

Kingdom of Cambodia

FY2021 Ex-Post Evaluation Report of Japanese Grant Aid Project

“The Project for Development of Traffic Management System in Phnom Penh”

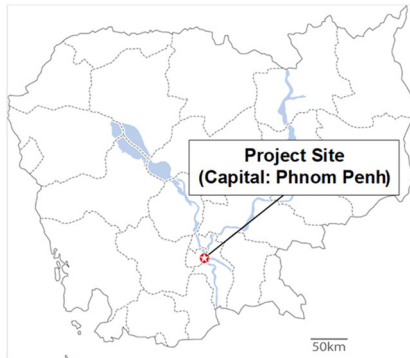
External Evaluator: Masumi Shimamura, Mitsubishi UFJ Research and Consulting Co., Ltd.

## **0. Summary**

This project developed traffic signals at intersections and a Traffic Control Center (hereinafter referred to as “TCC”), etc. to improve traffic conditions in Phnom Penh Capital City. This project, which aims to promote traffic improvement measures such as improvement of intersections and installation of traffic signals, is consistent with Cambodia’s development policy, development needs and project plan and approach were appropriate. The project is also consistent with Japan’s assistance policy and concrete results can be confirmed through collaboration with other JICA projects. Therefore, relevance and coherence of the project are high. In terms of project implementation, although the project cost was within the plan, the project period significantly exceeded the plan. Therefore, efficiency of the project is moderately low. Regarding project effects, of the indicators of quantitative effects set at the time of planning, “average travel speed” and “travel time cost” have mostly achieved as planned, but “average ratios of traffic demand/traffic capacity at 10 major locations” and “traffic police needed in traffic control” have not achieved. Regarding impacts, the results of interviews with local residents and public bus and truck drivers indicate that, overall, the project has contributed to the improvement of traffic flow, local residents’ lives and traffic safety. Regarding impacts on stimulation of economic activities in Phnom Penh Capital City, it was not possible to clearly confirm the contribution of this project from the interview results. This project also takes into consideration vulnerable road users. Regarding social systems and norms, the project has indirectly contributed to raising people’s awareness of traffic safety, however, there are still many traffic violators even after the project, and it is still necessary to continue to raise people’s awareness of traffic rules and manners. Therefore, this project has mostly achieved its objectives and thus, effectiveness and impacts of the project are high. No negative impacts on natural environment have been reported. Land acquisition and resettlement did not take place. Regarding operation and maintenance, slight issues have been observed in the technical, financial, and the current status, however, there are good prospects for improvement/resolution. Therefore, sustainability of the project effects is high.

In light of the above, this project is evaluated to be highly satisfactory.

## 1. Project Description



Project Location



TCC Control Room

### 1.1 Background

The number of registered vehicles in Phnom Penh Capital City has continued to increase due to recent economic development, resulting in lower average travel speed and more serious traffic congestion. Phnom Penh Capital City had been working on traffic improvement measures such as maintenance of traffic signals, improvement of intersections, and construction of grade separated crossing, etc., mainly with its own budget. However, the number of vehicles was increasing due to population and income growth, and the number of fatalities in traffic accidents was becoming serious, making it necessary to consider and implement drastic traffic improvement measures.

There were 69 existing signalized intersections in Phnom Penh Capital City, but the signal equipment and control systems at each intersection were not unified, and signals were displayed irrespective of traffic volume and flow. This has become serious problems, resulting in vehicle stagnation between the intersections, worsening traffic congestion, and increase in traffic fatalities. Thus, updating intersection equipment and improving control systems were urgently needed.

### 1.2 Project Outline

The objective of this project is to improve traffic conditions in Phnom Penh, where traffic congestion was becoming serious by installing 115 traffic signals (including replacement of 64 signals out of the total of 69 existing signalized intersections) and developing a TCC, etc., thereby contributing to the activation of economic activities in Phnom Penh.

Grant Limit / Actual Grant Amount	1,727 million yen / 1,591 million yen
Exchange of Notes Date /Grant Agreement Date	March 2015 / March 2015
Executing Agency	Department of Public Works and Transport: DPWT of Phnom Penh Capital Administration: PPCA
Project Completion	December 2018
Target Area	Phnom Penh Capital City
Main Contractors	Mitsubishi Corporation / Sumitomo Electric Industries, Ltd. (JV)
Main Consultants	Mets Research & Planning Inc. / CTI Engineering International Co., Ltd. (JV)
Preparatory Survey	May 2014–February 2015
Related Projects	<p>[Technical Cooperation]</p> <ul style="list-style-type: none"> <li>• Project for Capacity Development on Comprehensive Traffic Management Planning and Traffic Control Center Operation and Maintenance in Phnom Penh Capital City (January 2022–2024, on-going)</li> <li>• Phnom Penh City Comprehensive Urban Transport Planning Project (March 2012–December 2014)</li> <li>• The Project for Improvement of Public Bus Operation in Phnom Penh (January 2017–February 2022)</li> </ul> <p>[Grant Aid]</p> <ul style="list-style-type: none"> <li>• The Project for Improvement of Transportation Capacity of Public Bus in Phnom Penh (2016–2018)</li> <li>• The Project for Improvement of National Road No.1 (Phase 4) (2014–2017)</li> </ul> <p>[Asian Development Bank]</p> <ul style="list-style-type: none"> <li>• Supporting Sustainable Integrated Urban Public Transport Development (2018–present)</li> </ul>

## 2. Outline of the Evaluation Study

### 2.1 External Evaluator

Masumi Shimamura, Mitsubishi UFJ Research and Consulting Co., Ltd.

## 2.2 Duration of Evaluation Study

This ex-post evaluation study was conducted with the following schedule.

Duration of the Study: November 2021–February 2023

Duration of the Field Study: May 9–28, 2022, September 6–18, 2022

## 2.3 Constraints during the Evaluation Study

In this study, due to the global spread of COVID-19, the external evaluator could not travel to Cambodia. Instead, local consultant was utilized remotely to conduct the survey. For this reason, the local consultant collected the answers to the questionnaire and conducted interviews with stakeholders and beneficiaries, etc. The external evaluator conducted evaluation analysis and judgment by closely examining the information and data obtained through the remote surveys and desk research.

## 3. Results of the Evaluation (Overall Rating: A<sup>1</sup>)

### 3.1 Relevance/Coherence (Rating: ③<sup>2</sup>)

#### 3.1.1 Relevance (Rating: ③)

##### 3.1.1.1 Consistency with the Development Plan of Cambodia

At the time of planning, Cambodian government's *the Rectangular Strategy Phase III (2013–2018)* set out as one of the pillars to prioritize “infrastructure development.” In addition, this project was regarded as one of the top priority projects in the short-term plan until 2016 in *the Comprehensive Urban Transport Master Plan* that had been developed by the Phnom Penh Capital Administration (hereinafter referred to as “PPCA”).

At the time of the ex-post evaluation, Cambodian Government's *the Rectangular Strategy Phase IV (2018–2023)* set forth “economic diversification” as one of its key strategies and calls for enhanced connectivity in transportation infrastructure, as well as improved road safety and traffic order. In addition, *the Comprehensive Urban Transport Plan in Phnom Penh Capital City* with a target year of 2035 states that various traffic management plans will be promoted, including intersection improvements, traffic signalization, and introduction of one-way traffic system, together with the basic concept of this project. Thus, the implementation of the project is also consistent with the development policy of Cambodia at the time of the ex-post evaluation.<sup>3</sup>

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<sup>1</sup> A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

<sup>2</sup> ④: Very High, ③: High, ②: Moderately Low, ①: Low

<sup>3</sup> As described below in “3.4.1 Policy and System,” *the Comprehensive Urban Transport Plan in Phnom Penh Capital City* does not change the policies related to the promotion of various traffic management plans, but it no longer reflects the current situation due to significant changes in traffic flow and road development situations resulting from the rapid development of Phnom Penh Capital City, and thus needs to be updated.

### 3.1.1.2 Consistency with the Development Needs of Cambodia

At the time of planning, there were 69 existing signalized intersections in Phnom Penh Capital City, but signal equipment and control systems at each intersection were not unified, and independent display pattern at each intersection caused traffic flow between the intersections to stagnate. In some cases, traffic congestion was worsened, making it necessary to upgrade the equipment and control system.

At the time of the ex-post evaluation, traffic congestion and accidents are increasing due to increase in traffic volume in Phnom Penh Capital City, and improvement of traffic situation continues to be an urgent issue. In addition, as urban development progresses and urban areas expand, there is an urgent need to improve intersection signals and traffic management systems in the areas surrounding the project to promote traffic safety and traffic facilitation. Furthermore, traffic flow is changing as well as traffic volumes are increasing, which further increases the importance of improving intersection signals and traffic control systems. Therefore, the importance of this project is still maintained at the time of the ex-post evaluation.

### 3.1.1.3 Appropriateness of the Project Plan and Approach

The project plan and design were based on the lessons learned from similar projects, and the use of the lessons learned was appropriate and generated the expected effects. Specifically, through the soft component (capacity building program), technology transfer was conducted to the PPCA, the Department of Public Works and Transport (hereinafter referred to as “DPWT”) of Phnom Penh Capital City and the Traffic Police, and maintenance manuals, etc. were developed and knowledge training on traffic control systems was conducted. Participants of training program utilize the acquired skills and knowledge in the field by sharing them to new staff and introducing to university intern students.

According to the DPWT, there were no effects on the implementation of soft component due to the project period being significantly longer than planned. The project delayed in civil works and procurement of equipment for the TCC, and equipment such as signal controllers and intersection signals, but the technology transfer was carried out without any particular problems due to proper scheduling of the soft component.

From the standpoint of equity, possible actions have been taken within the budget of this project. According to the DPWT, partial road pavement was carried out at the intersection along Norodom Boulevard and Russian Boulevard, where vehicle and pedestrian congestion is particularly heavy, and slope for wheelchair was developed.

## 3.1.2 Coherence(Rating: ③)

### 3.1.2.1 Consistency with Japan’s ODA Policy

At the time of planning, Japanese government placed “development of economic

infrastructure” as one of the development issues in its *Country Assistance Program for Cambodia*. In addition, JICA supported the creation of a master plan in the “Phnom Penh City Comprehensive Urban Transport Planning Project,” that included traffic management such as expansion and improvement of the urban road network, introduction of public transportation, and traffic signals and traffic control systems. This project aimed to improve traffic conditions in Phnom Penh, where traffic congestion was becoming serious, by installing intersection signals and developing a TCC, etc. The project was consistent with Japan’s development cooperation policy at the time of planning.

#### 3.1.2.2 Internal Coherence

This project is internally coherent with a technical cooperation for development planning “Phnom Penh City Comprehensive Urban Transport Planning Project” (March 2012–December 2014), a technical cooperation project “The Project for Improvement of Public Bus Operation in Phnom Penh” (January 2017–February 2022) and a grant aid project “The Project for Improvement of Transportation Capacity of Public Bus in Phnom Penh” (2016–2018) as concrete synergistic effects have been generated. The basic concept for the development of public bus network in Phnom Penh is set forth in *the Comprehensive Urban Transport Plan in Phnom Penh Capital City* prepared by the “Phnom Penh City Comprehensive Urban Transport Planning Project,” and “The Project for Improvement of Public Bus Operation in Phnom Penh” to improve capacity of bus operators and “The Project for Improvement of Transportation Capacity of Public Bus in Phnom Penh” to procure bus were implemented with the aim of developing 10 routes by 2020 as proposed in the Master Plan. (Refer to Impacts for specific synergistic effects.)

Collaboration with a grant aid project “The Project for Improvement of National Road No.1 (Phase 4)” (2014–2017) took place which was not anticipated at the time of planning. Project scope was added as a result of collaboration. Specifically, road rehabilitation and widening were carried out from the Monivong Bridge to the 4 km point in the project phase 4, and at the request of Cambodian government, additional traffic signals were installed at six intersections where traffic congestion was expected in this section of the road. However, as discussed later in the Impacts, the traffic signals at the six locations are not connected to the optic fiber network and thus not yet integrated into the traffic control systems at the time of the ex-post evaluation.

#### 3.1.2.3 External Coherence

Collaboration with “Supporting Sustainable Integrated Urban Public Transport Development” (2018–present) implemented by the Asian Development Bank (hereinafter referred to as “ADB”) took place which was not anticipated at the time of planning. According to the DPWT, the ADB project is going to develop public transportation policy guides and planning toolkit

based on the results of this project. However, the ADB project is delayed due to the spread of COVID-19, and the project is still under implementation at the time of the ex-post evaluation.

Regarding consistency with the international frameworks, the DPWT confirmed that this project contributes to target 3.6 of the SDGs (halve the number of deaths and injuries from road traffic accidents by 2020). The number of traffic accidents and casualties in Phnom Penh Capital City from 2019 to 2021 are shown in Table 1. There is an overall downward trend, although there are likely to be some effects of lockdowns and travel restrictions (external factors) due to the spread of COVID-19 in 2020 and 2021.

Table 1: Number of Traffic Accidents and Casualties in Phnom Penh Capital City

(Unit: person)

	2019	2020	2021
Number of traffic accidents	1,862	950	537
Number of casualties	333	301	176
Number of serious injuries	1,216	947	488
Number of minor injuries	664	352	170

Source: The DPWT and Phnom Penh Traffic Police

The project is consistent with Cambodia's development policy and development needs, and the project plan and approach were appropriate. The project is also consistent with Japan's development cooperation policy, and concrete synergistic effects can be seen through coordination with other projects within JICA. Furthermore, collaborations with other donors, which was not anticipated at the time of planning took place. Therefore, its relevance and coherence are high.

### 3.2 Efficiency (Rating: ②)

#### 3.2.1 Project Outputs

This project aims to improve traffic conditions in Phnom Penh by installing intersection signals and developing a TCC, etc. Equipment at intersections and the TCC installed by the project is listed in Tables 2 and 3.

Table 2: Equipment at Intersections

Equipment	Function
Signal controller (centralized type, with sensing function)	Signal control in remote or isolated mode
Layer 2 switch	Network switch
Media converter	Electronic – optical conversion
Signal lights	Lights for various vehicles and pedestrians
Vehicle detector	Detection and counting of vehicles and speed measurement
Traffic monitoring video camera	Traffic monitoring camera and controller

Source: Preparatory Survey Report

Table 3: Equipment at the TCC

Equipment	Function
Network management server	Network monitoring
Signal control server	Signal control at higher level, equipment monitoring
Signal control workstation	Signal monitoring and control operation by operator
Network attached storage	Network equipment
Front-end processor	Signal control/vehicle detector data processing at real-time level
Network printer	System printer
Video wall	Display of traffic condition, system monitoring, etc.
Video wall controller	Control of video wall
Traffic monitoring workstation with console	Monitoring of traffic conditions
Vehicle detector data processing software	Raw vehicle detector data are processed into traffic flow data
Signal control software	Monitoring and control of signal
Equipment operation monitoring software	Monitoring of system equipment
Human-machine interface software	Display to operator and processing of input by operator
Statistics software	Statistical processing of traffic data and system operation data
Database software	Database management
Parameter setting for vehicle detector	Vehicle detector ID, location, adjustment factor, etc.
Signal control parameter setting	Controller ID, phase, step setting, etc.
Uninterruptible power supply (UPS)	Supply of interruptible power
Controller for traffic monitoring video camera	Control of traffic in remote or isolated mode
Layer 3 switch	Network switch
Layer 2 switch	Network switch
Media converter	Electronic – optical conversion

Source: Preparatory Survey Report



Major changes from the plan include changes in the quantities of equipment items, preparation of drawings and implementation of exploratory surveys of underground buried structures, addition of traffic signals at 15 intersections, reconstruction of new fiber optic cable network, and change in the site of the TCC. In addition, open-cut method of daytime construction was changed to night-time construction, and overhead wiring was buried underground. All of these changes were necessary and appropriate according to the actual conditions at the site, such as traffic volume.

Of the 15 intersections where traffic signals were added, six intersections are along National Road which has been improved by “The Project for Improvement of National Road No.1 (Phase 4),” as described earlier in Section 3.1.2.2 Internal Coherence. The TCC site was originally planned to be located within the DPWT, but the new PPCA building was constructed within the traffic control zone, and thus location was changed because it will reduce travel time from the new building to the site in the event of an accident or system failure. The change of open-cut method of daytime construction to night-time construction was due to adjustments and changes made as a result of development progress in the project area. Specifically, since large-scale construction work was taking place in the center of Phnom Penh Capital City, including the high-rise Vattanac Capital Tower, underground parking, and the Olympic Stadium, and traffic congestion was occurring during the daytime, installation of traffic signals and road signs, etc. was changed to night-time construction. The change to undergrounding of overhead wiring was also due to an instruction issued by the PPCA in 2016 regarding city planning. Specifically, instructions were issued to bury overhead lines along major roads from the perspective of urban landscape and safety and thus the project’s overhead wiring was buried underground.



Vattanac Capital Tower, Intersection Near  
Underground Parking



Intersection Near the PPCA

### 3.2.2 Project Inputs

#### 3.2.2.1 Project Cost

The total project cost was initially planned to be 1,731 million yen (1,727 million yen on the Japanese side, 4 million yen on the Cambodian side). In actuality, the total project cost was 1,595 million yen (1,591 million yen on the Japanese side, 4 million yen on the Cambodian side), which is within the plan (92% of the planned amount).

#### 3.2.2.2 Project Period

The overall project period was planned as 24 months, from April 2015 (start of the detailed design) to March 2017 (completion of construction) as opposed to 45 months in actuality, from April 2015 (start of the detailed design) to December 2018 (completion of construction), which significantly exceeded the plan (188% of the initial plan). Table 4 summarizes the comparison of planned and actual project period.

Table 4: Comparison of Planned and Actual Project Period

Plan	Actual
April 2015–March 2017 (24 months)	April 2015–December 2018 (45 months)
Breakdown: Detailed Design and Tendering Period	
Detailed design: 4.5 months Tendering period: 5.5 months	April 2015–December 2015 (9 months)
Breakdown: Construction and Procurement Period	
Construction and Procurement Period: 16.5 months	December 2015–December 2018 (37 months)

Source: Information provided by JICA and results from questionnaire survey of the DPWT

Note 1: The starting point of the project period is the start of the detailed design, and the definition of project completion is the date of completion of construction (the date of completion of removal work). The project period does not include the defect liability period for both planned and actual.

The reason for the significant increase over the plan was due to the combination of factors mentioned above in “3.2.1 Project Outputs.” Specifically, it was due to a combination of (1) installation of additional traffic signals at 15 intersections, (2) reconstruction of a new optical cable network, (3) change of the TCC location, (4) change of open-cut method of daytime construction to night-time construction, and (5) change from overhead wiring to underground installation. They are extensions of the project period due to changes in outputs. In addition, (4) change to night-time construction and (5) undergrounding of overhead wiring were due to the rapid urban development in the project area and the instruction regarding city planning

issued by the PPCA in 2016, and it would have been difficult to foresee these changes at the time of planning.

Therefore, efficiency of the project is moderately low.

### 3.3 Effectiveness and Impacts<sup>4</sup> (Rating: ③)

#### 3.3.1 Effectiveness

##### 3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

At the time of planning, “average travel speed,” “travel time cost,” “average ratios of traffic demand/traffic capacity at 10 major locations,” and “traffic police needed in traffic control” were set as quantitative effects of the project. Table 5 summarizes baseline, target and actual figures between 2017 and 2021 for each indicator. As the project completion is December 2018, the target year to be compared is 2021, three years after completion. The target achievement rates are shown in parentheses in the table.

According to the DPWT, due to the spread of COVID-19, they were unable to measure and calculate “average travel speed,” “travel time cost” and “average ratios of traffic demand/traffic capacity at 10 major locations” for 2021, and thus actual values for that year were not available. In addition, according to the DPWT, the actual figures for 2020 were affected by the lockdown and travel restrictions due to COVID-19, and the figures do not exclude these effects. For this reason, instead of looking at the achievement status of the actual values for a single year, 2021, analysis was made on the overall changes in the actual values that were available. As regards “traffic police needed in traffic control,” analysis was conducted by comparing the actual results for 2021 with the target values, since the actual values for 2021 were available from the Phnom Penh Traffic Police. (Actual values for other years were regarded as reference values.)

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<sup>4</sup> When providing the sub-rating, Effectiveness and Impacts are to be considered together.

Table 5: Quantitative Effects of the Project

Indicators	Baseline value 2014 Actual value	Target value 2020 3 Years After Completion	Actual value (Percentages in parentheses indicate achievement rates)				
			2017	2018 Project completion	2019	2020	2021
Average travel speed (km/hr) (average values of speed on major radial roads)	12.5 (Note 1)	14.2 (Note 2)	11.34	15.23 (107%)	13.72 (97%)	16.44 (116%)	N.A.
Travel time cost (million JPY) (Note 3)	14,742 (Note 4)	12,978	13,638	13,361 (97%)	13,453 (96%)	13,313 (97%)	N.A.
Average ratios of traffic demand/traffic capacity at 10 major locations (vehicles)	Morning Peak 1.18 Evening Peak 1.37	Morning Peak 1.13 Evening Peak 1.33	Morning 1.37 Evening 1.59	Morning 1.43 (79%) Evening 1.67 (80%)	Morning 1.51 (75%) Evening 1.75 (76%)	Morning 1.14 (99%) Evening 1.33 (100%)	Morning N.A. Evening N.A.
Traffic police needed in traffic control (person)	About 400 (Note 5)	About 320	N.A.	N.A.	552 (58%)	252 (127%) (Note 6)	478 (67%) (Note 7)

Source: Ex-ante evaluation report and results from questionnaire survey of the DPWT. “Traffic police needed in traffic control” data is from the Phnom Penh Traffic Police.

Note 1: Data from the travel speed results in the study.

Note 2: Based on examples of travel speed improvements effects of traffic control systems installation and intersection improvements in other countries (assuming 14% speed improvement effect).

Note 3: Travel time cost means a monetary value a person is willing to pay for a change in his/her travel time (JPY equivalent figure). For the actual, figures in USD were provided from the DPWT and converted to JPY by the evaluator using the average IMF rate (IFS) for each year.

Note 4: Average travel speed was used to calculate the total travel time cost for seven major routes (Monivong Blvd., Norodom Blvd., Charles de Gaulle Blvd., Russian Blvd., Sihanouk Blvd., Mou Tse Tong Blvd. and Inner Ring Road) in Phnom Penh Capital City.

Note 5: At the time, 64 locations with heavy traffic (inclusive of non signalized intersections) were staffed with two to four traffic police, or approximately 400 traffic police in two shifts. It was estimated that a reduction of 20% of traffic police can be achieved as non signalized intersections are signalized and signalized intersections with high traffic volume are facilitated.

Note 6: The sharp decrease in the number of traffic police in 2020 is due to the lockdown and travel restrictions caused by the COVID-19 pandemic, which also restricted traffic and reduced the deployment of traffic police.

Note 7: As of June 2022, the following year, the number of traffic police for traffic control is 586.

Looking at the trends in “average travel speed” and “travel time cost,” the target achievement rates were 97–116% and 96–97%, respectively, indicating that the targets were generally achieved as planned. On the other hand, although the achievement rates for the actual value in 2020 for “average ratios of traffic demand/traffic capacity at 10 major locations” are almost achieved at 99% for the morning peak and 100% for the evening peak, it cannot be said that the indicator is generally achieved as planned, considering that the impacts of lockdowns and travel restrictions due to the spread of COVID-19 are included, and that the achievement rates

in 2018 and 2019 have remained below 80% due to increase in traffic volume. The number of “traffic police needed in traffic control” has not achieved the target. At the time of planning, it was assumed that the number of traffic police on duty would be reduced by the project but the actual number in 2021 has increased to 478, which is 1.5 times the target, and the achievement rate is 67%. In 2020, it can be considered that the target was temporarily achieved due to an external factor, COVID-19. It was assumed that the actual value would be lower than the baseline value for this indicator, but it is conceivable that there was an assumption that road users will observe traffic rules and manners such as traffic signals and road signs (or that this project will promote such observance). However, since there are still traffic violators, traffic police should continue to be deployed at signalized intersections to control traffic. The actual values have increased and the target has not been achieved because increase in the number of traffic police is necessary to deter traffic violations, prevent accidents, and improve traffic flow. This is consistent with the results of the interviews with local residents discussed below in Section “3.3.2.2 Other Positive and Negative Impacts,” 5) Social Systems and Norms, Human Well-being and Human Rights.

#### 3.3.1.2 Qualitative Effects (Other Effects)

Qualitative effects were classified as impacts.

### 3.3.2 Impacts

#### 3.3.2.1 Intended Impacts

As impacts of this project, state of generation of “improvement of traffic flow in Phnom Penh Capital City,” “improvement of local residents’ lives,” “realization of safe and secure road traffic” and “stimulation of economic activities in Phnom Penh” were evaluated.

##### 1) Improvement of traffic flow in Phnom Penh Capital City

The DPWT explained that after the project, traffic signals have been operating under a unified control system, monitored and controlled from the TCC, and thus traffic flow has improved.

Interviews were conducted with 20<sup>5</sup> local residents of Phnom Penh Capital City (users of vehicles, motorcycles, etc. and pedestrians) and drivers of public buses and trucks. 19 respondents (95%) said that overall, traffic flow has improved as a result of the project, and one respondent did not know. However, public bus drivers (5), tuk-tuk driver (1), and

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<sup>5</sup> The 20 interviewees consisted of 14 men (one teenager, two in 20s, five in 30s, five in 40s and one in 70s) and six women (one teenager, two in 30s, one in 40s, one in 50s, and one in 60s). They include seven public bus drivers, one light truck driver, one tuk-tuk driver, one food delivery person, six clerks/salespeople, one security guard at university, one primary school teacher, one university student, and one junior high school student. One elderly person (a 73-year-old man) was interviewed for vulnerable road users (children, people requiring nursing care, the elderly, and people with disabilities), but the interviewees included local residents with small children and elderly family members.

salesperson (1) answered that traffic flow has not improved in some areas even after the project, and they expect that it will improve in the future.

## 2) Improvement of local residents' lives

The DPWT explained that after the project, traffic flow was improved, and complaints about traffic congestion from local residents decreased.

The results of interviews with local residents and drivers of public buses and trucks in Phnom Penh Capital City showed that 18 respondents (90%) answered that their lives had improved due to improved traffic flow after the project, one respondent said there was no change, and one respondent did not know. Specifically, following responses were obtained: “We can now go to work and school on time and do not have to leave home early in the morning,” “Ambulances can pass through with priority,” “I have less frustration due to traffic jams,” “I can pick up and drop off my children more smoothly and have better time management,” “I can move smoothly during delivery work and have lesser customer complaints.” Some respondents also noted that “traffic congestion has eased, saving money on gasoline.” Public bus drivers answered that “the overall delay time has been reduced (delays were 15 to 20 minutes before the project, but delays were limited to five to 10 minutes in most cases after the project).”

## 3) Realization of safe and secure road traffic

The DPWT explained that after the project, number of traffic accidents decreased due to improved traffic flow. (See Table 1)

The results of interviews with local residents of Phnom Penh Capital City and drivers of public buses and trucks showed that 19 respondents (95%) answered that the project has contributed to traffic safety, while one respondent answered no change. Specifically, a respondent answered that “Before the project, there were many accidents due to vehicles forcing their way into the road, but after the project, pedestrians can cross the road safely because they have to stop at red lights” and “Before the project, there were no traffic signals at the Neang Kung Hing Roundabout, causing traffic jams and accidents. After installation of traffic signals in this project, traffic jams have been eliminated and accidents are rarely heard of.” On the other hand, it was pointed out that “In the evening, roads are congested and many drivers ignore red lights on Russian Boulevard, which is scary. The passing time for pedestrian signals should be longer than the current set time (15 seconds)” and “This project has contributed to the reduction of traffic accidents, but vehicle drivers need to have better understanding of how to use the lanes and the dedicated public bus lane.”

#### 4) Stimulation of economic activities in Phnom Penh

The DPWT explained that after the project, waiting time at intersections has decreased and travel time has been reduced, leading to increased number of truck trips.

The results of interviews with local residents of Phnom Penh Capital City and drivers of public buses and trucks showed that five respondents (25%) (all public bus drivers) answered that the project has contributed to the increase in the number of truck trips and public bus services, three (15%) (two public bus drivers and one salesperson) answered other, and 12 (60%) did not answer or did not know. A public bus driver pointed out that although increase in the number of truck trips and the number of public buses operated may be due in part to the contribution of this project, it is more likely that increase in demand is the main factor. For example, rapid development of Phnom Penh Capital City has increased the demand for truck transportation due to increased business activities, and low-income people living far from the city center are increasingly using public buses for economic reasons, such as using public buses because they cannot afford to pay for gasoline. For this question, 60% of the respondents did not answer or did not know. Various factors other than the project have influenced stimulation of economic activities, and as far as reviewing the answers to the questions, which were given due consideration of causal relationship with this project, the contribution of this project could not be confirmed clearly.

#### 3.3.2.2 Other Positive and Negative Impacts

##### 1) Impacts on the Natural Environment

The project was classified as Category C based on the *JICA Guidelines for Confirmation of Environmental and Social Considerations* (April 2010) since the project was considered to have minimal undesirable effects on environment.

According to the DPWT, no specific negative impacts on the natural environment were identified. During construction, open-cut daytime work was changed to night-time to avoid road closures and effects on traffic flow. The DPWT also explained that large construction equipment was not used to reduce noise, vibration, and other environmental impacts. The results of interviews with local residents of Phnom Penh Capital City and drivers of public buses and trucks indicate that there were no major problems with the natural environment during construction and after completion.

##### 2) Resettlement and Land Acquisition

Resettlement and land acquisition did not take place for this project.

##### 3) Gender Equality

As a result of interviews with the DPWT and local residents and public bus and truck

drivers in Phnom Penh Capital City, no particular impacts on gender was observed.

#### 4) Marginalized People

The DPWT explained that the project has installed pedestrian signals, making crossing the street more convenient for all pedestrians. As mentioned earlier in “3.1.1.3 Appropriateness of the Project Plan and Approach,” road pavement was carried out at the intersection along Norodom Boulevard and Russian Boulevard and slope for wheelchair was developed. During planning, installation of audible pedestrian signals for the visually impaired was discussed, but it was not realized due to budget constraints.

The results of interviews with local residents of Phnom Penh Capital City and drivers of public buses and trucks showed that 19 respondents (95%) answered that the project takes vulnerable road users into consideration, while one respondent answered that it does not. Specifically, there were responses such as “The project helps children, pregnant women, and the elderly to cross intersections. Traffic signals and signs are easy to see,” “The pedestrian signal passing times are appropriate, and consideration is being given to vulnerable road users. I have seen elderly people, women pushing baby carriage, and people in wheelchairs crossing the road and they were crossing safely.” On the other hand, some respondents pointed out that “It would be better if pedestrian signals could be set longer for children crossing the street during evening school dismissal and for poor people pushing carts to sell general goods,” and “Although there are some intersections where pedestrian signal passing time is sufficient, the Petchen Intersection (intersection of Preah Sihanouk Boulevard and Preah Monivong Boulevard) is not sufficient for vulnerable pedestrians to safely cross the street because the green light is too short for the wide road and they have to run.”

#### 5) Social Systems and Norms, Human Well-being and Human Rights

The DPWT explained that, overall, number of vehicles and pedestrians who follow basic traffic rules and manners has increased after the project, for example, vehicles now follow basic rules such as when turning left at an intersection, they must move into the left turn lane. The DPWT mentioned that after project completion, they have installed road signs to guide and disperse traffic flow to improve project effectiveness. On the other hand, the DPWT pointed out that the target area of the project is the central area of Phnom Penh Capital City, and as urban development of Phnom Penh Capital City is progressing rapidly and the urban area is expanding, it is necessary to install traffic signals and deploy traffic police at intersections in the surrounding areas.

As a result of interviews with local residents and drivers of public buses and trucks of Phnom Penh Capital City, all 20 respondents answered that people’s awareness of traffic safety has improved compared to before the project. Of these, three respondents (two public



bus drivers and one salesperson) provided answers that were relevant to this project. However, it was pointed out that there are still many traffic violators and that it is necessary to inform the public about traffic rules and manners. Specifically, it was pointed out as follows. “After the project, some drivers began to obey traffic rules such as traffic signals when entering intersections, but some drivers still disregard road signs (turn right, turn left, go straight, white and yellow marks on the road, pedestrian marks),” “Public bus drivers are well aware of changes in traffic laws and regulations, but general drivers are not well aware of them. There are many drivers who do not follow lane rules, such as driving in the right turn lane when they want to turn left, driving in the left turn lane when they want to go straight, and not giving priority to pedestrians when the pedestrian signals are green. So, it is necessary to make people aware of traffic rules and manners.” “At intersections not monitored by traffic police, there are drivers who do not obey traffic rules and ignore traffic signals and signs. Traffic police needs to be deployed at these intersections.” As the reasons for not achieving the target of “traffic police needed in traffic control” is explained in “3.3.1.1 Quantitative Effects,” the interview survey results also suggest that the deployment of traffic police is still necessary to improve traffic flow and make road traffic safer and more secure.

#### 6) Unintended Positive/Negative Impacts

##### <Synergies with other projects in JICA>

As mentioned above in “3.1.2.2 Internal Coherence,” this project has generated concrete synergistic effects with “Phnom Penh City Comprehensive Urban Transport Planning Project,” “The Project for Improvement of Public Bus Operation in Phnom Penh” and “The Project for Improvement of Transportation Capacity of Public Bus in Phnom Penh.”

This project was implemented based on *the Comprehensive Urban Transport Plan in Phnom Penh Capital City* formulated in the “Phnom Penh City Comprehensive Urban Transport Planning Project,” and the concrete effects shown in the above Effectiveness and Impacts are all collaborative effects.

Regarding collaboration with “The Project for Improvement of Public Bus Operation in Phnom Penh” and “The Project for Improvement of Transportation Capacity of Public Bus in Phnom Penh,” according to the DPWT, a technical team of the technical cooperation project, in order to introduce a priority signalling system for public buses, is undertaking pilot survey on Charles de Gaulle Boulevard and Monireth Boulevard respectively in collaboration with the staff of the TCC developed by the project. In the signal control pattern experiment, the TCC staff have shared data such as public bus travel speed data with the technical team, and operations such as increasing the timing of green lights when public buses pass through intersections are being coordinated between the two parties to ensure that the bus priority signal system works well. As a result, improvements in public bus service

delays have been observed. According to the TCC, the pilot survey showed an increase in green light timing at intersections of approximately 2–4%, which converts to travel time savings of 4–7 seconds, depending on the intersection conditions. Buses provided under the grant aid project are being used.

As a collaboration that was not anticipated at the time of planning, as mentioned above in “3.1.2.2 Internal Coherence,” collaboration with “The Project for Improvement of National Road No.1 (Phase 4)” took place. However, the additional traffic signals installed at six intersections are not currently connected to the fiber optic network and have not yet been integrated into the traffic control systems. According to the DPWT, installation of the fiber optic network is costly and need to secure budget. Connection costs would need to be budgeted as a new investment project rather than in the maintenance budget.

<Synergies with organizations outside of JICA>

As mentioned earlier in “3.1.2.3 External Coherence,” collaboration with ADB project has taken place. According to the DPWT, public transportation policy guides and planning toolkit will be developed under the ADB project based on the results of this project, but the ADB project has been delayed due to the spread of COVID-19 and is still under implementation at the time of the ex-post evaluation, so concrete results have not yet been realized.

This project has mostly achieved its objectives. Therefore, effectiveness and impacts of the project are high.

### 3.4 Sustainability (Rating: ③)

#### 3.4.1 Policy and System

According to the DPWT, there is no change in the policies of *the Comprehensive Urban Transport Plan in Phnom Penh Capital City* with a target year of 2035, traffic signals and traffic control systems at intersections will continue to improve. However, it was pointed out that the Master Plan no longer reflects the current situation due to the rapid development of Phnom Penh Capital City, which has drastically changed traffic flow and road development situation etc., and that it needs to be updated.

From the above, sustainability of policy and system of the project is assured.

#### 3.4.2 Institutional/Organizational Aspect

After project completion, operation and maintenance of the project is carried out by the DPWT under the supervision of PPCA. Although the TCC is located in the PPCA building, it is an organization under the DPWT and is under the reporting line to the DPWT. Roles and responsibilities of the DPWT and the TCC are as follows.

- DPWT: Responsible for technical supervision on the operation and maintenance of

traffic control system

- TCC: Responsible for operation and maintenance of traffic control systems

According to the DPWT, the DPWT and the TCC directly carry out maintenance work of the traffic control systems because they can handle themselves, and they do not outsource the work to maintenance contractors. In addition, remote maintenance has not been implemented through direct access to the TCC's servers from Japan.

The DPWT prepares and submits operation and maintenance plan and budget plan to the PPCA every year and undertakes operation and maintenance work upon approval by the PPCA. The DPWT/the TCC is in constant communication with the PPCA and there is a system in which they can collaborate.

The TCC has 13 staff members. It consists of one TCC Chief, one Deputy Chief and 11 technical staff. According to the DPWT and the TCC, currently necessary personnel are secured to operate and maintain the traffic control systems. In the future, if the traffic control area is going to be expanded, the number of staff needs to be increased, but at present, 13 staff members are sufficient, and there are no particular problems.

At the time of the ex-post evaluation, a technical cooperation project "Project for Capacity Development on Comprehensive Traffic Management Planning and TCC Operation and Maintenance in Phnom Penh Capital City" (scheduled from January 2022 to December 2024) has been implemented for the PPCA, the DPWT, the TCC, and Phnom Penh Traffic Police, and one of its outputs is "establishment of a maintenance management system for traffic control systems." In view of expansion of the urban area due to the rapid urban development in Phnom Penh Capital City, there are plans to expand the development of intersection signals and traffic control systems to the surrounding areas of the project. With the expansion of operations, it is necessary to establish a more appropriate maintenance management system, and the following activities are planned for this technical cooperation project.

- Activity 1-1: Review the TCC's current organization and management structures
- Activity 1-2: Identify operation and maintenance management problems that have occurred since the start of operation of the traffic control systems and develop improvement measures
- Activity 1-3: Review existing system operation manuals, maintenance management manuals, and other manuals to make them suitable for the situation in Phnom Penh
- Activity 1-4: Investigate maintenance management organization (including possibility of outsourcing) and propose an appropriate maintenance management system

From the above, no particular problem has been identified regarding the Institutional/Organizational aspect of operation and maintenance.

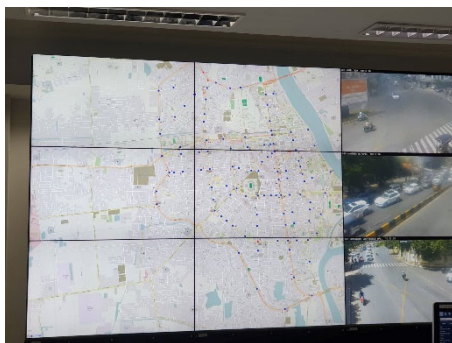
### 3.4.3 Technical Aspect

According to the DPWT and the TCC, the TCC staff have basic knowledge and skills to carryout day-to-day operations and maintenance work. However, traffic signal operation techniques need to be strengthened so that traffic flow can be controlled at appropriate times, especially during peak hours and in response to traffic conditions, and it is expected that the capacity of TCC staff will be enhanced through the on-going technical cooperation project.

According to the DPWT and the TCC, the soft component (capacity building program) of the project provided training and hands-on work related to basic knowledge and operation and maintenance of the traffic control systems. According to interviews with training participants, they found the training content easy to understand and comprehend. Although no training has been provided after completion of the project, the TCC staff are improving their skills through daily on-the-job training.

The manuals prepared under the soft component have not been updated, but updates to the manuals are planned through on-going technical cooperation project. The current manual is always available at the TCC and is referred to and utilized in daily operations.

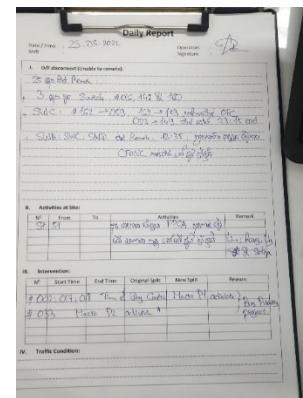
From the above, the TCC staff in charge of operation and maintenance has the basic technical skills necessary to undertake usual operation and maintenance work. More advanced technologies, such as controlling traffic flow in a timely manner during peak hours, will be transferred in an on-going technical cooperation project, and concrete prospects are in place. Therefore, although there are some minor problems with the technical aspects of operation and maintenance, prospects for improvement and resolution are high.



Monitoring Screen at the TCC



TCC Server



Daily Monitoring Records by the TCC Staff

### 3.4.4 Financial Aspect

As regards operation and maintenance costs of the project, necessary amounts are estimated by the DPWT annually, and budget request will be made to the PPCA where it is scrutinized.

Then, after approval by the PPCA, budget will be allocated to the DPWT. For urgent and high priority repairs, such as damage to traffic signal poles due to traffic accidents, the DPWT requests a budget each time, which will be approved by the PPCA.

Table 6 shows the budget (requested amount), actual allocation and actual expenditure of operation and maintenance cost of the project.

Table 6: Operation and Maintenance Cost for the Project

(Unit: USD)

	2019	2020	2021
Budget (Requested Amount)	74,700	74,700	74,700
Actual Allocation	22,250	21,070	5,640
Actual Expenditure	14,940	19,890	5,640

Source: Results of questionnaire survey of the DPWT

Note 1: According to the DPWT, budget request is made excessively (requested more than the expected expenditure) because full amount requested is not approved and allocated in a timely manner.

Note 2: Actual expenditures in 2019 and 2020 are lower than actual allocations because the cost of spare parts not procured in those years was carried over to the following year.

Note 3: The significant decrease in actual allocation and actual expenditure in 2021 is due to the effects of COVID-19. (Cambodian government prioritized its budget on COVID-19 countermeasures.)

According to the DPWT, budgeted request for operation and maintenance cost is made excessively because full amount requested is not approved. In addition, budget is not allocated in a timely manner. Actual expenditures are within the allocation. The reason for significant decrease in actual allocations and expenditures in 2021 is due to the fact that the government budget was prioritized for expenditures for COVID-19 countermeasures. The projected budget allocations for 2022 is unknown at the time of the ex-post evaluation.

From the above, there are some minor problems with financial aspect of operation and maintenance, but no substantial problems have occurred.

#### 3.4.5 Environmental and Social Aspect

As a result of confirming with the DPWT and the TCC, there were no unexpected environmental and social considerations.

#### 3.4.6 Preventative Measures to Risks

According to the DPWT and the TCC, traffic control systems are based on advanced technology of Japan. If there is anything unclear in the system maintenance, they consult with the Japanese contractors for this project via e-mail, etc., and can receive useful advice. However, a more detailed manual is necessary for the TCC to carry it out on its own. There are no software

compatibility issues.

According to the DPWT and the TCC, they do not have the tools and equipment to repair fiber optic cables in the event of a physical disconnection or other failures. Thus, the DPWT has plans to rent the equipment from private entities and have the TCC staff conduct repairs.

#### 3.4.7 Status of Operation and Maintenance

Condition of signals and fiber optic network is monitored on a daily basis and repaired by the TCC staff when problems occur. Physical damage to traffic signal poles and other equipment caused by traffic accidents, etc. is repaired by the DPWT after the TCC staff obtain information at the site in cooperation with the Traffic Police.

According to the DPWT and the TCC, frequent malfunction of Layer 2 switches is taking place and they are not available in a timely manner since suppliers do not have spare parts in stock. As a result, traffic signals at four intersections are not connected to the traffic control systems and currently have independent display patterns. In addition, the additional traffic signals installed at six intersections along National Road No.1 are not connected to the fiber optic network and have not yet been integrated into the traffic control systems. According to the TCC, these intersections are not major intersections and the independent traffic signals have no effects on traffic.

Spare parts are stored in the DPWT warehouse. Fiber optic cable and control power unit would be procured from Japan, and it would take about one to three months. Layer 2 switches that have been causing frequent malfunctions can be procured in Cambodia but are currently not available due to lack of stock.

From the above, there are some problems in the operation and maintenance status at the time of the ex-post evaluation, but as a whole, there is no problem because facilities are properly operated and maintained.

Slight issues have been observed in the technical, financial, and the current status of operation and maintenance, however, there are good prospects for improvement/resolution. Therefore, sustainability of the project effects is high.

## **4. Conclusion, Lessons Learned and Recommendations**

### 4.1 Conclusion

This project developed traffic signals at intersections and a TCC, etc. to improve traffic conditions in Phnom Penh Capital City. This project, which aims to promote traffic improvement measures such as improvement of intersections and installation of traffic signals, is consistent with Cambodia's development policy, development needs and project plan and approach were appropriate. The project is also consistent with Japan's assistance policy and concrete results can

be confirmed through collaboration with other JICA projects. Therefore, relevance and coherence of the project are high. In terms of project implementation, although the project cost was within the plan, the project period significantly exceeded the plan. Therefore, efficiency of the project is moderately low. Regarding project effects, of the indicators of quantitative effects set at the time of planning, “average travel speed” and “travel time cost” have mostly achieved as planned, but “average ratios of traffic demand/traffic capacity at 10 major locations” and “traffic police needed in traffic control” have not achieved. Regarding impacts, the results of interviews with local residents and public bus and truck drivers indicate that, overall, the project has contributed to the improvement of traffic flow, local residents’ lives and traffic safety. Regarding impacts on stimulation of economic activities in Phnom Penh Capital City, it was not possible to clearly confirm the contribution of this project from the interview results. This project also takes into consideration vulnerable road users. Regarding social systems and norms, the project has indirectly contributed to raising people’s awareness of traffic safety, however, there are still many traffic violators even after the project, and it is still necessary to continue to raise people’s awareness of traffic rules and manners. Therefore, this project has mostly achieved its objectives and thus, effectiveness and impacts of the project are high. No negative impacts on natural environment have been reported. Land acquisition and resettlement did not take place. Regarding operation and maintenance, slight issues have been observed in the technical, financial, and the current status, however, there are good prospects for improvement/resolution. Therefore, sustainability of the project effects is high.

In light of the above, this project is evaluated to be highly satisfactory.

## 4.2 Recommendations

### 4.2.1 Recommendations to the Executing Agency

Due to malfunction of Layer 2 switches, traffic signals at four intersections are not connected to the traffic control systems, resulting in independent display patterns. According to the TCC, these intersections are not major intersections, and the independent signals are not affecting traffic. However, in order for the project to generate effects, the entire project area needs to be integrated into the traffic control systems. Therefore, it is important for the DPWT to replace Layer 2 switches and integrate them into the system as soon as possible.

Traffic signals at six intersections along National Road No.1, which were installed as additional scope of the project, have not been integrated into the traffic control systems, resulting in independent display patterns. It is important for the PPCA and the DPWT to secure budgets for the installation of optic fiber network, etc. and integrate them into the system as soon as possible so as not to cause stagnation of traffic flow between intersections and worsening of traffic congestion.

Since the DPWT does not have equipment to repair when problems such as fiber optic cable

disconnections occur, it has been relying on the private sector to do the repair. In the future, the DPWT plans to rent repair equipment from the private sector and repair it by TCC itself and is currently preparing for it. Thus, it is important for the DPWT to secure budget for rental costs and establish a system to repair by itself.

#### 4.2.2 Recommendations to JICA

None.

#### 4.3 Lessons Learned

When providing support for the development of traffic control systems in urban transport sector, project effectiveness and sustainability can be enhanced by providing complementary support seamlessly, from a comprehensive perspective for overall urban transportation issues

The project was implemented based on *the Comprehensive Urban Transport Plan in Phnom Penh Capital City* formulated by the technical cooperation for development planning “Phnom Penh City Comprehensive Urban Transport Planning Project.” Based on the basic concept of *the Comprehensive Urban Transport Plan in Phnom Penh Capital City*, a technical cooperation project “The Project for Improvement of Public Bus Operation in Phnom Penh” and a grant aid project “The Project for Improvement of Transportation Capacity of Public Bus in Phnom Penh” were implemented at about the same time and collaboration among these projects took place. These collaborations have resulted in the development of concrete synergies to improve the urban transportation situation, such as addressing traffic congestion issues and improving bus service delays. In addition, synergistic effects with an ongoing technical cooperation project “Project for Capacity Development on Comprehensive Traffic Management Planning and TCC Operation and Maintenance in Phnom Penh Capital City” is expected. The project will address traffic rules and manners pointed out in interviews with local residents and drivers of public buses and trucks, and further strengthen the capacity of the TCC staff to operate and maintain traffic control systems introduced by the project. This suggests that when providing support for the development of traffic control systems in urban transport sector, project effectiveness and sustainability can be enhanced by seamlessly implementing complementary supports for overall urban transportation issues from a comprehensive perspective, both before and after the project.

End