Department of Public Works and Transport (DPWT),
Phnom Penh Capital Administration (PPCA), Kingdom of Cambodia

The Project for Capacity Development on Comprehensive Traffic Management Planning and Traffic Control Center Operation and Maintenance in Phnom Penh Capital City

(PPTMTC)

PROJECT COMPLETION REPORT

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Japan International Cooperation Agency (JICA)

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[Technical Cooperation Deliverables] Separate Volume（Electronic data only）

Maintenance Management Manual ..... Book 1

Pilot Project Handbook ..... Book 2

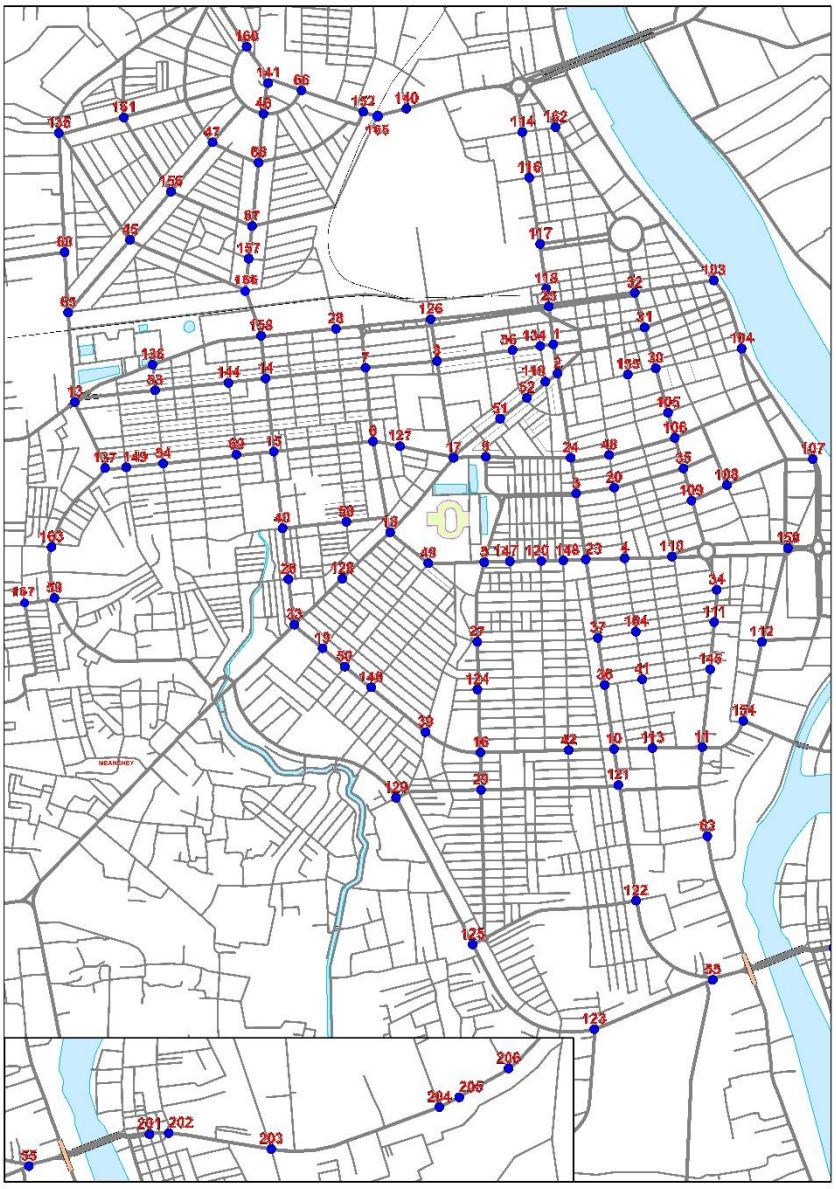
Traffic Control System Expansion Plan ..... Book 3

Traffic Enforcement and Traffic Safety Education Manual ..... Book 4

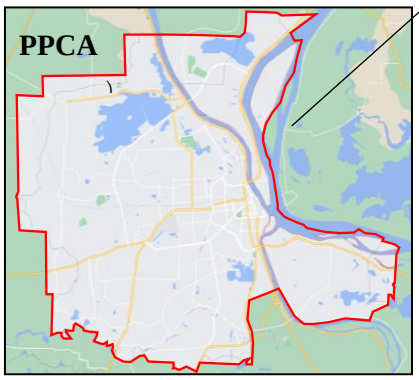
Abbreviations

ABD	Asian Development Bank
AI	Artificial Intelligent
CBA	City Bus Authority
CBD	Central Business District
CCTV	Closed Circuit Television
CDC	Council for the Development of Cambodia
CRC	Cambodian Red Cross
DPWT	Department of Public Works and Transport
EDC	Electricite Du Cambodge
ID	Intelligence Design Inc.
ICT	Information and Communication Technology
ITC	Institute of Technology of Cambodia
JCC	Joint Coordinating Committee
KPI	Key System Performance Index
M / P	Master Plan
MCL	Mayer, Metropolitan Corporation Lahore
MEF	Ministry of Economy and Finance
MPWT	Ministry of Public Works and Transport
NRSC	National Road Safety Committee
O&M	Operation and Maintenance
OFC	Optical Fiber Cable
OJT	On-the-Job Training
OTDR	Optical Time-Domain Reflectometer
PDM	Project Design Matrix
PLTSO	Public Lighting and Traffic Signals Office
PPCA	Phnom Penh Capital Administration
PPCC	Phnom Penh Capital City
PPCH	Phnom Penh Capital Hall
PPTMTC	The Project for Capacity Development on Comprehensive Traffic Management Planning and Traffic Control Center Operation and Maintenance in Phnom Penh Capital City
PPTP	Phnom Penh Traffic Police
PPUTMP	Phnom Penh Urban Transport Master Plan
PPWSA	Phnom Penh Water Supply Authority
PWO	Public Works Office
RCE	RCE Systems s.r.o.
RSO	Road Traffic Safety Office
TCC	Traffic Control Center
WG	Working Group

Location of 118 Signalized Intersections in the Central Phnom Penh



Source: PPTMTC Project



Photos 1



#126 intersection, which has revised a major geometric change from a 3-leg to 4-leg intersection after the traffic control system handover



Pedestrians walking on the roadway due to illegal parking on the sidewalk



TCC staff inspecting the local controller



TCC staff inspecting the signal lantern



Training on maintenance and management of traffic control system



Training on traffic signal operation of traffic control system

Source: PPTMTC Project Team

Photos 2



#166 intersection where road marking was completed during the pilot project



Cambodian Red Cross student volunteers calling for road safety to drivers during the pilot project road safety campaign



Traffic enforcement by Phnom Penh Traffic Police during the pilot project road safety campaign



A wide variety of traffic lanterns in the suburban area (confusing for drivers)



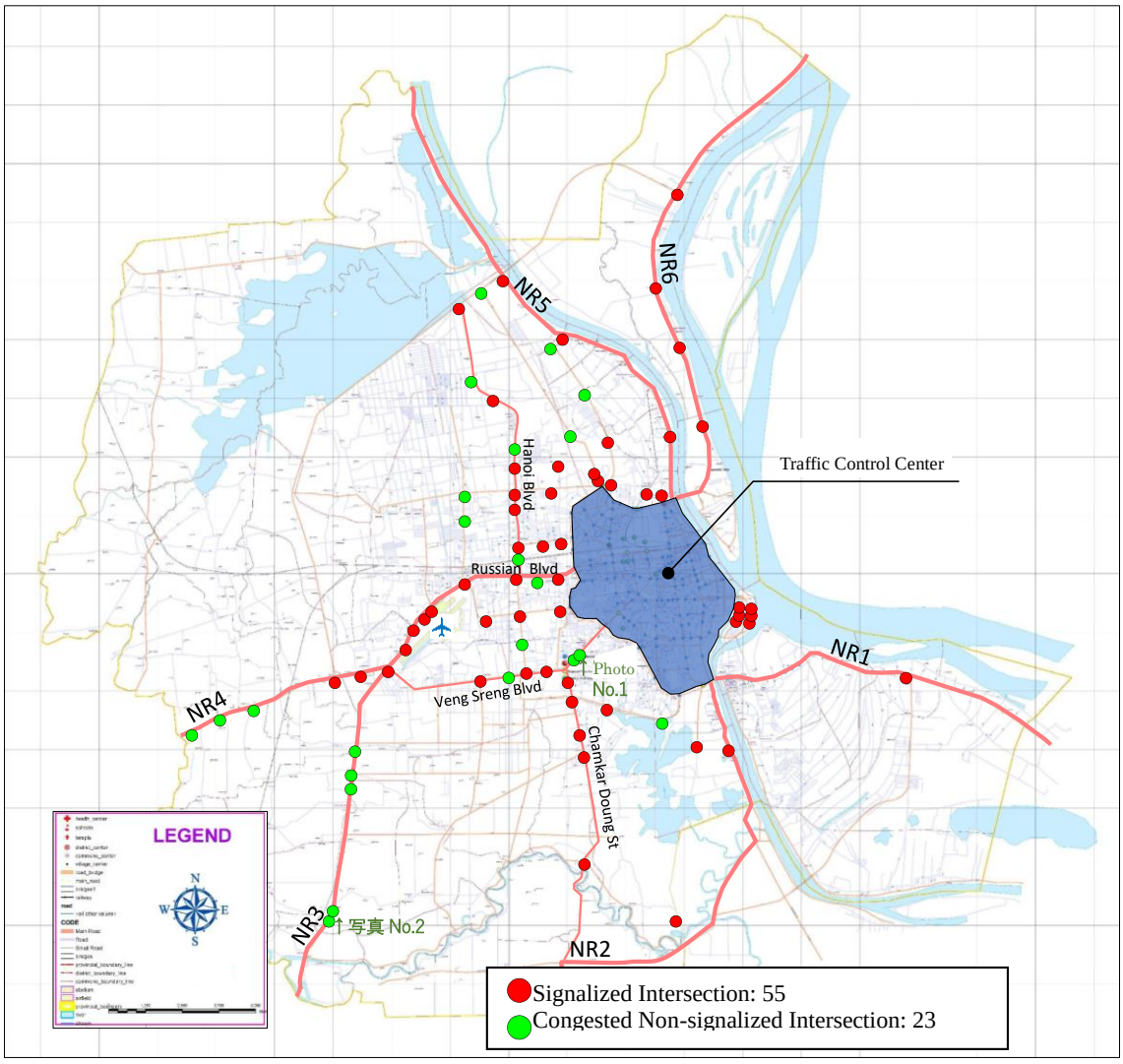
U-turn traffic at median opening along suburban trunk roads obstructs traffic on trunk roads, causing traffic congestion



Missing or defective road markings in suburban areas

Source: PPTMTC Project Team

Location of Standalone Signalized Intersections in Phnom Penh Suburban Area



Congested Non-signalized Intersections in the Suburban Area



Photo No.1



Photo No.2

Source: PPTMTC Project Team

1. INTRODUCTION

1.1 Background of the Project

Phnom Penh, the capital city of Cambodia, is the political and economic center of the country with a population of about 2.28 million (2019 Population Census). Because of recent economic development, the number of newly registered vehicles in Phnom Penh has more than doubled from about 260,000 in 2010 to about 580,000 in 2019. The average travel speed along the main roads in central Phnom Penh in 2017 was 12.2 km/h., and traffic congestion is becoming more serious. Furthermore, the number of traffic accidents in Phnom Penh has been on the rise since 2016 due to the increase in the number of vehicles and has increased about 2.0 times in the three years until 2019.

To respond to such serious traffic conditions in Phnom Penh, JICA received a request from the government of Cambodia to formulate an urban transportation master plan (M / P) and set a target year of 2035 (short-term plan: 2016, medium-term plan: 2020); thus "Project for Comprehensive Transport Plan in Phnom Penh Capital City (PPUTMP)" (2012-2014) was implemented. In PPUTMP, the development of the road network, the introduction of public transport and the strengthening of traffic management measures are the three main components. The introduction of the traffic control system as the main measure of the traffic management plan to improve the traffic situation was proposed as one of the short-term action plans. In response to the proposal, JICA provided a grant aid to implement "The Project for Development of Traffic Management System in Phnom Penh" (2015 G/A signing) for the purpose of introducing a traffic control system and constructing a traffic control center. Equipment such as traffic signal controllers and traffic signals were installed.

Phnom Penh Capital City (PPCC), the Department of Public Works and Transport (DPWT) and the Traffic Control Center (TCC) have been striving to make effective use of the equipment. Considering the sustainable and effective utilization of the traffic control system, it is necessary to cooperate with the Phnom Penh Traffic Police (PPTP) to properly fulfill the traffic management function of PPCC. Thus, PPCC requested Japanese technical cooperation to conduct a project aimed at improving the operation and maintenance capabilities of TCC staff and related agencies of the traffic control system and drawing up comprehensive traffic management measures in Phnom Penh.

In addition, In August 2023, Hun Manet, the new Prime Minister of Cambodia, unveiled the "Pentagonal Strategy," a 25-year socioeconomic strategy to be implemented in five phases, with

the first phase to run from 2023 to 2028. The five main strategies of the "Pentagonal Strategy" are to strengthen the construction and development of human resources, roads, hydropower, and electricity. Furthermore, the first phase of the "Pentagonal Strategy" outlines the specific goals Cambodia should pursue in the future, which include strengthening government institutional capacity, creating an environment suitable for economic and social development, developing human resources, diversifying the economy and improving competitiveness, growing private businesses and creating jobs, promoting adaptive, sustainable and inclusive development, and establishing a digital economy and society. "Roads" is one of the five key strategies in the "Pentagonal Strategy," and the future goal is defined as "creating an environment conducive to social and economic development." Therefore, the Project for Capacity Development on Comprehensive Traffic Management Planning and Traffic Control Center Operation and Maintenance in Phnom Penh Capital City (PPTMTC) is in line with Cambodia's national development policy since it enhances urban transportation in Phnom Penh and promotes social and economic development in Cambodia.

Furthermore, the basic policy of the Ministry of Foreign Affairs' Country Assistance Policy for Cambodia (April 2024) states that Japan will support industrial development to help Cambodia achieve its goal of becoming an upper-middle-income country by 2030 and will also support Cambodia in addressing the complex and diverse challenges of the international community and achieving sustainable, self-reliant growth and a vibrant society. In addition, of the three priority areas, "(1) Industrial transformation and development that brings about economic growth" states that connectivity will be strengthened by facilitating logistics (roads, ports, etc.) in order to develop infrastructure for industrial development and investment promotion, and "(2) Achieving sustainable and equitable growth" states that support will be provided in areas that contribute to the development of urban living environments, such as urban transportation and urban management using ICT, in order to further improve the quality of life of the people. This project is highly consistent with Japan's aid policy.

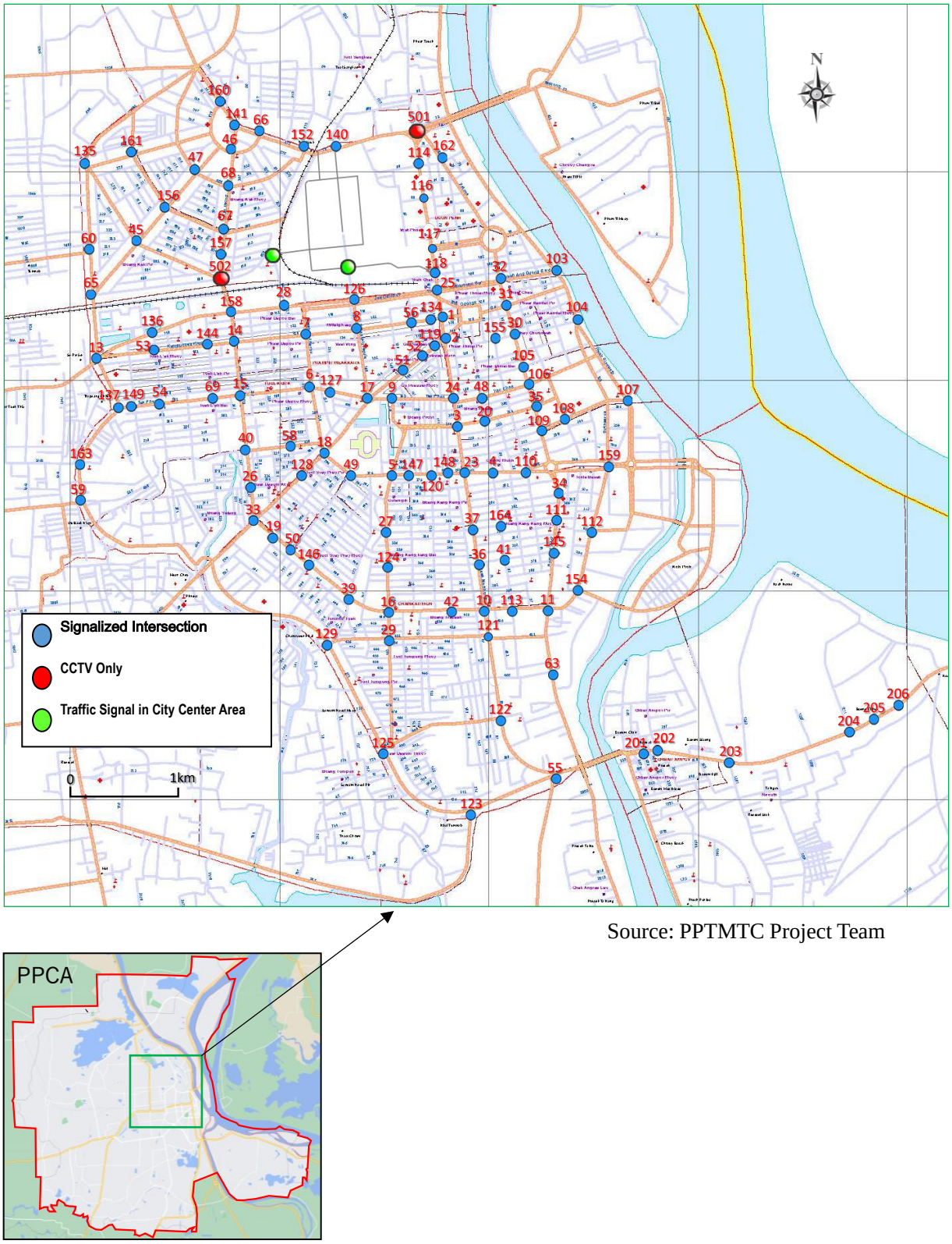
1.2 Project Purpose, Output and Activities

The project purpose, outputs and activities are given below.

Project Name	Project for Capacity Development on Comprehensive Traffic Management Planning and Traffic Control Center Operation and Maintenance in Phnom Penh Capital City
Project Area	The Whole Area of Phnom Penh
Counterpart Institution	Implementing Agency: Phnom Penh Capital Administration (PPCA), Department of Public Works and Transport (DPWT), Traffic Control Center (TCC) and Phnom Penh Traffic Police (PPTP)
Overall Goal	Sustainable Urban Transport Environment is Formed.
Project Purpose	Traffic Management Measures Including Traffic Safety Measures are improved in Phnom Penh

Expected Output		1	Maintenance Management System of Traffic Control System is Established.
		2	Capacity of TCC Staff on the Operation of Traffic Control System is Strengthened.
		3	Capacity to Design Traffic Signals is Strengthened through the Implementation of Pilot Projects for Traffic Signal Improvement.
		4	Capacity of the Relevant Staff to Traffic Control System in PPCA, DPWT and TCC Staff to Develop the Expansion Plan of Traffic Control System is Strengthened.
		5	Capacity of Urban Transport Related Organizations on Traffic Management Measures is Strengthened towards Enhancement of this Project Sustainability.
Outline of Activities	Activity 1	1-1	To review the current organization and management system of TCC.
		1-2	To identify operational and maintenance issues that have occurred since the traffic control system operation started and to develop improvement measures.
		1-3	To review the system operations manuals, maintenance manuals and other manuals and to assess their suitability to the circumstances in Phnom Penh.
		1-4	To investigate the existing maintenance management organizations and to propose proper maintenance management systems, including the possibility of out-sourcing.
	Activity 2	2-1	To study additional equipment and software which will be required to extract necessary data from TCC for image analysis, travel speed measurement, etc.
		2-2	To conduct training for TCC staff members to acquire necessary engineering knowledge related to traffic management.
		2-3	To conduct training on the mechanism of the traffic control system, operation, modification and upgrade procedures.
		2-4	To conduct training on general maintenance and management work, including the repair of optical fiber.
		2-5	To collect data and information at target intersections and road sections where traffic congestion and accidents have occurred frequently, using data and information from TCC and analyzing the issues.
	Activity 3	3-1	To identify traffic signals that need phasing and/or timing plan modification due to the change of traffic demand pattern Pre-Conditions
		3-2	To collect and analyze traffic data related to target intersections.
		3-3	To modify the design of traffic management systems including the use of traffic signal design software.
		3-4	To consider and procure necessary tools and/or equipment for traffic signal improvement.
		3-5	To evaluate the impact of traffic signal design modification.
		3-6	To summarize the procedure from planning to evaluation of implementation for traffic signal improvement in a handbook.
	Activity 4	4-1	To examine the area of the traffic control system expansion, considering the urbanization trend of Phnom Penh, the traffic conditions at major intersections and characteristics of the traffic control system.
		4-2	To develop the expansion plan of the traffic control system.
	Activity 5	5-1	To consider and identify tools and/or equipment for the conduct of traffic enforcement measures to support the traffic management system in Phnom Penh
		5-2	To review the current traffic enforcement measures and issues, and to conduct the on-the-job training for the traffic enforcement.
		5-3	To develop the traffic enforcement and driver's education handbook.
		5-4	To disseminate the Project's outputs/activities to the public through the mass media and workshops/seminars.

1.3 Project Area



Source: PPTMTC Project Team

Figure 1.3-1 Project Area

1.4 Project Implementation Structure

Project implementation structure is shown below.

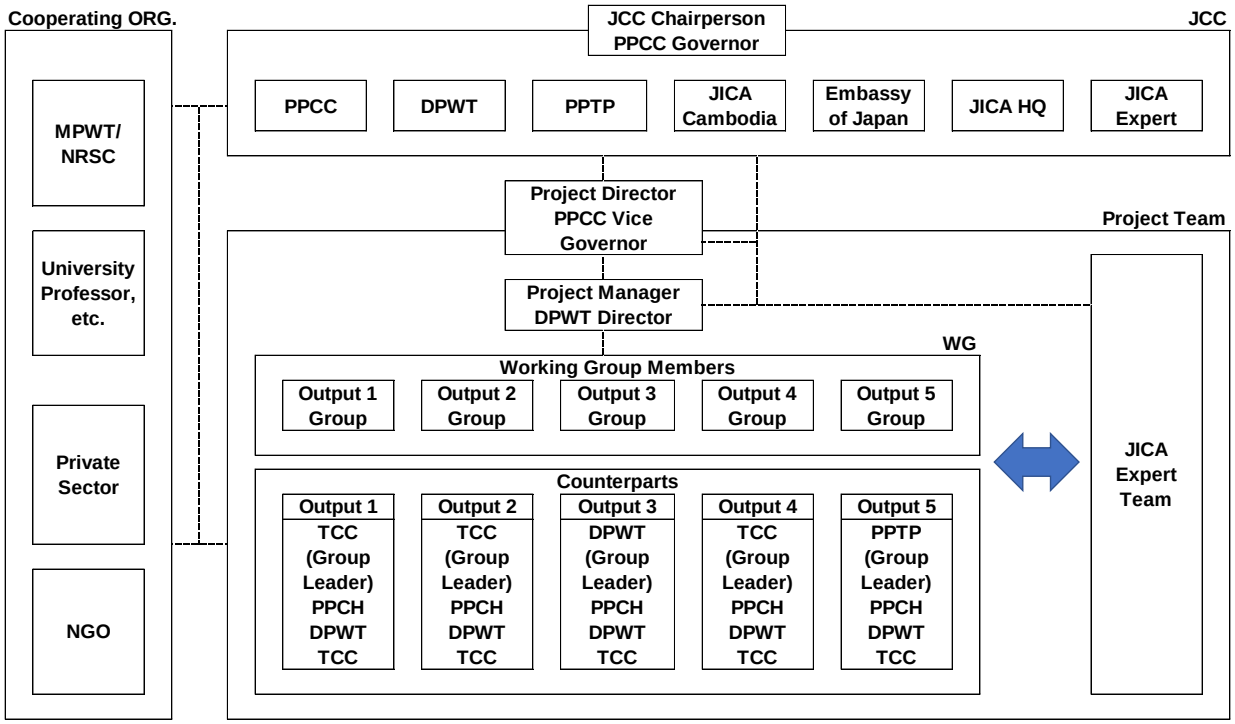


Figure 1.4-1 Project Implementation Structure

2. Activity Achievements of the Project

2.1 Activity Achievements related to the whole Project

As for the activity achievement related to the whole project, the goals and objectives achieved as summarized in the finalised version of PDM (Refer to Annex 1).

(1) Overall goal: Sustainable urban transport environment is formed through effective operation of the traffic control system.

The indicators for achieving the overall goal are: 1) An increase of 8% in travel speed of the main road after the project compared to before the project, and 2) An improvement in urban transport conditions for city residents.

1) Comparing the traffic volume of the project in 2023 and 2024, an increase of about 2% was observed. On the other hand, looking at the change in travel speed from the traffic survey results, there was almost no change at 13.3 km/h and 13.2 km/h, respectively.

2) Participants of PPTMTC seminar (approximately 170 people) were interviewed about changes in traffic conditions in 2023 and 2024. Sixty-nine percent (69%) of the respondents (123 people) answered that "traffic conditions have improved." The main reason given was that "traffic volume has increased, but the traffic conditions have improved due to the success of Phnom Penh's hard (signal installation and flyover construction) and soft (traffic safety education) measures."

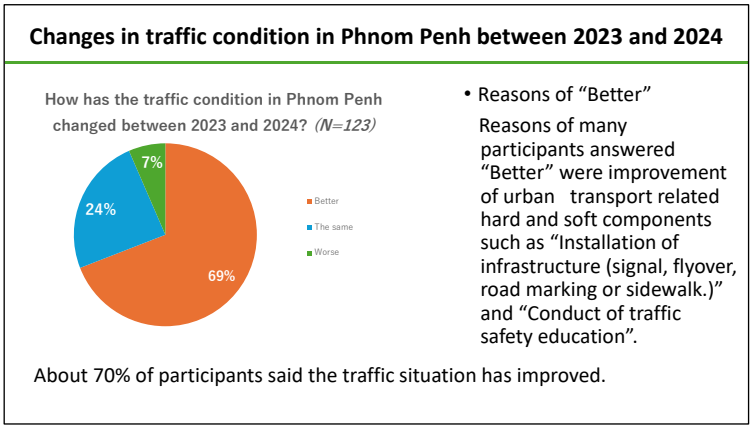


Figure 2.1-1 Comments from Participants at the PPTMTC Seminar held in August 2024

(2) Project Purpose: Traffic management, including traffic safety measures in Phnom Penh, is improved through strengthening the capacity of operation and maintenance of the traffic control system.

Indicators for achieving the project purpose are: 1) the reliability (operation rate) of the

traffic control system increases, 2) traffic conditions can monitor constantly, and 3) traffic violations decrease, leading to improved awareness of traffic congestion and traffic safety.

The operation rate of the entire traffic control system in Phnom Penh increased by 13.4%, from 83.2% to 94.4%, due to the improvement of maintenance management skills of the TCC staff after training. This figure has remained at the same level since then. Using the AI-powered DataFromSky service, which can quantify CCTV video images, constant fixed-point observation is possible and used for traffic situation analysis (see Figure 2.1-2). The number of traffic violations at intersections before and after the pilot project that introduced the 3Es (Engineering, Education and Enforcement) decreased by 21.1%, from 1,592 before to 1,256.

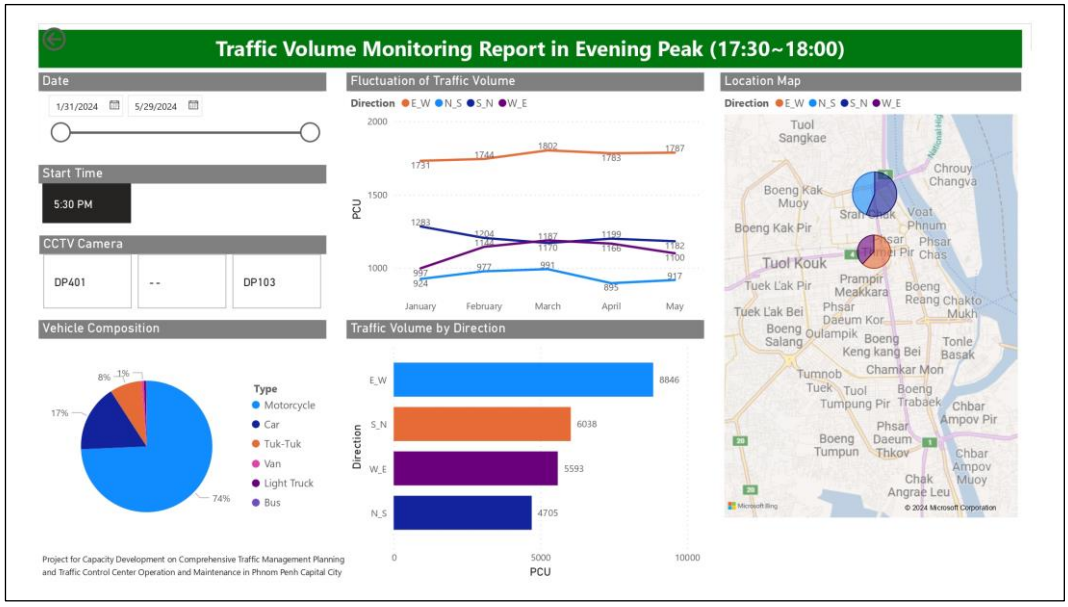


Figure 2.1-2 Fixed Point Survey Results of Traffic Volume and Vehicle Composition based on CCTV Camera Images and AI Data Analysis (Data From Sky)

2.2 Activity for Output 1

Output 1 is "A maintenance management system for the traffic control system is established." the TCC's maintenance management capacity has improved by actively participating in the training on the overall signal control system in Output 2 and the pilot project implemented in Output 3. Specifically, through the training on maintenance management, operation, intersection improvement, communication and traffic management implemented in 2022 under the current TCC organization (Activity 2-1 of Output 2), TCC staff were able to quantify, format and analysed their daily maintenance efforts, allowing them to incorporate these insights in their maintenance routines. The contents of each activity are as follows:

2.2.1 Review the current organization and management structure of TCC (Activity 1-1)

Through interviews with Phnom Penh Capital Administration (PPCA) / Department of

Public Works and Transport (DPWT) /TCC, the expert team understood the organization, structure and management methods for traffic control systems, and prepared an organizational chart at the start of the project, which was approved at the 2nd JCC meeting. During the planning process of the traffic control system expansion, it is necessary to consider the integration of the TCC organization and, as this will be essential for the central coordination of stand-alone junctions in the suburban area (see Figure 2.2-2). Therefore, it is necessary to hold meetings to discuss issues for integration and to communicate with the two organizations at an early stage.

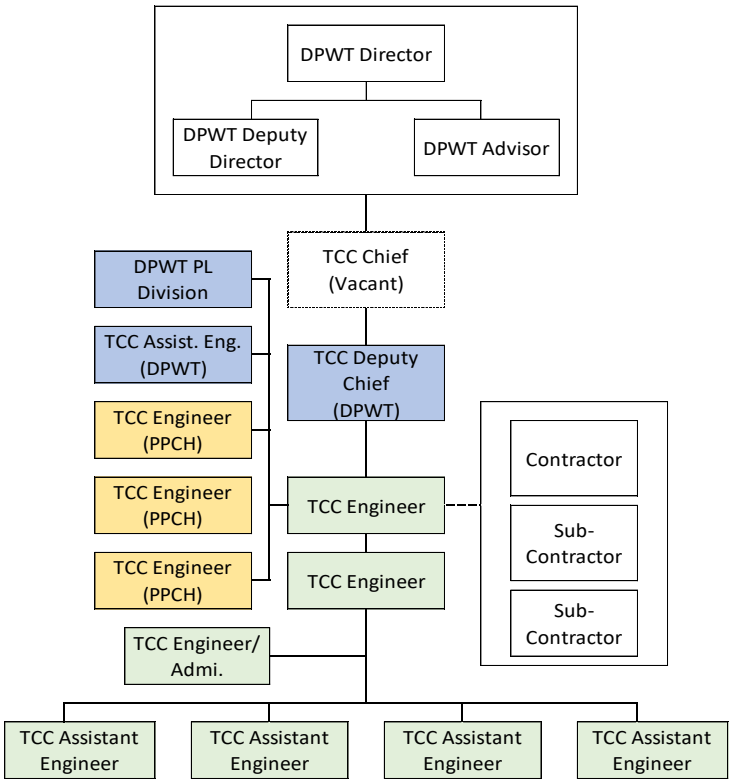


Figure 2.2-1 Organizational Chart of TCC at the Start of the Project

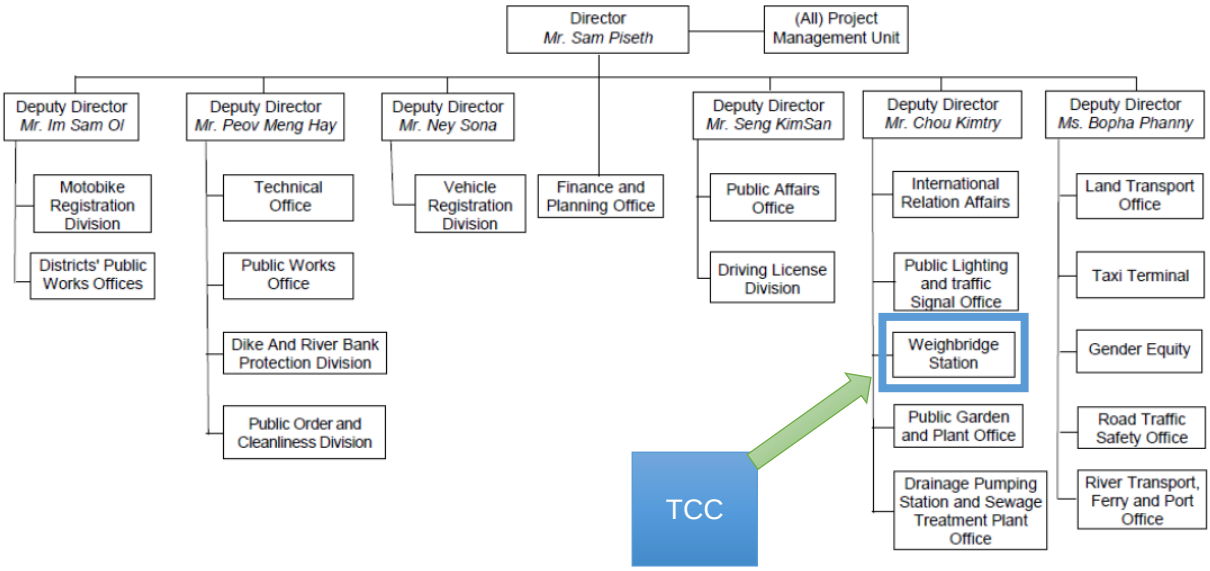


Figure 2.2-2 Integration of TCC and PLTSO

2.2.2 Identify operational and maintenance issues that have occurred since the traffic control system operation started and to develop improvement measures (Activity 1-2)

Every year, the list of issues that have occurred since the traffic control system started working updated (Refer to Annex 2). In 2023, the necessary spare parts identified based on the spare parts inventory list. The 2023 budget proposal submitted to the Ministry of Economy and Finance (MEF) and approved. Additionally, in the training for Output 2, maintenance and inspection work conducted as on-the-job training. This led to an understanding of the need of regular inspections and the on-site confirmation of equipment defects that happened after the traffic control system began operation. A list of defective equipment created. Furthermore, based on the operation, maintenance, and communication systems training in 2022, a new format put into place for the Key Performance Indicator (Signal operation Availability Rate, see Figure 2.2-3) and Spare Parts Inventory for the Phnom Penh traffic control system. Based on this, it became possible to analyse the type and frequency of accidents in the system, and the budget for purchasing spare parts necessary for TCC maintenance and management clarified and expedited.

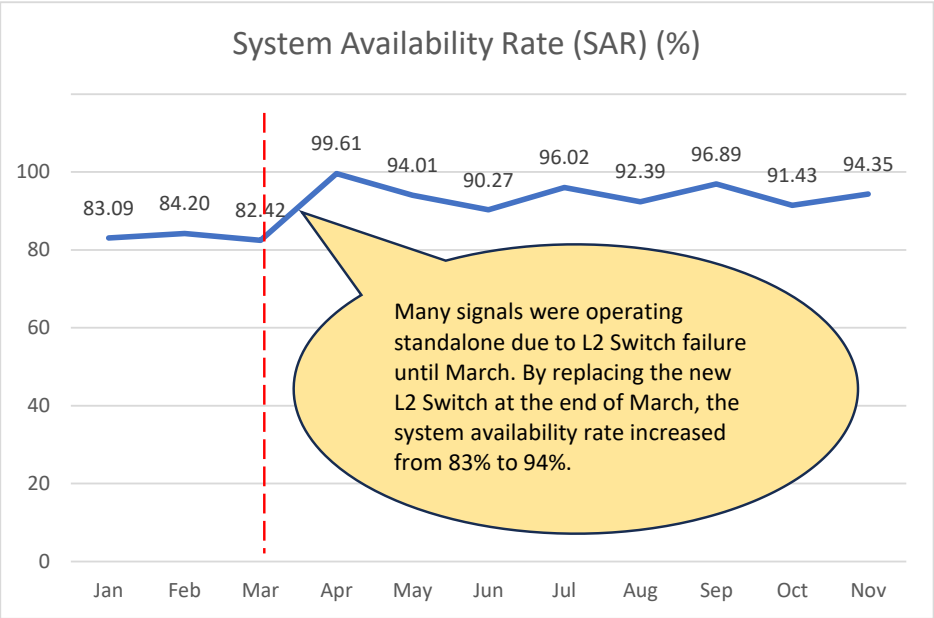


Figure 2.2-3 Traffic Control System Availability Rate (%)

2.2.3 Review the system operations manuals, maintenance manuals and other manuals and to assess their suitability to the circumstances in Phnom Penh (Activity 1-3)

The existing operation manual, which is approximately 3,900 pages, organized into 61 categories. Based on this, and in addition to the results of the maintenance management training in Output 2, a maintenance management manual that is easy to use on-site compiled. (Refer to Book1: Maintenance Management Manual).

2.2.4 Investigate the existing maintenance management organizations and propose a proper maintenance management system including the possibility of outsourcing (Activity1-4)

As of 2024, eight full-time TCC staff members are maintaining 118 signalized intersections in the 28 km²central Phnom Penh. On the other hand, in the suburban area, 14 staff members from the PLTSO, DPWT are maintaining 68 standalone signalized intersections. This urgent issue is how to maintain and manage the 268 signalized intersections throughout Phnom Penh, as proposed at the Traffic Signal Installation Coordination Meeting held on January 25, 2024. The DPWT will continue to play leading role in considering this issue, referring to examples from other countries, such as maintenance management systems in Japanese prefectures and traffic signal maintenance management systems in Metro Manila, Philippines.

2.3 Activity for Output 2

Output 2 is that “Capacity of the TCC staff on the operation of traffic control system is strengthened." Observation of traffic volume at fixed location is essential to analysed traffic characteristics in Phnom Penh, which is the most principal factor in calculating signal parameters.

Since the start of the project, TCC staff and JICA experts have been verifying the accuracy of automatic traffic counters using AI image analysis to obtain traffic analysis data for Phnom Penh, which has a complex vehicle composition. In 2023, we conducted accuracy verification of a new automatic traffic counter service, DataFromSky from the Czech Republic, which considered to effective in analysing traffic characteristics in Phnom Penh. The results shown in Figure 2.3. On the other hand, training on the overall traffic control system conducted by JICA and Sumitomo Electric Industries, Ltd. (Sumiden) engineers, which is important to the success of this project. Details found in Activity 2-2, but the technical evaluation results of TCC staff were 21.0 points before and 57.2 points after the training, passing the target of 55.0 points.

2.3.1 Study additional equipment and software which will be required to extract necessary data from TCC for image analysis, travel speed measurement, etc. (Activity 2-1)

The Team (TCC staff and JICA experts) conducted an experimental automatic traffic count using CCTV video image analysis by AI. It expected that TCC will have a traffic volume monitoring function and will utilize it for traffic control system operations in the future. The experiment conducted by comparing the services of two companies, Intelligence Design Inc. (Japan, hereinafter ID) and RCE systems s.r.o. (Czech Republic, hereinafter RCE). At the project start in 2022, there was no automatic traffic counter service that standardized for local vehicle models such as Remork (tuk-tuk) and Tricycle. After that, through continuous information collection, the Team obtained new information that RCE is offering an automatic traffic counter service, DataFromSky, using AI image analysis that can detect Tricycles as a standard vehicle model (December 2022); so the Team also conducted accuracy verification of this service and decided to use DataFromSky's service because the accuracy of traffic volume was 80% to 90% of the manually counted values for single-lane sections. However, data collection limited to single-lane sections with simple traffic flow. In the case of a four-branch intersection, it is currently not possible to count the intersection traffic volume with a maximum of 12 directions. It was determined that this would be difficult to apply to the traffic survey in the pilot project, and DPWT agreed that for the time being, the traffic survey in the pilot project will be conducted by manual counting using video images. (Refer to Annex 6)

2.3.2 Conduct training of TCC staff members to acquire necessary engineering knowledge related to traffic management (Activity2-2)

Over a period of approximately one month from August 24th, 2022, to September 23rd, 2022, five training sessions were held: 1) Maintenance Training, 2) Operation (Practical) Training, 3) Basic Training in Traffic Signal Control, 4) Communication System Training, and 5) Traffic

Management Training (Refer to Annex 5). Of these, the traffic management training session held over three days on September 21st, 22nd, and 23rd, 2022. The contents of the lectures included policy papers on traffic management (discussion and presentation), parking management, public transport priority measures, and plans for pilot traffic management schemes (discussion and presentation), and the trainees showed an elevated level of motivation in their work.

2.3.3 Conduct training on the mechanism of the traffic control system, operation, modification and upgrade procedures (Activity2-3)

The operational (practical) training conducted six days from August 29th to September 5th, 2022. The training covered basic work procedures, parameter placement for fixed seconds, intersection design methods, parameter placement for cycles, parameter placement for gap actuation, and parameter placement for offsets. Sumiden, which served as the trainers, had originally intended to teach core staff members who possessed exceptional knowledge among the TCC members and share it with the other members. However, at the core staff members' request, the training extended to all TCC members, and the other participants given the chance to practice system set-up and answer sample questions, which helped everyone understand the system better. In addition, basic training on traffic signal control conducted over three days on September 7th, 8th, and 9th, 2022. The training covered the basics of traffic engineering and signal control, traffic signal control planning, and traffic signal control exercises. During the training, there was a positive question and answer session, and participants were eager to understand all the training contents. (Refer to Annex 5)

2.3.4 Conduct training on general maintenance and management work, including the repair of optical fiber cables (Activity 2-4)

Three days of maintenance training held on August 24th, 25th and 26th, 2022. The trainees showed a high level of comprehension after attending lectures and hands-on exercises on topics such as maintenance management of traffic signal systems in foreign countries, maintenance management in Phnom Penh, preventive maintenance principles and processes, repair deceleration and processes, safety during maintenance, preventive maintenance inspection checklists, and reports and inventory management. (Refer to Annex 5).

A two-day training on communication systems also conducted on September 14th and 15th, 2022. Lectures given on the introduction of communication systems, the basics of networks, and the basics of all maintenance activities. The post-training evaluation confirmed that the trainees had a good understanding of the content.

2.3.5 Collect data and information at target intersections and road sections where traffic congestion and accidents have occurred frequently, using data and information from TCC, and analyzing the issues (Activity 2-5)

The figure below shows intersections with the highest congestion rates, which extracted by collecting congestion link data from Google Maps. The results reflected in the long of list of candidate intersections for the pilot project, which explained in Output 3, along with analysis of data on traffic accident hotspots from the National Road Safety Committee, MPWT (NRSC).

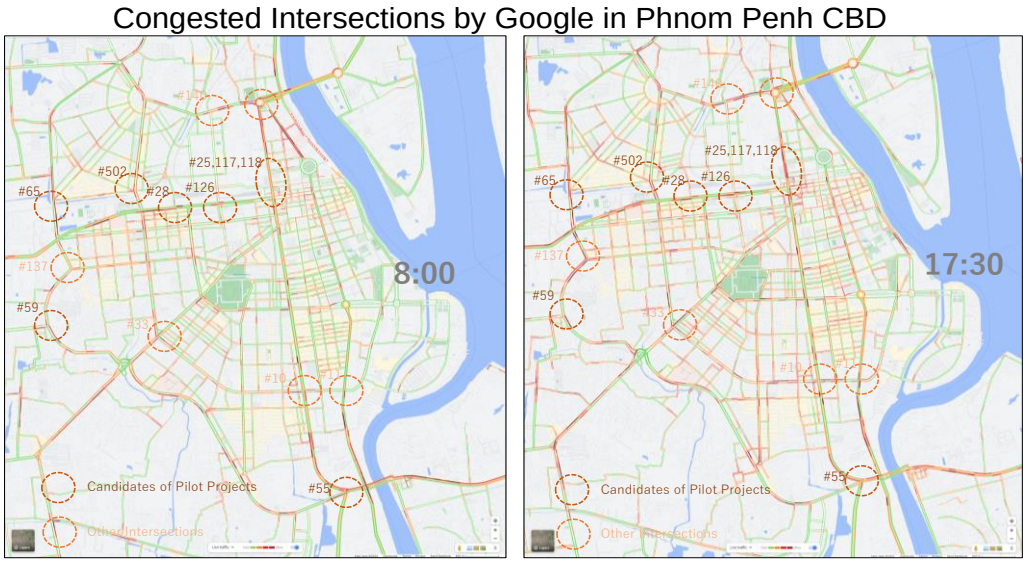


Figure 2.3-1 Example of Problem Intersections using Google Congestion Data

2.4 Activity for Output 3

Output 3 is “Capacity to design traffic signals is strengthened through the implementation of pilot project for traffic signal improvement." The pilot project planned to take into consideration the 3Es (Engineering, Education and Enforcement), procure equipment, install signals, run a traffic safety campaign, and conduct an evaluation. It took about one year from the start of planning to the evaluation.

Table 2.4-1 Implementation Schedule of the Pilot Project

Output 3: Capacity to design traffic signals is strengthened through the implementation of pilot projects	2023						2024						
	April - July	August	September	October	November	December	January	February	March	April	May	June	July
3-1 To identify traffic signals that need parameter modification due to the traffic demand change		3rd JCC Meeting (14 August 2023)									4th JCC Meeting (Beginning of May 2024)		
3-2 To collect and analyze traffic data related to target intersections													
3-3 To modify the design of traffic management incld. the use of traffic signal design software.	Discussion with JCC members												
3-4 To implement the Pilot Project construction, etc. — (1) Manufacturing & transport of Equipment (Pole, latern & controller)		Signal Pole											
		Local Controller											
			Level 5 Board										
				Signal Lantern									
(2) Civil works				Civil Works									
(3) Wiring works					Wiring Works								
(4) Wireless Connection					Wireless Connection (#201 - #206)								
5-1 To conduct of traffic education and enforcement measures					Driver's Education and Traffic Enforcement to the Pilot Project Intersections				Traffic Safety Campaign with 3Es				
3-5 To evaluate the impact of traffic signal design modification								Preparation	PP with 3E	Evaluation of PP			
3-6 To summarize the implementation for traffic signal improvement in a handbook													

2.4.1 Identify traffic signals that need phasing and/or timing plan modification due to the change of traffic demand pattern Pre-Conditions (Activity 3-1)

From the pilot project long of list, which developed based on the work plan proposed at the preparatory survey of the project and various traffic data examined in Activity 2-5, the characteristics/problems of intersections analysed. Then a pilot project short of list developed with an emphasis on contributing to capacity building of the TCC staff (allowing for practical training on several types of intersections, such as newly constructed intersections and intersections on the outskirts of urban areas). The pilot project target intersections shown in Figure 2.4-2 approved during the 2nd JCC meeting.

Location of the Pilot Project

(1) #165: To cope with City Center development (new signal)

(2) #166: To improve the signalized intersection from roundabout (new signal)

(3) #28: Additional left-turn arrow (revision of the phasing + left-turn arrow + revision of road marking)

(4) #126: To cope with intersection improvement, mainly revision of the signal phasing/timing (revision of the phasing)

(5) #25 and #118: Coordination of two intersections in the CBD (introduction of 3Es)

(6) #59 (revision of phasing) and #167 (new signal): Coordination of two intersections at the CBD fringe

(7) #201 - #206: Wireless connection between TCC and 6 intersections along NR No.1 and #59 West (wireless connection)

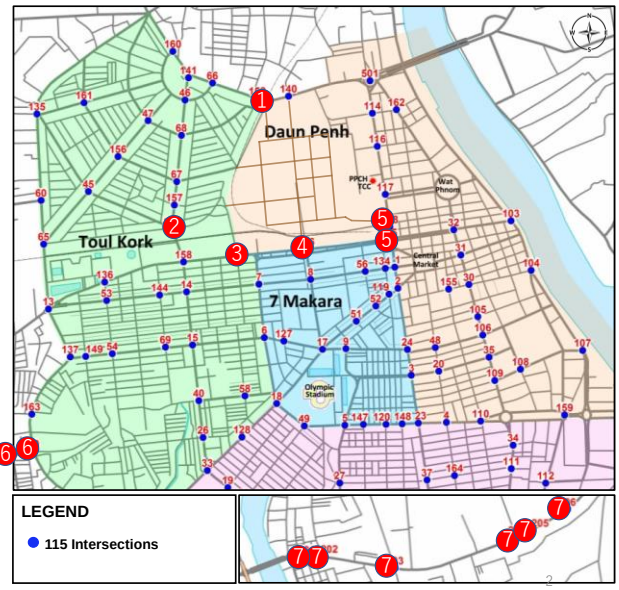


Figure 2.4-2 Pilot Project Intersections

2.4.2 Collect and analyze traffic data related to target intersections (Activity 3-2)

A traffic signal installation contractor chosen through competitive bidding in March 2023

after traffic surveys conducted to determine the contents, scope, period, and data collecting and analysis techniques needed for the updated design and assessment of the pilot project intersections. To evaluate the pilot project, the traffic surveys conducted on weekdays before and after the pilot project, with the pre-survey conducted in March and April 2023 and the post-survey conducted in April 2024. PPTMTC conducted in October 2024. A summary of these three surveys found in Annex 6: Transport Survey and Data for TCC (Pre- and Post-Pilot Project, and Post PPTMTC Project).

2.4.3 Modify the design of traffic management system including the use of traffic signal design software (Activity 3-3)

For the selected pilot project target intersections, signal parameters calculated for 6 of the 8 target intersections, considering the characteristics of each intersection and the results of traffic surveys. At the same time, the geometric design and road markings of the intersections that corresponded to the signal phase also analysed. Following discussions with pertinent DPWT engineers and traffic police officials, the signal and intersection geometric designs created. The two intersections for which signal parameter calculations did not perform were #25-#118 (BeKaSe intersection: pilot project implemented from the perspective of traffic safety and traffic enforcement) and #201-#206 (six standalone intersections along NR No. 1, pilot project for wireless communication was implemented).

2.4.4 Consider and procure necessary tools and/or equipment for traffic signal improvement (Activity 3-4)

a) Procurement of Equipment, etc.

During the Grant Aid Project, the primary tools and equipment for the signal-improved intersections implemented in the pilot project: signal controllers (manufactured by Sumiden) and signal lanterns (manufactured by Koito) made in Japan. In this technical cooperation project, plans were made to procure as much as possible from neighbouring countries, with the exception the controllers, to ensure fair competition and make procurement simple, quick and affordable when the Cambodian side secures its own budget in the future to plan and install new signalized intersections. In addition, ensuring quality that could manage the traffic in Phnom Penh was also a principal factor. As a result, it decided to use signal poles made in Vietnam, signal lanterns made in Thailand, and controllers made in Japan. On the other hand, all signal installation work and wireless connection work, except for the dispatch of engineers and the signal aspect software, ordered from local companies. Procurement and subcontracting related to the pilot project are as

follows:

Table 2.4-2 Subcontract Agreement for the Pilot Project

Type 1	Parameter design and dispatch engineer to Phnom Penh	Sumiden: single tendering, June 2023
Type 2	Wireless communication between TCC and 6 intersections along NR No. 1	Sumiden: single tendering, September 2023
Type 3	Procurement of Japanese-made signal controllers	Sumiden: single tendering, August 2023)
Type4	Signal installation work, including signal lamp procurement	Norak: designated competitive bidding including signal lamp procurement + on-site work for wireless connection work, August 2023

b) Signal installation work

On 24th September 2023, a contract signed with Norak for signal installation work, including the procurement of signal poles and lanterns. Initially, the construction period scheduled from October 2023 to the end of February 2024 (the production of controller completed at the end of January 2024). On 2nd October 2023, a briefing session held for construction-related organizations (Electricite Du Cambodge (EDC), ID, Phnom Penh Water Supply Authority (PPWSA), etc.). Due to a slight delay in obtaining the construction permission letter from the Phnom Penh Governor and the Pchum Ben holiday (Obon in Japan: 12th to 16th October 2023), construction started on 17th October 2023. Since it took time to procure the signal lanterns and controllers, the foundation work including wiring work and the installation of catch basins, started. The completion of the entire work delayed until early March 2024 due to delays in procuring equipment, including semiconductors for signalling equipment.

c) Wireless communication work

Wireless Communication work conducted by Sumiden and Forval (a local electric & communication company). Sumiden was responsible for overall coordination and management, as well as setting the parameter for #201 - #206 on the TCC side. Forval was charge of wireless connection and installing the roadside equipment and completed in December 2023. In the first half of January 2024, Sumiden's work of setting parameter on the TCC side and confirming the wireless connection also completed. (Refer to Annex 10, Book2: Handbook)

2.4.5 Evaluate the impact of traffic signal design modification (Activity 3-5)

To evaluate the intersection improvement plan implemented in the pilot project, a pre-project (April 2023) and post-project (April 2024) traffic survey conducted. The evaluation items were traffic volume, travel speed, congestion queue length, and number of traffic violations. Traffic volume in central Phnom Penh increased by approximately 2% in 2023 and 2024, but travel speed remained unchanged at approximately 13 km/h for both years, which is attributed to the improvement of the road environment and maintaining the travel speed through hard (signal improvement and road improvement) and soft (implementation of traffic safety education) measures to suppress the increase in traffic volume. Congestion length and traffic violations decreased by 15% to 20% and assumed that the signal intersection improvement contributed to the improvement of the urban traffic environment in Phnom Penh. (For details, see Annex 6)

2.4.6 To summarize the procedure from planning to evaluation of implementation for traffic signal improvement in a handbook (Activity 3-6)

The pilot project procedures on improving signalized intersections, from planning to implementation besides evaluation and compiled in a handbook. The purpose of the handbook was to make it available to TCC staff for use when constructing or improving signalized intersections in the future. Although the pilot project completed jointly by JICA experts, the major division of roles was that both parties jointly did the planning and evaluation stages of the pilot project, while the implementation stage led by TCC staff (Refer to Annex 10, Book 2:Handbook).

2.5 Activity for Output 4

Output 4 is " Capacity of the relevant staff to traffic control in PPCA, DPWT and TCC staff to develop the expansion plan of traffic control system is strengthened." Phnom Penh's traffic management system completed at the end of 2018, has contributed to improving the urban transport environment in central Phnom Penh. As urbanization of the suburban area of Phnom Penh continues to progress, the traffic control system expansion plan will also play a significant role to accommodate these circumstances.

2.5.1 Examine the area of the traffic control system expansion, considering the urbanization trend of Phnom Penh, the traffic conditions at major intersections and characteristics of the traffic control system (Activity 4-1)

Data collection and on-site surveys conducted to understand the urbanization trends in

Phnom Penh, including urban development, and the road traffic situation. Information collected and organized through interviews with relevant parties regarding the development of major transport infrastructure in Phnom Penh.

2.5.2 Develop the expansion plan of the traffic control system. (Activity 4-2)

The expansion plan for the traffic control system developed in suburban areas where urbanization is rapid besides the urbanization situation and road network are different from central Phnom Penh. PPTMTC Traffic Control System Expansion Plan Coordination Meeting held on 25th January 2024, the new signal intersection plan for Phnom Penh compiled by PPTMTC experts and TCC staff was exchanged with stakeholders (Phnom Penh Capital Hall (PPCH), DPWT, police, district (Khan) representatives), and the intersections targeted for the expansion plan, shown in the figure below, were approved.

Control System		Management Body	No. of Intersections	Remarks
Existing	Centrally Control	TCC/DPWT	118	109 (Central Area) 6 (Along NR No. 1) 3 (Pilot Project)
	Pre-time Setting	Public Lighting/DPWT Standalone	68	70 (Existing) 2 Relpaced by PPTMTC PP
	Sub Total		186	
Plan	DPWT		25	2021 - 2023
	JICA-PPTMTC		38	Proposed
	Requested by Khan		19	By Coordination Meeting held in 25 Jan. 2024
	Sub Total		82	
Grand Total			**268**	

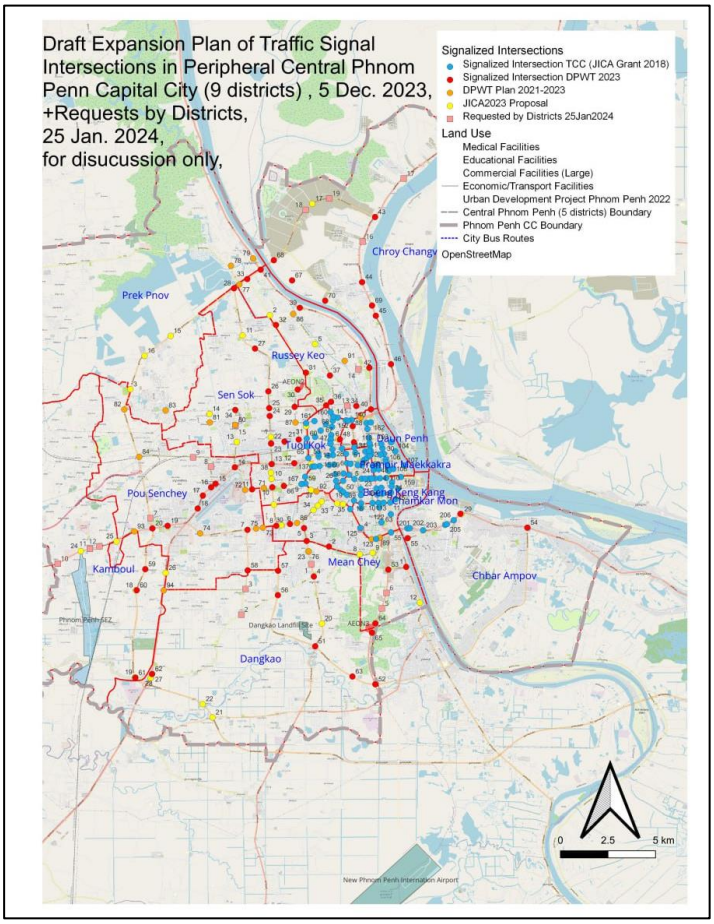


Figure 2.5-1 Proposed Intersections covered by the Traffic Control System Expansion Plan (as of January 31, 2024)

Based on the target signal intersections in this expansion plan, the traffic control system, communication system, intersection improvement plan and maintenance management system developed in discussion with TCC staff. (Refer to Annex 4, Book3: Traffic Control System

Expansion Plan)

2.6 Activity for Output 5

Output 5 is "Capacity of urban transport related organizations on traffic management measures is strengthened towards enhancement of the project sustainability."

2.6.1 Consider and identify tools and/or equipment for the conduct of traffic enforcement measures to support the traffic management system in Phnom Penh (Activity 5-1)

To address issues in the field of urban traffic management that Phnom Penh faces, especially parking measures and revitalization of public transport, in addition to the traffic control system, information is gathered and opinions are exchanged through interviews with urban transport-related organizations MPWT, DPWT, PPTP and Universities that oversee and collaborate with traffic management measures in Phnom Penh. Parking Management and City Bus Authority (CBA) Update are the materials created by PPTMTC urban traffic management experts throughout the discussion. A meeting with the Phnom Penh Traffic Police held to discuss the tools and equipment for complying with traffic laws. However, while the tools and equipment are important, there was a request to share the history and content of Japan's efforts in traffic enforcement to help the Phnom Penh Police in their enforcement. Therefore, a traffic enforcement instructor who was a former head of the traffic regulation division of the Tokyo Metropolitan Police Department gave a lecture on Japan's experience in traffic enforcement to the Phnom Penh Traffic Police and the National Traffic Police, and a traffic enforcement exercise was conducted on-site during the traffic safety campaign of the pilot project. These contents compiled into the Traffic Enforcement and Traffic Safety Education Manual, which described in Activity 5-3 below (Refer to Technical Cooperation Deliverable: Traffic Enforcement and Traffic Safety Education Manual).

2.6.2 Review the current traffic enforcement measures, issues and conduct the on-the-job training for the traffic enforcement (Activity 5-2)

After changing the signal control parameters and intersection geometric design of the pilot project (E1: Engineering of the 3Es), a traffic safety campaign incorporating traffic safety education (E2: Education) and traffic enforcement (E3: Enforcement) for road users implemented in March 2024. For traffic enforcement (E3), a former traffic police officer who served as the head of the Tokyo Metropolitan Police Department's Traffic Regulation Division invited as the lecturer to conduct practical training.

2.6.3 Develop the traffic enforcement and driver's education handbook (Activity 5-3)

The target group for the traffic enforcement manual is traffic police officers of the Phnom Penh Traffic Police, and the contents were lectured by a traffic enforcement instructor who was a former head of the traffic regulation section of the Tokyo Metropolitan Police Department to the Phnom Penh Traffic Police and the National Police Agency on the experience and content of traffic enforcement in Japan. Traffic enforcement exercises conducted by the traffic enforcement instructor at site during the pilot project enforcement. The Traffic Enforcement Manual is a compilation of these. The target group for the traffic safety education manual which made for the Phnom Penh Traffic Police and the Road Safety Office, DPWT. According to the latest traffic accident data, the highest traffic accident rate is motorbike riders between the ages of 16 and 40, considering gender, age group, and vehicle type. Therefore, this manual made to encourage compliance with traffic rules among Phnom Penh residents who use intersections, especially young adults. (Refer to Technical Cooperation Deliverable: Traffic Enforcement and Traffic Safety Education Manual)

2.6.4 Disseminate the Project's outputs/activities to the public through the mass media and workshop/seminar (Activity 5-4)

The project's results and activities communicated with stakeholders, mainly Phnom Penh residents, in the following ways:

(1) A newsletter introducing the project's activities was published in Khmer, English, and Japanese four times during the project period.

(2) During the pilot project's road safety campaign, 1) Banners were set up, 2)Pamphlets were distributed by Cambodian Red Cross student volunteers, 3)Traffic enforcement by the traffic police, 4)Traffic safety video clips were distributed on the Phnom Penh City website and social media (Phnom Penh Capital Hall (PPCH)'s X had approximately 500,000 followers, and the two video clips of the PPTMTC had a combined total views of approximately 120,000), and 5) An interview with FM102 was conducted.

(3) Two seminars were held; 1) PPTMTC Pilot Project Seminar: project was introduced at a project seminar attended by approximately 170 urban transport-related stakeholders and 2) Joint Seminar for Road Safety with NR No.5 Road Safety Technical Cooperation Project.

2.7 Training in Japan

The training in Japan of the first group (7 trainees) was from 31st January to 10th February

2024, while that of the second group (6 trainees) was from 14th -27th February 2024, with a schedule that included Tokyo, Hiroshima, and Kyoto. Representatives from each group gave presentations to summarize the program, and a presentation, evaluation session, project completion certificate presentation ceremony, and closing ceremony held with the participation of JICA HQ project staff and those in charge of training in Japan. The main places visited, and lectures given are as follows:

Table 2.7-1 Outline of Training in Japan

Target	Training Organization/Place	Contents of Training, etc.
Policy and Plan of Traffic Management in Japan	Otemachi-Marunouchi-Yurakucho (Dai-Maru-Yu) Urban Planning Council	Urban Planning and Parking Measures around Tokyo Station (Central Station in Japan)
	Tokyo Metropolitan Hall	Visit to Capital Hall in Japan (Same as Phnom Penh as the Capital Hall)
Learn Traffic Management Measures including Urban Planning in Japan	Institute for Traffic Accident Research and Data Analysis (ITARDA)	Role and Outline of ITARDA
	Traffic Control Center in Tokyo Metropolitan Police Department	Visit to Traffic Control Center
	Hiroshima City	Lecture of Public Transport System Planning, Visit to Redevelopment in Southern Hiroshima Station Plaza and Visit to Hiroshima Bus Center
	Kyoto City	Lecture for Urban Transport Planning in Kyoto City
	Basta Shinjuku	Largest Bus Terminal in Japan
Learn Japan's Cutting-edge ITS Technology	Professor OZAKI, Toyo University	Lecture on Japanese ITS technology
	Sumitomo Electric Company	Lecture for Repair of Optic Fiber Cable Cutting
Learn Japanese Culture	Tokyo Tower	Second tallest Radio Tower
	Odaiba (Commercial center in Tokyo Bay Reclamation Area)	The central commercial district of Tokyo Waterfront New City in the reclaimed land area of Tokyo Bay
	Kinkaku-ji Shrine	Japanese Shrine in Kyoto, Designated a World Heritage Site
	Hiroshima Peace Memorial Park	Hiroshima Peace Memorial Park is a Urban Planning Park established to commemorate the victims of the atomic bomb and to pray for lasting world peace.



Learn about "Administrative management using data-based road planning and ITS" from Professor Ozaki



Visit to the Traffic Control Center (TCC) in Tokyo Metropolitan Police Department

3. Activity Achievement of Project

3.1 JICA Expert Dispatch Record

The JICA experts' dispatch times are indicated below.

Table 3.1-1 JICA Expert Dispatch Record (Assignment in Cambodia)

Plan（PDM Ver.00）		Dispatch period	Actual
Masato Koto [METS] Chief Consultant/Traffic Management Policy	15.00MM	2022/1/16-2022/2/23 2022/4/1-2022/4/30 2022/6/1-2022/6/30 2022/7/15-2022/8/12 2022/9/6-2022/9/21 2022/10/11-2022/11/9 2023/1/11-2023/1/30 2023/2/13-2023/3/11 2023/6/22-2023/7/21 2023/9/20-2023/10/19 2023/12/10-2024/1/8 2024/2/25-2024/3/31 2024/5/28-2024/6/24 2024/7/3-2024/8/1 2024/11/1-2025/1/12 2025/1/31-2/14	15.33 MM
Masato Koto [METS] Road Design (1)/ Pilot Project Construction Supervision	-MM	2023/4/21-2023/6/4 2023/7/22-2023/8/20 2024/1/9-2024/1/29 2024/9/22-2024/9/30	3.63 MM
Masato Koto [METS] Traffic Control System Software	-MM	2024/8/2-2024/8/31	1.00 MM
Masato Koto [METS] Traffic Control System Hardware Expert/Signal Equipment	-MM	2024/12/20-2024/12/28	0.30 MM
Atsushi Suganuma [SET] Traffic Control System Planning	10.00MM	2022/4/1-2022/4/30 2022/8/1-2022/9/14 2022/11/14-2022/12/13 2023/6/14-2024/7/13 2023/11/27-2024/1/13 2024/3/25-2024/4/23 2024/5/22-2024/7/5 2024/9/19-2024/10/30	10.00 MM
Kiminari Takahashi [IDCJ] Traffic Management Planning	5.50MM	2021/3/22-2022/4/20 2022/8/18-2022/9/16 2022/3/29-2023/4/27 2023/11/28-2023/12/27 2024/9/25-2024/11/8	5.50 MM
Sungjoon Hong [PCKK] Traffic Signal Design and operation	6.00MM	2021/3/10-2022/4/10 2022/7/16-2022/8/27	6.00 MM

		2022/11/1-2022/11/30 2024/6/15-2024/7/17 2024/9/28-2024/11/8	
Ramon S Ona [RSO] Traffic Signal Maintenance	6.00MM	2022/11/1-2022/11/30 2022/3/2-2022/3/31 2023/8/1-2023/9/14 2023/10/25-2023/12/8 2024/1/20-2024/2/18	6.00 MM
Akitoshi Iio [METS] Road and Public Transport planning	4.50MM	2022/3/22-2022/4/6 2022/8/26-2022/9/24 2023/9/1-2023/9/30 2023/12/11-2023/12/27 2024/8/15-2024/9/12	4.50 MM
Michiko Kondo [PCKK] Communication System	5.50MM	2021/3/22-2022/4/20 2022/8/18-2022/9/16 2022/3/29-2023/4/27 2023/11/28-2023/12/27 2024/9/25-2024/11/8	5.50 MM
Chikahiko Machida [METS] Road Design/ Pilot Project Construction Supervision	9.00MM	2022/8/16-2022/9/14 2022/11/7-2023/12/6	2.00MM
Hideo Maeda [METS] Road Design (2)/ Pilot Project Construction Supervision	-MM	2023/5/10-2023/6/8 2023/9/21-2023/10/10 2023/11/6-2023/11/29 2024/2/5-2024/3/5 2024/12/9-2024/12/19	3.50 MM
Hideo Maeda [METS] Traffic Control System Hardware Expert/Signal Equipment	-MM	2024/2/24-2024/3/4	0.33 MM
Kaoru Yamada [OCG] Traffic Survey and Analysis	8.50MM	2022/4/3-2022/5/11 2022/6/20-2022/6/26 2022/11/24-2022/12/23 2023/3/22-2023/4/20 2023/8/2-2024/8/31 2024/1/23-2024/2/18 2024/4/1-2024/4/28 2024/8/19-2024/9/15 2024/10/21-2024/11/13	7.87 MM
Kong Sovann [INDRADAVY] Traffic Enforcement and Traffic Safety	4.50MM	2023/11/16-2024/1/29 2024/6/1-2024/6/15 2024/9/9-2024/10/23	4.50 MM
Mitsue Tamagake [IDCJ] Capacity Building and Training (1)	5.50MM	2022/5/18-2022/6/6 2022/8/26-2022/9/24 2022/11/2-2022/11/17 2024/1/22-2024/2/5 2024/5/13-2024/5/16 2024/7/9-2024/8/15 2024/11/29-2025/1/2	5.50 MM
Yuuji Mochizuki [SET] Traffic Control System Software	5.00MM	2022/8/1-2022/9/14 2023/5/28-2023/7/11	4.00 MM

		2024/5/22-2024/6/20	
Katsumi Edamatsu [METS] Traffic Control System Hardware Expert/Signal Equipment	2.50MM	2022/6/15-2022/6/29 2023/8/1-2023/8/19 2024/8/5-2024/8/26	1.87 MM
Ayako Akimoto [METS] Capacity Building and Training Expert (2)/Seminar	3.00MM	2023/8/2-2023/8/16 2024/4/8-2024/5/7 2024/7/22-2024/8/2 2024/11/28-024/12/15 2025/1/30-2025/2/13	3.00 MM
Total	96.00MM		93.27 MM

Table 3.1-2 JICA Expert Dispatch Record (Assignment in Japan)

Plan（PDM Ver.00）		Dispatch period	Actual
Masato Koto [METS] Chief Consultant/Traffic Management Policy	0.50MM	2022/12/27-2023/1/11	0.50 MM
Masato Koto [METS] Road Design (1)/ Pilot Project Construction Supervision	-MM	2023/10/23-2023/10/27 2023/12/21-2023/12/26 2024/6/17-2024/6/28	1.00 MM
Chikahiko Machida [METS] Road Design/ Pilot Project Construction Supervision	1.50MM	2022/12/27-2023/1/11	0.50 MM
Atsushi Suganuma [SET] Traffic Control System Planning	0.50MM	2022/12/27-2023/1/11	0.50 MM
Kiminari Takahashi [IDCJ] Traffic Management Planning	0.50MM	2022/9/28-2022/9/29 2022/5/1-2022/5/2 2023/7/31-2022/8/2 2023/9/4-2022/9/6	0.50 MM
Kaoru Yamada [OCG] Traffic Survey and Analysis	-MM	2023/6/16-2023/7/3 2024/6/4-2024/6/6 2024/6/26-2024/6/26 2024/12/16-2024/12/24 2025/1/8-2025/1/9	0.63 MM
Michiko Kondo [PCKK] Communication System	-MM	2024/9/13-2024/10/4	0.43 MM
Ayako Akimoto [METS] Capacity Building and Training Expert (2)/Seminar	3.00MM	2023/10/23-2023/10/27 2023/11/13-2023/11/17 2023/12/16-2023/12/26 2024/1/10-2024/1/23 2024/6/17-2024/6/28 2024/11/7-2024/11/20 2024/12/20-2024/12/26 2025/1/27-2025/1/28 2025/2/14-2025/2/18	3.00 MM
Total	6.00MM		7.06 MM
Grand total	100.00MM		100.33 MM

3.2 Supplied Equipment in the Pilot Project

Table 3.2-1 Main Supplied Equipment in the Pilot Project

No.	Equipment	Location	Purpose	Remarks
1.	Multifunction Color Printer	JICA Project Office PPCH (4th Floor)	To print materials related to this project	Transfer to DPWT(TCC)
2.	LEVEL5 Platform	Pilot project target intersections #201, #206	To improve the important internal infrastructure required for installing traffic lights at target intersections in the pilot project	〃
3.	Type A /Signal Pole + 1 Arm	Pilot Project Intersections #165, # 166 & # 167	For the signal poles required for installing traffic lights at the target intersections in the pilot project	〃
4.	Type C /Signal Pole + 2 Arms	Pilot Project Intersections #166	〃	〃
5.	Type P /Pedestrian Signal Pole	Pilot Project Intersections #166 & #167	For pedestrian signal poles required for installing traffic lights at target intersections in the pilot project	〃
6.	Vehicle Lantern 3 arrows	Pilot Project Intersections #165, # 166 & #167	It is a vehicle signal lamp that is necessary when installing traffic lights at target intersections in the pilot project.	〃
7.	Vehicle Lantern 3 balls	〃	〃	〃
8.	Pedestrian Lantern	〃	Drawing attention to drivers making right turns or are distracted while driving	〃
9.	Local Controller Large / J	Pilot Project Intersections #166	Traffic signal controller that is necessary when installing traffic signals at target intersections in the pilot project.	〃
10.	Local Controller Standard / R	Pilot Project Intersections #165, #167	〃	〃

11.	Cabinet	Pilot Project Intersections #165, #166 &#167	Supplementary case that is necessary for installing traffic lights at the target intersections in the pilot project.	〃
12.	Fusion Splicer	JICA Project Office PPCH (TCC/9th Floor)	It is possible to connect broken optical fiber cables using a fusion splicer, and this equipment will be useful in repairing problem areas in the future.	〃
13.	OTDR (Optical Time-Domain Reflectometer)	〃	OTDR is an optoelectronic instrument used to characterize an optical fiber. It is the optical equivalent of an electronic time domain reflectometer which measures the impedance of the cable or transmission line under test. When identifying a broken optical fiber cable, the optical pulse tester can find the broken part, which is useful for repairing problem areas and for maintenance and inspection in the future.	〃
14.	Small Truck	Car Parking of PPCH	In the event of an emergency or when immediate transportation is needed for maintenance, inspection, etc., TCC can respond promptly using a vehicle that can carry repair equipment.	〃

4. Revision History of PDM

4.1 Changes Made to PDM during the Project

The following details are the changes made to PDM during the project duration.

Table 4.1-1 Revision History of PDM

Version	Date	Revision detail
Version 00 Refer to 4.2 (1)	2022/02	Original (Described in R/D)
Version 01 Refer to 4.2 (2)	2024/07	[Revised Objectively Verifiable Indicators] **Overall Goal** 1. Travel speed of the main road after the project increases by 8% compared to before the project. Reason: The results of a survey on travel speed on Monivong Blvd. before and after the completion of the traffic control system through Grant Aid were 11.34 km/h (2017) and 15.23 km/h (2018)－an improvement of 34.3%. The ratio of investment cost for the Technical Cooperation Project and the Grant Aid construction was 1.00:4.25. Based on the above, the improvement target for travel speed was set at 8.0% (=34.3*0.24). 2. Changed from "Number of interviewees who understand traffic rules/regulations increases." to "Number of interviewees who answered "Better" for the comparison traffic conditions between 2023 and 2024." As a result, 69% of respondents answered that traffic conditions in 2024 will be "improved" compared to 2023. **Project Purpose** 1. The Key Performance Indicator (KPI) for the traffic control system was changed from Accident repair time of the traffic control system to Availability of the traffic control system. In addition, the improvement target was set at 95%. 2. The reduction rate of the number of traffic violators was set at 8%. **Output 2** 2-2 Target score of the evaluation test for TCC staff is 55 points. This is based on passing score of the test for the 1st or 2nd-class Qualified Electrician in Japan. (60 points). **Output 3** 3-2 The reduction rate of congestion queue length at the target major intersections was set at 8%.

4.2 PDM

PDM for each version is as shown below.

Version 00 (PDM described in R/D)

Table 4.2-1 PDM, Version 00 (PDM in the Record of Discussion of this Project)

Project Design Matrix

Project Title: Project for Capacity Development on Comprehensive Traffic Management Planning and Traffic Control Center operation and maintenance in Phnom Penh Capital City — **Version 00**

Implementing Agency: Phnom Penh City Administration, Department of Public Works and Transport in Phnom Penh Capital City,Traffic Control Center (TCC) and Phnom Penh Traffic Police — **Dated 15th July 2021**

Period of Project: February, 2025

Project Site: The whole area of the Phnom Penh Capital City (678.46km2)

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption	Achievement	Remarks
Overall Goal					
Sustainable urban transport environment is formed through effective operation of the traffic control system.	1. Travel speed of the main road after the project increases by XX% compared to before the project. Note:Target sites are selected by the end of the Project. 2. Number of interviewees who understand tragic rules/regulations increases. Note: Interviewees are selected from the participants in the Final Seminar of the Project.	1. Travel speed survey 2-1. TCC monthly/Annual report 2-2. Interviews with government agencies and citizens.			
Project Purpose					
Traffic management measures including traffic safety measures in Phnom Penh is improved through strengthening capacity of operation and maintenance of traffic control system.	1.Accident repair time of traffic control system is reduced by XX% compared to when the project starts. 2. Results of the traffic data analysis at major intersections are summarized in the monthly report. 3. Number of traffic violators decrease by XX%. * Target major intersections are determined within 3 months after the project starts.	1. TCC Monthly/Annual report 2. TCC Monthly/Annual report 3. Survey on the number of traffic offenders	The traffic management policy of the Cambodian government does not change.		
Outputs					
Output 1: Maintenance management system of traffic control system is established.	1-1. A trouble list that occurred after the traffic control system started operation is developed. 1-2. Proposed maintenance system is approved by DPWT Director. 1-3. Developed manual by counterparts is approved by the DPWT Director.	1-1 Project report 1-2 Project report 1-3 Project report			
Output 2: Capacity of TCC staff on the operation of trafic control system is strengthened.	2-1. Through the training, TCC staff are able to analyze / design / repair problematic intersections by themselves. 2-2. Target score of the evaluation test for TCC staff is achieved. Note: Target score will be decided by experts and counterparts within 6 months after starting the Project. 2-3. TCC staff can repair quickly at cutting OFC by themselves	2-1 Project report 2-2 Evaluation test results (before and after). 2-3 Project report			
Output 3: Capacity to design traffic signals is strengthened through the implementation of pilot projects for traffic signal improvement.	3-1. TCC staff can select the intersections which need revision of traffic control system design by using evaluation criteria developed by themselves. 3-2. A pilot project is implemented and the queue length at the target major intersections are reduced by XX%. 3-3. The counterparts take the lead in compiling pilot project handbook, which explains the procedure from planning to project evaluation.	3-1 Project report 3-2 Intersection queue length survey results 3-3 Project report			
Output 4: Capacity of the relevant staff to traffic control in PPCA, DPWT and TCC staff to develop the expansion plan of traffic control system is strengthened.	4-1. Counterparts can analyze the base data for the development of traffic control system extension plan such as urbanization in Phnom Penh and traffic situation at intersections where traffic signals are needed. 4-2. Traffic control system expansion plan is approved by the DPWT Director.	4-1 Project report 4-2 Project report			
Output 5: Capacity of urban transport related organizations on traffic management measures is stregnthened towards enhancement of the project sustainability.	5-1. Implementation training on traffic control is carried out XX times or more. 5-2. Traffic safety enforcement and a traffic safety education manual are developed and approved by the traffic police. 5-3. Workshops / seminars are held XX times or more.	5-1 Project report 5-2 Project report 5-3 Project report			

Version 01 (Revised at the 4th JCC meeting)

Table 4.2-2 PDM, Version 01 (PDM approved by the 4th JCC Meeting)

Project Design Matrix			
Narrative Summary	**Objectively Verifiable Indicators**	**Means of Verification**	**Achievement**
Overall Goal Sustainable urban transport environment is formed through effective operation of the traffic control system.	1. Travel speed of the main road after the project increases by 8% (*1) compared to before the project. Note: Target corridors are selected before the Pilot Project.	1. Travel speed survey (Daily Average along 3 Major Corridors in the Phnom Penh Central Area)	Before Pilot Project: 13.3km/h. After Pilot Project: 13.2km/h. (decreased by 0.8%) (*4)
	2. Number of interviewees who answered "Better" for the comparison traffic conditions between 2023 and 2024. Note: Interviewees are from the participants in the PPTMTC Seminar held on 08 August 2024.	2. Questionnare to PPTMTC Seminar participants of government agencies and citizens	69% of participants respond to the questionnare said "Better".
Project Purpose Traffic management measures including traffic safety measures in Phnom Penh is improved through strengthening capacity of operation and maintenance of traffic control system.	1. Target Availability of the Traffic Control System (Key Performance Indicator: KPI) sets by 95% (*2). 2. Results of the traffic data analysis at major intersections are summarized in the monthly report. 3. Number of traffic violators decrease by 8% (*1). Note: Target major intersections was determined before the Pilot Project.	1. TCC Monthly/Annual report	Before PPTMTC Training: 83.24% After PPTMTC Training: 94.37% (Increased by 11.2%)
		2. Traffic Volume Monitoring Report in Evening Peak (17:30 - 18:00)	Summarized in Dashboard Data: CCTV Camera Video Image Analysis:DataFromSky
		3. Pilot Project Traffic Survey on the number of traffic offenders of Traffic Rules at Pilot Project Intersections	Before Pilot Project: 1,592 After Pilot Project: 1,256 unit: drivers/intersection/3 hours (Decreased by 21.1%) (*5)
Outputs Output 1: Maintenance management system of traffic control system is established.	1-1. A trouble list that occurred after the traffic control system started operation is developed. 1-2. Proposed maintenance system is approved by DPWT Director. 1-3. Developed manual by counterparts is approved by the DPWT Director.	1-1 Responses to Accidents to the Traffic Signal System (2018 - 2023)	Top 3 TCC activites 1. OFC related: 38% 2. Local Controller related: 19% 3. Lantern/Must-arm related: 12%
		1-2 Maintenance Management Manual	Explain in the Maintenance Management Manual
		1-3 Maintenance Management Manual	Completed
Output 2: Capacity of TCC staff on the operation of traffic control system is strengthened.	2-1. Through the training, TCC staff are able to analyze / design / repair problematic intersections by themselves. 2-2. Target score of the evaluation test for TCC staff (55 points) is achieved (*3). Note: Target score was decided by experts and counterparts before Pilot Project. 2-3. TCC staff can repair quickly at cutting OFC by themselves	2-1 TCC Monthly Report and Pilot Project Handbook	Perform TCC Staff's Activities through PPTMTC Training and Pilot Project
		2-2 Evaluation test results of PPTMTC Training (before and after).	Before Training: 21.0 points After Training: 57.2 Points (Target Score is 55 points)
		2-3 TCC Monthly Report	TCC staff can repair OFC problems using Pickup truck, Fusion splicer and OTDR.
Output 3: Capacity to design traffic signals is strengthened through the implementation of pilot projects for traffic signal improvement.	3-1. TCC staff can select the intersections which need revision of traffic control system design by using evaluation criteria developed by themselves. 3-2. A pilot project is implemented and the queue length at the target major intersections are reduced by 8% (*1). 3-3. The counterparts take the lead in compiling pilot project handbook, which explains the procedure from planning to project evaluation.	3-1 Pilot project Work at Site and Pilot Project Handbook	Completed
		3-2 Intersection queue length survey results (Average Queue Length of each Inflow)	Before Pilot Project: 40m After Pilot Project: 34m (Decreased by 15.4%) (*6)
		3-3 Pilot Project Handbook	Completed
Output 4: Capacity of the relevant staff to traffic control in PPCA, DPWT and TCC staff to develop the expansion plan of traffic control system is strengthened.	4-1. Counterparts can analyze the base data for the development of traffic control system extension plan such as urbanization in Phnom Penh and traffic situation at intersections where traffic signals are needed. 4-2. Traffic control system expansion plan is approved by the DPWT Director.	4-1 Pilot Project Work and Traffic Control System Expansion Plan	Completed
		4-2 Approve by the DPWT Director by December 2024	Completed
Output 5: Capacity of urban transport related organizations on traffic management measures is strengthened towards enhancement of the project sustainability.	5-1. Implementation training on traffic control is carried out 2 times or more. 5-2. Traffic safety enforcement and a traffic safety education manual are developed and approved by the traffic police. 5-3. Workshops / seminars are held 2 times or more.	5-1 Training	Completed 1st Training: October 2022 from PPTMTC Experts and SUMIDEN Engineers 2nd Training: January 2024 from SUMIDEN Engineers
		5-2 Traffic Enforcement and Traffic Safety Education Manual	Completed
		5-3 Workshops/Seminars	Completed 1st Seminar: Hold in 8th August 2024 2nd Seminar: Joint Seminar with NR No. 5 Road Safety TCP Team hold in 03 December 2024

Red Text in red: Contents revised based on discussions with C/P.

Note

*1: Target increase rate of travel speed was based on the Travel Speed Survey along Monivong Blvd. in 2017 and in 2018 conducted before and after Traffic Signal System Installation Work by Japan Grant Aid. Before Grant Aid (Year 2017): 11.34 km/h. and after Grant Aid: 15.23 km/h. The increase rate between 2 years was 34.3%.
Based on above data, (1) Target increase rate of traffic related index which is indirectly affected to the Pilot Project, such as travel speed, is 5%, and (2) Target decrease rate of traffic related index which is directly affected to the Pilot Project, such as congestion queue length and no. of traffic offenders, is also 8%.

*2: Key Performance Index (KPI) of traffic control system changed to Availability of the Traffic Control System from Traffic Signal Repair Time, because of the easier data collection and understanding to the PPCH citizens. Target availability rate is 95%, hoping reach 100%.

*3: Target score of the evaluation test for TCC staff is 55 points. This is based on passing score of the test for the 1st or 2nd-class Qualified Electrician in Japan. (approx. 60 points).

*4: Average Travel speed along Russian Blvd., Monivong Blvd. and CDG&Monireth Blvd. inside the CBD in 6 hours including peak and off-peak.

*5: Number of vehicles going straight or turning left ignoring red light. Excluding #165 (newly installed traffic signal in 2024).

*6: Average in 3 hours in peak and off-peak, excluding #166 (Road closure on Russian Blvd. for VIP traffic) and #118 (Requesting remeasurement)

5. Joint Coordinating Committee (JCC) and Working Group (WG)

5.1 Structure of JCC and WG

The structure of the JCC and the WG is shown in Figure 5.1-1. The JCC is chaired by PPCA, and the WG is basically chaired by the Director General of DPWT. However, depending on the issue, TCC Chief or the Phnom Penh Police Chief may also serve as the chair.

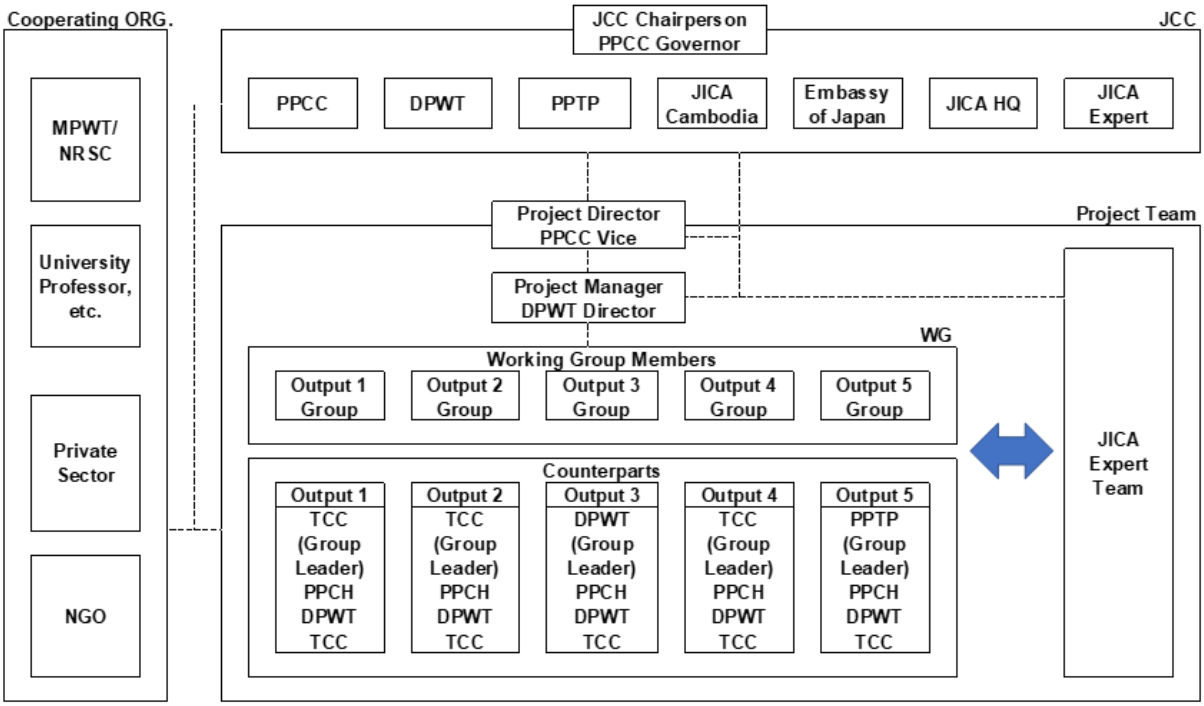


Figure 5.1-1 Structure of JCC and WG

5.1.1 JCC

The JCC was established to confirm the overall direction of the project, approve the pilot project implementation plan, construction work, etc., and share ideas to address issues that may arise during the implementation of the project. The members of the JCC are as follows:

Table 5.1-1 Members of JCC

	Designation	Position & Department
1	Chairperson	Governor, PPCA
2	Member from Cambodia Side	Project Director, Vice Governor, PPCA
3	Member from Cambodia Side	Project Manager, Director, DPWT
4	Member from Cambodia Side	Deputy Commissioner, PPTP
5	Member from Cambodia Side	Director of Administration, PPCA
6	Member from Cambodia Side	Deputy Director of Administration, PPCA
7	Member from Cambodia Side	Director of IRIC Division, PPCA
8	Member from Cambodia Side	Mayer, Metropolitan corporation Lahore (MCL)
9	Member from Cambodia Side	Representative of JICA Pakistan Office
10	Member from Cambodia Side	Deputy Director, DPWT
11	Member from Cambodia Side	Deputy Director of IRIC Division, PPCA
12	Member from Cambodia Side	Deputy Director of Urban Management Division, PPCA
13	Member from Cambodia Side	Chief of Traffic Police Office, PPTP
14	Member from Cambodia Side	Chief of Public Lighting and Traffic Signal, DPWT
15	Member from Cambodia Side	Chief of IR Office, PPCA
16	Member from Cambodia Side	Chief of Traffic Safety Office, DPWT
17	Member from Cambodia Side	Chief of Traffic Control Center, DPWT
18	Member from Cambodia Side	Deputy Chief of IR Office, PPCA
19	Member from Cambodia Side	Deputy Chief of Traffic Signal, TCC
20	Member from Cambodia Side	Advisor, DPWT
21	Member from Cambodia Side	Technical Staff, TCC
22	Member from Cambodia Side	Officer of IRIC Office, PPCA
23	Member from Japanese Side	JICA Headquarter
24	Member from Japanese Side	First Secretary, Japan Embassy
25	Member from Japanese Side	Chief Representative, JICA Cambodia
26	Member from Japanese Side	Japanese experts
27	Others	Persons who are invited by the Chairperson may attend the JCC meeting.

5.1.2 WG

The WG is established to solve technical problems/issues. The group membership is diverse. The Director General of DPWT served as the chairperson of many WG meetings.

5.2 Outline of the Joint Coordinating Committee (JCC) Meetings and Working Group (WG) Meetings

5.2.1 JCC Meetings

The outline of the JCC meetings is as follows. For details of the JCC attendees and the contents of the discussions, please refer to the attached document (Refer to Annex11).

Table5.2-1 Outline of JCC Meetings

M	Date	No. of Attendees	Agenda	Summary of consultation
Kick-off	2022/02/17	35	1. Description and discussion of the Inception Report 2. About TCC organization	1) The inception report was discussed and unanimously approved. 2) The organization of the TCC was basically approved. 3) Since the JCC members had not yet been officially approved, this was in fact the first JCC meeting, but it was called the kick-off meeting.
1st JCC	2022/07/22	36	1. About the TCC organization 2. About the PPTMTC training plan scheduled for August 2022	1) Continuing discussions on the organization of the TCC 2) Approval of the content of the PPTMTC training plan scheduled for August 2022
2nd JCC	2023/02/22	36	1. About the TCC organization 2. About the cooperation between the TCC and the traffic police 3. About the SEA Games and the traffic survey for the pilot project 4. About the procurement of equipment for the pilot project 5. About the defect inspection for the pilot project	1) The proposal for the TCC organization is approved, but further discussions are needed on the establishment of a financial department and the relationship with the DPWT Public Lighting Division. 4) The project team's proposal to procure equipment at low cost from neighboring countries is approved, but ensuring quality is essential. 5) The proposal for the defect inspection period will be discussed with the Director General of the DPWT.
3rd JCC	2023/08/14	40	1. Request for cooperation in implementing a pilot project 2. Regarding the introduction of bus routes on new roads 3. Regarding MPWT's parking law and paratransit measures 4. Request from Deputy Governor HE Nhoun Paroth to Japan ①Request for implementation of a technical cooperation project to conduct a feasibility study on a parking management plan ②Request for continuation of Smart bus shelter F/S (Ministry of Land, Infrastructure, Transport and Tourism project)	1) Cooperation in the implementation of the pilot project was approved. However, the Vice Governor commented that the basic principles of the 3Es should not be forgotten. 3) & 4) PPTMTC project team already cooperate with MPWT about issues Parking and Paratransit.

4th JCC	2024/07/23	35	1. Summary of Pilot Project 2. Training in Japan report 3. Traffic control system expansion plan (interim report) 4. PPTMTC seminar scheduled to be held in August 2024	1) Revisions in the PDM were approved. 2) Implementation of the PPTMTC seminar scheduled for August 2024 was approved. 4) Implementation of the PPTMTC seminar scheduled for August 2024 was approved. 5) Completion of activities for Outputs 1, 2, and 3 was approved. 6) The remaining project work, including the following, is to be completed by 2024. ① PPTMTC seminar ② Post-project traffic survey and analysis/ evaluation ③ Approval of the maintenance management manual, etc. by the Director General of DPWT
5th JCC	2025/01/08	35	1. 1. Joint seminar with NR No. 5 Road Safety Technical Cooperation Project 2. Handover of necessary equipment, etc. 3. Defect inspection 4. Approval of traffic control system expansion plan, submission of handbook, manual, traffic management plan 5. Conclusion of PPTMTC project and way forward	1) Participation in a joint seminar with NR No. 5 Road Safety Technical Project 2) & 3) Approval of completion of defect inspection and handover of necessary equipment 4) Approval of traffic control system expansion plan; Approval of handbooks, manuals, and traffic management plans 5) Approval of the conclusion of the PPTMTC project and future direction

5.2.2 WG Meetings

The Working Groups discussed technical proposals and issues for advancing the project, mainly focusing on Outputs 3, 4, and 5. There were 23 major meetings alone. The overview of meetings for each output is shown in Table 5.2-2.

Table5.2-2 Outline of WG Meetings

Type	Date	No. of WG	Agenda	Summary of consultation
Output 3: Working Group Meeting on Pilot Project	2023/06/01 ～ 2024/03/24	11 times	1. 1. Pilot project kick-off meeting and meeting for underground facilities (1 meeting each) 2. Pilot project bi-weekly meeting (6 meetings) 3. Pilot project road safety campaign stakeholders meeting (3 meetings, 1 of which was held at the	1) With the participation of organizations related to the pilot project, the construction period and contents of the pilot project were explained, and requests for cooperation in the construction and discussions on problems

Type	Date	No. of WG	Agenda	Summary of consultation
			PP Traffic Police)	and issues will be held. 2) After construction starts, bi-weekly meetings will be held to exchange opinions on the progress of construction and solutions of problems and issues.
Output 4: Working Group Meeting on Traffic Control System Expansion Plan	2023/08/24 ～ 2024/01/25	7 times	1. Meeting with DPWT Public Lighting and Traffic Signal Office 2. Meeting with related agencies on the Traffic Control System Expansion Plan 3. Coordination Meeting on Traffic Control System Expansion Plan on January 25, 2024	1) Prepare and present materials related to traffic management measures (parking measures, public transport revitalization and countermeasures on issues of paratransit), 2) Discussion on traffic enforcement, traffic safety education with related organizations. 3) During traffic safety campaigns, confirm with the DPWT Road Safety Office and PP Traffic Police the implementation content, timing, and number of involved parties including participating traffic police officers, and exchange views and coordinate enforcement methods.
Output 5: 3Es (E1: Technology, E2: Regulation, E3: Education) Working Group Meeting	2023/08/25 ～ 2024/03/25	5 times	1. Meetings with MPWT and DPWT on parking, public transport, and paratransit. 2. Coordination meetings with DPWT Road Safety Office and PP Traffic Police, mainly during road safety campaigns	1) Prepare and present materials related to traffic management measures (parking measures, public transport revitalization, countermeasures of paratransit issues), traffic enforcement, and traffic safety education, and exchange opinions with related organizations. 2) During traffic safety campaigns, confirm with the DPWT Traffic Safety Office and PP Traffic Police the implementation content, timing, and number of involved parties including participating traffic police officers, and exchange views and coordinate enforcement methods.

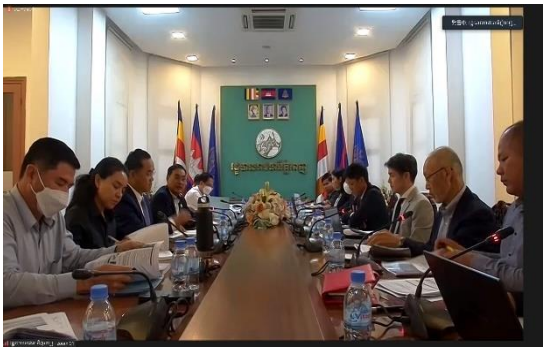
	
1st JCC Meeting	**3rd JCC Meeting**

Figure 5.2-1 Joint Coordinating Committee Meeting

	
Meeting on Underground Facility of the Pilot Project	**Construction Briefing Meeting of Pilot Project**
	
Safety Meeting of Pilot Project at Site	**weekly Meeting of Pilot Project**

Figure 5.2-2 Working Group Meeting

6. Issues, Ingenuities, Lessons Learned in the Project Implementation

6.1 Current Conditions and Problems of the Counterpart Agency

The counterpart agency for this project is DPWT, which includes TCC, and is a department under PPCA. DPWT is also under MPWT of the central government, but since most of its budget comes from the abundant financial resources of Phnom Penh, most of its activities are under the Governor of Phnom Penh.

DPWT is responsible for Phnom Penh's transport infrastructure (roads and water transport), flood control, traffic management measures (public lighting, traffic signals, road safety and vehicle registration), as well as parks and green spaces.

DPWT has 297 full-time employees, of which 73 (24.6%) are technical staff and 88 (29.6%) are women; moreover, there are 570 part-time employees. It cannot be said that DPWT has sufficient budget for the wide range of work (transport infrastructure, etc.) in the Cambodian capital. Consequently, particularly in suburban areas, there are many sections and intersections where traffic signals are not uniform, broken lights are left unrepaired, and road markings are fading. The DPWT compound is located 3.5 km north of central Phnom Penh along NR No. 6 and relocated to its current site in 2016. The expansion of the compound was due to the growth of business areas and the organization, the resulting increase in the number of employees, and the need for large equipment such as lift trucks due to the nature of the operations.

TCC is under the direct control of the Public Works Division, DPWT, which includes the International Affairs Office, Public Lighting and Traffic Signal Office. With the support of Japan, the traffic control system was launched in 2019 and operates and maintains 118 signalized intersections in central Phnom Penh. TCC, which houses the main server of the traffic control system, is located on the 9th floor of the new building in Phnom Penh City Hall. TCC has 13 employees, of which five in the management department are from Phnom Penh Capital Administration (PPCA) and DPWT, and eight are full-time employees at TCC. Seven of the eight full-time employees at TCC (the chief is a DPWT employee) are non-regular employees. The traffic control system was the first signal system introduced in Cambodia, and all previous signals were standalone types, so there were no engineers in the DPWT who could handle it. Therefore, Cambodian staff who worked under the Japanese engineers involved in the development of the traffic control system were transferred to TCC and have been involved in its operation and maintenance since 2019. As seen in the Phnom Penh traffic control system expansion plan, it is inevitable that the system will expand not only to central Phnom Penh but also to the suburbs in the future, so prompt adjustments will be required for the integration of the Public Lighting and Traffic Signals Office, DPWT (PLTSO) and TCC, which are directly related.

Table 6.1-1 History and Challenges of the Phnom Penh Traffic Control System

	Achievements											
Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
STAGE	STAGE 1 Master Plan			STAGE 2 Japan Grant Aid				STAGE 3 Managed by TCC			STAGE 4 Technical Cooperation Project		
Activities	A traffic control system was proposed as one of the short-term action plans of the 2035 PP Urban Transport Master Plan.			A traffic control system installation project with 105 intersections and TCC in central Phnom Penh (28 km2) by Japanese Grant Aid was completed.				The traffic control system connected 105 signal intersections to TCC whose employees started the operation themselves.			Technical cooperation project begins Objective: To enable TCC staff to maintain and manage the traffic control system themselves Activities: (1) Training for TCC staff, (2) Implementation of pilot project, and (3) Training in Japan.		As of the end of 2024 - 118 signalized intersections in the city center (28 km2) are centrally controlled by TCC - Approximately 70 standalone signalized intersections in the suburban area (640 km2) are installed and managed by the DPWT Public Lighting and Traffic Signal Office
Problems, Issues, Countermeasures, etc.	Location of TCC			・At the preparatory survey stage, TCC was located in DPWT compound, 7 km north of the city center, ・Just before the start of the Grant Aid Project, it was decided to locate TCC at the 9th floor of New PPCH Building in central PP ➡ Dramatically reduced access time from TCC to intersection where accident occurred.									
	TCC Staff			・Participation of local staff members in the Grant Aid Project (3 persons, all ITC graduates) One of them moved to Australia (the only one to leave since the system was handed over to Cambodia. ・When the traffic control system was handed over to the Cambodian side, TCC hired six additional staff, including graduates from a private technical university. ・ The current TCC staff consists of 13 people, including 5 who are concurrently serving at PPCH/DPWT, and 8 above.									
	Communication System			・Initially, the plan is to utilize the OFC network, which connects intergovernmental facilities of the MPTC. ・However, due to problems with the network, such as disconnected sections, the plan was abandoned. ・There was also an alternative plan to utilize a Chinese private OFC network, but this was abandoned due to security issues. The project will focus on installing a new aerial OFC network.									
	After the OFC installation started, central PP beautification project began.			・Phnom Penh City's policy: (1) All overhead wiring on major roads will be placed underground, and (2) all unused aerial wiring will be removed. ・All OFCs for signals on trunk roads will be moved underground (design revision) ・When the beautification project began, many signal-related OFCs were disconnected. ・After that, the TCC staff went to the removal section and confirmed with the removal team and removed the unused aerial wiring, which resulted in a significant reduction in accidental signal OFC disconnections.									
	O&M costs	O&M cost budgeting		・When the system was handed over, the consultant proposed the following three O&M costs to the PPCA Governor, and all of them were budgeted. (1) TCC staff costs, (2) Spare parts purchase costs, (3) Three business trips per year by engineers from the system provider									
		Implementing budget for O&M costs		(1) Executed on time, (2) Executed but not on time, (3) Failed to execute Reviewing the failure to implement (3) above; TCC staff, PPCA Financial Department, and JICA Experts developed a flowchart for the TCC-related budget implementation process and shared it with the relevant parties.									
		Spare parts procurement		・Procurement of spare parts to the system provider's specifications was carried out twice in Stage 3 through consultants. ・Other spare parts are available locally.									
	Training for TCC staff			・TCC training was held four times during Stages 2 to 4, and TCC staff skills improved. Example: Improvement plan for #167 Stage 2: Soft components for Grant Aid Project Stage 3: Because of COVID-19, the Technical Cooperation Project could not start, so TCC staff had to operate and maintain it themselves (OJT) Stage 4: Training in five fields provided by JICA Experts and system provider in Output 2 Stage 4: OJT during pilot project in Output 3									

6.2 Current Conditions and Issues of the Traffic Management Related Agencies

The following are the relevant departments of Phnom Penh City, DPWT, traffic police, Electricity Authority, universities, etc. that are directly or indirectly related to this project. Among them, (1) to (3) are organizations that had a large impact on the entire project but were not directly involved in the project, (4) to (6) are departments that were directly related to the hard aspects of the main activities of PPTMTC, such as

the pilot project, and (7) to (11) are departments that were directly related to the soft aspects of the pilot project, such as the traffic safety campaign.

(1) International Relations Office, PPCA

This is the department that coordinates international cooperation for Phnom Penh and is the Phnom Penh liaison office for projects supported by donors such as Japan. In addition to functioning as the secretariat for the JCC for this project, this organization supports the work of the Governor and Deputy Governor, who both serve as JCC chairpersons. At the same time, it is the liaison office for CDC, which is the approval body for customs clearance tax-free for equipment procured through ODA projects.

(2) Urban Planning Division, PPCA

This division oversees urban planning for Phnom Penh, and the "White Paper" that was developed with assistance from France in 2009 is the Phnom Penh Urban Planning Master Plan for 2030. Subsequently, the Urban Planning Division began revising the urban planning master plan, but its revising work is only halfway done. The traffic control system expansion plan developed in this project involved an exchange of opinions between the PPTMTC team and the head of the Urban Planning Division regarding future land use plans, etc.

(3) Financial Division, PPCA

The TCC's personnel cost and maintenance management cost are consolidated as part of the expenses of Phnom Penh's IT office; and after approval by the Governor, it is approved by Ministry of Economy and Finance (MEF) and budgeted. The process up to the budgeting stage has gone somewhat smoothly, but the budget's execution has always lasted longer than anticipated. There have been many instances where problems with the traffic control system could not be repaired promptly. It is expected that both the budgeting process and budget implementation processes will speed up.

(4) Public Lighting and Traffic Signal Office, DPWT (PLTSO)

Until the end of 2018, when the traffic control system is completed by connecting 109 signal intersections over 30 km2 of central Phnom Penh with the traffic control center under a Japan Grant Aid project, the installation of signals throughout Phnom Penh was the responsibility of PLTSO. After the traffic control system was completed, TCC was responsible for the central area, while PLTSO was responsible for the suburban areas. The integration of the two organizations in line with the traffic control system expansion plans is an urgent task.

(5) Public Works Office, DPWT (PWO)

This is the organization responsible for road development in Phnom Penh, and coordination is always required when considering signalized intersections in suburban areas where urbanization is rapidly ongoing. Six national roads that start and end in Phnom Penh are arterial roads in the suburban

areas of Phnom Penh, and coordination with not only DPWT but also MPWT is required for these intersections.

(6) Electricite de Cambodge (EDC)

As well as supplying electric power to 118 signalized intersections in central Phnom Penh, some of EDC's utility poles are used to the aerial sections of the optical fiber cables (OFC) that are the communication system for the traffic control system. The OFC along the main roads is underground in line with Phnom Penh's urban beautification plan.

(7) National Road Safety Committee, MPWT (NRSC)

NRSC, which is under the MPWT and Transport, is responsible for road safety in Cambodia. With the goal of reducing road traffic accident fatalities and injuries by 50% over the next 10 years by 2030, it is presently carrying out the National Road Safety 10-Year Action Plan 2021-2030. The NRSC publishes the RCVIS ― an annual report of road accident data, and the only one of its kind in Cambodia. It offers information on the trends and characteristics of accidents in the country. In this project, RCVIS data was effectively utilized to plan and implement road safety campaigns.

(8) Road Traffic Safety Office, DPWT (RSO)

This is an organization under the DPWT that is responsible for road traffic safety in Phnom Penh. Although this office does not conduct activities such as regular road safety weeks, its staff actively participated in the road safety campaign of this pilot project. The Road Traffic Safety Office submits a proposal for implementing a road safety campaign to the Director of DPWT, but due to financial constraints, only a few are carried out. In this pilot project, a financially feasible plan was implemented in the 2nd Pilot Project road safety campaign so that the Cambodian side could regularly hold a road safety campaign twice a year, and the PPTMTC Team shared their knowledge about holding such campaigns with the Road Traffic Safety Office.

(9) Phnom Penh Traffic Police (PPTP)

PPTP is under the jurisdiction of the Phnom Penh Police Headquarters and is responsible for traffic enforcement. There are only 600 traffic police officers in Phnom Penh with a population of approximately 2.3 million, which is a small compared to Tokyo. Even in this environment, a total of 70 traffic police officers (at 6 intersections) participated in the traffic safety campaign in this pilot project.

(10) Cambodian Red Cross (CRC)

CRC is an organization officially recognized by the Cambodian government with the role of supporting humanitarian projects. It is also active in road safety activities and requested the participation of CRC student volunteers (high school students) in the pilot project road safety campaign. They actively

installed banners at traffic signal intersections, called on drivers to be safe on the roads using loudspeakers, and distributed pamphlets.

(11) Institute of Technology of Cambodia (ITC)

This is the only national technical university in Phnom Penh, and it has only recently established the urban transport field. Its staff members are essential to JICA's urban transport-related projects as researchers and technical assistants for transport surveys. A Cambodian lecturer who studied in the urban transport field at a national technical university in Japan is one of the members of the JCC for this project.

6.3 Issues, Ingenuities, Lessons Learned in the Project Implementation

Table 6.3-1 shows the measures taken to overcome the "challenges in project implementation management" mainly by the project-related organizations described in 6.1 to 6.2 and their impact on the six project evaluation items.

Table 6.3-1 Issues, Ingenuities, Lessons Learned in the Project Implementation

Project Issues	Ingenuities	Project Evaluation of 6 Evaluation Criteria						Output/Lessons Learned
		Relevance	Coherence	Effectiveness	Efficiency	Impact	Sustain-ability	
Clarification of the defect	Before PPTMTC, traffic control system malfunctions were only recorded in monthly reports, but now the malfunctions are classified, compiled into tables, and analyzed.			✔			✔	This was then used for maintenance management.
Establishment of procedures for securing budgets and prompt budget execution	Although the budget approval process was relatively smooth, there were many cases where it took time to execute the budget. Therefore, a detailed flowchart was developed from budget approval to execution.				✔		✔	Shared and discussed with stakeholders (what the problem is, how to speed up the process, etc.)
Collaboration with related organizations, focusing on traffic management	In Phnom Penh, vertical administrative divisions were also a bottleneck in communication between organizations, but PPTMTC was able to maintain collaboration between the relevant agencies by flexibly adjusting the composition of the Working Groups.			✔		✔	✔	A good example of this is the planning and implementation of the pilot project road safety campaign in collaboration with TCC, DPWT Road Safety Office, PPTP, Cambodian Red Cross and NRSC.

Project Issues	Ingenuities	Project Evaluation of 6 Evaluation Criteria						Output/Lessons Learned
		Relevance	Coherence	Effectiveness	Efficiency	Impact	Sustain-ability	
Accumulation of transportation-related data and ease of use of the data	Prior to PPTMTC, data was collected and analyzed for each project and was dispersed when the project ended. This project has made it possible to accumulate data in TCC through fixed-point observations (traffic volume at two locations, vehicle type composition, etc.) using technology (DataFromSky) that quantifies video images using AI.			✔		✔	✔	Before PPTMTC, traffic surveys were conducted for each project and the data was kept for the implementation period. After PPTMTC, the data will be available for any organization for trend analysis.
In response to large fluctuations in the yen-dollar exchange rate	From the second year of the project, due to unexpected increases in costs because the yen started to weaken significantly, the pilot project was concentrated on traffic control measures from the overall traffic management measures.			✔	✔			Efforts were made to deepen the pilot project content, such as by holding two road safety campaigns (in the future, the Cambodian side will be able to hold road safety campaigns twice a year periodically).
Delays in equipment procurement due to a global shortage of semiconductors	Due to limited budget and not well-developed public transport, Mobility Management is selected from among TDMs as soft measure for Pilot Project			✔	✔			Initially, the pilot project was scheduled to be carried out in two phases in 2023 and 2024. However, due to delays in the arrival of equipment in Phnom Penh because of a global shortage of semiconductors, the implementation of the pilot project was consolidated from two phases (2023 and 2024) to one phase from April 2023 to March 2024.
Regarding the organization of the traffic control system	Currently, the traffic control system in central Phnom Penh is operated and maintained by TCC, while the standalone signal intersections in the suburbs are maintained by PLTSO. When the traffic control system is to be expanded to the suburbs in the future, it is necessary to integrate the two organizations.		✔		✔		✔	PPTMTC proposes to integrate TCC and PLTSO by 2030.
Regarding the sustainability of traffic control system	Considering the effective use and lifespan of the current traffic control system, a replacement of the current system was proposed in the expansion plan.	✔	✔			✔	✔	In the expansion plan, the roadmap for replacing the traffic control system is divided into three stages. 2025-2030: Preparation period 2030-2035: Transition period 2035: Replacement completed

6.4 Project Evaluation of 6 Evaluation Criteria

6.4.1 Relevance

(1) Consistency with Cambodia's National Development Policy

In August 2023, Hun Manet, the new Prime Minister of Cambodia, unveiled the "Pentagonal Strategy," a 25-year socioeconomic strategy to be implemented in five phases, with the first phase to run from 2023 to 2028. The five main strategies of the "Pentagonal Strategy" are to strengthen the construction and development of human resources, roads, hydropower, and electricity. The five concepts of the strategy are growth, employment, equality, efficiency, and sustainability. Furthermore, the first phase of the "Pentagonal Strategy" outlines the specific goals Cambodia should pursue in the future, which include strengthening government institutional capacity, creating an environment suitable for economic and social development, developing human resources, diversifying the economy and improving competitiveness, growing private businesses and creating jobs, promoting adaptive, sustainable and inclusive development, and establishing a digital economy and society. "Roads" is one of the five key strategies in the "Pentagonal Strategy," and the future goal is defined as "creating an environment conducive to social and economic development." Therefore, PPTMTC is in line with Cambodia's national development policy since it enhances urban transportation in Phnom Penh and promotes social and economic development in Cambodia.

(2) Consistency with Japan's ODA Policy

The basic policy of the Ministry of Foreign Affairs' Country Assistance Policy for Cambodia (April 2024) states that Japan will support industrial development to help Cambodia achieve its goal of becoming an upper-middle-income country by 2030 and will also support Cambodia in addressing the complex and diverse challenges of the international community and achieving sustainable, self-reliant growth and a vibrant society. In addition, of the three priority areas, "(1) Industrial transformation and development that brings about economic growth" states that connectivity will be strengthened by facilitating logistics (roads, ports, etc.) in order to develop infrastructure for industrial development and investment promotion, and "(2) Achieving sustainable and equitable growth" states that support will be provided in areas that contribute to the development of urban living environments, such as urban transportation and urban management using ICT, in order to further improve the quality of life of the people. This project is highly consistent with Japan's aid policy.

6.4.2 Coherence

Phnom Penh, the capital of Cambodia, has been facing serious traffic problems in recent years due to population concentration and the resulting increase in traffic volume. To improve the mobility of Phnom Penh residents, 13 bus routes cover the entire Phnom Penh area (680 km2: roughly the same area

as Tokyo's 23 wards). However, the number of users is low due to lack of punctuality of bus operation, issues with the bus stop environment and the difficulty of getting to the bus stops safely and easily. Therefore, the bus system has yet to resolve Phnom Penh's traffic problems. For this reason, as an immediate response, traffic management measures that make maximum use of the existing transport infrastructure will play a very important role in solving Phnom Penh's current urban traffic problems. The 2014 Phnom Penh Urban Transport Master Plan (PPUTMP) recommendations, which include (1) developing a traffic control system as a trigger, (2) improving intersections, (3) improving pedestrian signals and crossings, (4) allowing one-way traffic on local roads, (5) developing on-street parking spaces on the shoulders of one-way roads (moving on-sidewalk illegal parking to these spaces), (6) developing a pedestrian network, and (7) enforcing traffic laws and providing traffic safety education to ensure that these measures are implemented, do not contribute to drastically improve traffic in central Phnom Penh. Nonetheless, these are realistic measures that will have a certain positive effect in urban traffic in Phnom Penh.

Therefore, the PPTMTC project, which supports the Cambodian side to be able to operate and maintain the traffic control system themselves, is consistent with the urban traffic situation in Phnom Penh.

6.4.3 Effectiveness

（1） Achievement Status of Outputs

In this section, the achievement status of each Output set in PDM was evaluated. And based on this, the achievement degree of Project Goal was also evaluated to check the effectiveness of the Project.

Output 1: Maintenance management system of traffic control system is established

1-1 A trouble list that occurred after the traffic control system started operation is developed

Before this technical cooperation project, any troubles that occurred in the traffic control system were only recorded in daily and monthly reports. With the start of the PPTMTC project, the TCC staff received training from JICA experts and exchanged opinions afterwards and compiled a "Daily Activity Record (number of times they were active when a trouble occurred or during maintenance work)." The most common trouble was the cutting of optical fiber cable (OFC). OFC is an important communication system that is networked with TCC and 112 intersections in central Phnom Penh by overhead and underground cables. The lecture on cutting and repair during the training in Japan and the procurement of Fusion Splicer and Optical Time-Domain Reflectometers (OTDR) were extremely effective in maintaining the safety of the traffic control system.

1-2 Proposed maintenance system is approved by DPWT Director

The TTC organization, including the maintenance management system, which incorporated the opinions of the TCC staff, was discussed and conditionally approved at the first and second JCC meetings. This meant that the proposal for the TCC organization was approved, but the establishment of a financial department and the relationship with the DPWT public lighting and traffic signal office needed to be discussed in the future traffic control system expansion plan.

1-3 Developed manual by counterparts is approved by the DPWT Director

The Maintenance Management Manual was approved at the 5th JCC in December 2024; but due to its extensive scope, its completion was delayed to 2024, far behind the initial target of 2022. The Maintenance Management Manual was developed to summarize the policies, plans, procedures, and other support activities to be carried out to achieve the mission, goals, and objectives of TCC. The manual consists of 10 chapters and describes road safety not only for maintenance personnel but also for drivers, pedestrians, and the public. The manual also focuses on the functions of the various components of the system and how they work together as a whole. One of the most important topics also includes spare parts inventory of system components to build an accurate database.

Output 2: Capacity of TCC staff on the operation of traffic control system is strengthened

2-1 Through the training, TCC staff can be able to analyze/design/repair problematic intersections by themselves

During the pilot project, the signal phasing pattern of signal parameters were set in the system, which was a black box of the traffic control system provider. However, the signal parameters such as timing settings were carried out by TCC staff themselves with the support of JICA experts.

2-2 Target score of the evaluation test for TCC staff is achieved

Over the course of a month, from August 24 to September 23, 2022, the PPTMTC training covered four topics (five sessions): maintenance management, operations (basic and operational), communication systems, and traffic management. The training was mainly held in a meeting room at the Phnom Penh Capital Hall (PPCH) but also included practical training such as regular inspection exercises and operational training observing actual traffic flow. At the beginning and end of each session, the level of technical acquisition was evaluated. Finally, an overall evaluation of all areas of the PPTMTC training was conducted. As a result, the overall evaluation of the four areas was 21.0 points before the training and 57.2 points after the training. This is more than double the change before and after the training. The passing grade was set at 55.0 points based on the test results for the first- and second-class electrical work management engineers, which are Japanese national qualifications.

2-3 TCC staff can repair quickly at cutting OFC by themselves

During the construction period of the grant aid project, Phnom Penh announced an urban beautification program and decided to remove unused overhead cables in central Phnom Penh. Although the person in charge of both the grant aid project and the urban beautification program was the same Vice Governor for Infrastructure, OFCs, which are important devices in the traffic control system, were cut in many sections along with the unused overhead cables. After many coordination meetings, the number of cases of OFCs being accidentally cut was greatly reduced, but this experience gave TCC staff many opportunities to repair OFCs. Training in Japan and subsequent procurement of fusion splicer and optical time domain reflectometer (OTDR) contributed to accelerating OFC repairs.

Output 3: Capacity to design traffic signals is strengthened through the implementation of pilot projects for traffic signal improvement

3-1 Capacity to design traffic signals is strengthened through the implementation of pilot projects for traffic signal improvement

Before the project started, Japanese experts were revising signal parameters; but after the Grant Aid Project, TCC was launched, and a technical cooperation project was planned. However, due to unexpected interruptions such as the outbreak of COVID-19, TCC staff had to operate and maintain the traffic control system themselves for three years from 2019 to 2021. Although they received support from signal manufacturers and consultants, the fact that TCC staff themselves had a three-year period of management made the subsequent training more effective.

3-2 A pilot project is implemented and the queue length at the target major intersections is reduced by 8%

The average congestion queue length at pilot project intersections decreased by 15.4%, from 40m before the pilot project to 34m after the pilot project.

3-3 The counterparts take the lead in compiling the pilot project handbook, which explains the procedure from planning to project evaluation

The Pilot Project Handbook for this project consists of eight chapters and was developed by the various JICA experts, mainly taking into consideration the characteristics of the TCC staff who will be using the handbook. At the same time, the content incorporates the opinions of the TCC staff. The Pilot Project Handbook will also be useful for installing traffic signals in regional cities in Cambodia (such as Siem Reap and Sihanoukville) where urban traffic problems have become apparent in recent years. It is expected that the handbook will also serve as a guide for traffic management measures in areas other than Phnom Penh.

Output 4: Capacity of the relevant staff on traffic control in PPCA, DPWT and TCC staff to develop the expansion plan of traffic control system is strengthened

4-1 Counterparts can analyze data based on the development of traffic control system extension plans such as urbanization in Phnom Penh and traffic situation at intersections where traffic signals are needed

TCC staff and JICA experts compiled the current situation and issues for the expansion plan, such as trends in urbanization in Phnom Penh, the characteristics of the transportation network, and problems with signalized intersections in suburban areas, by collecting existing data, utilizing GIS, and conducting on-site surveys. They also referred to examples from the neighboring country of the Philippines, which started traffic control system operations in the mid-1980s.

4-2 Traffic control system expansion plan is approved by the DPWT Director

The traffic control system expansion plan was approved by the Director General of DPWT in January 2025, and the details are summarized as follows:

The expansion plan, which ensures the sustainability of Phnom Penh's traffic management system, was developed taking into consideration the effective use and lifespan (approx. 15 years) of the current system. From the perspective of effective use, 5 years have passed since the system operating without any major accidents, the current system will continue to operate for at least the next 10 years. However, within the first five years (2025 – 2030), the Cambodian side will take the lead in improving the problematic intersection on the west side of the suburban areas, where urbanization is currently rapid. At the same time, this will be a preparation period for a complete transition to the new traffic control system in 15 years, and the concept of the new system, the development scheme, estimated costs, etc. will be considered. Based on the results, construction work for the transition to the new system will begin in 5 years (2030), with the aim of completing the transition by 10 years in 2035.

Output 5: Capacity of urban transport-related organizations on traffic management measures is strengthened towards enhancement of the project sustainability

5-1 Implementation training on traffic enforcement is carried out 2 times or more

For the practical training on traffic enforcement, an expert with extensive experience in the Traffic Enforcement Division of the Tokyo Metropolitan Police Department was invited from Japan. In addition to sharing Japan's experience in the training for the Phnom Penh Traffic Police, two on-site training sessions on traffic enforcement at the pilot project intersections were held, one in the preparation period before the traffic safety campaign and the other during the campaign. Regarding Output 5, to address traffic management measures of urban transport-related agencies other than traffic enforcement and traffic safety education, discussions were held with officials from the MPWT on 1) parking measures,

2) paratransit measures such as tuk-tuk, and 3) revitalization of the bus company.

5-2 Traffic safety enforcement and a traffic safety education manual are developed and approved by the traffic police

Using the latest data from the Cambodia Annual Report on Road Traffic Accidents (RCVIS) issued by National Road Safety Committee, MPWT (NRSC), a traffic enforcement and road safety education manual was developed and approved by the Phnom Penh Traffic Police in January 2025. The traffic enforcement manual was developed based on the materials from the two training lectures by the traffic enforcement experts mentioned above, because of the request of the traffic police. Meanwhile, the road safety education manual was developed in cooperation with the Road Safety Office (RSO) staff, targeting young people aged 15 to 40 who use motorbikes, tuk-tuk, and private cars on the road/intersection.

5-3 Workshops/seminars are held 2 times or more

Approximately 170 urban transport-related personnel were invited to attend the PPTMTC project seminar held on August 8, 2024. The seminar presented an overview of the project and the daily activities of TCC; a Q & A session and survey were held after the presentation. In response to the question, "How has the traffic situation in Phnom Penh changed in 2024 compared to 2023", approximately 70% of the seminar participants answered, "It has improved." The reason given was "traffic volume has increased slightly, but Phnom Penh's efforts in hard (installation of traffic signals, construction of flyovers, etc.) and soft (promotion of traffic safety education) measures" were cited. On December 3, 2024, a seminar was held mainly to consider traffic safety in Cambodia and was a joint seminar with the NR No. 5 Traffic Safety Technical Project Team. From PPTMTC project, a presentation was given mainly on the traffic safety campaign in the pilot project.

（2） Achievement Level to Project Purpose

The project purpose was defined as "Traffic management measures including traffic safety measures in Phnom Penh are improved through strengthening capacity of operation and maintenance of traffic control system." The degree of achievement of this project was verified using the following three indicators:

PP-1 The traffic control system will have an availability rate of 95% or more

PP-1 in PDM version 0 was "The time from the occurrence of an accident to the completion of repairs will be reduced by XX%." In this project, the system availability rate was adopted as the key system performance index (KPI). As a result of the PPTMTC training covering five subjects conducted in 2022 in Output 2 and the procurement of necessary spare parts, the system availability rate improved

from an average of 83.2% until March 2023, slightly short of the target of 95%, to 94.4% after April.

PP-2 The analysis results of major intersection data are shown in the monthly report

CCTV cameras were installed at two locations along the corridor section of the main road (in front of the French Embassy on Monivong Blvd. and near the BeKaSe intersection on Russian Blvd.) and it became possible to compile traffic volume using AI image analysis (Czech's DataFromSky). As a result, fixed-point observation results can be collected and can be used not only in the TCC monthly report but also by other organizations for urban transport planning.

PP-3 The number of traffic violators at major intersections decreases by 8%

The implementation of the pilot project by 3Es (E1: Engineering, E2: Education, and E3: Enforcement) reduced the number of traffic violators at pilot project intersections (per intersection) from 1,592 before the implementation to 1,256, a 21.1% decrease, far exceeding the target of 8%.

6.4.4 Efficiency

The short-term experts for this project were deployed as planned (actual: 100.00 MM compared to the planned: 100.33 MM). The project was able to be finished within the allotted three years (2022-2024) despite the following factors: (1) the start of the project was the peak of COVID-19, and activities were severely restricted; (2) the yen depreciated (from about 109 yen to the dollar at the start of the project to about 160 yen by beginning of 2024, which had a significant negative impact on equipment procurement and subcontracting; and (3) the project was affected by a global semiconductor shortage, which delayed the procurement of equipment related to the traffic control system, for which semiconductors are essential. In summary, the completion of the project as scheduled is attributed to the following: (1) deploying experts as originally planned, (2) subcontracting and equipment procurement costs were below the initial budget, and (3) the pilot project was implemented by one time.

6.4.5 Impact

(1) To TCC staff in charge of operation and maintenance of Phnom Penh's traffic management system

Before the PPTMTC project started, the staff learned the operation and maintenance techniques of the traffic control system through short-term training during a Grant Aid Project. In practice after that, operation and maintenance were carried out by changing the timing of signal parameters and relying on orders and equipment rentals from private telecommunications companies in Phnom Penh. After the PPTMTC project, the staff gained experience in construction supervision during signal installation work in a pilot project. Not only did they acquire the skills to install new signals in the future, but the procurement of fusion splicer and OTDR enabled TCC staff to quickly respond to repairs such as when

OFCs are cut off. In other words, aside from determining the signal phasing among signal parameters, TCC staff could manage the necessary operation and maintenance tasks at TCC following the PPTMTC project.

(2) To C/P members such as DPWT, PPCA, PPTP, NRSC

In the pilot project, the Phnom Penh Traffic Police, DPWT Road Safety Division, and student volunteers from the Cambodian Red Cross collaborated to conduct a road safety campaign incorporating the 3Es concepts of traffic enforcement (Enforcement) and road safety education (Education) in addition to signal installation work (Engineering) to ensure the safe and smooth use of the improved intersections and the effectiveness of the implementation. Traditionally, road safety campaigns in Cambodia were generally carried out by donor agencies in each country during their respective project periods. Based on Japan's experience, PPTMTC aimed to carry out road safety campaigns twice a year, i.e., “before the Khmer New Year at the end of March” and “before Pchum Ben (Cambodian Obon) at the end of September.” In Japan, the number of traffic fatalities has decreased by 85% in about 50 years, from about 16,800 in 1970 to about 2,600 in 2022. During this time, National Road Safety Weeks were held in spring in April and autumn in October, which is known to have contributed to a certain extent to the reduction in the number of traffic fatalities. The program itself of the second road safety campaign was generally the same as the first, but costs were kept as low as possible to make it easier for Cambodia side to implement in the future. If the number of traffic accidents in Phnom Penh decreases in the future, and the citizens of Phnom Penh feel that one of the factors is the twice-yearly road safety campaign, this project will have demonstrated that a big impact can be achieved with a small cost.

(3) To beneficiaries of the traffic control system, such as Phnom Penh residents and students

In 2017 and 2018, when the Grant Aid Project was implemented, travel speeds were measured on the 3.4 km stretch of Monivong Blvd. between the PPCH and Mao Tse Tong Blvd., a major north-south corridor in central Phnom Penh. The results showed that the travel speed before the traffic control system was installed along Monivong Blvd. was 11.34 km/h (in 2017), but after the installation (in 2018), it increased by 34.3%, to 15.23 km/h. In terms of the national economy, the reduction in travel time cost for residents using Monivong Blvd. reached $2.5 million per year. Moreover, regarding the evaluation of the pilot project, 69% of participants in the PPTMTC pilot project seminar were asked in a questionnaire, "How has traffic in Phnom Penh changed in 2024 compared to 2023?" and answered, "It has improved." Although the above results do not represent a large impact in the daily lives of Phnom Penh residents and students, it is expected that in the long run the impact will take hold among Phnom Penh residents.

6.4.6 Sustainability

The sustainability for the TCC staff and stakeholders is based on the condition that the Cambodian side can carry out the following three activities

(1) Traffic control system expansion plan

In addition to the TCC staff, the Cambodian side and the company that provides the new traffic control system must work together to carry out the traffic control system expansion plan. Nonetheless, the following are the most important points in verifying the sustainability: ① the construction of the improvement of standalone signal intersections (about 10 intersections) in the western suburban areas where urbanization is rapid, which is the current issue of the traffic management system, and ② TCC will take the lead in operating and maintaining the new traffic control system after its completion.

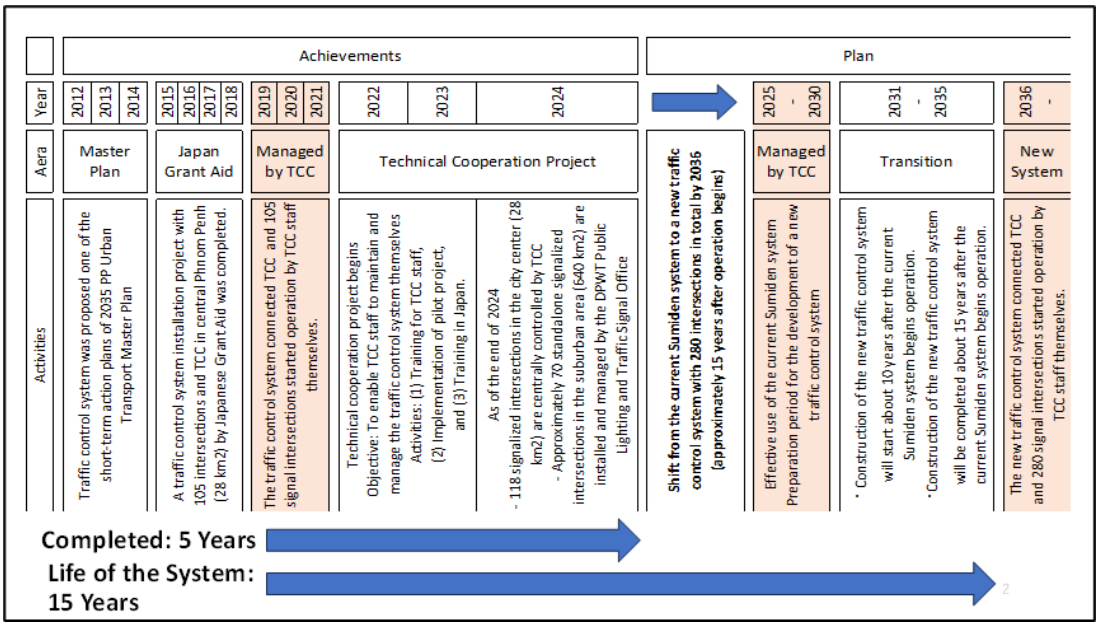


Figure 6.4-1 History and Plan of the Phnom Penh Traffic Control System

(2) Implementing comprehensive traffic management measures

The Phnom Penh Urban Transport Master Plan (PPUTMP), developed in 2014, proposed the implementation of a comprehensive traffic management measure that combines seven (7) measures, with the installation of traffic signals as a trigger. This is expected to enhance the urban transportation landscape in central Phnom Penh. Five (5) of the seven measures have been implemented, but measures against on-street parking and improvements to the pedestrian environment are only halfway done. The first step to creating a smart city will be for the C/P to have authority over the urban environment, including sidewalks, which are controlled by illegal parking. This will allow citizens to walk comfortably and use public transportation with ease. Fortunately, a new technical cooperation project aimed at revising the Phnom Penh Urban Transport Master Plan has started in 2024, so it is better to

consider working together to implement comprehensive traffic management measures.

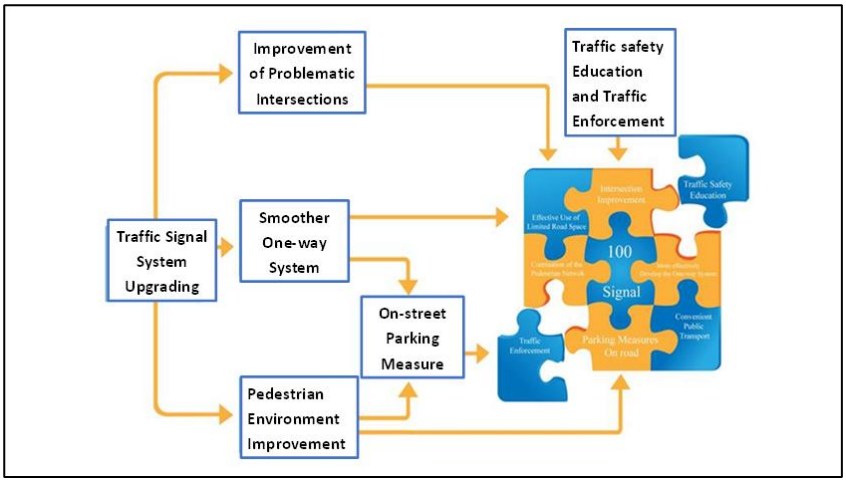


Figure 6.4-2 Concept of Comprehensive Traffic Management Plan proposed by PPUTMP

(3) Conduct periodic road safety campaigns twice a year (at least until 2050, the target year of "Pentagonal Strategy")

As mentioned in 6.4.5(2), the adoption of the twice-yearly continuous road safety campaign proposed in this project will significantly reduce the number of traffic accidents. Cambodia's "Pentagonal Strategy" aims to make the country a high-income nation by 2050 and turn Phnom Penh into a smart city. The design of intersections' geometric structure is predicated on the assumption that road users understand traffic laws. For that reason, if most road users obey traffic laws and a safe and comfortable traffic environment is developed in 2050, it is expected that Cambodia will become a high-income country in 2050 and a sustainable urban environment suitable for a smart city will be formed.

6.5 Project Conclusion and Way forward

6.5.1 Project Conclusion

The overall goal of this project is described by this statement: "Sustainable urban transport environment is formed through effective operation of the traffic control system." The Pentagonal Strategy, a national strategy with a target year of 2050 announced by Cambodian Prime Minister Hun Manet in August 2023, the mid-year of this project, aims for Cambodia to become a high-income country by 2050. The Pentagonal Strategy lists "roads" as one of the five key strategies, and states "creating an environment suitable for social and economic development" as the future to be aimed for. This means that PPTMTC, which contributes to improving urban transport environment in Phnom Penh, which leads the country of economic and social development, is well-timed and aligned with Cambodia's national development policy.

The project goal is "Traffic management measures including traffic safety measures are improved

through strengthening capacity of operation and maintenance of traffic control system in Phnom Penh." And the traffic control system implemented in this project was able to plan and implement a wide range of traffic management measures in Phnom Penh, including operation and maintenance, traffic enforcement, and traffic safety education. The conclusions of each outcome that supports the project of the purpose are as follows:

Output 1: Regarding the maintenance of the traffic control system, the activity record since the start of the traffic control system was analyzed and evaluated, and the activity record of the TCC staff was analyzed and evaluated through training in 2022, and the maintenance problems were summarized in a chart and the trend of the problems was clarified. On the other hand, regarding the organization that manages the traffic control system, considering the future expansion of the system, it is inevitable to integrate the TCC and the Public Lighting and Traffic Signals Office, DPWT (PLTSO) by 2030, which have different organizational structures, staff backgrounds, and daily activities. DPWT Director stated that he will tackle this issue.

Output 2: Until now, urban transport data in Phnom Penh was collected, analyzed, and used for each project, and was stored by each implementing agency, and was never consolidated for Phnom Penh. However, by using software that can digitize CCTV images using AI, it became possible to collect continuous data (30-minute traffic volume and vehicle type composition) at two major roads in Phnom Penh, although there are limitations, and it was possible to chart and share the information with related agencies. The PPTMTC training conducted in 2022 was about traffic control systems and traffic management measures in general, and after its implementation, it contributed greatly to the operation and maintenance of the traffic control system and can be said to be a factor in the smooth implementation of activities from pilot project planning to construction and evaluation.

Output 3: The pilot project was an opportunity for TCC staff to demonstrate their past experiences and the results of the training conducted on this project. However, TCC staff and JICA experts faced problems that were not initially anticipated, such as 1） withdrawal of company that was introducing the current traffic control system equipment midway through the project, 2） COVID-19, and 3） large exchange rate fluctuations. However, TCC staff and JICA expert team were able to overcome them with the collaboration of TCC staff + JICA experts + traffic management related stakeholders.

Output 4: TCC staff and JICA experts will take the lead in planning the traffic control system expansion, which is the most crucial phase to guarantee the sustainability of the project. TCC will alternate between 1） managing the organization and 2） working with related groups, including the private sector. And develop a roadmap of expansion plan for the next stage.

Output 5: A traffic safety campaign was carried out as part of traffic safety education for Phnom Penh residents, which will greatly contribute to the formation of a sustainable urban traffic environment, and was implemented with the participation of all relevant stakeholders such as 1）TCC, 2）JICA experts, 3）Phnom Penh Capital Hall (PPCH) International Cooperation and Public Relations Division, 4）DPWT Road Safety Office, 5）Phnom Penh Traffic Police, 6）National Road Safety Committee, 7）Cambodian Red Cross.

6.5.2 Way Forward

The next step after the completion of this project (2025-2035) is to address the immediate issues and implement the traffic management system expansion plan developed in this project. Considering the lifespan of the current traffic control system (about 15 years), it has been in operation for five years since its launch without any major problems. Therefore, it is preferable to transition to a new system in the next 10 years. To achieve this,

1) 2025-2030

Improvement of 10 Problem Standalone Signalized Intersections in the western suburban areas of Phnom Penh where traffic congestion is already significant, proposes to proceed with the improvement using TCC's technology and funds from the Phnom Penh Capital Administration (PPCA). It is important to not only installation signals, but also to simultaneously improve the surrounding environment, especially intersections. This is a pilot project exercise but does not include consideration of the communication system because of the improvement of standalone signalized intersections.

Regarding the implementation of the traffic control system expansion plan, 1）the details of the expansion plan will be finalized within the next five years (whether to use domestic funds or receive support from foreign donors), etc. and 2）construction will start around 2030.

2) 2030 – 2035

This is the transition period from the current traffic control system to a new system, and it is hoped that the complete transition to the next system will finish in 2035.

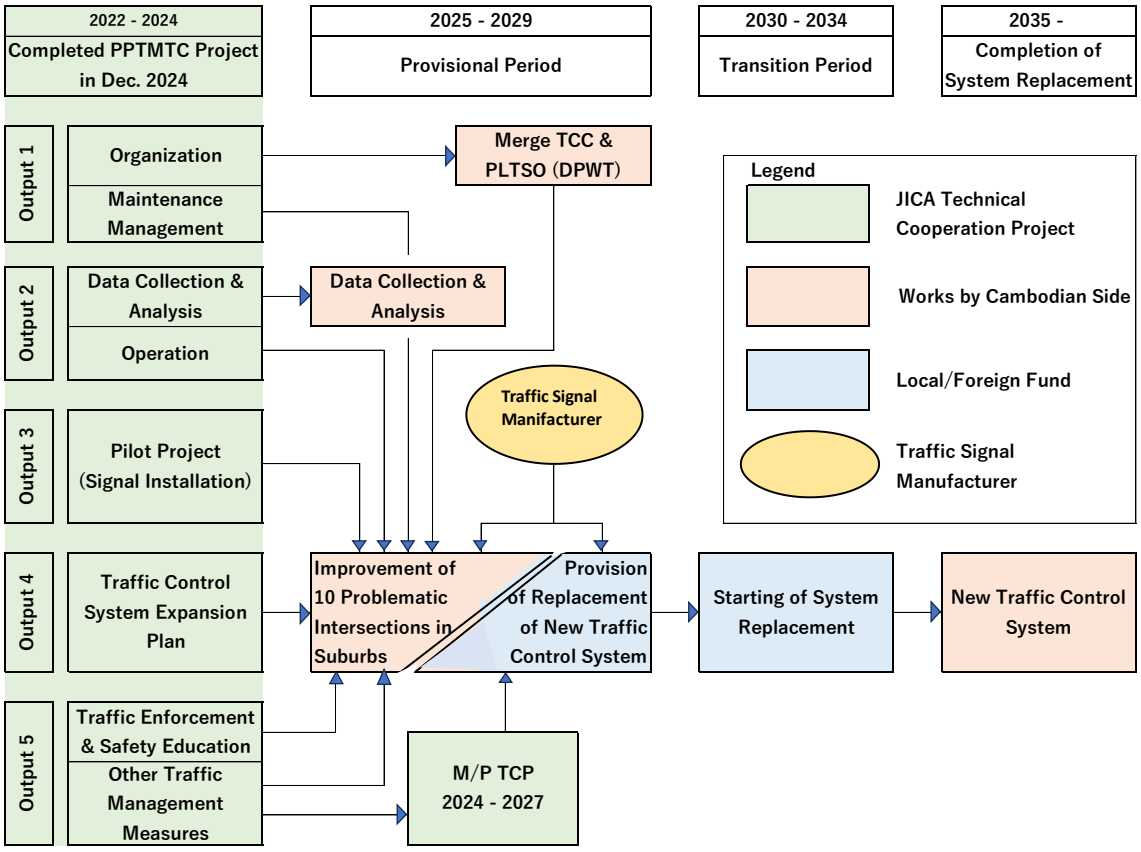


Figure 6.5-1 Project Conclusion and Way Forward

6.6 Lessons Learned, Recommendations, etc. in Future Cooperation Implementation

6.6.1 Positive lessons learned from the project

DashboardingF of data

A lot of data is required for the operation and maintenance of the traffic control system, and the TCC staff have basically recorded that data in daily and monthly reports. In this project, by dashboarding this data (basically by graphing the figures in the daily and monthly reports to make them easier to see and understand), a tool was created that can share data in real time not only with TCC but also with other agencies to analyze the current situation of urban traffic in Phnom Penh. These can be seen in the activity records of TCC staff and the fixed-point observation results of traffic volume using AI.

Flowcharting the TCC-related budget implementation process and tax exemption procedures for donated equipment

The TCC-related budget implementation process and tax exemption procedures for donated equipment are very complicated, so TCC staff and JICA Expert developed a flow chart based on actual actions and interviews with many related organizations. In particular, the development of this flow chart was important because the implementation of the TCC-related budget is directly linked to operation and maintenance costs. The actual procedures were carried out in parallel with the development of the flow

chart, so although there was no direct benefit to this project, it will be possible to respond to cases that arise in the future.

Pilot project and traffic safety campaign involving many related organizations

In Cambodia, traffic safety campaigns are mainly conducted by donors and their C/P organizations, and cases involving many related organizations like this one are very rare. This case has laid the foundation for the DPWT Road Safety Office (RSO) to take the initiative in conducting regular and extensive traffic safety campaigns in the future, because 1) the active participation of the RSO (until now, even if the RSO proposed traffic safety education activities to the Director General of DPWT, many of them could not be implemented due to budgetary constraints), 2) the flexible response of the Phnom Penh Traffic Police (in order to ask the police to participate in activities such as traffic safety campaigns, coordination with many related organizations such as Phnom Penh City, Phnom Penh Traffic Police, and the Ministry of Interior is required), 3) the provision of the latest and detailed data by National Road Safety Committee, MPWT (NRSC), and 4) the active participation of Cambodian Red Cross (CRC) and NGOs.

Numerous training sessions, including on-the-job training, were conducted four times during the project, which enabled TCC staff to develop their independence

From the implementation of 1) the soft component in Stage 2, to 2) the on-the-job training in Stage 3, when the traffic control system was transferred to the Cambodian side in 2019 and the following year, the TCC staff had no choice but to operate and maintain the traffic control system themselves due to the unpredictable COVID-19 outbreak, to 3) the in-depth training in five areas provided by JICA experts and system provider engineers in the PPTMTC project in Stage 4. The above-mentioned extensive training in technology transfer led to TCC staff taking on many of 4) the signal installation activities (OJT) for the Pilot Project in Stage 4, leading to their success.

（1） Deploying the traffic control system to other cities in Cambodia

In June 2019, while the ADB project was being implemented, the Governor of Sihanoukville made an informal request to the chief consultant of this project through local staff, saying, "We would like to formulate a traffic management plan, including the installation of traffic signals in the center of Sihanoukville. In this regard, could you please explain the contents of Phnom Penh's urban traffic master plan?" A presentation was made at the provincial office, and a site survey was conducted. With a population of about 310,000, Sihanoukville is a city (about 1/7 of Phnom Penh), and many hotels are being built with investment from China. And in the city center, traffic congestion was more serious than expected due to drivers who do not follow traffic rules. For regional cities where urbanization is progressing, especially the above-mentioned Siem Reap and Cambodia's largest tourist spot Siem Reap

(population: 140,000), even if it is not necessary to introduce a traffic control system that mainly controls the area of central Phnom Penh, it is effective to introduce measures such as setting signal aspects according to traffic flow and corridor control to reduce traffic congestion in the center. In planning, it is recommended that TCC staff be dispatched to the site and that the pilot project handbook developed in this project be utilized.

6.6.2 Negative lessons learned from the project

Of the O&M costs for the Phnom Penh traffic control system, the personnel costs of TCC staff and the costs of spare parts were covered, but the budget for business trips for system maintenance by the system provider was not implemented. Since the traffic control system's signal aspect parameter settings are the responsibility of the system provider, it is important that the system of provider's periodical business trip to Phnom Penh is to check the entire system in the early stages of system installation. However, since online communication between TCC and system provider was also possible in this project, the budget for the system provider's business trip was not implemented. Regarding the development of such IT-related systems, it is necessary to thoroughly consider the future state of operation and maintenance management, especially involving private companies. In Japan, maintenance activities after the system are installed are a continuous source of income for the system provider and are thought to contribute greatly to ensuring the sustainability of the system. Daily progress in the IT-related field is remarkable and it is not easy to predict the future, but it is necessary to create a roadmap for the development of the next-generation traffic control system, taking into an account the lifespan of traffic control systems, which is usually said to be about 15 years. However, private companies must not simply rely everything on donors when participating in projects; they must also make efforts to proactively build close communication with relevant Cambodian agencies, especially the DPWT.

6.6.3 Recommendations

Traffic management measures are more effective in combination with many measures than in a single measure. To ensure the independence of the Cambodian side, the Cambodian side will implement the current issue of "improving standalone signalized intersections" in the western suburban areas where urbanization is rapid. In this case, it is important that the Cambodian side manages the entire project while fully utilizing the operation and maintenance management technology of the traffic control system cultivated in this project. In addition, to incorporate suburban signals into the central system in the future, collaboration between TCC staff and the Public Lighting and Traffic Signals Office, DPWT (PLTSO) staff is necessary to understand the characteristics of the suburban areas, and it is essential to pave the way for future organizational integration.

Although the traffic management plan was not the main theme of this project, it is important to

continue the attempt to improve the urban transport environment by implementing comprehensive traffic management measures while involving many stakeholders. No matter how beautiful a city is, no one will recognize a city with illegal parking on the sidewalks as a smart city.

ANNEX1: PDM

Project Design Matrix

Project Title: Project for Capacity Development on Comprehensive Traffic Management Planning and Traffic Control Center operation and maintenance in Phnom Penh Capital City **Version 00**

Implementing Agency: Phnom Penh City Administration, Department of Public Works and Transport in Phnom Penh Capital City,Traffic Control Center (TCC) and Phnom Penh Traffic Police **Dated 15th July 2021**

Period of Project: February, 2025

Project Site: The whole area of the Phnom Penh Capital City (678.46km2)

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption	Achievement	Remarks
Overall Goal					
Sustainable urban transport environment is formed through effective operation of the traffic control system.	1. Travel speed of the main road after the project increases by XX% compared to before the project. Note:Target sites are selected by the end of the Project. 2. Number of interviewees who understand tragic rules/regulations increases. Note: Interviewees are selected from the participants in the Final Seminar of the Project.	1. Travel speed survey 2-1. TCC monthly/Annual report 2-2. Interviews with government agencies and citizens.			
Project Purpose					
Traffic management measures including traffic safety measures in Phnom Penh is improved through strengthening capacity of operation and maintenance of traffic control system.	1.Accident repair time of traffic control system is reduced by XX% compared to when the project starts. 2. Results of the traffic data analysis at major intersections are summarized in the monthly report. 3. Number of traffic violators decrease by XX%. * Target major intersections are determined within 3 months after the project starts.	1. TCC Monthly/Annual report 2. TCC Monthly/Annual report 3. Survey on the number of traffic offenders	The traffic management policy of the Cambodian government does not change.		
Outputs					
Output 1: Maintenance management system of traffic control system is established.	1-1. A trouble list that occurred after the traffic control system started operation is developed. 1-2. Proposed maintenance system is approved by DPWT Director. 1-3. Developed manual by counterparts is approved by the DPWT Director.	1-1 Project report 1-2 Project report 1-3 Project report			
Output 2: Capacity of TCC staff on the operation of trafic control system is strengthened.	2-1. Through the training, TCC staff are able to analyze / design / repair problematic intersections by themselves. 2-2. Target score of the evaluation test for TCC staff is achieved. Note: Target score will be decided by experts and counterparts within 6 months after starting the Project. 2-3. TCC staff can repair quickly at cutting OFC by themselves	2-1 Project report 2-2 Evaluation test results (before and after). 2-3 Project report			
Output 3: Capacity to design traffic signals is strengthened through the implementation of pilot projects for traffic signal improvement.	3-1. TCC staff can select the intersections which need revision of traffic control system design by using evaluation criteria developed by themselves. 3-2. A pilot project is implemented and the queue length at the target major intersections are reduced by XX%. 3-3. The counterparts take the lead in compiling pilot project handbook, which explains the procedure from planning to project evaluation.	3-1 Project report 3-2 Intersection queue length survey results 3-3 Project report			
Output 4: Capacity of the relevant staff to traffic control in PPCA, DPWT and TCC staff to develop the expansion plan of traffic control system is strengthened.	4-1. Counterparts can analyze the base data for the development of traffic control system extension plan such as urbanization in Phnom Penh and traffic situation at intersections where traffic signals are needed. 4-2. Traffic control system expansion plan is approved by the DPWT Director.	4-1 Project report 4-2 Project report			
Output 5: Capacity of urban transport related organizations on traffic management measures is stregnthened towards enhancement of the project sustainability.	5-1. Implementation training on traffic control is carried out XX times or more. 5-2. Traffic safety enforcement and a traffic safety education manual are developed and approved by the traffic police. 5-3. Workshops / seminars are held XX times or more.	5-1 Project report 5-2 Project report 5-3 Project report			

Activities	Inputs		Important Assumption
	The Japanese Side	The Cambodia Side	
1-1 To review the current organization and management system of TCC. 1-2 To identify operational and maintenance issues that have occurred since the traffic control system operation started and to develop improvement measures. 1-3 To review the system operations manuals, maintenance manuals and other manuals and to assess their suitability to the circumstances in Phnom Penh. 1-4 To investigate the exisiting maintenance management organizations and to propose proper maintenance management system including the possibility of outsourcing . 2-1 To study additional equipment and software which will be required to extract necessary data from TCC for image analysis, travel speed measurement, etc. 2-2 To conduct trainings to TCC staff members to acquire necessary engineering knowledge related to traffic management 2-3 To conduct trainings on the mechanism of the traffic control system, operation, modification and upgrade procedures 2-4 To conduct trainings on general maintenance and management work, including the repair of optical fiber cables 2-5 To collect data and information at target intersections and road sections where traffic congestions and accidents have occurred frequently, using data and information from TCC、and analyze the issues. 3-1 To identify traffic signals that need phasing and/or timing plan modification due to the change of traffic demand pattern 3-2 To collect and analyze traffic data related to target intersections. 3-3 To modify the design of traffic management system including the use of traffic signal design software. 3-4 To consider and procure necessary tools and/or equipment for traffic signal improvement. 3-5 To evaluate the impact of traffic signal design modification 3-6 To summarize the procedure from planning to evaluation of implementation for traffic signal improvement in a handbook 4-1 To examine the area of the traffic control system expansion, considering the urbanization trend of Phnom Penh, the traffic conditions at major intersections and characteristics of the traffic control system 4-2 To develop the expansion plan of the traffic control system. 5-1 To consider and identify tools and/or equipment for the conduct of traffic enforcement measures to support the traffic management system in Phnom Penh 5-2 To review the current traffic enforcement measures and issues, and to conduct the on-the-job training for the traffic enforcement 5-3 To develop the traffic enforcement and driver's education handbook 5-4 To disseminate the Project's outputs/activities to the public through the mass media and workshop/seminar	Japanese side: 1. Dispatch of Japanese experts: 1) Traffic Management Policy Expert 2) Traffic Control System Planning Expert 3) Traffic Management Planning Expert 4) Traffic Signal Design and Operation Expert 5) Traffic Signal Maintenance Expert 6) Road and Public Transport Planning Expert 7) Communication System Expert 8) Road Design/ Pilot Project Construction Supervision Expert 9) Traffic Survey and Analysis Expert 10)Traffic Enfoecement and Traffic Safety Expert. 11) Capacity building and training Expert(1) 12) Traffic Control System Software Expert 13) Traffic Control System Hardware Expert/Signal equipment Expert 14) Capacity building and training Expert(2)/Seminar / Project Coordination 2. Training Implementation of technical training in Cambodia Implementation of training in Japan 3. Materials and equipment Procurement of materials and equipment for technical training 4. Pilot Project Expenses for implementing the pilot project 5. Workshop / Seminar Implementation costs for seminars, etc. to disseminate project results 6. Printing Handbook / Manual Printing Expenses NOTE:Outputs (Provided by Experts and C / P) 1. Maintenance manual for ATC system. 2. TCC operation/management manual. 3. Pilot project handbook. 4. ATC system expansion plan. 5. Traffic safety enforcement handbook and traffic safety education handbook.	Cambodia side: 1) Office space for JICA Experts with air conditioning and telephone line 2)Following DPWT staff are the counterpart personnel (1) Project Director:Vice Governor, PPCA (2) Project Manager: Director, DPWT (3)Deputy Project Manager: PPCA Deputy Head of Public Relations and International Cooperation Division (4) C/P Chief: Deputy Director, DPWT (5) C/P Staff: Adviser, DPWT (6) C/P Staff: TCC Deputy Chief (7) C/P Staff: DPWT Engineer, Public Lighting Division (8) C/P Staff: DPWT Engineer, TCC Assistant Engineer (9) C/P Staff: PPCA Engineer (10) C/P Staff: PPCA Engineer (11) C/P Staff: PPCA Engineer (12) C/P Staff:TCC Engineer (13) C/P Staff:TCC Engineer (14) C/P Staff:TCC Engineer (15) C/P Staff: Traffic Police Officer NOTE:Outputs (Provided by C / P) 1.TCC monthly/Annual report.	Turnover and change of counterparts are not frequently happened. **Pre-Conditions** N/A **<Issues and countermesures>**

Project Design Matrix

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Achievement
Overall Goal Sustainable urban transport environment is formed through effective operation of the traffic control system.	1. Travel speed of the main road after the project increases by 8% (*1) compared to before the project. Note: Target corridors are selected before the Pilot Project.	1. Travel speed survey (Daily Average along 3 Major Corridors in the Phnom Penh Central Area)	Before Pilot Project: 13.3km/h. After Pilot Project: 13.2km/h. (decreased by 0.8%) (*4)
	2. Number of interviewees who answered "Better" for the comparison traffic conditions between 2023 and 2024. Note: Interviewees are from the participants in the PPTMTC Seminar held on 08 August 2024.	2. Questionnare to PPTMTC Seminar participants of government agencies and citizens	69% of participants respond to the questionnare said "Better".
Project Purpose Traffic management measures including traffic safety measures in Phnom Penh is improved through strengthening capacity of operation and maintenance of traffic control system.	1. Target Availability of the Traffic Control System (Key Performance Indicator: KPI) sets by 95% (*2). 2. Results of the traffic data analysis at major intersections are summarized in the monthly report. 3. Number of traffic violators decrease by 8% (*1). Note: Target major intersections was determined before the Pilot Project.	1. TCC Monthly/Annual report	Before PPTMTC Training: 83.24% After PPTMTC Training: 94.37% (Increased by 11.2%)
		2. Traffic Volume Monitoring Report in Evening Peak (17:30 - 18:00)	Summarized in Dashboard Data: CCTV Camera Video Image Analysis:DataFromSky
		3. Pilot Project Traffic Survey on the number of traffic offenders of Traffic Rules at Pilot Project Intersections	Before Pilot Project: 1,592 After Pilot Project: 1,256 unit: drivers/intersection/3 hours (Decreased by 21.1%) (*5)
Outputs Output 1: Maintenance management system of traffic control system is established.	1-1. A trouble list that occurred after the traffic control system started operation is developed. 1-2. Proposed maintenance system is approved by DPWT Director. 1-3. Developed manual by counterparts is approved by the DPWT Director.	1-1 Responses to Accidents to the Traffic Signal System (2018 - 2023)	Top 3 TCC activites 1. OFC related: 38% 2. Local Controller related: 19% 3. Lantern/Must-arm related: 12%
		1-2 Maintenance Management Manual	Explain in the Maintenance Management Manual
		1-3 Maintenance Management Manual	Completed
Output 2: Capacity of TCC staff on the operation of traffic control system is strengthened.	2-1. Through the training, TCC staff are able to analyze / design / repair problematic intersections by themselves. 2-2. Target score of the evaluation test for TCC staff (55 points) is achieved (*3). Note: Target score was decided by experts and counterparts before Pilot Project. 2-3. TCC staff can repair quickly at cutting OFC by themselves	2-1 TCC Monthly Report and Pilot Project Handbook	Perform TCC Staff's Activities through PPTMTC Training and Pilot Project
		2-2 Evaluation test results of PPTMTC Training (before and after).	Before Training: 21.0 points After Training: 57.2 Points (Target Score is 55 points)
		2-3 TCC Monthly Report	TCC staff can repair OFC problems using Pickup truck, Fusion splicer and OTDR.
Output 3: Capacity to design traffic signals is strengthened through the implementation of pilot projects for traffic signal improvement.	3-1. TCC staff can select the intersections which need revision of traffic control system design by using evaluation criteria developed by themselves. 3-2. A pilot project is implemented and the queue length at the target major intersections are reduced by 8% (*1). 3-3. The counterparts take the lead in compiling pilot project handbook, which explains the procedure from planning to project evaluation.	3-1 Pilot project Work at Site and Pilot Project Handbook	Completed
		3-2 Intersection queue length survey results (Average Queue Length of each Inflow)	Before Pilot Project: 40m After Pilot Project: 34m (Decreased by 15.4%) (*6)
		3-3 Pilot Project Handbook	Completed
Output 4: Capacity of the relevant staff to traffic control in PPCA, DPWT and TCC staff to develop the expansion plan of traffic control system is strengthened.	4-1. Counterparts can analyze the base data for the development of traffic control system extension plan such as urbanization in Phnom Penh and traffic situation at intersections where traffic signals are needed. 4-2. Traffic control system expansion plan is approved by the DPWT Director.	4-1 Pilot Project Work and Traffic Control System Expansion Plan	Completed
		4-2 Approve by the DPWT Director by December 2024	Completed
Output 5: Capacity of urban transport related organizations on traffic management measures is strengthened towards enhancement of the project sustainability.	5-1. Implementation training on traffic control is carried out 2 times or more. 5-2. Traffic safety enforcement and a traffic safety education manual are developed and approved by the traffic police. 5-3. Workshops / seminars are held 2 times or more.	5-1 Training	Completed 1st Training: October 2022 from PPTMTC Experts and SUMIDEN Engineers 2nd Training: January 2024 from SUMIDEN Engineers
		5-2 Traffic Enforcement and Traffic Safety Education Manual	Completed
		5-3 Workshops/Seminars	Completed 1st Seminar: Hold in 8th August 2024 2nd Seminar: Joint Seminar with NR No. 5 Road Safety TCP Team hold in 03 December 2024

Note
*1: Target increase rate of travel speed was based on the Travel Speed Survey along Monivong Blvd. in 2017 and in 2018 conducted before and after Traffic Signal System Installation Work by Japan Grant Aid. Before Grant Aid (Year 2017): 11.34 km/h. and after Grant Aid: 15.23 km/h. The increase rate between 2 years was 34.3%.
Based on above data, (1) Target increase rate of traffic related index which is indirectly affected to the Pilot Project, such as travel speed, is 5%, and (2) Target decrease rate of traffic related index which is directly affected to the Pilot Project, such as congestion queue length and no. of traffic offenders, is also 8%.
*2: Key Performance Index (KPI) of traffic control system changed to Availability of the Traffic Control System from Traffic Signal Repair Time, because of the easier data collection and understanding to the PPCH citizens. Target availability rate is 95%, hoping reach 100%.
*3: Target score of the evaluation test for TCC staff is 55 points. This is based on passing score of the test for the 1st or 2nd-class Qualified Electrician in Japan. (approx. 60 points).
*4: Average Travel speed along Russian Blvd., Monivong Blvd. and CDG&Monireth Blvd. inside the CBD in 6 hours including peak and off-peak.
*5: Number of vehicles going straight or turning left ignoring red light. Excluding #165 (newly installed traffic signal in 2024).
*6: Average in 3 hours in peak and off-peak, excluding #166 (Road closure on Russian Blvd. for VIP traffic) and #118 (Requesting remeasurement)

Activities	Inputs		Important Assumption
	The Japanese Side	**The Cambodia Side**	
1-1 To review the current organization and management system of TCC. 1-2 To identify operational and maintenance issues that have occurred since the traffic control system operation started and to develop improvement measures. 1-3 To review the system operations manuals, maintenance manuals and other manuals and to assess their suitability to the circumstances in Phnom Penh. 1-4 To investigate the exisiting maintenance management organizations and to propose proper maintenance management system including the possibility of outsourcing . 2-1 To study additional equipment and software which will be required to extract necessary data from TCC for image analysis, travel speed measurement, etc. 2-2 To conduct trainings to TCC staff members to acquire necessary engineering knowledge related to traffic management 2-3 To conduct trainings on the mechanism of the traffic control system, operation, modification and upgrade procedures 2-4 To conduct trainings on general maintenance and management work, including the repair of optical fiber cables 2-5 To collect data and information at target intersections and road sections where traffic congestions and accidents have occurred frequently, using data and information from TCC、and analyze the issues. 3-1 To identify traffic signals that need phasing and/or timing plan modification due to the change of traffic demand pattern 3-2 To collect and analyze traffic data related to target intersections. 3-3 To modify the design of traffic management system including the use of traffic signal design software. 3-4 To consider and procure necessary tools and/or equipment for traffic signal improvement. 3-5 To evaluate the impact of traffic signal design modification 3-6 To summarize the procedure from planning to evaluation of implementation for traffic signal improvement in a handbook 4-1 To examine the area of the traffic control system expansion, considering the urbanization trend of Phnom Penh, the traffic conditions at major intersections and characteristics of the traffic control system 4-2 To develop the expansion plan of the traffic control system. 5-1 To consider and identify tools and/or equipment for the conduct of traffic enforcement measures to support the traffic management system in Phnom Penh 5-2 To review the current traffic enforcement measures and issues, and to conduct the on-the-job training for the traffic enforcement 5-3 To develop the traffic enforcement and driver's education handbook 5-4 To disseminate the Project's outputs/activities to the public through the mass media and workshop/seminar	Japanese side: 1. Dispatch of Japanese experts: 1) Traffic Management Policy Expert 2) Traffic Control System Planning Expert 3) Traffic Management Planning Expert 4) Traffic Signal Design and Operation Expert 5) Traffic Signal Maintenance Expert 6) Road and Public Transport Planning Expert 7) Communication System Expert 8) Road Design/ Pilot Project Construction Supervision Expert 9) Traffic Survey and Analysis Expert 10)Traffic Enfoecement and Traffic Safety Expert. 11) Capacity building and training Expert(1) 12) Traffic Control System Software Expert 13) Traffic Control System Hardware Expert/Signal equipment Expert 14) Capacity building and training Expert(2)/Seminar / Project Coordination 2. Training Implementation of technical training in Cambodia Implementation of training in Japan 3. Materials and equipment Procurement of materials and equipment for technical training 4. Pilot Project Expenses for implementing the pilot project 5. Workshop / Seminar Implementation costs for seminars, etc. to disseminate project results 6. Printing Handbook / Manual Printing Expenses NOTE:Outputs (Provided by Experts and C / P) 1. Maintenance manual for ATC system. 2. TCC operation/management manual. 3. Pilot project handbook. 4. ATC system expansion plan. 5. Traffic safety enforcement handbook and traffic safety education handbook.	Cambodia side: 1) Office space for JICA Experts with air conditioning and telephone line 2)Following DPWT staff are the counterpart personnel (1) Project Director:Vice Governor, PPCA (2) Project Manager: Director, DPWT (3)Deputy Project Manager: PPCA Deputy Head of Public Relations and International Cooperation Division (4) C/P Chief: Deputy Director, DPWT (5) C/P Staff: Adviser, DPWT (6) C/P Staff: TCC Deputy Chief (7) C/P Staff: DPWT Engineer, Public Lighting Division (8) C/P Staff: DPWT Engineer, TCC Assistant Engineer (9) C/P Staff: PPCA Engineer (10) C/P Staff: PPCA Engineer (11) C/P Staff: PPCA Engineer (12) C/P Staff:TCC Engineer (13) C/P Staff:TCC Engineer (14) C/P Staff:TCC Engineer (15) C/P Staff: Traffic Police Officer NOTE:Outputs (Provided by C / P) 1.TCC monthly/Annual report.	Turnover and change of counterparts are not frequently happened. **Pre-Conditions** N/A **<Issues and countermesures>**

ANNEX2: Responses to accidents to the Traffic Control System by TCC

Annex 2 Responses to accidents to the traffic signal system by TCC

Year	Month	Aerial cable cutting activities	Fire incident	OFC troubleshooting/maintenance	Local controller problem, replace broken parts	Damage lantern or mast-arm, field equipments	CCTV problem	TCC system troubleshooting	Site survey/Meeting	Tree braches trim / Visibilities of traffic signal	Total
2018	Dec	3			1				2	6	
2019	Jan	10		3	2	1		1			17
	Feb	6		4			1	1		1	13
	Mar	8						1		1	10
	Apr			4			1				5
	May	3	2		2		2				9
	Jun		1	1		2		1	2	2	9
	Jul			5	2	1		2		2	12
	Aug	1			6			2		2	11
	Sep		1	7	7		1	1	1		18
	Oct	2		4	8		1		3	1	19
	Nov	1			11				1	1	14
	Dec			15	5		1	1	3		25
2020	Jan	1		3	9	3		1		1	18
	Feb	1	1	4	1	1			3		11
	Mar	6		2	3				1		12
	Apr			6	2	2			3		13
	May			3					4		7
	Jun			4	6	8	2		2		22
	Jul	7		8	5	1	3		1	1	26
	Aug	1		5	1		2			1	10
	Sep			1	13	1		3			18
	Oct	7		4	2			2			15
	Nov	3	1	1	2	1	1				9
	Dec			1	3	5			1		10
2021	Jan			1	3	7		1			12
	Feb			5	3	3	3		2		16
	Mar				1						1
	Apr										0
	May			1	1	1			1		4
	Jun			5	5	3	1	1	4		19
	Jul			1	6				3		10
	Aug			1		1					2
	Sep	4		3	2	1	3		1	2	16
	Oct		1	3	2				4	1	11
	Nov			5		1		1	3	1	11
	Dec			4	6				2	1	13
2022	Jan	1		6	6	2		3	1	5	24
	Feb			10			1		1		12
	Mar	1		10		6	1		5		23
	Apr					1			1		2
	May	4		2			1		1		8
	Jun	2		1			2		4		9
	Jul	4		2							6
	Aug	12		3					7		22
	Sep	4		3					10		17
	Oct			4	2		6		3		15
	Nov			5	4	1			1		11
	Dec			8					5		13
2023	Jan			1	2						3
	Feb			4	1	1			6		12
	Mar	1		10		1			3		15
	Apr			6	3				2		11
	May			3		2		1	3		9
	Jun			10					7		17
	Jul	2		6				2	4		14
	Aug	1		13					10		24
	Sep			3	1	2			2		8
	Oct	2				6			11		19
	Nov			10	10	6			23		49
	Dec				1	14			4		19
2024	Jan			2	10	6			8	1	27
	Feb			1	3	4			6		14
	Mar	1		1	1		3		3		9
	Apr				2	1			2		5
	May			1	1	1		1	5		9
	Jun			6	3	3			7		19
	Jul	1		4	3	3			2		13
	Aug		1	2	7	4			5		19
	Sep			9	2	1			1		13
Total		100 10.59%	8 0.85%	260 27.54%	181 19.17%	109 11.55%	36 3.81%	26 2.75%	198 20.97%	26 2.75%	944 100.00%

Total Number of Activities and by type of Activities

2018 - 2019	13	34	4	43	43	5	7	10	10	12	168
2020	12	26	2	42	47	22	8	6	15	3	171
2021	12	4	1	29	29	17	7	3	20	5	115
2022	12	28	0	54	12	10	11	3	39	5	162
2023	12	6	0	66	18	32	0	3	75	0	200
2024	9	2	1	26	32	23	3	1	39	1	128
2018 - 2024	70	100	8	260	181	109	36	26	198	26	944

Percentages of activities

2018 - 2019	13	20.24%	2.38%	25.60%	25.60%	2.98%	4.17%	5.95%	5.95%	7.14%
2020	12	15.20%	1.17%	24.56%	27.49%	12.87%	4.68%	3.51%	8.77%	1.75%
2021	12	3.48%	0.87%	25.22%	25.22%	14.78%	6.09%	2.61%	17.39%	4.35%
2022	12	17.28%	0.00%	33.33%	7.41%	6.17%	6.79%	1.85%	24.07%	3.09%
2023	12	3.00%	0.00%	33.00%	9.00%	16.00%	0.00%	1.50%	37.50%	0.00%
2024	9	1.56%	0.78%	20.31%	25.00%	17.97%	2.34%	0.78%	30.47%	0.78%
2018 - 2024	70	10.59%	0.85%	27.54%	19.17%	11.55%	3.81%	2.75%	20.97%	2.75%

Average number of activities per month

2018 - 2019	13	2.62	0.31	3.31	3.31	0.38	0.54	0.77	0.77	0.92	12.92
2020	12	2.17	0.17	3.50	3.92	1.83	0.67	0.50	1.25	0.25	14.25
2021	12	0.33	0.08	2.42	2.42	1.42	0.58	0.25	1.67	0.42	9.58
2022	12	2.33	0.00	4.50	1.00	0.83	0.92	0.25	3.25	0.42	13.50
2023	12	0.50	0.00	5.50	1.50	2.67	0.00	0.25	6.25	0.00	16.67
2024	9	0.22	0.11	2.89	3.56	2.56	0.33	0.11	4.33	0.11	14.22
2018 - 2024	70	1.43	0.11	3.71	2.59	1.56	0.51	0.37	2.83	0.37	13.49

[Technical Cooperation Deliverables]

ANNEX 3: Maintenance Management Manual

[Technical Cooperation Deliverables]

Annex 4: Traffic Control System Expansion Plan

ANNEX 5: PPTMTC Training Report

Project for Capacity Development on Comprehensive Traffic Management Planning and Traffic Control Center Operation and Maintenance in Phnom Penh Capital City (PPTMTC)

PPTMTC TRAINING

24th August – 23rd September 2022

Mets Research & Planning, Inc.
International Development Center of Japan
Oriental Consultants Global Co., Ltd.

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APPENDIX

- **Training Materials**

1. INTRODUCTION

1.1 Background of the PPTMTC Training

With financing from Japan's Grant Aid, a traffic signal system has been developed and handed over to Phnom Penh Capital City. The primary objective of the traffic signal system is to create a comfortable traffic environment in the entire city center. However, the traffic signal system is not entirely responsible for creating this comfortable environment as roads, public transport and traffic management should also be considered.

To achieve above circumstances, it is important to minimize unavoidable accidents and recovery time after an accident to maximize the use of the system and to practice a sustainable operation.

1.2 Project Goal, Purpose and Output

The overall project goal, as mentioned above, is that sustainable urban transport environment is formed. And the project purpose is that traffic management measures including traffic safety measures in Phnom Penh are improved. Through this training, the following abilities of the Traffic Control Center (TCC) staff will be enhanced:

- ✓ TCC staff are able to analyze / design / repair problematic intersections by themselves;
- ✓ TCC staff are able to quickly repair cut OFC by themselves; and
- ✓ TCC staff are also able to consider / propose the effective traffic management measures by themselves.

1.3 Design of the PPTMTC Training

More than three years after the transfer of the traffic control system to Phnom Penh at the end of 2018, the traffic control system has been continuously operated with the efforts of the TCC staff, despite the fact that TCC's budget and equipment are insufficient. However, it has been found that there are many planning and technical issues to address for future sustainability; for example, the lack of regular inspections for maintenance management and the appropriateness of operation system interventions.

In drafting the training plan, the PPTMTC experts understood what TCC staff could and could not do to properly operate the traffic control system through careful review of the past three years of activity results and evaluation of interviews, and referred manuals in Japan and the Philippines. From the standpoint of each expert, a custom training plan for this project was drafted and implemented.

The PPTMTC training was held from August 24th to September 23rd, 2022, for almost one month in four (4) fields (5 sessions): maintenance management, operation (basic and operation), communication system, and traffic management. Both instructors and trainees showed enthusiasm, even with TCC staff having to allot two days a week (Monday and Tuesday) during the training period, to cut unnecessary areal cables, which is a part of the urban beautification projects in Phnom Penh. This is important to avoid unexpected cutting by TCC of areal OFC cables.

At the beginning and the end of each session, pre- and post- tests were carried out to evaluate the level of increased knowledge of the trainees. Finally, a comprehensive evaluation of overall PPTMTC training was conducted.

The training was mainly conducted in the classroom, but such activities as exercise of regular inspection of maintenance and observation of actual traffic flow of operation training were conducted in the field.

2. OUTLINE OF THE PPTMTC TRAINING

2.1 Duration of the Training

The PPTMTC Training was conducted for almost one month, from 24th August to 23rd September.

2.2 Venue for Training

Training was held in the two meeting rooms (2nd Floor and 11th Floor) in the New Building of Phnom Penh Capital Hall.

2.3 Trainers

Trainers were invited from PPTMTC Project Experts and SUMIDEN.

Table 1: List of Trainers

No.	Name	Responsibility
I	**Trainer**	
1	Mr. ATSUSHI SUGANUMA	Traffic Control System Planning
2	Mr. KIMINARI TAKAHASHI	Traffic Management Planning
3	Dr. SUNGJOON HONG	Traffic Signal Design and Operation
4	Mr. RAMON S. ONA	Traffic Signal Maintenance
5	Ms. MICHIKO KONDO	Communication System
6	Mr. CHIKAHIKO MACHIDA	Road Design/Pilot Project Construction Supervision
7	Mr. KAORU YAMADA	Traffic Survey and Analysis
8	Ms. MITSUE TAMAGAKE	Capacity Building and Training
9	Mr. YUJI MOCHIZUKI	Traffic Control System Software
10	Mr. HAJIME SAKAKIBARA	Traffic Control System Engineering (SUMIDEN)
11	Mr. MASAYUKI OKADA	Traffic Control System Engineering (SUMIDEN)
12	Mr. MASAZUMI HORIE	Traffic Control System Engineering (SUMIDEN)

2.4 Trainees

Out of the 21 personnel invited from TCC, DPWT, PPCH and Phnom Penh Traffic Police (PPTP), 19 attended the training. Their names and positions are shown below (Nos. 2 and 4 did not attend the training).

Table 2: List of the Trainees

No.	Name & Surname	Organization
II	**Trainee**	
1	Ms. PHENG PHARINET	Chief at TCC, DPWT
2	Mr. OUCH SANSOTHY	Deputy Chief at TCC, DPWT
3	Mr. LIM KIMSEANG	Technical Staff at TCC, DPWT
4	Ms. LAK SIVCHENG	Technical Staff at TCC, DPWT
5	Mr. EANG SOPHALLA	Technical Staff at TCC, PPCH
6	Mr. MAN KIMCHHUON	Technical Staff at TCC, PPCH
7	Mr. SAM PHALLA	Technical Staff at TCC, PPCH
8	Mr. CHEA VANDETH	Technical Staff at TCC, Private
9	Ms. KUN SOKHIM	Technical Staff at TCC, Private
10	Mr. HENG VENGLIM	Technical Staff at TCC, Private
11	Mr. PHOK UY	Technical Staff at TCC, Private
12	Mr. KEM RAVY	Technical Staff at TCC, Private
13	Mr. IM SETHA	Technical Staff at TCC, Private
14	Mr. UY LYSIN	Technical Staff at TCC, Private
15	Mr. SOUN BORIN	Deputy Chief of Road Traffic Police Office, PPTP
16	Mr. RIN ROTHA	Deputy Chief of Road Traffic Police Office, PPTP
17	Mr. SO SAMBATH	Technical Staff at Public Lighting Division, DPWT
18	Mr. SEIV YUVAREITH	Technical Staff at Public Lighting Division, DPWT
19	Mr. SOR PHARA	Chief of Development and Construction Management Office, PPCH

20	Mr. PROM KAMPOUL	Chief of Road Safety Office, DPWT
21	Mr. MET CHANREACH	Technical Staff of Transport Office, DPWT

2.5 Training Program

The training programs of 4 fields (5 sessions) are shown in Tables 3.1 – 3.5.

Table 3-1 Training Program for Maintenance Management

Date	Time	Contents
24 August 2022	9:35 - 10:40	Message of the HE Vice Governor Introduction by Chikahico Machida (METS) - Training Purposes, Knowledge Test 20 min, Introduction to Maintenance Management - Ramon S. Ona.
	10:55 - 12:00	Maintenance Management of Traffic Signal System in other countries 1. Europe, 2. Middle East, 3. Australia, 4. Asia
	14:05 - 15:10	Maintenance Management in Phnom Penh Recording/logging system, development of forms for all kinds of maintenance, definitions: Operation and Maintenance, Importance of Maintenance, Preventive Maintenance, Corrective Maintenance.
	15:25 - 16:30	Preventive maintenance principles and processes. 1. Frequency, setting schedules, 2. Check List of items for inspection
25 August 2022	9:35 - 10:40	Corrective Maintenance principles and processes 1. Required response to faults & damages, urgency of needed repair, 2. Record forms
	10:55 - 12:00	Personal Safety during the conduct of maintenance - RSE and TCC equipment, wearing of PPEs
	14:05 - 16:30	Inspection for preventive maintenance procedure - based on check list. (Request Manlift Truck from DPWT, wear PPEs)
26 August 2022	9:35 - 10:40	Reporting and Inventory Management Recording, preparation of Daily, Monthly, and Yearly Reports, materials inventory. Procedures & forms, request preparation, procurement of spare parts, disposal.
	10:55 - 12:00	Assessment and review, Evaluation Test

Trainers: Mr. Ona, Mr. Suganuma, Mr. Machida and Mr. Mochizuki

Table 3-2 Training Program for Practical Aspect of Operation

Date	Time	Contents
29 August 2022	9:35 - 10:40	Introduction Training Purposes, Knowledge Test 15 min. Orientation (Introduction for OJT menu & schedule)
	10:55 - 12:00	Basic work procedure (how to backup, store, delete)
	14:05 - 15:10	Arrangement of parameter (Fixed second)
	15:25 - 16:30	Arrangement of parameter (Fixed second) How to design intersection (phase plan / lane marking / etc….) (if time permits)
30 August 2022	9:35 - 10:40	Arrangement of parameter (Cycle/Split) Lecture
	10:55 - 12:00	Arrangement of parameter (Cycle/Split) Actual Operation
	14:05 - 15:10	Arrangement of parameter (Cycle/Split) Site Survey
	15:25 - 16:30	Data tuning (if necessary) How to design intersection (phase plan / lane marking / etc….) (if time permits)
31 August 2022	9:35 - 10:40	How to design intersection (phase plan / lane marking / etc….)
	10:55 - 12:00	Arrangement of parameter (Gap actuation) Lecture
	14:05 - 15:10	Arrangement of parameter (Gap actuation) Actual Operation
	15:25 - 16:30	Arrangement of parameter (Gap actuation) Site Survey
01 September 2022	9:35 - 10:40	Arrangement of parameter (Offset) Lecture
	10:55 - 12:00	Arrangement of parameter (Offset) Actual Operation
	14:05 - 15:10	Arrangement of parameter (Offset) Site Survey
	15:25 - 16:30	Reserve (Data tuning, if necessary) How to design intersection (phase plan / lane marking / etc….) (if time permits)
02 September 2022	9:35 - 10:40	Site survey (candidate sites for pilot project)
	10:55 - 12:00	Site survey (candidate sites for pilot project)
	14:05 - 15:10	Q & A
	15:25 - 16:30	Total review / Wrap up / Test (15 minutes)
05 September 2022	9:35 - 10:40	Presentation & demo for NW monitoring software by local SIer

Trainers: Mr. Sakakibara, Mr. Okada and Mr. Horie

Table 3-3 Training Program for Traffic Signal Control

Date	Time	Contents
07 September 2022	9:35 - 10:40	Introduction of the course & Performance evaluation (Before-training)
	10:55 - 12:00	Basics of traffic engineering and traffic signal control (1)
	14:05 - 15:10	Basics of traffic engineering and traffic signal control (2)
	15:25 - 16:30	Traffic signal control planning (1)
08 September 2022	9:35 - 10:40	Traffic signal control planning (2)
	10:55 - 12:00	Traffic signal control planning (3)
	14:05 - 15:10	Traffic signal control planning (4)
	15:25 - 16:30	Traffic signal control planning (5)
09 September 2022	9:35 - 10:40	Exercise of traffic signal control planning (1)
	10:55 - 12:00	Exercise of traffic signal control planning (2)
	14:05 - 15:10	Exercise of traffic signal control planning (3)
	15:25 - 16:30	Performance evaluation (After-training) & Discussion

Trainers: DR. Hong, Mr. Suganuma, Mr. Mochizuki and Mr. Machida

Table 3-4 Training Program for Communication System

Date	Time	Contents
14 September 2022	14:00 - 15:10	Introduction of the course & Performance evaluation (Before-training) Introduction of Communication System
	15:25 - 16:30	Introduction of Network
15 September 2022	9:35 - 10:40	Introduction of KPIs (Key Performance Indicator)
	10:55 - 12:00	Introduction of Conservation Activities Performance evaluation (After-training)

Trainer: Ms. Kondo

Table 3-5 Training Program for Traffic Management

Date	Time	Contents
21 September 2022	9:35 - 10:40	Traffic Management (1)
	10:55 - 12:00	Traffic Management (2)
	14:05 - 15:10	Exercise: Draft Policy Paper on Traffic Management (Discussion)
	15:25 - 16:30	Exercise: Draft Policy Paper on Traffic Management (Presentation)
22 September 2022	9:35 - 10:40	Parking Management
	10:55 - 12:00	Parking Management
	14:05 - 15:10	Public Transport Priority Measure
	15:25 - 16:30	Public Transport Priority Measure
23 September 2022	9:35 - 10:40	Wrap-up Session
	10:55 - 12:00	Exercise: Planning Pilot Traffic Management Scheme (Discussion)
	14:05 - 15:10	Exercise: Planning Pilot Traffic Management Scheme (Presentation)

Trainer: Mr. Takahashi

3. CONTENTS OF TRAINING

3.1 Maintenance

➢ Summary of Training

After assessing the capabilities of the TCC staff in maintenance management, the training content was customized to address the weak spots such as maintenance operating procedure. It was found that preventive maintenance is seldom done and no routine inspection is performed, among other things. However, corrective maintenance is fairly done and fortunately, no major hardware problem has yet been encountered during the 3 years of operation.

Contents and summary of the maintenance training are as follows:

A. Pre-evaluation and introduction to maintenance management

Before the start of the training, a short test was conducted during the opening ceremony to assess the trainees' knowledge in maintenance and traffic engineering in general, in which traffic signal operation and maintenance are important components.

The training started with an introduction to Maintenance Management – the general approach and practices adopted internationally in industries – under items described as follows: a) Definition: MM is the process of maintaining assets and resources efficiently; b) Purpose: To ensure that operation proceeds efficiently, and resources are used effectively; c) Basic approaches: Reactive and Proactive; and d) Importance: It helps agencies maintain their resources while controlling time and costs to ensure maximum efficiency of the signal operation, the utilities, related facilities, etc.

B. Maintenance Management in some other countries including experiences in Japan and the Philippines

The present status and procedures of traffic signal system maintenance in other countries that successfully performed were presented. This was intended to enhance interest, appreciation and awareness by the trainees on the maintenance of the present Phnom Penh system as compared to other countries.

C. Maintenance Management in Phnom Penh

The history of the introduction of the traffic control system in Phnom Penh, the current traffic situation and the impact of the control system on the urban environment were presented. Then, the new TCC organization and direction of maintenance management were also presented.



Maintenance Training Class (1)



Maintenance Training Class (2)

D. Inventory Management & Reporting

Spare parts inventory management is very important as it helps to run traffic signal system operation efficiently. By managing the inventory status and future required number of spare parts, the reliability of the traffic signal system will be further improved.

The TCC staff members manage spare parts by listing them to understand the current status of spare parts in detail. Based on the TCC staff's lists and issues on inventory management, a revised inventory management list was proposed by the expert and TCC staff.

E. Preventive Maintenance

Definition and contents of Preventive Maintenance and importance of conduct of corrective maintenance, preventive maintenance procedures for all equipment and traffic signal components which was not conducted during the last 3 years in TCC, were taken up in the training.

F. Corrective Maintenance

Definition and tasks, types, steps and tactics on how to perform the corrective maintenance, required response to faults and damages, and introduction of corrective maintenance forms.

G. Occupational Safety

There are some hazards associated with the maintenance of traffic signal equipment to maintenance personnel and which can also pose risks to motorists and pedestrians. And, recently, TCC's response to safety measures when doing fieldwork is to strictly implement them such as helmet wearing.

H. Field training.

Field training was conducted in preventive maintenance activities teaching the trainees the proper procedures and safety precaution in the field for maintaining roadside equipment. The activities include Occupational Safety in three aspects – Accident prevention, Electrical safety, and Safety from fall.



Maintenance Training Field Work (1)



Maintenance Training Field Work (2)

- <u>Training Evaluation</u>

Assessment was made on the overall absorption of training activities by the trainees through a comparison of the pre-test and post-test in general and specific topics included in the lectures. Out of the 19 trainees listed, only 11 attended in the opening and introduction of the training, 9 on the second day and 8 on the third day. The evaluation result is shown hereunder.

The pre-test is made up of two parts. The first part includes questions on general knowledge in traffic engineering and management (this is to determine the lecture topics, level of instruction and material choices for the training). The second part of the test includes items in the lecture curriculum to assess the trainees' basic knowledge on the topics and knowledge acquired by each one of them.

The post-test is given immediately after the completion of all lecture topics and is intended to determine the absorption level of each trainee. The total knowledge on maintenance management is computed by adding their basic knowledge and the knowledge acquired during the lecture series.

In order to evaluate the knowledge on maintenance management of the trainees (7 trainees who attended pre- and post-test out of 11), knowledge tests were carried out pre- and post the training. The pre-test average score of the trainees is 0.078 (correct answers is 7.8%), However, for the post-test, after the training, the average score jumped to 44.2%, as shown in below table.

Table 4 Pre- and Post- Evaluation Test of the Maintenance Management

No.	Name	Atten-dance	Pre-Test		Post Test		Remarks
			No.	%	No.	%	
1	Pheng Pharinet	1.00	-	-	25/32	0.781	TCC
2	Eang Sophalla	1.00	2/22	0.091	20/32	0.625	PPCH
3	Man Kimchuon	0.33	0/22	0.000	-	-	PPCH
4	Sam Phalla	0.33	0/22	0.000	-	-	PPCH
5	Chea Vandeth	1.00	10/22	0.455	21/32	0.656	TCC
6	Heng Venglim	1.00	0/22	0.000	12/32	0.375	TCC
7	Phok Uy	1.00	0/22	0.000	10/32	0.313	TCC
8	Kem Ravy	1.00	0/22	0.000	12/32	0.375	TCC
9	Im Setha	1.00	0/22	0.000	10/32	0.313	TCC
10	Uy Lysin	1.00	0/22	0.000	14/32	0.438	TCC
11	Seiv Yuvareith	0.66	-	-	-	-	DPWT
Average (2 and 5-10)				**0.078**	⇒	**0.442**	

Considering that the level of appreciation or absorption by the trainees was not 100% due to the limited time for the test evaluation, which is immediately after the last lecture, and due to the difficulty of English language comprehension by some participants, the performance of the trainees was still rated as satisfactory. This is a good showing to be able to start the development process for the maintenance management procedure that is well adapted to the Phnom Penh environment. Trainee Nos. 1, 2 and 5 will be well enough to develop the management procedure and could do well to teach the other staff members in the field of system maintenance procedures.

3.2 Operation (Practical)

➢ Summary of Training

The Phnom Penh Traffic Control Center (TCC) has been in continuous operation since it was handed over to Phnom Penh in 2018, thanks to Phnom Penh Capital Hall's (PPCH's) financial support and the efforts of the TCC staff. However, with regards the latter, there is a need to further improve their capabilities to properly operate the system.

Traffic conditions are constantly changing at about 100 intersections controlled by the TCC. With the TCC staff's limited operational knowledge of the system, they try their best to cope with these changing traffic conditions and perform operational maintenance.

The purpose of this training was to provide TCC staff with the operational knowledge necessary for the sustainable operation of TCC in the future. The training focused on operational procedures and the basics of traffic engineering, inviting a traffic control system manufacturer (Sumitomo Electric Industries) as lecturer.

The contents and summary of the operation training are as follows:

A. Operation

Because configuration changes are often made by specific staff, there were lectures given on the necessary operating procedures so that all TCC staff could handle the changes.

・Backing up data

Various problems at TCC, such as unintended data loss or corruption, inconsistent data changes, etc. may result in situations where operational data needs to be restored. Therefore, data backup before and after setting changes at TCC needs to be established as an essential task, and the lecture was given to make the students aware of the importance of this task and to help them learn accurate operations.

・Procedure for changing signal control parameters

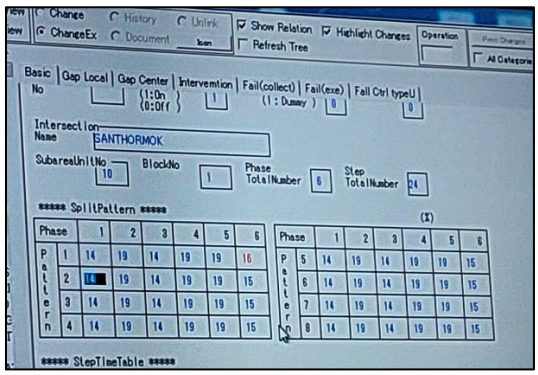
The procedure for changing the basic signal control parameters cycle, split, offset, and fixed second was explained. Training was given to TCC staff on how to change parameters using actual implementation.

・Control Transition Procedure

For intersections where current traffic conditions do not match the signal control parameters in place when TCC was first introduced, intervention control by TCC staff has been added to improve traffic conditions. However, intervention control is used differently from its original control purpose, and heavy use of this control is undesirable in system operation. Therefore, a lecture was given on the procedure for shifting from the current intervention control to time control and automatic control.



Operation Training (1)



Operation Training (2)

B. Explanation of Traffic Control System Functions

Lectures were given on knowledge and procedures to understand the functions of traffic control systems and to operate them correctly.

・Automatic control

TCC staff had no knowledge of automatic control of traffic signals by the system. Lectures were given to acquire knowledge about convenience and decision logic related to automatic control.

・Gap actuation control

The effectiveness of gap actuation with detectors installed at various locations and how it works was explained.

C. Onsite training

Onsite training on offsetting was conducted and lectures were given on the following items:

・Timing of change in signal operation after offset change instruction from TCC.
・Signal movement when offset is changed.
・Lighting of the local controller's lamp when changing the offset.
・Change in car flow due to offset change.
・Importance of checking traffic conditions on site.



Onsite Training (1)



Onsite Training (2)

D. Basic traffic engineering training

The objective was to acquire the minimum design knowledge required for intersection design (lane layout, lane markings, Phase planning). The lecture also explained the basic calculations for designing parameters such as cycles, splits, and fixed seconds. TCC staff also participated in the training, which took the form of lectures and answers to exercises.



Basic traffic engineering Training (1)



Basic traffic engineering Training (2)

➢ Training Evaluation

The overall absorption of training activities by the trainees was evaluated by comparing self-assessment tests (pre-test and post-test). Of the 19 trainees, 7 participated in the 5-day training. The evaluation results are as follows.

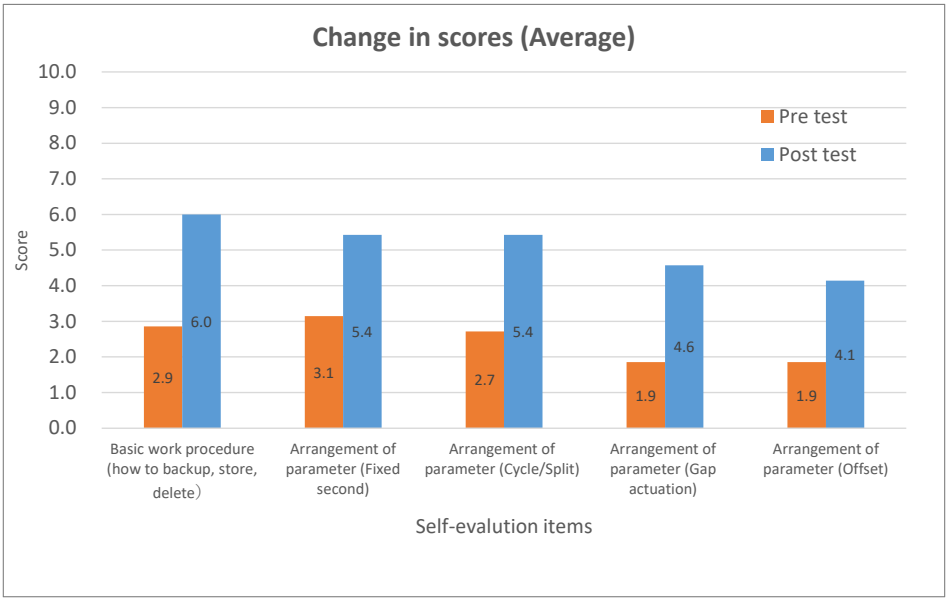
The content of both the pre-test and the post-test is the same, with five items rated on a scale of 1 to 10. The content of the five items is as follows:

- Basic work procedure (how to back up, store, delete)
- Arrangement of parameter (Fixed second)
- Arrangement of parameter (Cycle/Split)
- Arrangement of parameter (Gap actuation)
- Arrangement of parameter (Offset)

Although a self-evaluation, each item resulted in an increase of 2.3 to 3.1 points. Prior to the training, there were noticeable differences in staff knowledge; but after undergoing training, there was an increase in the level of basic operating techniques and traffic engineering. Specifically, TCC staff can now review signal control parameter changes, simple intersection designs, and control parameter designs.

Pre- and Post- Self Evaluation Test of the Operation (Practical)

Items	CHEA Vandeth		Im Setha		Phok Uy		Uy Lysin		Heng Veng Lim		Kem Ravy		Pheng Pharinet		**Average**	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Basic work procedure (how to backup, store, delete)	8	9	1	5	2	6	1	4	2	7	4	6	2	5	2.9	**6.0**
Arrangement of parameter (Fixed second)	8	9	2	4	3	4	2	4	2	7	3	5	2	5	3.1	**5.4**
Arrangement of parameter (Cycle/Split)	8	9	2	4	1	3	1	5	2	6	3	5	2	6	2.7	**5.4**
Arrangement of parameter (Gap actuation)	1	5	2	4	1	4	2	5	2	4	3	5	2	5	1.9	**4.6**
Arrangement of parameter (Offset)	1	6	2	4	1	4	2	3	2	4	3	5	2	3	1.9	**4.1**



In the future, TCC staff will need to go through training with the same content again to consolidate their knowledge. It is also important to develop the field skills necessary to assess traffic conditions and determine the appropriateness of operational parameters. In addition to these skills, TCC staff need to improve their daily operational skills and deepen their knowledge of traffic engineering in order to continue to operate TCC efficiently.

3.3 Traffic Signal Control

- Current Abilities and Issues of TCC Staff

TCC staff constantly monitor the traffic condition of signalized intersections under the jurisdiction of TCC by utilizing CCTV and Google Map traffic information and contribute to alleviating traffic congestion in Phnom Penh by adjusting signal splits as necessary. It is considered that the signal operation capability of TCC has been built up and secured, based on the experience of traffic signal operation since the establishment of TCC in December 2018, so that TCC is at a level of considering specific countermeasures for some problematic intersections including changing signal phasing patterns.

However, all TCC staff members except the newly appointed Chief of TCC have not received any formal education in traffic engineering including traffic signal control and they rely heavily on their previous experience in traffic signal operation. Furthermore, the previous experience is considered limited due to constraints on TCC's operating budget and limitations on the range of signal parameter adjustments that can be implemented independently by TCC. Under such circumstances, it is difficult for the TCC to examine signal control methods, and it is considered that there is a limit to the implementation of appropriate signal operation. In addition, it is considered difficult for TCC staff to even review the results of signal control studies conducted by consultants or other specialists of traffic signal control.

Currently, motorization is being accelerated in Phnom Penh and, as a result, the signalization of existing intersections and the construction of new signalized intersections are increasing. Since the traffic signal control for safe and smooth operation of intersections is closely related to and greatly affected by the intersection geometry, it is desirable that an organization in charge of traffic signal control is involved in the examination of signalized intersection geometry and the approval of the construction of signalized intersections. Thus, it is recommended that the TCC should take on that role. For that purpose, knowledge of traffic engineering and traffic signal control is indispensable for TCC staff, and a strategy to improve the signal control ability of TCC staff is required from a long-term perspective.

- Training Planning

Considering the current abilities and issues of TCC staff mentioned above, a training program for traffic signal control was held from 7th September 2022 (Wed.) until 9th September 2022 (Fri.) for three days, which consisted of lectures on the basics of traffic engineering and planning & design of traffic signal control. Due to the limited training time, lectures on the basics of traffic engineering were prepared at the minimum level required for understanding the planning & design of traffic signal control. However, the lectures on the traffic signal control were planned at the minimum but practical level with details required for the actual planning and design and prepared in the order of the general procedure of the traffic signal control planning & design. In addition, a traffic signal control exercise for simple signalized intersections (2 patterns) was organized at the end of this training program for trainees to deepen their understanding of signal control planning and design. Simple self-evaluations and tests on traffic engineering and traffic signal control were conducted before and after the training program to measure the effect of the training.

- Implementation of Training

The contents of the lectures are as shown below, summarized in the order that the lectures were given.

A. Introduction to Training

A brief explanation was given on the mechanism of traffic congestion from the perspective

of traffic demand and traffic capacity, and the contents of the lectures in the training were introduced.

B. Basics of Traffic Engineering

For the basic knowledge of traffic engineering, this lecture focused on the explanation of technical terms frequently used in traffic engineering, characteristics of traffic demand and traffic flow, fundamental theories on traffic conditions, and traffic capacity. Since the method of calculating traffic capacity is complicated and varies greatly depending on the country and the manual, the lecture was focused on the explanation of various factors that affect the traffic capacity. Also, this lecture was planned to explain those of the basic section of road, which is the road section between two adjacent intersections, since the traffic flow characteristics on the basic section and at the intersection as well as the concepts of theories of them are significantly different.

C. Basics of Signalized Intersections

The concepts and methods of signalized intersection planning and design are different from those at the basic section since a special traffic control is applied to forcibly stop traffic flow by traffic signals at signalized intersections. Thus, the lecture was focused on explanations on traffic flow, traffic capacity, planning, and design concepts of signalized intersections. Especially, this lecture included the explanation of technical terms that are essential for the signal operation by the TCC, such as the signal control parameters, and basic knowledge directly related to signal control planning and design, as well as general procedures of signalized intersection planning and design.

D. Planning and Design of Traffic Signal Control

Based on the general planning and design procedures for signalized intersections, this lecture was given on the tasks to be implemented at each stage and their specific methods. Focusing on the stages that TCC staff would be directly involved in, this lecture was given intensively on the signal phasing pattern, concepts and calculation methods of yellow/All-red times, concepts and calculation methods of loss time and effective green time, calculation and survey methods of saturation flow rate, and calculation method of optimum cycle length, which covers the overall procedures from the initial planning of signalized intersections to the determination of signal split (timing). In addition, the safety of not only vehicle traffic but also pedestrians was emphasized in this lecture by explaining the minimum green time that should be determined by considering the green time for pedestrian.

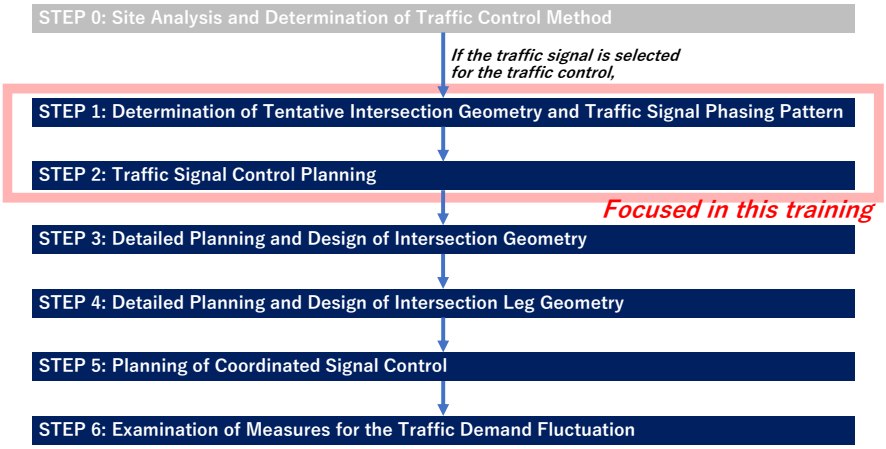


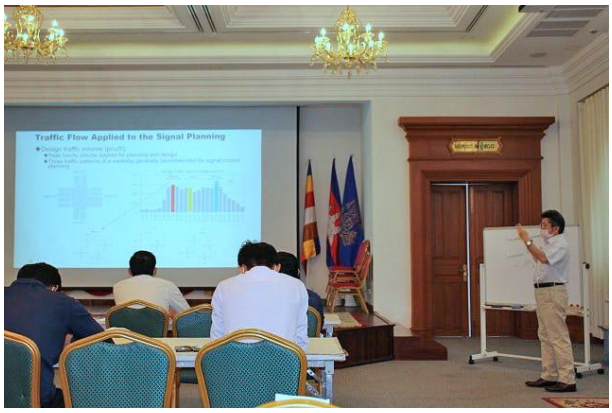
Figure 1 General Procedures of Signalized Intersection Planning and Design

E. Exercise of Traffic Signal Control Planning and Design

Based on the contents of the lecture on the planning and design of traffic signal control, an exercise was conducted in which the trainees calculated the signal parameters by themselves. By targeting two intersections with simple geometric features, it was implemented as a plan to have the lecture contents well understood.

F. Introduction to Traffic Simulation

A brief introduction to traffic simulation was given, and points to note in conducting traffic simulation and interpreting the results were explained. Although it is not expected that TCC staff will carry out traffic simulations, it is considered important even for TCC staff to properly interpret the results when traffic simulation results are shown by consultants or other specialists.



Lecture on the Traffic Signal Control



Exercise of Traffic Signal Planning & Design



Test and Self-Evaluation of Traffic Signal Control



Instructors and Trainees of Traffic Signal Control

➢ <u>Training Evaluation</u>

A test was conducted with 17 questions in total about four categories: basics of signal control, signal phasing, essential technical terms, and determination of signal parameters. At the same time, a self-evaluation (4-level evaluation) of the level of understanding was carried out on three categories: traffic engineering, signal control procedures, and optimum signal control. The test and the self-evaluation were conducted before and after this training with the same questions, so that the effect of this training program could be measured and evaluated by directly comparing the results of the tests and self-evaluations before and after this training.

Nine trainees in total (7 from TCC including the Chief of TCC, 1 from traffic police, and 1 from PPCA) participated in this training program. One trainee was absent for one day due to his

urgent task, but all TCC staff were present. Questions and answers were actively made during the training, and it was confirmed that the trainees were trying to understand all the training contents. Although many of the TCC staff were not used to lectures in English, all trainees were actively participating in all lectures, supported by English-to-Khmer interpretation and summarization by the Chief of TCC and a local staff of the JICA Study Team.

The figures below show the results of the tests and the self-evaluations before and after the training. The Chief of TCC, who received a formal education in traffic engineering, scored high in the pre-test. However, the scores of the other participants in the pre-test were low, with an average score of 2.8 points (out of 17 points) in the pre-test, which indicates a lack of basic knowledge of traffic engineering and signal control of most TCC members. Nevertheless, Mr. Vandeth, the technical leader of the TCC staff, scored relatively high.

However, in the post-training test, the scores of all the trainees increased, and the average score of the participants, excluding the Chief of TCC, was 12.3 points. In addition, there is less dispersion among individuals in the post-training scores. The self-evaluation on the understanding of traffic engineering, signal control procedures, and optimum signal control using a four-level evaluation also improved by 1.1, 1.3, and 1.3 levels, respectively, compared to the self-evaluation before the training. This indicates a deepened understanding about traffic engineering and traffic signal control of the trainees. From this result, it is evaluated that the training will effect an important on the traffic signal control by TCC staff.

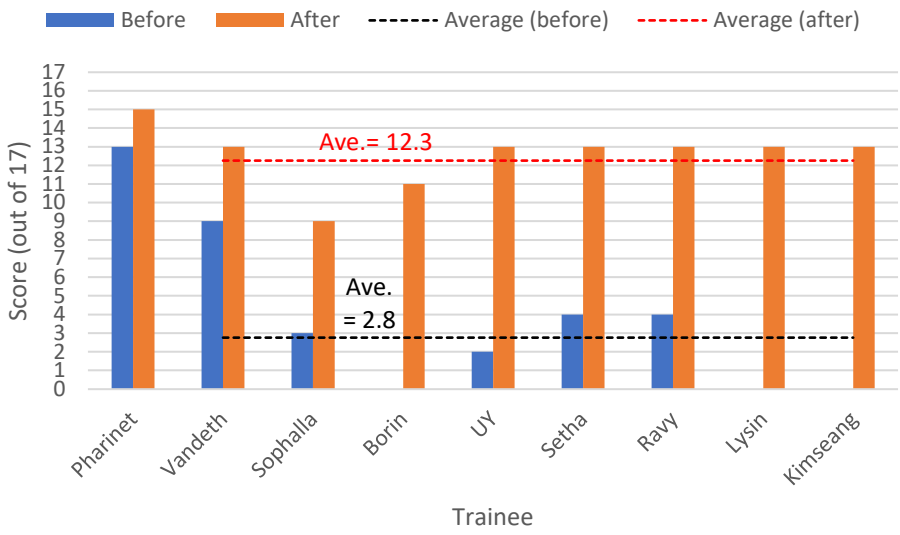


Figure 2: Test Results of Traffic Signal Control before and after the Training

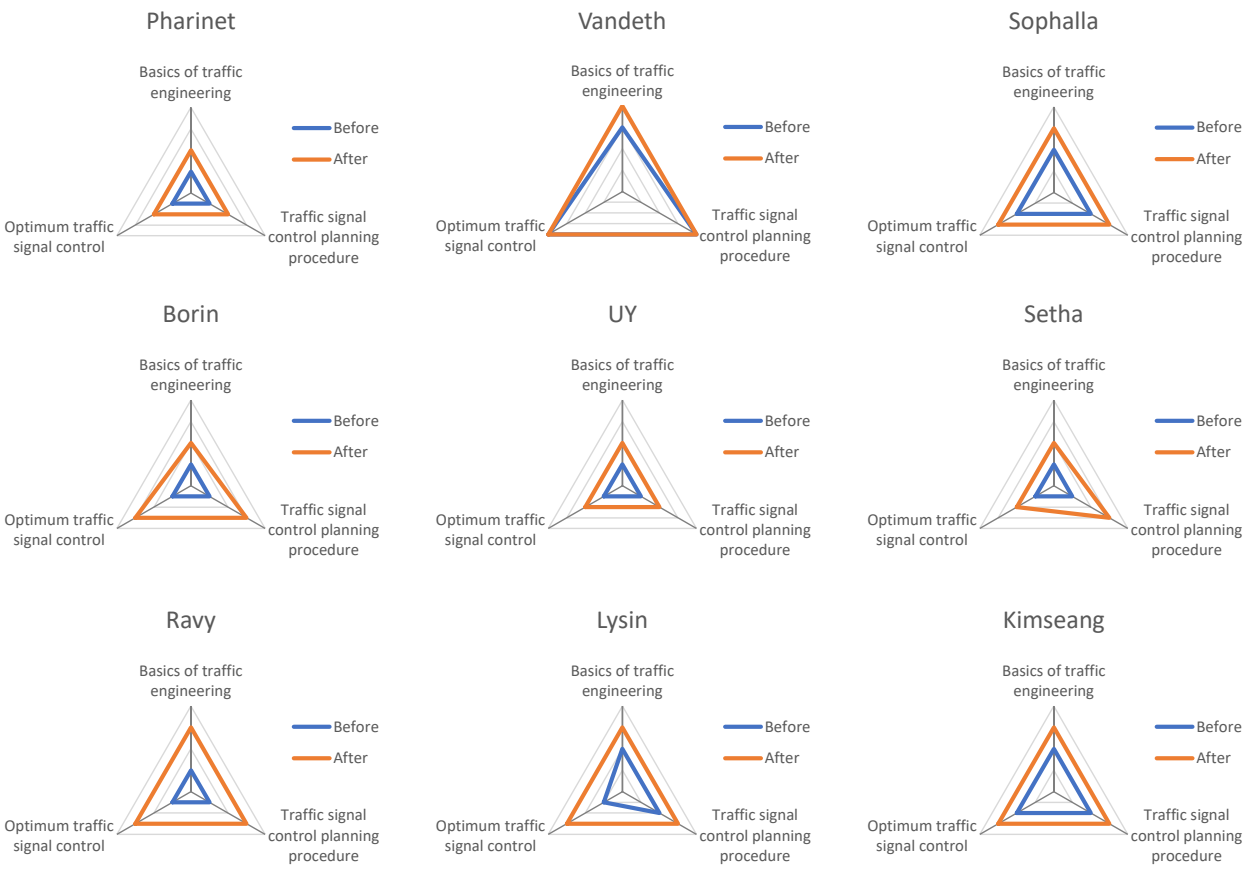


Figure 3: Self-Evaluation Results on Traffic Signal Control (Individual)

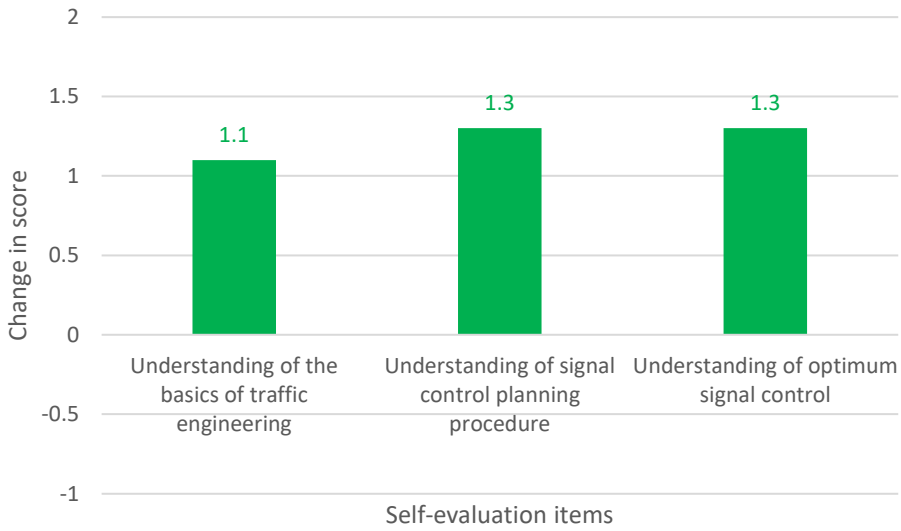


Figure 4: Average of Change in Self-Evaluation Score after the Traffic Signal Control Training

➢ <u>Future Issues</u>

As can be seen from the pre- and post-training self-evaluations, the level of understanding and basic knowledge of TCC staff regarding traffic engineering and traffic signal control has improved. However, the training program provided only the minimum necessary contents of lectures, and it is considered that the knowledge level of the TCC members about Traffic signal control has not reached the level at which they can carry out the planning and design by themselves. To reach a level where TCC staff can examine signal control methods and review

examination results of traffic signal control conducted by consultants or a third party, the following measures are desirable:

A. Training of Specialized Staff for Signal Operation
Some staff already have basic knowledge of traffic signal control. It is considered necessary to train those members as signal operation specialists by entrusting education to external organizations or graduate schools (including overseas study). It is also recommended to employ human resources who specialize in traffic signals.

B. Self-Capacity-Building
Self-capacity-building through On-the-Job Training (OJT) and study sessions within TCC is desirable. It is conceivable that staff who have basic knowledge of traffic signal control hold the study sessions, and that lectures by those staff with the updated contents of this training program are periodically given to other TCC members to improve their abilities.

C. Pilot project
A pilot project scheduled to be implemented in this JICA project would be a good chance for the TCC staff to improve their knowledge and experience. It is planned to encourage the TCC staff to participate in the pilot project from the beginning until the end and carry out planning & design of signalized intersections and examination of signalization of existing intersections under the guidance of the JICA Study team.

3.4 Communication System

- Current Abilities and Issues of TCC Staff

Since the start of the project, interviews have been conducted with TCC staff regarding the current status and issues of communication systems, as well as their abilities and issues. The communication system problem reported by TCC is mainly disconnection of optical fiber cables laid outdoors. In addition, failures of communication equipment have also occurred due to power outages at traffic signal points. Although the causes of these accidents are considered to be other than the TCC, they cause network failures between each traffic signal point and the TCC. Currently, network failures can be detected at TCC, and TCC personnel are able to identify the cause of its failure through field investigations, eliminate the problem, and restore the network. However, it is difficult to prevent network failures in advance, and it is necessary to respond to each onsite failure and to procure replacement parts, resulting in downtime until the network is restored. For this reason, the training policy is to focus on identifying the root cause of failures, understanding trends in failures, and learning the knowledge to continuously improve network availability through maintenance and management activities.

- Training Planning

The training was planned considering the current status of communication systems and the abilities and issues of TCC staff. It started with basic training for all TCC staff to understand current communication systems, followed by an introduction to network basics and network monitoring methods. Also included is a Key Performance Index method to quantitatively evaluate communication systems to improve network availability. In addition, the training on maintenance activities was designed to prevent failures in advance, not just dealing with them after the current failure, so that TCC members can not only operate and maintain the current system, but also further develop the current system in the future.



Communication System Training (1st Day)



Communication System Training (2nd Day)

➢ Implementation of Training

The contents and summary of the communication system training are as follows:

A. Pre-evaluation and introduction to project communication system

Before the start of the training, a short test was conducted to assess the trainees' knowledge in communication system and maintenance in general, in which communication network is crucial to remote monitoring and operation of traffic signal system.

The training started with an introduction to Communication System – including its components and the role of each component. General knowledge about communication systems also introduces general communication topics other than current systems. Communication system related pilot project planned at the time of training was also introduced during this session.

B. Introduction of Network

Communication network technology is critical to the Phnom Penh traffic signal system in terms of remote monitoring and operation. The training introduced the types of networks, their basic characteristics, and basic knowledge of data transmission. This enabled TCC staff to consider the merits of each network method by themselves when expanding the traffic signal network in the future. Lecture of monitoring technology was also given that enables instantaneous detection of network anomalies and prompt implementation of necessary measures.

C. Introduction of Key Performance Indicator (KPI)

In order to make use of past experience in maintenance, event analysis is necessary, and analysis and implementation are always repeated. For that purpose, the trainees learned to first analyze the current situation appropriately and to visualize (quantify) them for continuous implementation. Depending on the degree of failure of the equipment, it can be used as a reference for future equipment introduction and can also be used as a reference for deciding whether to repair or replace.

D. Introduction of Conservation Activities

Lectures were given with the aim of understanding various conservation activities and selecting and optimizing them appropriately. Conservation Activities include post-failure maintenance after failure occurs, pre-failure regular maintenance, predictive maintenance to predict failures based on past trends and prevent them from occurring, corrective maintenance against susceptibility (weaknesses) to failures, and maintenance prevention that changes the design from root.

E. Post Evaluation

After all the training, the same test as before the training was conducted to confirm changes in understanding before and after the training. The evaluation results of each participant

before and after the training are as follows:

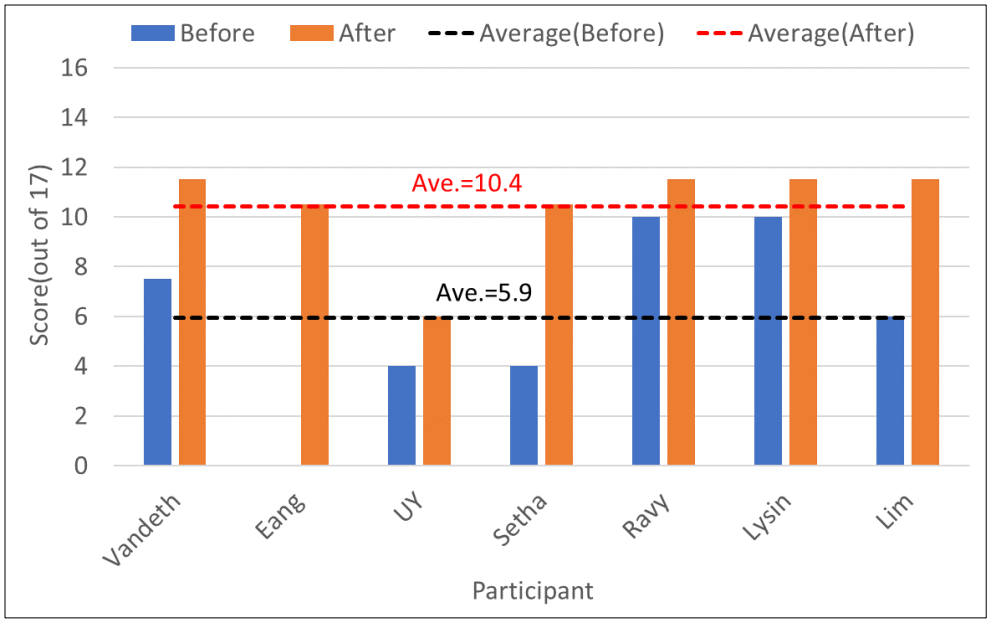


Figure 5 Test result before and after Communication System Training

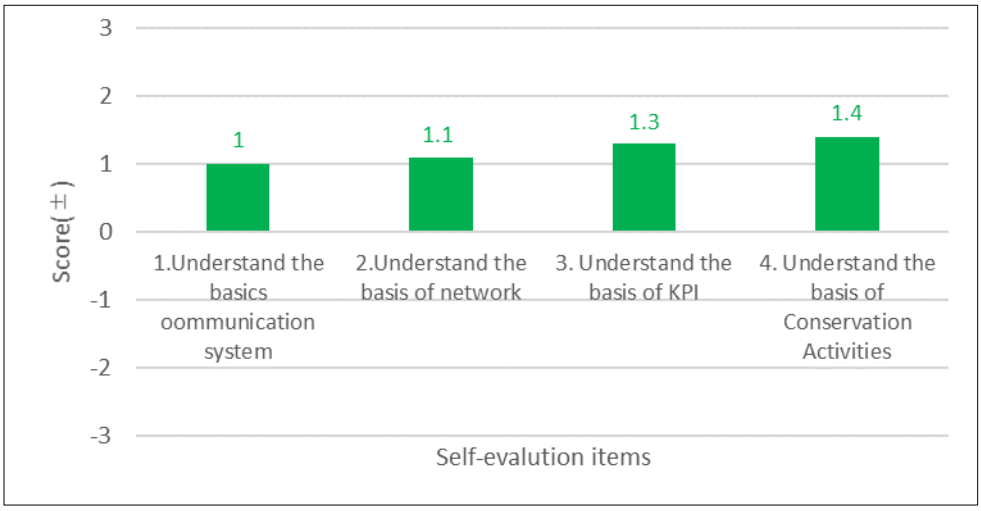


Figure 6 Self-evaluation result After training to Before training

3.5 Traffic Management

The Project Design Matrix (PDM) stipulates agreed objectives for improved traffic management under JICA Project:

Overall goal: Sustainable urban transport environment is formed.
Project purpose: Traffic management measures including traffic safety measures in Phnom Penh is improved.
Output (5): Capacity of urban transport related organizations on traffic management measures is strengthened towards enhancement of the project sustainability.
Implementing agencies: PPCA, DPWT/TCC (Phnom Penh), Traffic Police (Phnom Penh)

Although a number of definitions are found in textbooks, the project reasonably defines traffic management referring to the combination of measures that serve to preserve traffic capacity and improve reliability of the overall road transport system. It covers (i) Traffic circulation, (ii) Parking management, (iii) Pedestrian environment improvement, (iv) Demand management, and (v) Public transport and modal shift under JICA Project.

➢ Stakeholder and capacity assessment

Through a number of interviews with local counterparts, the project identifies duties and responsibilities of the traffic management scheme and their implementing agencies. Coordinated and systematic traffic management requires (i) Law maker, (ii) Policy maker, (iii) Regulator, (iv) System manager and (v) Enforcer. These duties fall under MPWT, MOLM, PPCA, DPWT/TCC and Traffic Police.

Each duty requires instruments such as laws, strategic plans, guidelines and manuals, etc. But some duties do not follow these instruments (highlighted in red in the following table). A fundamental issue is the non-existence of strategic policy/plan of the traffic management scheme.

Table 6 Stakeholder and Capacity Assessment

	MPWT	MOLM	PPCA		DPWT/TCC	Traffic Police
Traffic circulation	Law maker (Traffic sign)		Policy maker		Road manager (NR)* Khan (LR)	
Parking management		Law maker (Property)		**Law maker (Urban road),** Regulator (Property)	Road manager (NR)* Khan (LR)	Enforcer
Pedestrian improvement	Law maker (Road law)			**Law maker (Urban road)**	Road manager (NR)* Khan (LR)	
Demand management		Law maker (Land use)		**Law maker (Traffic)**, Regulator (Land use/**Traffic**)		
Public transport	Law maker, Regulator			Network manager, Service provider (CBA)		

➢ Training needs assessment

From stakeholders and capacity assessment and interviews to concerned counterparts, the following training needs are identified:

- Improved capacity to develop strategic planning for traffic management,
- Improved organizational capacity to implement a strategic plan for traffic management,
- Improved instruments (by-laws, orders, manuals/guidelines, etc.),
- Understanding of good practices of traffic management exercises in developed and developing countries,
- Trial and error and gaining experiences through pilot project implementation,
- Improved coordination between/among central government and different local governments.

➢ Training plan

The training consists of three training methods:

- Intensive Training: Learn good practices of traffic management exercise in developed and developing countries and examine the applicability of these practices into Phnom Penh
- OJT: Prepare instruments to examine some of the traffic management measures
- Pilot Project: Test these instruments through implementation of pilot project(s)

Table 7 Training Plan on Subjects

	Intensive Training				OJT				Pilot Project (Tentative)
	Strategic plan	By-law	Design standard	Guide and manual	Strategic plan	By-law	Design standard	Guide and manual	
Traffic circulation	○			○	○			○	One-way system and improved parking control
Parking management	○	○	○	○	○	○	○	○	On street parking contract
Pedestrian improvement	○		○	○	○			○	Transit mall and improved walkway
Demand management	○			○					
Public transport	○			○	○			○	Intercity bus terminal

Concerned counterparts more or less engaged in the intensive training and OJT, depending on the traffic management measure. Through implementation of pilot project, OJT targets its implementing agencies (shown as ◎ in the table) and other concerned counterparts.

Table 8 Training Plan for Stakeholders

	Intensive Training				OJT				Pilot Project (Tentative)
	MPWT/MOLM	PPCA	DPWT/TCC	Traffic Police	MPWT/MOLM	PPCA	DPWT/TCC	Traffic Police	
Traffic circulation		○	○			○	◎		One-way system and improved parking control
Parking management	○	○	○	○		◎	○	○	On street parking contract
Pedestrian improvement		○	○			◎	○		Transit mall and improved walkway
Demand management		○				◎			
Public transport	○	○				◎			Intercity bus terminal

➢ Contents of Traffic management training

Following the training plan discussed above, the 3-day intensive training is designed consisting of (i) Traffic Management, (ii) Parking Management and (iii) Public Transport Priority Measures and engages (i) PPCA, (ii) DPWT/TCC and (iii) Traffic Police.

A. Traffic Management Training (Day 1): The contents of training include the following:
   1. *Objective of JICA PPTMTC*
   2. *Expected goals of today's training*
   3. *Why is traffic management necessary?*

4. Urban transport in Phnom Penh at a glance
5. Comparison with other GMS cities
6. Proposed Traffic Management Scheme by JICA/ADB Studies
7. Traffic management in general
(1) Definition of Traffic management
(2) Physical measures of traffic management
(3) Economic measures of traffic management
(4) Supporting measures of traffic management
(5) Policy measures of traffic management
8. Draft traffic management strategy for Phnom Penh:
(1) Mission statement
(2) Strategy and action plan for traffic management

B. Parking Management Training (Day 2): The contents of training include the following:
1. Objective of JICA PPTMTC
2. Expected goals of today's training
3. Situation analysis on parking
4. Parking management interventions
5. Institutional and legal framework
6. Issues and benefits of parking management
7. Integrated parking policy and strategies
8. Planning toolkit
(1) Designation of Parking Management Area
(2) Baseline surveys & demand/supply analysis
(3) Development of area parking strategy & implementation plan
(4) Plans & layouts
(5) Vehicle/parking dimension
(6) Pricing
(7) Private vs public operation and contract model
(8) ICT & payment system

C. Public Transport Priority Measures Training (Day 3): The contents of training include the following:
1. Objective of JICA PPTMTC
2. Expected goals of today's training
3. Situation analysis and issues arising for public transport in Phnom Penh
4. Public transport priority measures across the world
5. Draft urban transport development strategy proposed by JICA
Result of Trial test for Bus Priority Control
Bus Priority Measures for Bus Line 4

- Groupwork (Day 1)

After the lecture session of Traffic Management training, trainees had group work. The trainees were divided into two groups and each group was given the following task:

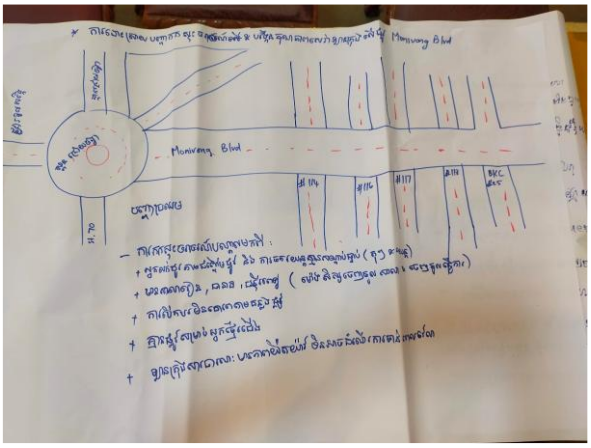
You are tasked by PPCA Governor to plan the pilot project to implement a comprehensive Traffic Management scheme to address the urban transport problem in a designated area of Phnom Penh (e.g., CBD, Central Market, Central Station).
Select the area applied to traffic management and draft a one-page pilot project plan (Any format, including texts/graph/map/table, is acceptable).
Time: 20 minutes for discussion, 20 minutes for preparation of presentation, 5-10 minutes of presentation for each group*
Presentation:(i) transport issue in selected area, (ii) Cause of issue and countermeasures, and (iii) Implementation plan/budget



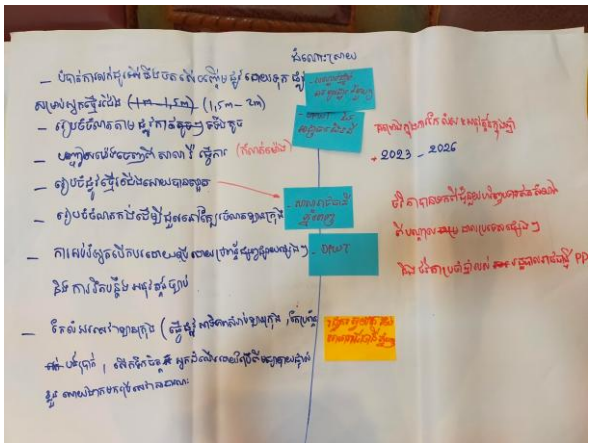
Presentation by Group A



Groupwork A



Presentation by Group B



Presentation by Group B



Groupwork B

After the presentation by each group, the facilitators including a representative from DPWT/TCC and JICA expert team evaluated their work using a set of criteria and then given a ranking from 1 (worst) - 5 (excellent). The result of evaluation showed that both groups received high marks of 4-5 on each evaluation criteria.

Table 9 Training Evaluation on Group Work

	Group A	Group B
Identification of pilot area (logic/evidence-based)	5	4
Analysis of the urban transport issue in pilot area	4	4
Effectiveness of countermeasures to address urban transport issues	4	5
Organizational capacity to implement the countermeasures	4	5
Financial feasibility of the countermeasures	4	4
Legal framework in place to implement the countermeasures	4	4
Comprehensiveness of countermeasures	4	5
Overall score	**29**	**31**

- Groupwork (Day 3)

After all the lecture sessions of Parking Management training and Public Transport Priority Measures training, the trainees had a final group work to assess their understanding level of the traffic management training. The trainees were divided into two groups and each group was given the following task:

Exercise: Group A- Bus Lane for SEA Games

You are tasked by PPCA Governor to justify the necessity of bus lane for the coming SEA Games at New National Stadium and prepare the route plan/design of the bus lane and operation plan of shuttle bus service.

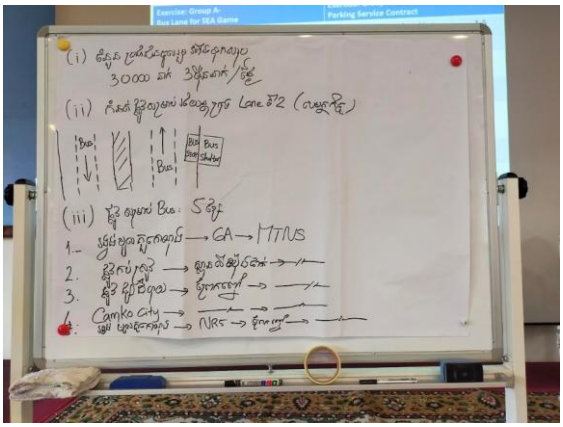
Presentation: (i) Existing traffic condition and expected traffic demand for SEA Games, (ii) Justification of bus lane, (iii) Route plan/design of bus lane, (iv) Operation plan and necessary cost, (v) Implementation schedule

Exercise: Group B- Parking Service Contract

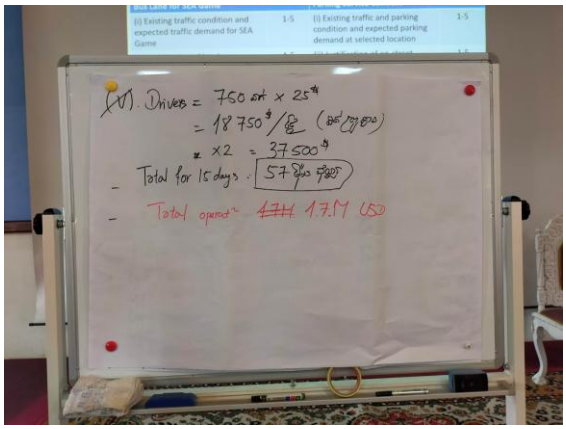
You are tasked by PPCA Governor to draft an on-street parking service contract at an optimum location and a dissemination campaign plan for the affected persons.

Presentation: (i) Existing traffic and parking condition and expected parking demand at selected location, (ii) Justification of on-street parking management (charge), (iii) Outline of parking service contract, (iv) Operation cost (service contractor) and revenue (PPCA/Khan), (v) Outline of dissemination campaign.

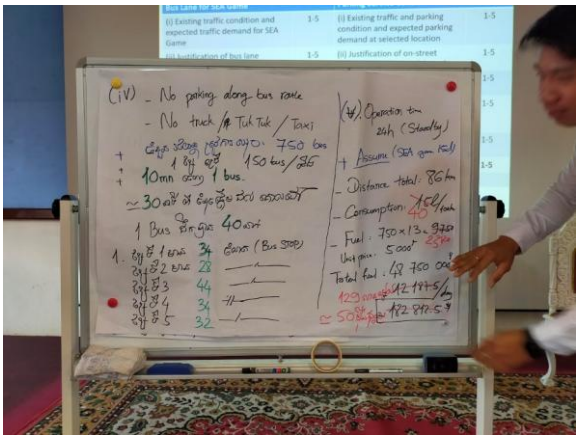
Time: 30 minutes for discussion, 30 minutes for preparation of presentation, 15 minutes presentation for each group (presentation), 15 minutes Q&A per group



Presentation by Group A



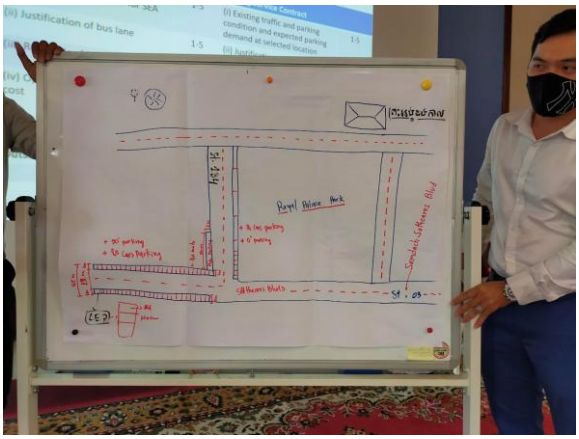
Presentation by Group A



Presentation by Group A



Group work A



Presentation by Group B



Group work B

After the presentation of each group, the facilitators including a representative from DPWT/TCC and JICA expert team made an evaluation using set of criteria and ranking of 1 (worst) to 5 (excellent). As a result of evaluation, both groups were highly evaluated with a rank of 4-5 on each evaluation criteria.

Table 10 Training evaluation on group work

Exercise: Group A- Bus Lane for SEA Game		Exercise: Group B- Parking Service Contract	
(i) Existing traffic condition and expected traffic demand for SEA Game	4	(i) Existing traffic and parking condition and expected parking demand at selected location	4
(ii) Justification of bus lane	5	(ii) Justification of on-street parking management (charge)	4
(iii) Route plan/design of bus lane	4	(iii) Outline of parking service contract	5
(iv) Operation plan and necessary cost	5	(iv) Operation cost (service contractor) and revenue (PPCA/Khan)	5
(v) Implementation schedule	5	(v) Outline of dissemination campaign	5
Outstanding presentation score	**5**	**Outstanding presentation score**	**4**
Total score	**28**	**Total score**	**27**



Trainees awarded certificates



Awarding outstanding group work

4. OVERALL EVALUATION OF THE PPTMTC TRAINING

4.1 Introduction

(1) Evaluation Method

In order to evaluate this training program, an online participant survey was conducted after all five trainings were conducted to figure out the organizations of the participants, their careers, the number of years they have been engaged in their current positions, and their level of understanding and satisfaction with the training program. The total number of responses was 11.

At the same time, JICA expert team lecturers were also asked how well they were able to convey the content they wanted the participants to learn, how well they thought the students understood the content, what kind of devise they used in their lectures to enhance understanding to conduct a more multifaceted evaluation. The total number of responses was 12 from 7 trainers.

(2) Background of Lecturers

The following nine instructors delivered lectures for this training course. Experts in the fields of maintenance, traffic signals, telecommunications, and traffic management shared their experiences and knowledge with the participants for better management of TCC and improvement of traffic conditions in Phnom Penh.

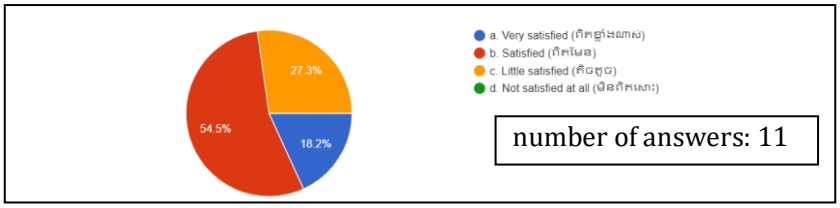
Name	Area of Responsibility	Background
Ramon Ona	Maintenance Management	He has been involved in Phnom Penh's signaling system since the soft component of the grant aid and is familiar with the capabilities of each engineer. He pointed out the importance of periodic inspections from an early stage through his experience as the director of TCC in Manila, and added on-site safety measures, which tend to be neglected, to his training lessons.
Sakakibara Okada, Horie (Sumiden)	Practial Aspect of Operation	Training specialists of equipment handling from the manufacturer. They are familiar with signaling system in Phnom Penh and answered questions raised by TCC staffs relating system intervention.
Chikahiko Mahida	Maintenance Management Traffic Signal Control	He has been participating in the urban planning of Phnom Penh since the mid-2010s and has a network with engineers in DPWT. He also has a deep knowledge in the field of road design, including geometric structures of intersections.
Atsushi Suganuma	Maintenance Management Practial Aspect of Operation Traffic Signal Control	He has been involved in the soft component of grant aid project to improve the signaling system in Phnom Penh. He has plenty of experiences in designing TCC in regional cities in Japan of which urbanized area is almost the same size as Phnom Penh metropolitan area.
Yuji Mochizuki	Maintenance Management Practial Aspect of Operation Traffic Signal Control	He has plenty of experience in designing TCC in regional cities in Japan of which urbanized area is almost the same size as Phnom Penh metropolitan area
Sungjoon Hong	Traffic Signal Control	He is skilled in providing instruction on all aspects of traffic control systems, from basic to advanced. He has worked to strengthen TCC staff's ability to design new signalized intersections in response to their lack of responsiveness.
Michiko Kondo	Communication System Training	She is an expert of telecommunications. She instructed TCC staff about the concept of "system management," including reducing the number of accidents and repair time, and early detection of OFC failure points.
Kiminari Takahashi	Traffic Management Training	Specialist in the field of urban transportation. He has extensive experience in developing plans for public transport and traffic management in Southeast Asia and Africa. He specializes in developing plans of public transportation and traffic management in a way that allows counterparts and stakeholders to take ownership. .

4.2 Self-Evaluation by the Trainees

(1) Level of Satisfaction of Overall Training Course

The trainees' self-evaluation of their level of satisfaction toward the overall training course is given below. About 70% of them were satisfied with the program.

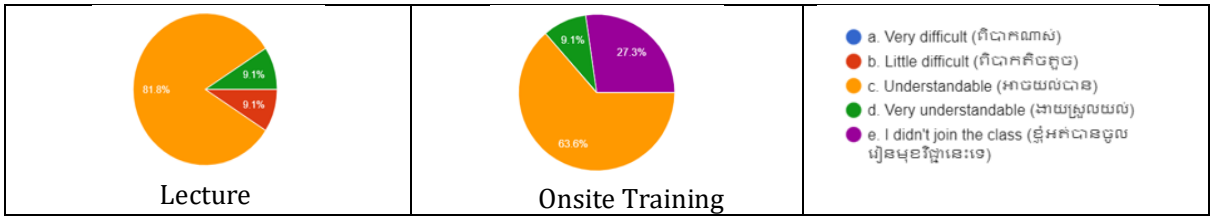
"Very Satisfied : 2 persons (18.2%)
"Satisfied" : 6 persons (54.5%)
"Little Satisfied" : 3 persons (27.3%)



(2) Level of Understanding of Overall Training Course

The trainees' level of understanding of the overall training course is given below. They answered they could understand both the lectures and the onsite training.

【lecture】 "Very Understandable" : 2 persons (18.2%)
"Understandable" : 8 persons (54.5%)
"Little Difficult" : 1 person (9.1%)
【onsite training】 "Very Understandable : 1 person (9.1%)
"Understandable" : 7 persons (63.6%)
"I didn't join the class : 3 persons (27.3%)



(3) Level of Understanding of each Training Course

The result of self-evaluation about understanding level of each training course is shown below.

All of the training programs seemed to be generally well received, except for those who were absent. But the distribution of responses varies slightly from one training course to another.

It shows that ① Maintenance Training has the most "Very Understandable" answer. The breakdown of self-evaluations is as follows:

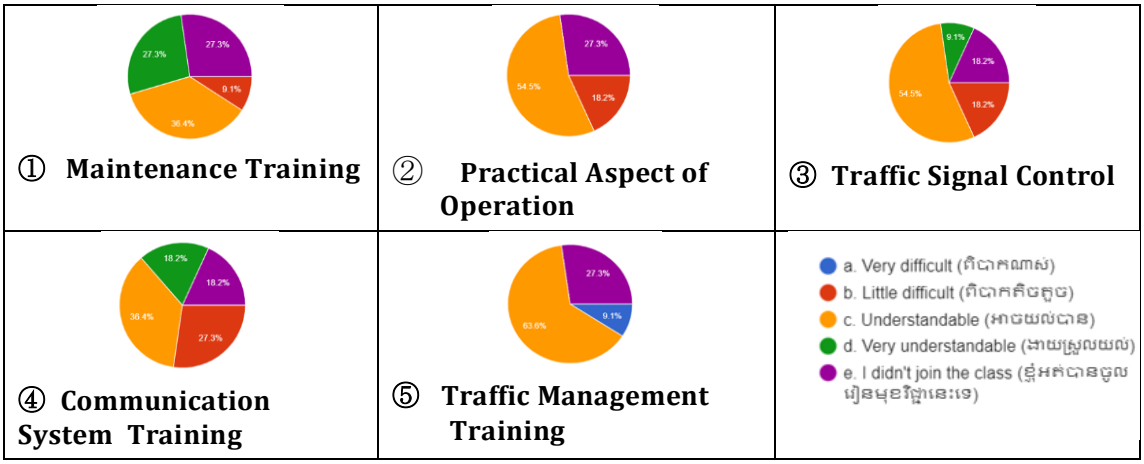
"Very Understandable : 3 persons (27.3%)
"Understandable" : 4 persons (36.4%)
"Little Difficult" : 1 person (9.1%)

On the other hand, ⑤Traffic Management Training has the most "Understandable" answer. The breakdown of self-evaluations is as follows:

"Understandable" : 7 persons (63.6%)
"Very Difficult" : 1 person (9.1%)
"I didn't join the class" : 3 persons (27.3%)

Adding “Very Understandable” and “Understandable”, ③Traffic Signal Control has also 7 answers (63.6%).

“Understandable” : 1 person (9.1%)
“Understandable” : 5 persons (54.5%)
“Little Difficult” : 2 persons (18.2%)
“I didn’t join the class” : 2 persons (18.2%)



(4) Willingness to apply to Daily Work

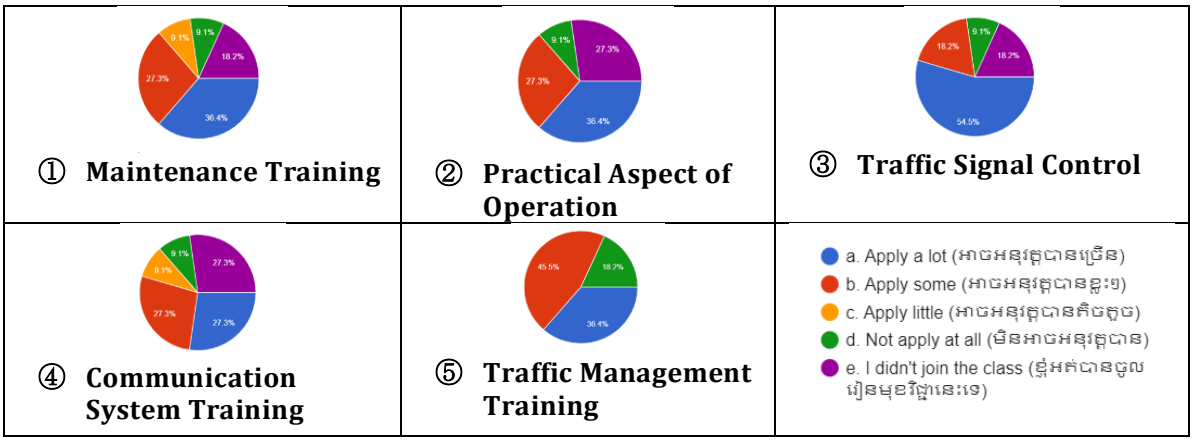
The result of willingness to apply what they learned to daily work is presented below.
It shows that the participants of ⑤ Maintenance Training have the highest “willingness to apply” to daily work. The breakdown of self-evaluations is as follows:

“Apply a lot” : 4 persons (36.4%)
“Apply some” : 5 persons (45.5%)
“Not Apply at all” : 2 persons (18.2%)

According to the next section "Self- Evaluation by the Trainers”, it can be said that the participants gained experiences to be able to discuss with each other and develop practical policies for traffic control through 2 sessions of group work. Through the training course, they positioned what they learned on the extension of their daily work.

The participants of ③Traffic Signal Control have the second highest willingness to apply to daily work. The breakdown of the self-evaluations is shown below. According to the next section "Self-Evaluation by the Trainers”, participants performed an exercise to calculate the signal parameters, which seemed to be effective.

“Apply a lot” : 6 persons (54.5%)
“Apply some” : 2 persons (18.2%)
“Not Apply at all” : 1 person (9.1%)
“I didn’t join the class” : 2 persons (18.2%)



(5) Willingness to Knowledge Sharing

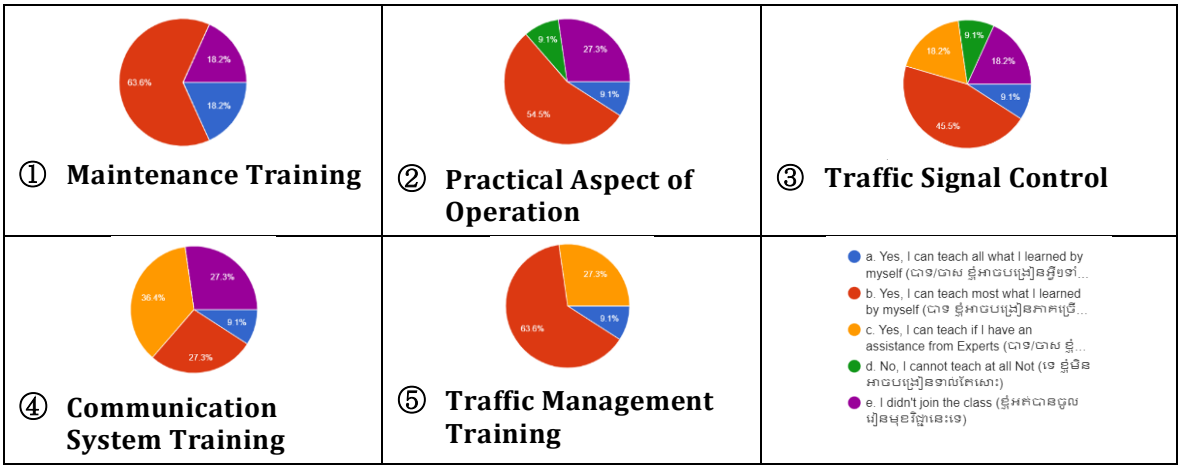
The result of "willingness to knowledge sharing" of trainees is presented below. (number of response is 11)

It shows that participants of ①Maintenance Training have the highest willingness to share what they have learned. According to the next section "Self-Evaluation by the Trainers", it can be said that such efforts as equipping the trainees with tools and safety equipment themselves and having them experience maintenance work in both Japan and the Philippines increased their safety awareness. It seems that TCC staff, who previously repaired only after accidents, are now more motivated to share their knowledge with others through gaining new concepts of preventive maintenance.

"I can teach all what I learned by myself" : 2 persons (18.2%)
"I can teach most what I learned by myself" : 7 persons (63.6%)
"I didn't join the class" : 2 persons (18.2%)

The participants of ⑤Traffic Management Training have the second highest "willingness to knowledge sharing". During the course, the lecturer conducted group work for 2 times and let participants discuss with each other and develop practical policies for traffic control. They seem to gain deep insights and self-confidence through the experiences.

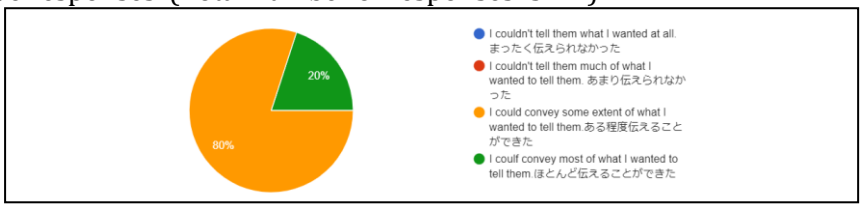
"I can teach all what I learned by myself" : 1 person (9.1%)
"I can teach most what I learned by myself" : 7 persons (63.6%)
"I can teach if I have an assistance from Experts" : 2 persons (18.2%)



4.3 Self-Evaluation by the Trainers

(1) How well did you convey the points through training course?

The result of self-evaluation by trainers about each training content is shown below. All trainers gave positive responses. (Total number of responses is 12.)

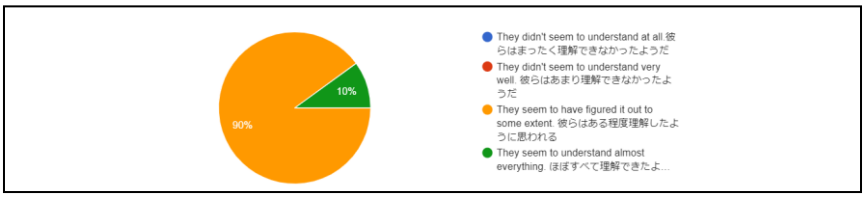


The result of free text messaging about each training contents is shown below.

①Maintenance Training
I felt language barrier（Ona）
Even for someone like me who has been engaged in traffic control systems for many years, the content provided new discoveries and insights. It would have been well-balanced if it had included more technical content, such as more specific inspection procedures. (Suganuma)
As far as I was in charge of, I could explain and model at the same time on site. I think it was well balanced. (Mochizuki)
Until now, TCC staff and related personnel have only dealt with post-accident maintenance, but the training provided an opportunity to learn new concepts such as preventive maintenance and safety measures. Although many things were new to me, I was still able to convey some of them. (Machida)
② Practical Aspect of Operation
Detailed explanations of operation methods of traffic control system (signal control), such as intervention control, time control, automatic control and the setting methods, and intersection design were generally conveyed through lecture and on-site training. (Mochizuki)
③Traffic Signal Control
The post-test showed a higher percentage of correct answers than we had expected through the efforts to encourage active participation. (Hong)
Some contents seemed to be a little difficult for some trainees, such as calculation method of signal parameters, and could not be fully conveyed. (Machida)
The lecture covered a wide range of topics on signal control, from basic to advanced. However, based on the results of the pre-evaluation test, I felt that more simple contents were better. (Mochizuki)
Although the theme of the training was Traffic Signal Control, the contents included a wide range of topics that TCC staff should know, including not only signal control but also road design and control method considerations. It covered the necessary content in terms of giving a broad perspective. (Suganuma)
③ Communication System Training
Although I felt the language barrier having talk in English, I think I could convey the essence using diagrams instead. (Kondo)
⑥ Traffic Management Training
Group work activities were conducted on the first day and on the last day, in which there was active discussion based on the content of the training program. (Takahashi)

(2) How well did trainees understand the training course?

The result of self-evaluation by trainers about the level of understanding of trainees is shown below. All trainers feel good about the training and gave positive feedback. (Total number of responses is 12.)

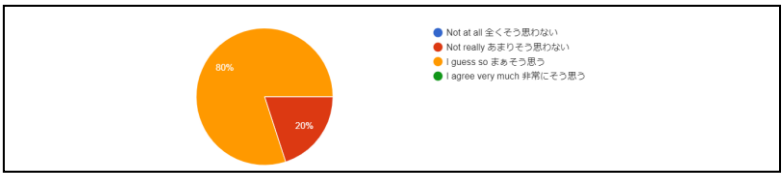


The result of free text messaging about each understanding level by lecturers is shown below.

① **Maintenance**
They now seem to have a better understanding toward the biggest problem, the lack of well-planned activities. I think that the awareness of "safety initiatives," which was quite low in the past, has also been raised through this training program. (Suganuma)
It seems they could understand deeply through practicing what we explained in the training with us. (Mochizuki)
The reactions of the students indicate that they now have a better understanding of the importance of periodic inspections and how to ensure the safety of their work. (Machida)
② **Practical Aspect of Operation**
Since most TCC staff could operate the system, it can be said that they could understand some content of the training program. Furthermore, the operations manual provided in this training course can be used to deepen the learning. (Suganuma)
At first, SUMIDEN considered giving the lecture only to Vandeth, who had a deeper understanding of the system. But by having other members participate in the training, practice setting up the system, and answering questions, they all seemed to have a better understanding in the end. (Mochizuki)
③Traffic Signal Control
We conducted the same examination before and after the training and the percentage of correct answers improved after the training. (Hong)
All of the trainees who participated in the workshop worked together to complete the exercises. They were so active that they even asked for extra time. (Machida)
The results of the evaluation test indicate that the basic terms and definitions were generally understood (Suganuma).
④Communication System Training
Since the only participants were TCC staff, it was assumed that they understood the training to some extent before they received it. The post-training evaluation also showed that the participants mostly understood the training. (Kondo)
⑥ **Traffic Management Training**
Group work activities were conducted on the first day and on the last day, in which there was active discussion based on the content of the training program. (Takahashi)

(3) Time distribution (lecture /onsite training /group work)

Regarding the impression of time distribution (lecture /onsite training /group work), the result is provided below. Almost all lecturers feel it was appropriate, except for 2 who answered “Not really”. (Total number of answers is 12.)



The result of free text messaging by lecturers about time distribution is shown below.

①**Maintenance**
The one-week (five-day) lecture schedule was shortened to three days (two days of lecture and one day of on-the-job training), but it was so unfortunate that the on-the-job training had to be further shortened due to rainfall. (Ona)
I think group work time was too short. It would have been much better if the attendees were given longer time to figure things out by themselves. (Suganuma)
Considering the field of maintenance, I felt that the ratio of lectures was a little too much. If we could have had a little more time for specific hands-on training, the attendees would have had a better understanding. (Mochizuki)

I think the training was conducted as efficiently, effectively, and appropriately as possible. However, it would have been much better if we had more time to wait for the unexpected rainfall to stop during the on-the-job training. (Machida)
③ Practical Aspect of Operation
When operating traffic signals, it is very important to assess the traffic situation at the site. In this context, I think It would have been much effective if the time of hands-on training at the site were longer. (Suganuma)
The balance of content was generally appropriate, as participants were never bored with the training. (Mochizuki)
④ Traffic Signal Control
The content and structure of the training were good, as it was not simply about trying to get them to learn how to do things, but also included various level of content from basic lectures to practical exercises in which participants calculated signal parameters by themselves. (Hong)
Lectures and group work were conducted in a well-balanced manner, and trainees were able to participate without losing attention and focus. (Machida)
If the content of the lecture could have been reviewed through site visits, it would have further deepened the learning process. It was good and much effective to let them consider exercises by themselves first and make explanations later. (Suganuma)
I felt that the lecture part was a little too much. It would have been better to incorporate group work to identify and discuss the causes of traffic congestion in the field. As for the exercises, they turned out to be a kind of group work without any intension for this to be so. However, it was kind of refreshing to see them exchanging opinions and coming up with solutions. (Mochizuki)
④Communication System Training
It is regrettable that the course was only a one-way lecture without exercises or group work. (Kondo)
⑤Traffic Management Training
I could conduct both lectures and group works within the planned time frame. (Takahashi)

(4) Notes and points to be improved

The result of free text messaging about notes and points to be improved is shown below.

Since the maintenance and management of traffic signal systems is a topic of little interest to TCC engineers as it has a strong administrative rather than technical tinge, I used illustrations and videos to stimulate their interest and understanding. (Ona)
During the on-the-job training, the trainees were equipped with tools and safety equipment, and they experienced maintenance work on site in a fusion of Japanese and Filipino way, which was very useful. (Machida)
The exercise improved their understanding. However, the traffic simulation demonstration which was planned to visually show the traffic situation with different signal controls could not be used as planned due to lack of preparation. It had to be used during the lecture on the introduction of traffic simulation. (Hong)
During the exercises, the instructors checked with each trainee on points they did not understand and gave them advice, which greatly improved their understanding. (Machida)
(What we tried) We included not only textual but also visual information to promote understanding. In addition, I also created a PowerPoint animation. (Points for reflection) The training materials were based on Japanese technical manuals, which were difficult to apply directly to Cambodia's traffic conditions. It would have been easier for the participants if the materials had been prepared in consideration of the differences in vehicle configuration (ex. motorcycles and tuk-tuks). (Suganuma)
We tried to keep the sentences as simple as possible. In addition, we prepared examples to encourage trainees' participation and included charts and diagrams in the materials. According to the results of a test conducted before the lecture, I felt that the level of their understanding about signal control was lower than expected. But through the training, we could raise their level. (Mochizuki)
Since the course was not in their NATIVE language, I tried to make materials easy to understand intuitively by using many diagrams. It would have been better if I had provided an opportunity for the participants to participate in the course. (Kondo)
I could have had time to include a site visit. (Takahashi)

5. CONCLUSIONS

These training programs were conducted to improve the operational maintenance and management capacity of the Phnom Penh Traffic Control Center. As we have seen above, it was confirmed that the attitude and motivation of the participants have increased.

After all training courses were completed, the participants were encouraged to freely describe the reason why their capacity were/or were not improved. Many of them said that they "gained more knowledge through the training. In addition, following comments were given:

- “This training changed my awareness of traffic management. I would like to make use of what I have learned and contribute to the development of the entire city of Phnom Penh”.
- I was able to relearn fundamentals rather than knowledge directly related to my daily work.
- I could gain clear understanding about the control system, as I received a lot of information through this training.
- I gained new knowledge about solving traffic problems, such as designing parking lots and studying traffic policies.

Based on the above, the content of the training program can be said to comprehensively match the interests and technical skills of the trainees.

The participants were also asked to write freely about their ideas for traffic management measures to improve traffic in Phnom Penh. Comments received comments were as follows:

- Prohibit street vending
- To improve traffic in Phnom Penh and other provinces, traffic laws regarding traffic signs, lane markings, traffic lights, etc. need to be widely disseminated
- Designing roads, enforcing illegal parking, and dividing lanes according to vehicle type is important.
- Need to provide and disseminate basic knowledge about signal systems, such as signal indications, steps and intersection layout design.
- For maintenance, it is very important that proper handover is made from the contractor at the time of handover
- Provide training on traffic laws to all drivers in Cambodia.
- Ensure that traffic rules are disseminated to all.
- I was reminded of the importance of Japanese support for improving transportation in Phnom Penh.

These comments will be incorporated into future pilot project discussions and training.

On the other hand, there were a few comments from the trainees that the course was "a Little Difficult" or "Very Difficult". Some instructors also pointed out the difficulties caused by language barrier. Taking those comments into account, further study and improvement of training method is required, including allocation of an interpreter to translate lecturer's English into Khmer and/or translation of handouts into Khmer, instead of English.

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As previously mentioned, this training program was conducted by experts in the fields of maintenance, traffic signaling, communications, and traffic management. Based on their wide experience and knowledge, they conveyed the knowledge necessary for the operation of TCCs and the improvement of Phnom Penh's transportation system.

Each training course is not standardized in content and method, but is conducted in a unique style according to the instructors' backgrounds and themes, and is designed to provide participants with the opportunity to learn from each other's experiences.

The member of participants also varied according to the training course. For example, the trainees of ②Practical Aspect of Operation and ④Communication System Training were only TCC staff,

while there were more than 20 participants in ⑤Traffic Management Training not only from TCC, but also from PPCA, DPWT and Traffic Police.

Actually, SUMIDEN, lecturers of ②Practical Aspect of Operation, firstly planned to teach only Mr. Vandeth, the most skilled and trained TCC staff by way of trainer's training. They thought it would be more effective if they focus on him and let him teach other members later. But in response to a strong request from Mr. Vandeth, SUMIDEN conducted training in TCC for all its staff. As a result, practical guidance was given while tinkering with parameters on the computer used in daily operation, which became to be a very good chance for them. They actively participated in the program. In particular, when SUMIDEN directed to design a traffic lane of intersection based on traffic volume, all the staff considered their assignments very seriously and made individual presentations with pleasure. Their faces showed positive and active attitude to learn.

In the other training sessions, the participants were also very active. It was so impressive that they listen intently to the lectures, work hard on assignments, make discussions with other members and express surprise when they saw how signal indication changes at intersections.

In addition, it is worthy of special mention that TCC members started checking the conditions of traffic signals at each intersection handed over at the end of year 2018 through ①Maintenance Management training

Furthermore, as mentioned above, participants of ⑤Traffic Management Training have considered the practical policies to improve traffic conditions in Phnom Penh, proposed suitable bus route for the SEA games in 2023, and drawn the draft of action plan for better parking management. These outputs will be taken into considered for pilot project and further implementation of PPTMTC.

Considering these results above, JICA expert team can evaluate and conclude that training programs this time were all organically linked to the whole project and conducted successfully.

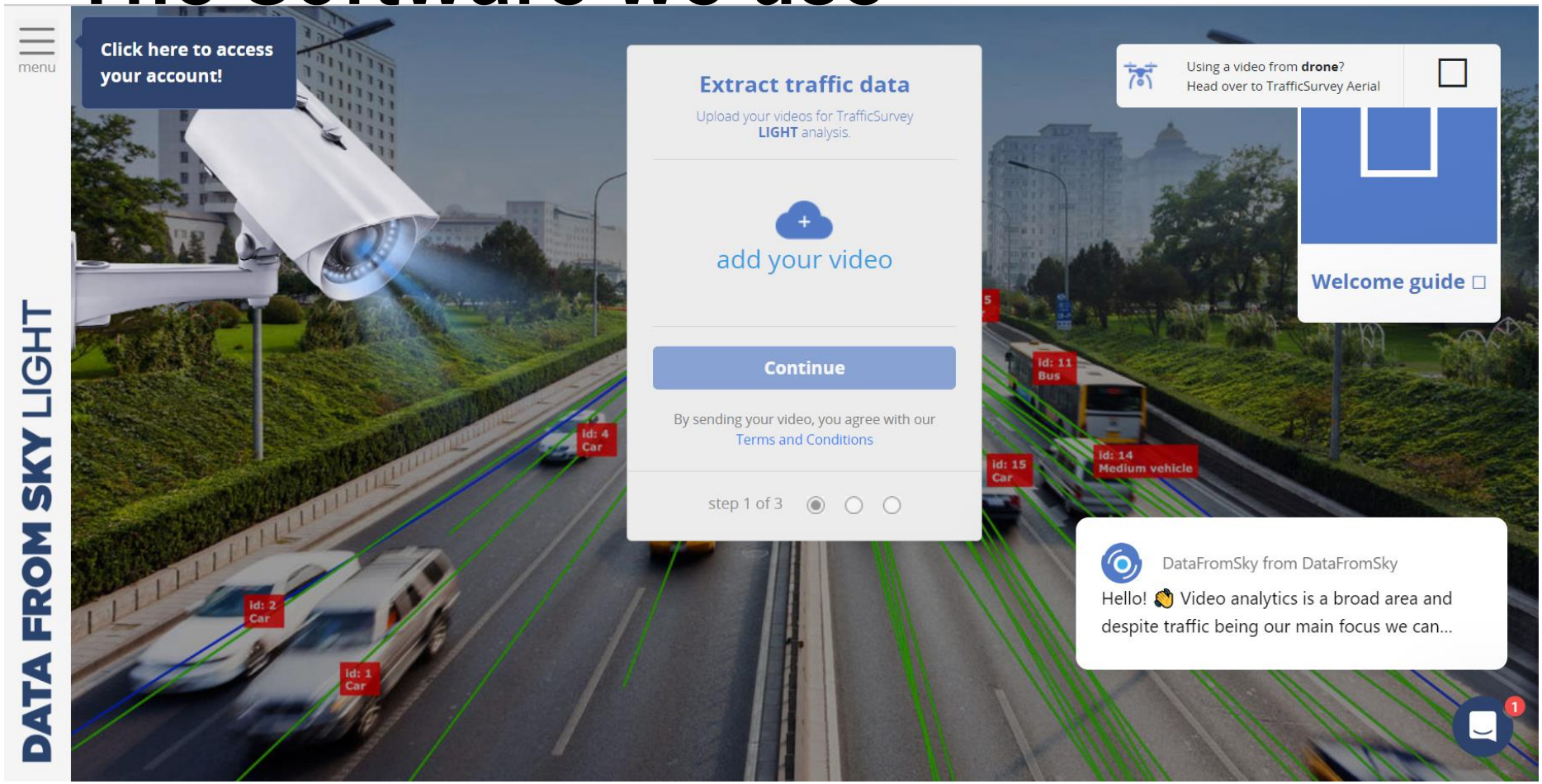
ANNEX6: Traffic survey and

Data for TCC

Transport survey and data for TCC

1. **Detector data and CCTV** (Aug. 2023)
2. **Transport Survey Results in April 2023** (Aug. 2023)
3. **Image Processing AI to Monitor Traffic Volume** (Aug. 2023)
4. **How to manage Transport Survey** (Feb. 2024)
5. **Simplified Transport Survey by TCC** (Feb. 2024)
6. **Evaluation of the Pilot Projects** (Mid 2024)

The Software we use



https://ai.datafromsky.com/light/my-account

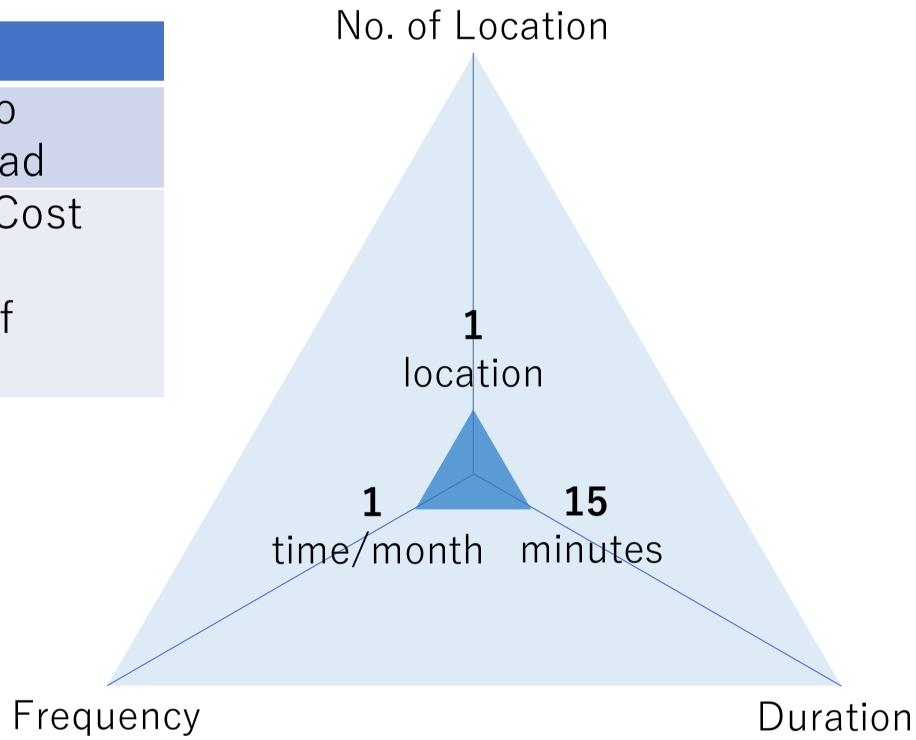
Options of Computing system

	Pros	Cons
Cloud	• Easy to Start • No Initial, O&M Cost	• Pay as you go • Need to upload
Edge, Local server	• No need to upload	• Initial, O&M Cost • Import and Installation of equipment

Cloud is cost effective when small amount of use.

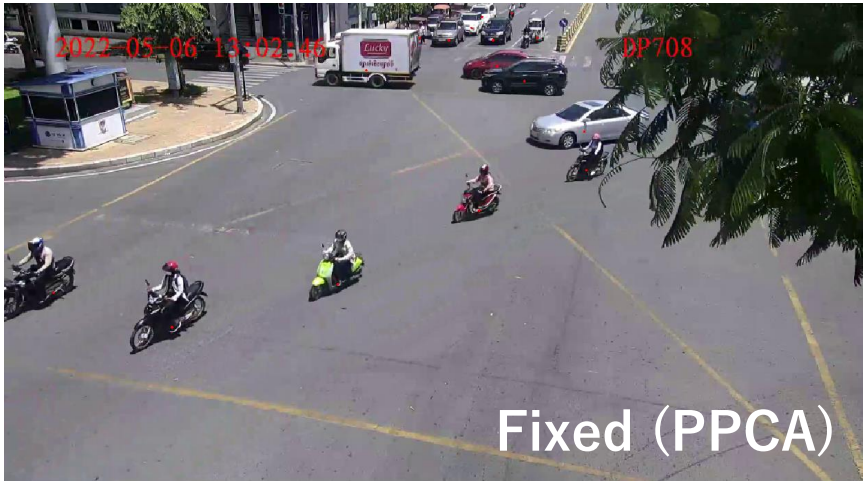
Start small and grow big.

Location:
Frequency:
Duration:



Options of Camera

	Pros	Cons
Fixed	• **8 m** from ground level • No need to installation work	• Limited location and angle • Cannot cover all inflow & outflow direction at the same time
Commercial	• Any location • Possible to install multiple camera at one location to cover inflow & outflow	• Difficult to install at high place • Need installation work • Limited duration of recording





Accuracy of the DFS in PNH (Inflow)

Angle = Good, fps=27 or 30 (10 inflows time slot)

		Vehicles / 15 min										PCU / 15 min	
	Start	Bicycle	MC	Remork	Tricycle	Car	Bus	Truck	Large Truck	Total Excl. MC	Total	Total Excl. MC	Total
Manual Count	7:30	13	1,209	26	106	321	2	22	2	**492**	**1,701**	**494**	**857**
	13:00	4	394	17	74	161	2	5	0	**263**	**657**	**254**	**372**
	17:00	25	926	29	125	354	3	5	0	**541**	**1,467**	**507**	**785**
	20:00	1	378	8	63	151	0	1	0	**224**	**602**	**211**	**324**
	Total	**43**	**2,907**	**80**	**368**	**987**	**7**	**33**	**2**	**1,520**	**4,427**	**1,466**	**2,338**
Image Processing AI / Manual Count	7:30	108%	95%	0%	84%	104%	100%	141%	0%	**96%**	**95%**	**97%**	**96%**
	13:00	125%	98%	0%	66%	117%	50%	240%		**97%**	**97%**	**100%**	**99%**
	17:00	92%	96%	0%	94%	102%	100%	160%		**95%**	**95%**	**94%**	**95%**
	20:00	500%	85%	0%	21%	123%		300%		**92%**	**88%**	**96%**	**92%**
	Total	**109%**	**94%**	**0%**	**73%**	**108%**	**86%**	**164%**	**0%**	**95%**	**95%**	**96%**	**96%**

Angle = Poor, fps=27 or 30 (9 inflows time slot)

		Vehicles / 15 min										PCU / 15 min	
	Start	Bicycle	MC	Remork	Tricycle	Car	Bus	Truck	Large Truck	Total Excl. MC	Total	Total Excl. MC	Total
Manual Count	7:30	10	1,465	46	105	308	3	22	0	**494**	**1,959**	**502**	**941**
	13:00	3	817	39	181	300	0	14	0	**537**	**1,354**	**516**	**761**
	17:00	9	536	5	48	242	0	0	0	**304**	**840**	**286**	**447**
	20:00	6	717	13	130	242	6	5	0	**402**	**1,119**	**381**	**596**
	Total	**28**	**3,535**	**103**	**464**	**1,092**	**9**	**41**	**0**	**1,737**	**5,272**	**1,685**	**2,745**
Image Processing AI / Manual Count	7:30	180%	89%	0%	71%	106%	67%	114%		**90%**	**89%**	**89%**	**89%**
	13:00	167%	85%	0%	93%	96%		93%		**89%**	**86%**	**86%**	**86%**
	17:00	111%	87%	0%	98%	99%				**97%**	**91%**	**97%**	**93%**
	20:00	67%	56%	0%	53%	106%	100%	80%		**84%**	**66%**	**87%**	**76%**
	Total	**132%**	**81%**	**0%**	**78%**	**102%**	**89%**	**102%**		**90%**	**84%**	**89%**	**86%**

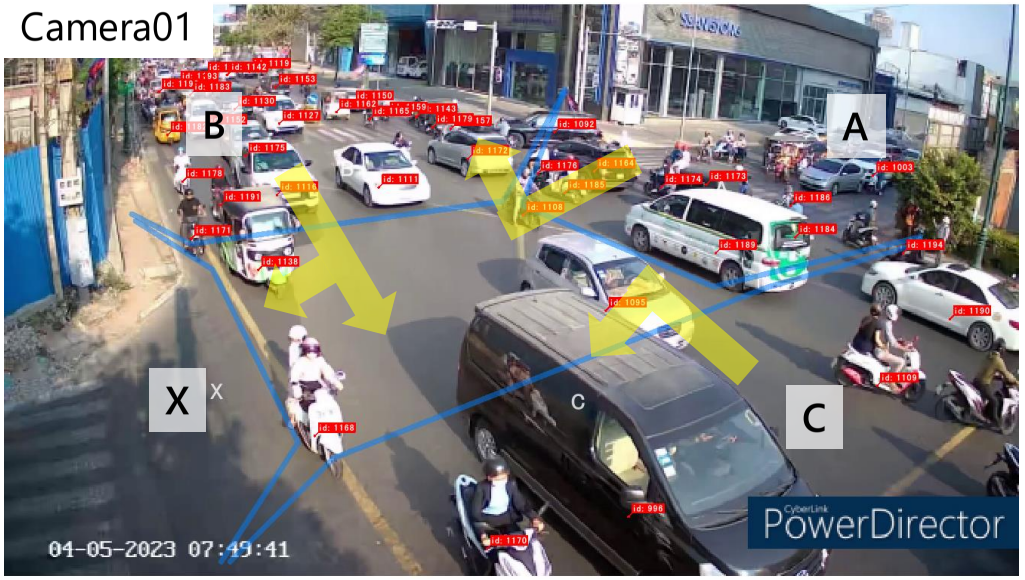
Accuracy of the DFS in PNH (Inflow & Outflow)

#28 (IS-3) Morning Peak (7:45~8:00)

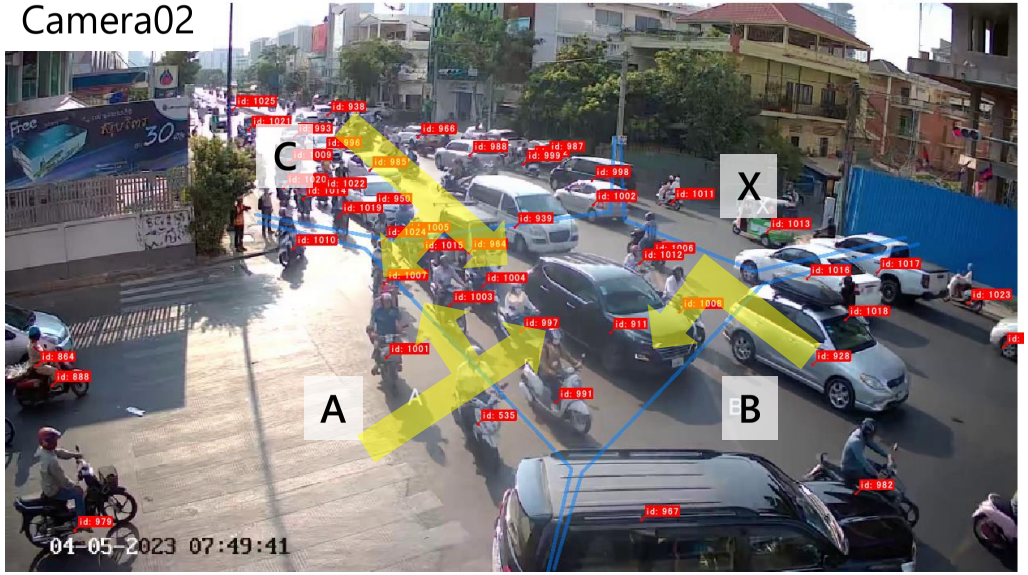
Inflow	Outflow	PCU AI	PCU Manual	Rate	Diff.
A	B	172	198	87%	-26
B	C	705	720	98%	-15
B	X	16	11	145%	5
C	X	0	0		0

Inflow	Outflow	PCU AI	PCU Manual	Rate	Diff.
A	C	73	69	106%	4
A	X	104	118	89%	-14
B	A	77	89	86%	-13
C	A	81	90	90%	-9
C	B	336	358	94%	-22

Camera01



Camera02



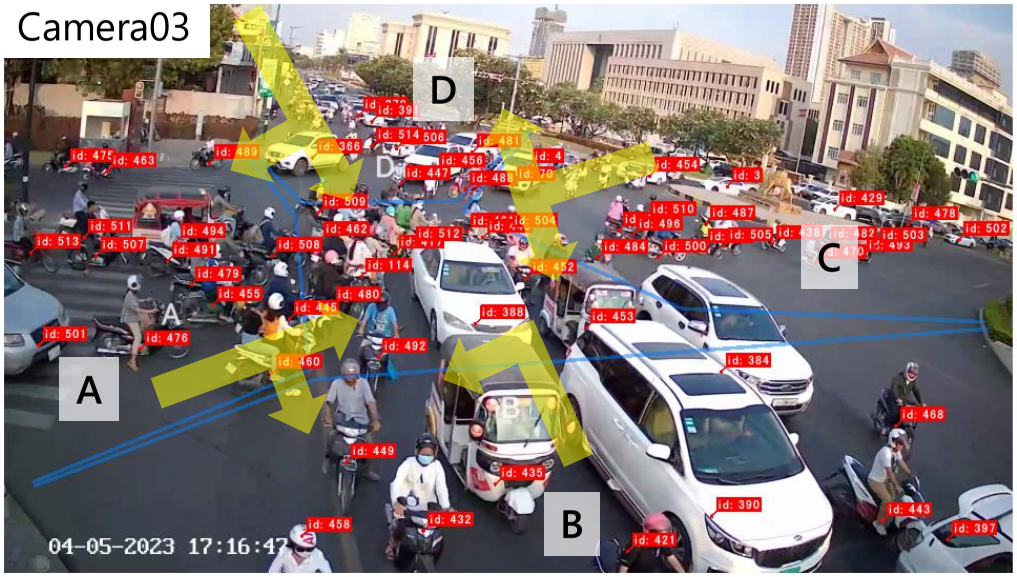
Accuracy of the DFS in PNH (Inflow & Outflow)

Inflow	Outflow	PCU AI	PCU Manual	Rate	Diff.
A	B	44	51	87%	-7
A	C	158	172	92%	-14
B	A	114	117	97%	-3
C	B	68	52	131%	16
C	D	21	62	34%	-41
D	A	214	123	174%	91
D	B	513	586	88%	-73

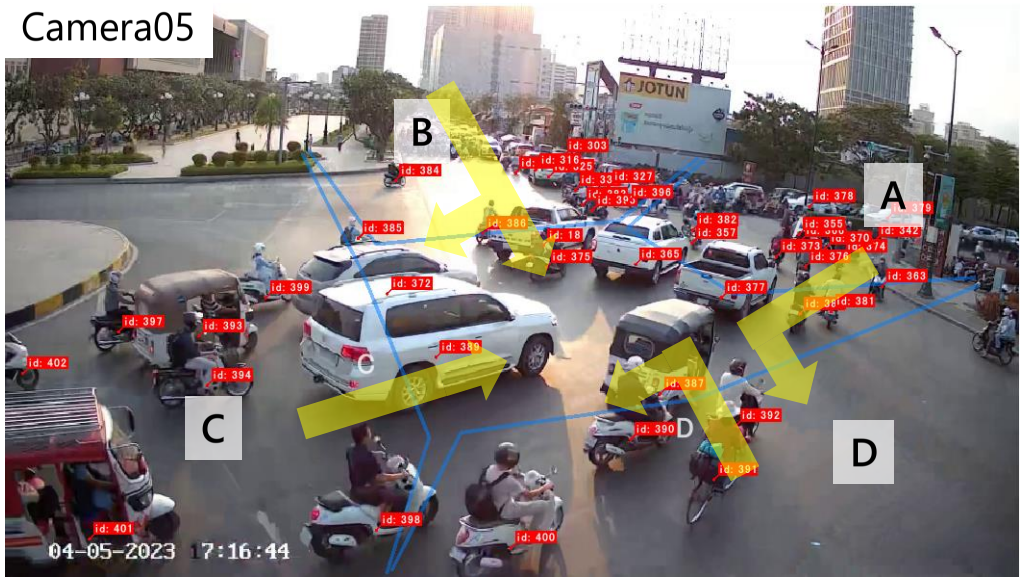
#126 (IS-4) Evenign Peak (17:15~17:30)

Inflow	Outflow	PCU AI	PCU Manual	Rate	Diff.
A	D	0	6	5%	-6
B	C	118	41	288%	77
B	D	298	239	124%	59
C	A	180	250	72%	-70
D	C	126	127	99%	-1

Camera03



Camera05



Factors which can affect accuracy

1. **Occlusion (camera angle and congestion)**
2. Out of image
3. Frame rate and resolution
4. Clearness of the camera lens
5. Nighttime, rain
6. Shadow, etc.

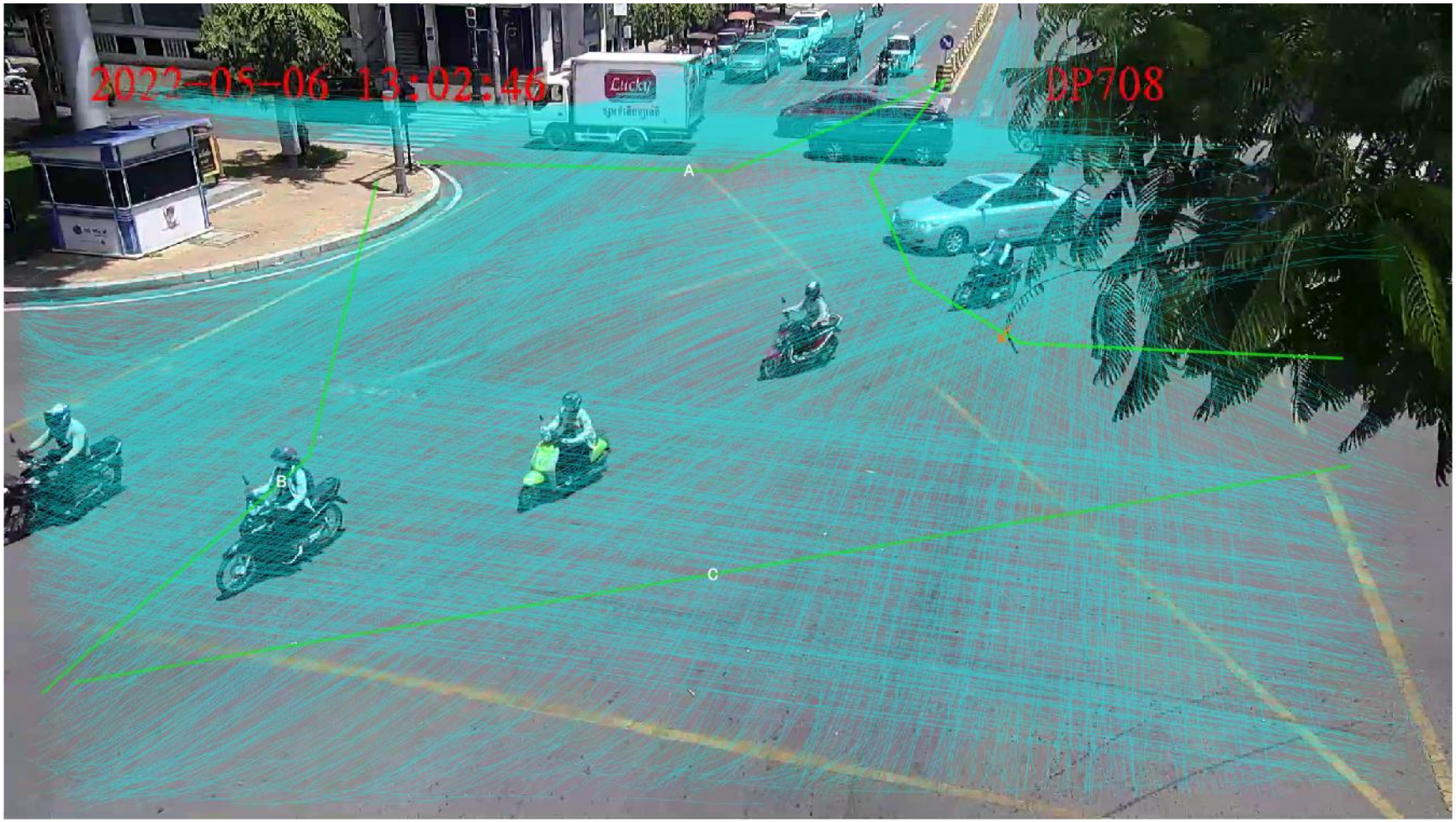
Steps of Traffic Count by Image Processing AI

1. **Set camera angle**
2. Export and trip the target footage (Clear, High resolution, 30 fps)
3. Upload the footage and download the output file
4. **Determine the “gates” for each inflow direction**
5. Check how the “gates” work and modify
6. Export csv and analyze

1. Set camera angle



4. Determine the “gates” for each inflow direction

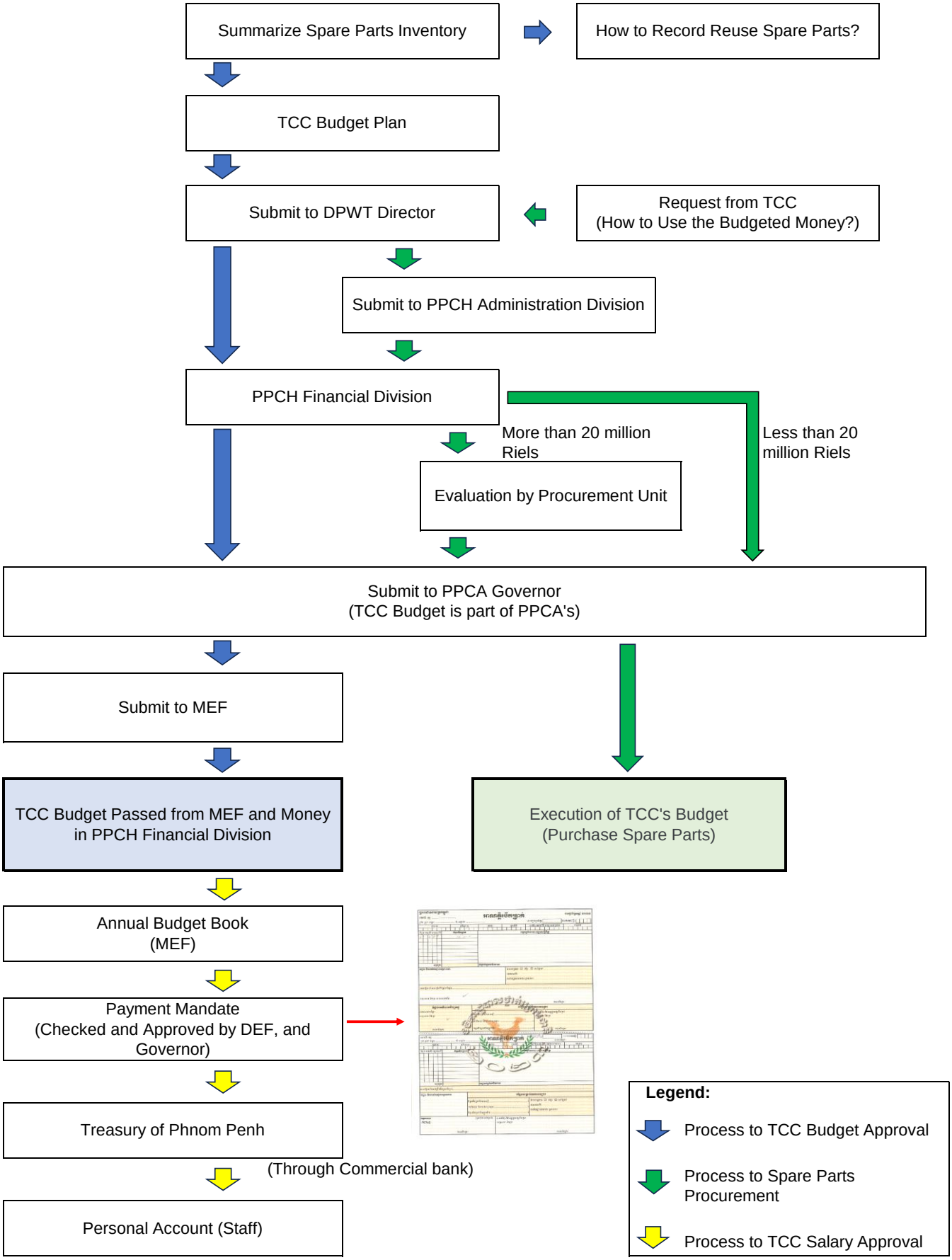


[Technical Cooperation Deliverables]

Annex 7: Traffic Enforcement and Traffic Safety Education Manual

ANNEX8: How to Use TCC budgeted Money

Annex 9: HOW TO USE TCC BUDGETED MONEY?



ANNEX9: Required Documents and Procedure for Tax Exemption of Pickup Truck

Annex 9: Required Documents and Procedure for Tax Exemption of Pickup Truck

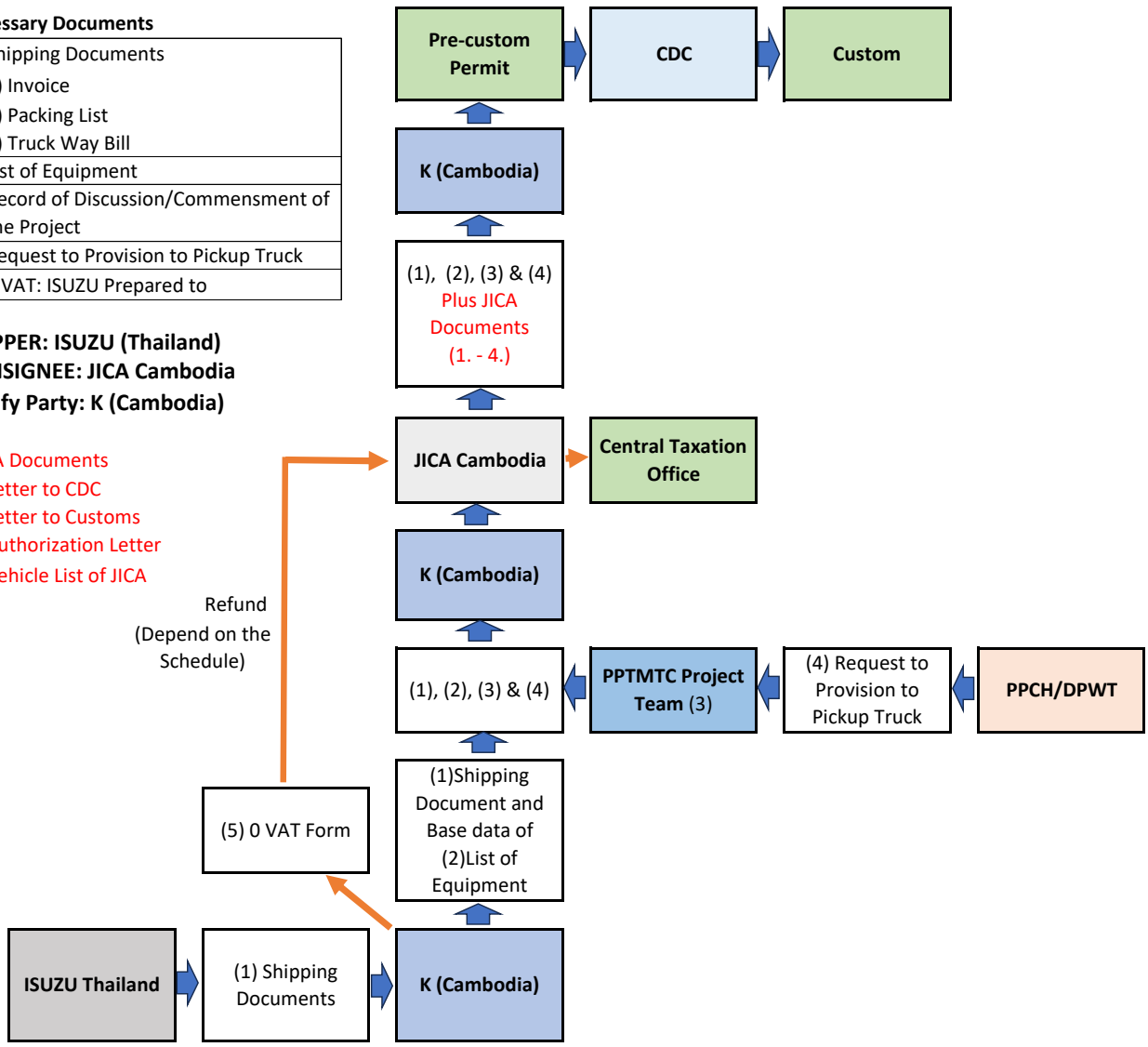
Prepared by JICA PPTMTC Project Team

Necessary Documents

(1) Shipping Documents 1) Invoice 2) Packing List 3) Truck Way Bill
(2) List of Equipment
(3) Record of Discussion/Commensment of the Project
(4) Request to Provision to Pickup Truck
(5) 0 VAT: ISUZU Prepared to

SHIPPER: ISUZU (Thailand)
CONSIGNEE: JICA Cambodia
Notify Party: K (Cambodia)

*JICA Documents
1. Letter to CDC
2. Letter to Customs
3. Authorization Letter
4. Vehicle List of JICA



[Technical Cooperation Deliverables]

Annex 10: Pilot Project Handbook

ANNEX11-0: JCC Kick off Meeting

Minutes of the Kick-off Meeting

of

The Project for Capacity Development on Comprehensive Traffic Management Planning and Traffic Control Center Operation and Maintenance in Phnom Penh Capital City (PPTMTC)

The Kick-off meeting between Phnom Penh Capital Administration, Department of Public Works and Transport of Phnom Penh (DPWT), Japan International Cooperation Agency (JICA), and the concerned members of the Project for Capacity Development on Comprehensive Traffic Management Planning and Traffic Control Center Operation and Maintenance in Phnom Penh Capital City (PPTMTC) was held virtually via video conference (Zoom Meeting), on 17th of February, 2022. The comments and discussions on several items are provided below.

1. Opening remarks by PPCA, JICA and DPWT:

H.E. **Suy Serith, Vice Governor of PPCC,** welcomed all the participants and expressed his sincere thanks to the government of Japan for extending is support through JICA as well as to the JICA project team (Mr. Koto) for the implementation of PPTMTC project.

Mr. Tomohiro Kozono, JICA representative in charge of PPTMTC project, gave brief remarks on the long history of JICA's support on the transport sector in Phnom Penh, and highlighted the key components of this PPTMTC project. He further mentioned that traffic congestion has become serious, and that through this project, it will help to sustain the traffic environment. He sincerely requested the project members from the Cambodia side to cooperate with the JICA project team to smoothly implement this project.

Mr. Chou Kimtry, Deputy Director of DPWT, thanked JICA and the JICA project team for their continuous support on the transport sector in Phnom Penh which could help to mitigate the traffic congestion and facilitate the traffic flow in the city. He is very glad to have the implementation of this 3-year Technical Cooperation Project

2. Contents of Presentations:

Mr. Masato Koto, team leader of the JICA Project team, gave a presentation on the overall outline of the PPTMTC project (goal, purpose, and outputs) based on Project Design Matrix, Basic Directions, Project Schedule, Current situation of traffic control center and Issues.

3. Main Points of Discussion:

No.	Comments/Questions	Answers
1.	**One-way System**	
	H.E. Suy Serith asked the project team if it is possible to consider Street 19 (circle line) for one-way system in addition to the Street 240 proposed by the project.	**Mr. Koto** said that for the traffic management measures of the pilot project, small-scale measures related to the traffic control system will be implemented. As for the one-way system along Street 19, this can be discussed with stakeholders how to implement.

2.	**Signals along NR1**	
(1)	**H.E. Suy Serith** stated that there are many complaints regarding the signal along NR1 such as congestion, too close signals, especially Borey Peng Hout Intersection. He asked Mr. Chou Kimtry (DPWT) and the project team if it is possible for these signals along NR1 to be integrated with the rest of the signals in the city and be connected to TCC.	- **Mr. Chou Kimtry** said that they also requested to connect 6 signals along NR1 to TCC, but the budget is very limited. Connection using communication cable is costly, so they are discussing if it is possible to connect using wireless network. This is subject to further study under this project. - **Mr. Koto** responded that it could be considered one of the Pilot Projects.
(2)	**Mr. Sunpheak,** TCC Officer, suggested to add more cameras to the signalized intersections along NR1 to help monitor the traffic situation and to provide intervention when it is necessary	- **Mr. Koto** said that this suggestion will be carefully considered such as capacity of internet and decided upon we the pilot project is finalized.
3.	**Traffic Management including Parking Management Measure**	
(1)	**Mr. Kimtry** said that DPWT wants the project team to include overall goal on how to achieve an efficient traffic system and reduce congestion and accidents in this project.	- **Mr. Koto**: Overall goal is more comprehensive, so we set the overall goal: "Sustainable Urban Transport Environment is Formed". We already included indicators related reduce congestion and traffic accidents in the PDM. - **Mr. Kimtry** took note and agreed with this and will cooperate with the project team to achieve this goal.
(2)	**Mr. Kimtry** stated that Parking arrangements (on street and off-street parking) in Phnom Penh, are not balance and do not yet meet the demand. He suggested that this project study the overall parking demand in the city in addition to the pilot project area.	- **Mr. Koto** replied that this project is mainly focus on traffic control system; parking policy/measure is an urban transport issue. Master Plan Revision Report submitted PPCA has mentioned several ideas regarding the parking measures. - **Mr. Kimtry** added that through TCC capacity development, there should also be traffic management for smooth traffic flow. The project is small but there should at least be a direction plan to implement in the future.
(3)	**Mr. Kimtry** mentioned that intercity buses entering the city have caused traffic congestion. Arrangement of the intercity bus terminals should be considered in this study.	**Mr. Koto** responded that this is a public transport issue and countermeasures of this issue are in the Master Plan Revision Report.

4.	**Organization Structure**	
	H.E Suy Serith asked Mr. Koto to refer to PPT slide 22, and to clarify the organization structure. To be consistent with what is stated in RD, he recommended adding the upper part of the structure, as the budget comes from PPCA. As for the lower part proposed by the project, he agreed with it.	- **Mr. Koto** replied that the organization structure shown in PPT slide 22 is an operational/ maintenance organization chart. The Project Team understands that PPCA is responsible for overall management. - **Mr. Kimtry** added that this chart is organization structure based on actual situation. TCC is a technical department. Operation and maintenance are under DPWT. In general, it is under PPCA, but for technical aspect, DPWT is the one who manage. If H.E. would like to change it, this will be discussed during the Project. - **H.E. Suy Serith** said if it is just an operational structure, he agreed with this, while the overall management structure would remain as the one shown in PPT slide 7.
5.	**Staffing for TCC**	
	H.E. Suy Serith said 12 staff is enough to operate the TCC. He asked the opinion of Mr. Kimchhuon and Mr. Koto on this matter.	- **Mr. Kimchhuon**: Current number of staff at TCC are enough and not much problem. -**Mr. Koto:** Originally, we have proposed 13 technical staff for TCC, but now there are only 7 staff members. As the staffing at TCC is engineering- oriented, we will propose a new number and to be discussed later. -**H.E. Suy Serith:** For the engineering staff, he agreed to have more, but for the administrative staff, he suggested to use the existing structure of PPCA. -**Mr. Koto:** Until now, TCC has focused only on maintenance management. But the capacity development of management, finance, planning, operation and maintenance will be considered and improved through the project. TCC should has many components, but maintenance is the most important.

4. Other information:

Mr. Koto informed everyone that the work plan of this project will be distributed to the participants within this week (after JICA Headquarters checks it).

3. Conclusion:

Before closing, H.E. Suy Serith expressed his gladness with the 5 key outputs set by the project. He mentioned that the limited budget makes it impossible to cover everything, but the PPCA budget can be considered for use to address some issues such as traffic education and traffic enforcement for the police, which are also important.

CONFIRMED BY:

H.E. SUY SERITH
Vice Governor
Phnom Penh Capital City

Mr. TOMOHIRO KOZONO
Representative
JICA Headquarters

H.E. Nuon Pharat
Vice Governor
Phnom Penh Capital City

22 March 2022
Mr. MASATO KOTO
Team Leader
JICA PPTMTC Project Team

Attached
1. Agenda
2. Attendance List
3. Photos
4. Presentation Material

1. Agenda

AGENDA

Kick-off Meeting for Project for Capacity Development on Comprehensive Traffic Management Planning and Traffic Control Center Operation and Maintenance in Phnom Penh Capital City (PPTMTC)

Venue: Zoom

Date: 17th February, 2022
Time: 09:00 to 10:45 Cambodia Time
Time: 11:00 to 12:45 Japan Time

09:00 – 09:20	**Opening Keynotes**

Representative of JICA

Mr. Tomohiro Kozono, Infrastructure Management Department, JICA

Representative of the Governor

H.E. Suy Sareth, Vice Governor, PPCH

09:20 – 10:00	**Presentation of the Project outline**

Mr. Sam Piseth, Director, DPWT, PPCC, Project Manager of the PPTMTC Project
(Introduction)

Mr. Masato KOTO, Chief Consultant, JICA PPTMTC Project Team
(Outline of the pilot project)

10:00 – 10:30	**Discussion**

10:30 – 10:45	**Closing Remarks**

Representative of the Governor

H.E. Noun Parat, Vice Governor, PPCH, Project Director of the PPTMTC Project

2. Attendant List

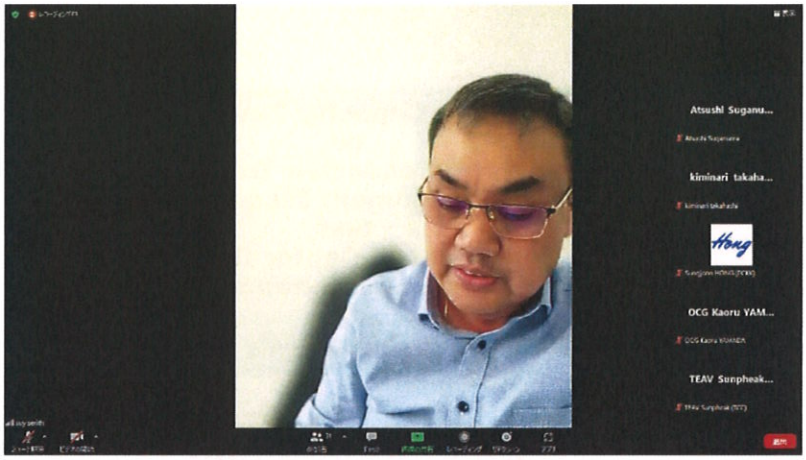
JCC Members

1. H.E. Suy Serith (Vice Governor, PPCA, Member of JCC)
2. H.E. Noun Pharat (Vice Governor, PPCA, Project Director of the PPTMTC Project, Member of JCC)
3. Mr. Chou Kimtry (Deputy Director, DPWT, Member of JCC)
4. Mr. Tomohiro Kozono (JICA Headquarters. Member of JCC)
5. Mr. Hiroaki Kubota (JICA Cambodia Office, Member of JCC)
6. Mr. Masato Koto (JICA Expert, Member of JCC)
7. Mr. Atsushi Suganuma (JICA Expert, Member of JCC)
8. Mr. Kiminari Takahashi (JICA Expert, Member of JCC)
9. Mr. Sungjoon Hong (JICA Expert, Member of JCC)
10. Mr. Ramon S Ona (JICA Expert, Member of JCC)
11. Mr. Akitoshi Iio (JICA Expert, Member of JCC)
12. Ms. Michiko Kondo (JICA Expert, Member of JCC)
13. Mr. Chikahiko Machida (JICA Expert, Member of JCC)
14. Mr. Kaoru Yamada (JICA Expert, Member of JCC)
15. Ms. Mitsue Tamagake (JICA Expert, Member of JCC)
16. Ms. Ayako Akimoto (JICA Expert, Member of JCC)

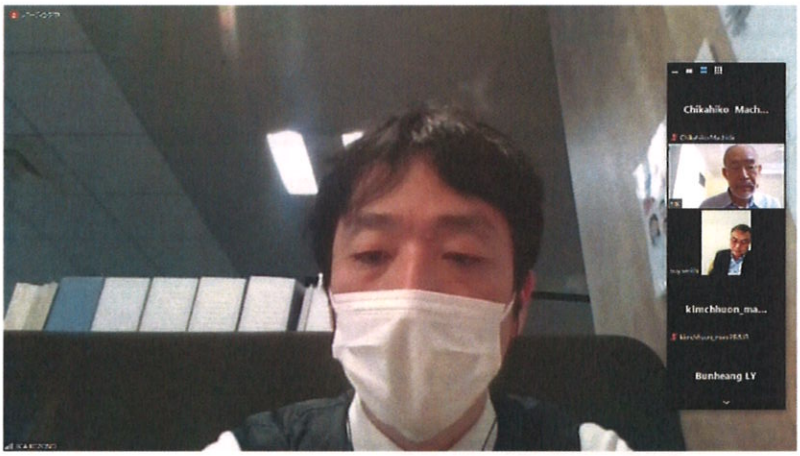
Stakeholders/Counterparts

1. Ms. Tema Vichekal (Deputy Director of Administration, PPCA)
2. Ms. Phan Sopheaknita (Head of Public Relations and International Relation Division, PPCA)
3. Mr. Khun Vanna (Head of Human Resource Division, PPCA)
4. Mr. Eang Sophalla (Chief of IT Office, PPCA)
5. Mr. Chhay Sopheara (Assistant to HE Suy Serith, PPCA)
6. Ms. Kim Maly(Assistant to HE Noun Pharat, PPCA)
7. Mr. Man Kimchhuon (Deputy Chief of Public Relations and International Relation Division, PPCA)
8. Mr. Soth Rothanurak (Deputy Chief of Public Relations and International Relation Division, PPCA)
9. Ms. Pak Kuntheary (Officer, PPCA
10. Mr. Sam Saorith (Officer, PPCA)
11. Mr. Prom Kampoul (Chief of Traffic Safety Office, DPWT)
12. Mr. Chea Sovann (Chief of Public Lighting and Traffic Light Office, DPWT)
13. Mr. Teav Sunpheak (Senior Traffic Signal Engineer, TCC)
14. Mr. Chea Vandeth (Traffic Signal Engineer, TCC)
15. Mr. Phok Oudomkitya (Traffic Signal Engineer (intern), TCC)
16. Ms. Pheng Pharinet (JICA Cambodia Office)
17. Mr. Kheang Key (Officer, PPCA)
18. Mr. Bunheang LY (Interpreter, JICA Project Team)

3. Photos



HE Suy Sareth, Vice Governor, PPCC

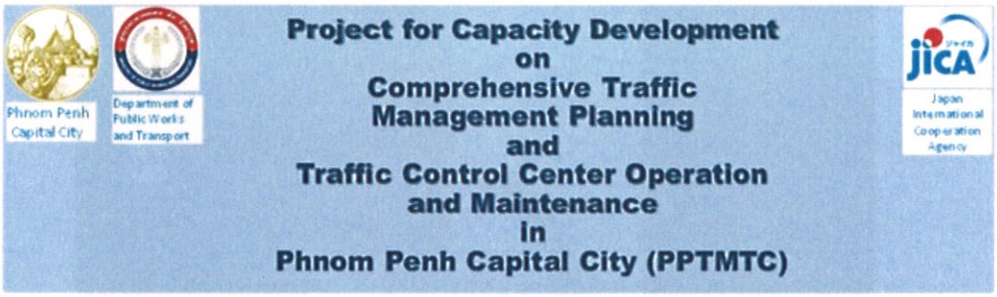


Mr. Tomohiro Kozano, Representative, JICA Headquarters



Mr. Chou Kimtry, Deputy Director, DPWT

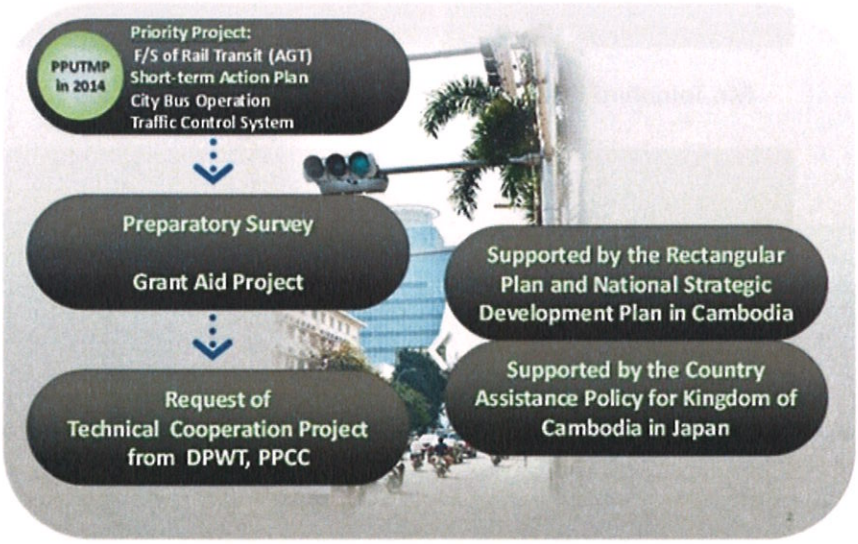
4. Presentation Material



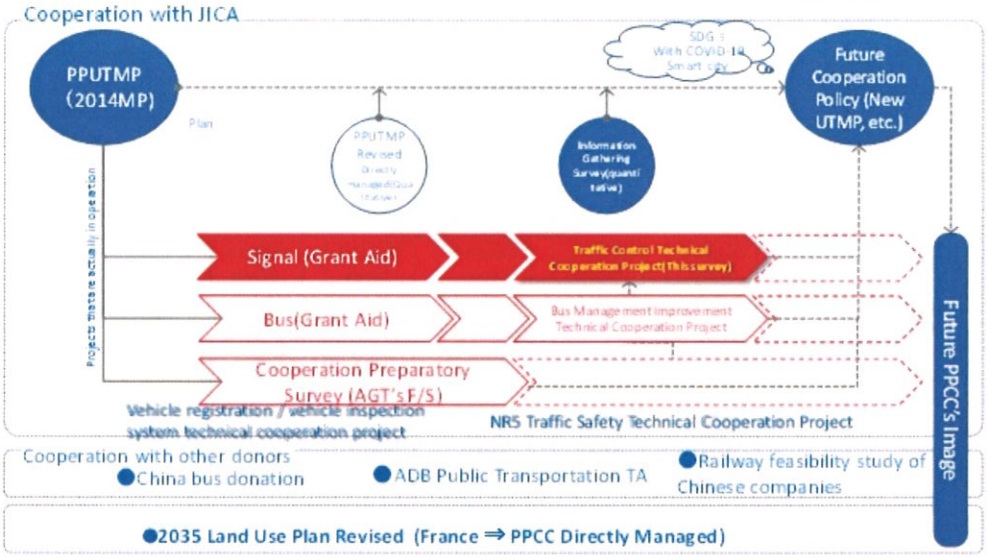
Kick-off Meeting
17 February 2022



1. Background of the Project



1. Background of the Project (2)

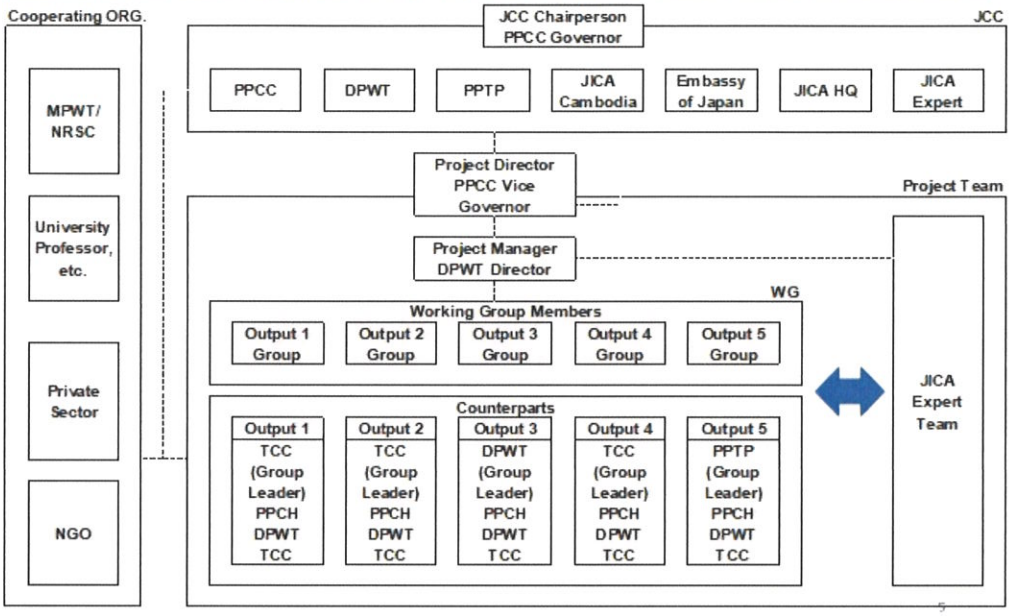


3

2. Outline of Project

Project Name	**Project for Capacity Development on Comprehensive Traffic Management Planning and Traffic Control Center Operation and Maintenance in Phnom Penh Capital City**
Project Period	January 2022 to February 2025
Overall Goal	Sustainable Urban Transport Environment is Formed
Project Purpose	Traffic Management Measures Including Traffic Safety Measures in Phnom Penh is Improved
Expected Output	**Output 1**: Maintenance Management System of Traffic Control System is Established **Output 2**: Capacity of TCC Staff on the Operation of Traffic Control System is Strengthened **Output 3**: Capacity to Design Traffic Signals is Strengthened through the Implementation of Pilot Projects for Traffic Signal Improvement **Output 4**: Capacity of the Relevant Staff to Traffic Control in PPCA, DPWT and TCC Staff to Develop the Expansion Plan of Traffic Control System is Strengthened **Output 5**: Capacity of Urban Transport Related Organizations on Traffic Management Measures is Strengthened towards Enhancement of the Project Sustainability
Counterpart Institution	Implementing Agency: Phnom Penh Capital Administration (PPCA), Department of Public Works and Transport (DPWT), Traffic Control Center (TCC) and Phnom Penh Traffic Police (PPTP)
Project Area	Whole Area of Phnom Penh

3. Joint Coordinating Committee (JCC)



4. Basic Project Direction

- To maximize the current traffic control system's resources
- Toward the second step of PPUTMP implementation through the pilot project (First step was AGT's F/S, PP city bus operation and materialize the traffic control system.)
- To establish a comprehensive traffic management system for Phnom Penh from TCC that is sustainable and utilizes organizational strength

5. Awareness of the Current Situation and Issues of the Project

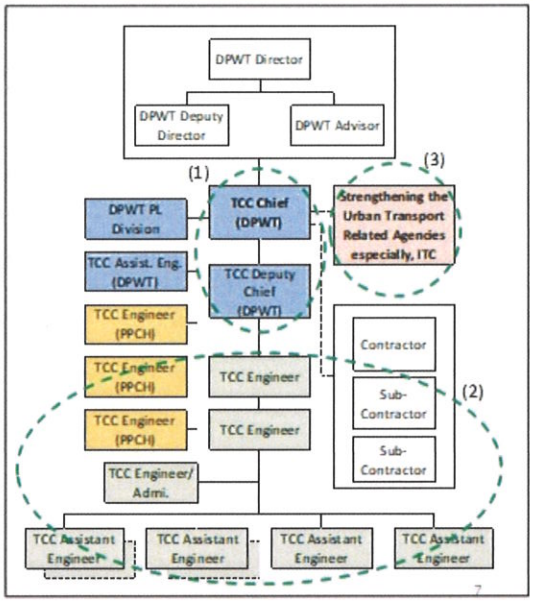
(1) Efficient maintenance management of traffic control system under the TCC system that utilizes organizational strength
(2) Collection of unutilized valuable traffic information from CCTV cameras and vehicle detectors
(3) Traffic control system that responds to urban development trends and changes in urban traffic conditions (Phnom Penh CBD)
(4) Expansion of traffic control system to the suburban area that supports the growth of Phnom Penh (Phnom Penh suburban area)
(5) Enlightenment of traffic safety education rooted in social mores and culture, and strengthening of traffic enforcement

Basic Direction 1: Efficient maintenance management of traffic control system under the TCC system that utilizes organizational strength

Establishment of TCC that is sustainable and maximize the organizational strength
Through the activities of technical cooperation project, the following will be carried out in response to TCC's organizational issues such as poor management of TCC that emerged through awareness of the current situation and problem analysis.

(1) Strengthening the management of the TCC by the assignment of new TCC chief.
(2) Through the activities of TCP, TCC will put effort to break away from being an organization that can only respond to problems/incidents of traffic signal system.

TCC Plus One
(2) + (3) TCC will be strengthened through the activities of TCP, and the capability to collect and analyze urban transport-related data, including TCC's CCTV data, will be improved, and the urban transportation research center function will be added. (Strengthening cooperation with urban transport related organizations such as ITC is required)



Basic Direction 2: Unutilized valuable traffic information collected from CCTV cameras and vehicle detectors

Survey Location of Traffic Count



Out of 11 pilot project intersections, #25, #55, and #502 are CCTV installed. #25 is also selected as a directional traffic volume count intersection.

Examples of automatic vehicle detectors by video image analysis in Japan and other countries

	Future Standard	HITACHI	NEC	Good Vision	Good Vision	LUMA System
Name of Service	SCORER Traffic Counter	TRACDUKE	Field Analyst For Vehicles	Video Insights Platform	Live Traffic	–
Country	JAPAN	JAPAN	JAPAN	ENGLAND	ENGLAND	Cambodia
On premise	✓	✓	✓		✓	–
Cloud	✓			✓		–
By direction	✓	✓	✓	✓	✓	–
Type of Vehicle	8 types + pedestrian	2 types	4 types	8 types + pedestrian	8 types + pedestrian	8 types + pedestrian
Cost	16 650 yen/Hour	2 mil. yen or 0.4 mil. Yen /3 months	0.80 mil. yen	15EUR/h. Or 199EUR/ month + 4EUR/h.	99EUR/ month /Camera	?

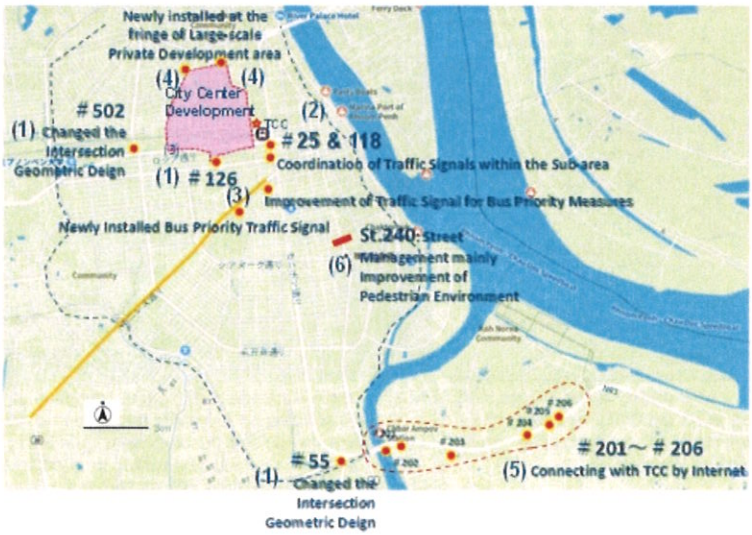
Most of them are made in developed countries and are mainly 4-wheeled vehicles, so it is difficult to recognize 2-wheeers. LUMA has many issues, but automatic counting of 2- and 3-wheel vehicles is possible at a certain level, and there is a high possibility of collaboration with this project.

Basic Direction 3: Implementation of Pilot Projects and Support for Formulating Traffic Management Plans from the Perspective of 3Es

Type	Criteria	Purpose of Pilot Project	Related Measures	Candidate Intersections
(1)	Improvement of intersections where the road geometric design and traffic conditions have changed since the handover of the traffic control system	Consideration of changes including traffic lights corresponding to signalized intersections where the road structure, traffic volume, and conditions have changed significantly since the start of operation of the traffic control system	· Traffic safety measures by 3Es (Engineering: installation of road marking and traffic sign, Education: traffic safety campaign, Enforcement: traffic enforcement by traffic police officers)	#55 ,#126 and #502
(2)	Coordination of intersections in sub-areas along trunk roads	To change the traffic signal control parameters to cope with the change of traffic conditions in the sub-area	· Improvement of sidewalk surrounded area of 2 intersections, directly connected to the Central Station (collaboration with DPWT) · Traffic safety measures by 3Es	#25 and #118
(3)	Intersection improvement in collaboration with the Project for the Improvement of City Bus Operation	To collaborate with City Bus Improvement TCP through the introduction of bus priority traffic signal system	· Bus priority traffic signal · redundancy of OFC · Improvement of sidewalk (collaboration with DPWT) · Traffic safety measures by 3Es	Traffic Signal Newly installed
(4)	Installation of new traffic signal at intersection at fringe of private development area	To introduce new traffic signal at intersections located at fringe of large-scale private development where an increase of traffic volume in near future is anticipated	· Traffic safety measures by 3Es	Traffic Signal Newly installed
(5)	Connection between TCC and stand alone intersections along NR No.1	To connect the TCC and stand alone signalized intersections along NR No.1 by using private internet connection	· Driver education and traffic enforcement from 3Es (Traffic safety campaign and traffic enforcement by traffic police officers)	#201～#206
(6)	Improvement of St. 240 after traffic signal installation mainly of pedestrian circumstances	Improvement of safe and comfortable pedestrian network by traffic signal installation	· Traffic safety measures by 3Es · Installation of safe and comfortable pedestrian environment (Installation of street furniture such as benches and flower boxes)	St.240 (Norodom - St.19)

Basic Direction 3: Implementation of Pilot Projects and Support for Formulating Traffic Management Plans from the Perspective of 3Es

Location Map

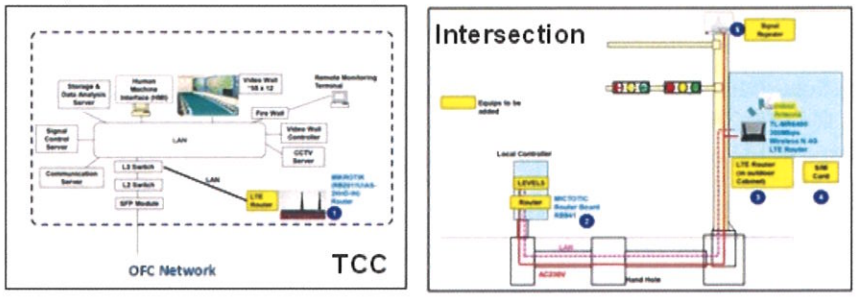


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Basic Direction 3: Implementation of Pilot Projects and Support for Formulating Traffic Management Plans from the Perspective of 3Es

TCC Connection with 6 Intersections of NR No. 1 by Wireless Internet Use

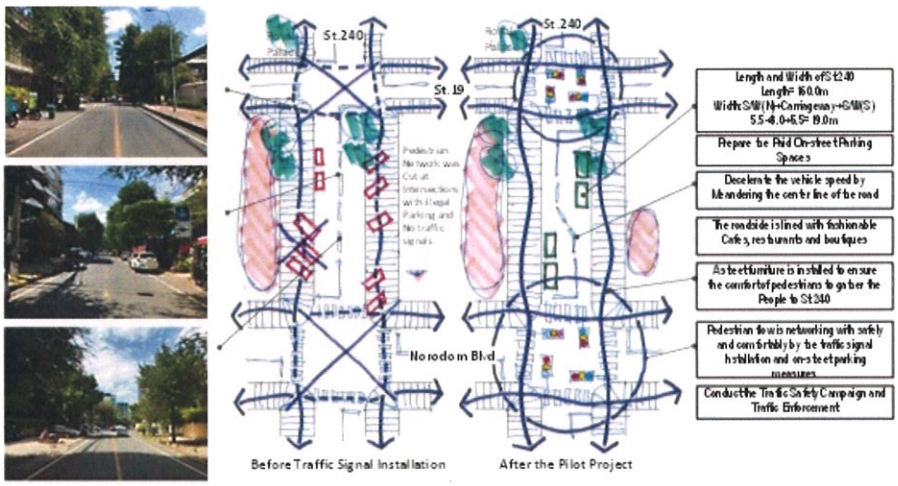
The 6 intersections along NR No.1, which will have a wireless connection to TCC, will be used to solve problems/issues at these intersections. As a result, all 115 signalized intersections developed by the Japan Grant Aid project will be connected to the TCC. Also, if the pilot project of this new communication system is successful, it can be one of the alternatives to the communication system when the traffic control system is expanded to the suburban area. There is also the advantage that all the wireless routers (yellow devices in the image below) required for this trial can be procured in Cambodia.



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Basic Direction 3: Implementation of Pilot Projects and Support for Formulating Traffic Management Plans from the Perspective of 3Es

Street Management mainly Improvement of Pedestrian Environment and On-street Parking Measures



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Basic Direction 4: Building a Safe and Comfortable Urban Transport Environment by Expanding the Traffic Control System throughout Phnom Penh

Preconditions when considering an expanded area for traffic control system

- Urbanization spreads to 216.6ha in the suburbs, 7.6 times that of 28.4ha in the CBD.
- On the other hand, the road network in the suburbs is more varied than the CBD's (main roads: radial-ring pattern, local roads: grid pattern).

(1) There are two types of urbanized areas, mainly spread between radial trunk roads, as described below.

(2) Suburban urban area networked by secondary road network developed by a large-scale development by the private sector. Density of road network is coarser than the CBD's.

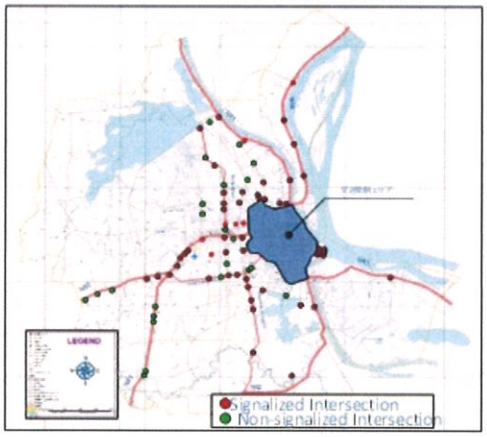
(3) Suburban urban areas where roads are narrow due to sprawl and there is no order in road development.

- Since traffic congestion is concentrated on radial trunk roads, DPWT has already installed standalone and fixed phasing traffic signals at 55 intersections. In addition, traffic congestion is remarkable at 23 non-signalized intersections.
- It is necessary to implement the countermeasures to control the entry/exit traffic from/to many local roads along trunk road.
- ADB plans BRT on 4 trunk road corridors in the suburban area.

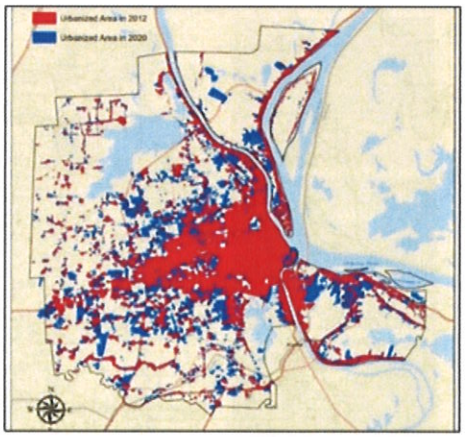
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Basic Direction 4: Building a Safe and Comfortable Urban Transport Environment by Expanding the Traffic Control System throughout Phnom Penh

Signalized and Congested Non-signalized Intersections in the Suburban Area



Built-up Area in 2012 and in 2020

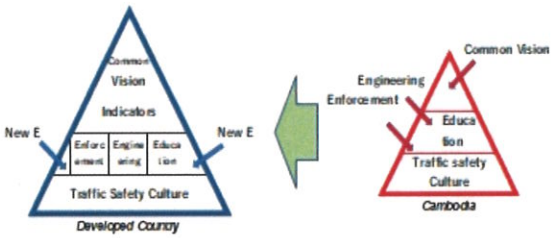


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Basic Direction 5: Enlightenment of Traffic Safety Education Rooted in Social Mores and Culture, and Strengthening of Traffic Enforcement

- Recent concept of traffic safety measures: 3Es (Traffic Safety System) on the road safety culture, indicators and goals that are the basis of cooperation and exchange, for example, Vision Zero of Sweden and SDGs of the World Bank: 3.6.

In Cambodia, traffic enforcement is the weak link among the 3Es, and a well-balanced traffic safety system has not yet been completed as in Europe, the United States and Japan.



Source: The left side of the figure is from the presentation material of Professor Naohiro Kitano (Waseda University) at the International Traffic Safety Society Workshop on November 27, 2020.
Note: Currently, there is growing interest in the role of culture in traffic safety. Road safety culture, in particular, is considered an integral part of the safety system's approach to achieving Vision Zero, which is to eliminate fatalities and serious injuries from road accidents. Road safety culture can be defined as "a system of people's shared beliefs that influences the behavior of road users and traffic safety measures by stakeholders." (Nicholas Ward, Professor, Montana State University)

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Basic Direction 5: Enlightenment of Traffic Safety Education Rooted in Social Mores and Culture, and Strengthening of Traffic Enforcement

- Importance of the viewpoint of traffic safety culture: In Japan, it is common for children to think that "fathers who drink alcohol do not ride motorcycles or cars." In a situation like Cambodia where driver education and traffic enforcement are not sufficient and public transport is not well developed, although it has improved recently, "Mode of transport of father regardless of whether he drank or not is a motorcycle/car. " In Phnom Penh, motorcycles accounted for 80% of total accidents, followed by pedestrian accidents (10%). These are for the reason that "A license is not required to drive a motorcycle of 125cc or less (2016 Road Traffic Law revision item)" and "Pedestrians have to walk on the carriageway due to illegal occupation of sidewalks (illegal parking and vendors)". This TCP will mainly focus on traffic accidents and congestion related to signalized intersections, and take countermeasures from the viewpoint of driver education and traffic enforcement.

Cause of Accidents: Accident due to speed violation (46% of total accidents in 2019) → Damage to signal poles and due to ignoring signal

Traffic Accident/Congestion Factors, etc.:

■ Cars intending to go straight do not keep lanes and stop at the left turn lane, and illegal parking at intersections (paratransit waiting for customers, etc.).

■ In Cambodia, the traffic safety campaign will be held before the four major events, namely, (1) Chinese New Year, (2) Khmer New Year, (3) Pchum Ben and (3) Water Festival. The reason is that there is a tendency for traffic accidents such as drunk driving to increase during these periods.

■ As a tool for traffic safety campaigns, the use of social media is considered to be highly effective in addition to TV and radio.

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Guidebooks and Manuals to be Developed in the Project (1)

The knowledges obtained through the activities of the Project which will be documented in guidebooks and manuals are summarized as follows.

Name	Contents	Related Activities
Maintenance Management Manual (Approx. 50 pages)	· Maintenance system of TCC · Overall TCC organization chart · Schedule for daily/monthly/yearly activities · Revised version of the existing operation / maintenance manual (index system) · TCC management manual / financial manual · Scheduled inspection list & manual · Accident/incident response list & manual	Activity 1 
Training Textbook for Capacity Development of comprehensive traffic management and TCC operation maintenance management (Approx. 50 pages)	· Data collection such as image analysis, problem analysis method [Comprehensive traffic management plan training] · Traffic management (one-way street, parking measures, sidewalk environment, TDM, bus stop, etc.) [Comprehensive traffic management plan training] · Traffic signal phasing plan based on geometric design/traffic flow, parameter adjustment, system installation method [Traffic control system training] · OFC maintenance, wireless communication network [Communication training]	Activity 2 

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Guidebooks and Manuals Developed in the Project (2)

Name	Contents	Related Activities
Traffic signal improvement procedure manual ⇒ Pilot project handbook (Approx. 50 pages)	· Pilot project handbook (Planning / related organization coordination / implementation / evaluation) 	Activity 3
Traffic control system expansion Plan (Approx. 50 pages)	· Long list of target intersections in the expanded area · Planning procedure of examination of expansion area · Necessity of traffic control system equipment for area expansion [Traffic control system training] · Study for communication network (redundancy, wireless communication network) [Communication training] · Traffic control system expansion plan in Phnom Penh · Proposed TCC organization plan in the future after TCP	Activity 4 + (Activities 1 - 3) 
Traffic enforcement and traffic safety manual (Approx. 50 pages)	· Tools / equipment for traffic enforcement [Traffic enforcement training] · How to handle traffic signals by the traffic police officers (do not turn off the traffic control system unnecessarily) [Traffic police officer training] · Accident analysis and traffic enforcement method at signalized intersections [Traffic control training] · Planning, implementation and evaluation of traffic safety campaign for drivers	Activity 5 

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Basic Operational Policy 1: Proposal for Conducting a Seminar on Comprehensive Traffic Management Plan in Phnom Penh by TCC Staff

- Based on the results of the TCP activities, which are summarized by TCC members, a conduct of "Seminar on Comprehensive Traffic Management Plan in Phnom Penh" is managed by TCC members themselves.

Basic Operational Policy 2: Training in Japan That Can Be Reflected in the Traffic Management Policy in Phnom Penh

1. Number of participants, period, etc.: 8 persons, 2 weeks / time, 2 years, 2 times, currently planned in July 2023 and July 2024
2. Purposes of training in Japan
   - Promotion of project results
   - Gain knowledge of Japan's traffic management policies and plans, operation and maintenance of traffic management systems
   - Learn urban traffic management measures including urban development in Japan
   - Learn Japanese ITS technology including cutting-edge technology
3. Features of the training in Japan proposed by this joint venture
   While planning a wide range of training, the characteristic viewpoint is to experience the process and contents of parking measures and town development in the central Tokyo such as DaiMaruYu Area (Otemachi, Marunouchi, and Yurakucho), and to consider new urban traffic management measures in central Phnom Penh. 19

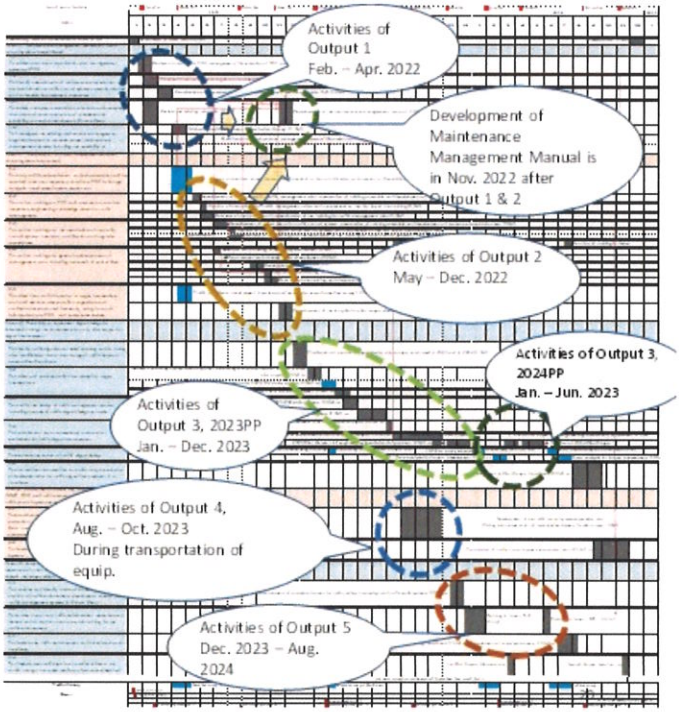
6. Project Schedule

◆ JCC will be held every six (6) month and 7 times in Total

◆ Project Schedule: January 2021 – January 2025 (37 months)

◆ Pilot Project (PP)
First Time: January – December 2023 (including Preparation, Procurement and Transport)
Second Time: January – June 2024

◆ Number of Times of Traffic Surveys will be conducted: 4 times



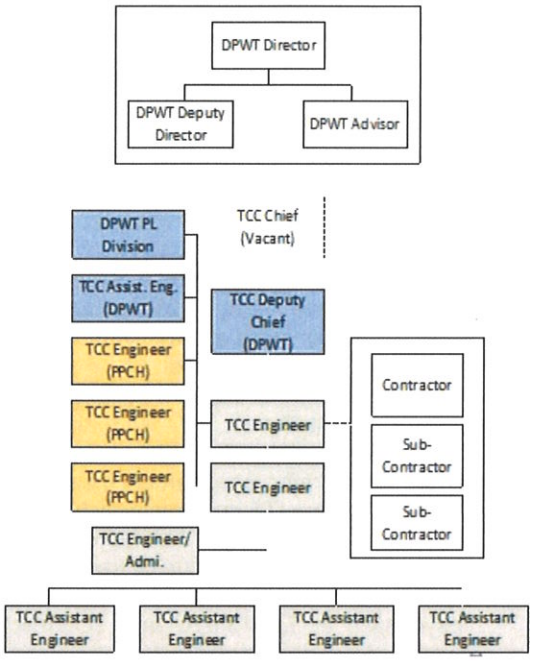
7. Current Situation of Traffic Control Center

(1) Proposed TCC organization for public-private collaboration in October 2018

(2) Approved by the governor for a one-year time limit

(3) Submitted TCC's annual report to the Governor for the continuation of the second year including effectiveness of signal installation and request for necessary budget for 2020





Saving the Travel Time Cost of Monivong Blvd. Users by the Traffic Signal Installation in PPCH

Saving Travel Time Cost of Monivong Blvd. Users by the Traffic Signal Installation in PPCH

Type	TTC (USD/hr.) ①	Traffic Volume along Monivong (veh./24hr.) ②	Section of Monivong = 3.575km		Daily Travel Time Cost travelling along Monivong		Daily Travel Time Cost Saving	Annual Travel Time Cost Saving
			Before Signal System 11.34 km/hour ③Travel Time 18.6 0.31	After Signal System 15.23 km/hour ④Travel Time 13.8 0.23	Before Signal System ⑤=①*②*③	After Signal System ⑥=①*②*④	⑦=⑤-⑥	⑧=⑦*300days
Bike	0.48	58,538	0.31	0.23	8,710	6,463	2,248	674,358
Car	3.65	19,340	0.31	0.23	21,883	16,236	5,647	1,694,184
Para-tra.	0.71	6,940	0.31	0.23	1,527	1,133	394	118,258
Bus	1.95	207	0.31	0.23	125	93	32	9,688
Truck	0.30	206	0.31	0.23	19	14	5	1,483
		85,231			32,265	23,939	8,327	2,497,970
					USD/day			USD/year

Note

1. Travel Time Cost is based on the Preparatory Survey of 100 Traffic Signal Installation Project

2. 6-hour Traffic Volume along Monivong is the 2017 Survey at Monivong/Kampuchea Krom Intersection. Converted traffic volume to 24-hour traffic from 6-hour traffic is from TCC data. And it is assumed that the 6- hour/24-hour ratio is 0.34.

3. Travel speed data is from travel speed survey along Monivong (PPCH - Moa Tsu Tong) and conducted 2 periods (Before traffic signal in 2017 and After traffic signal in 2018).

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Issues of the PPTMTC

(1) Assignment of the TCC Chief (dedicated)

(2) How to involve Sumitomo Electric, which provided Phnom Penh's traffic control system by the Grant Aid project from Japan

(3) It is necessary to consider how to start the PPTMTC activities based on the background that TCC local staff themselves maintained the TCC through trial and error after hand over of the Traffic Control System to them.

(4) How to involve the current TCC staff from PPCH and DPWT, and busy traffic police at the same time.

(5) Maintenance management manual includes 1) TCC overall management manual and 2) operation management manual

(6) Ideas of the traffic management plan training are to understand the comprehensive traffic management plan in PPUTMP and to gain the knowledge to propose the TCC's traffic management measures to the Governor.

(7) Ideas of the traffic control system training are to learn the basic knowledge how to implement the Pilot Project and how to sustain the Phnom Penh traffic control system

(8) Ideas of the communication system training are to train how to shorten the Optical Fiber Cable (OFC) repair time against the OFC cutting risk, which happened unexpectedly many times.

(9) Worldwide semiconductor shortage problems will also affect this TCP. Therefore, it is necessary to confirm the equipment procurement as soon as possible.

(10) Considering the above, the first year's activity will be the key. It also will determine the necessary traffic surveys and interview surveys as well as the need for equipment procurement.

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7. Expert

Name	Work Responsibility	Affiliation
Mr. MASATO KOTO	Chief / Traffic Management Policy	METS
Mr. ATUSHI SUGANUMA	Traffic Control System Planning	SET Data Service
Mr. KIMUNARI TAKAHASHI	Traffic Management Planning	IDCJ
Mr. SUNGJOON HONG	Traffic Signal Design and Operation	PCKK
Mr. Ramon S Ona	Traffic Signal Maintenance	RSO Engineering Solutions
Mr. AKITOSHI IIO	Road and Public Transport Planning	METS
Ms. MICHIKO KONDO	Communication System	PCKK
Mr. CHIKAHIKO MACHIDA	Road Design/ Pilot Project Construction Supervision	METS
Mr. KAORU YAMADA	Traffic Survey and Analysis	OCG
Mr. KONG SOVANN	Traffic Enforcement and Traffic Safety	INDRADAVY
Ms. MITSUE TAMAGAKE	Capacity building and training (1)	IDCJ
Mr. YUUJI MOCHIDUKI	Traffic Control System Software	SET Data Service
Mr. KATSUMI EDAMATSU	Traffic Control System Hardware Expert/Signal equipment	METS
Ms. AYAKO AKIMOTO	Capacity building and training Expert (2)/Seminar	METS

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ANNEX11-1: 1st JCC Meeting

Minutes of the 1st Joint Coordinating Committee Meeting of

The Project for Capacity Development on Comprehensive Traffic Management Planning and Traffic Control Center Operation and Maintenance in Phnom Penh Capital City (PPTMTC)

The 1st Joint Coordinating Committee (JCC) meeting between Phnom Penh Capital Administration (PPCA), Department of Public Works and Transport of Phnom Penh (DPWT), Japan International Cooperation Agency (JICA), and the concerned members of the Project for Capacity Development on Comprehensive Traffic Management Planning and Traffic Control Center Operation and Maintenance in Phnom Penh Capital City (PPTMTC) was held in a hybrid format at PPCA, on 22nd of July, 2022. The comments and the discussions were made on several items as described below.

1. Opening remarks by PPCA and JICA:

Mr. Yoshimoto Koyanagi, Director of Transportation Group 1, Infrastructure Management Department, JICA representative, welcomed all the participants. He continued giving his brief remarks on the long history of JICA support on transport sector in Phnom Penh, as well as highlighted the key components of this PPTMTC project. He further mentioned that traffic congestion has become more serious in Phnom Penh, through this project, it will help to sustain the traffic environment. He would like to express his sincere appreciation to the colleagues from DPWT, PPCA and JICA Expert team for their efforts and cooperation for the smooth implementation of this project.

H.E. Nuon Pharat, Vice Governor of PPCC and PPTMTC Project Director, welcomed all the participants and expressed his sincere thanks to the Government of Japan for extending the support through JICA, as well as to JICA expert team for the implementation of PPTMTC project. He continued stating that traffic condition in Phnom Penh now is getting worse and needs to be improved. This project addressed the issues of the traffic congestion. He suggested all traffic related stakeholders to have a well collaboration in implementing this project. On behalf of H.E. Governor of PPCC, he sincerely thanked to the JICA for continuous support to the development of Phnom Penh Capital City.

2. Contents of Presentations:

Mr. Masato Koto, team leader of JICA expert team made presentation on the overall outline of the PPTMTC project covering outline of the project, JCC and Project organization, DX and PPTMTC project, proposed of the TCC organization and PPTMTC training plan. For the details, please refer to the presentation material.

3. Main Points of Discussion:

No.	Comments/Questions	Answers
1.	**TCC organization**	
(1)	**H.E Nuon Pharat** asked the project team regarding to the organization staff of Traffic Control Center (TCC), how many staff will be expected to increase with this proposed organization?	- **Mr. Koto** replied that currently there are 14 staff at TCC. He expected that the number of staff in the future will be increased to 20 staff with this proposed organization. - **Mr. Chou Kimtry**, Deputy Director of DPWT, expressed sincerely thank to JICA and JICA Expert team for continuous support and implementing the project. He

		raised up some challenges for the implementation of this project the limitation of human resource and budget as well as the incidents caused by fire incident, traffic accident, cable cutting, natural disaster, etc. TCC team go to site regularly for site inspection and repairing, however, we do not have enough equipment and spare parts for repairing. To address these challenges, all the concerned stakeholders are required to work together. Regarding the proposed organization structure of TCC on slide no. 14, He suggested that the maintenance section should be included the staff from DPWT, as DPWT would like to have their staff to contribute to the maintenance work.
(2)	**Mr. Sor Phara**, Chief of Development Management & Construction Office, PPCA, stated that TCC needs a permanent organizational structure which required experts and financial resource for its sustainable operation and implementation. Therefore, he suggested that PPCA should consider how to set up an organization structure for TCC either under the structure of PPCA or DPWT and to under which level government should we request to.	- **H.E Nuon Pharat** responded that the discussion on how to set up organizational structure of TCC will be done later. However, he suggested that the organizational structure of TCC should be flexible, strong and low cost. And we need to carefully consider about work demarcation between the public and the private sector.
(3)	**H.E Nuon Pharat** suggested that the expert team should consider to involve the participation from academic institutions such as Institute of Technology of Cambodia (ITC) to the capacity training to increase human resource necessary for the future operation of TCC. And if possible, should provide a presentation at ITC about this project.	- **Mr. Koto** responded that he will invite universities and transport study group to the next JCC meeting and consider how to involve them the next project activities.

4. Conclusion:

Before closing, H.E Nuon Pharat express his sincere thanks to JICA and expert team and suggested all the relevant organizations to work collaboratively for the smooth implementation of this project. Proposed new TCC organization and PPTMTC training plan were mainly discussed during the JCC Meeting. JCC members had no objection to the PPTMTC training plan, but for the proposed new TCC organization was still need further discussion.

CONFIRMED BY:

H.E. NUON PHARAT
Vice Governor
Phnom Penh Capital City

MR. YOSHIMOTO KOYANAGI
Representative
JICA

Mr. MASATO KOTO
Team Leader
JICA Project Team

1. Agenda

AGENDA

1st Joint Coordinating Committee Meeting for Project for Capacity Development on Comprehensive Traffic Management Planning and Traffic Control Center Operation and Maintenance in Phnom Penh Capital City (PPTMTC)

Venue: PPCH Meeting Room + Zoom

Date: 22nd July, 2022
Time: 09:00 to 10:45 Cambodia Time
Time: 11:00 to 12:45 Japan Time

09:00 – 09:20	**Opening Keynotes**

Representative of JICA

Mr. Yoshimoto Koyanagi, Director of Transportation Group 1, Infrastructure Management Department, JICA

Representative of the Governor

H.E. Nuon Pharat, Vice Governor, PPCC, PPTMTC Project Director

09:20 – 10:00	**Presentation of the PPTMTC Project**

Mr. Masato KOTO, Chief Consultant, JICA PPTMTC Project Team
(Proposed TCC Organization and PPTMTC Training Plan)

10:00 – 10:30	**Discussion**

10:30 – 10:45	**Closing Remarks**

Representative of the Governor

H.E. Nuon Pharat, Vice Governor, PPCC, PPTMTC Project Director

2. Expected Attendants

JCC Members

1. H.E. Khuong Sreng (Governor, PPCA, Chairperson of JCC)
2. H.E. Nuon Pharat (Vice Governor, PPCA, Project Director of the PPTMTC Project, Vice-chairperson of JCC)
3. H.E. Suy Serith (Vice Governor, PPCA, Vice-chairperson of JCC)
4. Mr. Sam Piseth (Director, DPWT, Project Manager of the PPTMTC Project, Member of JCC)
5. Mr. Man Kimchhuon (Deputy Head of International Relations and International Cooperation Division, PPCA, Deputy Project Manager of the PPTMTC Project, Member of JCC)
6. Mr. Chev Hak (Deputy Commissioner, PPTP, Member of JCC)
7. Mr. Sor Phara (Chief, Development Management & Construction Office, PPCA, Member of JCC)
8. Mr. Chou Kimtry (Deputy Director, DPWT, Member of JCC)
9. Mr. Moueng Sophan (Adviser, DPWT, Member of JCC)
10. Mr. Sem Ratana (Office Chief, PPTP, Member of JCC)
11. Mr. Ouch Sansothy (Deputy Chief, TCC, DPWT Member of JCC)
12. Mr. Takanori Kuribayashi (1st Secretary, Japan Embassy, Member of JCC)
13. Mr. Tomohiro Kozono (JICA Headquarters. Member of JCC)
14. Ms. Haruko Kamei (Chief Representative, JICA Cambodia Office, Member of JCC)
15. JICA PPTMTC Experts (Member of JCC)

Stakeholders/Counterparts

1. Ms. Tema Vichekal (Deputy General Secretary, PPCC)
2. Ms. Phan Sopheaknita (Chief of International Relations)
3. Mr. Eang Sophalla (Chief of IT Division, PPCC)
4. Mr. Proum Kampoul (Chief of Traffic Safety Office, DPWT)
5. Mr. Chea Sovan (Chief of Public Lighting Office, DPWT)
6. Ms. Lak Siveheng (Engineer, Public Lighting Office, DPWT)
7. Mr. Chea Vandeth (Traffic Signal Engineer, TCC, DPWT)

4. Photos



H.E. Nuon Pharat, Vice Governor, PPCC



Mr. Yoshimoto Koyanagi, JICA Headquarters



Participants of 1st JCC meeting

5. Presentation Material



Questions and Answers during the Kick-off Meeting held on 17 February 2022

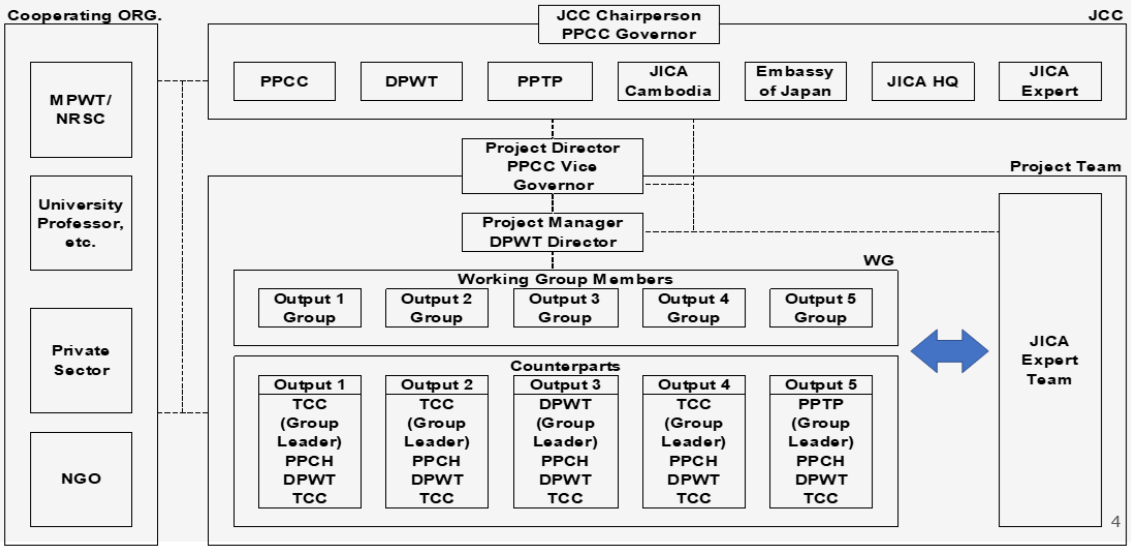
Items	Question	Answer
About PDM	• Includes "achieve an efficient traffic system reduce congestion and accidents" in the Overall Goal (Mr. Kimtry, DPWT)	Overall goal is more comprehensive Already includes indicators related reduce congestion and accidets
About TCC Organization	• Adding PPCA upper part of the org. structure (HE Suy Serith)	Discuss in 4. in this presentation
	• Appropriate number of TCC Staff (HE Suy Serith)	
About Pilot Project	• Possibility of the study of one-way system along St.19 in PPTMTC Project (HE Suy Serith)	Discuss the possibility during the PPTMTC Training
	• Includes traffic signals along NR No.1 to TCC system (HE Suy Serith)	TCC connection with 6 intersections of NR No.1 by internet
	• More CCTV camera to intersections along NR No.1 (Mr. Sunpheak, TCC)	Discuss the possibility during the PPTMTC Training
About Traffic Management	• Study of overall parking demand (Mr. Kimtry, DPWT)	Discuss the possibility during the PPTMTC Training
	• Intercity bus entering city center causes traffic congestion (Mr. Kimtry, DPWT)	

1. Outline of the Project

Project Name	**Project for Capacity Development on Comprehensive Traffic Management Planning and Traffic Control Center Operation and Maintenance in Phnom Penh Capital City**
Project Period	January 2022 to February 2025
Overall Goal	Sustainable Urban Transport Environment is Formed
Project Purpose	Traffic Management Measures Including Traffic Safety Measures in Phnom Penh is Improved
Expected Output	**Output 1**: Maintenance Management System of Traffic Control System is Established **Output 2**: Capacity of TCC Staff on the Operation of Traffic Control System is Strengthened **Output 3**: Capacity to Design Traffic Signals is Strengthened through the Implementation of Pilot Projects for Traffic Signal Improvement **Output 4**: Capacity of the Relevant Staff to Traffic Control in PPCA, DPWT and TCC Staff to Develop the Expansion Plan of Traffic Control System is Strengthened **Output 5**: Capacity of Urban Transport Related Organizations on Traffic Management Measures is Strengthened towards Enhancement of the Project Sustainability
Counterpart Institution	Implementing Agencies: Phnom Penh Capital Administration (PPCA), Department of Public Works and Transport (DPWT), Traffic Control Center (TCC) and Phnom Penh Traffic Police (PPTP)
Project Area	Whole Area of Phnom Penh

3

2. Joint Coordinating Committee and Project Organization



4

3.1 DX and the PPTMTC Project



One of the Digital Transformation (DX) competencies worked out by Phnom Penh is the new centralized traffic control system, which replaced the old standalone analog traffic lights. This DX has transformed the daily life of PP inhabitants with having to follow the rules to enable smooth travel; it has also improved the urban environment. These are major first steps taken by Phnom Penh towards supporting the SDGs and becoming a smart city.

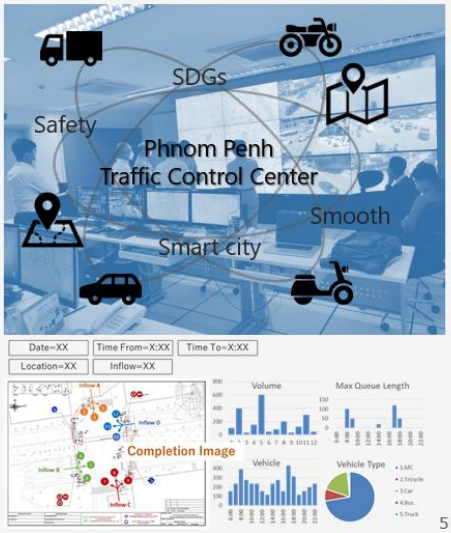
(1) Changes in people's awareness of road use

(2) Travel speed changes in 2017 and 2018

(3) Reduced travel costs

(4) Contributing to the Urban Environment and the Reduction of Global Warming

Digitalization: Traffic volume is collected from CCTV video images using artificial intelligence (AI)-driven data processing technology from manual work and utilized in urban transport policy/measures.



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3.2 Saving the Travel Time Cost of Monivong Blvd. Users by the Traffic Signal Installation in PPCH

Saving Travel Time Cost of Monivong Blvd. Users by the Traffic Signal Installation in PPCH

Type	TTC (USD/hr.) ①	Traffic Volume along Monivong (veh./24hr.) ②	Section of Monivong = 3.575km: Before Signal System 11.34 km/hour ③Travel Time	Section of Monivong = 3.575km: After Signal System 15.23 km/hour ④Travel Time	Daily Travel Time Cost travelling along Monivong: Before Signal System ⑤=①*②*③	Daily Travel Time Cost travelling along Monivong: After Signal System ⑥=①*②*④	Daily Travel Time Cost Saving ⑦=⑤-⑥	Annual Travel Time Cost Saving ⑧=⑦*300days
Increase of Travel Speed			18.6	13.8				
			0.31	0.23				
Bike	0.48	58,538	0.31	0.23	8,710	6,463	2,248	674,358
Car	3.65	19,340	0.31	0.23	21,883	16,236	5,647	1,694,184
Para-tra.	0.71	6,940	0.31	0.23	1,527	1,133	394	118,258
Bus	1.95	207	0.31	0.23	125	93	32	9,688
Truck	0.30	206	0.31	0.23	19	14	5	1,483
		85,231			32,265	23,939	8,327	2,497,970
					USD/day			USD/year

Saving Travel Time Cost

Note
1. Travel Time Cost is based on the Preparatory Survey of 100 Traffic Signal Installation Project
2. 6-hour Traffic Volume along Monivong is the 2017 Survey at Monivong/Kampuchea Krom Intersection. Converted traffic volume to 24-hour traffic from 6-hour traffic is from TCC data. And it is assumed that the 6- hour/24-hour ratio is 0.34.
3. Travel speed data is from travel speed survey along Monivong (PPCH - Moa Tsu Tong) and conducted 2 periods (Before traffic signal in 2017 and After traffic signal in 2018).

6

4.1 Comparison of Traffic Control Centers in 3 Cities (Phnom Penh CBD, Aomori Pref. and Metro Manila)

Comparison of TCC in Phnom Penh CBD (Cambodia), Aomori Prefecture and Aomori City (Japan) and Metro Manila (Philippines).

1. The coverage area and population size of the traffic control centers in these cities are very different, and the maintenance management system is also different. So it is not possible to simply compare them. But the traffic control center in Metro Manila can be used as a reference for developing an organizational structure in Phnom Penh.

2. An interesting figure is that the area of Phnom Penh, Aomori City and Metro Manila is almost the same at about 640 - 830km2 (however, the population size of Metro Manila is about 6 times larger). The population density of Phnom Penh CBD and Metro Manila is almost the same at about 21,000 people / km2.

3. In the case of Aomori Prefecture in Japan, the TCC is managed by the traffic police department in local government, but revision work of traffic signal operation such as phasing and timing and maintenance are outsourced to the private sector.

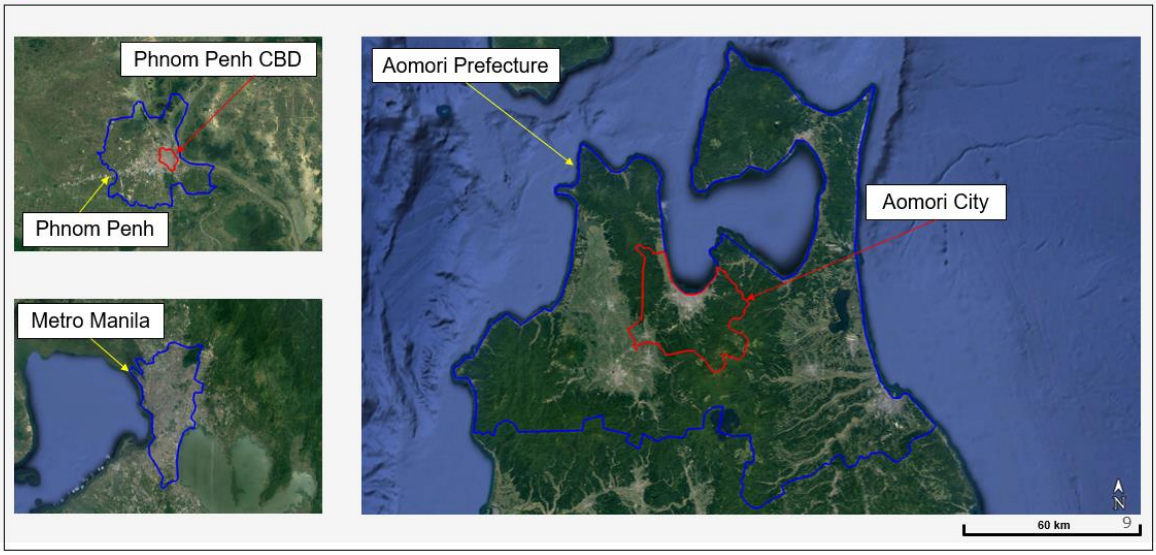
4. Metro Manila's TCC (Traffic Engineering Center: TEC) covers a wide range of fields such as civil engineering at intersection, public lighting and disaster prevention, as well as traffic control; and almost all activities are in-house; in addition, the staff of the traffic control center work in three shifts.

5. From all TEC staff in Metro Manila, the number of staff who are only engaged in the traffic control system is estimated at about 80.

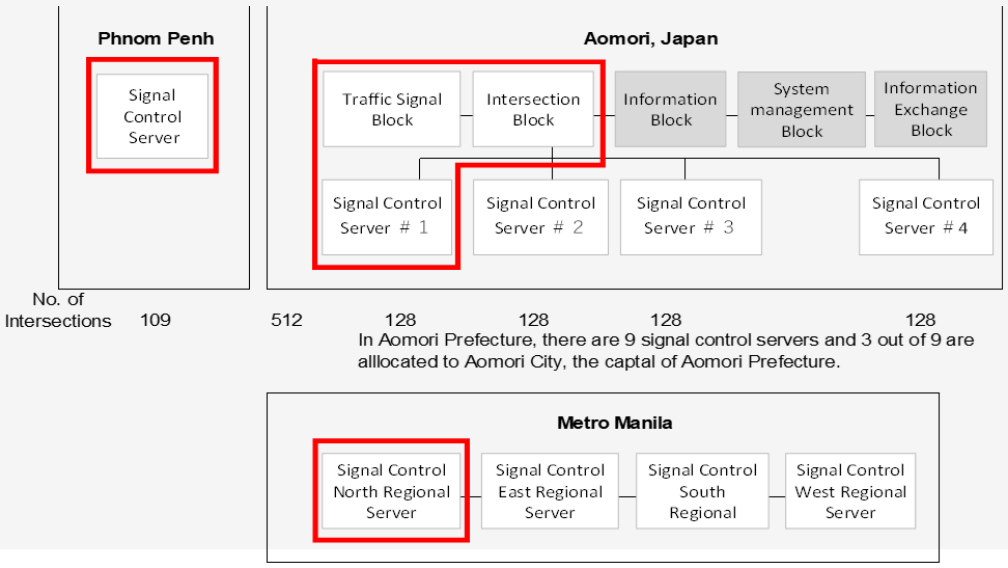
4.2 Comparison Table of TCC between Phnom Penh, Aomori and Metro Manila

Items	Cambodia		Japan		Philippines	Remarks
	Phnom Pemh CBD	Phnom Pemh	Aomori City	Aomori Pref.	Metro Manila	
Population (1,000 pop.)	610,000	2,281,951	287,648	1,308,265	13,484,462	From PPUTMP (PP) As of Oct. 2019 (Japan) As of 2020 (Philippines)
Area (km2)	29.00	679.00	824.61	9,645.64	636.00	
Population Density (1,000 Pop./km2)	**21.03**	**3.36**	**0.35**	**0.14**	**21.20**	
No. of Signalized Intersections	**115**	**—**	**248**	**578**	**633**	
No. of Signal Intersections/ 10,000 pop.	**1.89**		**8.62**	**4.42**	**0.47**	
No. of Signal Intersections/km2	**3.97**	**—**	**0.30**	**0.06**	**1.00**	
Local Controller	178	—	779	1953		
Organization	Refer to the Organization Chart of PPTCC	—	—	Refer to the Org. Chart of Aomori pref.	Refer to the Organization Chart of MMDA	
No. of Staff	13 From PPCA/DPWT: 6 and From Private: 7	—	—	Approx. 30 Excluding night time shift	Approx. 280, (80) Including not only 3-shift of Operation/Maintenance Section but also Public Lighting and Disaster Prevention activities	In Metro Manila, no. of staff only Traffic Control System is estimated in approx. 80.
No. of Signal Intersections/ No. of TCC Staff	**8.85**			**19.27**	**7.91**	
Outsourcing (TCC operation/mantenance)		—	—	✔	✔	

4.3 Area of Phnom Penh, Aomori Pref. and Metro Manila



4.4 Basic Traffic Control System in the 3 Cities

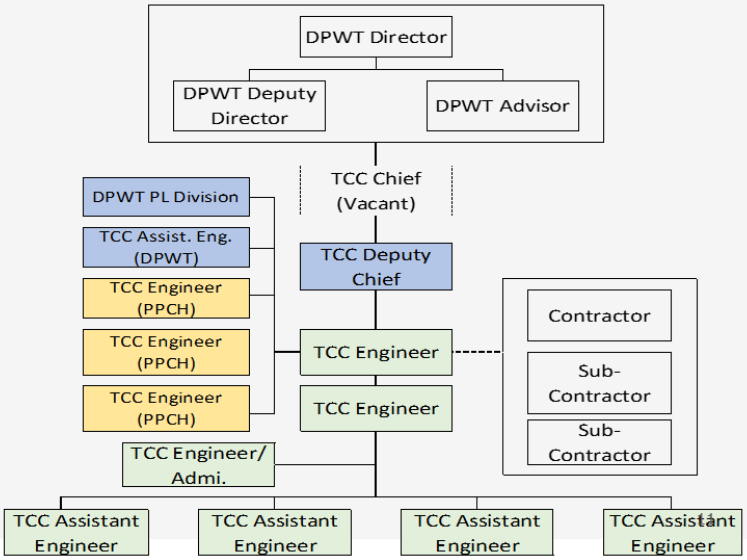


4.5 Phnom Penh Traffic Control Center

(1) Proposed TCC organization for public-private collaboration in October 2018

(2) There are no sub-sections at TCC.





4.6 Organization Chart of TCC in Aomori in Japan

Traffic Police Office in Prefecture

・System Operation: Operation and Expansion of Traffic Control System

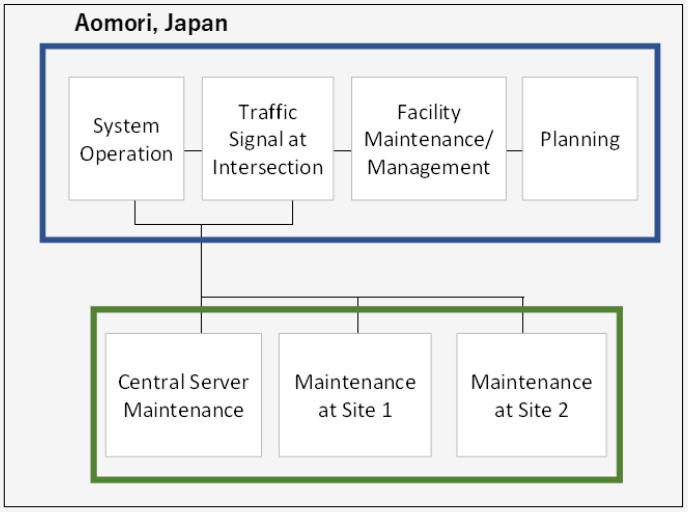
・Traffic Signal at Site: Installation and Improvement of traffic Signal at Intersection

・ Facility Maintenance/ Management: Details are not known

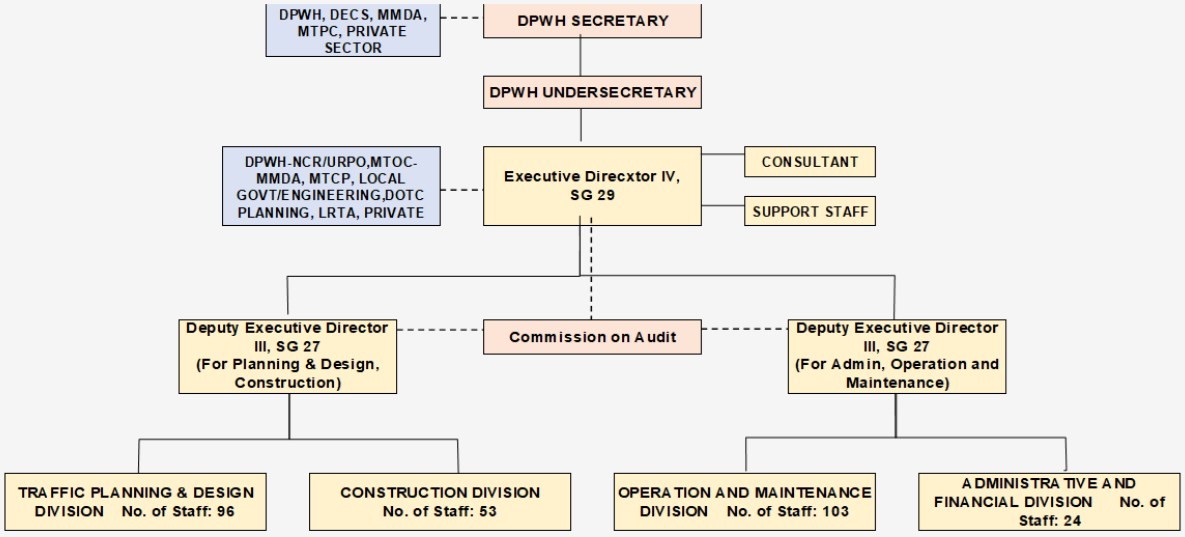
・Planning: Details are not known

Outsourcing

・Area/Unit of Maintenance at Site is different by Prefecture



4.7 Organization Chart of TEC in MMDA in the Philippines

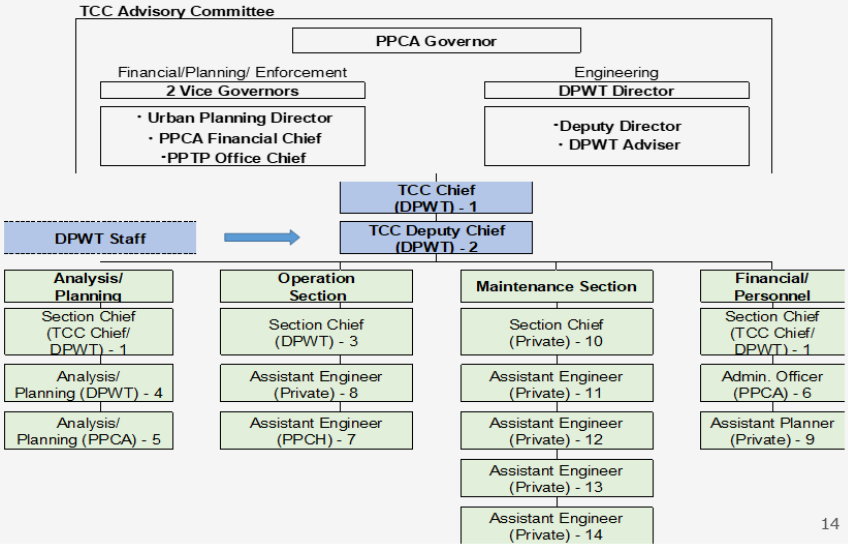


Note: Number of staff is including not only 3-shift of Operation/Maintenance Section but also Public Lighting and Disaster Prevention activities.

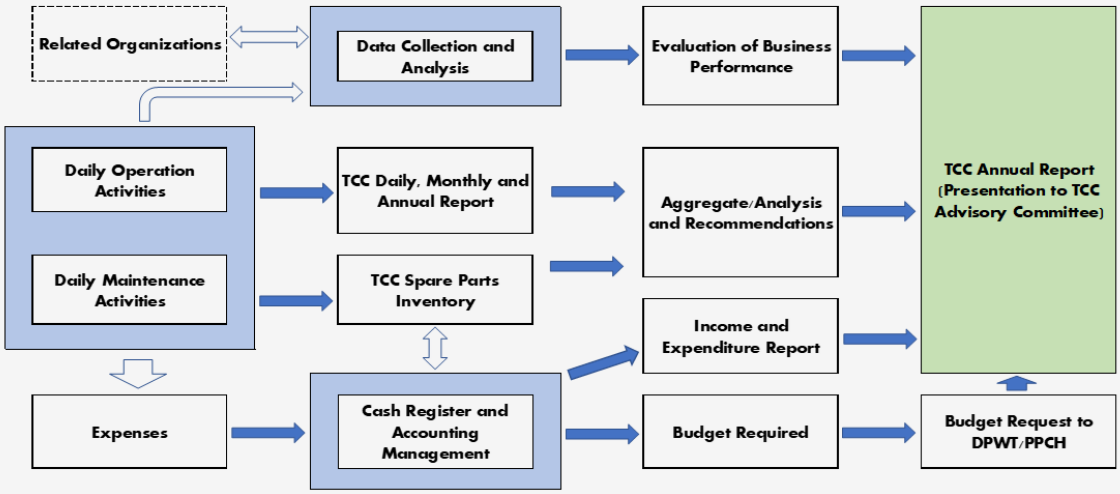
4.8 Proposed Organization of the Traffic Control Center

(1) Under the management of TCC Advisory Committee, Proposed TCC organization for public-private collaboration.

(2) There are 4 sections under TCC Chief and Deputy Chief.



4.9 TCC Activities and TCC Management



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4.10 TCC Activities by Section

Analysis/Planning Section	Development of a database of urban transprt by converting CCTV camera images of TCC and PPCH into traffic data. It will be useful for TCC activities and for formulation of urban transport policies of PPCH and DPWT.
Operation Section	Through PPTMTC training, wider range interventions of traffic control systems will be possible.
Maintenance Management Section	・Introduction of Preventive Inspection considering the outsourcing to private sectors ・Improvement of Corrective/Accident Inspection ・Improvement of Spare Parts Inventory
Finance/ Personnel Section	Through effective use of spare parts inventory, to grasp necessary maintenance costs in advance and speed up accident recovery.

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5. PPTMTC Training Plan

Due to the soft components of the Grant Aid, TCC staff has general operational skills and knowledge. With the strong support of PPCH and DPWT, TCC has been operating sustainably from 2019 when the signal system was handed over to Phnom Penh to the present, but it is hard to say that the current SUMIDEN system is fully used. In order to minimize the occurrence of signal system accidents and accidents repair time by maximum use of current signal system, conduct of training will be implemented in line with Phnom Penh's traffic control system and traffic conditions.

(1) Traffic Management

・The signal system is one of the traffic management measures, and in order to eliminate the urban traffic congestion related to many factors, comprehensive traffic management measures based on cooperation with not only PPCH and DPWT but also many related agencies are required.

(2) Operation and Maintenance Management

・Current maintenance management in TCC is accident response and corrective maintenance. An efficient and effective preventive maintenance such as regular inspection is required.

(3) Communications

・Since the communication network (OFC) consisted of a one-stroke loop, it suffered serious damage due to frequent disconnection accidents.

・JICA-PiBO Project has taken measures for OFC network redundancy. However, the issue of disconnected location not being identified remains.

5.1 Training Plan of Traffic Management
(1) Stakeholder and Capacity Assessment

Stakeholder Assessment: Coordinated and systematic traffic management by (i) Law maker, (ii) Policy maker, (iii) Regulator, (iv) System manager and (v) Enforcer.

	MPWT	MLMUPC	PPCA		DPWT	Traffic Police
Traffic circulation	Law maker (Traffic sign)		Policy maker		Road manager (NR)* Khan (LR)	
Parking management		Law maker (Property)		**Law maker (Urban road), Regulator (Land use)**	Road manager (NR)* Khan (LR)	Enforcer
Pedestrian improvement	Law maker (Road law)			**Law maker (Urban road)**	Road manager (NR)* Khan (LR)	
Demand management		Law maker (Land use)		**Law maker (Traffic)**, Regulator (Land use/**Traffic**)		
Public transport	Law maker, Regulator			Network manager, Service provider (CBA)		

(2) Training Needs

From Stakeholder and Capacity Assessment and interviews to concerned counterparts, the following training needs are identified:

- Improved capacity to develop strategic planning for traffic management,
- Improved organizational capacity to implement strategic plan for traffic management,
- Improved instruments (such as by-law, order and manual/guideline),
- Understanding of good practices of traffic management exercises in developed and developing countries,
- Trial and error and gaining experiences through pilot project implementation,
- Improved coordination between/among central government and the different local governments.

(3) Training Plan: Methodology (Intensive training, OJT and Pilot project)

Intensive Training: Learn good practices of traffic management exercise in developed and developing countries and examine applicability of these practices into Phnom Penh
OJT: Prepare instruments to examine some of traffic management measures
Pilot Project: Test these instruments thru implementation of pilot project(s)

	Intensive Training				OJT				Pilot Project (Tentative)
	Strategic plan	By-law	Design standard	Guide and manual	Strategic plan	By-law	Design standard	Guide and manual	
Traffic circulation	○			○	○			○	One-way system and improved parking control
Parking management	○	○	○	○	○	○	○	○	On street parking contract
Pedestrian improvement	○		○	○	○			○	Transit mall and improved walkway
Demand management	○			○					
Public transport	○			○	○			○	Intercity bus terminal

5.2 Training Plan of Traffic Control System

(1) Training Outline of Traffic Control System

Number of Training: 2 times （First Training and Second Training）
Training Timing: First Training: Aug. - Sept. 2022; Second Training: Feb. – Mar. 2023
Contents of Training: First Training: Operation and Maintenance; Second Training: Pilot Project

Items		1st Training (Aug. – Sept. 2022)		2nd Training (Feb. – Mar. 2023)
Contents of the Training	Operation	**Basics of Operation** Suganuma & Hong A	**Practical Aspect of Operation** SUMIDEN B	**For the Pilot Project Implementation** Suganuma, Hong, Machida & SUMIDAN C
	Maintenance	**Maintenance** Ona (1) Daily/monthly Report (2) Preventive Inspection (3) Corrective/Accident Inspection (4) Spare parts inventory		

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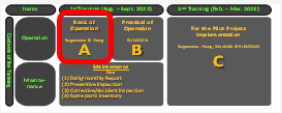
(2) Operation

1) Basic Training of Traffic Signal Operation

Lectures on basic knowledge and practice about traffic signal planning and design will be given to TCC staff for better traffic signal control in Phnom Penh.

<Typical Procedure of Traffic Signal Planning and Design in Japan>

STEP 0: Site Analysis and Determination of Traffic Control Method
↓
STEP 1: Determination of Tentative Intersection Geometry and Traffic Signal Phasing Pattern
↓
STEP 2: Traffic Signal Control Planning
↓
STEP 3: Detailed Planning and Design of Intersection Geometry
↓
STEP 4: Detailed Planning and Design of Intersection Leg Geometry
↓
STEP 5: Planning of Coordinated Signal Control
↓
STEP 6: Examination of Measures for the Traffic Demand Fluctuation



This training aims at the improvement of TCC staff's performance so that the TCC staff can plan and design the traffic signal control by themselves.

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2) Practical Training of Traffic Signal Operation

1) Site survey of saturation flow rate and traffic volume

1.1 Counting at TCC (using CCTV video image)
1.2 Counting at site

2) Site Survey of Congestion Queue Length and Vehicle Density in the Congestion Queue

Site survey

3) How to revise the current settings without construction

3.1 Arrangement of parameter
(1) Cycle
(2) Split
(3) Offset
(4) Fixed second
3.2 Arrangement of Time Zone
(1) Revision of the applied time
(2) Addition of new pattern
3.3 Arrangement of Actuation
(1) Extension
(2) Revision of minimum time



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4) How to check the history data when a local controller malfunctions

3) For the Pilot Project Implementation

1) Signal phasing plan and split design at intersection

Experience the design procedure of typical 4-leg intersection

METS



2) Improvement of intersection control including the revision of signal phasing

2.1 Arrangement of information that can be collected at the traffic control center and information that requires field surveys
2.2 Field Survey
2.3 Discussion with data arrangement and the countermeasures
2.4 Design of signal phasing plan

METS

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(3) Maintenance Management

1) Outline of the Training for Maintenance Management of Traffic Control System

1. Basics of Maintenance Management of Traffic Control System

At first, the basics of maintenance management are explained.

2-1 TCC Activities 19 - 21

TCC activities from Dec. 2018 to Dec. 2021

2-2 Issues of TCC Activities 19 - 21
(1) Lack of Protective Inspection
(2) Lack of Equipment for Repairing
(3) Lack of Budget Allocation System
(4) Lack of Coordination between Relevant Agencies

Issues are summarized from activity results of TCC staff from 2019 to 2021 considering the basics of maintenance management in Chap.1.

3. Contents of the Training of Maintenance Management

Based on the above issues, the following four items will be summarized as training items for maintenance management (by roadside, communication, and TCC equipment).

4. Daily and Monthly Report	5. Preventive Maintenance	6. Corrective/Accident Maintenance	7. Spare Parts Inventory
・ Based on the daily and monthly reports used by TCC, revised one will be developed with examples from Japan & the Philippines. ・ OJT is also conducted.	・ Conduct the training on preventive inspections that are not currently being done at TCC. ・ OJT is also conducted.	・ Identify the problems of current repairs and accident inspections, and provide training on corrective inspections. ・ OJT is also conducted.	・ Development of spare parts inventory form by referring to the examples of Japan and the Philippines.

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2) What is Maintenance Management?

The purposes of maintenance are as follows:

1) to make the equipment run smoothly free from defects,

2) to prevent failure, and

3) to recover the function immediately after failure occurs.

In order to make the equipment trouble-free, it is necessary to perform feedback statistical analysis of failures and attempt to improve equipment, construction methods, and materials.

In order to prevent breakdowns, preventive inspection is necessary, and inspection cycles, inspection items, and inspection methods must be defined and carried out systematically.

In the event of a breakdown, the situation at the site must first be grasped, and in parallel with that, immediate repair must be carried out.

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2) What is Maintenance Management?

(1) Preventive Maintenance

In order to maintain the performance of the equipment and prevent breakdowns, the following inspections are performed:

1) Normal inspection

Normally, the inspection work is performed without stopping the operation of the equipment, and if it is performed at regularity, the period is about once every three months or once a year as a standard.

2) Detailed inspection (Once a year, this is subcontracted to SUMIDEN)

This is an inspection work that is performed by stopping the operation of the equipment and focusing on where failures occur more frequently than in the normal operation.

(2) Corrective Maintenance

In the event of a failure, inspection and repair must be carried out immediately. For that purpose, it is necessary to improve the failure repair system and failure repair technique. When repairing a failure, be sure to create a failure repair format, perform statistical analysis of the failure, and manage the history of the device.

3) Training Needs

Based on the activities of TCC staff during the 3 years since the start of operation of the traffic control system, the training needs of maintenance management are as follows:

(1) Improvement of daily/weekly/monthly reports for accurate records of TCC staff daily activities and corrective/accident activities,

(2) Introduction of regular (preventive) inspection,

(3) Improvement of spare parts inventory for equipment and vehicle arrangements including inventory inspection and regular purchase of necessary equipment, and

(4) Cooperation with related organizations including traffic police officers and for redevelopment work, etc., it is obligatory to submit the work schedule and contents to DPWT in advance.

4) Training Contents

1) Daily and Monthly Reports

Fill out the appropriate form for daily activities, and record for analysis.

2) Preventive Inspection and Maintenance

It is necessary to carry out preventive inspections to detect and avoid serious accidents in advance.

3) Corrective/Accident Inspection and Maintenance

Fill out the appropriate form for corrective/accident activities, and record for analysis.

4) Spare Parts Inventory

Inventory management of spare parts is one of the important activities to keep the traffic control system operating normally, such as quick recovery after an accident. This includes how to prepare the purchase request.

5.3 Training Plan of Communication System

The most frequent accidents of traffic control system in Phnom Penh in the last three years have been related to OFC. Since the OFC network is one of the most important traffic control system infrastructures connecting the TCC and the intersections, and accidents are unavoidable, the main focus of the communications' training is to minimize the number of OFC accidents and OFC repair time. And the at the same time to improve the system that is less likely to cause accidents.

Based on above, the training contents of the communication system are as follows:

1) To minimize the OFC repair time, project team purchase OFC repair equipment such as Ground Resistance Meter, Fusion Splicer and Optical Time Domain Reflectometers including vehicle for inspection, and conduct training how effectively repair the OFC network, and

2) To minimize the number of OFC accidents, maintenance activity of communication system is conducted together with examination of key performance indicator (KPI).

(1) Training Contents for Maintenance Activity of Communication System

1) What is Conservation Activities?

There are two types of conservation activities, which are maintenance activities such as preventive maintenance and post-maintenance to maintain the system in a usable state, and improvement activities to improve the system.

2) What is Key Performance Indicator (KPI)?

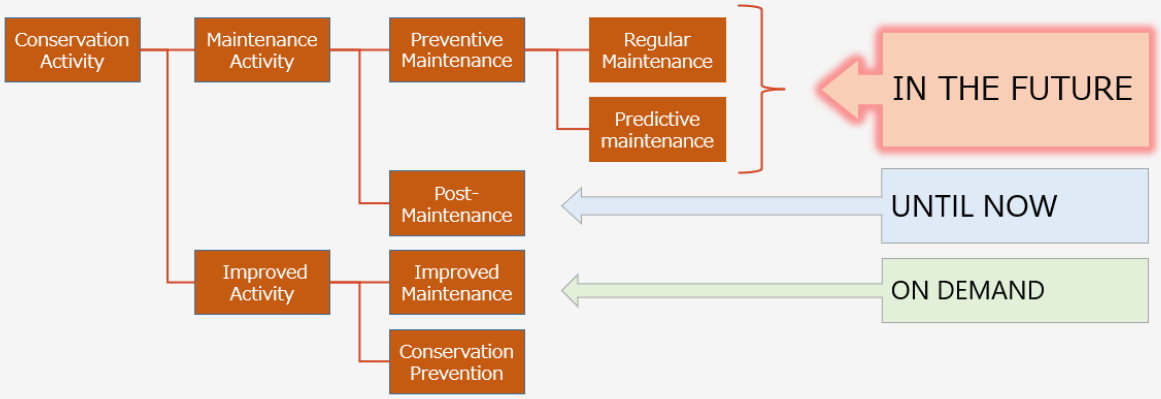
Various numerical values are used to maintenance and improvement the quality of the system. Those numbers are referred to as Key Performance Indicators (KPIs).

3) How to perform Conservation Activities?

Performing system maintenance activities is the implementation of each item of maintenance and improvement activities. For instance, conducting regular Inspections and recording the results are part of preventive maintenance. Those results are to be verified and reflected in improved maintenance, leading to effective maintenance activities.

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1) What is Conservation Activities?



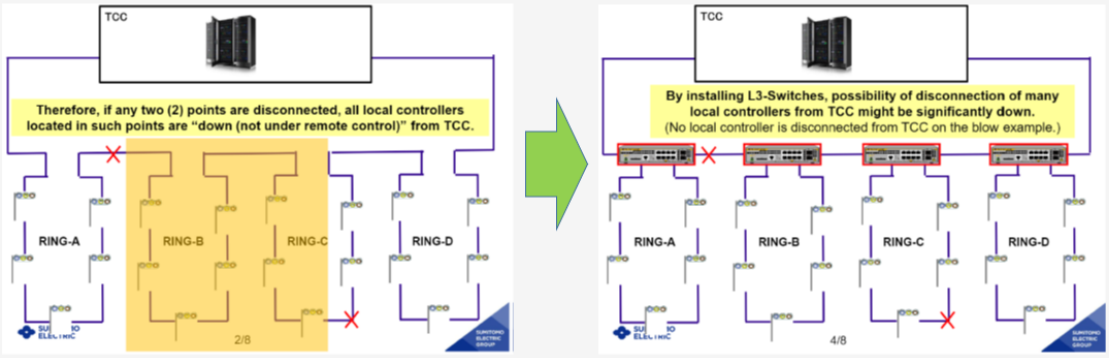
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1) -1 Type of Activities and Description

Type		Description
Preventive Maintenance		Maintenance of a method that estimates the life before a failure and prevents the failure.
	Regular Maintenance	Maintenance method (time-based maintenance activity) that determines the cycle from the evaluation of conventional failure records and maintenance records and performs each cycle.
	Predictive Maintenance	Preventive maintenance method (maintenance activity based on the condition of equipment) that manages the deterioration tendency of equipment by diagnosis technology and takes the best measures at the optimum time before failure.
Post-Maintenance		Maintenance of the method to eliminate the failure when the failure is found in the equipment
Improved Maintenance		Maintenance activities aimed at improving equipment that is less prone to failure or improving performance
Conservation Prevention		Activities to predict and predict matters related to defects and failures using past maintenance results or information from the planning and design stages for equipment, systems, units, assemblies, parts, etc., and incorporate measures to eliminate them.

1)-2 Example of Improved Maintenance

Improved Network Redundancy



2) What is Key Performance Indicator?

What is MTBF, MTTR, MTTR, System Availability Rate?

- MTBF denotes Mean Time Between Failure, calculated by taking the total time a piece of equipment is running (i.e. uptime) and dividing it by the number of breakdowns that occurred over the same period
- MTTR denotes Mean Time To Repair
- MTTF denotes Mean Time To Failure
- System Availability is expressed as a percentage of the actual operation time divided by the total amount of observational time. In other words, it's the total asset uptime divided by the sum of the total amount of uptime and downtime.

How to calculate them?

- System Availability Formula:
  System availability = uptime / (uptime + downtime) * 100
- MTBF Formula:
  MTBF = Total uptime / # of breakdowns

2) -1 How to perform Conservation Activities?

By Using Key Performance Index

ID	Name of Intersection	January 2022																													Nos of Days	Nos of Days System Uptime	Nos of System Downtime
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31			
501	CHROY CHANGVA R/A	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	31	31	0
152	….	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	31	31	0
46	….	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	31	31	0
47	….	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	31	31	0
67	….	1	1	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	31	21	2
157	….	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	31	31	0
502	….	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	31	31	0
45	….	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	31	31	0
65	….	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	31	31	0
60	….	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	31	31	0
135	….	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	31	31	0
161	….	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	31	31	0
160	….	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	31	11	1
141	….	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	31	11	1
66	….	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	31	31	0
140	….	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	31	31	0
34	KABKO MARKET	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	31	31	0
159	….	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	31	31	0
	Total																																558	508	4
	System Avalablity Rate(%)																																		91%
	MTBF(Days)																																		127
	Mean Time between Failures																																		

Legend

Type of Problem
- 1 Normal Operation
- 2 OFC related Problem
- 3 Local Controller related Problem including Spare Parts and Damage of Signal Lantern and
- 4 EDC Problem
- 5 Other Problmes

Duration of the Problem
- 0 More than 24 hours
- Less than 24 hours

2)-2 How to perform Conservation Activities (Case Study)

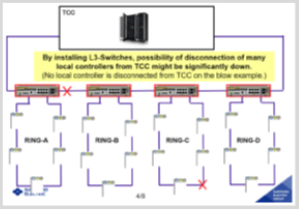
Current Issue

Even if the OFC is down (up to 5 places), the traffic signal is still functioning, and OFC disconnection will not be noticed until there are further breaks or traffic signals are down.

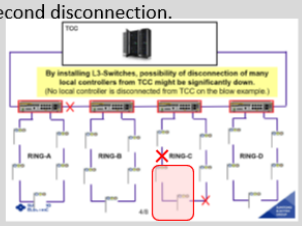
Countermeasures to current issue

1. Currently, both L2 and L3 switches have OFC connections from two directions. Create a mechanism to alert the TCC when one of the connections is down. (Change existing settings or add equipment)
2. In the same above case, develop a mechanism to log the event in TCC when the connection is Down.
3. Install a separate OFC cable ring for cable monitoring

OFC disconnection cannot be recognized at TCC.



The traffic signal goes down due to the second disconnection.



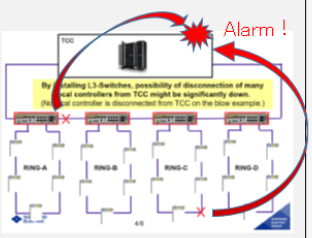
Downtime occurs at traffic signals in the above area in red.

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2)-3 How to perform Conservation Activities (Case Study)

Countermeasures in Current Issue

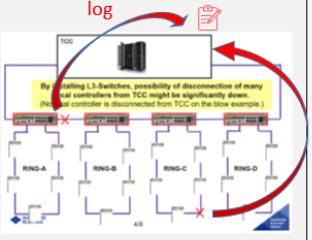
Alternative 1



Alarm sounds at TCC when the OFC is disconnected.

Alternative 2

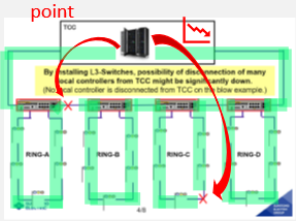
Automatically generates log



Maintain a log at TCC when the OFC is disconnected.

Alternative 3

Measures by OTDR
Estimates the disconnection point



Install a separate OFC cable ring for cable monitoring

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