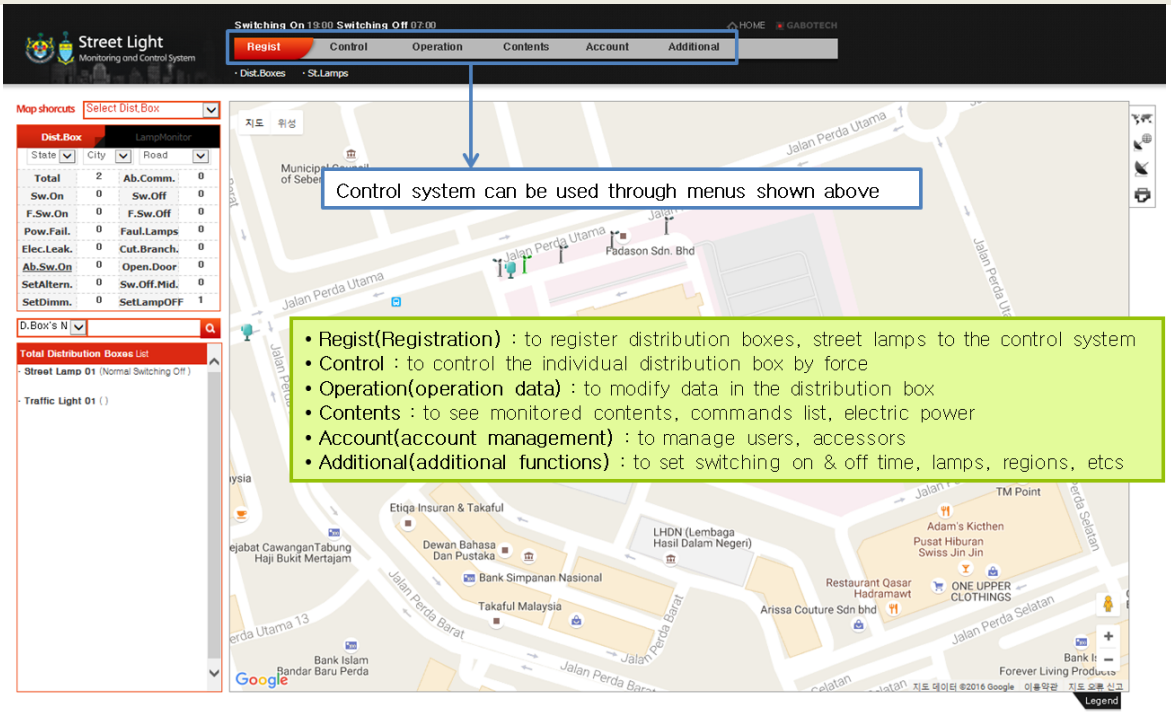
- **Web Control System**

The language of the web control system that will be used to monitor and control SL/TL real-time will be translated into English upon the MPSP's request. This system will feature Google Map to locate SL/TL.

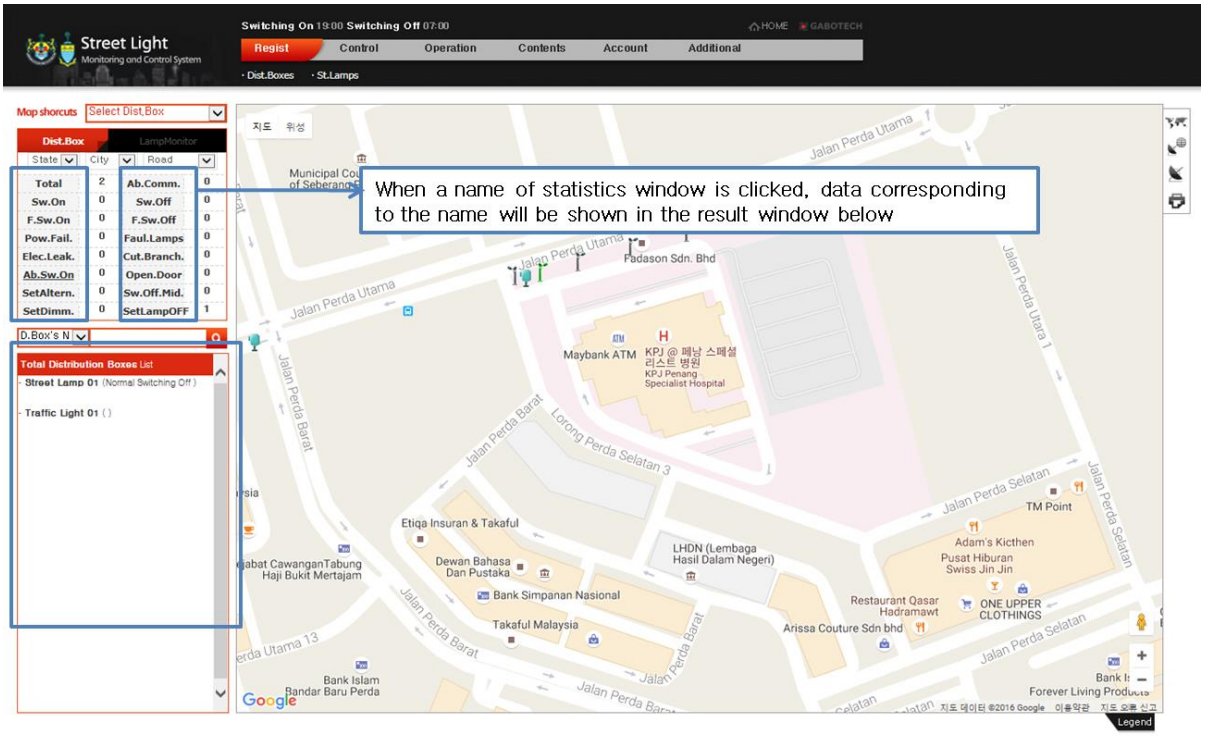
< Table 32. Web Control System >

Login Page


Main Page



Statistics



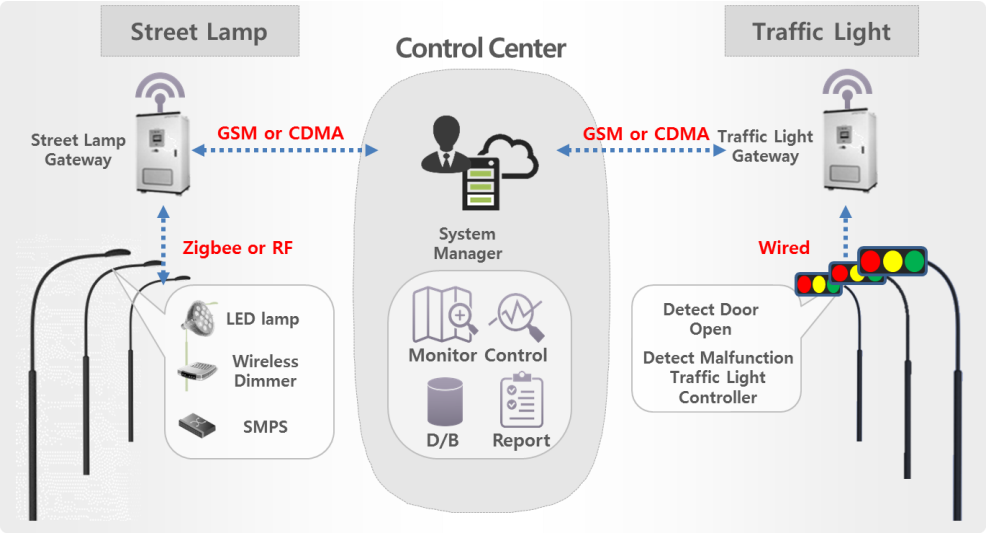
Language of the mobile control system will also be translated into English upon the MPSP's request. This system will utilize Google Map to locate SL/TL.

< Figure 49. Mobile Control System >

3. System Implementation

The pilot system consists of four major components: 1. Web Control System (Mobile Control System), 2. Smart Controller, 3. Sub-Controller, 4. LED Lamps. The Web Control System is installed in the SL/TL control center in the MPSP, and the Mobile Control System is installed in smart phones of MPSP officers and contractors. Smart Controller is installed in SL/TL Gateway which will connect the control center and SL/TL. Sub-Controller and LED lamps are installed on each street lamp poles. Pilot System installation was performed in the 3rd visit by Gabotech engineers from Dec. 7 to Dec. 14, 2016.

< Figure 50. SL/TL Monitoring System (Pilot) >



< Figure 51. Pilot System Implementation Schedule >

Date	7	8	9	10	11	12	13	14	15	16	17	Note
Arrival	→											
Installation		→	→									Vehicle for Installation Support / Installation Training
Wireless Communication Test				→	→	→						
Training							→	→				Operation Training
Final Report								→	→			

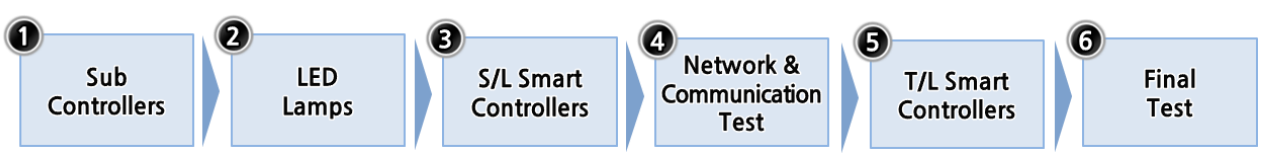
- **Transportation of Pilot System Components**

The Gabotech team prepared and transported all components as checked in luggage from South Korea to Malaysia. The MPSP supported custom clearance and transportation from the Penang Airport to the MPSP headquarters. Tax issue was solved with an official letter of donation from Gabotech to Penang State.

< Figure 52. Transportation of Pilot System Components >

- **Installation of Pilot System Components**

< Figure 53. Installation of Pilot System Components >



1. Sub Controllers

   - Network module (Zigbee) and wireless dimmer is installed in external box attached on streets

< Figure 54. Installation of Sub Controller >

2. Sub Controllers

   - Five LED Lamps were installed with the help of MPSP officers and sky-lift

< Figure 55. Installation of LED Lamps >

3. S/L Smart Controllers

   - Analyze status of distribution box

   - Install Smart Controller inside of the distribution box

   - Test working status of distribution box

< Figure 56. Installation of S/L Smart Controller >

4. Network & Telecommunication Test

   - U-SIM card test: Compatibility Test (3G network / text message function)

   - SL/TL smart controller modem test: Test the connection status between the server and this controller

< Figure 57. Network & Telecommunication Test >

5. T/L Smart Controllers

   - Analyze status of distribution box

   - Install Smart Controller inside of the distribution box

   - Test working status of distribution box

< Figure 58. Installation of T/L Smart Controller >

6. Final Test

- Modem and network test: Final check of network connected to control system
- SL/TL monitoring and controlling test: Check operations with mobile apps and PCs

< Figure 59. Installation of T/L Smart Controller >

- **Training for Operation**

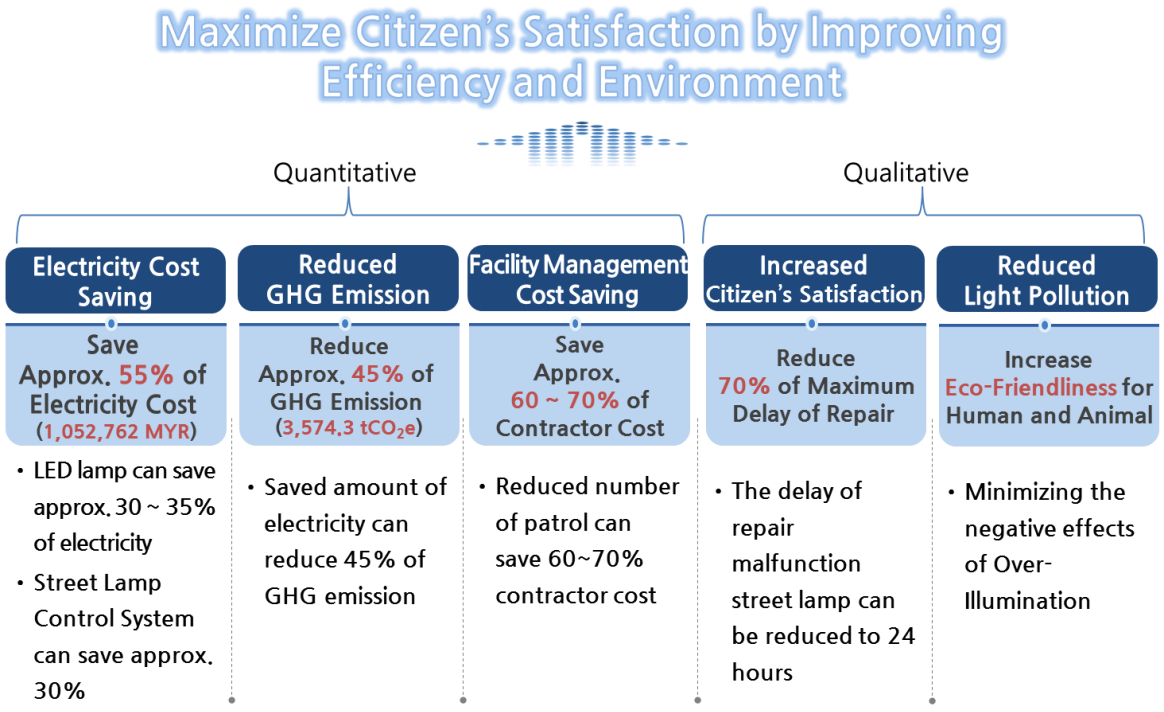
  - Smart system training using mobile applications
  - Smart system training using laptops
  - Training related to Smart Controller (with manual)
  - On-site operational training
  - Preparation for Final Report Ceremony

< Figure 60. Training for Operation >

VIII Feasibility Analysis

Implementing SL/TL Monitoring System will bring many positive effects. Among them, there are five major outcomes that are more important to the MPSP regarding its vision and mission; Electricity Cost Saving, Reduced GHG Emissions, Cost Saving for Facility Management, Increased Citizen Satisfaction, and Reduced Light Pollution. These expected effects will far outweigh potential expenditure and investment.

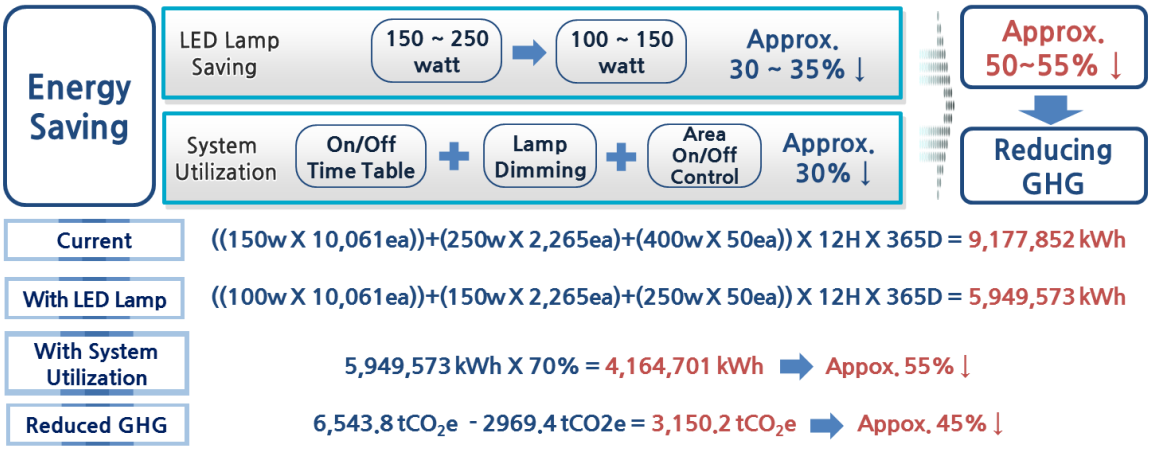
< Figure 61. Total Expected Effect >



1. Quantitative Analysis

Financial gains are one of the high priorities for the MPSP. By implementing the SL/TL monitoring system, the MPSP will be able to utilize highly efficient lamps such as LED. For example, by replacing sodium lamps with LEDs for galvanized street light poles in Seberang Perai, approximately 35% of electricity cost (3,228,279 MYR≒717,798 USD) can be saved. Less GHG emissions lead to less electricity consumption, which is also of crucial issue for the MPSP to pursue Eco-Tourism. Furthermore, at the climate summit of world leaders in Paris last December, Prime Minister Najib Razak "renewed his government's pledge to reduce Malaysia's greenhouse gas emissions by as much as 45%, relative to 2005 levels, by 2030. (Malaysia Pledges 45% Reduction in Greenhouse Gases by 2030 2015)" Figure 62 shows the formula and estimates of electricity saving and GHG emissions reduction.

< Figure 62. Financial Benefit & GHG Emission Effect >



Total Expected Effect (for a year)			
	By LED	By System Utilization	Total Reduction
Amount of Electricity	3,228,279 kWh	1,784,872 kWh	5,013,151 kWh
Cost Saving (0.21 MYR/kWh)	677,938 MYR	374,823 MYR	1,052,762 MYR
Reduced GHG emission	2,301.7 tCO_2e	1272.6 tCO_2e	3,574.3 tCO_2e

(Source: http://www.carbonfootprint.com)

In addition to the electricity saving and GHG emissions reduction, utilizing an SL/TL monitoring system can also benefit economic effect in terms of facility cost saving. The real-time monitoring system will cut human resource-related cost by 60 to 70% by reducing patrolling from three times to once a week.

< Figure 63. Facility Cost Saving >

- SL/TL Monitoring System replaces regular street lamp patrolling
- Efficient process of SL/TL maintenance reduces the input of human resources

2. Qualitative Analysis

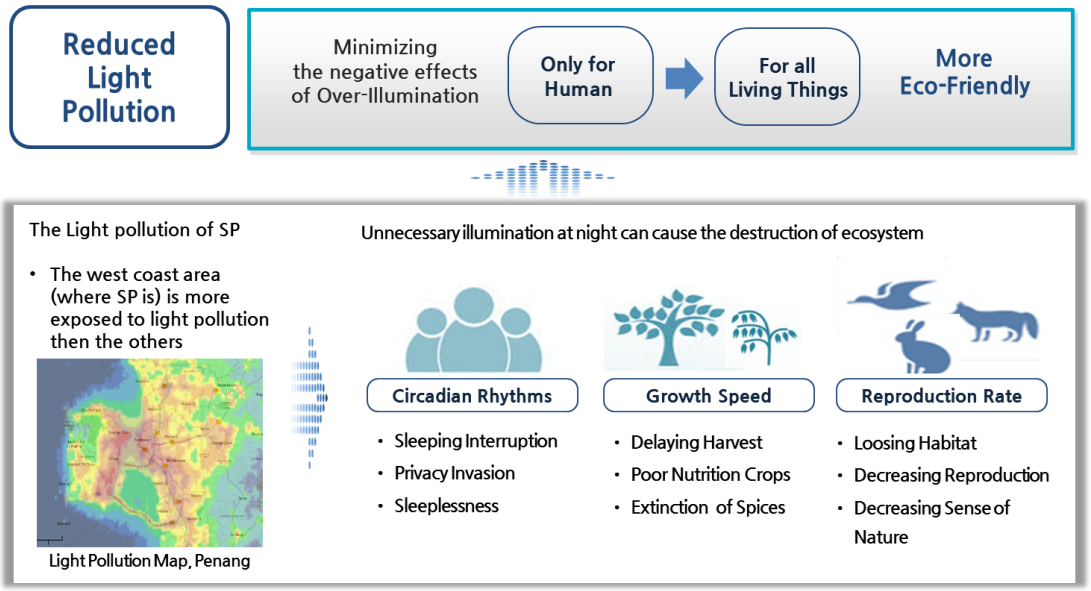
Maximum delay in fixing malfunctions will be reduced from 96 hours to 24 hours thanks to real-time notification of malfunctions. This will help the MPSP to meet its ultimate goal of increasing citizen satisfaction, the driver behind all MPSP work and efforts.

< Figure 64. Increased Citizen Satisfaction >

- SL/TL Monitoring System detects malfunction in real-time, which reduces recovery time

The MPSP held the international conference Seberang Perai International Conference on Ecotourism and Conservation Efforts (SPICEC) 2016 which promotes Eco-Tourism of Seberang Perai. Eco-Tourism focuses on providing favorable environment to animals and plants as well as the citizens. In this context, it is meaningful that with the SL/TL monitoring system, street lamps can turn themselves on or off and automatically adjust brightness using sensors. This means that street lamps can dim when there is no movement detected and brighten up when human traffic is detected, thereby reducing light pollution. As such, this function can promote eco-friendliness of Seberang Perai.

< Figure 65. Reduced Light Pollution >



In many metropolitan areas and densely populated areas, light pollution is already a big problem. That is why Korea enacted the Act on the Prevention of Light Pollution by Artificial Lighting in February 2013 with an aim to prevent light pollution. Any new lighting equipment in a lighting control area must meet the light emission levels set by the rule. The Ministry of Environment also set out the standards on public lighting in 2013. It announced the lighting equipment installation and control standards for advertisement lighting in 2014 and decorative lighting in 2015 (Improving Living Environments 2015).

3. Technical Analysis

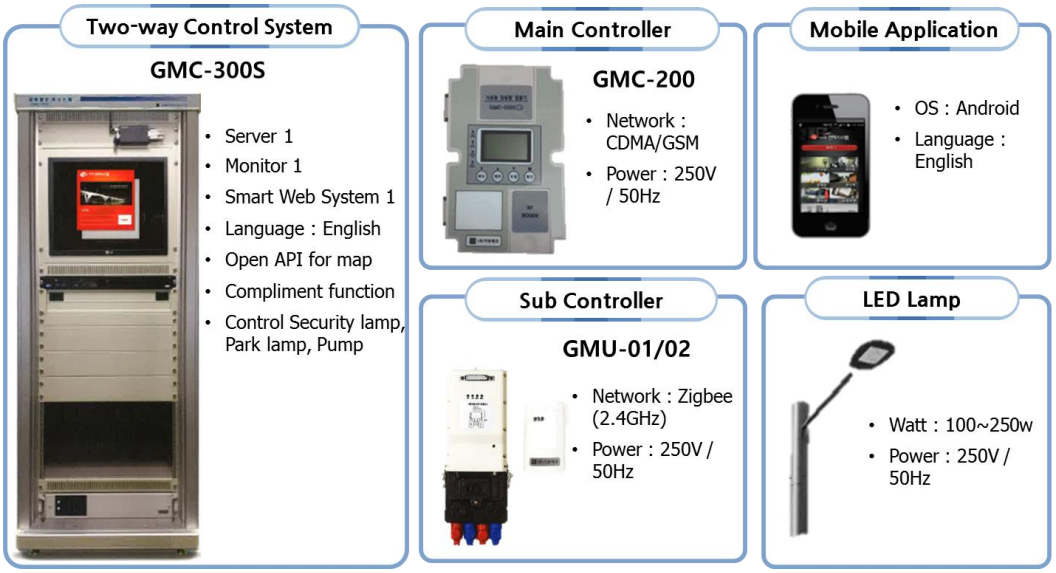
The MPSP is technically well-prepared for operating the STMS with its relatively advanced IT infrastructure, and the STMS does not require highly advanced IT infrastructure. That is why the MPSP can implement the pilot system without any difficulties through this project.

< Table 33. IT Infrastructure of MPSP >

IT Components	
Core Switch	Cisco Catalyst 4500 X 2 unit
Internet connection bandwidth	Lease line Metro-E 12mbps, Unifi 50mbps X 2
Virtual Server	HP Converged System 250HC StoreVirtual
Physical Server	20 Units (HP and Dell)
Database Server	Oracle 10 G / HP RX2620 Oracle 12 C / HP Integrity RX2800 i4
Numbers of Computers	PCs: 20, Laptops: 6
Numbers of Human Resources	IT Technicians: 3 IT Department Officials: 12

Gabotech's STMS solution consists of Two-way Control System, Main Controller (Smart Controller), Sub-Controller, Mobile Application, and LED lamp (optional). Since these system components are all suitable for the MPSP's IT infrastructure, the MPSP does not need to enhance its facility for the pilot system. In a nutshell, implementing the STMS is technically feasible for the MPSP.

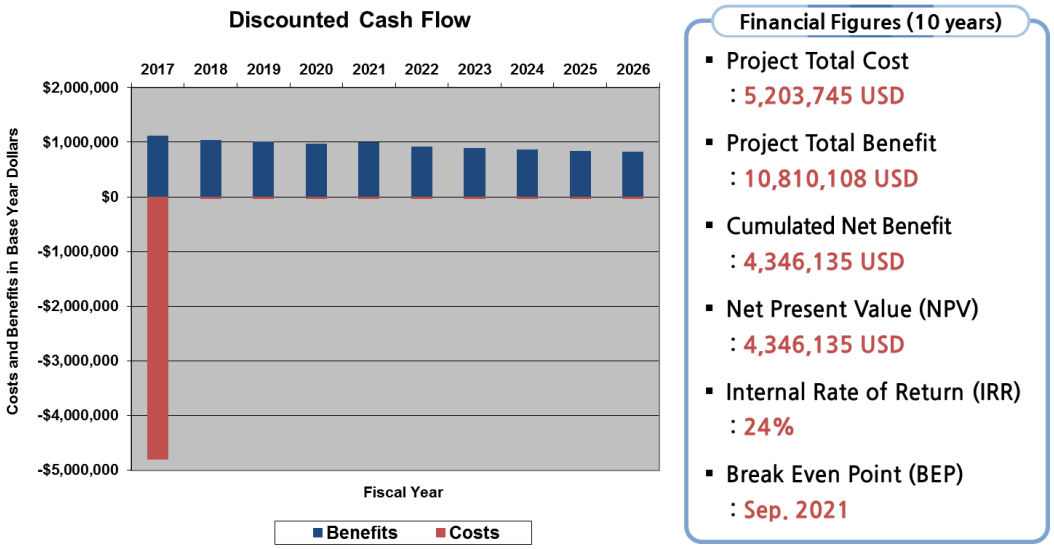
< Figure 66. Equipment for STMS >



4. Economic Analysis

Citizen satisfaction matters more than economic feasibility when it comes to public services. However, public services or goods that are economically feasible and meet the needs of the citizens are of course the best. This SMTS project is the perfect example.

< Figure 67. Discounted Cash Flow & Financial Figures >



The Cost-Benefit analysis suggests a net present value (NPV) of USD 4,346,135 and break-even point (BEP) of Sep. 2021. In other words, the project has a current value of USD 4,346,135 as of now, and the investment for the project can be made up in five years and nine months.

The phased implementations are carried out as planned in the to-be model in Chapter VI. Based on the to-be model and road map in Chapter VI, the total cost of ownership (TCO) could largely be broken down into six categories as follows:

< Figure 68. Cost Breakdown >

Subject(1)	Subject(2)	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Intergrated Control Center	H/W	34,000									
	S/W	25,000									
	Installation	12,500									
Smart Controller	H/W	822,900									
	Installation	34,815									
Sub controller	H/W	2,152,370									
	Installation	506,440									
LED Lamp	H/W	990,080									
	Installation	185,640									
Wireless Network Fee	Monthly Fee	42,000	42,000	42,000	42,000	42,000	42,000	42,000	42,000	42,000	42,000
System Maintenance	-	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
Total Cost by Year (USD)		$4,807,745	$44,000	$44,000	$44,000	$44,000	$44,000	$44,000	$44,000	$44,000	$44,000
Project Grand Total Cost (USD)		$5,203,745									

H/W and installation costs and system maintenance fees are calculated based on Gabotech's quotation; wireless network fees are calculated based on Celcom's network charge.

< Figure 69. Benefit Breakdown >

Benefit Sources	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Electricity Cost Reduction	$238,610	$238,610	$238,610	$238,610	$238,610	$238,610	$238,610	$238,610	$238,610	$238,610
Labor Reduction	$831,600	$831,600	$831,600	$831,600	$831,600	$831,600	$831,600	$831,600	$831,600	$831,600
Sodium light Cost	$49,504				$49,504					
Total Benefits Per Year	$1,119,714	$1,070,210	$1,070,210	$1,070,210	$1,119,714	$1,070,210	$1,070,210	$1,070,210	$1,070,210	$1,070,210
Confidence Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Benefits Claimed for Analysis	$1,119,714	$1,070,210	$1,070,210	$1,070,210	$1,119,714	$1,070,210	$1,070,210	$1,070,210	$1,070,210	$1,070,210
Program Grand Total Benefit	$10,801,108									

Benefit sources consist of three things; electricity cost reduction, labor reduction, and sodium light cost. The labor reduction cost is calculated based on total number of street lamps and approximate minimum wage (450 USD). And each sodium light bulb price is set as USD 4 considering current market prices. The confidence factor is set at 100% on the assumption that there are no variables.

< Figure 70. Overall Summary >

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Undiscounted Flows										
Costs	-$4,807,745	-$44,000	-$44,000	-$44,000	-$44,000	-$44,000	-$44,000	-$44,000	-$44,000	-$44,000
Benefits	$1,119,714	$1,070,210	$1,070,210	$1,070,210	$1,119,714	$1,070,210	$1,070,210	$1,070,210	$1,070,210	$1,070,210
Net Cash Flow	-$3,688,031	$1,026,210	$1,026,210	$1,026,210	$1,075,714	$1,026,210	$1,026,210	$1,026,210	$1,026,210	$1,026,210
Discount Factors										
Discount Rate	3%									
Base Year	2017									
Year Index	0	1	2	3	4	5	6	7	8	9
Discount Factor	1.0000	0.9709	0.9426	0.9151	0.8885	0.8626	0.8375	0.8131	0.7894	0.7664
Discounted Flows										
Costs	-$4,807,745	-$42,718	-$41,474	-$40,266	-$39,093	-$37,955	-$36,849	-$35,776	-$34,734	-$33,722
Benefits	$1,119,714	$1,039,039	$1,008,776	$979,394	$994,851	$923,173	$896,284	$870,179	$844,834	$820,227
Net	-$3,688,031	$996,320	$967,301	$939,128	$955,758	$885,218	$859,435	$834,403	$810,100	$786,505
Cumulative	-$3,688,031	-$2,691,711	-$1,724,409	-$785,282	$170,476	$1,055,694	$1,915,129	$2,749,531	$3,559,631	$4,346,135

Net cash flow turns positive in 2018, and cumulative discounted flows turn positive in 2021. Discount rate of 3% is applied for this cost-benefit analysis, considering Malaysia's current interest rate.

5. Conclusion

This Feasibility Study report includes As-Is analysis, pilot system implementation and feasibility analysis to help make a judgement on whether the SL/TL Monitoring System is feasible for the MPSP. The As-Is analysis shows that implementing the STMS can be highly beneficial to the MPSP in many ways.

Also, the successful pilot system implementation showed the possibility of a full implementation of the system in the city and proved that the MPSP is technically feasible for the STMS. In addition to the technical feasibility, economic feasibility came out to be highly positive. For example, by replacing sodium lamps with LEDs for galvanized street light poles in Seberang Perai, approximately 64% of electricity cost (3,228,279 MYR≒717,798 USD) can be saved. In addition to the electricity saving and GHG emissions reduction, utilizing an SL/TL monitoring system can also benefit economic effect in terms of facility cost saving. The real-time monitoring system will cut human resource-related cost by 60 to 70% by reducing patrolling from three times to once a week. And this economic benefit has brought tremendous contribution on over-all conclusion of this feasibility study.

The result of As-Is analysis proved that the MPSP has a concrete foundation for further IT system development. IT Department has a total of twelve officers and three IT specialists for maintaining more than 100 IT systems and IT infrastructure in the city. Although the MPSP has a sufficient IT infrastructure, there is no IT system for real-time detection of SL/TL malfunction. Managing the SL/TL in the city is directly related to citizens' safety, and it is an important reason that the MPSP put the first priority on STMS. In addition to economic benefit, STMS can significantly contribute to Smart City (Eco-City) development. STMS's automatic dimming function can have an important role for reducing light pollution, and the STMS can be pivotal infrastructure for BDA using IoT.

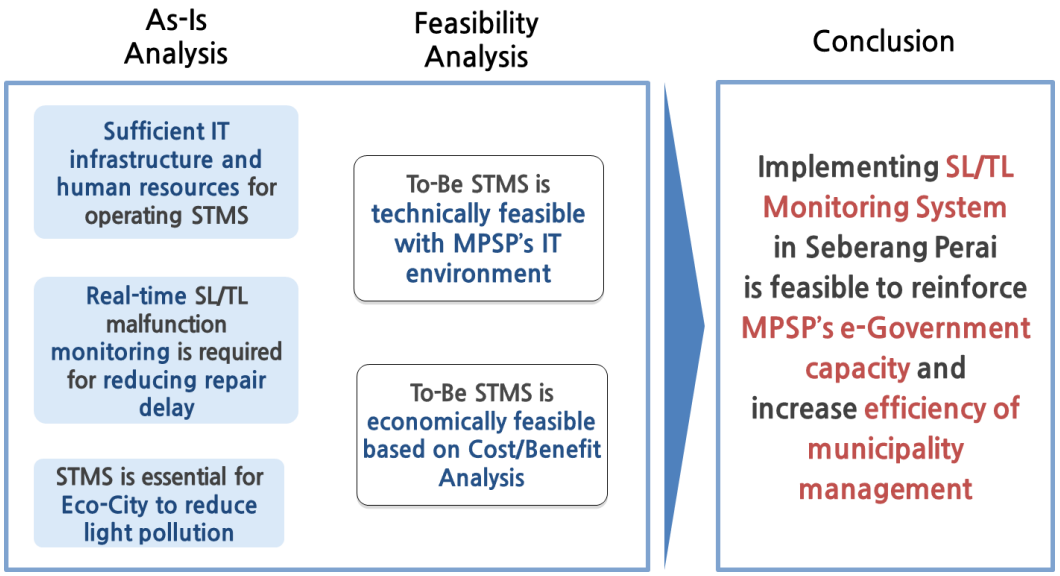
As a part of this FS, a pilot system was implemented at a selected area in the city with the support of the MPSP, and the system was installed by Gabotech. The pilot STMS was successfully implemented in December 2016 and will be operated by the MPSP until approximately June 2017 as a trial period. This big

achievement was a tangible outcome of MPSP's concrete IT foundation and strong will of MPSP's leadership. President Datuk Maimunah Mohd Sharif's strong commitment and support has been the driving force behind this project, and her leadership has been one of the most important factors in successfully implementing the pilot system.

The feasibility analysis is focused on three aspects; financial, environmental and citizen's satisfaction. Financially, the STMS can reduce electricity cost and facility management cost; electricity cost reduction will ultimately lead to GHG emission reduction. Environmentally, light pollution reduction is a plus especially for MPSP's Strategy for developing the "Eco-City." Most importantly, the satisfaction of citizens can be significantly increased by reduced delays in the SL/TL malfunction recovery, and this directly leads to providing a safer environment for the citizens.

As a result of this 2016 WeGO Feasibility Study for establishment of street lamp & traffic light monitoring system in Seberang Perai, implementing the STMS in the MPSP is highly feasible in many aspects and will bring three major benefits: increasing citizen satisfaction in terms of their safety, providing better services for citizens through BDA, and enhancing the eco-friendliness index of Seberang Perai.

< Figure 71. Conclusion >

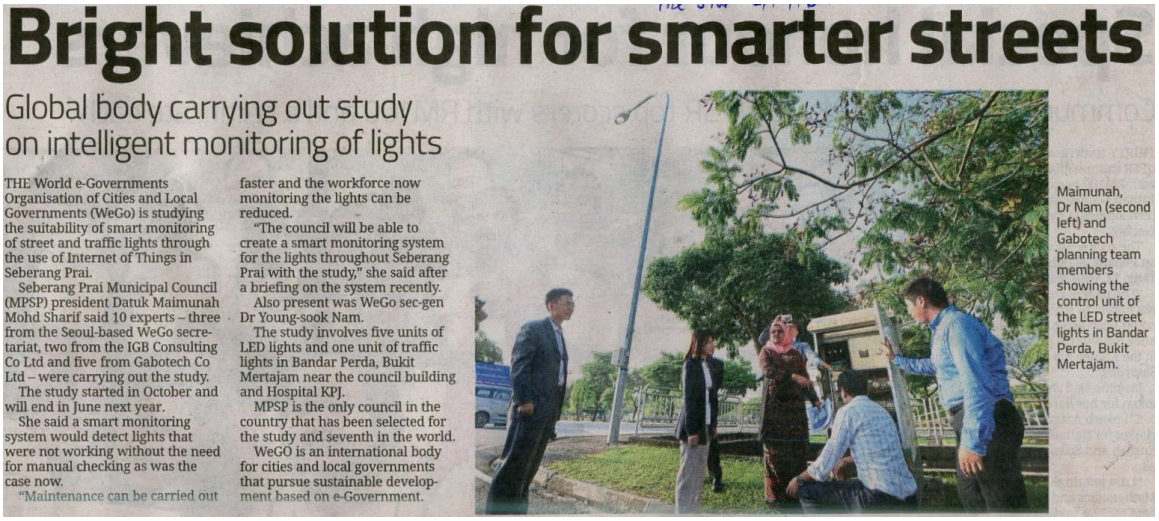


Appendix

Public Relations (Newspaper Articles)

Seven newspapers (one in English, one in Malaysian and five in Chinese) in Malaysia published articles about this FS project. All seven newspapers included pictures and specific explanation about the project, and most of them also inserted descriptions of the WeGO, IGB Consulting and Gabotech.

- **Star Newspaper (Dec. 21, 2016)**



Bright solution for smarter streets

Global body carrying out study on intelligent monitoring of lights

THE World e-Governments Organisation of Cities and Local Governments (WeGo) is studying the suitability of smart monitoring of street and traffic lights through the use of Internet of Things in Seberang Prai.

Seberang Prai Municipal Council (MPSP) president Datuk Maimunah Mohd Sharif said 10 experts – three from the Seoul-based WeGo secretariat, two from the IGB Consulting Co Ltd and five from Gabotech Co Ltd – were carrying out the study.

The study started in October and will end in June next year.

She said a smart monitoring system would detect lights that were not working without the need for manual checking as was the case now.

"Maintenance can be carried out faster and the workforce now monitoring the lights can be reduced.

"The council will be able to create a smart monitoring system for the lights throughout Seberang Prai with the study," she said after a briefing on the system recently.

Also present was WeGo sec-gen Dr Young-sook Nam.

The study involves five units of LED lights and one unit of traffic lights in Bandar Perda, Bukit Mertajam near the council building and Hospital KPJ.

MPSP is the only council in the country that has been selected for the study and seventh in the world.

WeGO is an international body for cities and local governments that pursue sustainable development based on e-Government.

Maimunah, Dr Nam (second left) and Gabotech planning team members showing the control unit of the LED street lights in Bandar Perda, Bukit Mertajam.

- **Sinar Newspaper (Dec. 15, 2016)**

Seberang Perai terpilih jalani kajian Wego

BUKIT MERTAJAM - Majlis Perbandaran Seberang Perai (MPSP) menjadi pilihan World e-Government Organization of Cities and Local Government (Wego) untuk menjalani kajian kesesuaian sistem pemantauan pintar lampu jalan dan lampu isyarat.

Yang Dipertuanya, Datuk Maimunah Sharif berkata, pemilihan Seberang Perai dari kalangan tujuh bandar di dunia untuk mengikuti kajian tersebut adalah penghormatan cukup tinggi diberikan badan dunia berkenaan.

Menurutnya, dalam mencapai bandar pintar bertaraf antarabangsa, MPSP bersedia bekerjasama dalam menjayakan kajian tersebut yang akan mengambil masa selama tujuh bulan bermula Oktober lalu.

"Kajian ini dilakukan untuk membangun serta mengkaji kesesuaian sistem pemantauan pintar lampu jalan dan lampu isyarat melalui penggunaan teknologi terkini serta aplikasi pintar.

"Sistem berkenaan akan memudahkan MPSP melakukan pemantauan dan penyelenggaraan yang lebih cekap, cepat dan produktif," katanya ketika ditemui media selepas membuat pemantauan perlaksanaan kajian tersebut di hadapan Ibu Pejabat MPSP di Bandar Perda, di sini.

Turut hadir, Setiausaha Agung Wego, Youngsook Nam bersama beberapa delegasi dari Korea.

Mengulas lanjut mengenai kajian tersebut, Maimunah berkata, sekiranya teknologi berkenaan digunakan kelak, ia akan memudahkan pihaknya mengesan kerosakan lampu jalan dan lampu isyarat melalui aplikasi pintar tanpa perlu membuat rondaan secara manual seperti dilakukan sekarang.

Katanya, penyelenggaraan dapat dilakukan dengan segera, berkesan dan mengurangkan tenaga kerja bagi memantau lampu isyarat serta lampu jalan di sekitar Seberang Perai.

"Buat masa ini, Wego memasang lima lampu LED, pemasangan sistem kawalan lampu isyarat, pemasangan server dan perisian sistem kawalan untuk projek pilot.

"Sekiranya memberangsangkan, kita akan melakukan satu pelan induk serta strategi untuk mewujudkan sistem pemantauan pintar untuk lampu jalan dan lampu isyarat di seluruh Seberang Perai," katanya.

Maimunah (dua, kiri) dan Youngsook (kiri) mendengar taklimat mengenai aplikasi pintar lampu jalan serta lampu isyarat.

- **Guang Ming Daily (Dec. 16, 2016)**

■柏达镇路段装置路灯及交通灯智能感应系统正式启用；前右起为麦慕娜及南英淑。

侦查失灵路燈交通燈
柏達鎮試用感應系統

（大山脚15日讯）威省市政局与世界电子化政府组织（WeGo）首次合作，在柏达镇的5支路灯及1支交通灯上装置智能感应系统，以更快侦查到失灵的路灯及交通灯，同时也能节省能源。

威省市政局主席拿督麦慕娜披露，上述计划仍处于试验性阶段，一旦试验成功，该局将会进一步推广有关计划，让威省各区的路灯及交通灯都能安装智能感应系统。

麦慕娜昨日傍晚在柏达镇KPJ槟城专科医院前方的路段主持路灯及交通灯安装智能感应系统推介活动时，向媒体这么透露。她指出，威省一共有1万2500支路灯、280支交通灯，以往总是要等接获民众投报才知道路灯或交通灯出现故障，如今装置智能感应系统后，当局随时都能掌握路况，一旦出现故障，即可马上修补。

"装置智能感应系统后，一旦路灯或交通灯出现问题，我们通过系统或手机能马上接到消息。"

当局每年的电源开销高达100万令吉，装置智能感应系统也可节能及减低开销。世界电子化政府组织秘书长南英淑补充，通过智能感应系统，不仅环保节能及快速掌握路面情况，也能结合各种控制及网络通信技术，包括侦视车流量、人潮、气候转变，以及在适时降低照度减低光污染等。

"智能感应系统也可以根据气候、人潮或车流量调节亮度，进一步节省电源，降低光污染，还能根据情况进行实时监控。"（CYY）

- **Kwong Wah Yit Poh (Dec. 16, 2016)**

全球仅7城市获选试用
威省设智能街灯红绿灯

（大山脚15日讯）威省市政局获世界都市电子政府协议组织（WeGo）挑选成为全球7个城市试用街灯及红绿灯智能系统。在有关系统下，街灯及红绿灯一出现问题，市局官员就可透过手机马上获知，这个系统有望减少延误维修带给市民的困扰。

有关系统正由世界都市电子政府协议组织（WeGo）进行"可行性研究"（Feasibility Study）。

威省市政局主席拿督麦慕娜周三率同市政局官员、该组织及技术支援公司，召开记者会宣布这项合作计划说，全球只有7座城市获选为试跑城市，威省荣幸被当局选中。

她说，总部设在韩国首尔的世界都市电子政府协议组织，是一个由来自世界各地的城市组成的国际组织，旨在推动永续发展、资讯通讯技术共享、改善公共管理等，威省市政局是我国唯一一个加入该组织的地方政府，2012年已成为该组织成员。

她说，当局圈定威省柏达镇为试跑地点，在KPJ医院前的5个街灯及附近十字路口的1个红绿灯安装智能系统，经费由当局赞助，并派出10名该组织、IGB Consulting有限公司及Gabotech有限公司的专才传授技术。

麦慕娜：透过手机可即时监控

麦慕娜解释，此系统采用LED半导体光源、物联网（IoT）及海量数据分析（BDA）等先进技术，具备多项功能，其中一项是实时监控，用户透过手机就可即时监控远处的街灯和红绿灯。

她说，技术人员在灯柱安装了感应器，此感应器对提市政局办公室里的伺服器，一旦侦测到街灯和红绿灯出现故障，感应器就会自动发送信号到伺服器，而连接伺服器的电子设备就可接收到实时数据。

她说，威省地域广阔，全威省共有1万2500个街灯和280个红绿灯，在现行的作业方式下，市局每次都会派出3名员工负责巡逻检查基设状态，单靠3人走遍全威省780平方公里来收集资料，效率过于缓慢，市局透过员工检查及公众投诉才获知基设故障，但往往发现到的时候已经事隔多天，延误了维修，导致市局遭到公众责骂没做工。

她说，此系统也具备自动调节街灯亮度的功能，若感应器侦测到四周光线明亮，就会自动调暗街灯，达到节能减碳的效用之余，也可替市局节约电费，目前一年下来，单是付给街灯的电费就要约莫1000万令吉。

同时，她指出，有关感应器也可收集交通流量、行人流量、气温、碳排放量等环境数据，有了此系统，从此不再需要派人在烈日下收集交通数据。

询及是否担心安装在触手可及的感应器遭不法之徒破坏，她说，若有人打开感应器，就会即刻触动连接感应器的手机设备，官员就可马上得知感应器被打开。

她说，只有相关的官员被授权下载手机应用程序操控系统，此计划将试跑至2017年6月，倘若取得正面的成效，市局将考虑扩大此系统至威省其他地区，理论上而言，她相信此系统有助市局迈向精明、绿色和电子城市的志愿。

南英淑：威省率先全马拥有此系统

来自韩国的世界都市电子政府协议组织秘书南英淑说，很地观察，大马其他城市尚未有智能路灯和红绿灯，她相信威省是全马率先拥有此系统的城市。

她说，目前，一些韩国及欧洲城市也有套用此系统。

她赞扬市局主席麦慕娜拥有优秀的领导表现，且活跃于该组织的活动，威省市政局积极推动永续的努力有目共睹，这也是为什么该组织在众多的城市当中，选择威省成为试跑计划的城市。

她承诺，倘若市政局未来有意扩大此系统至其他地区，该组织将协助募资。

▲威省市政局与来自韩国的世界都市电子政府协议组织及技术支援公司的专才，展示后方的智能街灯，前左3起是南英淑及麦慕娜。

- **Nanyang Siang Pau (Dec. 16, 2016)**

智能街灯及交通灯系统试跑

威省迈向智慧型城市

韩国电子化政府组织赞助

威省全国唯一获选城市

（大山脚15日讯）威省市议会“智能街灯及交通灯管理系统”试跑，这项智能管理系统一旦试跑成功，威省未来将朝向智慧型城市迈进，并逐步在全威省1万2500个街灯及280个交通灯落实这项智能管理系统。

威省市议会主席拿督斯里麦姆娜说，这项智能管理系统试跑活动，是获得韩国威市及地方政府世界电子化政府组织（WeGO）全力赞助，包括提供训练、智财及专才等，并选择在威中柏达镇市议会大厦附近5个发光二极管街灯及1个交通灯装置智能管理系统，试跑期限长达8个月。

她说，这项智能管理系统，除了可使用智能手机监管街灯及交通灯外，所收集的实时数据将传送至市议会信息技术组的主要伺服器，让市议会能够即时掌握街灯及交通灯的状况，预料能够达到高通管理、减少人力及节省电能的效益。

麦姆娜于周三特地带领威市及地方政府世界电子化政府组织及市议会信息技术组官员巡视威中柏达镇市议会大厦前街灯时，向媒体透露这项消息。WeGO秘书长南美斯说，这项智能管理系统是在街灯及交通灯装置智能感应器，这项智能感应器除了可感应街灯及交通灯的实际状况外，也可感应周遭的交通、天气、污染等，然后将实时数据传送至主要伺服器，因此，这项实时数据也可成为警方查案的重要线索。

麦姆娜说，韩国城市及地方政府世界电子化政府组织目前选择在7个城市进行“智能街灯及交通灯管理系统”可行性研究，市议会是我国唯一获选城市。这项可行性研究的试用期限是从2016年10月至2017年6月。

“有关组织已成立拥有10名专才的团队，包括WeGO秘书处3人、IGB咨询有限公司2人及Gabotech有限公司5人，全程负责这项可行性研究。”

她说，以往市议会仅有3名员工负责监管全威省1万2500个街灯及280个交通灯，虽然他们会进行例常巡逻，但仍然无法掌握街灯及交通灯的实时状况。因此，市议会时常接获民众投诉，即使在接获投诉后，也需花费2、3天时间才能派员维修。

她说，这项智能管理系统是在街灯及交通灯装置智能感应器监管实时状况，然后使用物联网（IoT）、海量数据分析（BDA）及智能应用程序科技，将所获得的实时数据传送至智能手机或主案伺服器。

不需例常巡逻掌握实况

“因此，市议会负责员工将通过智能手机或电脑，即时掌握街灯及交通灯的实时数据，在不需例常巡逻及接获投诉情况下，仍然能掌握街灯及交通灯的损坏程度，这项系统让市议会更主动、有效及迅速地管理街灯及交通灯，而且达到减少成本及节省人力的效果。”

她说，市议会每年需要耗费1000万令吉缴付街灯电费，因此，希望通过智能管理系统能适时调整街灯光亮度的功能，协助市议会节省电能，进而达到环保的效果。

威中柏达镇市议会大厦附近5个发光二极管街灯及1个交通灯已装置智能管理系统，试跑期限长达8个月。

麦姆娜（左四）带领巡视已装置“智能街灯及交通灯管理系统”的街灯。

韩国城市及地方政府世界电子化政府组织专才向众人讲解如何操作智能管理系统。

- **China Press (Dec. 16, 2016)**

威省路燈設IoT感應器

官員實時監控省人力

■实智能监应路灯及红绿灯”。■南槟岛姆娜（左一起）与麦基娜，公布该组织与市议会合作落

（大山脚15日讯）威省市议会获得专家提供物联网（IoT）技术，率先在5条路灯及1座红绿灯安装感应器，透过实时监控系统操作，用科技反映不符合服务效益的“有投诉才处理”模式。

这项为期9个月的高效智能监控设施可行性研究于今年10月展开，明年6月取得成效；市议会未来或分阶段对威省58地共1万2500盏路灯及280座红绿灯，安装类似感应器。

通过此技术，市议会只需授权1位官员使用应用程式（Apps），便能在手机上，或电脑前，对红绿灯及路灯进行高效检查，省却巡逻人力。

逾致節能效益

此研究是由世界电子化政府组织（WeGO）提供市议会物联网，及海量数据分析（BDA）技术，专家，并协助作威省市议会大厦周边5盏路灯及1座红绿灯，装置感应器，有关路灯以发光二极管（LED）路灯取代传统灯泡，达致节能效益。

值得一提是，威省市议会是我国唯一获得该组织，遴选为其中7座城市，以进行“路灯及红绿灯监控”研究先驱的地方政府。

该研究由组织遴选10名专家进行，其中3人来自该组织秘书处、2人来自IGB咨询公司及5人来自Gabotech公司。

威省市议会主席拿督斯里麦基娜昨午与世界电子化政府组织秘书长南威斯、相关公司专家及市议会官员，带领媒体视察及示范智能设施的操作。

麦基娜说，市议会常被指慢速维修路灯，被投诉故障几天后才修理，等民众投诉及通过巡逻逐个路灯检查，不再符合效益，透过科技即时检查设施“健康状况”的效率、反而更佳。

“目前我们不够人手确保威省每盏路灯及红绿灯良好操作。”

■佳示范，用手机检视路灯及红绿灯的操作。”一名技术专家向麦基娜（左二）及媒

■威省市议会未来计划分阶段落实这项系统，覆盖3地的所有路灯。

■威省市议会大厦旁的5个路灯及1座红绿灯，率先进行这项高效监控的可行性研究。

通過網絡連結管理

新聞辭典

物联网（Internet of Things，简称IoT），即通过网络将普通的物体，通过网络连结起来，数据化现实世界，通过网络连结家居电器、公共设施、机器等，使用电脑就能达到智理、搜寻位置、遥控、远程监测、收集数据及资讯的目的。

物联网应用范围广泛，通过系统可控近分散的资讯，统整物与物的数位资讯。物联网的应用领域主要包括运输和物流领域、健康医疗领域范围、智慧环境（家庭、办公、工厂）领域、个人和社会领域等，具有十分广阔的市场和应用前景。（资料：维基百科）

- **Sin Chew Daily (Dec. 16, 2016)**

星洲日报 SIN CHEW DAILY

大北馬 社區報

Northern Edition 16・12・2016 | 星期五

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威省威全馬

智能照明城市 我領先

E-Government 2016 F/S Project for a member city of WeGO

Implementation of Street Lamp & Traffic Light Monitoring System by Using BDA, IoT & Mobile Technology

- Seberang Perai, Malaysia -

Project Performed by IGB CONSULTING & (주)가보테크

大北馬 報道・洪東凱

▲麥慕娜（中）、南英淑（左四）等人向记者指出已安装智能系统的其中一根路灯。

（大山腳）威省市政局獲得世界電子政府組織支援裝置智能路燈和交通燈系統，擁有遠程控制亮度、全天候監視運作、偵測氣候、監督車輛流量和人流等功能，讓威省成為全馬首個擁有這類智能照明系統的城市。

唯一地方政府加入WeGO

威省市政局也是全马唯一加入世界电子政府组织（WeGO）的地方政府，配合世界电子政府组织推展的“智能路灯与交通灯先驱计划”，威省幸运地成为全球7个受惠城市之一。

威省市政局主席拿督麦慕娜说，世界电子政府组织的这项先驱计划旨于测试物联网（IoT）和智能程式，提升管理路灯、交通灯等的效率，使得市政局在接获投诉之前便可以即时前往检查或维修，减少需要监督路灯和交通灯正常运作的人力。

故障会马上发警报

“市政局在威省区拥有1万2500根灯柱以及管理280个交通灯，但管理人员只有3名。倘若使用智能路灯与交通灯程式，每根灯柱和每个交通灯都与本身的智能系连线，一旦出现故障，系统会立即发出警报，同时显示发生故障的正确地点。”

麦慕娜周天傍晚与世界电子政府组织秘书长南英淑等人，以及来自韩国的智能路灯与交通灯先驱计划企划单位Gabotech的工程师，在市政局对面的KPJ医院前召开新闻发布会，以及向记者示范当地智能路灯的操作方法。

她说：“不仅如此，安装在工作人员手机上的程式，还可以控制特定路灯的亮度。目前，市政局每年花费在路灯和交通灯的电费高达1千万令吉，倘若采用LED灯和智能系统，相信会大幅度减少市政局在电费方面的支出。”

试跑至明年6月

她说，这项先驱计划将预先试跑半年至明年6月，倘若测试结果达到令人满意的程度，不排除市政局会采用这类智能系统。

不过，她说，这套系统的成本并不便宜，在场的南英淑则透露世界电子政府组织可通过其他合作方式，譬如公共、私人与人民合作关系等，设法协助有需要的城市提供智能路灯与交通灯系统。

▲工作人员只需在原有的电源供应箱加装智能控制器，根本无需更换整个系统，降低了改换成智能系统的成本。

▲路灯下方的接收器可分析各种数据，定时发送到市政局工作人员的手机程式上。

狀況即時傳送至工作人員手機

Gabotech企划部副总经理宋圭珍说，智能路灯与交通灯的感应器可收集海量数据，然后通过3G或4G电讯网络，把即时状况传送到工作人员手机内的程式，将让各种数据的分析变得更简易。

Gabotech已在KPJ医院前的5根电灯柱，以及柏达镇市政局前的交通灯分别安装智能感应器。

源供应箱装置一个智能控制器，然后在每根灯柱加装一个感应器、一个接收器和一个LED灯变压器，就完成了智能路灯与交通灯的基本系统。

“当感应器发现一些道路在夜晚时车辆流量稀少，相关讯息会发送到工作人员的手机程式，对方将远程遥控降低路灯的亮度，这样便能够避免消耗太多不必要的能源。”

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