

Study of Intelligent Transport System Development Master Plan in Bangkok Metropolitan Region



Executive Summary Report

Abbreviation Index

Abbreviation	Explanation
DLT	Department of Land Transport
BMTA	Bangkok Mass Transit Authority
CMRT	Commission for the Management of Road Traffic
DOH	Department of Highway
TIS	Thai Industrial Standard
OTP	Office of Transport and Traffic Policy and Planning
AASHTO	American Association of State Highway and Transportation Officials
AHP	Analytic Hierarchy Process
ANSI	American National Standards Institute
API	Application Programming Interface
APTS	Advance Public Transport System
ARL	Airport Rail Link
ARMS	Accident Report Management System
ARTS	Advanced Rural Transportation Systems
ASD	Assistance for Safe Driving
ASN.1	Abstract Syntax Notation One
ASTM	American Society for Testing and Material
ATC	Area Traffic Control
ATE	Automation Traffic Enforcement
ATIS	Advanced Traveler Information System
ATMS	Advanced Transport Management System
AVCS	Advanced Vehicle Control System
AVI/AEI	Automated Vehicle/Equipment Identification
BEM	Bangkok Expressway and Metro
BIMS	Bus Information and Management System
BTS	Bangkok Mass Transit System
C2C	Center to Center Communications

Abbreviation Index

Abbreviation	Explanation
C2F	Center to Field Communications
CALM	Communications access for land mobiles
CCTV	Closed Circuit Television
CD	Committee Draft
CEN	European Committee for Standardization
CENELEC	European Committee for Electrotechnical Standardization
CVOS	Commercial Vehicle Operation System
DSRC	Dedicated short range communication
EFC	Electronic fee collection and access control
EFC/ETC	Electronic Fee & Toll Collection
ETSI	The European Telecommunications Standards Institute
FDIS	Final Draft International Standard
FDNS	Final Draft National Standard
GPS	Global Positioning System
IECVO	Increasing Efficiency in Commercial Vehicles Operations
IEEE	The Institute of Electrical and Electronics Engineers
IERM	Increasing Efficiency in Road Management
IMS	Incident Management System
IoT	Internet of Things
IS	International Standard
ISO	International Standard Organization
ITS	Intelligent Transport System
IVHS	Intelligent Vehicle Highway System
JISC	Japanese Industrial Standards Committee
KATS	Korean Agency for Technology and Standards
KPI	Key Performance Indicator

Abbreviation Index

Abbreviation	Explanation
MaaS	Mobility as a Service
MRT	Mass Rapid Transit
MMI	Man-machine interfaces
MOU	Memorandum of Understanding
NEMA	National Electrical Manufacturers Association
NMTIC	National Multimodal Transport Integration Center
NP	New Work Item Proposal
NTCC	National Traffic Control Centre
NTCIP	National Transportation Communications for Intelligent Transportation System Protocol
OTM	Optimization of Traffic Management
PES	Parking and Bus Exclusive Lane Enforcement System
PIS	Parking Information System
PT	Public transport
RFID	Radio Frequency Identification
RTD	Road traffic data
SAC	Standardization Administration of China
SAE	Society of Automotive Engineers
SEVO	Support for Emergency Vehicle Operation
SP	Support for Pedestrians
SPT	Support for Public Transport
SR	Systematic Review
SRTET	State Railway of Thailand Electrified Train
TC	Technical Committee
TCS	Toll Collection System
TDM	Travel Demand Management
TIA	Telecommunications Industry Association
TIS	Traveler Information System

Abbreviation Index

Abbreviation	Explanation
TJP	Travel Journey Planner
TRAMS	Thailand Road Accident Management System
TTI	Traffic and traveler information
UITP	Union Internationale des Transports Publics
V2I	Vehicle to infrastructure
V2V	Vehicle to Vehicle communication
V2X	Vehicle to Any Communication
VII	Vehicle Infrastructure Integration
VMS	Variable Message Sign
WG	Working groups
WHO	World Health Organization

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Chapter1

Introduction

Chapter1

Introduction

1.1 Introduction

- 1) The government has announced its policy on September 12, 2014. Policy 6: Economic Growth Article 6.12 Development of Transport and Communication Infrastructure and Policy Article 8 Development and promotion of the use of science, technology, research and development, and innovation. Article 8.4 Promotes large national investment projects such as clean energy, rail, electric vehicles, water and waste management, and utilization of research and development. And Thai innovation as appropriate.
- 2) 20-year National Strategic Framework (2060-2016); 2nd Strategic Capacity Building Issue 2.5 Development of Information and Communication Technology (ICT) Infrastructure by promoting the use of technology in energy-related capacity building. Innovation Integrated government services and research support aimed at meeting the needs. In developing countries.
- 3) National Economic and Social Development Plan No. 12 (2060-2021) Strategy 7: Infrastructure and Logistics Development focus on expanding capacity and improving service quality, improving the quality of life of all groups in society and encouraging interconnected networks to increase access to basic services. It also focuses on the use of Intelligent Transport Systems (ITS) to control and direct traffic by integrating travel information.
- 4) Digital Development for Economic and Social Development Plan (Cabinet approved on April 5, 2016) has set a vision for Thailand's reform into digital Thailand, which means that the country can create and Utilize digital technology to maximize the potential of developing innovative information infrastructure, human capital and other resources to propel the country's economic and social development to stability, wealth and sustainability.
- 5) Trends in the development of transport and traffic systems in the future focus on the use of digital technology to help transport and traffic to improve efficiency, convenience, safety and environmental protection as well as help to fix problems and development of transportation and traffic systems. It is important for economic development and enhancement, competitiveness of the country and to pass on the quality of life of the people.
- 6) Based on government policies and trends, development of transportation and traffic systems, the Ministry of Transport by Bureau of Transport and Traffic Policy and Planning (OTP) as the policy and planning agency, who has the role of planning and policy, directs the development of appropriate transport and traffic systems, including the development of intelligent transportation technologies (Intelligent Transportation Systems: ITS). It is therefore desirable to study and develop a master plan for ITS development. Scope of development to enable the relevant agencies to implement the strategic plan. ITS projects are integrated and do not generate duplicate investments. Digital technology is used for public transportation and transportation of goods to

facilitate efficiency and security, drive the country's economic and social development and provide policy information for ITS development.

1.2 Objectives

- 1) To review the operation of the ITS system in both domestic and international ITS.
- 2) To prepare a master plan for ITS development in both the national and regional contexts in Bangkok Metropolitan Region as a guiding framework for ITS operations.
- 3) To standardize ITS and ITS approach for implementation.
- 4) To develop a pilot project for ITS development in Bangkok Metropolitan Region.

1.3 Scope of Work

The study area consists of four parts:

- 1) The study collected data. Study results and implementation related to ITS development.
- 2) ITS master plan development and pilot project for ITS development.
- 3) ITS standardization and ITS approach for implementation.
- 4) Seminar for listening and academic training.

1.4 Outputs

1. Database of ITS development in both domestic and international countries as integrated information for ITS operations and ITS master plan development.
2. ITS master plan development of the country and Bangkok Metropolitan Region as a framework for shaping the direction of ITS development and integration of system development projects of relevant agencies including the policy proposals and the management and implementation of ITS development plan in the overall country, ITS Development Project in Bangkok Metropolitan Region for policy decision in ITS development.
3. National ITS standards that are necessary for the development of the ITS system in accordance with the Master Plan including the priority of the standard that will be implemented in the future and the actual approach.
4. Pilot projects from the Bangkok Metropolitan Region can serve as an example of a project to implement the ITS development process by providing a realistic implementation plan that can be forwarded to responsible agencies for implementation.

1.5 The Concept of Project work

The operation is divided into 4 parts as follows:

- The study of collected related data, results and implementation of ITS development.
- ITS master plan development and pilot project for ITS development.
- ITS standardization and ITS approach for implementation.
- Seminar for listening and academic training.

For the concept of operation, the first part is the study of ITS in Thailand and international countries. This is the beginning of all education. The results of this operation are: Analysis of the environment ITS Development and ITS Development Facility in Thailand. Results lead to the study in part 2 and 3. Part 2 will be the ITS Master Plan Development. The results include vision, mission, strategic goals, plan implementation and the pilot projects. The Implemented plan is another set of information that helps in making ITS Standards decisions and prioritization. This will be the third part of the project.

The work in the 4th section will be carried out through the project period. The results of three activities are published and received feedbacks from involving people. The feedbacks will be summarized, and the project will be updated. The operational guidelines are summarized in **Figure 1.5-1**.

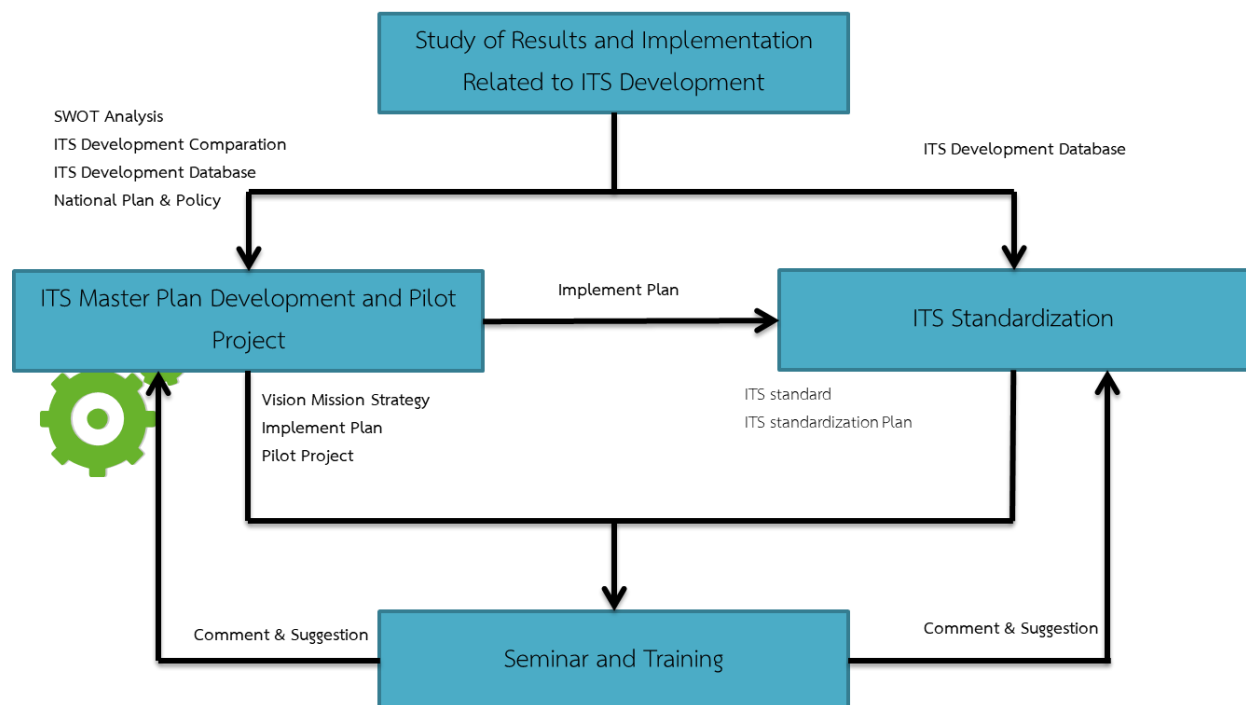


Figure 1.5-1 Concept of Project Work

Chapter 2

Review of ITS Development

Chapter 2

Review of ITS Development

2.1 ITS Concepts and Theories Related to ITS Development

2.1.1 Definition

Intelligent Transportation System (ITS) is system development focusing on the integration of various technologies, such as communication technology, automated data collection technology, computer technology and data analysis programs, to facilitate the use of transport and traffic systems for comfort and safety of travelers.

In addition, Intelligent Transportation System is an intelligent system solving traffic and transportation problems. Intelligent means ability to gather information real-time from several sources as database for evaluating situations including methods and solutions as well as responding instructions or commands for immediate action.

2.1.2 The Characteristics and Elements of Intelligent Traffic and Transportation Systems

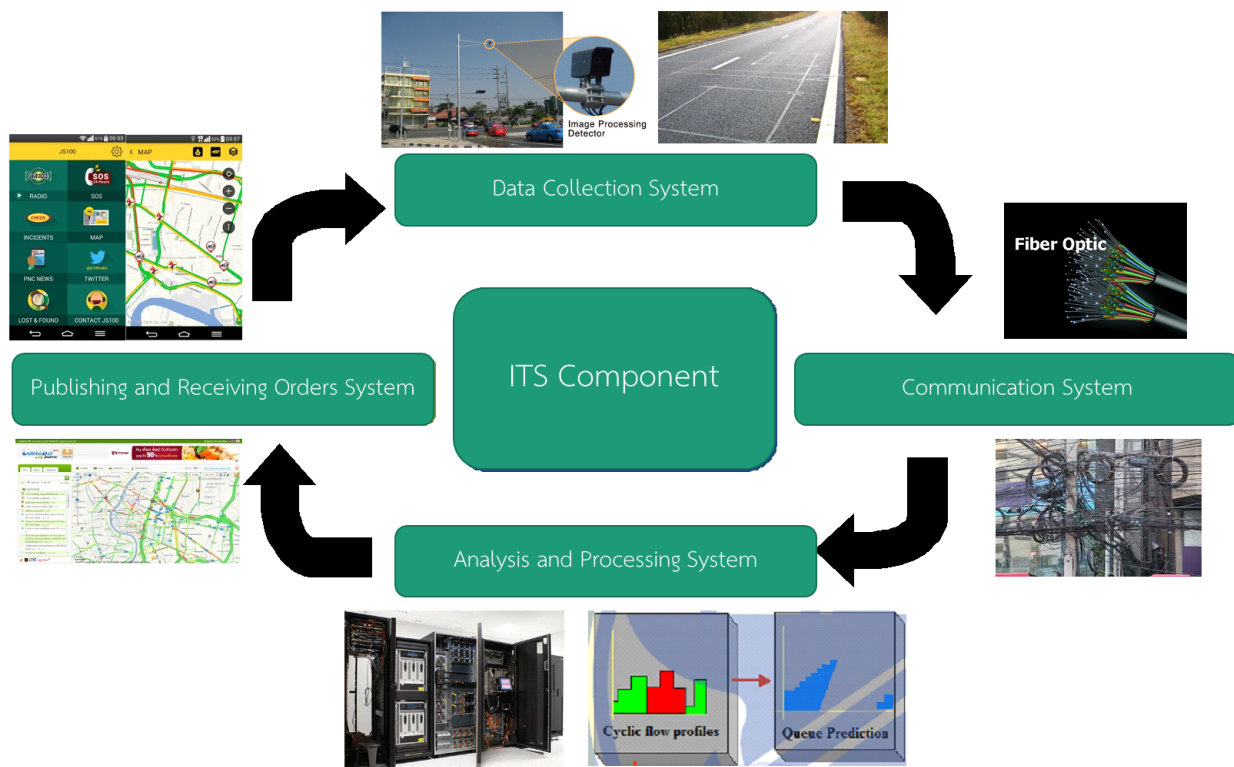


Figure 2.1-1 Intelligent Transportation System Component

1. Data collection system is a system that collects information about travel, transportation, traffic, infrastructure, environment, etc. The system includes various type of sensors or detectors for automatic data collection and send to information center.
2. The communication system is components or systems that transfer or exchange data between sources and destinations through mediators such as computer softwares.
3. Analysis and processing system consists of processing machine (computer) and data analysis methods. Computer system is interconnection of computers, servers and workgroups as network at the center. Servers have computer program for data analysis process which is commonly known as “Operation Models”.
4. The publishing and receiving orders system is a system that receives results from the operation model and transfers to users and devices in vehicles or on roads.

2.1.3 ITS Classification

Although, ITS systems are various at the present, it could be classified as 7 catagories of development. Each catagories is named as follows.

- Advanced Traffic Management System (ATMS)
- Advanced Traveler Information System (ATIS)
- Advanced Public Transportation System (APTS)
- Commercial Vehicle Operation System (CVOS)
- Infrastructure Management System (IMS)
- Infrastructure Vehicle Safety System (IVSS)
- Connected & Autonomus Vehicle (CCTV & AV)

2.2 Policy and Master Plan for ITS Development in Foreign Countries and Thailand

2.2.1 Policy and Master Plan for ITS Development in Foreign Countries

ITS system is formerly known as IVHS which stands for Intelligent Vehicle Highway System. The system emphasizes the importance of vehicles and roads. As the interest in this system grows and the system is applicable with other modes, tasks in this field are widely known as ITS which is the intentional development to facilitate every modes of transport.

During this time, the ITS system has been recognized. The development is widely used. Major cities have added this activity to tackle urban transport at the national level. The leading developers of this system are the United States, followed by Europe and Japan. Large state-run economies such as California, Texas and Massachusette, have been developing extensive ITS systems. The US federal government has made an effort to encourage better understanding in other states and develop this system. Therefore, the role of ITS has been distributed widely.

It is important to support the study and adoption of ITS as a strategies and major projects in the development of transport systems in major cities. The summary key issue of the master plans is presented in **Table 2.2-1**.

Table 2.2-1 Summary of Key Issues of the Master Plans of Different Countries

Goal	USA	Canada	Austria	Malta	South Africa	Saudi arabia	Japan
Road Transport							
Road safty	√	√	√	√	√	√	√
Road Mobility	√	√	√		√	√	√
Accident response						√	√
Travel Behavior							
Travel demand Management				√			
Non- motorized Transport				√			
Accessibility					√		
Environment							
Reduce Environment Impact	√		√	√	√		√
Reduce Envionment cost		√		√			√
System Improvment							
Improve ITS Environment		√					
Promote innovation to meet future transportation needs.	√						
Vehicle-Infrastrucure Comunication	√		√	√		√	√
Data Collection Improvment		√					√
Reduce ITS Cost					√	√	
Industry							
Increase the productivity and competitiveness of the ITS industry.		√					

Reference : Summary by the advisory board

2.2.2 Policy and Master Plan Related to ITS Development in Thailand

National policies and strategies of Thailand include:

- Cabinet Policy
- National Strategic Framework
- The Twelfth National Economic and Social Development Plan (2017-2022)
- Digital Economy Strategic Plan
- Minister of Transport Strategic Plan (2017-2022)
- Digital Economy Strategic Plan for Minister of Transport
- National Strategic Framework for Transportation

Goals are summarized as shown in **Figure 2.2-1**



Figure 2.2-1 Thailand's plans and policies related to ITS development

2.3 ITS Systems in Thailand and Foreign Countries

2.3.1 Study of Concepts and Theories Related to ITS Development and ITS Experiences

Reviewing ITS development in several countries helps in system understanding. The actual development is often a development that responds to the current situation, needs in the area and the possibility of developing and maintaining the system. This section, therefore, has summarized the revision of the system for 2 purposes, Advanced Traffic Management Systems (ATMS) to implement successful ITS from foreign countries to Thailand and Advanced Traveler Information Systems (ATIS) to establish ITS development master plan for Bangkok Metropolitan Region.

2.3.1.1 United State of America

There are 6 main types of ITS in USA.

- 1) Advanced Traffic Management Systems (ATMS)
- 2) Advanced Traveler Information Systems (ATIS)
- 3) Advanced Vehicle Control System (AVCS)
- 4) Commercial Vehicle Operations (CVO)
- 5) Advanced Public Transportation Systems (APTS)
- 6) Advanced Rural Transportation Systems (ARTS)

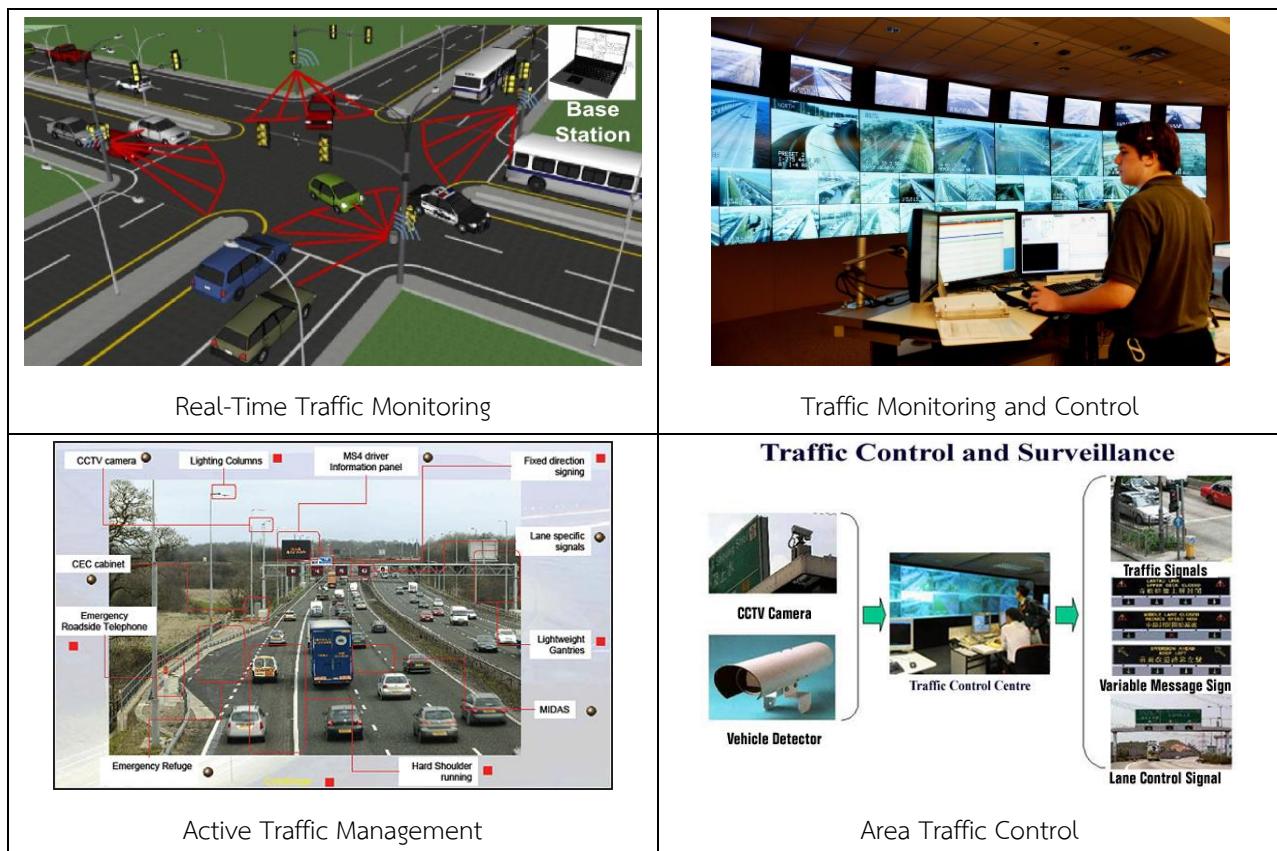


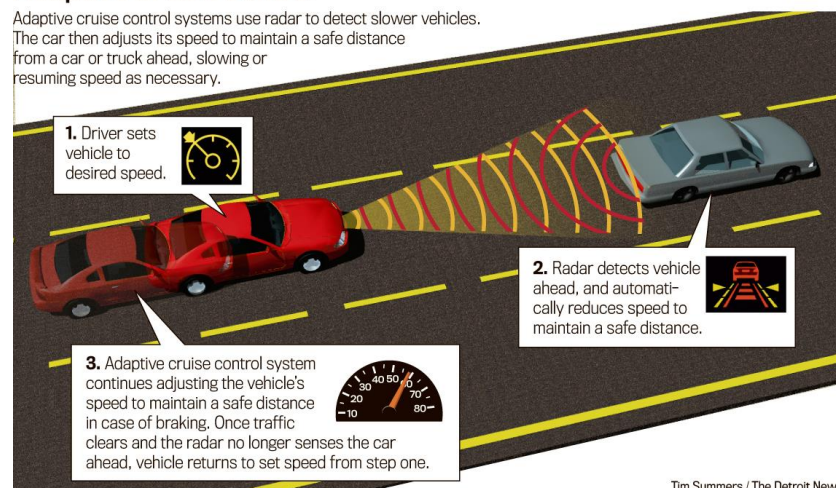
Figure 2.3-1 Advanced Traffic Management Systems



Figure 2.3-2 Advanced Traveler Information Systems (ATIS)

Adaptive cruise control

Adaptive cruise control systems use radar to detect slower vehicles. The car then adjusts its speed to maintain a safe distance from a car or truck ahead, slowing or resuming speed as necessary.



Tim Summers / The Detroit News

Figure 2.3-3 Advanced Vehicle Control System (AVCS)

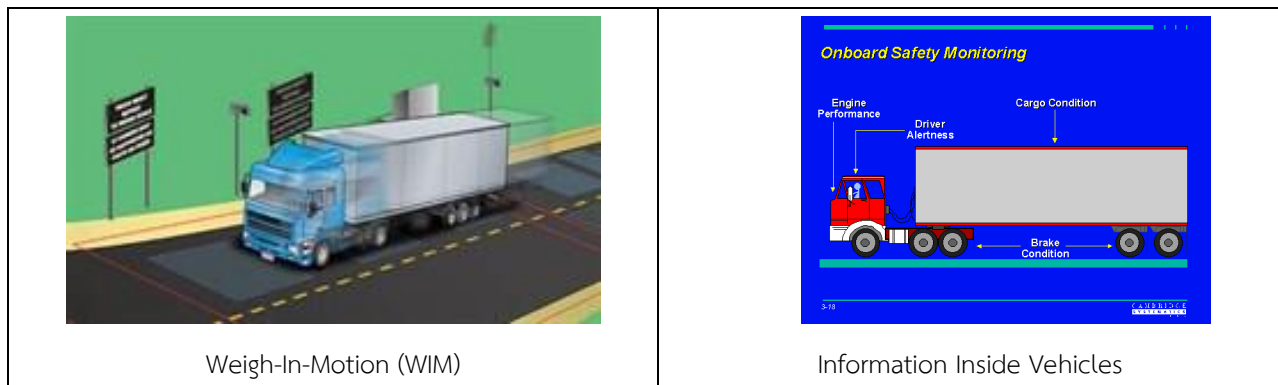


Figure 2.3-4 Commercial Vehicle Operations (CVO)

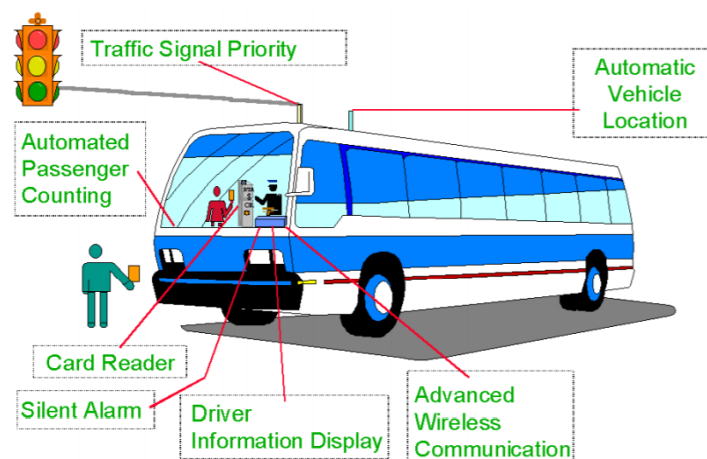


Figure 2.3-5 Advanced Public Transportation Systems (APTS)

2.3.1.2 United Kingdom

The United Kingdom is one of the countries where ITS systems are being developed. There are four types of ITS:

1. Optimal Use of road traffic and Travel Data
 - National Traffic Control Centre (NTCC)
 - Transport Direct



Figure 2.3-6 Website for Trip Planning in United Kingdom

2. Continuity of Traffic & Freight Management Service
 - eFreight
 - Weight in Motion
3. Road Safty and Security application
 - eCALL
 - Rest Area
 - Speed Adaptation
4. Linking Vehicle with Transport Infrastructure

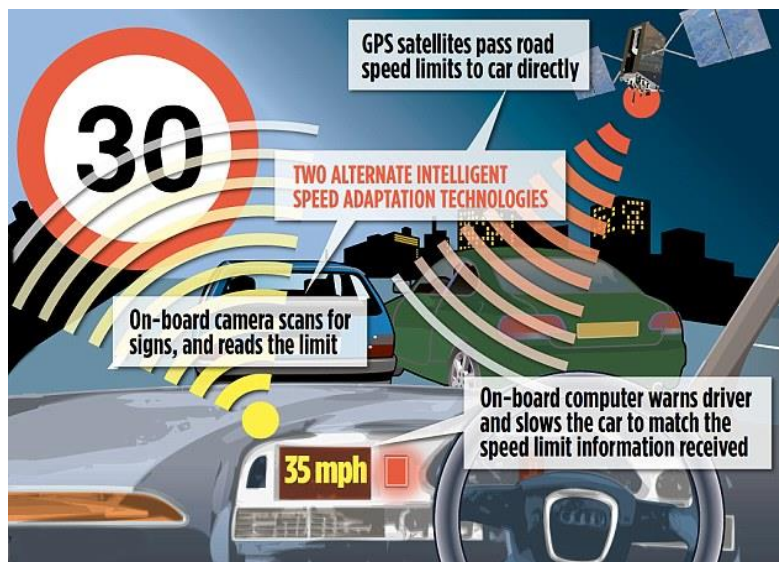


Figure 2.3-7 Speed Adaptation

2.3.1.3 Japan

At present, ITS Japan has assembled ITS systems that has been developed in the country as 9 aspects.

- 1) Advances in Navigation Systems (ANS)
- 2) Electronic Toll Collection (ETC)
- 3) Assistance for Safe Driving (ASD)
- 4) Optimization of Traffic Management (OTM)
- 5) Increasing Efficiency in Road Management (IERM)
- 6) Support for Public Transport (SPT)
- 7) Increasing Efficiency in Commercial Vehicles Operations (IECVO)
- 8) Support for Pedestrians (SP)
- 9) Support for Emergency Vehicle Operation (SEVO)



Figure 2.3-8 Advances in Navigation Systems

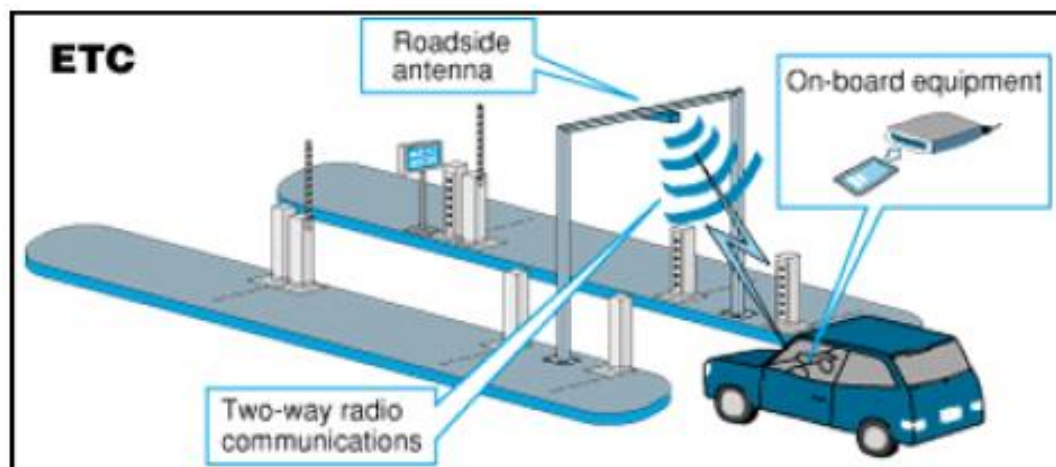


Figure 2.3-9 ETC



Figure 2.3-10 Assistance for Safe Driving

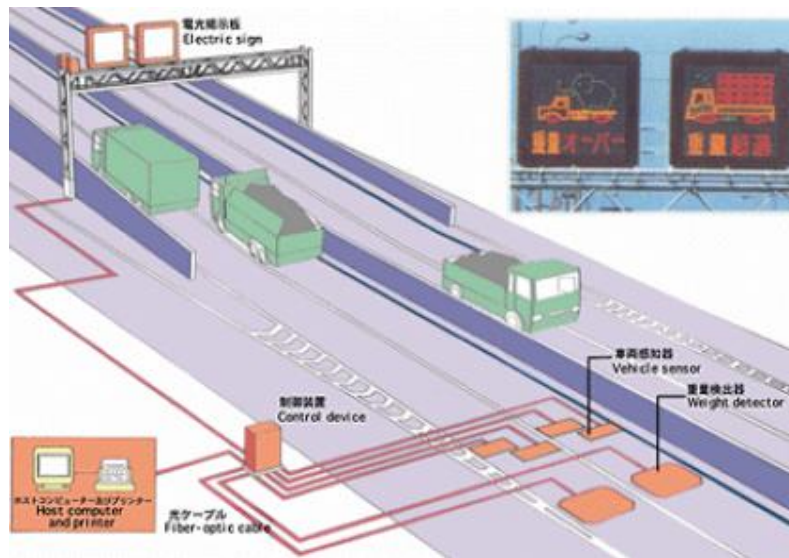


Figure 2.3-11 CVO



Figure 2.3-12 Support for Pedestrians



Figure 2.3-13 Support for Emergency Vehicle Operation

2.3.1.4 South Korea

The ITS system in South Korea was developed as 8 components:

- Advance Traffic Management System (ATMS)
- Advance Traffic Signal Control System (ATC)
- Bus Information and Management System (BIMS)
- Electronic Toll Collection System (ETC)
- Electronic Fare Collection & Card (EFC)
- Parking and Bus Exclusive Lane Enforcement System (PES)
- Parking Information System (PIS)
- Automation Traffic Enforcement (ATE)



Figure 2.3-14 Advance Traffic Management System (ATMS)

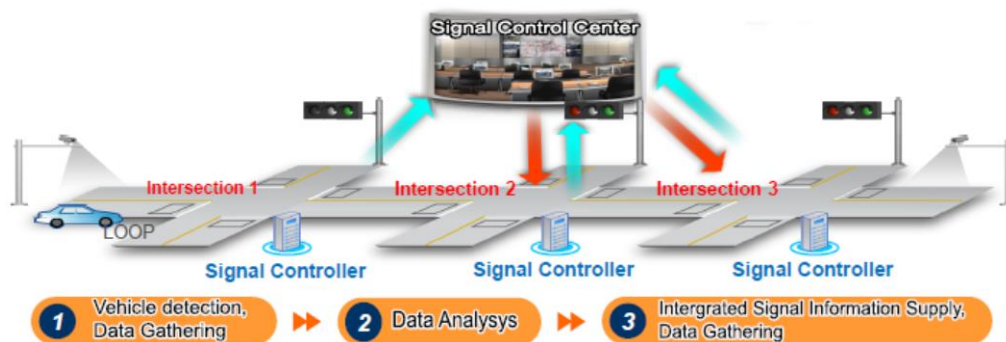


Figure 2.3-15 Advance Traffic Signal Control System (ATC)



Figure 2.3-16 Bus Information

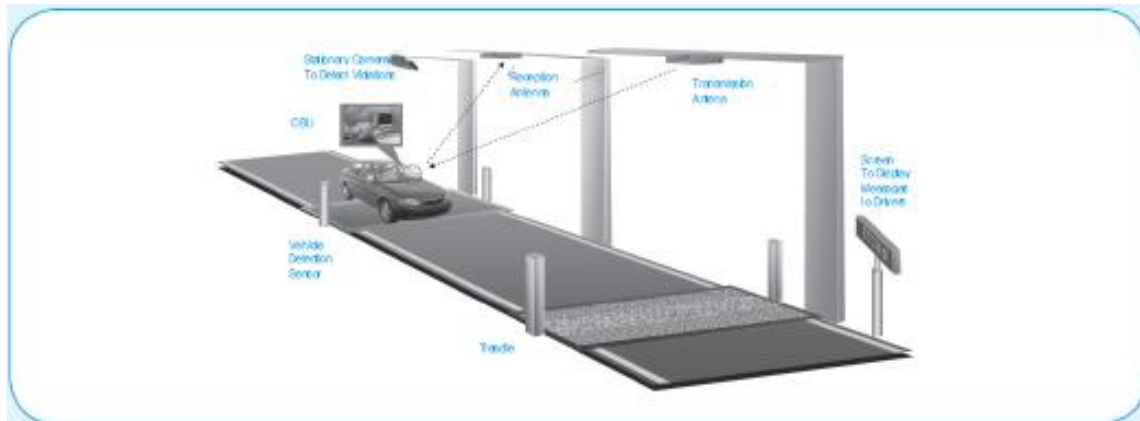


Figure 2.3-17 ETC

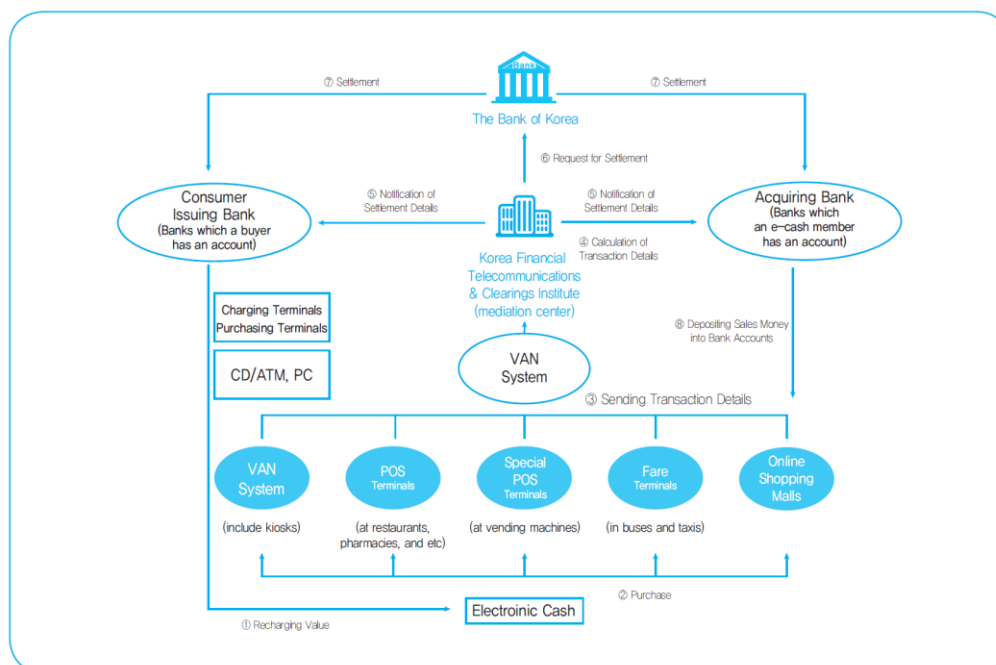


Figure 2.3-18 AFC

2.3.2 Study of the Existing ITS System in Thailand

The ITS operations in Thailand are shown in **Table 2.3-1**. The operations are classified into 6 types as followed:

- Advanced Traffic Management Systems (ATMS)
- Advanced Traveler Information Systems (ATIS)
- Advanced Vehicle Control System (AVCS)
- Commercial Vehicle Operations (CVO)
- Advanced Public Transportation Systems (APTS)
- Fare or Toll System

Table 2.3-1 ITS Development in Thailand

Order	ITS Development	ATMS	ATIS	CVOS	PTMS	AVCS	Fare or Toll System
Public Sector							
1	Office of Transport and Traffic Policy and Planning						
	1.1 Real-time Status Reporting System*		•				
	1.2 Intelligent Traffic Information Integration System*		•				
	1.3 Common Ticket System						•
2	Bangkok						
	2.1 Traffic Signal Control System	•					
	2.2 CCTV System for Traffic					•	
	2.3 Signal Timer		•				
	2.4 Intelligent Traffic Signs		•				
	2.5 Intelligent Street Lighting System						•
	2.7 BRT Express Bus System				•		
3	Traffic Police Division						
	3.1 Closed Circuit Television System (CCTV)					•	
	3.1 Vehicle Detection System Violating Traffic Signs					•	
	3.2 Thai Intelligent Traffic Information Center		•				
4	National Electronics and Computer Technology Center		•				
	4.1. Bus Information System				•		
5	Ministry of Transport						
	5.1 TRAMS System		•				
	5.2 Online Mapping Service		•				
	5.3 Travel Journey Planner		•				
	5.4 National Multimodal Transport Integration Center		•	•	•		

Remark: * Closed Operation

Table 2.3-1 ITS Development in Thailand (Cons.)

Order	ITS Development	ATMS	ATIS	CVOS	PTMS	AVCS	Fare or Toll System
6	Department of Highways						
	6.1 Traffic System		●				
	6.2. Traffic control system at intersections	●					
	6.3 Unusual Incident Management System	●					
	6.4 Automatic Toll Collection System						●
7	Department of Rural Roads						
	7.1 Accident Reporting System (ARMS)		●				
	7.2 Traffic Control System in Chiang Mai road 700 years	●					
	7.3 Automatic Drainage Control System	●					
	7.4 Auto Barrier System and Warning Light	●					
	7.5 CCTV		●				
	7.6 Truck Weighing Systems			●			
	7.7 VMS for Speed Display					●	
	7.8 Road Condition Monitoring System					●	
8	Expressway Authority of Thailand						
	8.1 CCTV System					●	
	8.2 Emergency Telephone System					●	
	8.3 Text Modification System		●				
	8.4 Automatic Fare Collection System						●
	8.5 Traffic Report System		●				
9	Mass Rapid Transit Authority of Thailand						
	9.1 Automatic Control Center				●		
	9.2 Automatic Door Systems				●		
	9.3 CCTV				●		
	9.4 Automatic Fare Collection System						●
	9.5 Automated Ticketing System				●		
10	State Railway of Thailand						
	10.1 Train Track System				●		
	10.2 Seat Inspection System				●		
11	Bangkok Mass Transit Authority						
	11.1 GPS Tracking System				●		
	11.2 Real-Time Information System		●				
12	Harbor Department						
	12.1 CCTV and Other Systems Associated				●		
	12.2 Traffic Safety and Maritime Safety	●					

Table 2.3-1 ITS Development in Thailand (Cons.)

Order	ITS Development	ATMS	ATIS	CVOS	PTMS	AVCS	Fare or Toll System
13	Department of Transport						
	13.1 Thai Truck Center			●			
	13.2 Tracking System for Buses and Trucks			●	●		
Private Sector							
1	Bangkok Mass Transit System Public Company Limited						
	1.1 Automated Bus System				●		
	1.2 Intercom System and CCTV				●		
	1.3 Automatic Fare Collection System				●		
2	Donmuang Elevated Highway						
	2.1 Traffic Information System through Message Change Signs		●				
	2.2 CCTV					●	
	2.3 Emergency Telephone System					●	
3	iTIC		●				
4	Google Maps / Google Transit		●	●	●	●	
5	Longdo Map / Traffic		●	●	●	●	
6	GlobeTech / Nostra Map		●			●	
7	AAPICO	●	●	●			
6	NuMAP		●				
7	TomTom		●	●	●	●	
8	Here		●	●	●	●	
9	TTET / T-Square			●	●		
10	Mappoint Asia		●	●	●	●	
11	VIABUS				●		
12	GRAB				●		
13	ALLTHAI				●		
Reginal Sector							
1	Samut Sakorn Provincial Highway						
	1.1 Intelligent Signal Control System	●					

2.4 Comparison of ITS Developments in Thailand and Foreign Countries.

The main content is a comparative study of ITS development trends in the country and foreign countries. Reviewing will help to understand trends and development of ITS for solving traffic problems including operation and the achievement of various systems.

The comparative method is only implemented with similar projects. Moreover, this method reveals the current prioritized ITS aspects of development and the reasons behind for further development of ITS master plan.

The classification of ITS systems is described as the previous section, based on the nature of the project in the country and the development of ITS systems in 4 countries, as summarized in Table 2.4-1 through Table 2.4-4.

Table 2.4-1 ITS for-Traffic Management

Other Countries	Thailand
- Initially install ATC system at 20-40 intersections. - Gradually expand the coverage of traffic light all over the city - Supervised by traffic engineering experts. - Traffic policemen are supporting. - Traffic policemen are subordinated to the city's traffic department.	- ATC system is partially installed, however, not fully utilized. - Policemen control and manage traffic. - BMA is responsible for overseeing infrastructure and traffic facilities.

Table 2.4-2 ITS for Information

Other Countries	Thailand
- Sub-data centers collect data and send to main data center. The main data center divides tasks regarding to division's expertise. - The collected data belongs to government and is generally published to private sectors for extensive use. - Data analysis process is prioritized for suggesting routes. - Forecasting traffic condition in 15 minutes is available.	- There are many departments that collecting data, however, data is insufficient for calculating real-time traffic condition. - Lack of publishing information. - Analysed traffic condition is not trustworthy for travelers. - Data collection is mainly done by public sectors which has less understanding in the market than private sectors. The information, therefore, cannot yield the highest benefit.

Table 2.4-3 ITS for Public Transport

Other Countries	Thailand
Successful countries have transport operations as listed. • Real-time location tracking on vehicles • Public transport schedule, employee working schedule and vehicle maintenance schedule • Transit signal priority system • Safety on board system • Common ticketing system	Thailand has on-going projects as listed. Mass Transit • Install Pubic bus tracking system including location, number of passenger and CCTV. • Install 12 bus stops with arrival time of each bus which is under cooperation with BMA. • Install ticket scanner for common ticketing system Bangkok • Transit Signal Priority for BRT has been approached, however, shortage of support is occurred. OTP • Develop common ticket system.

Table 2.4-4 ITS for Safty

Other Countries	Thailand
Successful countries implemented ITS for safety in the following aspects: • Law Enforcment System • Truck Control System • Accident Detection System • Accident Response System • Accident Information System In addition, they also initiated using autonomous vehicles on road to reduce accidents caused by human error.	Thailand has on-going projects as listed. Royal Thai Police • Camera installation to detect traffic violations with automated system and watchmen Department of Land Transport • GPS tracking system for buses and trucks Expressway Authority of Thailand • Incident Management System Department of Highways and Department of Rural Roads • Weight in Motion System • Road Accident Information System Ministry of Transport • Thailand Road Accident Management Systems

2.5 SWOT Analysis

Table 2.5-1 SWOT Analysis

Strengths	Weaknessess
- The government prioritizes the development of technology to facilitate the management such as digital economic development plan. - Transport information has been initially developed such as GPS (Department of Land Transport). - Ministry of Transport has initially integrated internal information. - Management technology has been applied in the city such as CCTV and intelligent traffic signal.	- Lack of ITS development plan - Inadequate budget for system maintenance leads to incontinuity of project development. - Shortage of knowledgeable and specialized personnel in ITS - No common agreement and standard of ITS - Lack of integration of public and private sectors' data - Lack of research and development in ITS
Oppotunities	Treats
- Availability of technology in foreign countries - Infrastructure investment overseas about railway system and high-speed trains leads to higher technology - Many private sectors are interested in developing and utilizing ITS in activities which is good opportunity for government to develop and rely on ITS for common benefit. - Objectives of Thailand's development strategies - Transportation problems	- The cost of importing ITS system is high. - ITS licensing causes difficulty in system development. - Problems from the budget auditing leads to less requirable budget and ITS maintenance budget is inadequate. - Transport infrastructure conditions in some areas is not capable to develop and deploy ITS systems. - Lack of confidence in ITS

Table 2.5-2 Analysis of ITS Development Guideline in the Country by Blue Ocean Strategy

Prioritized topics	Main ideas	Blue Ocean Strategy
Strengths		
1	Initiate transport and traffic information improvement	Addition: Develop information to be complete and useful.
2	Initiate integrated information	Addition: Support integrating information
Weaknesses		
1	Lack of budget	Addition: Encourage private sectors to involve in ITS Addition: Demonstrate solid benefits of ITS to clarify significanc of ITS.
2	Lack of personnel	Addition: Enhance potential of officers to be professional in ITS. Addition: Encourage private sectos to develop ITS.
3	Lack of integrated information and operation	Formation: Establish ITS organization Addition: Integrate work between organization and define clear pathway of ITS improvement.

Table 2.5-2 Analysis of ITS Development Guideline in the Country by Blue Ocean Strategy (Cons.)

Prioritized topics	Main ideas	Blue Ocean Strategy
Opportunities		
1	Readiness of technologies in other countries	Addition: Implement ITS to support national strategies.
2	Rediness of private sectors to invest in ITS	Addition: Encourage private sectos to develop ITS.
3	Objectives of national strategies	Addition: Implement ITS to support national strategies.
4	Tranportation issues	Addition: Implement ITS to solve transport and traffic problems.
Threats		
1	High import cost	Addition: Support researches in ITS field.
2	Internal financial investigating organiations	Formation: Establish organization in ITS field as major role in ITS development.

It can be summarized as guideline for developing master plan regarding to goals as followed.

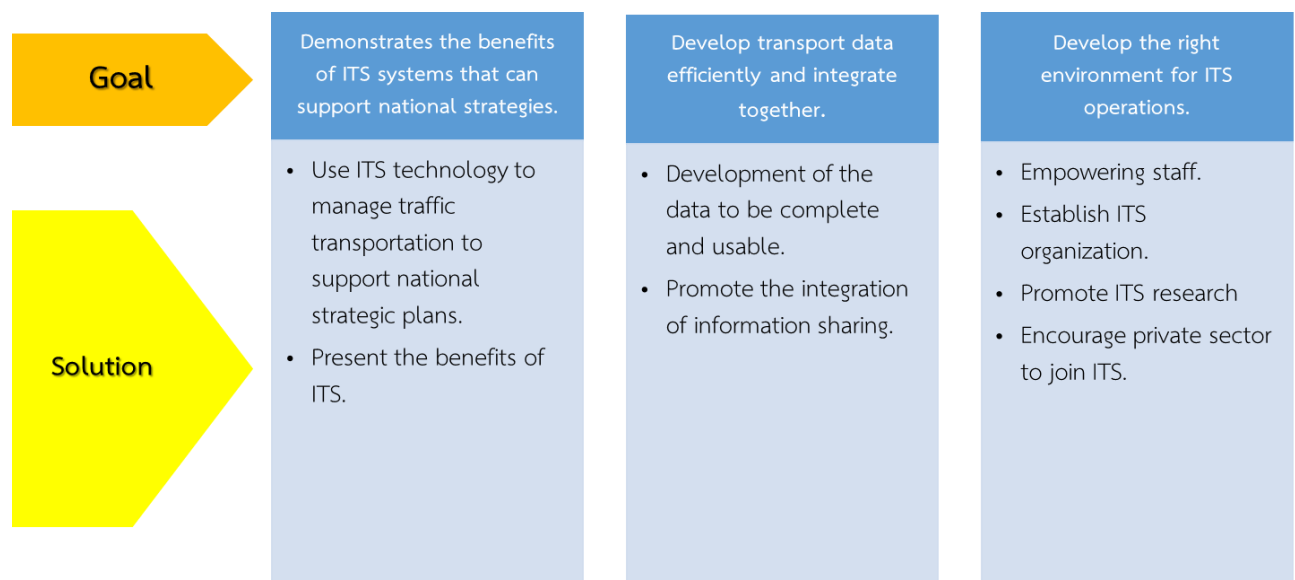


Figure 2.5-1 Guidelines for the implementation of the objectives of the country

Moreover, SWOT of ITS in Bangkok Metropolitan Region is shown in **Table 2.5-2**

Table 2.5-3 SWOT of Bangkok Metropolitan Region

Strengths	Weaknesses
- Some organizations have experienced in ITS such as EXAT. - Transport and traffic information has initiated and integrated. - Modern public transport with common ticket system is being developed.	- Lack of budget for system maintenance leads to incontinuity of project development. - Shortage of knowledgeable and specialized personnel in the ITS system of each agency. - Shortage of knowledgeable and specialized personnel in ITS. - No common agreement and standard of ITS causes incompatible process between departments. - Cooperation problems between traffic controller. Controlling traffic depends on one's instinct. - Delay in government work processes
Oppotunities	Treats
- Availability of technology in foreign countries. - Value of domestic travelling time is higher because of higher wage leads to higher willingness to pay for better facilities. - Many private sectors are interested in developing and utilizing ITS which is good opportunity for government to develop and rely on ITS for common benefit. - It is the strategies for country to raise huge investment in infrastructure. - Transportation problems within the area is not solved.	- The cost of importing ITS system is high. - ITS licensing causes difficulty in system development. - Problems from the budget auditing leads to less requirable budget and ITS maintenance budget is inadequate. - Transport infrastructure conditions in some areas is not capable to develop and deploy ITS systems. - Lack of confidence in ITS

Table 2.5-4 Analysis of ITS Development Guideline in Bangkok Metropolitan Region
by Blue Ocean Strategy

Prioritized topics	Main ideas	Blue Ocean Strategy
Strengths		
1	Having experienced organizations in ITS such as EXAT and BMTA	Addition: Effective ITS for operation.
2	Having modern public transport and common ticket system.	Addition: ITS supports public transport.
Weaknesses		
1	Cooperation between organization responsible for traffic signals control.	Formation: Centralized control center for Bangkok Metropolitan Region.
2	Lacking professional in ITS in local areas.	Addition: Authorized organization directly operates ITS.
3	Integration of information from organizations.	Formation: Integrate information between organizations. Addition: Standard form of information.
Opportunities		
1	Time value of travelers in country increases as salary increases. Thus, people tends to pay for mobility of ITS.	Formation: Organization spends money from income for operation.
2	Having high budget for infrastructure development.	Addition: ITS operates effectively.
3	Construction fo large project in the area.	Reduction: Using private vehicles. Formation: Raising confidence in ITS from distinct benefits.
.4	Transportation problems.	Addition: Implement ITS to solve transport and traffic issues.
Threats		
1	Low confidence in the system.	Formation: Raising confidence in ITS from distinct benefits.
2	Internal financial investigating organiations	Formation: Establish organization that is directly responsible for ITS.

It can be summarized as guideline for developing mater plan regarding to goals as followed.

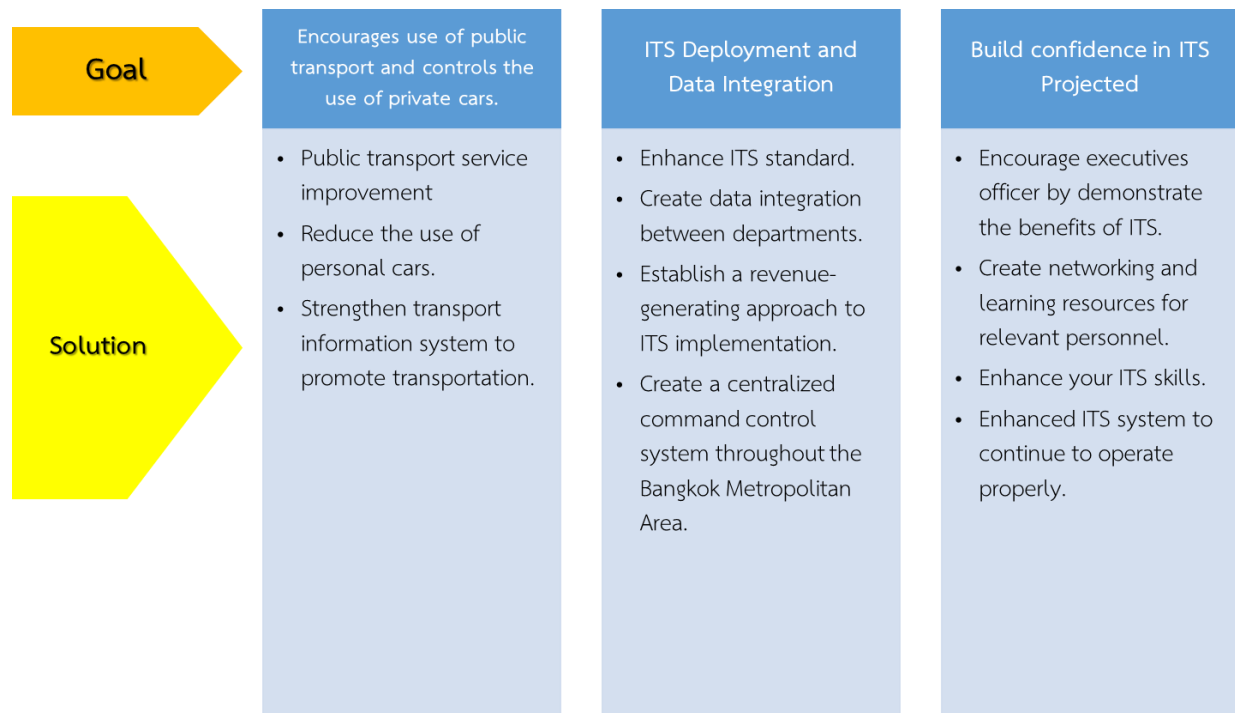


Figure 2.5-2 Guidelines for the implementation of the Objectives of Bangkok Metropolitan Region

Chapter 3

ITS Master Plan Development and Pilot Projects

Chapter 3

ITS Development Master Plan and Pilot Projects

This chapter covers ITS Development Master Plan and pilot projects for practicality. ITS development process in foreign countries and ITS current situation in Thailand were analyzed and resulted in ITS development plan for Bangkok Metropolitan Region.

3.1 ITS Master Plan in Thailand

3.1.1 Conceptual Framework for ITS Master Plan in Thailand

ITS conceptual development in Thailand is under the definition “Smart Transportation”, Transportation is modes of transport in Thailand and Smart is intelligent technologies responsible for human’s need, consisted of 3 factors, Informative, Assistive, Integrated.

- Strength of ITS operation is traffic and transport information which is collected from public and private sectors. For example, Department of Land Transport has location tracking on trucks and public vehicles. Department of Highways has traffic volume on their responsible roads. iTIC owns represented vehicles. Moreover, integrating information has been initiated under NMTIC, Ministry of Transport. Develop transport data efficiently and integrate together is the important approach and solid base for further ITS development. Developing this part should be under “**Informative ITS**” or ITS information wide coverage and reliable.
- Difficulty of ITS implementation is limited budget for operation and maintenance because most organizations focus on infrastructure investment such as road, railway or expressways construction rather than technology implementation for management. However, plan and policy of developing the country and traffic conditions at the present are the opportunity to implement ITS to tackle with the issues and respond to policies especially in the developed area. ITS will demonstrates the benefits of ITS Systems that can support national strategy called “**Assistive ITS**”.
- Apart from budgeting issue, problems are caused by authorities of organizations at present which has no ITS operation as major role. Therefore, budget is secure for their direct responsibility than ITS. Solving the issues should also consider integrating ITS operation within an organization to develop the right environment for IS operations or called “**Integrate ITS**”. This organization is responsible in budgeting ITS installation, maintenance, supporting research and development in ITS, standardization for integrating information and private sector involving encouragement.

According to objectives for ITS Development Master Plan, the strategical plan is as followed.

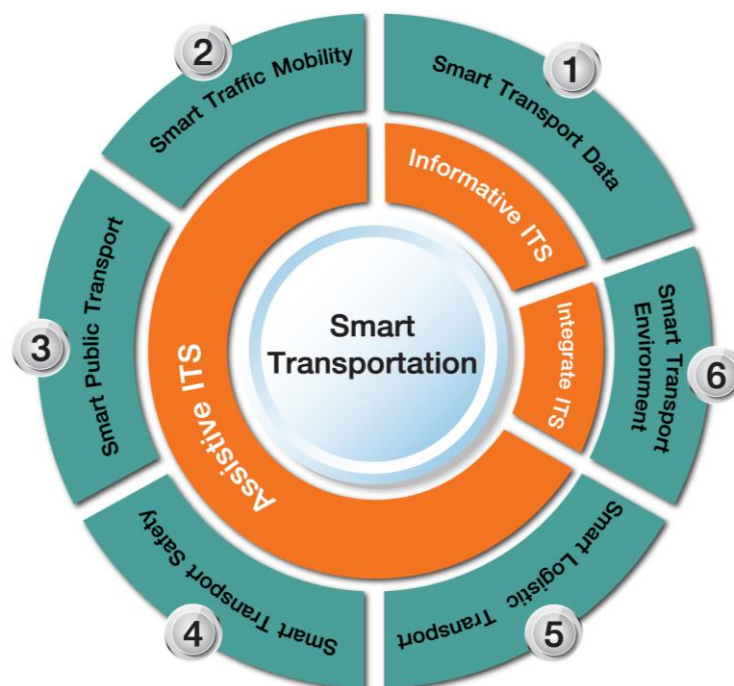


Figure 3.1-1 Connection between objectives and strategical plans

3.1.2 Vision, Mission and Strategy for ITS Development in Thailand

3.1.2.1 Vision, Mission and Conceptual Prospective Development

Vision: “Traffic and Intelligent Transportation System Drive Smart Transportation in Thailand”

Smart Transportation is a hybridization of technologies and transportation system under the concept of Informative, Assistive and Integrated which influence transportation system responding need of people and freight transport.

Mission: “To develop traffic information system and ITS management for transport strategy support aiming Thailand Smart Transport”

Developing traffic information system and ITS management for transport strategy support leads to Thailand Smart Transportation by clarifying development and objectives. Objective is divided into 3 stages, first stage (0-3 years), second stage (4-5 years) and third stage (6-10 years).

Direction of development and objectives are divided as shown in **Table 3.1-1**.

Table 3.1-1 Details of Objectives

<i>Elements</i>	<i>Short Term (3 years) Thailand Informative Transportation</i>	<i>Intermediate term (5 years) Thailand Integrated Transportation</i>	<i>Long term (10 years) Thailand Smart Transportation</i>	<i>Pilot projects area</i>
<i>Existence</i>	Internal country trip is informative and active which is information for trip planning.	Transport in Bangkok Metropolitan Region is integrated with ITS such as toll collection, traffic management and interactive connection between travelers, service providers and infrastructure.	Integrate and interactive system. Transport in major Country of Thailand turns to autonomous era.	-
<i>Intercity trip</i>	- Acquire information collection system on road and GPS information from vehicles. - Traffic offense on ASEAN road	Toll common collection system	Pilot route for Connected & Autonomous Vehicles on highways between big cities	Smart Route (Ladkabung-Laemchabung)
<i>Internal City Trip</i>	Traffic information and common ticket in the city	Traffic control center in the city with autonomous vehicles specific area integration	Autonomous vehicles can travel within the main road of the city.	Bangkok Metropolitan Region
<i>Goods. transport</i>	Digital information of transport goods	Connect goods transport information and developed as Smart Gateway and Smart Terminal.		Smart Route (Ladkabung-Laemchabung)
<i>Public Transport Service</i>	Update law and regulation	Existing MaaS and Sharing Mobility in Bangkok Metropolitan Region	MaaS and Sharing Mobility in the big cities	Bangkok Metropolitan Region
<i>Organization</i>	ITS committee establishment to monitor ITS all over country	Establishing ITS organization of Thailand	ITS organization of region establishment	-
<i>Private Sectors</i>	Initiating ITS operation with support from the government	Liberate the ITS competition	ITS industries and innovations export	-

3.1.2.2 Development Strategies

1) Strategy 1: Smart Transportation Data

The development focuses on traffic information and transportation to be active and integrated for the most benefits as well as considering informative quality for system management and providing information for all.

2) Strategy 2: Smart Traffic Mobility

Solving delay problem is prioritized for internal city and intercity travel with integrated technology within area, automatic cooperation, informative suggested journey and active as well as interactive cooperation between traveler and infrastructures.

3) Strategy 3: Smart Public Transport

Prioritized ITS for encourage decision-making public transport choices both internal and intercity for fully integrated and interactive connectivity between traveler, service provider and infrastructure.

4) Strategy 4: Smart Transport Safety

Focus on traffic and intelligent transport for less number of accidents and fatalities with automatic, for example, Automated Fraud Detection System and Automatic Engine.

5) Strategy 5: Smart Logistic Transport

Prioritize management efficiency and vehicle classifications for worthy transport businesses and good transport with integrated information and automatic management at the connecting point.

6) Strategy 6: Smart Transport Environment

Focus on ITS development, modification and operation for ITS prospective usage.

ITS Development Master Plan is summed up as shown in **Figure 3.1-2**.

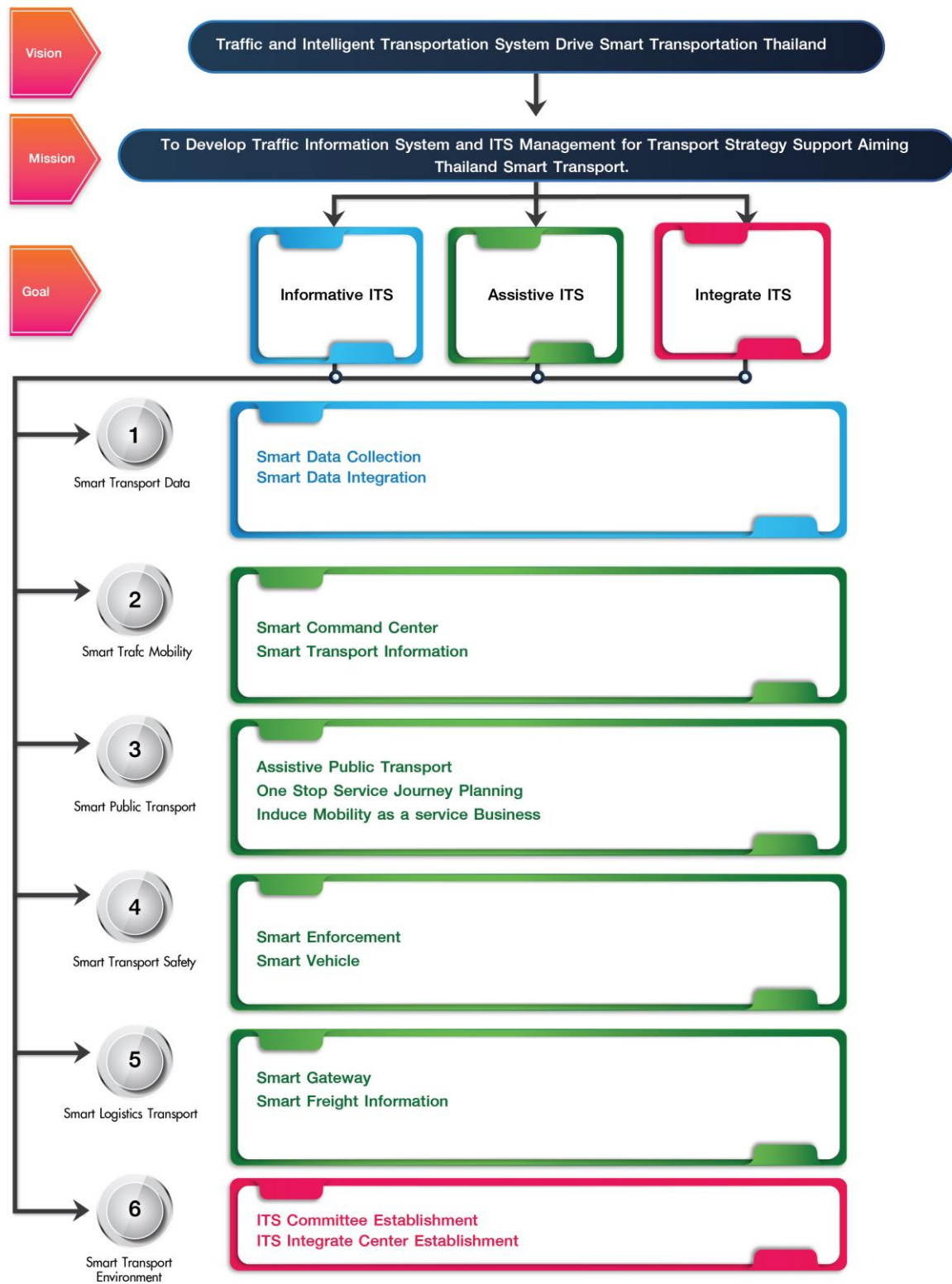


Figure 3.1-2 ITS Development Master Plan for Thailand

Table 3.1-2 Guideline for Master Plan Performance

		Short Term (3 Year)	Middle Term (5 Year)	Long Term 10 Year
Strategy	1	Smart Data Collection		
			Smart Data Integration	
	2	Smart Command Center		
		Smart Transport Information		
	3	Assistive Public Transport		
		One Stop Service Journey Planning		
		Promote Mobility as a Service		
	4	Smart Enforcement		
			Smart Vehicle	
	5	Smart Gateway		
			Smart Freight Information	
	6	ITS Committee Establishment		
		ITS Integrate Center Establishment		

3.1.2.3 Indicators for ITS Development in Thailand

Indicators of Success regards to the study aiming for the study of traffic and transport informatic database establishment to evaluate the competitiveness of the country, national socioeconomic development plan, transport development 20 years plan as well as the new indicators defined as shown in the **Table 3.1-3**.

Table 3.1-3 Indicators of Success

Purpose	Strategy	Goal	Indicators	Current	Target			Agency responsible for information
					3 Year	5 Year	10 Year	
Informative ITS	1	Data Collection	1.1.1 Average distance between traffic counts on ASEAN highways (km)	90	66	50	10	DOH
			1.1.2 Number of truck and Bus data lining to the NMTIC	N/A	100	100	100	DLT
		Disseminate Information	1.2.1 A number of cities have set up centers with a mission to integrate traffic and transport data (city)	None	-	6	12	OTP
			1.2.2 A number of information standard adopted	None	1	3	3	OTP
Assistive ITS	2	Improve Mobility	2.1.1 A number of cities with speeds greater than 28 km / h (city)	N/A	4	6	12	Local Authority
	3	Promotion of public transport	2.2.1 A number of cities with more than 45% using Public transport	N/A	4	6	12	DLT
			2.2.2 Proportion of public transport users traveling between cities (%)	50.28	56	60	70	DLT
	4	Improve Safety	2.3.1 A number of fatal accidents on road network (People / billion vehicles - km)	6.35	2.25	1.91	1.05	DOH/DRR
	5	Improve Freight transport	2.4.1 Transaction time at border checkpoint (minute)	131	126	66	7	Thai Customs
Integrate ITS	6	ITS Committee Establish	3.1.1 ITS Subcommittee is set up specifically under the CMRT	None	set up	set up	set up	CMRT
		ITS Integrate Center establish	3.1.2 A number of cities have set up centers with a mission to operate ITS within the city	None	-	6	12	OTP

3.1.3 Policy Recommendation to Drive ITS Development in Thailand

Driving strategical plan along with the objectives could be done by the main policy and supporting policies as described below.

- Strategy 1: Smart Transport Data
 - Integrated and Published Public Sector's Information Policy
- Strategy 2: Smart Traffic Mobility
 - ITS integrated operation Policy
 - Autonomous Vehicle Support Policy
- Strategy 3: Smart Public Transport
 - Mobility as a Service Policy
- Strategy 4: Smart Transport Safety
 - Autonomous Vehicle Support Policy

- Strategy 5: Smart Freight Transport
 - Autonomous Vehicle Support Policy
- Strategy 6: Smart Transport Environment
 - Organization Development Policy
 - Research Support Policy
 - Public-Private Partnership policy

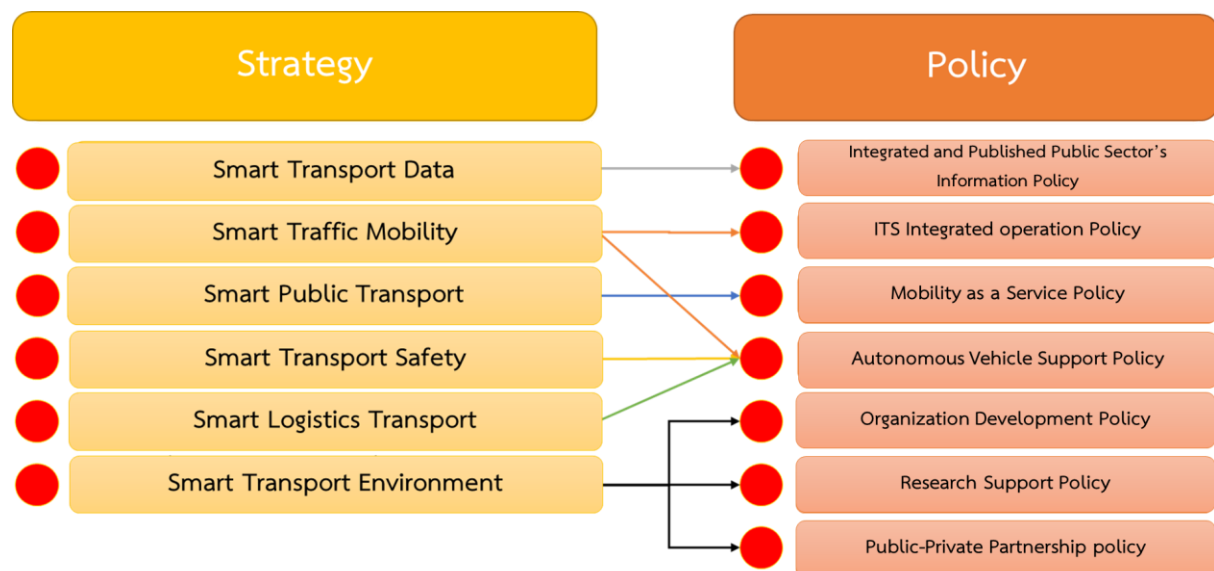


Figure 3.1-3 Strategies and Policies relations

Strategical plan for ITS development in Thailand is driven by 8 policies as summed below.

1. Integrated and Published Public Sector's Information Policy

Objective: To decrease cost of gathering public sector's data and increasing number of transportation business.

Performance Guidelines:

- Support integrated information by NMTIC by ordering departments to connect necessary information with NMTIC.
- Support budget for purchasing or exchanging information between private sectors and state enterprise for better coverage of information.
- Determine NMTIC role as a publishing department as well as sharing with public sectors and private sectors.
- Shift NMTIC operation to the NMTIC to the lately launching ITS center (wherever possible).
- Determine the past information publishing policy for who interested in any fields for example number of vehicles passed might be applied as number of people seeing the advertisement in the area.

Result: Integrate transportation information is more effective management because of the big data and increasing number of transport information service businesses. Thus, traveler can plan the trip effectively.

2. ITS Integrated operation Policy

Objective: To reduce the operational redundancy in ITS which leads to less cost and more efficiency.

Performance Guideline:

- Revise MOU agreement between departments
- Establish committee and working group for ITS development
- Establish ITS center for ITS operation supervision

Result: ITS integration within Bangkok Metropolitan Region

3. Autonomous Vehicle Supporting Policy

Objective: 10-year-objective according to the ITS Development Master Plan is an area for autonomous vehicle pilot project and the compatibility of the autonomous and traditional vehicles in the future.

Performance Guideline:

- Study and revise laws such as allowing autonomous vehicles
- Support autonomous vehicle development researches and maintainance technologies.
- Encourage tax policies by decreasing tax for mechanical parts providing safety.

Result: Readiness of autonomous vehicle application which leads to less number of accidents

4. Mobility as a Service Policy

Objective: To establish Mobility as a Service business model in country especially the large cities and metropolis.

Performance Guideline:

- Revise the limitation of law for example revising public transport requirements.
- Support information according to publishing policies of the government.
- Determine the sequences of the allowance to be clear and focus on reducing time and cost of public service.

Result: This policy results in more options of transport and decreasing number of private vehicle as well as total trip time and less pollution.

5. Organization Development policy

Objective: To focus on ITS projects since initiation, for example, study and development to achieve objectives and continue the project effectively.

Performance Guideline:

- Study for an organization restructure guidance under the Ministry of Transport, each organization should possess ITS and law departments by the Office of the Secretary of the Ministry of Transport.
- Establish an act for organization restructure.
- Control and track the reconstruction.

Result: This policy exactly effect departments involving in traffic and transport to restructure. People who is responsible for ITS, consequently, will achieve ITS development, have a budget for the development and continue the performance efficiently. The ITS development and operation, therefore, will be successful.

6. Research Support Policy

Objective: To solve traffic congestion issues exactly fit with the issue condition, reasons, working condition and solution in foreign countries as well as encourage digital industry in Thailand

Performance Guideline:

- Encourage transport technologies' research institute establishment.
- Standardize ITS investment support.
- Modify the purchase focusing on products.

Result: ITS development for solving traffic and transport condition operates continuously.

7. Public-Private Partnership Policy

Objective: To develop ITS for serving people and transport businesses responsively. The private sector can involve in traffic and transport condition solving, thus, can operate effectively.

Performance Guideline:

- Suggest type of projects that can be Public-Private Partnership.
- Establish regulations and procedures for private sectors selection for licensing, concession and grant of using state properties for ITS projects.

Result: Develop and modify ITS for effective public transport and transport goods which directly affect capability of solving traffic and transport issues and prospective competitiveness of Thailand.

3.2 ITS Masterplan for Bangkok Metropolitan Region

3.2.1 Conceptual Framework for ITS Development in Bangkok Metropolitan Region

According to ITS master plan in Thailand, the focus is traffic and transport improvement with intelligent technologies combined with infrastructures and vehicles. To develop the same direction, therefore, ITS development in districts should integrate intelligent technologies, infrastructures and vehicles within. Bangkok Metropolitan Region should be developed to Smart Metropolis, likewise, others are Smart City.

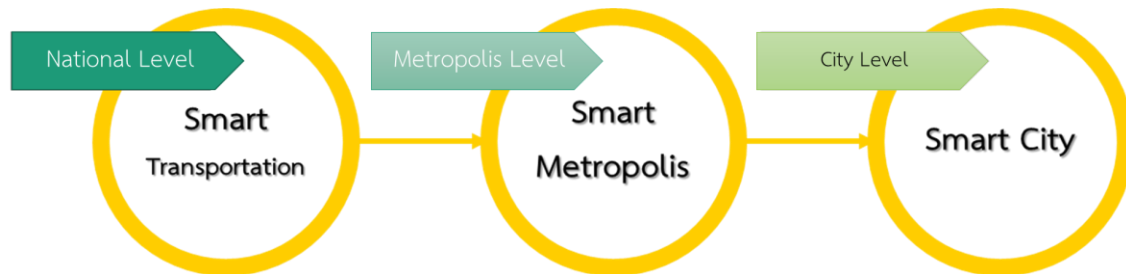


Figure 3.2-1 Concept of ITS development for Smart Metropolis Region

To meet the goals that set by SWOT analysis of the ITS development in Bangkok and the vicinities with the Blue Ocean Strategy in Topic 2.5, we can summarize the guidelines for developing the Master Plan as below.

1. ITS for Green Mobility

Within 3-5 years from now, situation in Bangkok Metropolitan Region is turning to the significant transport infrastructure development especially metro and public bus. This leads to less capacity of traffic within the network because of closing routes for construction. Reducing the severity of the situation is encourages use of public transport and control the use of private cars, therefore, the demand will be compatible with actual capacity.

ITS technologies help managing demand because it can reduce weaknesses of public transport such as waiting time, increasing efficiency of the public transport service and prioritized signal. ITS, furthermore, supports information for the traveler in deciding the most suitable route for the intended destination.

2. ITS Integrate Center

Transportation complicated issues is mostly continuous issues, one solution effects others. The most suitable solution in Bangkok Metropolitan Region, therefore, is ITS deployment and data integration. This can start from integrating separately such as integrating information, safety and public transport then merging all the operation at the center.

3. ITS Assistive Solution

ITS Assistive Solution is the implementation of ITS to build confidence in ITS projected by solve major transportation problems in Bangkok Region.

According to the objectives, the development strategies are determined as shown in Figure 3.2-3.

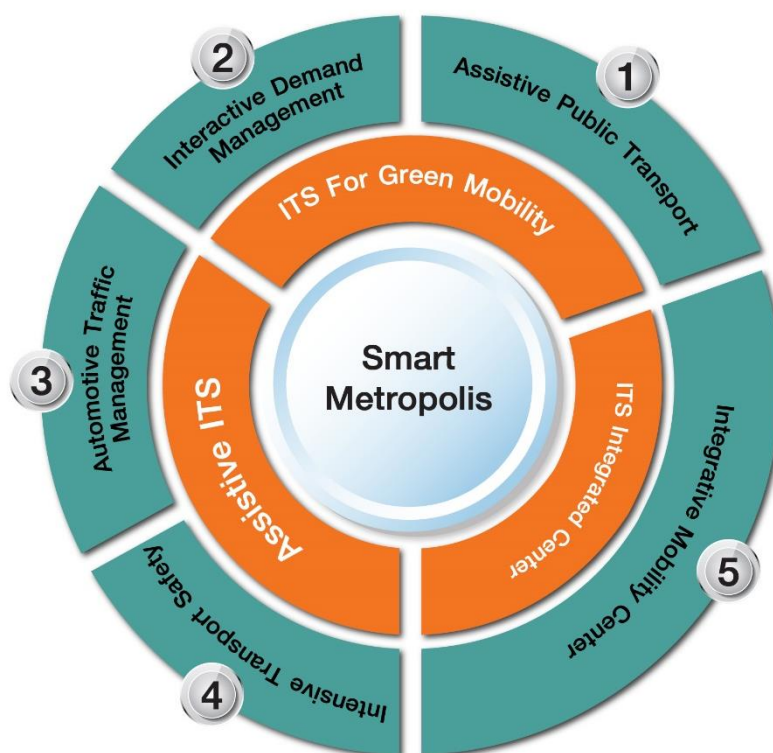


Figure 3.2-2 Relations between objectives and strategies

3.2.2 Vision, Mission and Strategies for ITS Development in Bangkok Metropolitan Region

3.2.2.1 Vision, Mission and Conceptual Prospective Development

Vision: “Intelligent Traffic and Transport to Enhance the Metropolis to Smart Metropolis”

Develop cities by combining infrastructures, traffic and transport system with intelligent technologies for the better resources management at the best efficiency. Missions are determined to serve vision well. Objectives mainly support public transport use, integrating information with operation and ensuring ITS reliability.

Mission: “Developing ITS for Managing Travel Demand to be Balance”

Integrate information and operation as well as ensuring ITS reliability to users for being Smart Metropolis by determining the direction of development.

Development and objectives are divided into 3 phases as shown in Table 3.2-1.

Table 3.2-1 Objective of Master Plan Development Framework in Bangkok Metropolitan Region

Topics	Short term (3 years) Informative Metropolis	Intermediate term (5 years) Integrated Metropolis	Long term (10 years) Smart Metropolis	Pilot project area
Traffic Management	- Gather information system which covers all the area and publishing information for Trip Planning through Traffic Sign and Application. - Install intelligent traffic signal at the main road connecting cities.	- Install intelligent traffic signal all over Ratchadapisek ring road - Control traffic by integrating traffic information and management	- Equipped with TDM system such as Road pricing and parking fee. - Install intelligent traffic signal all over Bangkok Metropolitan.	Ratchadapisek Ring Road
Public Transport	- Develop common ticket for every system. - Gather public bus information and publishing. - Acquire mobility as a service from private sector by regulatory update supporting private sector.	- Have mobility as a service and sharing mobility from public sector - Publishing public bus information through bus stop all over Ratchadapisek Ring Road - Pilot automatic public bus service	- Have fully automatic public bus service provided. - Publish public bus information through bus stop.	Ratchadapisek Ring Road
Transport Safety	- Install public transport tracking for offense prevention - Install devices for offense prevention all over main roads and connecting cities road	Install devices for offense prevention and tracking at Ratchadapisek ring road	Install devices for offense tracking all over Bangkok Metropolitan.	Highway number 1, 2, 3, 4, 7 and 9
Connected & Autonomous Vehicles	Update law and regulation	Initial pilot project for autonomous vehicles around Government Center Commemorating 80th Birthday Anniversary and Phaholyothin Transportation Center	Be readiness for autonomous vehicle around Bangkok Metropolitan.	Government Center Commemorating 80 th Birthday Anniversary and Phaholyothin Transportation Center

3.2.2.2 ITS Development Strategies

Summary of strategies consideration is as shown in **figure 3.2-2**, however, development for public transport encouragement is the main factor which should be done first to alter people's mindset and lifestyle of transportation in Bangkok Metropolitan Region as amending from using private cars to using public transport, increasing trip demand and reducing traffic congestion. Besides, public transport is more ready than other improvements because lower need of infrastructure.

- **Strategy 1: Assistive Public Transport**

Capacity of road in Bangkok Metropolitan Region does not serve actual demand on road, in other words, ratio of public transport users is lower than expectation.

Unbalance ratio of public transport and private car users, partly, results from public transport efficiency does not attract people enough. Therefore, ITS should be developed to improve serviceability or commonly known as IPTS – Intelligent Public Transport System.

- **Strategy 2: Interactive Demand Management**

Traffic and transport condition in Bangkok Metropolitan Region is a consequence of deficient capacity on road and plenty of private car users. Thus, solution according to strategies and ITS is necessary for demand control.

- **Strategy 3: Automotive Traffic Management**

Main objectives or strategic objectives are using ITS technologies for traffic management in Bangkok Metropolitan Region to reduce the severity of traffic congestion as well as world's metropolis by reducing travel time variation, improving overall performance measurement, improving efficiency and facilitating staffs in charge.

- **Strategy 4: Smart Safety Management**

Accident on road network is a major issue and World Health Organization (WHO) has ranked Thailand as the world second most number of accidents, which is considerably severe.

Our behaviors, therefore, has been the main reason behind the accidents. Controlling driver's behavior for safety certainly reduces risk of accidents. Emergency, however, can help reduce fatalities from accidents in an inevitable situation.

- **Strategy 5: Smart Mobility Center**

This strategy is aiming for integrating information and operating ITS for departments in Bangkok Metropolitan Region as a single order. The main objective is ITS center center integrating traffic signal information, promoting safety and public transport for the sake of unity in traffic and transport management.

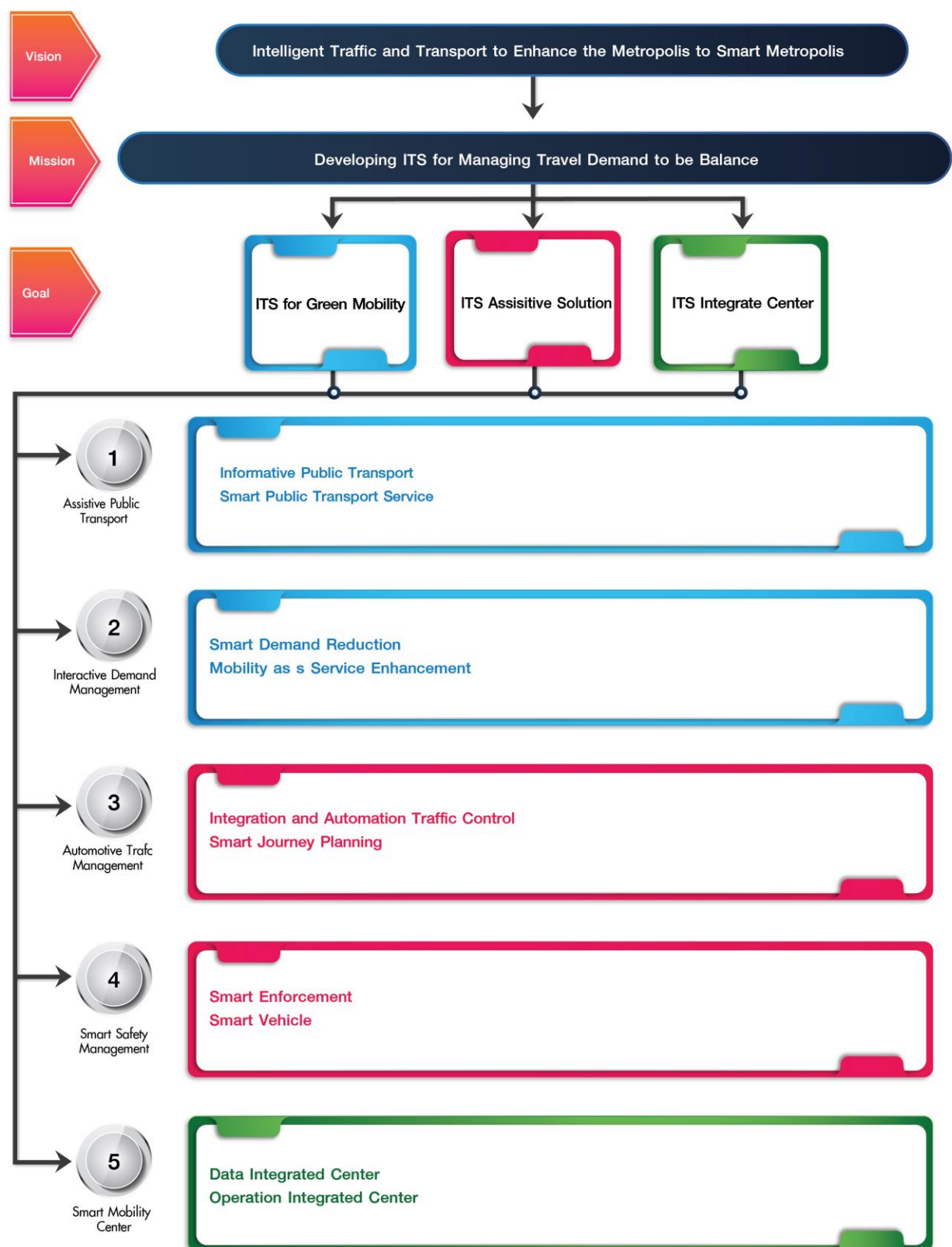


Figure 3.2-3 Strategy of ITS development in Bangkok Metropolitan

Table 3.2-2 Guideline for ITS Development in Bangkok Metropolitan Region

		Short Term (3 Year)	Middle Term (5 Year)	Long Term 10 Year
Strategy	1	Informative Public Transport		
		Smart Public Transport Service		
	2	Smart Demand Reduction		
			Mobility as a Service Enhancement	
	3	Integrated and Automated Traffic Control		
		Informative Journey Planning		
	4	Smart Enforcement		
			Smart Vehicle	
	5	Data Integrated Center		
			Operation Integrated Center	

3.2.2.3 Indicators for ITS Development in Bangkok Metropolitan Region

Success indicators regards to the study of traffic and transport informatic database establishment to evaluate the competitiveness of the country, national socioeconomic strategy plan, transport development 20 years plan and comparison of annual ratio, collaborating with the new indicators that the advisory board has analysed and setted up.

Table 3.2-3 Success Indicators

Purpose	Strategy	Goal	Indicators	Current	Target			Agency responsible for information
					3 Year	5 Year	10 Year	
ITS For Green Mobility	1	Promotion of Public Transport	1.1.1 The proportion of public transport users (%)	32.82	42	45	53	MOT
		Mobility Improvement	1.1.2 Average speed on city streets network during rush hour (km / h)	22.30	28	28	28	OTP
ITS Assistive Solution	4	Safety Increase	2.1.1 Number of road accident (100,000 time)	0.53	0.28	0.24	0.13	Thai RSC
ITS Integrated Center	5	Establishment of an Information Integration Center	3.1.1 ITS Integrate Center authorities have been set up in Bangkok and vicinities	none	-	Set-up	Set-up	OTP
			3.1.2 Percentage of units that link data to center	none	-	60	100	OTP
			3.1.3 Percentage of signal junction controlled and commanded by the center.	none	-	-	100	OTP
			3.1.4 Percentage of Traffic Enforcement Camera connected to the center.	none	-	-	100	OTP

3.2.3 Policy Recommendation to Drive ITS development in Bangkok Metropolitan Region

Driving strategies to their aim can be encourage with supporting strategies as listed.

- Strategy 1: Assistive Public Transport
 - Autonomous Vehicle Support Policy
- Strategy 2: Interactive Demand Management
 - Mobility as a Service Support Policy
- Strategy 3: Automotive Traffic Management
 - ITS integrated operation Policy
- Strategy 4: Smart Safety Management
 - Autonomous Vehicle Support Policy
- Strategy 5: Smart Mobility Center
 - Integrated and Published Public Sector's Information Policy

By the driven guidance as described in **Topic 3.1.3**.

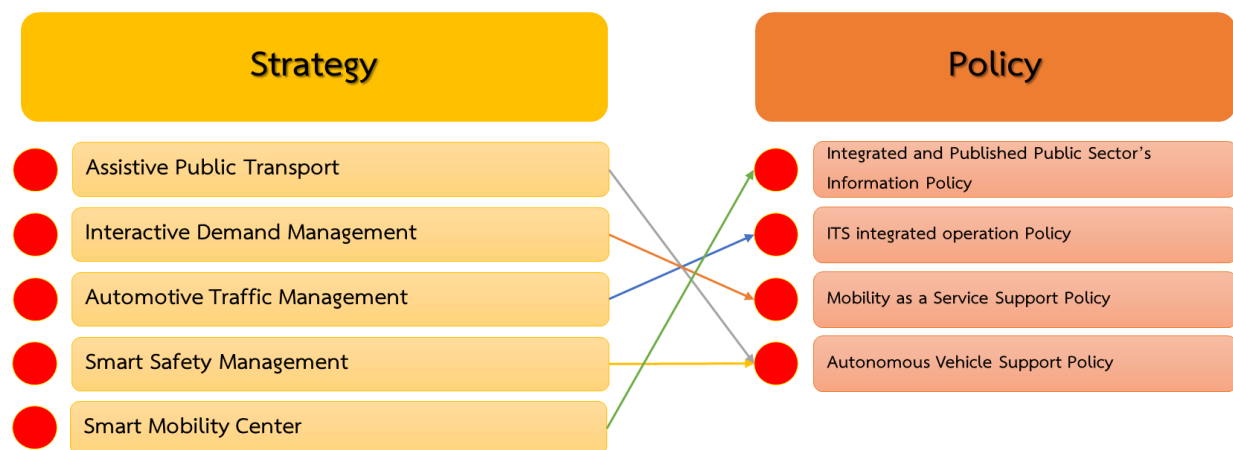


Figure 3.2-4 Relations of Strategies and Policies Summary

3.2.4 ITS Development Projects Plan in Bangkok Metropolitan Region

Projects plan of ITS Development in Bangkok Metropolitan Region is shown in **Table 3.2-4**

Table 3.2-4 Action Plan for ITS Development in Bangkok and Vinicities

Strategy	Tactics	Projects	Responsible Organizations		Short	Intermediate	Long
Strategy 1: Assistive Public Transport	1.1 Encourage information development for trip planning with public transport	Bus information Guidance Project	Office of Transport and Traffic Policy and Planning	Year	2561		
				Budget (Milion baht)	20		
		Standardization for Public Transport Information Project	Office of Transport and Traffic Policy and Planning	Year	2561		
				Budget (Milion baht)	3.5		
		Intelligent Bus stop Project	Bangkok Mass Transit Authority	Year	2562	2564	2568
				Budget (Milion baht)	400	300	1300
		Intelligent Port Project	Marine Department	Year	2562		
				Budget (Milion baht)	40		
	1./ Using ITS for potential public transport services	Common Ticket Development Project	Office of Transport and Traffic Policy and Planning	Year	2561		
				Budget (Milion baht)	576		
		Bus Speed Guidance Project	Bangkok Mass Transit Authority	Year		2565	
				Budget (Milion baht)		260	
		Automatic Public Bus Pilot Project	Department of Land Transport	Year		2564	
				Budget (Milion baht)		60	
Strategy 2: Interactive Demand Management	2.1 Motivate or obstruct for decreasing volume of trips	Automatic Public Bus Project	Department of Land Transport	Year			2566
				Budget (Milion baht)			1300
		Smart School Bus Project	Bangkok Metropolitan Administration	Year		2564	
				Budget (Milion baht)		50	
		Car Sharing Encouragement Project	Department of Land Transport	Year	2561		
				Budget (Milion baht)	8		
	2.2 Encourage multi-modal trips	Demand Responsive Public Transport phase 1 Project	Bangkok Mass Transit Authority	Year		2564	
				Budget (Milion baht)		50	
		Demand Responsive Public transport need phase 2 Project	Bangkok Mass Transit Authority	Year			2566
				Budget (Milion baht)			870
		ITS for Street Parking Management Project	Bangkok Metropolitan Administration	Year		2564	
				Budget (Milion baht)		50	
		Road pricing Project	Bangkok Metropolitan Administration	Year			2567
				Budget (Milion baht)			50
Strategy 3: Automotive Traffic Management	3.1 Develop integrated and automatic traffic management	Signal information exchange Standardization for Bangkok metropolitan Project	Office of Transport and Traffic Policy and Planning	Year	2561		
				Budget (Milion baht)	3.5		
		Integrated Traffic Signal phase 1 Project	Department of Highway, Department of Rural Raod, Local administration	Year	2563		
				Budget (Milion baht)	400		
		VMS for Optimim speed development Project	Department of Highway, Department of Rural Raod	Year	2562		
				Budget (Milion baht)	80		
		Integrated Traffic Signal phase 2 Project	Department of Highway, Department of Rural Raod, Local administration	Year		2564	
				Budget (Milion baht)		650	
	3.2 Develop fully and timely trip planning	Integrated Traffic Signal phase 3 Project	Department of Highway, Department of Rural Raod, Local administration	Year			2566
				Budget (Milion baht)			650
		Multilanes Free Flow Project	Expressway and Rapid Transit Authority of Thailand	Year			2568
				Budget (Milion baht)			260
		Incidents and Accidents information for trip planning Project	Office of the Permanent Secretary, Ministry of Transport	Year	2561		
				Budget (Milion baht)	5		
		Intelligent Shortcut Path Sign Project	Local administration	Year	2561		
				Budget (Milion baht)	524		

Table 3.2-4 Action Plan for ITS development in Bangkok and vicinities (cons.)

Strategy	Tactics	Projects	Responsible Organizations		Short	Intermediate	Long
Strategy 4: Smart Safety Management	4.1 Prevent accidents with ITS	Speed Detection phase 1 Project	Royal Thai Police	Year	2561		
				Budget (Milion baht)	320		
		Red Light Running Detection phase 1 Project	Royal Thai Police	Year	2561		
				Budget (Milion baht)	700		
		Helmet-Wearing Detection phase 1 Project	Royal Thai Police	Year	2562		
				Budget (Milion baht)	338		
		Supervising Public Transport and Truck drivers Project	Department of Land Transport	Year	2561		
				Budget (Milion baht)	400		
		Speed Detection phase 2 Project	Royal Thai Police	Year		2564	
				Budget (Milion baht)		300	
		Red Light Running Detection phase 2 Project	Royal Thai Police	Year		2564	
				Budget (Milion baht)		428	
		Helmet-Wearing Detection phase 2 Project	Royal Thai Police	Year		2564	
				Budget (Milion baht)		352	
		Speed detection phase 3 Project	Royal Thai Police	Year			2566
				Budget (Milion baht)			350
		Red Light Running Detection phase 3 Project	Royal Thai Police	Year			2566
				Budget (Milion baht)			600
		Helmet-Wearing Detection phase 3 Project	Royal Thai Police	Year			2567
				Budget (Milion baht)			300
	Develop to intelligent vehicles	Develop and modify Digital Map for Intelligent Vehicles	Office of the Permanent Secretary, Ministry of Transport	Year	2563		
				Budget (Milion baht)	100		
		Study for Intelligent Vehicles implementation and Vehicle-Infrastructure Information Exchange Standardization Project	Office of Transport and Traffic Policy and Planning	Year	2563		
				Budget (Milion baht)	20		
		Intelligent Vehicles at the pilot area Project	Office of Transport and Traffic Policy and Planning	Year		2564	
				Budget (Milion baht)		40	
Strategy 5: Smart Mobility Center	Update law for establishing ITS center	Gathering Traffic and Transport Information Development Project	Department of Highway, Department of Rural Raod, Expressway and Rapid Transit Authority of Thailand	Year	2561		
				Budget (Milion baht)	355		
		ITS Integrated Center establishment Project	Office of the Permanent Secretary, Ministry of Transport	Year		2565	
				Budget (Milion baht)		450	
	ITS standardization	Traffic Standardization for Integrating Information Project	Office of Transport and Traffic Policy and Planning	Year	2563		
				Budget (Milion baht)	3.5		

3.3 Pilot Projects

Three selected pilot projects corresponding to strategies the ITS Master Plan in Bangkok Metropolitan Region (BMR) include:

- (1) Integration of Miscellaneous Information for Incident and Accident Reports to Travellers
- (2) Evaluation of Traffic Offender Detection Measurement Based on Detection Camera
- (3) Development of Intelligent Traffic Sign together with Alternate Route Introduction.

All three proposed pilot projects can directly indicate current transport problems in BMR consisting of traffic congestion, traffic accidents, and efficiency of public transport services. In addition, these pilot projects correspond to the strategic plans indicated in the short-term (within 3 years). Desirable pilot projects should have potential, use low budget, and can achieve in short-term.

3.3.1 Integration of Miscellaneous Information for Incident and Accident Reports to Travellers

Currently, the Office of the Permanent Secretary for the Ministry of Transport (MOT) has the Thailand Journey Planner (TJP) system providing travel information to the travellers who can add points on the TJP's map for avoiding undesirable roadways due to traffic jams, accidents, traffic incidents, or other causes. All travellers can approach the TJP via website (<http://maps.mot.go.th/tmot/>) and its application via mobile phone.

However, the TJP system imports only information from minor departments of the MOT, namely the Department of Highways, the Department of Rural Roads, and the Expressway Authority of Thailand.

To develop the system to maximize efficiency and make the traveller know information for journey planning, additional information should consist of:

- 1) Broken vehicle information
- 2) Traffic information
- 3) Mass transit information such as train delay reports
- 4) Event information affecting road closure or partial lane closure, such as graduation ceremony, running events, protests, and other activities
- 5) Weather information such as heavy rain and fog (affecting visibility of travellers)
- 6) Natural disasters such as flood.

To get fully information, this pilot project aims to integrate incident and accident data from various sources collected by the Office of the Permanent Secretary of the MOT. This organization is as the coordinator between providing primary information from many agencies and reporting information.

According to the methodology, the Office of the Permanent Secretary of the MOT, who has developed the TJP system, should be the main organization for developing this project. However, the Office of Transport and Traffic Policy and Planning (OTP) via the consultant will propose methodology for the Office of the Permanent Secretary of the MOT to apply. The methodology of this project includes 3 main steps (Integrating, filtering, and reporting information).

(1) Integrating Information

The Office of the Permanent Secretary of the MOT has responsibility to coordinate and collect incident and accident information from many agencies providing those information under the Memorandum of Understanding (MOU). This agreement includes information transmission via internet system based on the Application Programming Interface (API) which can automatically collect from data source. At least, collected information must consist of type of the incidents or accidents, location, and violence or impact of incidents or accidents.

(2) Filtering Information

After the Office of the Permanent Secretary of the MOT can receive incident and accident information from the available sources of data, the Office of the Permanent Secretary of the MOT have to maintain and develop the existing TJP system for supporting more information. In addition, the TJP must filter the data by sorting information types of incidents or accidents, and indicate how data will be displayed as positions or lines. Also, instead of making travellers' own decisions, the TJP should display how it can use those information to select the appropriate route automatically.

(3) Reporting Information

The Office of the Permanent Secretary of the MOT reports information via website and application in order to widely provide standard information to travellers. The Office of the Permanent Secretary of the MOT should specify guidelines for providing information to private sectors developing applications via mobile phones. As a results, they can earn revenue from advertising when travellers open their applications or charging service fee for providing more information.

According to the condition of enabled information, there are 10 agencies providing those information by using API via internet system. Each agency has condition of permission, divided into two conditions.

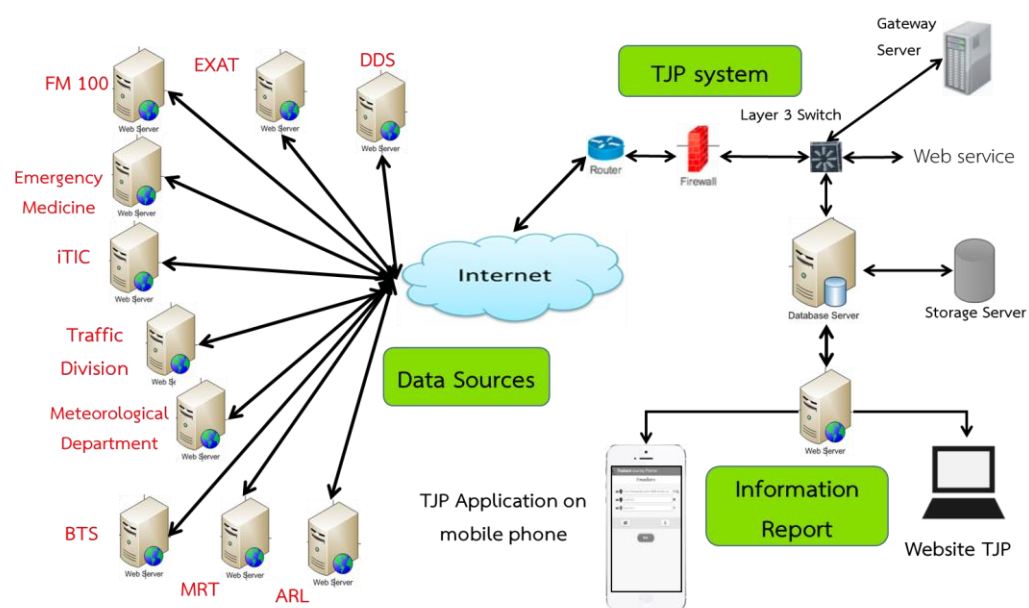
(1) Useful Information Exchange (3 Agencies)

- FM 100 Radio Station (accidents, broken vehicles, and flood)
- National Institute for Emergency Medicine (accidents)
- Thai Intelligent Traffic Information Center Foundation: iTIC (traffic information)

(2) Without Condition (7 Agencies)

- Traffic Division, the Royal Thai Police (events that require road closure or closes lane sections)
- Expressway Authority of Thailand: EXAT (event information affecting road closure)
- BTS (mass transit information)
- MRT (mass transit information)
- ARL (mass transit information)
- Meteorological Department (bad visibility)
- Department of Drainage & Sewerage, Bangkok Metropolitan Administration: DDS (heavy rain and flood)

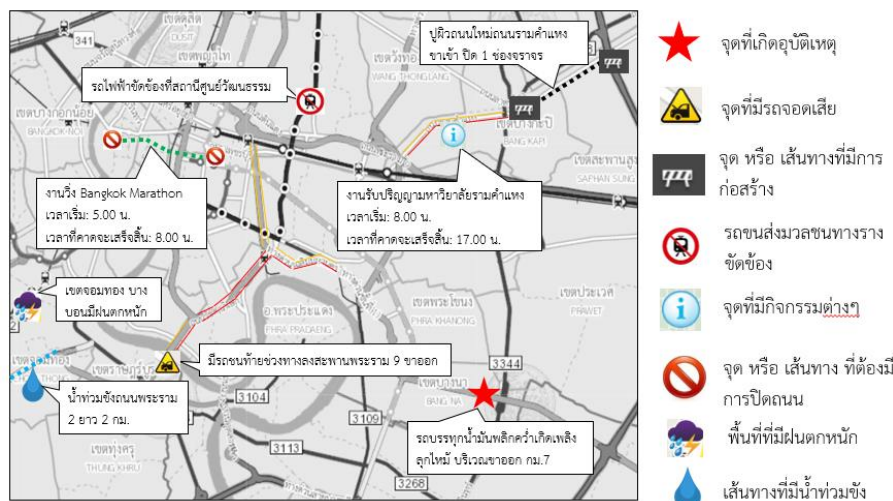
The mechanism of importing, processing, and disseminating information can be divided into 3 parts: information from various sources, TJP system, and information report. Each part can be displayed in **Figure 3.3-1**.



Source: the consultant

Figure 3.3-1 Importing, Processing, and Reporting Information of the TJP

Reporting incident and accident information through the website of TJP or application via mobile phones starts with a symbolic specification of information on the map as shown in an example in **Figure 3.3-2**.



Source: the consultant

Figure 3.3-2 An Example of Map Indicating Incidents and Accidents

After the TJP system has already been developed, travellers using this system can plan the trip properly, because the TJP will be able to avoid positions or paths of usual incidents or accidents, and it will offer to use nearby routes instead.

During the first phase of this project, the Office of the Permanent Secretary of the MOT will be responsible for the preliminary study, until its proposal will be completed in the first 3 months. Then, the Office of the Permanent Secretary of the MOT will have to develop computer server system for screening and disseminating information by hiring the contractor. Then, the system can be utilized in 14 months after the beginning. The estimated project budget is 5,712,037.24 baht.

According from public opinion questionnaires and results, using the ITS Deployment Analysis System (IDAS), It is estimated that users of the system can reduce the travel time by 8.5%, which results in a 2% decrease in road network traffic in Bangkok and its vicinity

3.3.2 Evaluation of Traffic Offender Detection Measure by Using Detection Camera

According to the road accident data on the highway in 2016, 88% of the road accidents occurred from the drivers themselves and those 77% occurred from excessive speed limit¹. For the issue of the severity of the accident, it was found that the most common casualty is motorcyclists as calculated to 75%, and 88% of them were killed because they did not wear the helmet².

Currently, although traffic offender detection cameras were installed for sending traffic tickets to their houses by mails, it is not still widespread, and in each position of detection can detect only one offender such as excessive speed limit or without wearing helmet. Therefore, most drivers still break traffic regulations.

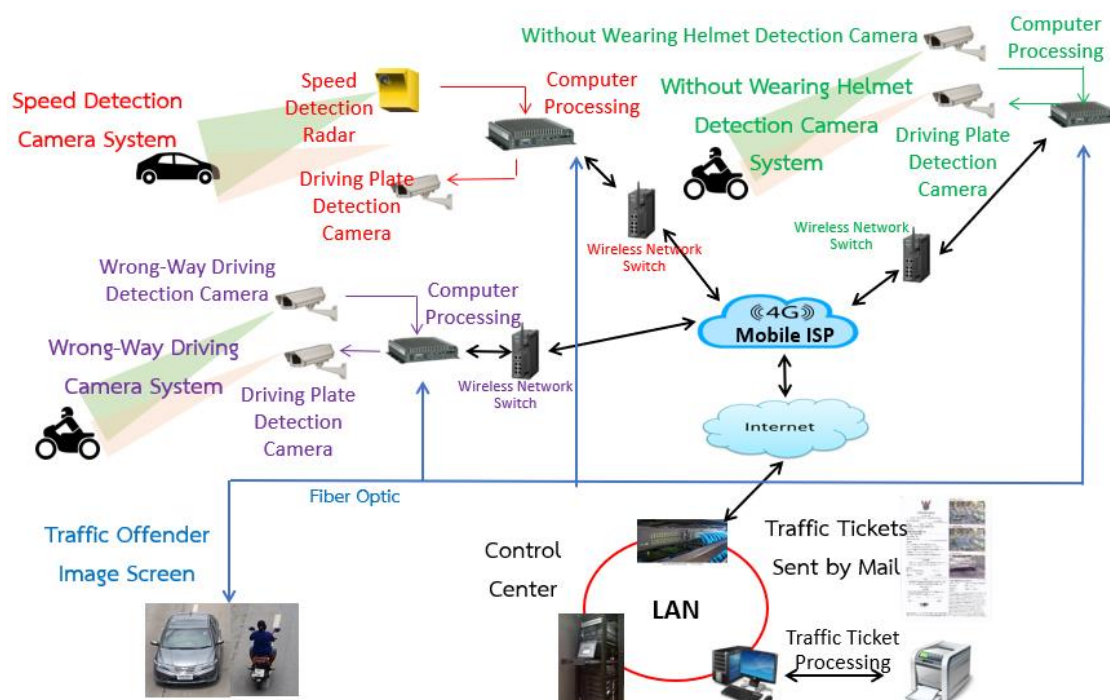
¹ Accident data on the national highways in 2016, Department of Highways

² The project of injury and death data from road accidents of motorcyclists

The purpose of this pilot project is to

- 1) detect traffic offenders using automatic detection cameras
- 2) notify the drivers breaking traffic regulation by image of them
- 3) evaluate the results of the number of offenders and of the accident after using this measure.

The consultant has the idea for real-time warning drivers, who break the traffic regulations in case of excessive speed limit, wrong-way driving, and without wearing helmet, to make the drivers more aware of traffic regulations, not only they have already received traffic tickets. The mechanism of detection system in this project can be shown in **Figure 3.3-3**.



Source: the consultant

Figure 3.3-3 The Mechanism of Automatic Traffic Offender Detection System

Rangsit - Nakorn Nayok section (The National Highway No.305) located in Thanyaburi district, Pathumthani province, will be selected as the study site of this pilot project. This section is in control of the Pathum Thani Highway Police Division, which is the main agency for development of this pilot project. The Office of Transport and Traffic Policy and Planning (OTP) will be the agency that will propose plans and guidelines to the operation of the Highway Police Division to operate the installation of equipment by hiring a contractor, and to detect traffic offenders.

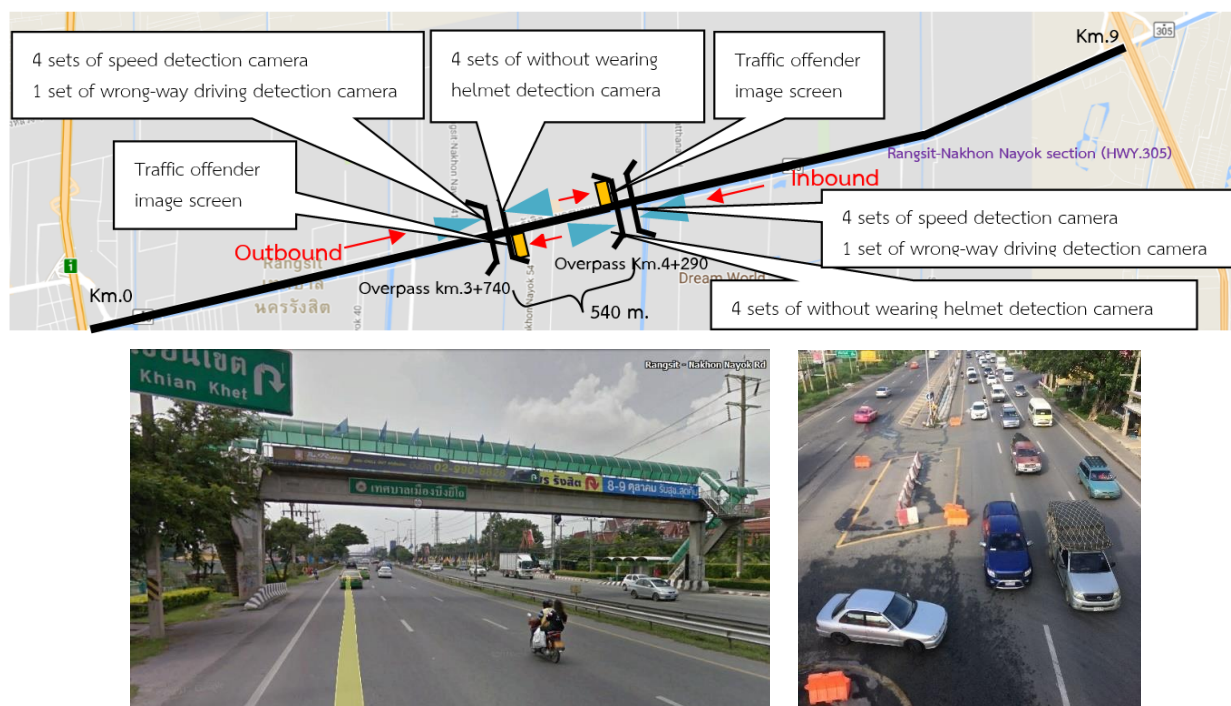
The methodology of this pilot project includes:

- (1) The Pathum Thani Highway Police Division should hire the contractor to install traffic offender detection equipment including one set of a speed detection radar and a driving plate detection camera, one set of wrong-way driving of motorcyclist detection camera and a driving plate detection camera, and one set of without wearing helmet of motorcyclist detection camera and a driving plate detection camera. Each set will be installed in each

lane. In case of image screen, there will be one of it by the size of 3.0 x 3.0 m. in each direction.

- (2) The Pathum Thani Highway Police Division must install equipment following the study site as shown in **Figure 3.3-4**. There are two overpass bridges for pedestrians which is convenient for installation.
- (3) Testing and Advertising

After the contractor has completely installed all equipments. The contractor controlled by the Highways Police Division must test the detection system as accurate and precise level. If the system is still error, the contractor must check the system before the project will fully start. In addition, the Highways Police Division should also announce to the public or drivers before the real detection will start.



Source: the consultant

**Figure 3.3-4 Location of the Detection System and Image Screen Installation (Up),
a Pedestrians' Overpass Bridge for Installation (Left down),
and View from the Overpass Bridge (Right down)**

After the system has been improved and the project has started, the benefits of the project will be evaluated in the first three months and six months of the project. If the results are better change of the driver's behavior by reduced number of accidents, injuries, and death, this pilot project will be considered in success.

During the first phase of the project, the Pathum Thani Highway Police Division will be responsible for the preliminary study in the first 4 months. Then, to summarize the operating guidelines, hire contractor, and install the equipment will finish in 3 months later. After the system trial and improvement, and project announcement, the system can be utilized in 10 months after the beginning. The estimated project budget is 19,806,192.20 Baht.

According to the initial survey on selected road section, most of vehicles are motorcycles as accounted for 33%. Private cars are the second as accounted for 30%. From all vehicles, breaking traffic regulations consist of excessive speed limit driving (20%), without wearing helmet of motorcyclists (45%), wrong-way driving of motorcyclists (30%), and other offences (5%) such as changing traffic lanes on a solid line or overtaking. Therefore, traffic offender detection in this pilot project is suitable for considering excessive speed limit driving, without wearing helmet of motorcyclists, and wrong-way driving of motorcyclists.

3.3.3 Development of Intelligent Traffic Sign with Introducing Alternate Route

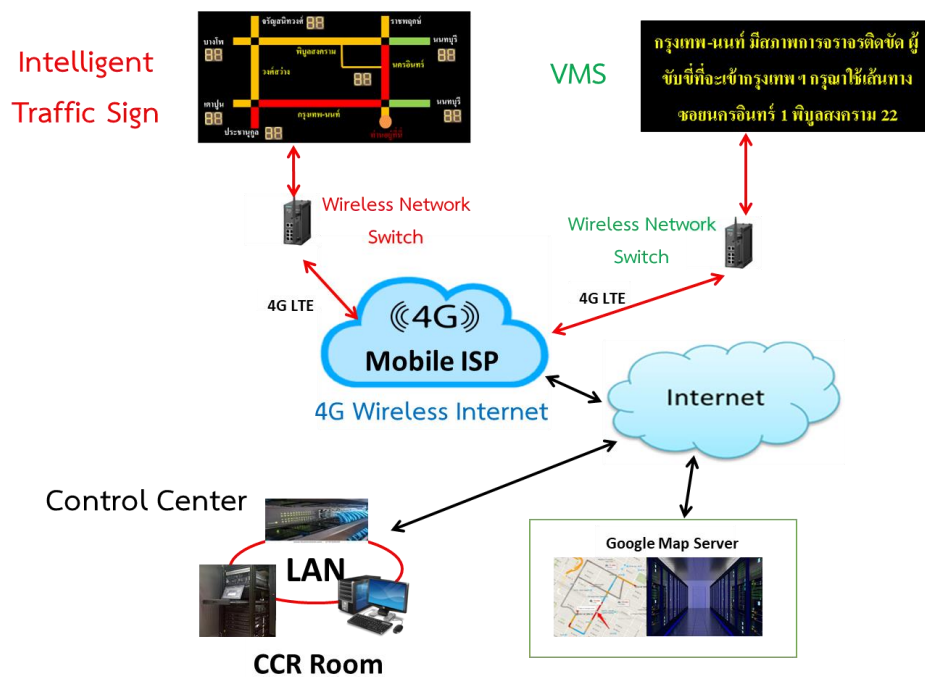
Intelligent traffic signs can provide real-time traffic information to travellers by color lines. Each color line can explain the different level of traffic condition. However, intelligent traffic signs, which can identify how the drivers avoid congested ways, has not been yet introduced. In addition, nowadays, CCTVs, installed near intelligent traffic signs both upstream and downstream directions, are used to identify level of traffic congestion by observation from operators by sight at the control center that may have errors.

Because of the meeting with government agencies and local authorities in several provinces, it was found that Nonthaburi province has necessary to have intelligent traffic sign similar with Bangkok. The new intelligent traffic signs together with the decision to select the alternate route. If the main route has traffic congestion until travel time is greater than the alternate route, the control center will command to the Variable Message Sign (VMS) to report the driver's recommendations to select the alternate route where it can run through another main route faster.

This objective in pilot project is to report traffic information to drivers using intelligent traffic signs by providing the color line and the message for introducing the alternate route. This traffic report is an example of a traffic management method used by intelligent transport system to introduce drivers to select routes to avoid main routes during traffic congestion.

According to the mechanism of this project, traffic information from Google Map Server will be used to report because of lower budget and more accurate than other traffic information sources, such as the installation of traffic sensors, or mobile sensors, which they are installed at each intersection to capture the Wi-Fi or Bluetooth signals from the drivers.

Based on receiving traffic information from Google Map Server, intelligent traffic sign and control center will receive traffic data including speed and color lines from it directly by the 4G wireless internet connection at least every 5 minutes. When the control center receives speed data from both the main route and the alternate route and it was found that the alternate route can take less than the main route, the control system will command the VMS to display the message to the driver to the alternate route.



Source: the consultant

Figure 3.3-5 The Mechanism of the Alternate Route Introduction System by Receiving Traffic Information from Google Map Server

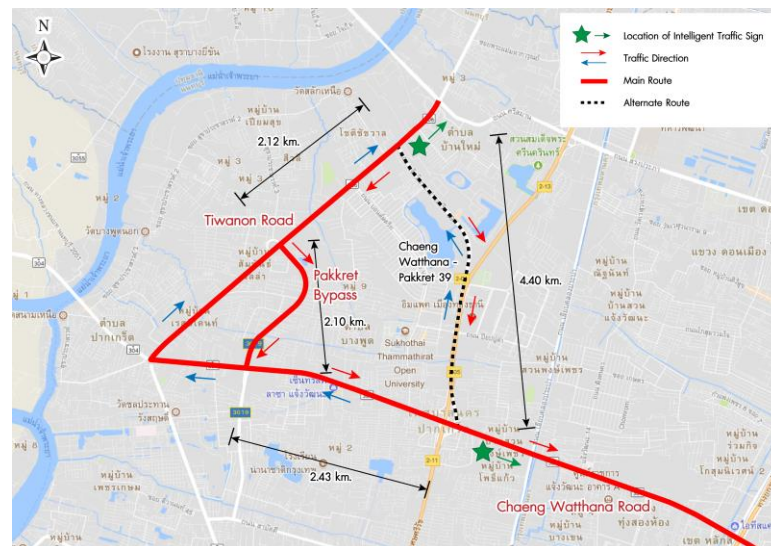
The layout of the intelligent traffic sign for this pilot project. It displays traffic conditions on the road network using color lines, similar with intelligent traffic signs in Bangkok, and the message introducing the alternate route via the VMS, as shown in Figure 3.3-6.



Source: the consultant

Figure 3.3-6 An Example of an Intelligent Traffic Sign Together with VMS for Introducing the Alternate Route

The consultant has selected the Tiwanon and Chaengwattana Road network in Pak Kret District, which is the main route and The Chaengwattana Pakkret 39 as the alternate route. Because of traffic congestion especially in the morning, if the drivers select to use this alternate route, travel time of each vehicle will be fewer than those on the main route. Moreover, in the future, there will be a project to construct the Pink Line subway, which runs through Chaengwattana Road. As a result, traffic condition on this road network will be more congested.



Source: the consultant

Figure 3.3-7 The Main and the Alternate Route of Selected Road Network

During the first phase of the project, the Office of Nonthaburi will be responsible for proposing the plan and hiring contractor within the first 4 months. Then, the contractor will have to install the equipment, test and improve the system before it can be utilized in 8 months after the beginning. The budget for this project is about 5,695,888.20 million baht.

Based on initial survey on selected road network in morning rush hours and public opinion questionnaire, by microscopic traffic simulation model analysis considering the distance traveled and travel time of all vehicles on road network, the results found that speed increases from 36.8 to 41.1 km/h after drivers increase on the alternate route. Therefore, introducing the drivers to use alternate routes can help the traffic system on selected road network has well mobility, and this pilot project is useful and can be implemented immediately.

Chapter 4

ITS Standard

Chapter4

ITS Standard

4.1 Introduction

4.1.1 Definition of ITS standard

“Standard” is an agreement or requirement for common practices with straightforward objectives development, for example, services or products quality control, operation cost control and services or products teamwork facilities.

National Standardization Act has defined “Standard” as requirement of one component or several components.

According to Act of Land Transport Commission¹, Standard is a requirement of symbols, signals and infrastructure about volume, weight and quality. Also, standard prescribes safety of vehicles and equipment that is directly related or affected to land traffic.

ISO, International Organization for Standardization, defines ITS standard as standard of Information Communication and System Control in both urban and rural areas including Mono-modal Transport, Multi-modal Transports, Travel Information, Traffic Management, Public Transport, Commercial Transport, Emergency Service and Commercial Service.

Particularly, ITS standard is not defined as product quality control but encourage ITS and/or devices seamlessly connected. Standard shapes information between hardware and software for cooperation.

4.1.2 Elements of ITS Standard

ITS standard is separated into 2 sections, System Architecture and sub-elements including hardware and software supporting the system to seamlessly cooperate. Standard is primary criteria of each elements as minimum requirements for each element or conditional steps and components of the work which is compatible for all, one size Fit for all. The ITS has the following components:

- Process and types of information for each element
- Connecting information
- Types of messages exchanged between elements
- Elements compatible with service concept
- Definition of information, measurement and communication

¹ Act of Land Transport Commission No. 2 BE 2535
Section 3 In this Act.

"Standard" means the requirements for the size, quantity, weight and quality of markings and structures, as well as safety requirements for vehicles and equipment, as far as relevant or affecting traffic.

- Programs and devices configuration reveal behavior and potential of ITS
- Informatic exchanged or protocol inform information exchanged in ITS

4.1.3 Benefits of ITS Standard

Benefits of ITS standard are listed below ;

- Increasing comfort and safety in travelling
- The more ITS distributor, the better support for public sectors that responsible for ITS standard administration to work more effectively
- Development of ITS innovation
- Facilitate cooperation between departments
- Easier to investigate and evaluate ITS

4.1.4 Conceptual Framework for ITS Standardization in Thailand

ITS Standard is a mediator cooperating between ITS technologies to work effectively. ITS standard in Thailand should be suitable with environment, the current system and future developments. This chapter explains how the standard is constructed as 4 parts, foreign standards revision, Thai standards revision, carefully selected suitable standards and operation standards encouragement as shown in **figure 4.1-1**

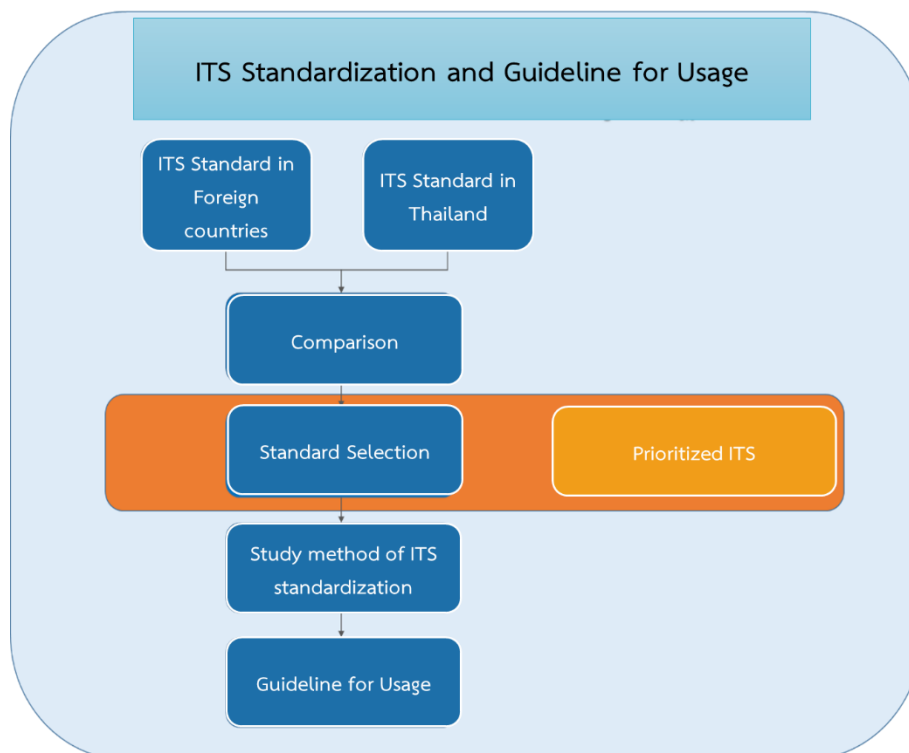


Figure 4.1-1 Working Guideline

4.2 ITS Standard and Usage in Foreign Countries

This section gathers all the related standards of ITS and examples standard usage in foreign countries and Thailand.

4.2.1 ITS Standards in Foreign Countries

In the present, ITS standard is widely used by many organizations, for example, European Committee for Standardization (CEN), International Organization for Standardization (ISO) and European Telecommunications Standards Institute (ETSI) which have significant roles in standard duties. Each sector has developed the standard up to their interests, area problems, or industrial needs. These could be classified into 4 major clusters as listed.

1. Cluster of Information covers gathering, storing, processing, describing and publishing information, for example, traffic condition, public transport, parking, petroleum pricing, weather forecast and traffic forecast.
2. Cluster of Communication, for example, Radio Frequency Identification: RFID, Dedicated Short Range Communication: DSRC, Communications Access for Land Mobiles: CALM, vehicles communication and vehicle-infrastructure communication.
3. Cluster of Devices and connectivity, for example, Standard of Electronic Toll Collection (ETC), On-Board and Roadside Equipment and on pavement surface.
4. Cluster of Processes and operation, for example, traffic light control, emergency response and emigrate, adaptive cruise control, collision emergency and speed control.

The consultants has done the revision of every clusters that has been developing standard. The standard list of each clusters as shown in **Table 4.2-1**.

Table 4.2-1 ITS Standard Summary

Org.	Standards
NTCIP	- Center to Field Communications: C2F - Center to Center: C2C
ISO TC204	- Architecture - ITS Database Technology - Automated Vehicle/Equipment ID: AVI/AEI - Electronic Fee & Toll Collection: EFC/ETC - Fleet, Commercial & Freight Management - Public Transport & Emergency Services - Integrated Transport Info, Management and Control - Traveler Information Systems - Route Guidance and Navigation Systems - Vehicle/Roadway Warning and Control Systems - Wide Area Communication Systems - Nomadic Devices in ITS Systems - Cooperative System ITS
CEN TC278	- Electronic Fee Collection and access control: EFC - Public Transport: PT - Traffic and Traveler Information: TTI - Road Traffic data: RTD - Dedicated Short Range Communication: DSRC - Man-machine Interfaces: MMI - Automatic Vehicle Identification and Automatic Equipment Identification: AVI/AEI - Architecture and Terminology - After Theft Systems for the Recovery of Stolen Vehicles - Safety - Cooperative ITS - Urban ITS
ETSI TC ITS	- Application Requirements and Service - Architecture and Cross Layer - Transport and Networks - Media & Medium Related - Security

4.2.2 ITS Standard in Thailand

After revising ITS related standards in Thailand, the consultant has found that “Specify Standard of Industrial Product: Service Provided and Information Exchanging for Traffic Assessment, definition of Thai Industrial Standard, Service and information exchange for traffic” has been published as part of Ministry Notification 4628-4630 by Thai Industrial Standards Institute and National Electronics and Computer Technology Center (NECTEC).

4.2.3 ITS Standard in Thailand and Foreign Countries Comparison

Considering relation of published ITS standard in Thailand and foreign countries (ISO standard) as 4 clusters, (1) Information, (2) Communication, (3) Devices and Connectivity, and (4) Processes and Operation. Infrastructure and information connectivity in Thailand, however, is under development, some clusters only have requirement for common usage in a project. Details are as shown in **Table 4.2-2**.

Table 4.2-2 ITS standard in Thailand and Foreign Countries Classified by Clusters of Information

Clusters of information	International Standards (ISO)	Thai Standards
Information	- WG1: Architecture - WG3: ITS Database Technology - WG8: Public Transport & Emergency Services - WG10: Traveler Information Systems - WG11: Route guidance and navigation systems - WG18: Cooperative System ITS	- TIS 2604 no. 1 - TIS 2604 no. 2 - TIS 2604 no. 3 - GPS Tracking Service Installation Requirement, Department of Land Transport
Communication	WG16: Wide Area Communication Systems	-
Devices and connectivity	- WG4: AVI/AEI (Automated Vehicle/Equipment ID) - WG5: EFC/ETC (Electronic Fee & Toll Collection) - WG17: Nomadic Devices in ITS Systems	Common Ticket Requirement, The Office of Transport and Traffic Policy and Planning
Processes and operation	- WG7: Fleet, Commercial & Freight Management - WG9: Integrated Transport Info, Management and Control - WG14: Vehicle/ Roadway Warning and Control Systems	-

Source: Consultant

4.3 ITS Standard Selection

Selecting process considers several aspects of the standard such as urgent necessity and concordance with strategic plan. Thus, the selected standard would be useful guideline for Thailand. Constructing process should be cooperate between stakeholders. Establishment of a standard development working group is the most suggested solution to carry out a specific task.

4.3.1 Standard Grouping for Development

According to the foreign countries' standard revision, standard is separated into several concerns. After that, Professionals and stakeholders will help construct the standard as a working group of specialization. This process will benefit as a distinct developed standard and the standard will be useful for all.

There is no official working group who responsible for ITS standard in Thailand. However, It could be grouped as 4 categories, information, process, communication and devices and connectivity as shown in **Table 4.3-1** and the current considering project as discussed in chapter 3.

Table 4.3-1 Projects grouping as 4 categories of ITS

Project Groups	Information	Processes	Communication	Devices and Connectivity
Public Transport Information	✓		✓	
Public Transport Sign	✓		✓	✓
Public Transport Related Application Development	✓	✓		
Signal Control		✓	✓	✓
CTV for Law Enforcement	✓			✓
Traffic Information	✓			✓
Traffic Sign System	✓		✓	✓
Parking Management		✓		✓
Ticketing Improvement	✓	✓	✓	✓
Toll Collecting System		✓		✓
Parking Information	✓		✓	
Map Improvement	✓			
Connected & Autonomous Vehicle			✓	✓

Regarding to projects grouping, we have classified standard operating group to work as 6 standard working groups in accordance with stakeholders, public sectors and private sectors as shown in Table 4.3-2.

1. **Public Transport** – group of public transport information such as bus, metro, are responsible for providing travelling information for public users.
2. **Controller and Traffic Management** – group of traffic, signal and related information management, including exchanging information between traffic control center
3. **Toll Collection** – group of toll collection which covers both devices and communication of automatic toll collection
4. **Parking Information** – group of service and exchanged parking information, for example, parking place and number of parking
5. **Mapping** – group of service and mapping information development
6. **Intelligent Automobile** – group of vehicles structure, automatic vehicles, communication between vehicles.

Table 4.3-2 Standard Grouping and Stakeholders

Projects Grouping	Standard Clusters	Standard Grouping	Stakeholders
Public Transport Information	Information/Process/Communication/Devices and Connectivity	Public Transport Information	- Office of the Permanent Secretary, Ministry of Transport - Department of Land Transport - State Railway of Thailand - Bangkok Mass Transit Authority - Mass Rapid Transit Authority of Thailand - Private Sectors, Bus Services - Private Sectors, Vehicle Tracking - Private Sectors, Application Development
Public Transport Sign			
Public Transport Related Application Development			
Signal Control	Information/Process/Communication/Devices and Connectivity	Control and Traffic Management	- Thai Traffic Police - Department of Highways - Department of Rural Roads - Traffic Policy and Transport Office, Bangkok Metropolitan Administration - Private Sectors
CTV for Law Enforcement			
Traffic Information			
Traffic Sign System			
Ticketing Improvement	Information/Process/Communication/Devices and Connectivity	Toll Collection	- Department of Highways - State Railway of Thailand - Bangkok Mass Transit Authority - Expressway Authority of Thailand - Mass Rapid Transit Authority of Thailand - Traffic Policy and Transport Office, Bangkok Metropolitan Administration
Parking Management			
Toll Collecting System			
Parking Information	Information/Communication	Parking	- Office of the Permanent Secretary, Ministry of Transport - Private Sectors

Table 4.3-2 Standard Grouping and Stakeholders (Cons.)

Projects Grouping	Standard Clusters	Standard Grouping	Stakeholders
Map Improvement	Information	Mapping	- Office of the Permanent Secretary, Ministry of Transport - Department of Public Works and Town Planning - Department of Highways - Department of Rural Roads - Private Sectors
Connected & Autonomous Vehicle	Communication/Devices and Connectivity	Intelligent Automobile	- Department of Highways - Department of Rural Roads - Traffic Policy and Transport Office, Bangkok Metropolitan Administration - Private Sectors

4.3.2 ITS Selection Process for Standardization

ITS Selection process considers from standard working group to examine the key and urgent group. Firstly, several effects and concerns are prioritized. Then, Analytic Hierarchy Process (AHP) is applied to decide the most suitable standard.

List of specialists from public sector evaluation, private sectors evaluation and ITS specialists.

Table 4.3-3 Specialists who weigh and select standard working group

ORDER	NAME	POSITION	ORGANIZATION
1.	Ms. Amporn Chatbusayamas	Director of Transport and Traffic Information Technology Center	Ministry of Transport (MOT)
2.	Mr. Luksanawadee Tanamee	Director of Transport and Traffic Information Technology Center	Office of Transport and Traffic Policy and Planning (OTP)
3.	Assoc. Prof. Sorawit Narupiti	President of ITS Association Thailand	ITS Association Thailand
4.	Mr. Wasan Pattaraatikom	Senior Researcher, ITS Laboratory	National Electronics and Computer Technology Center (NECTEC)
5.	Mr. Surajit Wanpae	Senior Standards Academician	Thai Industrial Standards Institute (TISI)
6.	Dr. Nachai Kulhintung	Senior Telecommunication Engineer	Ministry of Digital Economy and Society
7.	Dr. Kunchit Phiu-Nual	Project Director	Consultants
8.	Assoc. Prof. Supornchai Utainarumol	Traffic and transport specialist	Consultants
9.	Assoc. Prof. Ampol Karoonsoontawong	Traffic and transport specialist	Consultants
10.	Dr. Rerkchai Fooprateepsiri	Intelligent Transport and Traffic Specialist	Consultants
11.	Dr. Pattara Kiatisevi	General Manager	Metamedia Technology Co., Ltd
12.	Dr. Passakon Prathombutr	Director of Innovation Management Program	National Science and Technology Development Agency (NSTDA)

After interviewing aforementioned specialists and analyzing data with AHP procedure, we obtain each elements' decision by calculating weight according to dimensions and mode of transportation as shown in Table 4.3-4.

Table 4.3-4 Summary of factors' weight and standard working group

Standard Working Group Selection	Factors	Weight	Standard Group	Weight
	Urgency (A)	0.36	Public Transport Information (1)	0.30
			Control and Traffic Management (2)	0.30
			Toll Collection (3)	0.10
			Parking (4)	0.06
			Mapping (5)	0.15
			Intelligent Automobile (6)	0.09
	Compliance with the development strategy (B)	0.09	Public Transport Information (1)	0.40
			Control and Traffic Management (2)	0.20
			Toll Collection (3)	0.11
			Parking (4)	0.06
			Mapping (5)	0.12
			Intelligent Automobile (6)	0.12
	Benefits of ITS Standardization (C)	0.54	Public Transport Information (1)	0.32
			Control and Traffic Management (2)	0.19
			Toll Collection (3)	0.14
			Parking (4)	0.06
			Mapping (5)	0.19
			Intelligent Automobile (6)	0.10

It is noticeable that “Benefits of ITS Standardization” weights the most (0.54), following by “concordance with Development Strategies” (0.36) and “Urgent of each standard working group” (0.09) because of distinct advantages from external operation and ITS development in Thailand.

And according to **Table 4.3-5**, it is clearly seen that Transport Information factor weights the most as 0.32 which means public transport has the largest impact from this standardization.

Table 4.3-5 Average weight of standard group

Rank	Standard Working Group	Average Weight
1	Public Transport	0.32
2	Controller and Traffic Management	0.23
3	Toll Collection	0.12
4	Parking Information	0.06
5	Mapping	0.17
6	Intelligent Automobile	0.10

4.3.3 Concordance with Strategic Plan of ITS Development Master Plan

Revisions has revealed that standard would benefit exchanging and publishing Traffic Conditions which align with Strategic Master Plan for Traffic and Transport Systems in the Short Term (3 years), ITS for Informative Metropolis focusing on traffic information system development, improving accuracy and practicality.

Moreover, it also aligns with Strategy 1 of the Master Plan for the Development of Intelligent Traffic and Transportation Systems in Thailand, Smart Transportation Data and Strategy 1 and 5 of the Master Plan for the Development of Intelligent Traffic and Transportation Systems in Bangkok Metropolitan Area, Assistive Public Transport and Integrative Mobility Center.

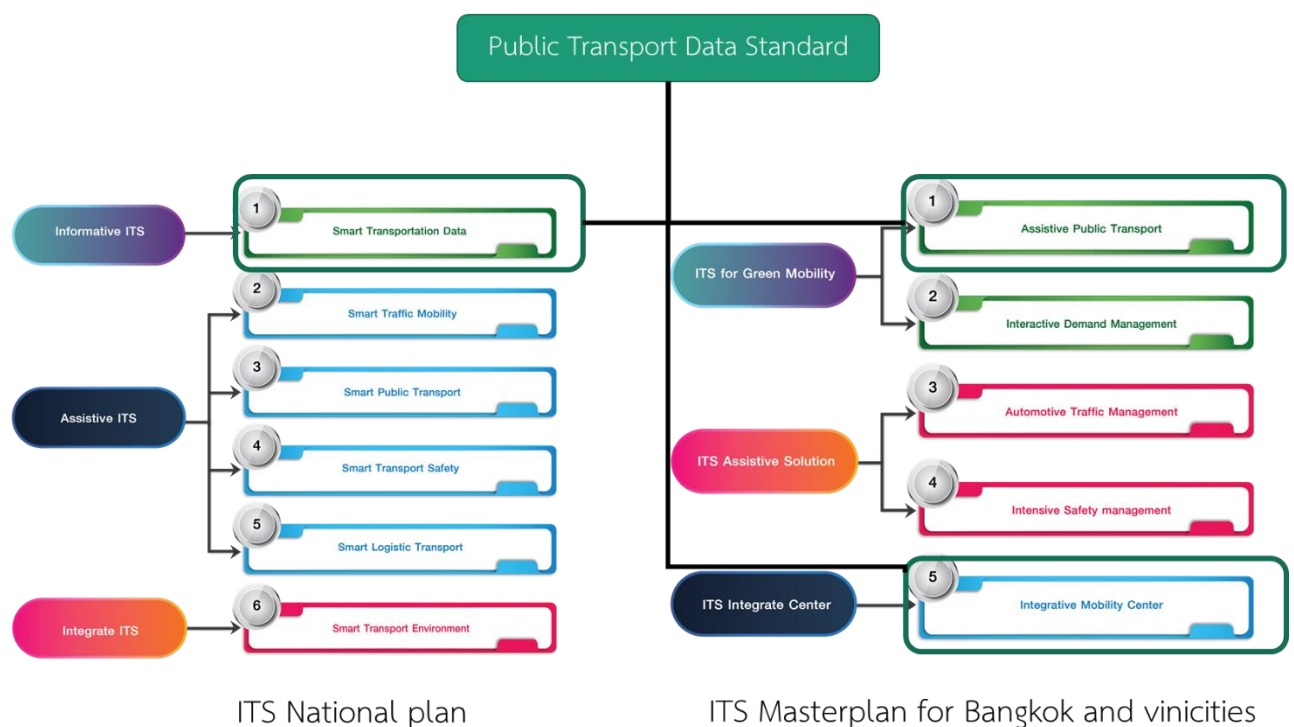


Figure 4.3-1 Concordance with the ITS Development Strategy

4.4 Comparative Study of the Requirements and Standards in Foreign Countries

This part covers comparative study of the requirements of standard usage, operation and optional procedure in foreign countries and study of the most suitable standard operational procedure of ITS public transport information for Thailand. These lead to the better practices and analysis of the suggested standard.

4.4.1 The Suitable ITS Approach for Thailand

ITS standard has been promulgated in several countries as shown in **Table 4.4-1**. Thailand has been part of ASEAN countries and ASEAN has its own ITS Policy Framework version 2 (2017) for planning, operation and prioritization. Thus, ASEAN's various ITS projects will be harmonic. ITS standard policy has suggested open standards or international standard for technologies, system and other parts to work smoothly but there is no specific requirement for international ITS standard.

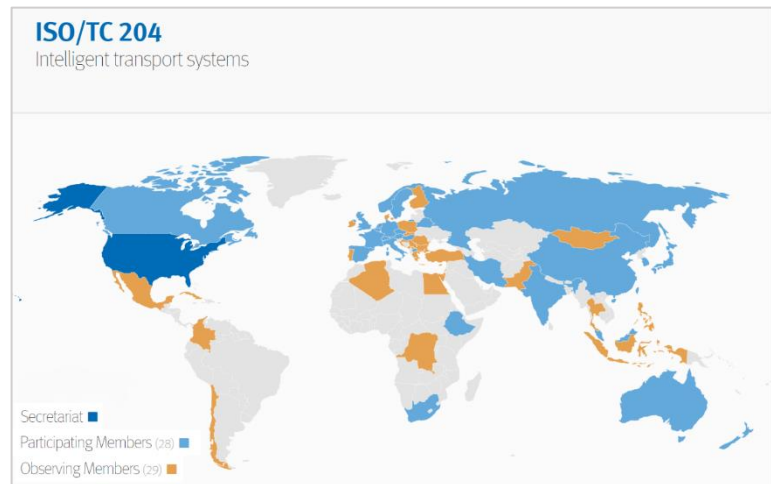
Table 4.4-1 National and International Standardization Department

Standard levels	USA	Europe	Japan	Korea	China	ASEAN
National	- American National Standards Institute (ANSI) - Institute of Electrical and Electronics Engineers (IEEE) - American Association of State Highway and Transportation Officials (AASHTO) - American Society for Testing and Material (ASTM) - National Electrical Manufacturers Association (NEMA) - Society of Automotive Engineer (SAE) - National Transportation Communications for ITS Protocol (NTCIP) - Telecommunications Industry Association (TIA)	- European Committee for Standardization (CEN) - European Committee for Electrotechnical Standardization (CENELEC) - European Telecommunications Standards Institute (ETSI)	Japanese Industrial Standards Committee (JISC)	Korean Agency for Technology and Standards (KATS)	Standardization Administration of China (SAC)	N/A*
International	International Organization for Standardization (ISO)					

Remarks: No enforcement

Source: Consultant

Developed countries have their own ITS standard and some have developed international standard for common use as ISO/TC 204. USA has been leading working group 16 (ISO/TC 204 WG16 Cooperative ITS) which mainly responsible for communication system and Japan has been leading working group 3 (ISO/TC 204 WG 3 ITS Database Technology) which responsible for mapping and database. ISO/TC 204 is ITS standard that has 57-member countries, 28 countries are participating members and 29 countries are observing countries. ANSI is the secretariat of the standard and Thailand is an observing country. Details are shown in **figure 4.4-1**.



Source: www.iso.org

Figure 4.4-1 country members of ISO/TC 204 Intelligent Transport Systems

Guideline for Thailand standardization that suites Thailand the most is ITS/TC 204 because of its fairness and international recognition. Standardization should refer the developer's technologies. Using international standard is easier in operation and has better efficiency because international standard is constructed by several countries to be common use between countries in the future. Standard under control of ISO/TC 204 that attracts Thailand the most is standard for connectivity and exchanging information. Reasons are listed below.

- 1) Thailand operations are completely separated. Information format and usage are various and unconnected.
- 2) Thailand has been developing software and data analyzing for a long period of time with potential people and technologies for a proactive role in data standards and information exchange.
- 3) Possibility that big data raises its preciseness and variation. Thus, there would be more information.
- 4) Thailand cannot produce advanced technologies, for example, automotive, rail track system and electronics. Currently, Thailand's production is partly manufacturing for world-wide companies which may lack the readiness to target this standard as proactive manner.

4.5 ITS Standardization and Thailand's Practical Usage Guideline

This part demonstrates operation process or procedure, including standard planning, promulgated promoting and usage guideline.

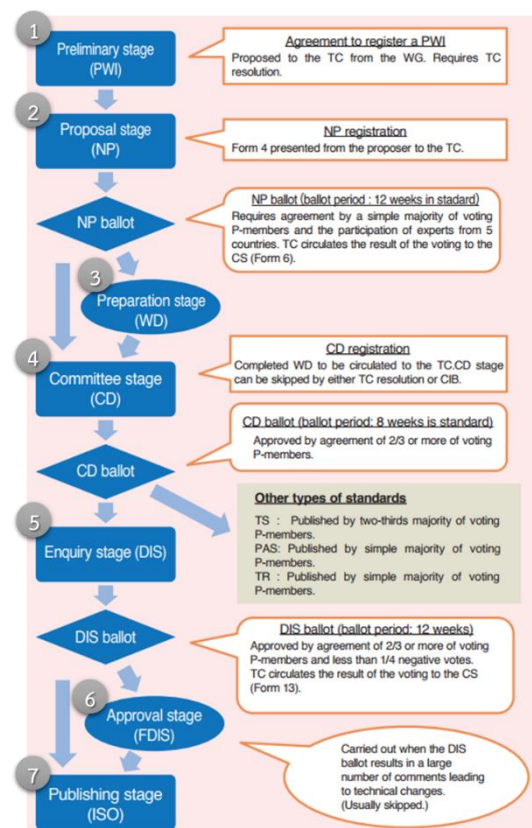
4.5.1 Study of Standardization Process

This part is process and procedure study to promote approved standard and promulgate in Thailand and foreign countries.

4.5.1.1 Standardization Procedure in Foreign Countries

The consultants would like to present International Organization for Standardization (ISO) as ITS standardization in foreign countries. ISO procedure has 7 stages as shown in **figure 4.5-1**.

1. **Preliminary Stage** - Standard developers propose interested topic as Preliminary Work Item to Technical Committee (TC).
2. **Proposal Stage** - Propose New Work Item Proposal (NP) to Ballot and vote
3. **Preparatory Stage** - Common drafting standard process on working group. When the proposal has passed, it enters the preparation stage
4. **Committee Stage** - The procedure for submitting a standard draft to the ISO Board for the recommendation of P- member is considered a draft international standard.
5. **Enquiry Stage** - Process after the circular drafted standard for ISO and receive feedback within 5 months period. A Final Draft International Standard (FDIS) is considered.
6. **Approval Stage** - Within 2 months, if there is no adjustment or member's comment, DIS documents could be established.
7. **Publication Stage** - ISO recommends revision and adjustment every 5 years for revising established standard called Systematic Review Ballot (SR Ballot). The result could be adjustment needed, remaining the same or revoking the standard.

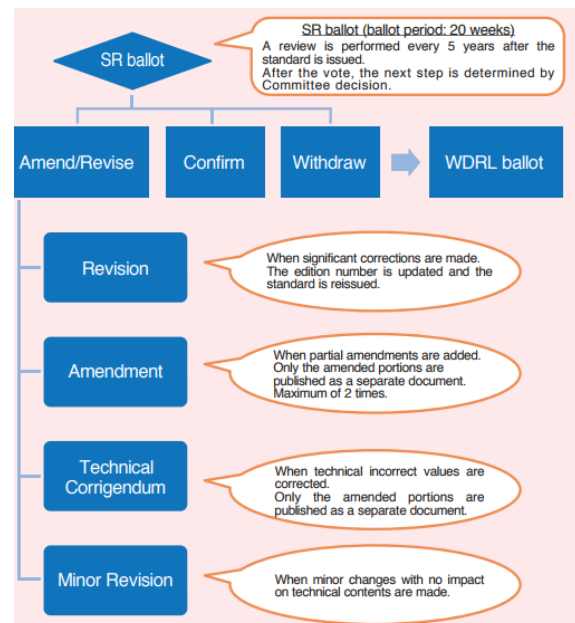


Source: www.iso.org

Figure 4.5-1 ISO Standardization Procedure

After standard promulgation, if correctness or improvement are necessary with Systematic Review Ballot (SR Ballot) approval, the changes could be done after promulgation in 4 classifications.

- 1) Revision - Changing main content of the standard should be published as a new consequent number of standard.
- 2) Amendment - Adding some content without editing the former, the supplement will be published as separated document. Amendment is allowed only 2 times.
- 3) Technical Corrigendum - When correcting is necessary for technical number such as length, height and frequency, the changes will be published separately.
- 4) Minor Revision - minor changes that does not affect technical terms



Source: www.iso.org

Figure 4.5-2 ISO Standard Amendment

4.5.1.2 Standardization Procedures in Thailand

Standardization ITS in Thailand could be done according to Act of Commission for the Management of Road Traffic and announcement from Ministry of Industry. It has stated the procedure and responsible department as described below.

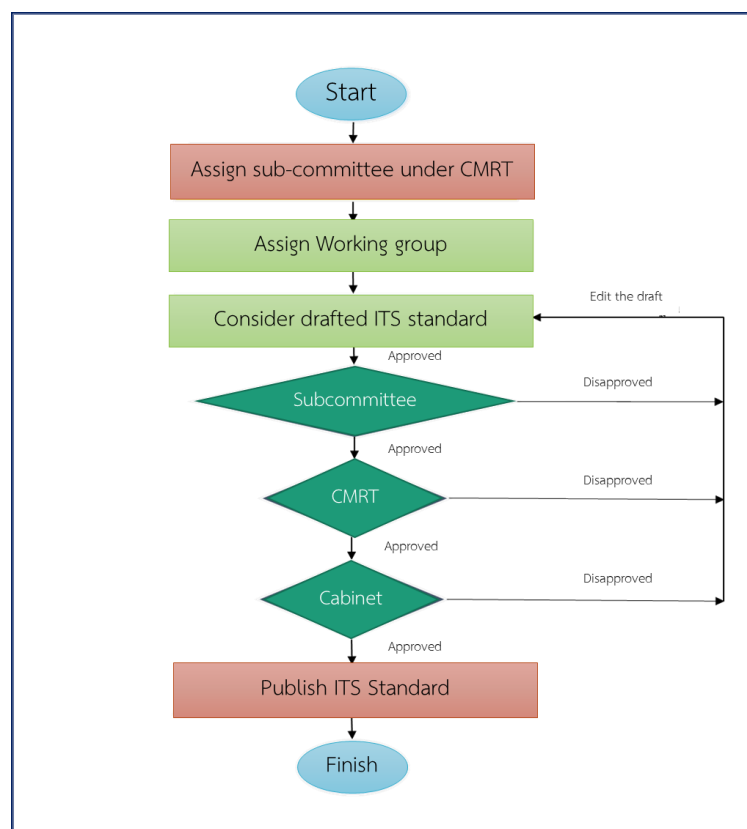
1. Standard promulgation by Commission for the Management of Road Traffic

Standard promulgation by Commission for the Management of Road Traffic who responsible for ITS could be done under Commission for the Management of Road Traffic of Ministry of Transport. The common promulgation is according to Road Traffic Act, B.E. 2522 under section 5: The Commission shall have the power to: (3) establish standards for the organization of land traffic systems, submit them to the Council of Ministers; (4) establish measures for the resolution of land traffic problems and accelerate the performance of relevant agencies and coordinate actions in accordance with measures, policy and master plan.

Moreover, under section 10, The Office of Transport and Traffic Policy and Planning shall be established under the Ministry of Transport and responsible for (1) study, survey and analyze land traffic condition for proposing policy, defining standards for traffic management as well as traffic congestion measurement for board's consideration.

In standardization process, The Office of Transport and Traffic Policy and Planning should **draft the notification of the commission for land administration** and state the considered standard. Sign standard, for example, have been done in the past. The procedure is described below.

1. Commission for the Management of Road Traffic appoints Sub-committee for standard consideration.
2. Sub-committee considers standardization by new working group establishment for drafting and editing standard, then, proposes to Commission for the Management of Road Traffic for approval.
3. Commission for the Management of Road Traffic proposes drafted standard to The Secretariat of the Cabinet and the Cabinet for approval from Council of State.
4. The Secretariat of the Cabinet sends draft to Commission for the Management of Road Traffic for signature
5. Commission for the Management of Road Traffic send to the Secretariat of the Cabinet to publish in the Government Gazette.



Source: Meeting Documents

Figure 4.5-3 Standardization by Commission for the Management of Road Traffic

If the standard was not approved by Commission for the Management of Road Traffic, Office of the Council of State, Secretariat of the Cabinet or the Cabinet, partly or wholly, Sub-committee would edit the standard and present to Land Traffic Management Commission as shown in figure 4.5-3.

2. Standard Promulgation by Office of Industrial Product Standards

Office of Industrial Product Standards is responsible for standardization in Thailand and international cooperation for defining common standard such as ISO. Standardization by Office of Industrial Product Standards could be classified into 2 types.

1. International Standard Acceptance, Modification and Drafting

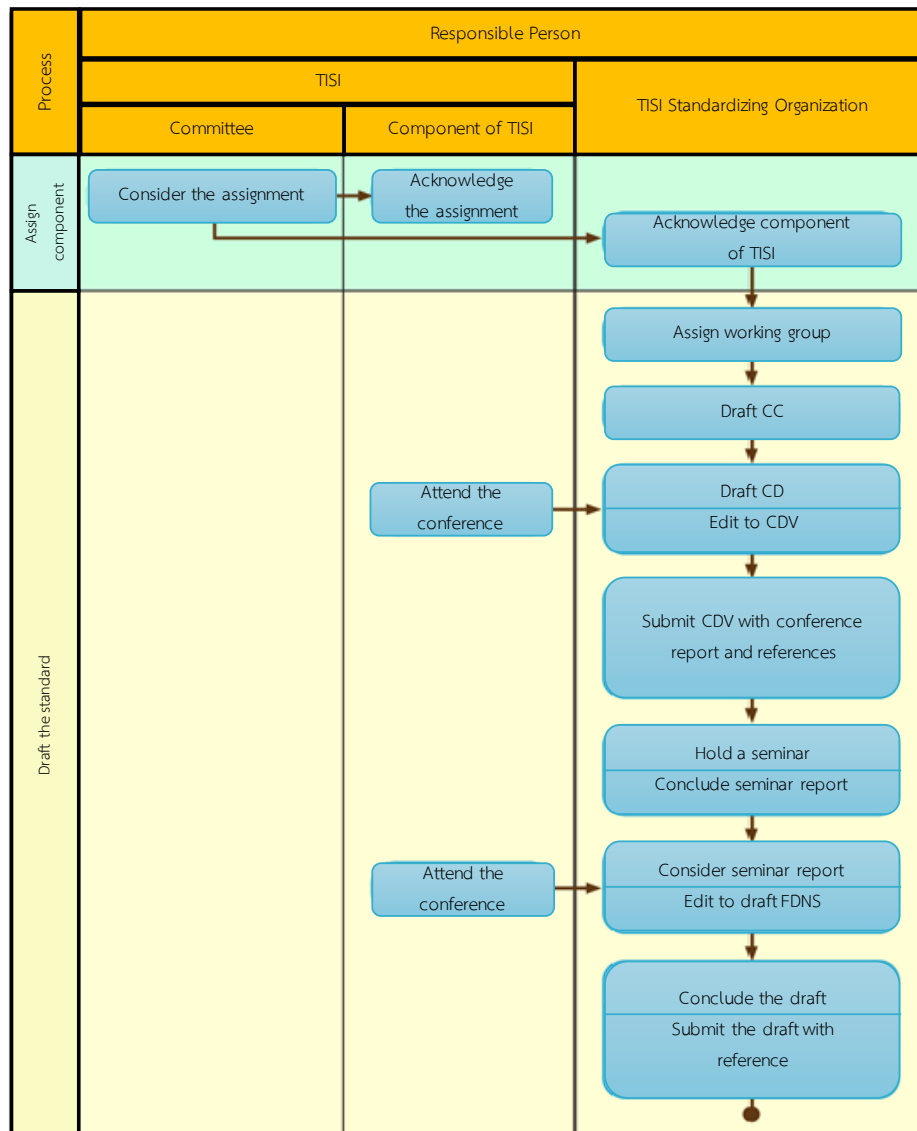
Follow the published international standard and translate cover into Thai, specify important information such as standard name, standard international referable number, introduction, scope and defined words but the main content is still in English.

2. Drafting Standard

Drafting standard requires the new committee to design and draft the new standard. ITS standard was announced by Thai Industrial Standards Institute which is Thai Industrial Standard 2604 to service and exchange information for traffic.

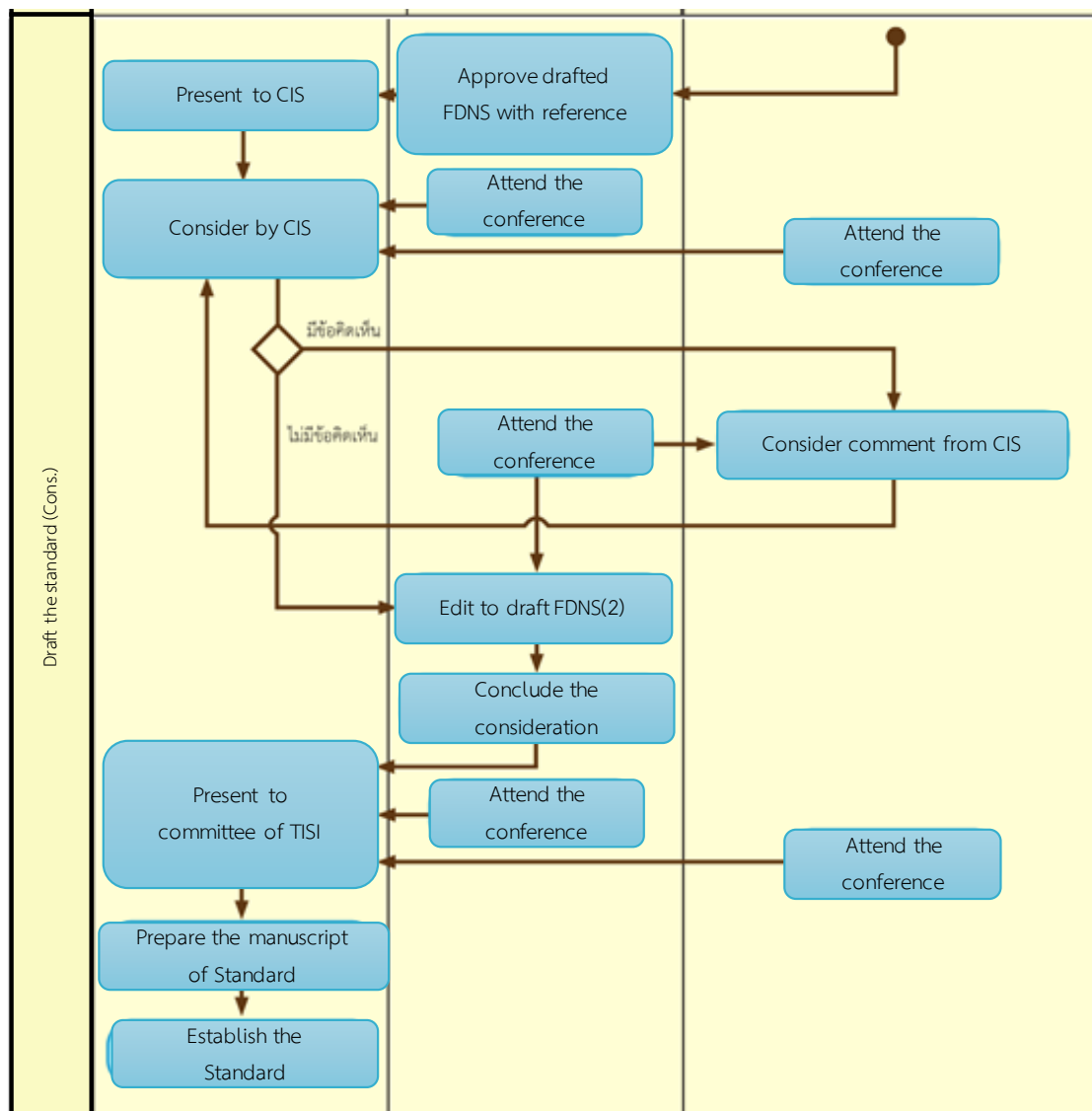
Standardization process according to Thai Industrial Standard Institute is as shown in figure 4.5-4

1. Set preferable standard, identify standard that needs improvement and appointing responsible Office of Industrial Product Standards staffs.
2. Assign standard drafting committee consisting specialists in various fields with Office of Industrial Product Standards staffs.
3. Identify the responsible person for standard drafting, called the Committee Draft (CD), then propose to the standard drafting committee.
4. Send the standard to related departments for comments or hold a seminar for a concluded drafting standard called Final Draft National Standard (FDNS).
5. Propose the draft to Committee on Industrial Product Standards Review through Office of Industrial Product Standards. The standard drafting committee should consider reliable Committee of Industrial Standards Review to identify FDNS.
6. If Committee of Industrial Standards Review has a comment on the standard, the standard drafting committee should discuss and appropriately edit. Then, resend it to Committee of Industrial Standards Review until it is thoroughly accepted. After that, the standard drafting committee send it to Industrial Product Standards Board appointed by Office of Industrial Product Standards to establish the original version and promulgate the standard.



Source: Office of Industrial Product Standards, 2559

Figure 4.5-4 Standardization by Office of Industrial Product Standards



Source: Office of Industrial Product Standards, 2559

Figure 4.5-4 Standardization by Office of Industrial Product Standards (Cons.)

4.5.2 Standardization Process of the Selected ITS

After standard working group is selected from professionals and analyzed by AHP as discussed on 4.3.1, the result is public transport information group.

Public transport information group includes public bus, mass transit system, boats and taxi with better service information for users. Details are described below.

4.5.2.1 Drafting Standard

After suitable standard selection, the content should be scoped precisely and covers all usage aspects. Several levels of information and variety of identification depend on type of information and level of usage.

1. Main Content in Standard Documents

- 1) Standard framework should be clear such as public transport information application, private transport information application and the usage extension such as vehicle-database information exchange, information storage, analysis and interpretation or as connection for communication.
- 2) Public transport data encryption standard as TPEG (ISO/TS 18234-5) has stated the referable standards as listed below.
 - a) Date and time, ISO 8601
 - b) Introduction to Data Flow TPEG Requirements, Numbering and Versions as stated in ISO/TS 18234-1.
 - c) Syntax, Semantics and Framing Structure descriptions as ISO/TS 18234-2
 - d) Location referencing as ISO/TS 18234-6
- 3) Definition and description of technical terms includes in the standard for user's understanding
- 4) Technical requirements and information structure is described as chart or figure with clear description.
- 5) Information example and usage for accurate usage

2. The Standardization Model Consideration as 2 Procedures

1) New Standard Development

New Standard Development is recommended if the existing standard does not cover the usage or the scope does not fit with Thailand's context.

2) Standard Modification

Standard modification could be the current standard by the directly responsible department or the international standard. It is possible to take the standard without any modification.

Drafting new standard should start from pilot projects or on-going related projects to compile critical issues and transform the common issues into technical terms and study the applicable standard. Concluding all the information, the technical issues will be drafted as descriptive documents and guidelines for standard promulgation.

4.5.2.2 ITS Standard Proposal

1. The Importance of Standards

Currently, Thailand lacks traffic information, the shortage of route coverage and type. Thus, travelers could not properly plan their trip. The supplementary mode of choices is not comfortable, fast or economical, therefore, people tend to use private cars. The public

transport real-time information would release the number of private cars on road. Shifting batch of people from private cars to public transport is considerably possible because of raised convenience and comfort.

Furthermore, Department of Land Transport has announced that all the public vehicles should be equipped with GPS to track the status focusing on security awareness and speed tracking. The common requirement for public transport should be considered as integrated information for trip planning and public transport management as the whole picture for Thailand.

Public transport also helps solving current traffic congestion, accidents and socioeconomically loss as well as improves people's quality of life, if establishing and exchanging information of public transport is available. Public transport status tracking and integrated modes of transport will benefit for travelers and service providers, for example, increasing number of bus or adjusting schedule when the number of flights is arriving.

Government gains advantages from disclosing connectivity of information and sharing information to the public, including transport operation, policy planning, providing information to the public, improving traffic conditions and commercial application. Precise location tracking and vehicle status information, for example, will raised competitive trip planning application for better travelling experiences by private sectors. Consequently, private sectors would make more income and potentially gain technological skills or innovations. Planning and multiple routes guiding application, for example, is compatible with traffic condition, cost, traveler's daily activities, timing as well as travelling suggestion, informing traveler to stay in a department store longer because the metro is delaying.

2. Drafting Standard Formatting and Referencing

Considering standard development working group by AHP, standard for public transport information publication is classified as public transport development working group and selected to draft the standard. Public transport standardization considers practical use in Thailand for better connectivity and integrated public transport. Identifying type of usage is necessary for connecting neighbor countries in the near future. Thus, the standard for public transport information is called **Public Transport Information Service Standards** according to International Standard (ISO) by using ISO/TS 18234-5 Traffic and Travel Information (TTI) -- TTI via Transport Protocol Expert Group (TPEG) data-streams -- Part 5: Public Transport Information (PTI) application (Transport Protocol Expert Group (TPEG) -- Part 5 informatic application for public transport) which is standard for public transport information covering all modes including bus, metro, vans, paratransit and taxi. In addition, it is possible to transfer data between other modes in the future such as railway and airplane. Although, ISO/TS or ISO Technical Specification is not officially approved because only 2/3 of the conference attendees approve, therefore, it is necessary to revise every 3-5 years and reconsider if it should be discontinued or stay still. ISO/TS 18234-5 is widely used in Europe.

3. Conclusion of Public Transport Service Standard

Details of drafted standard for public information services scope on format and structure of exchanging public transport information with technology called TPEG (Transport Protocol

Experts Group). Thus, the format of information is compatible and easier to public for future users. The drafted standard contains 8 parts as listed below.

1. Scope
2. Normative References
3. Terms and Definitions
4. Abbreviations
5. Public Transport Information Application Overview
6. Public Transport Information Container
7. Message Management Container
8. Event Container

Exchanging public transport information exchanges information between users and service providers with main elements including situations report, station information, route information and private service information.

Format of public transport service information, according to TPEG messages exchanging, concepts include management container, event container and location container.

1. Management Container includes
 - Elements
 - Date and Time with Expiration
 - Cross Reference Information connection between Batch of Information
2. Event Container presents current situation information including TPEG-PTI and TPEG-RTM.
3. Location Container presents location of information referencing global coordinates.

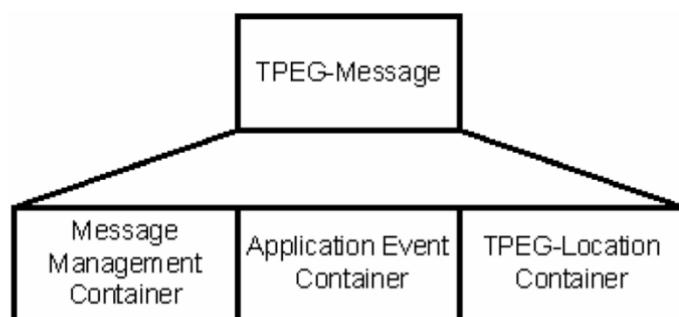


Figure 4.5-5 Concept of public information structure

Exchanging information for public transport covers multimodal public transport such as railway, bus, taxi and boat, urban transport and rural transport, to support future travel.

4. Information Usage

Providing various sources and level of analyzing information lead to variety of exchanging and servicing information. However, it takes time to develop and adjust to environment.

Relation between connectivity standard and level of usage are shown in **Figure 4.5-6**. Levels of usage are classified as raw data, first stage analyzed data, reported data and integrated data.

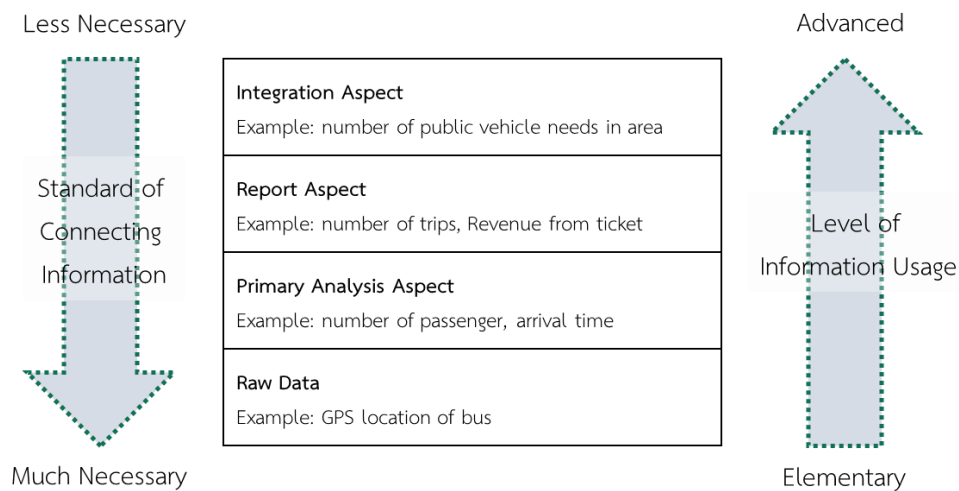


Figure 4.5-6 Relation between Connectivity Standard and Levels of Usage

4.5.3 ITS Standardization Process

According to first stage study of Thailand standardization, ITS standard should be established as Sub-committee of Intelligent Transportation and Traffic System Development (under Commission for the Management of Road Traffic) who responsible for Traffic System and Intelligent Transportation standard consideration under The Office of Transport and Traffic Policy and Planning who work as sub-committee's secretary as described in 5.3.

Establishing ITS standard is separated into 3 processes including Proposal, Drafting and Promulgation.

4.5.3.1 Standardization Proposal Procedure

Proposing standard for providing public transport information is consequences of The Master Plan for Development of Intelligent Traffic System and Traffic Management in Bangkok Metropolitan Region Project by The Office of Transport and Traffic Policy and Planning, Ministry of Transport. The project has proposed standard for providing public transport information as a pilot project for ITS standard in Thailand. The standard should also be proposed for establishment as described below.

1. Commission for the Management of Road Traffic appoints Sub-committee of Transportation and Traffic Intelligence who partly responsible for drafted ITS standard consideration focusing on public transport information.
2. Sub-committee of Transportation and Traffic Intelligence proposes public transport information service standardization to Commission for the Management of Road Traffic for approval.
3. Commission for the Management of Road Traffic proposes public transport information service standardization to the Cabinet for approval and carry out the project.

Moreover, Sub-committee of Transportation and Traffic Intelligence could establish working group according to clusters of ITS standard with stakeholders including public sectors representative, private sector representative, operators, affected people, academic people and directly related specialists. Standardization should consider drafted standard as new standard development or standard modification.



Figure 4.5-7 Drafting Standard Process

4.5.3.2 Drafting Standard Procedure and Promulgation

After the Committee of Land Transport Management and the Cabinet have approved the standardization, informing Thai Industrial Standards Institute (TISI) and promulgation should be done consequently. Thai Industrial Standards Institute appoints standard producer from specialists and Sub-committee to draft standard for public transport information and adjusts requirement to be suitable with Thailand.

Consequences from drafting standard to promulgation will be considered as listed.

1. Commission for the Management of Road Traffic informs Thai Industrial Standards Institute to appoint standard producer for drafting public transport information standard.
2. Standard producer drafts the standard to ask for comments from stakeholders or hold a seminar and modify some relevant comments. The final draft is called Final Draft National Standard (FDNS).
3. Propose Final Draft National Standard to Committee of Industrial Standards Review for consideration and adjust up to comments until Committee of Industrial Standards Review approves.
4. Propose drafted standard to Industrial Product Standards Committee to establish manual and promulgate.

The process of drafting standard is as shown in Figure 4.5-8.

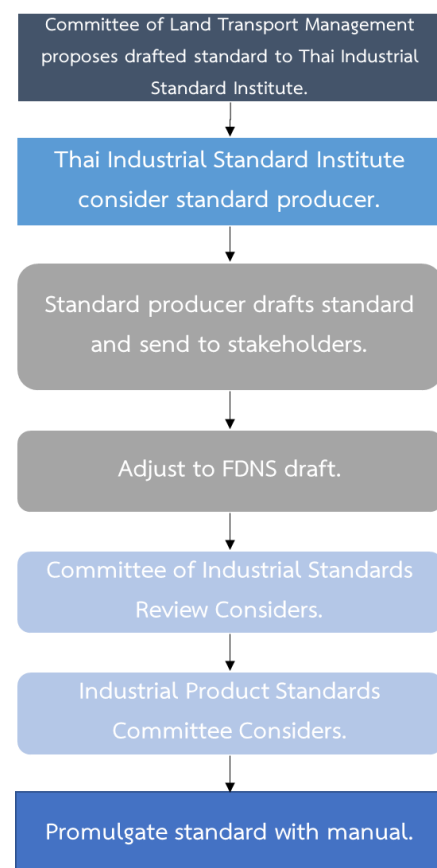


Figure 4.5-8 Drafting Standard

4.5.4 Guidelines for Practical Use ITS in Thailand

4.5.4.1 Procedure to Encourage Standard Usage

ITS standard encouragement guideline is responsible by **Commission for the Management of Road Traffic** consisted of qualified committee who are specialized in traffic management, traffic engineering, environmental engineering, economics or urban planning. Sub-committee of Transportation and Traffic Intelligence could be supplementary appointed to the committee afterwards. Sub-committee of Transportation and Traffic Intelligence can appoint more committee for specific standard development working group.

The operation by Commission for the Management of Road Traffic under the Office of the Prime Minister can reduce the restrictions of the operation with government sectors outside the Ministry of Transport and the private sectors involvement to integrate data linkages and inter-agency operations.

Guidelines for implementing the Public Transport Information Service Standards encouragement is Under Section 5, the Commission shall have the powers and duties to set standards for the organization of the land traffic system and submit to the Council of Ministers.

Commission for the Management of Road Traffic can appoint Sub-committee of Transportation and Traffic Intelligence by having The Office of Transport and Traffic Policy and Planning as secretary under the authority of Section 8 of the Land Traffic Management Commission Act, BE 2521. Details are described in 5.3.

Commission for the Management of Road Traffic has the authority to call the relevant or affected public sectors for drafting standard committee selection and give opinions upon the developed standard from the public information service encouragement related departments as listed below.

Table 4.5-1 Departments Involving with Public Transport Information Services Standard Encouragement

Director	Considering Organization	Organization using Standard
- Commission for the Management of Road Traffic having The Office of Transport and Traffic Policy and Planning as secretary and committee. - Thailand Industrial Standards Institute	Public Sectors and Government-owned company - The Office of Transport and Traffic Policy and Planning - Expressway Authority of Thailand - Department of Highways - Department of Land Transport - Bangkok Mass Transit Authority - Mass Rapid Transit Authority of Thailand - Bangkok Mass Transit System Public Company Limited - Bangkok Expressway and Metro Public Company Limited - The Krungthep Thanakom Company Limited	Public Sectors and Government-owned company - The Office of Transport and Traffic Policy and Planning - Expressway Authority of Thailand - Department of Highways - Department of Land Transport - Bangkok Mass Transit Authority - Mass Rapid Transit Authority of Thailand - Bangkok Mass Transit System Public Company Limited - Bangkok Expressway and Metro Public Company Limited - The Krungthep Thanakom Company Limited

Director	Considering Organization	Organization using Standard
	S. R. T Electrified Train Company Limited - Bangkok	S. R. T Electrified Train Company Limited - Bangkok
	Private Sectors - Taxi Drivers Association - Van Drivers Association - Public Transport Drivers Association	Private Sectors - Taxi Drivers - Van Drivers - Public Bus Operators - Public Vehicle Drivers except Song-Taew, vehicle class 4 and regional vehicle class 1

Meanwhile, departments using standard in the future could also consider the standard if the committee approves for the better and more practical standard. Government should encourage more for fair usage of the information, establish clear information services laws or regulations which will be useful and benefit as socioeconomic development. The brief process for standard is shown in **Table 4.5-2**.

Table 4.5-2 Timeframe for Standards Encouragement

Standardization	Timeframe												
	Total	Month											
		1	2	3	4	5	6	7	8	9	10	11	12
Standard proposal													
Commission for the Management of Road Traffic. appoints subcommittee.	30 days												
Subcommittee proposes standard to Commission for the Management of Road Traffic.	30 days												
Commission for the Management of Road Traffic. proposes standard to the Cabinet.	60 days												
Drafting and establishing standard													
Commission for the Management of Road Traffic. informs Thai Industrial Standards Institute to consider Standard producer.	60 days												
Standard producer drafts the standard and asks for comments.	120 days												
Standard producer proposes drafted standard to Committee of Industrial Standards Review.	30 days												
Standard producer proposes drafted standard to Industrial Product Standards Committee.	30 days												

4.5.4.2 ITS Standard Usage

Guidelines for ITS standard covers ITS continuous usage and development as 3 periods of time, short term (0-3 years), intermediate term (4-5 years) and long term (6-10 years) as described below.

- 1) *Short term: Encourage the former standard and establish standard developing group.*

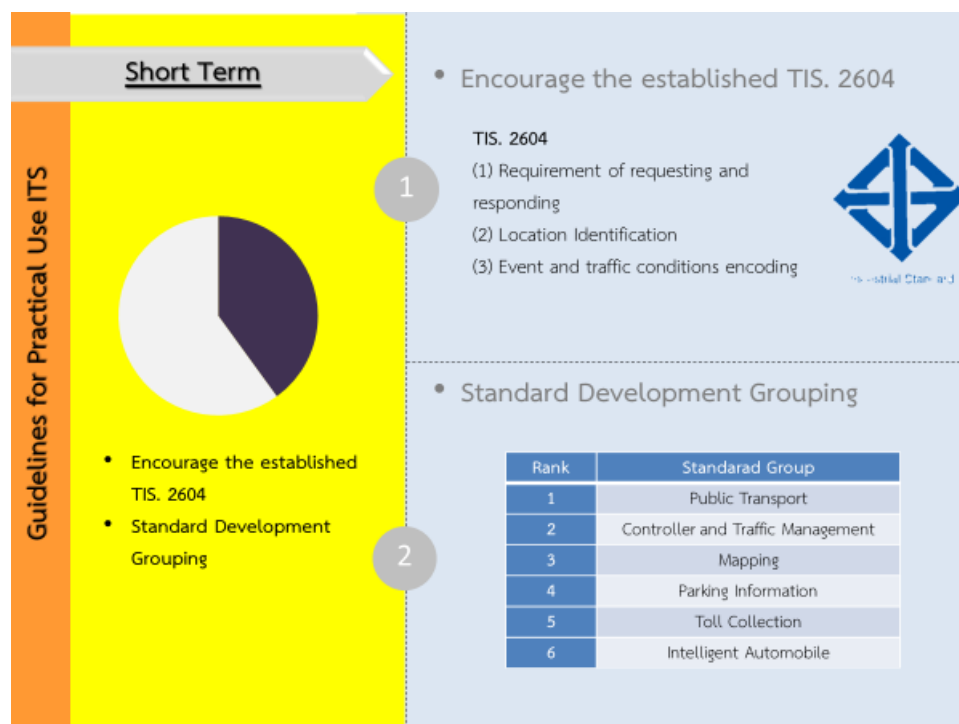


Figure 4.5-9 Guideline for Short Term

- 2) *Intermediate term: Develop the new standard and establish the new organization supporting ITS standard.*

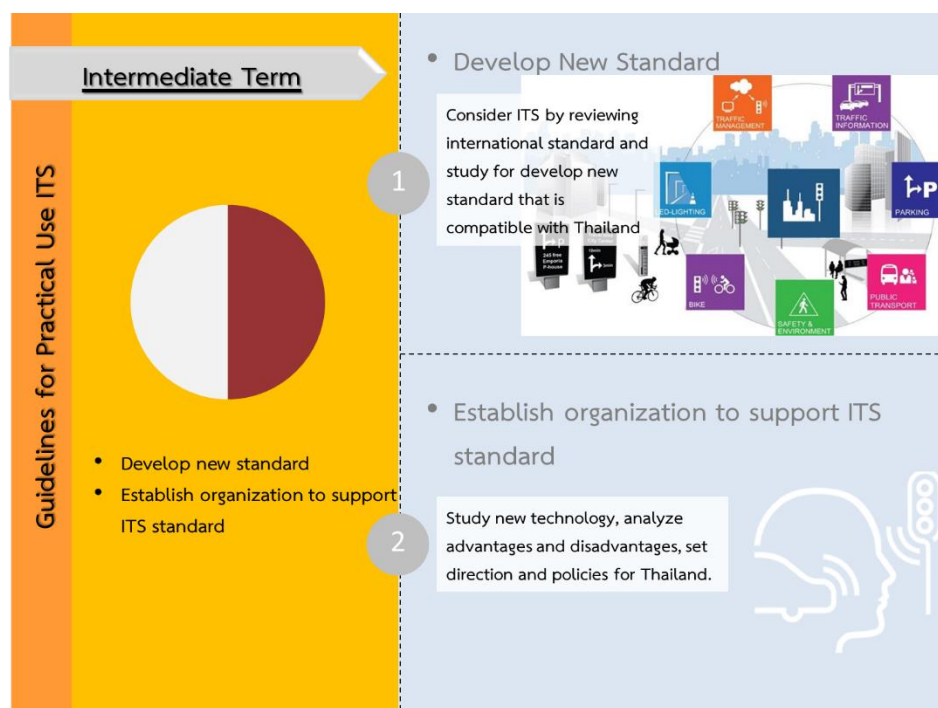


Figure 4.5-10 Guideline for Intermediate Term

3) Long term: Educate skilled manpower and revise standards to align with technologies

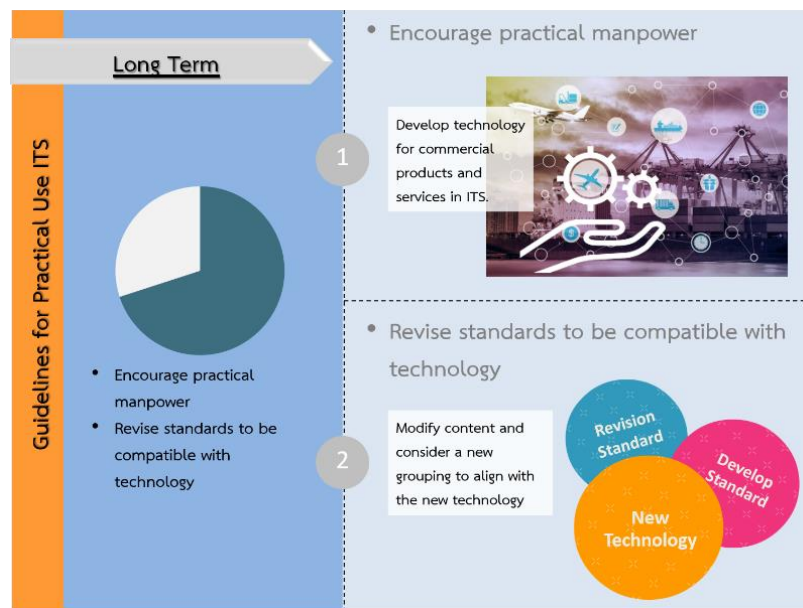


Figure 4.5-11 Guideline for Long Term

Table 4.5-3 Summary for ITS Standardization

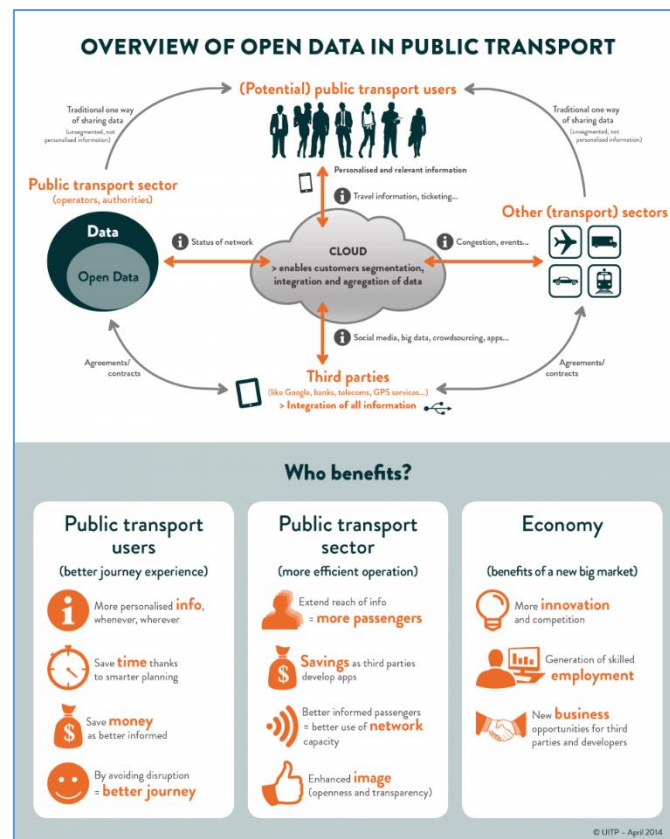
Rank	Timing	Activities	Responsible Organization
1	Short	Encourage the established TIS. 2604	OTP, TISI
2		Standard Development Grouping	OTP, Commission for the Management of Road Traffic
3	intermediate	Standardize by priority.	TISI Working Group
4		Establish organization	ITS Department
5	Long	Human Development on a standard person.	ITS Department
6		Review the standards in accordance with current technology.	TISI Working Group

4.5.5 Analysis of the Forecasted Results of the Standardization

4.5.5.1 Direct Results of Exchanging Information Standards

Using public transport is not only reducing environmental issues but also releasing traffic congestion as Thailand is facing at the moment. Also, it helps reduce number of accidents, socioeconomic loss and improve people's quality of life. Encouragement and supporting public transport information standard is the major factor of modal shifted to public transport which considerably benefits both travelers and service providers as trackable status of each modes and integrated system. Thus, people will thoroughly receive information for planning journey, better transport management and country-wide integrated service.

Seen in this light, benefits of transportation information publicity by International Association of Public Transport (UITP), well-known public transport organization gathering stakeholders from 96 countries around the world are described the sharing information concept from service providers to others for commercial application. There are distinct benefits for users, service providers and economy as listed below.



Source: www.uitp.org

Figure 4.5-12 Overall of Public Transport Information

1. Public Transport Users have better transport experiences
 - Provide information for personal trips.
 - Reduce total travel time and better planned trip.
 - Reduce cost in travelling.
 - Avoid discontinuously connected path.
2. Public Transport Service Providers improves operating potential
 - Expand the range of information accessibility – more users.
 - Reduce cost for application developers.
 - Better traveler information – better network capacity usage.
 - Enhance sector's image.
3. Economy, Bigger Market
 - Increase competitive innovations.
 - Increase specific employment.
 - Increase business opportunities and development.

4.5.5.2 Indirect Results of Exchanging Information Standards

After standard selection for drafting and promulgation, standard usage results in big data especially ITS field. According to the study of Ministry of Transport in United States of America, Big Data's Implication for Transportation Operations (US Department of Transportation, December 2014), the effect of big data to transportation and traffic is sensors in every vehicle for tracking information such as acceleration, direction of steered wheel, engine condition, location, speed and driver's current information. Every vehicle will be connected for communication and connected to the database which also known as big data.

Gathering batch of information as information center will be done by National Multimodal Transport Integration Center (NMTIC) focusing on reporting traffic status and traffic security, inclusively with connectivity and database development standard suggestion, for better comfort and safe driving with on-time information such as traffic condition, public transport location and public transport services status.

Information center under NMTIC, however, scopes only ITS usage and mainly direct connection between public sectors. Developing information center or ITS big data for every sector are recommended for the greater advantages. ITS could include other information such as quality of atmosphere and air pollution from Smart Environment of the city for considering area fare collection. With storing and developing exchange information standard, the former information for ITS could be integrated for various use and it would benefit for socioeconomic. If private sectors use information commercially, it will be more valuable for overall picture.

4.5.5.3 Affect Evaluation from Connectivity and Information Center, ITS Big Data, Standard Encouragement

Apart from connectivity and information center, ITS big data, standard development, back-end development for performance detection and evaluation is necessary. Back-end automatic programming traces information usage statistic including issues as listed below.

- Number of download separated cluster of information – for popularity of information
- Number of connectivity and Real-Time information feeds through API – for affects from service providers and applications
- Number of searching keywords
- Volume of information, date and time used by outsources
- Volume of information, date and time from outsources
- External connectivity issues statistic
- Sharing analyzed information and returning to ITS Big Data statistic

Statistic information should be analyzed 3 months and report annually for operation revising. Frequently used information, webpage, function or API should be improved consequently and receive feedback from users. Besides, ITS Big Data Platform responsible person should develop promotional strategies and the usage should be mostly high. The promotional strategies, for example, are cooperation for more information, analyzing information campaign, releasing press and holding seminars for experiences sharing.

Chapter 5

The proposal of
an Organization for ITS
Integration Establishment

Chapter 5

The proposal of an Organization for ITS Integration Establishment

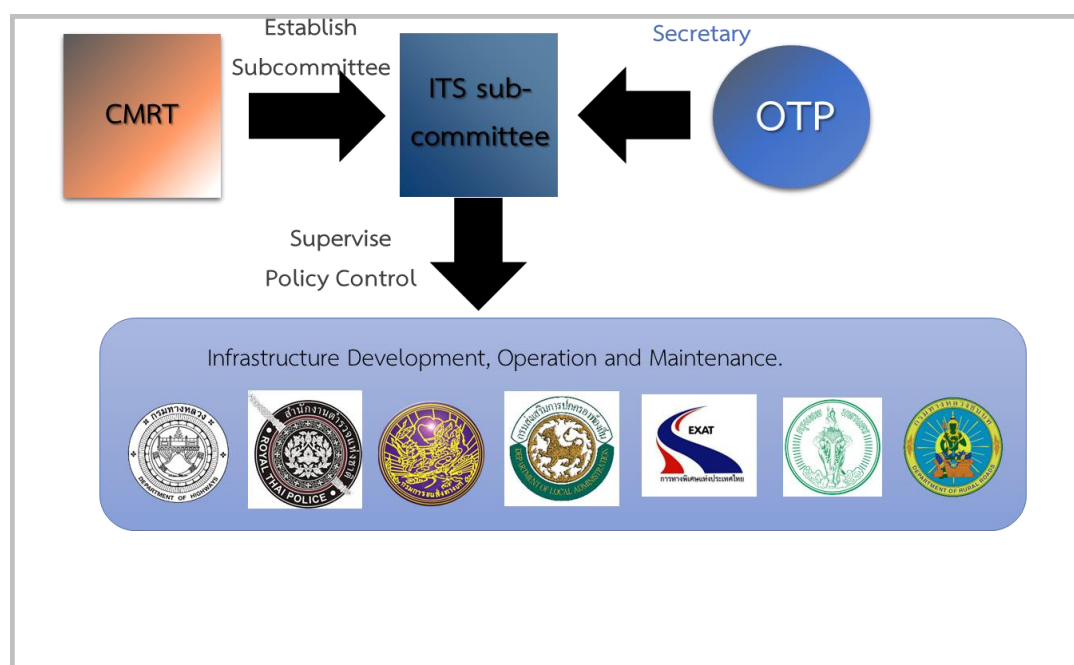
5.1 Objective

According to the 6th strategy of ITS development Master Plan in Thailand and the 5th strategy of Master Plan for ITS Development in Bangkok Metropolitan Region. The establishment of an organization is to integrate operations and information to centralize ITS development in the country.

The main objective of ITS establishment is to solve the main issue of ITS development which is the process development from project proposal to system development by organizations. This issue should be continuously improved.

5.2 Alternatives and Sequence of Development

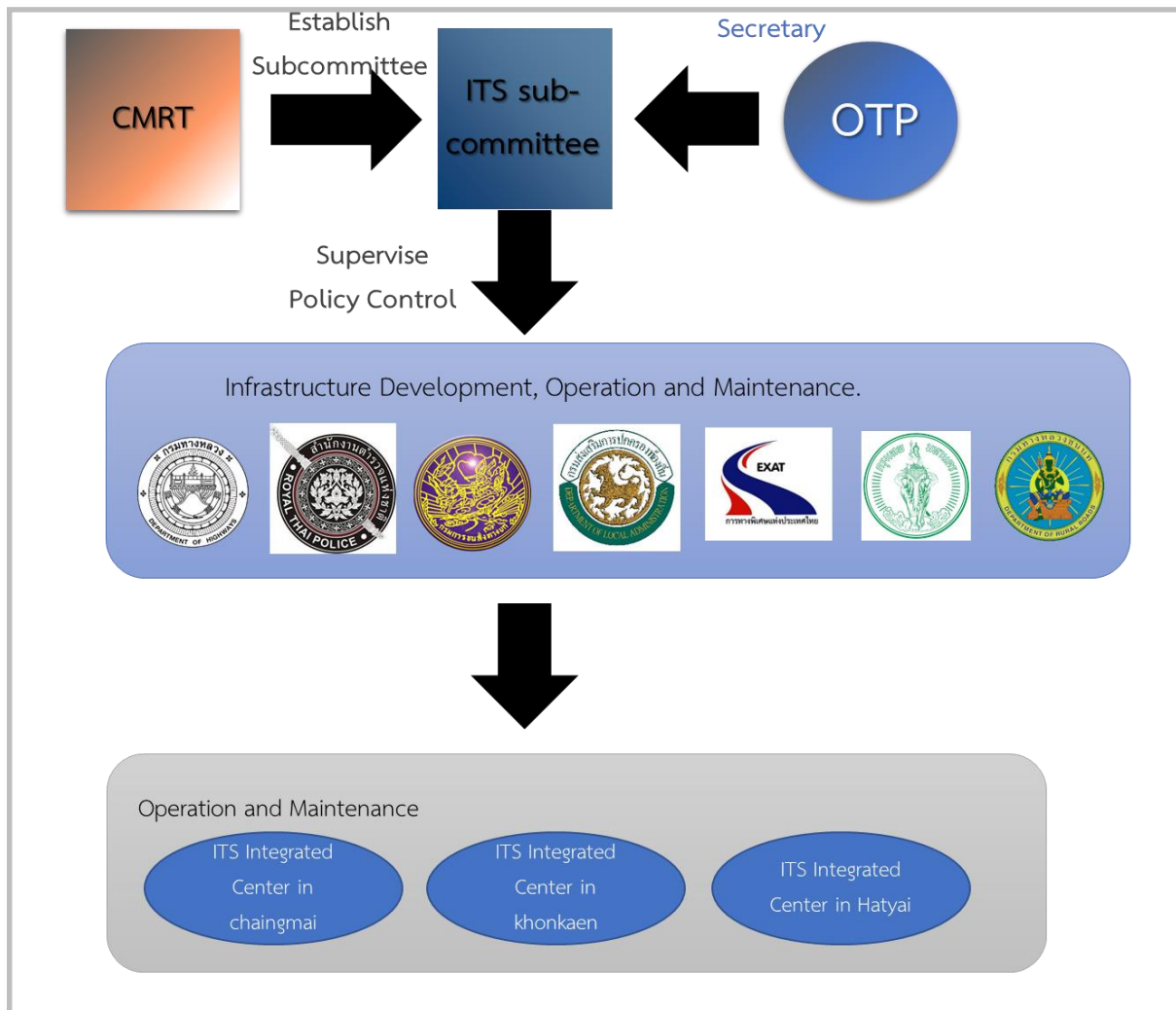
The development of the organization is divided into 2 phases, which can be summarized as Figure 5.2-1 to 5.2-3.



Remark: CMRT is Commission for the Management of Road Traffic

OTP is The Office of Transport and Traffic Policy and Planning

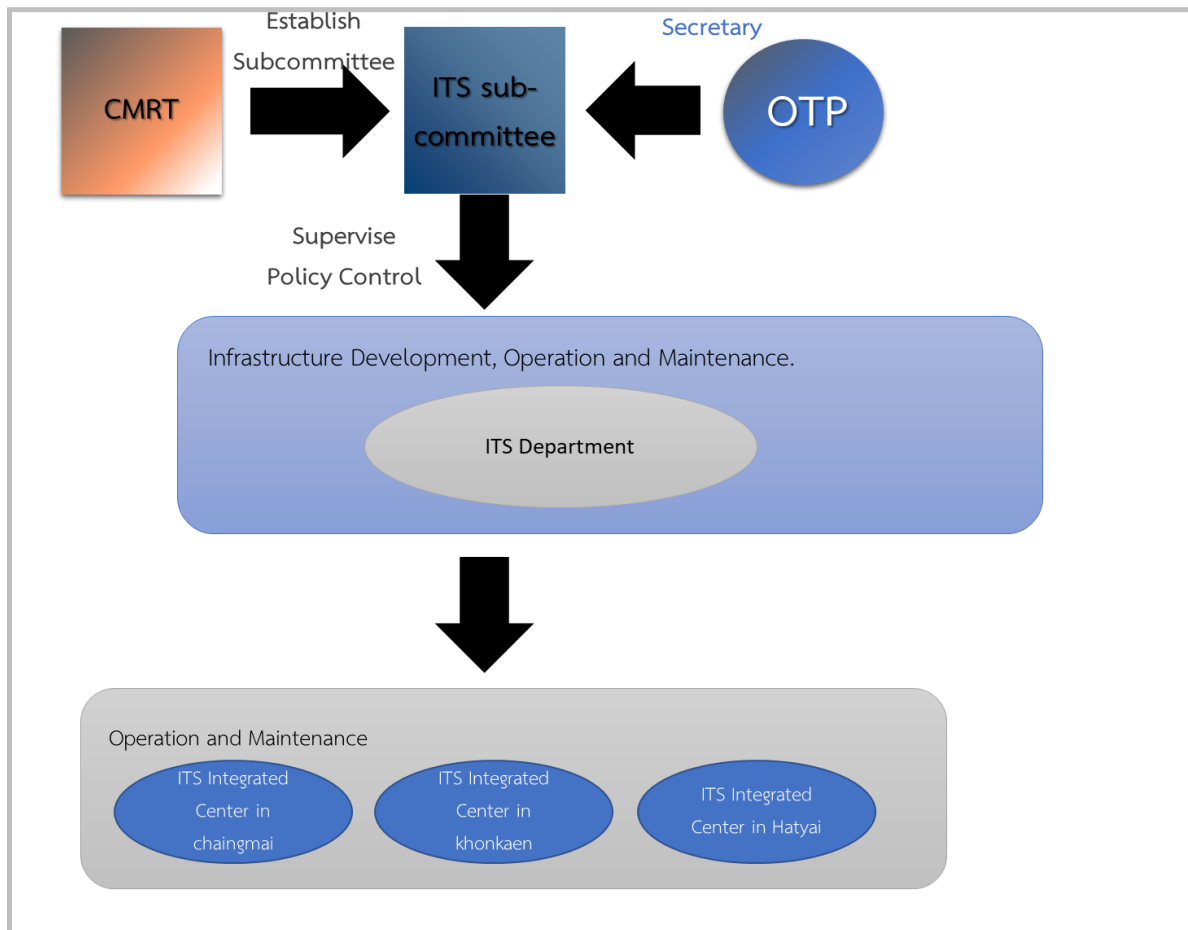
Figure 5.2-1 Short Term



Remark: CMRT is Commission for the Management of Road Traffic

OTP is The Office of Transport and Traffic Policy and Planning

Figure 5.2-2 Mid-Long Term Alternative 1



Remark: CMRT is Commission for the Management of Road Traffic

OTP is The Office of Transport and Traffic Policy and Planning

Figure 5.2-3 Mid-Long Term Alternative 2

5.3 ITS Sub-committee

1) Authority

- Provide an initial approval of the ITS measurement or plan before presenting them to the agency or CMRT.
- Monitor and evaluate the operation if it is as planned.
- Coordinate ITS implementation of the various agencies to be harmonized.
- Consider and establish ITS standards.

2) Board composition

The ITS Development Board is set up by the CMRT and consists of Sub-committee as listed.

- President: Permanent Secretary, Ministry of Transport
- Vice president:
 - Deputy Secretary of the Interior

- The Deputy Permanent Secretary, Ministry of Digital Economy and Social Affairs
- Deputy Permanent Secretary for Science and Technology
- Deputy Permanent Secretary for Industry
- Secretary
 - Director of Information Technology Center, OTP
- Sub-committee consists of:
 - Representatives from the Department of Highways Department of Rural Roads Expressway Authority of Thailand Department of Land Transport
 - President of ITS Thailand Association
 - Representatives from local agencies, including provincial offices in Bangkok and its vicinities and the six major cities include Chiang Mai, Phitsanulok, Khon Kaen, Nakhon Ratchasima, Phuket and Hat Yai
 - Representatives from Bureau of Traffic and Transportation Bangkok
 - Representatives from the Royal Thai Police

5.4 An alternative of Integrating Infrastructure Development, Department of Intelligent Transport

Department of Intelligent Transport is an alternative of centralization the infrastructure development which is directly responsible for ITS, promotes easiness of infrastructure development and budgeting. Moreover, developing department of intelligent transport facilitates in Thailand.

1) Principles and Rationale

At present, the development and support of Intelligent Transport System (ITS) is responsible by separated departments which causes the duplication of operations, lack of budget and expertise in maintenance. Thus, the establishment of a responsible organization leads to systematic and integrated development.

2) Missions

- Promote the development of ITS infrastructure to help solve transport problems and integrate in each unit.
- Promote research, development and innovation in transport and traffic technologies.

3) Authorities

- Develop ITS for transport infrastructure of public sectors.
- Support the establishment of an ITS Integration Center.
- Indicate ITS Research and Development.
- Establish ITS Funding.

4) Organizational structure

Organizational structure is as shown in **Figure 5.4-1**.

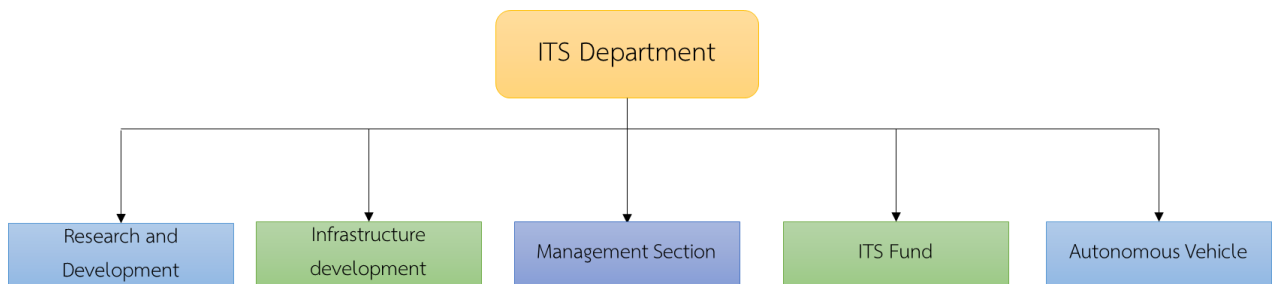


Figure 5.4-1 Organizational Structure of Department of Intelligent Transport

5.5 ITS Integrated Center

1) Principles and Rationale

Strategy 6 of the ITS development master plan aims for the integrated center of ITS within seven major cities, including Bangkok Metropolitan Region, Chiang Mai, Phitsanulok, Khon Kaen, Nakhon Ratchasima, Phuket and Hat Yai, which are responsible for operations and maintenance related to ITS, such as CCTV cameras, signaling systems, data centers and traffic control centers. The ITS integrated center initially uses the national budget for implementation but in the long term, the revenue from operations can be used for maintenance and operation.

Therefore, the implementation of the center will solve the funding problems of operation and maintenance, expertise of personnel and the unclarity of authority.

2) Missions

- Promote traffic safety with intelligent transport and traffic system.
- Publish transport and traffic information for people's acknowledgement and trip planning.
- Facilitate travel, mobility, and safety.

3) Authorities

- Carry out traffic control with intelligent signal.
- Operate Law Enforcement by CCTV.
- Collect and publish transport information.
- Manage public transport such as bus and passenger boat.

4) Guidelines for the Establishment

ITS integrated center will be pushed through the Commission for the Management of Road Traffic. Each province is responsible for establishing their centers. Bangkok Metropolitan Region has broad responsible area. Thus, Central organization should be established to cover all the operation.

The cabinet resolution of 3 May 2011 has approved the Ministry of Transport as the center of multimodal transport development. The center should encourage development of sub-centers to connect NMTIC including Traffic Control and Management, Transport & Logistics Management, and Transport & Logistics. Traffic Data Exchange. These are consistent with the mission of the ITS Integrated Center. The Bangkok Metropolitan Region, therefore, the NMTIC should be primarily responsible for establishment.

5) Organizational Structure

Organizational structure is as shown in **Figure 5.5-1**.

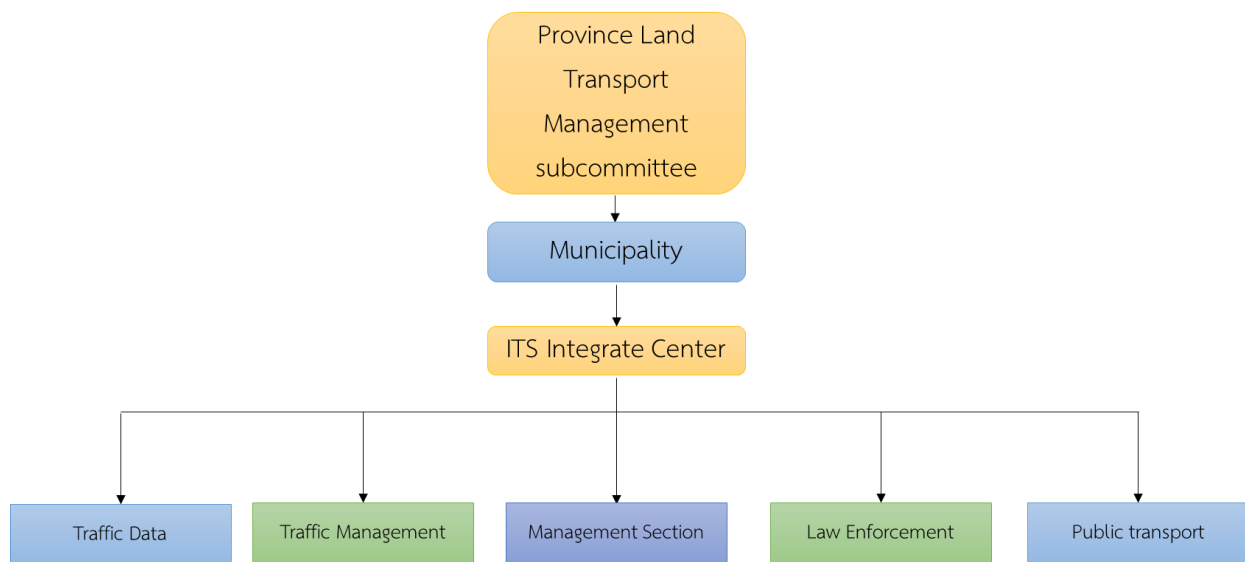


Figure 5.5-1 Organizational Structure of ITS Integrated Center

6) Budgeting of the ITS Integrated Center

The budget for ITS operations can be divided into two phases. The first phase, the national budget will be used to set up ITS centers. Then, the ITS centers should be able to earn money from 5 sources as below.

- Energy Conservation Promotion Fund
- Revenue Sharing from Road Pricing
- Revenue Sharing from Roadside Parking
- Road Safety Fund

- Traffic Enforcement Revenue Share

Chapter 6

Public Relations Plan

Chapter 6

Public Relations Plan

6.1 Introduction

Currently, according to the Constitution of the Kingdom of Thailand, it is necessary to publish information and give opportunities to stakeholders in the development of significant projects from both public and private sectors. Participating of stakeholders could be in various form such as seminar for comments, seminar for publication or training seminar.

The seminar should be in a timely manner and compatible with the process of project. Involvement of publicity is also agreeable with the Cabinet's policy about the public involvement.

6.2 Purposes

- 1) To disseminate the ITS development master plan in Bangkok Metropolitan Region to all parties involved.
- 2) To gather feedback or suggestions from the people involved to contribute to the study of the project.
- 3) To publicize the project through website, brochure or sign.

6.3. Operational Plans

The work in this section includes the first symposium, the second symposium and the public relations. The plan is as shown in **Table 6.3-1**.

Table 6.3-1 Operational Plans

Activity	Period								
	Jan-60	Feb-60	Mar-60	Apr-60	May-60	Jun-60	Jul-60	Aug-60	Sep-60
<u>Seminar</u>									
1st Seminar						←→			
2nd Seminar								←→	
<u>Academic Training</u>									
Training								←→	
Technology Transfer							←→		
<u>Public Outreach</u>									
Advertising boards						←→		←→	
Brochure						←→		←→	
Seminar Document						★		★	
Training Document								★	
VDO Presentation						←→		←→	
Website	←								→
Social Media	←								→

6.3.1 Report of the 1st Seminar

The first seminar was publication of the study, presented the study, review and process of the implementation of ITS in both domestic and international and the drafted master plan for the development of ITS in both the national and sub-national levels in Bangkok Metropolitan Region as guideline framework for implementing ITS in the related sectors. The related sectors are involved in the study through feedback and suggestion in the seminar as an initially information for the consequent phase of the project or the pilot project of ITS which thoroughly follow the objectives. Number of participants were 112. (Figure 6.3-1)



Figure 6.3-1 Seminar Photos



Figure 6.3-1 Seminar Photos (Cons.)



Figure 6.3-1 Seminar Picture (Cons.)

6.3.2 Report of Academic Training

Academic training has promoted the study, exchanged information and suggestion in the next step as ITS standardization and ITS development guideline. The operation follows all objectives and there were 73 participants. (Figure 6.3-2)



Figure 6.3-2 Activity Photos



Figure 6.3-2 Activity Photos (cons.)

6.3.3 Report of the 2nd Seminar

The second academic symposium presented a study of ITS development master plan and the ITS pilot project to stakeholders, exchanged information, received feedback and suggestion about the ITS pilot project. Operation follows every objective and 101 people participated. (Figure 6.3-3)



Figure 6.3-3 Activity Photos



Figure 6.3-3 Activity Photos (cons.)

6.3.4 Other Public Relations

- Video Presentation for publishing in the conference was 5.28 minutes. It presented the necessity of the project at the 1st and 2nd symposiums.



Figure 6.3-4 VDO Presentation

- Website promoting the project for information and projects. The updated preceeding conferences, agencies discussion, sub-assembly meetings and the results will be on the website. The consultants have created a site named <http://www.thailanditsmasterplan.com> including the list below.
 - Project Information
 - Educational Advisory Board
 - Seminar
 - Project activities
 - PR
 - Download
 - Contact
- The YouTube channel for project publicity that will broadcast the conferences, and project videos that summarize the overall understanding of the project.
- Facebook page for project publicity and communication with interested parties has the updated preceeding conferences, agencies discussion, sub-assembly meetings and the results.