カンボジア国

公共事業運輸局、プノンペン都庁

カンボジア国
プノンペンにおける総合交通管理計画
及び交通管制センター運営維持管理の
能力改善プロジェクト

事業完了報告書

令和 7 年 2 月
(2025 年)

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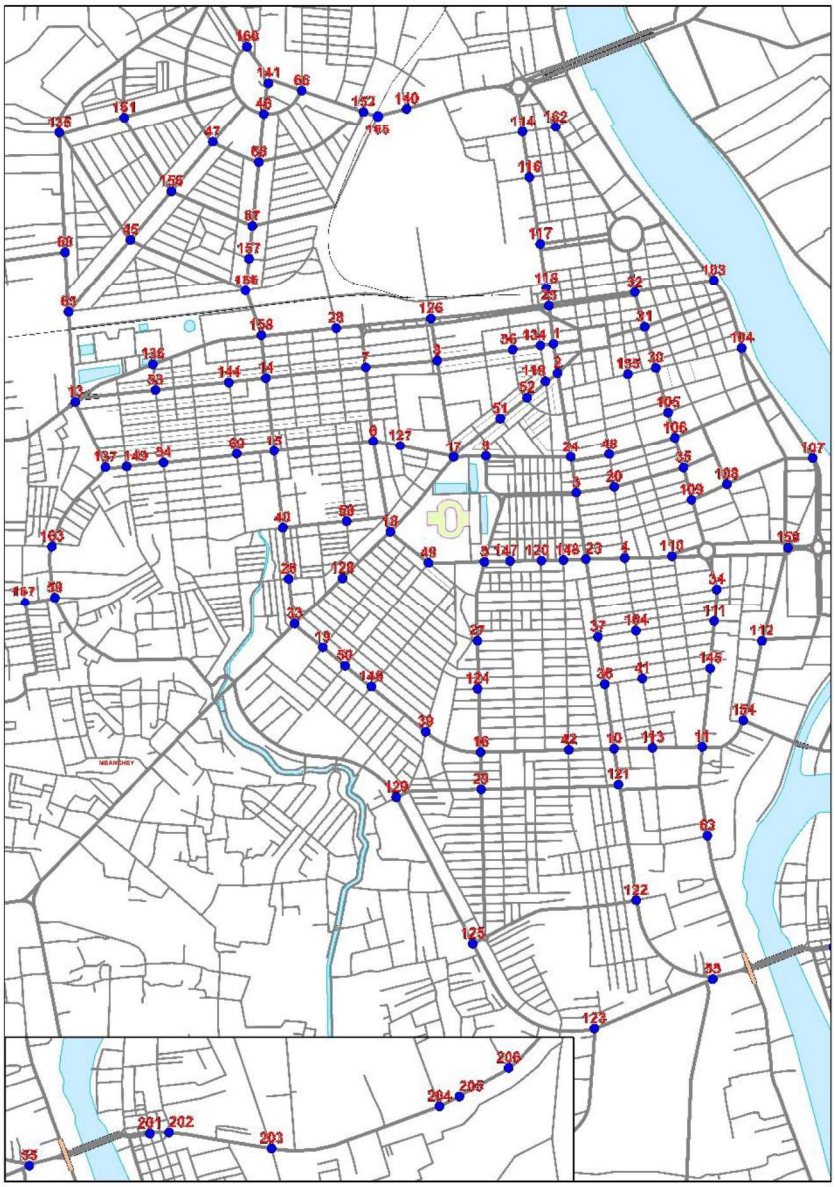
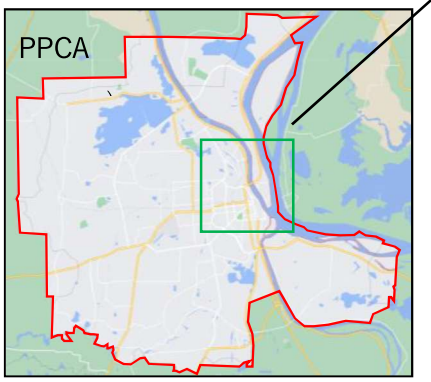
略語集

ABD	Asian Development Bank	アジア開発銀行
AI	Artificial Intelligent	人口知能
CBA	City Bus Authority	プノンペンバス公社
CBD	Central Business District	中心市街地
CCTV	Closed Circuit Television	防犯・監視用カメラ
CDC	Council for the Development of Cambodia	カンボジア開発評議会
CRC	Cambodian Red Cross	カンボジア赤十字
DPWT	Department of Public Works and Transport	公共事業運輸局
EDC	Electricite Du Cambodge	カンボジア電力公社
ID	Intelligence Design Inc.	インテリジェンス・デザイン社（民間企業）
ICT	Information and Communication Technology	情報通信技術
ITC	Institute of Technology of Cambodia	カンボジア工科大学
JCC	Joint Coordinating Committee	合同調整会議
KPI	Key System Performance Index	重要システム評価指数
M / P	Master Plan	重要業績評価指数
MCL	Mayer, Metropolitan Corporation Lahore	マスタープラン
MEF	Ministry of Economy and Finance	経済財務省
MPWT	Ministry of Public Works and Transport	公共事業運輸省
NRSC	National Road Safety Committee	国家交通安全委員会
O&M	Operation and Maintenance	運用と保守
OFC	Optical Fiber Cable	光ファイバーケーブル
OJT	On-the-Job Training	実地研修
OTDR	Optical Time-Domain Reflectometer	光パルス試験器
PDM	Project Design Matrix	プロジェクト計画概要表
PLTSO	Public Lighting and Traffic Signals Office	公共照明・交通信号室
PPCA	Phnom Penh Capital Administration	プノンペン都
PPCC	Phnom Penh Capital City	プノンペン都
PPCH	Phnom Penh Capital Hall	プノンペン都庁舎
PPTMTC	The Project for Capacity Development on Comprehensive Traffic Management Planning and Traffic Control Center Operation and Maintenance in Phnom Penh Capital City	カンボジア国プノンペンにおける 総合交通管理計画及び交通管制センター 運営維持管理の能力改善プロジェクト
PPTP	Phnom Penh Traffic Police	プノンペン交通警察
PPUTMP	Phnom Penh Urban Transport Master Plan	プノンペン都市交通マスタープラン
PPWSA	Phnom Penh Water Supply Authority	プノンペン上水道公社
PWO	Public Works Office	公共事業室
RCE	RCE Systems s.r.o.	RCE システム社（民間企業）
RSO	Road Traffic Safety Office	道路安全室
TCC	Traffic Control Center	交通管制センター
WG	Working Group	ワーキンググループ

【巻頭図】プノンペン交通管制システム
都心部の **118** 交差点位置図



出典: PPTMTC Project



写真集 1

交通管制システムハンドオーバー後に
交差点から大きく幾何構造を変更した
#126 交差点

歩道上の不法駐車の為車道を歩く歩行者

制御器を点検する TCC スタッフ

信号灯を点検する TCC スタッフ

交通管制システムの維持管理に関する
研修

交通管制システムの運用に関する研修

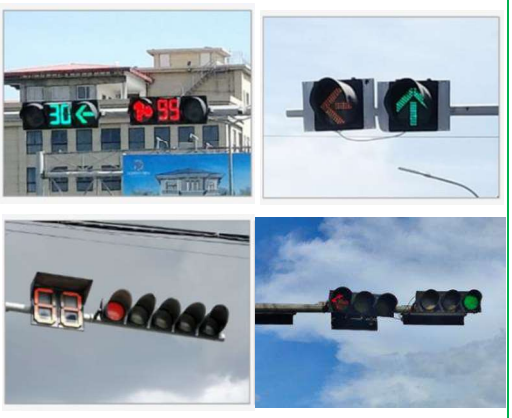
出典: PPTMTC Project Team

写真集 2

パイロットプロジェクトで道路マーキングを完了した#166 交差点

パイロットプロジェクト交通安全キャンペーン時のカンボジア赤十字学生ボランティアによる運転者へ交通安全の呼びかけ

パイロットプロジェクト交通安全キャンペーン時のプノンペン交通警察による交通取締



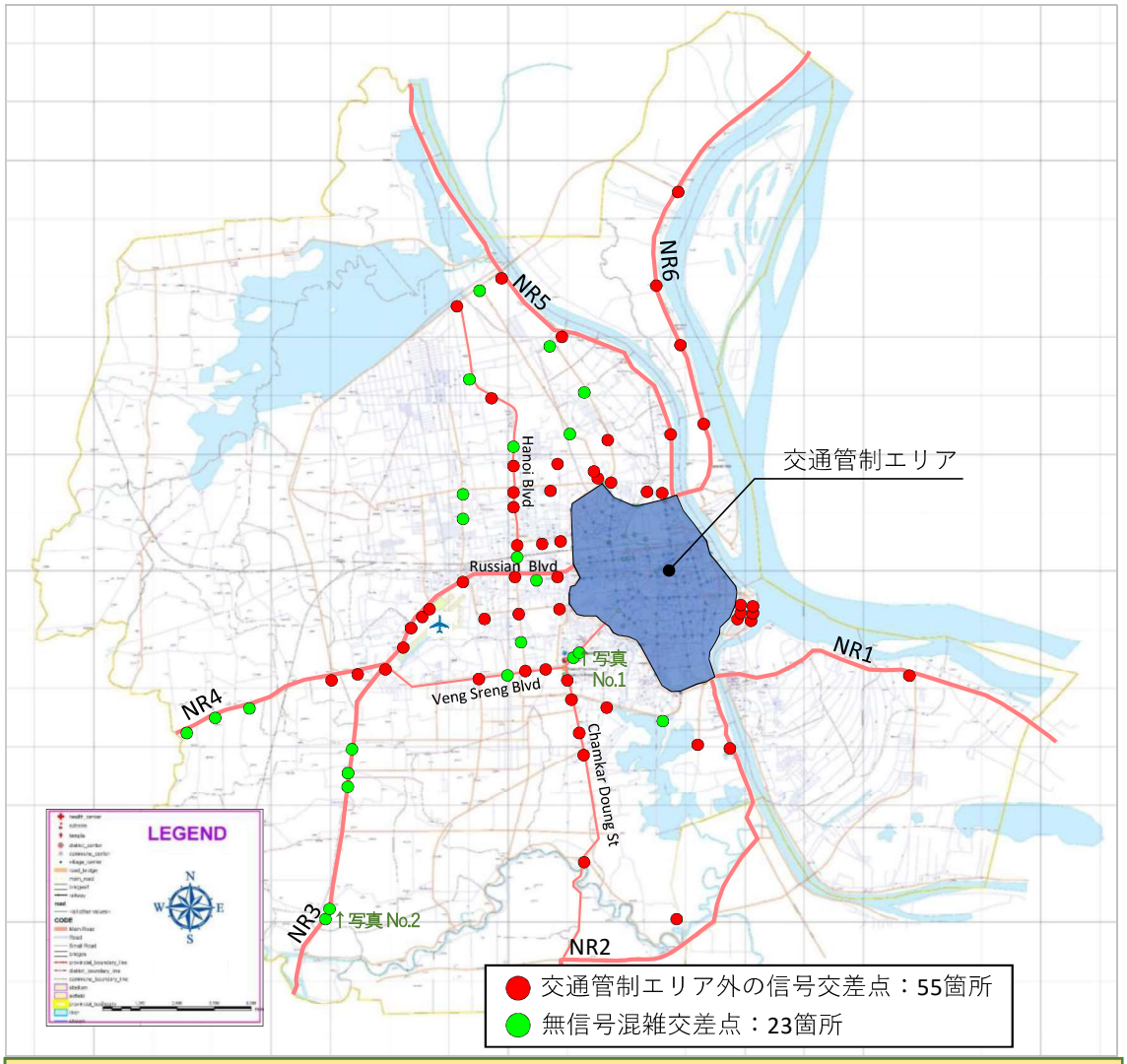
郊外部の多種多様な信号灯器（運転者は混乱する）

郊外部の幹線道路の中央分離帯開口部 U ターン交通が幹線道路の交通を妨げ交通渋滞の要因となっている

消えていることや不具合のある郊外部の道路マーキング

出典: PPTMTC Project Team

巻頭図(参考：交通管制エリア外の信号交差点位置図)



＜無信号混雑交差点 (交差点内錯綜) の例＞

写真 No.1

写真 No.2

（2021 年 9 月末時点）

出典：PPTMTC Project Team

第1章　プロジェクトの概要

1.1.　プロジェクトの背景

カンボジア国の首都プノンペン都は、人口約 228 万人（Population Census, 2019 年）を有する当国の政治経済の中心である。近年の経済発展を背景に当国の新規登録車両台数は 2010 年の約 26 万台から 2019 年は約 58 万台と 10 年弱で 2 倍以上に増加し、また、2017 年にはプノンペン都中心部主要道路の平均旅行速度は 12.2km/h と交通渋滞が深刻化している。さらに、車両台数の増加等に伴い、プノンペン都の交通事故数は 2016 年以降増加傾向にあり、2019 年までの 3 年間で約 2.0 倍に増加した。こうしたプノンペン都の深刻な交通状況に対応するため、JICA は当国政府より都市交通マスタープラン（M/P）策定の要請を受け、2035 年を目標年次（短期計画：2016 年、中期計画：2020 年）とした「プノンペン都総合交通計画プロジェクト」（2012 年～2014 年）を実施した。都市交通 M/P では、道路網の整備、公共交通の導入及び交通管理施策の強化を 3 つの主要コンポーネントとし、交通管理計画の主要施策として交通管制システムの導入が、交通状況を改善するための短期アクションプランの一つとして提案された。同提案を受け、JICA は交通管制システムの導入を目的とした無償資金協力「プノンペン交通管制システム整備計画」（2015 年 G/A 署名）を実施し、交通管制センター（TCC）の建設や信号制御機、交差点信号機等の機材を整備した。

その後、プノンペン都庁（PPCA）、公共事業運輸局（DPWT）および TCC はこれらの施設・資機材の有効活用に努めてきており、今後も交通量増大が予測される中、整備された交通管制システム等を持続的かつ有効活用を更に促進させるとともに、交通管制システムがプノンペン都の交通管理機能を的確に果たすようプノンペン都交通警察（PPTP）とも協力し、交通取締り等の交通安全対策の向上などが合わせて求められている。今般、プノンペン都等の関係機関職員を対象とした無償資金協力により整備された交通管制システムの運用及び維持管理に関する能力向上、並びにプノンペン都内の総合交通管理対策を目的した技術協力プロジェクトに関して我が国に協力要請があった。

また、2023 年 8 月にカンボジアの新首相フン・マネット氏が「五角形戦略」を発表した。これは 5 段階で実施される 25 年間の社会経済戦略であり、「五角形戦略」の 5 つの主要戦略は、人材、道路、水力、電力の建設と開発を強化することである。さらに、「五角形戦略」の第 1 段階（2023 年から 2028 年まで）では、カンボジアが将来追求すべき具体的な目標が示されており、政府の制度的能力の強化、経済社会の発展に適した環境の創出、人材の育成、経済の多様化と競争力の向上、民間企業の成長と雇用の創出、適応型で持続可能かつ包括的な開発の促進、デジタル経済社会の構築などが含まれている。「道路」は、「五角形戦略」の 5 つの主要戦略の 1 つであり、将来目標として「社会経済の発展につながる環境の創出」と定義されている。したがって、カンボジア国プノンペンにおける総合交通管理計画及び交通管制センター運営維持管理の能力改善プロジェクト（PPTMTC）は、首都であるプノンペンの都市交通を強化し、カンボジアの社会経済発展の促進をサポートすることから、カンボジアの国家開発政策と一致している。

また、2024 年 4 月の外務省による対カンボジア国別援助方針の基本方針では、カンボジアが 2030 年に高中所得国入りするという目標の達成に向け、産業育成を支援するとともに、国際社会の複雑かつ多様な課題に対処し､持続可能で自立的な成長と活力ある社会の実現を支援することとされている。また、重点 3 分野のうち「(1) 経済成長をもたらす産業構造転換・発展」では、産業育成や投資促進のためのインフラ整備のため、物流（道路、港湾等）の円滑化による連結性強化、「(2) 持続可能で公正な成長の実現」では、人々の生活の質の更なる向上のため、都市交通や ICT（情報通信技術）を活用した都市経営など、都市生活環境の整備に資する分野への支援を行うこととされており、PPTMTC プロジェクトは日本の援助政策と高い整合性を有している。

1.2. プロジェクトの概要

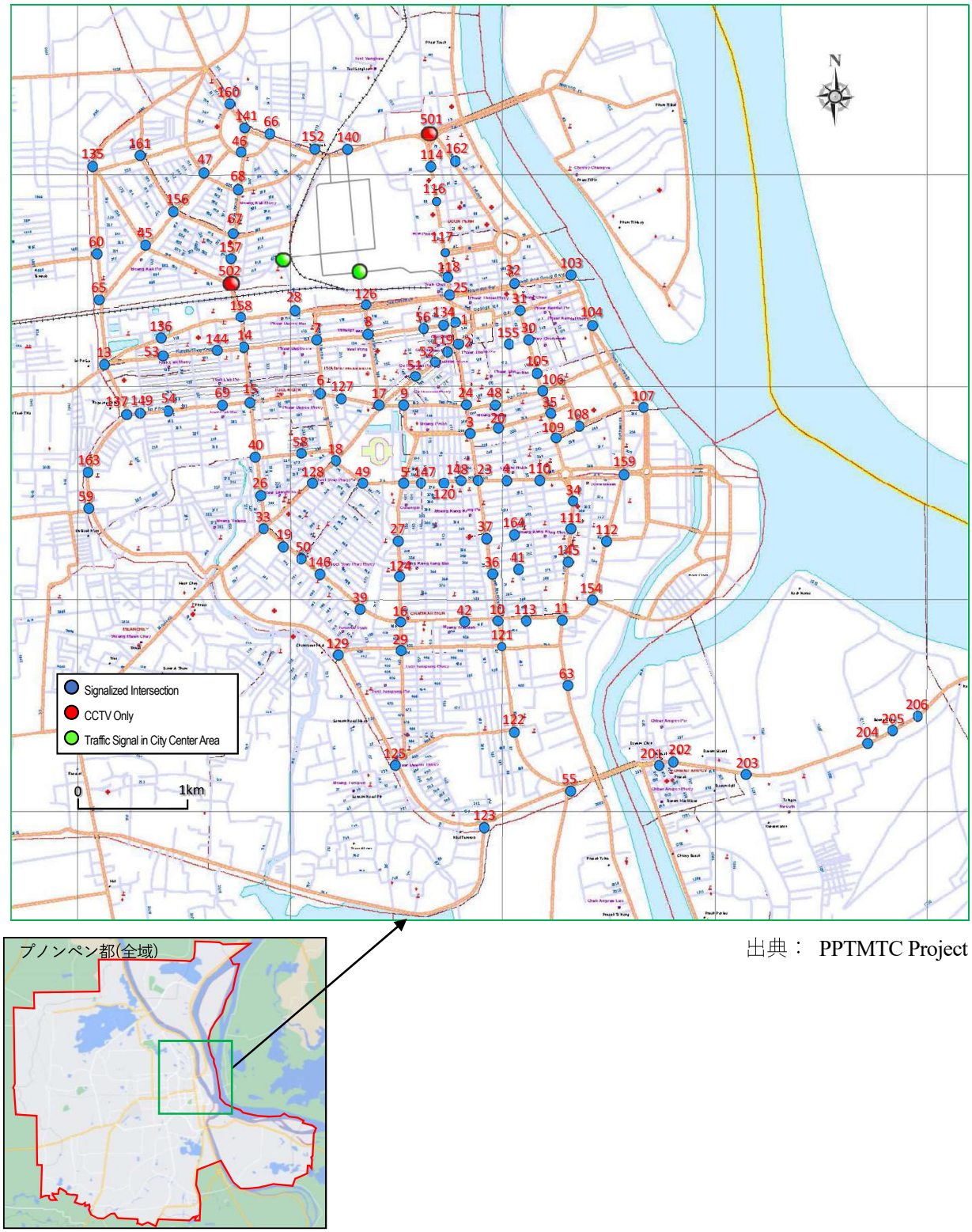
PPTMTC プロジェクトの概要を以下に示す。

プロジェクト名		プノンペンにおける総合交通管理計画及び交通管制センター運営維持管理の能力改善プロジェクト
対象地域		プノンペン都
関係官庁・機関		実施機関：PPCA、DPWT、TCC
上位目標		持続可能な都市交通環境が形成される
プロジェクト目標		プノンペン都における交通管理対策(交通安全対策を含む)が改善される
期待される成果		成果１　交通管制システムの保守管理体制が確立される 成果２　交通管制システムの運用に関する TCC 職員の能力が向上する 成果３　信号機改良のパイロット事業実施を通じた信号設計の実施能力が向上する。 成果４　プノンペン都（PPCA,DPWT,TCC を含む）職員の交通管制システム拡充計画策定能力が向上する 成果５　プロジェクト効果持続化のための都市交通関連機関の交通管理対策の能力が向上する
活動の概要	成果１	活動 1-1　TCC の現在の組織と管理体制をレビューする。 活動 1-2　交通管制システムの運用の開始以降に発生した運用・保守管理上の問題を特定し、改善策を策定する。 活動 1-3　既存のシステム運用マニュアル、保守管理マニュアル、その他のマニュアルをプノンペンの状況に適するように見直す。 活動 1-4　保守管理組織（外部委託の可能性を含む）を調査し、適切な保守管理体制を提案する。
	成果２	活動 2-1　画像解析、速度測定などに必要な、交通管理システムからデータ抽出に必要とされる追加の機材およびソフトウェアを検討する。 活動 2-2　交通管理に関する必要な工学的知識等を理解・習得する研修を実施する。 活動 2-3　交通管制のシステムの仕組みの理解や、運用、修正、アップグレード手順に関する研修を実施する。 活動 2-4　光ファイバーケーブルの修繕を含み全般的な保守維持管理作業に関する研修を実施する。 活動 2-5　TCC からのデータや情報を使用し、渋滞や事故が頻繁に発生した対象交差点や道路区間におけるデータ・情報を収集し、課題の分析を行う。
	成果３	活動 3-1　交通需要パターンの変更により、信号表示の順番、また表示時間等の修正を必要とする信号機を特定する。 活動 3-2　対象交差点に関連する交通データを収集し分析する。 活動 3-3　信号設計ソフトウェアを含む交通管制システムの設計修正を行う。

		活動 3-4　信号改良に必要なツールおよび／または機材を検討し、調達を行う。 活動 3-5　信号設計の修正に対する影響を評価する。 活動 3-6　信号改良に関する計画から実施評価までの手順等をハンドブックにまとめる。
	成果４	活動 4-1　プノンペンの都 市化動向、主要交差点の交通状況、交通管制システムの特性を考慮し、交通管制システム拡張エリアを検討する 。 活動 4-2　交通管制システムの拡充計画を策定する。
	成果 5	活動 5-1　プノンペンの交通管理システムを補完する、交通法規遵守等のためのツール・機材を検討する。 活動 5-2　PPTP の過去の交通取締り実績や課題をレビューし、交通取締りに関する実地研修を実施する。 活動 5-3　交通取締り、交通安全ハンドブックを作成する。 活動 5-4　マスメディアおよびワークショップ／セミナーを通して本プロジェクトの成果／活動を国民に広める。

1.3. プロジェクトの対象地域

プロジェクト対象地域はプノンペン都全域である。現時点では都心部が交通管制エリアとなっている。



出典： PPTMTC Project

図 1.3-1 プロジェクト対象地域

1.4. プロジェクト実施体制

PPTMTC プロジェクト実施体制を以下に示す。

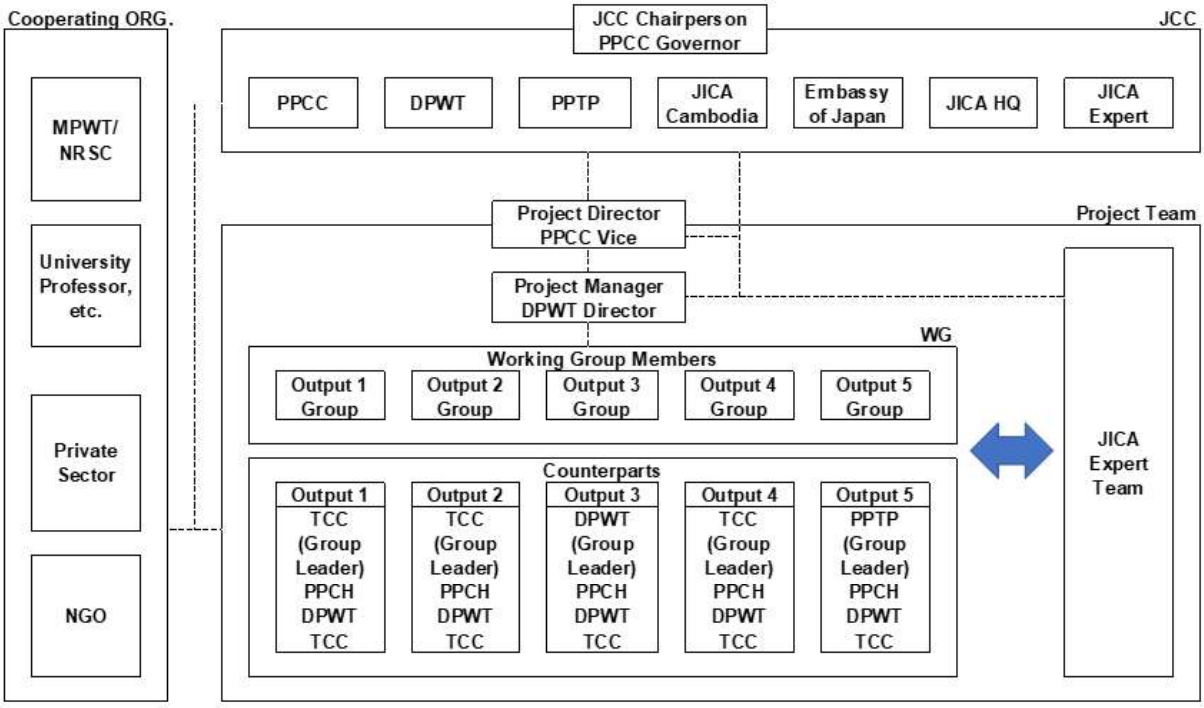


図 1.4-1 プロジェクト実施体制

第2章　プロジェクトの活動実績

2.1.　プロジェクト全体に関わる活動成果

プロジェクト全体に関わる活動成果については、プロジェクト計画概要表（PDM）(Annex 1 参照)の最終版にまとめたとおりその目標、目的を概ね達成できた。

(1)　上位目標：交通管制システムの効果的な運用を通じ、持続可能な都市交通環境が形成される

上位目標達成の指標は、① 交通環境改善の目安として市内の旅行速度が向上し、② 都民の交通状況改善がプロジェクト終了後に実感されることである。2024 年 12 月の時点で二つの指標は以下のとおりである。上位目標達成の見込みは 2 つの指標から難しいかもしれないが、プノンペン都民は PPCA や DPWT の都市交通環境改善への努力を好意的にみているよう伺える。

① プロジェクトの 2023 年と 2024 年の交通量を比較すると約２％の伸びがみられた。一方、旅行速度の変化を交通調査結果からみると 13.3 ㎞/時と 13.2km･時とほとんど変化は無かった。

② PPTMTC セミナーの参加者(約 170 名)に 2023 年と 2024 年の交通状況の変化をインタビューした。回答者(約 120 名)の 69%が「交通状況は改善した」と回答した。その理由は、「交通量は増加したが、プノンペン都のハード(信号設置や道路改良)ソフト(交通安全教育が進んだ)の対策が功を奏し交通状況が改善した」との答えが最も多かった。

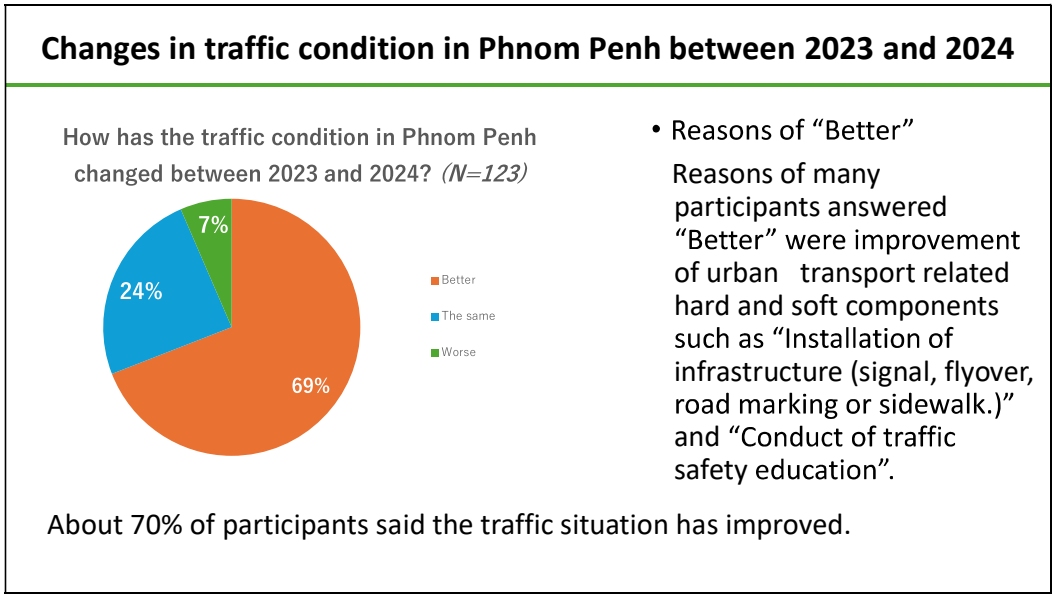


図 2.1-1　2024 年 8 月開催の PPTMTC セミナーの参加者のコメント

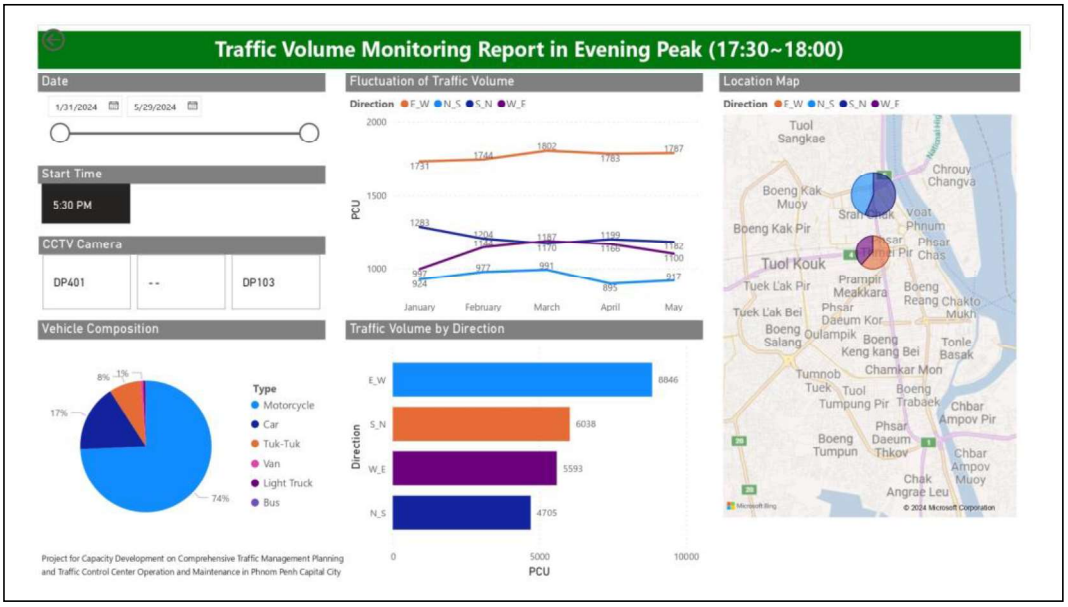
(2) プロジェクト目標：交通管制システムの運用、維持管理能力向上を通じ、プノンペン都における交通管理対策（交通安全対策を含む）が改善される

プロジェクト目標達成の指標は、① 交通管制システムの信頼性（稼働率）が上がり、② 常に交通状況が把握でき、③ 交通違反者が減少して、交通渋滞や交通安全への意識が向上することにある。

① プノンペンの交通管制システム全体の稼働率は、TCC スタッフの研修後の保守管理技術の向上により 83.2%から 94.4%へと 13.4%の増加がみられた。この数値はその後もほぼ同じレベルで推移している。

② AI を利用した CCTV（防犯・監視用カメラ）ビデオイメージを数量化できる DataFromSky サービスを利用して、常時定点観測が可能になり交通状況分析に利用している(図 2.1-2 参照)。

③ 3Es（Engineering, Education and Enforcement）を導入したパイロットプロジェクト前後の交差点における交通違反者の数は、事前の 1,592 人から 1,256 人と 21.1%減少した。



(注) モニボン通り（フランス大使館前）とロシア通り（ベカセ交差点）の夕方の交通量（pcu/30min.）

図 2.1-2　CCTV イメージをもとに AT を使ったデータ解析（DataFromSky）による定点観測

2.2.　成果 1 に係る活動

成果 1 は「交通管制システムの保守管理体制が確立される」である。成果 2 の信号管制システム全般にわたる研修や、成果 3 で実施したパイロットプロジェクトに積極的に参加して TCC の保守管理対処能力は大いに向上した。

具体的には、現在の TCC の組織のもとで 2022 年に実施した保守管理、運用、交差点改良、通信及び交通管理の研修（成果 2 の活動 2-1）を受けて、日々の TCC の保守管理活動を数値化・フォーマット化して分析して、TCC スタッフ自らが保守管理活動に活かせるようになった。各活動の内容は以下のとおりである。

2.2.1　活動 1-1：TCC の現在の組織と管理体制をレビュー

専門家チームはプノンペン都（PPCA）/　公共事業運輸局（DPWT）/　交通管制センターTCC へのヒアリングにより、交通管制にかかる組織及び体制や管理方法について把握し、プロジェクト開始時の組織図を作成し第２回合同調整会議（JCC）で承認された。

ただ、プノンペンの交通管制システムの拡張計画立案時には TCC の中央管制システムと結ばれている都心 118 信号交差点のみならず、郊外部のスタンドアロン交差点の中央システム統合も視野に入れなければならないので公共照明・交通信号課との統合は不可欠である（図 2.2-2 参照）。そこで、統合のための課題を議論しあう会議を月に一回位の頻度で開催し、早い段階から両組織のコミュニケーションを取っていく必要がある。

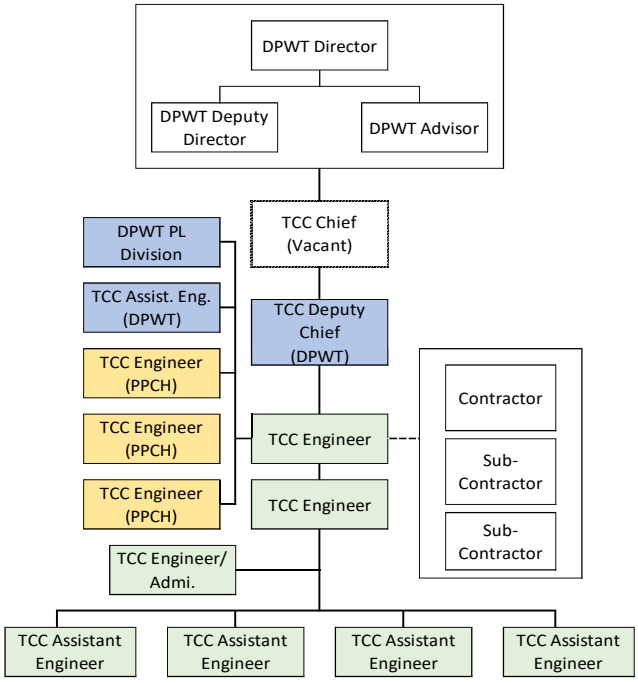


図 2.2-1　TCC の PPTMTC スタート時の組織図

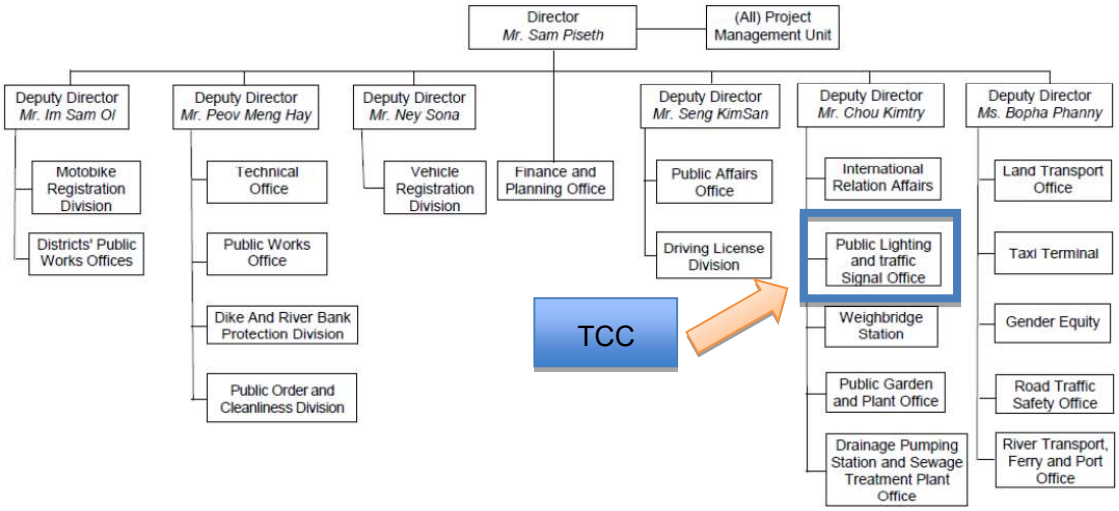


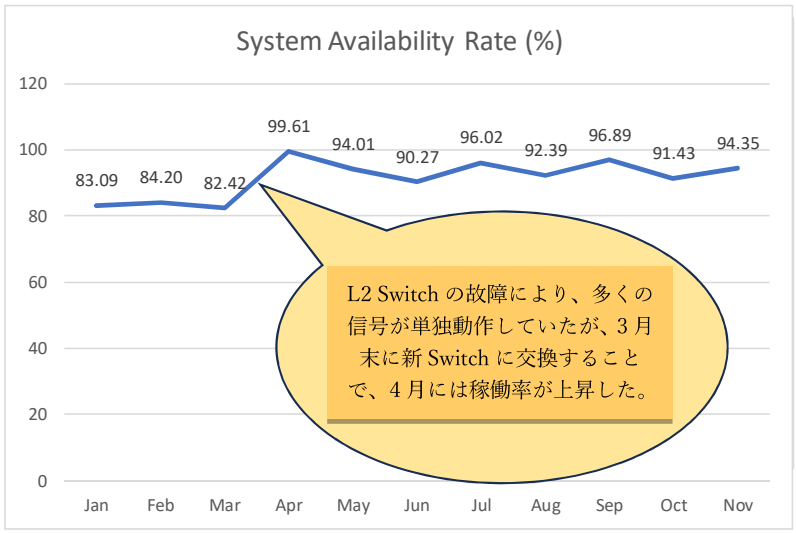
図 2.2-2　Public Lighting and Traffic Signal Office への TCC 統合

2.2.2　活動 1-2：交通管制システムの運用開始後に発生した運用・保守管理上の問題特定と改善策を策定

交通管制システム運用開始後の問題発生リストを毎年更新（Annex 2 参照）している。2023 年は、このリストに基づき必要なスペアパーツ確定し、作成した 2023 年度予算案を経済財務省（MEF）に提出し承認された。また、活動 2 の研修では保守点検作業を実地研修（OJT）で実施した。これを受け、定期点検の必要性を理解し交通管制システム運用開始後に発生した機器の不具合を現場にて確認、不具合機器リストを作成した。

また、2022 年の運用・保守管理や通信システムの研修を踏まえ、上述のように新たにプノンペン交通管制システムの重要業績評価指数（KPI、ここでは、信号の稼働率、図 2.2-3 参照）や Spare Parts Inventory（部品在庫管理）のフォーマット化を実践した。これに基づきシステムの事故の種類や頻度の把握が可能になり、また TCC の保守管理に必要なスペアパーツ購入時の予算の明確化や迅速化が達成された。

Month	SAR(%)	Ave. (%)
Jan	83.09	**83.24**
Feb	84.20	
Mar	82.42	
Apr	99.61	**94.37**
May	94.01	
Jun	90.27	
Jul	96.02	
Aug	92.39	
Sep	96.89	
Oct	91.43	
Nov	94.35	
Total	1,004.68	
Average	91.33	



L2Switchの故障により、多くの信号が単独動作していたが、3月末に新Switchに交換することで、4月には稼働率が上昇した。

図 2.2-3　プノンペン交通管制システムの稼働率（KPI：信号の稼働率）

2.2.3　活動 1-3：既存のシステム運用マニュアル、保守管理マニュアル、その他のマニュアルをプノンペンの状況に適するように見直す

約 3,900 ページに及ぶ既存のシステム運用マニュアルについてその構成を 61 項目に分類整理した。これを基本に、活動 2 における保守管理研修の結果もあわせて、現場で使いやすい保守管理マニュアルに取り纏めた。（技術作成資料 Book 1：保守管理マニュアル参照）

2.2.4　活動 1-4：保守管理組織（外部委託の可能性を含む）を調査し、適切な保守管理体制を提案

2024 年現在、8 名の TCC 専任スタッフは、28km^2 のプノンペン中心部の 118 信号交差点を対象に保守管理を行っている。一方、郊外部では DPWT の公共照明・交通信号課の 14 名がスタンドアロンの

68 信号交差点を保守管理している。

当面の課題としては、2024 年 1 月 25 日に行われた交通信号設置調整会議で提案されたプノンペン全体で 268 信号交差点をどのように保守管理していくかである。

これには、他国の先進事例（日本の都道府県の保守管理体制の事例やフィリピン、マニラ首都圏の交通信号の保守管理体制の事例）を参考に今後も DPWT が中心となって検討を進めていくことになる。

2.3. 成果 2 に係る活動

成果 2 は「交通管制システムの運用に関する TCC 職員の能力が向上する」ことである。

信号パラメータ検討の最も重要な要素である交通量の把握のために、交通量の定期的な定点観測は不可欠である。複雑な車種構成となっているプノンペンの交通解析データ取得のために、プロジェクトスタート時から画像解析 AI を用いた自動トラカンの精度実証を行っている。2023 年はプノンペンの交通特性把握に有効と思われる新たな自動トラカンサービス DataFromSky について精度検証を実施した。その結果は図 2.3 に示したとおりである。

一方、PPTMTC プロジェクトの肝でもある JICA 及び住電技術者による交通管制システム全般にわたる研修が行われた。詳細は以下活動 2-2 のとおりであるが、研修前後の TCC スタッフの技術評価は事前の 21.0 点に対して事後は 57.2 点となり、目標としていた 55.0 点をクリアすることができた。

2.3.1 活動 2-1：画像解析、速度測定などに必要な、交通管理システムからデータ抽出に必要とされる追加の機材およびソフトウェアを検討

CCTV 映像と画像解析 AI を用いた自動トラカンの実証実験を行った。これは、将来的に TCC が交通量のモニタリング機能を有し､交通管制システム運用に活用することを想定している｡実証実験は、インテリジェンス・デザイン社(Intelligence Design Inc.（日本、以下 ID）)及び RCE システム社（RCE systems s.r.o（チェコ共和国、以下 RCE）） の 2 社のサービスを比較して実施した。

プロジェクトスタートの 2022 年時点では Remork（ツクツク）、Tricycle（三輪車）など現地特有の車種に標準対応した自動トラカンサービスがなかったため、現地特有の車種に対応させる追加学習および精度検証を実施した。

その後の継続的な情報収集により、RCE が Tricycle を標準車種として検出可能な画像解析 AI による自動トラカンサービス DataFromSky を提供しているという情報を新たに入手したため（2022 年 12 月）、このサービスについても精度検証を実施し単路部であれば、交通量の精度が手動でカウントした数値の 80%～90%であったため、DataFromSky のサービスを利用することとした。ただし、データ収取は交通動線が単純な単路部のみとなる。4 枝交差点の場合、最大 12 方向となる交差点交通量は現在のところまだ不可能である。

なお、パイロット事業における交通調査への適用は困難と判断し、パイロットプロジェクトにおける交通調査は当面はビデオ画像をマニュアルカウントする手法とすることで DPWT から承認を得た。（Annex 6 参照）

2.3.2 活動 2-2：交通管理に関する必要な工学的知識等を理解・習得する研修を実施

2022 年 8 月 24 日から 2022 年 9 月 23 日までの約 1 ヶ月間に渡って、1)メンテナンス研修、2)運用（実用）研修、3)交通信号制御の基礎研修、4)通信システム研修、5)交通管理研修の 5 セッションの研修が実施された。（ANNEX 5 参照）このうち、交通管理に関しては、9 月 21 日、22 日、23 日の 3 日間に渡り実施された実施された、講義の内容については、交通管理に関するポリシーペーパー（ディスカッションとプレゼンテーション）、駐車管理、公共交通優先施策、パイロット交通管理スキームの計画（ディスカッションとプレゼンテーション）が実施され、受講生の高い業務への還元意欲が示された。

2.3.3 活動 2-3：交通管制のシステムの仕組みの理解や、運用、修正、アップグレード手順に関する研修を実施

運用(実用)研修は、2022 年 8 月 29 日から 9 月 5 日のうち、6 日間に渡り実施された。基本的な作業手順、固定秒に関するパラメータの配置、交差点の設計方法、サイクル/スプリットにかかるパラメータの配置（講義・操作・サイト調査）、ギャップアクチュエーションにかかるパラメータの配置（講義・操作・サイト調査）、オフセットにかかるパラメータの配置（講義・操作・サイト調査）について実施された。講師を務めた住友電気工業は当初、TCC メンバーの中でも知識レベルが突出して高い、中核スタッフ一人に教え、他のメンバーには彼から共有してもらうという方法を予定していたが、中核スタッフ自身のたっての希望から TCC 内で研修が行われており、他の参加者にもシステムの設定方法を実践させたり、例題に回答させたりしたことで参加者全員の理解が深まった。

また、交通信号制御の基礎研修は、2022 年 9 月 7 日、8 日、9 日の 3 日間に渡り実施された。交通工学・信号制御基礎、交通信号制御計画、交通信号制御演習の内容で実施された。本研修では活発に質問応答が行われ、全ての研修内容を理解しよう試みる参加者の意欲的な様子が確認できた。（ANNEX 5 参照）

2.3.4 活動 2-4：光ファイバーケーブルの修繕を含み、全般的な保守維持管理作業に関する研修を実施

メンテナンスに関する研修は、2022 年 8 月 24 日、25 日、26 日の 3 日間に渡り実施された。諸外国における交通信号システムの保守管理、プノンペンにおける保守管理、予防保全の原則とプロセス、修繕の減速とプロセス、メンテナンス中の安全、予防保全検査のチェックリスト、レポートと在庫管理について座学および実地演習が実施され、受講生の理解度も高かった。（ANNEX 5 参照）

また、通信システムに関する研修は、2022 年 9 月 14 日、15 日の 2 日間に渡り実施された。通信システムの導入、ネットワークの基礎、保守全活動の基礎についての講義が行われ、研修後の評価でも受講生にほぼ理解されたことが確認された。

2.3.5 活動 2-5：TCC からのデータや情報を使用し、渋滞や事故が頻繁に発生した対象交差点や道路区間におけるデータ・情報を収集し、課題を分析

グーグルマップから混雑リンクデータを収集し、混雑が集中している交差点を抽出したのが下図で

ある。MPWT 国家交通安全委員会（NRSC）（公共事業運輸省（MPWT）傘下の国家道路安全委員会）の交通事故多発地点データなどの分析も含め、成果３で説明するパイロットプロジェクトの候補交差点ロングリストに反映した。

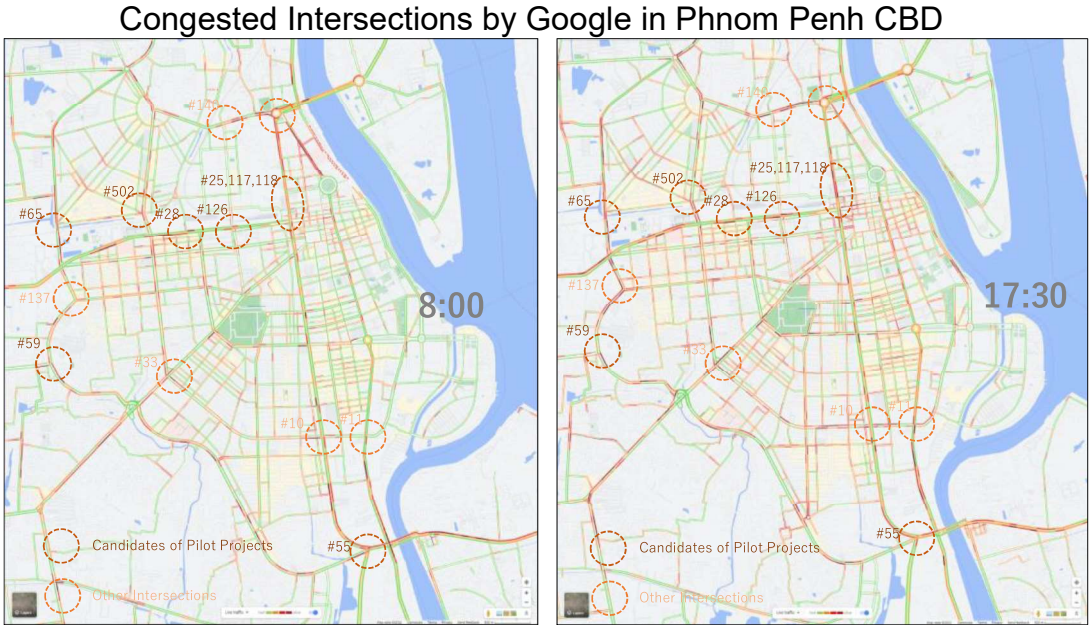


図 2.3-1　グーグル混雑データによる課題交差点の抽出例

2.4.　成果３に係る活動

成果 3 は「信号機改良のパイロットプロジェクトを通じた信号設計の実施能力が向上」することである。ここでは、3Es（Engineering, Education and Enforcement）を考慮したパイロットプロジェクトの計画、機器調達、信号等の設置工事、交通安全キャンペーン及び評価を行った。計画スタートから評価まで約 1 年を要した。

表 2.4-1 パイロットプロジェクトの実施スケジュール

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)								
3-1 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　活動 3-1：交通需要パターンの変更により、信号表示の順番、また表示時間等の修正を必要とする信号機を特定

プロジェクトスタート時のワークプランの提案や活動 2-5 で検討した各種交通データに基づき作成したパイロットプロジェクト・ロングリストから、交差点等の特徴/問題課題を抽出し、TCC スタッフの能力向上に寄与する（新設交差点、市街地縁辺の交差点など色々なタイプの交差点実習ができること）ことに重点を置きパイロットプロジェクト・ショートリストが作成された。これが図 2.4-2 のパイロットプロジェクト対象交差点であり、第 2 回 JCC で承認された。

2.4.2　活動 3-2：対象交差点に関連する交通データを収集し分析

パイロットプロジェクト対象交差点について修正設計や評価のために必要なデータ内容、範囲、時間帯、データ収集・分析方法等、交通調査について検討を進め 2023 年 3 月に指名競争入札により交通調査実施業者を確定した。交通調査の実施はパイロットプロジェクトを評価するため前後の平日とし、事前調査は 2023 年 3 月～4 月に、事後調査は 202 4 年 4 月にそれぞれ行った。また、PPTMTC 全体の事後調査としては 2024 年 10 月に実施した。以上 3 つの調査の概要は Annex 6：Transport Survey and Data for TCC（Pre- and Post-Pilot Project, and Post PPTMTC Project）にまとめた。

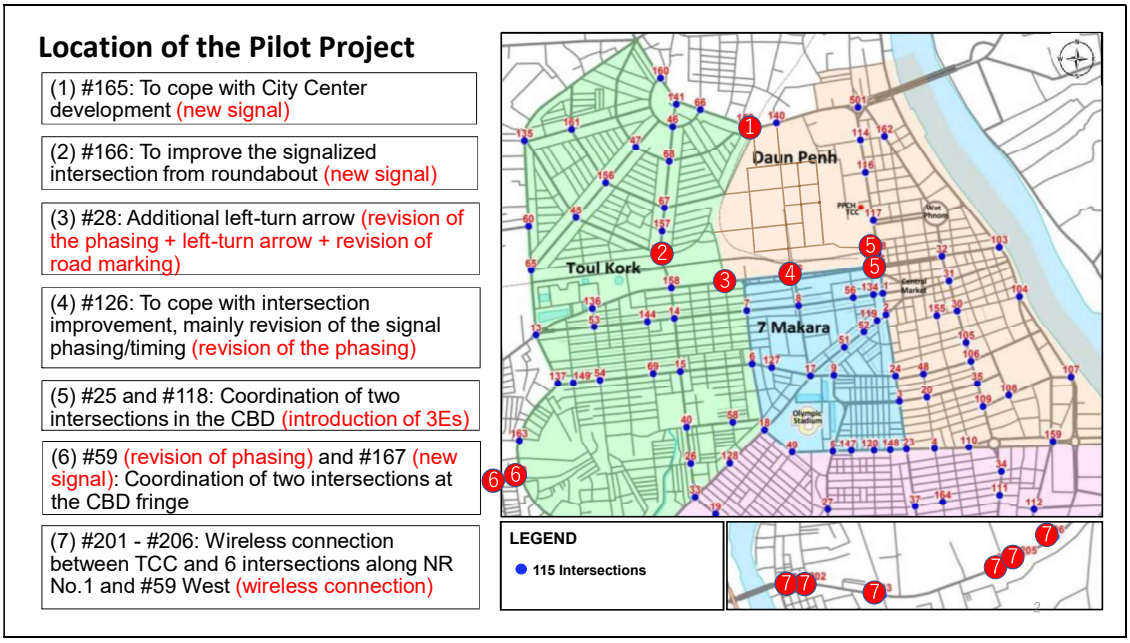


図 2.4-2　パイロットプロジェクト対象交差点

2.4.3　活動 3-3：信号設計ソフトウェアを含む交通管制システムの設計修正を行う

選定されたパイロットプロジェクト対象交差点に対して、各交差点の特徴、交通調査結果等を踏まえ、対象 8 交差点のうち、6 交差点に対して信号パラメータの算定を行った。同時に、信号現示に対応した交差点の幾何構造や道路マーキングの検討を行い、関係する DPWT 技術者や交通警察関係者と議論を重ね信号設計と交差点幾何構造等の設計を行った。

なお、信号パラメータ計算を行わなかった 2 交差点は、#25-#118（ベカセ交差点：主に交通安全・

交通取締の観点でパイロットプロジェクトを実施）と#201-#206（1 号線沿道のスタンドアロン 6 交差点で、無線連絡のパイロットプロジェクトを実施）である。

2.4.4 活動 3-4：信号改良に必要なツールおよび／または機材を検討し、調達を行う

a) 機材等の調達

パイロットプロジェクトで実施される信号改良交差点のツールや機材の中心である信号制御機（住電製）や信号灯器（小糸製）は無償プロジェクト時では日本製が採用された。

今回の技プロでは、競争の平等性や将来カンボジア側自らが予算を確保して新たな信号交差点を計画・設置する時に、調達のしやすさやスピード、廉価で調達できる必要があるため、制御機以外は極力近隣諸国で調達できるよう調整した。また、プノンペンの交通に対応できる質の確保も重要なファクターとなった。結果として、信号柱はベトナム製、信号灯器はタイ製、制御機は日本製を採用することとなった。

一方、信号取付工事や無線連絡工事は一部の技術者の派遣や信号現示ソフトウェアを除き、全て現地の会社へ発注した。パイロットプロジェクトに関連する調達や再委託は以下のとおりである。

表 2.4-2 パイロットプロジェクトの再委託

Type 1	パラメータ設計と技師 PP 出張	住電：随意契約／2023 年 6 月
Type 2	TCC と NR No.1 の 6 交差点を無線連絡	住電：随意契約／2023 年 9 月
Type 3	日本製信号制御器の調達	住電：随意契約／2023 年 8 月
Type4	信号灯器調達含む信号設置工事等	ノラック：指名競争入札信号灯器調達 無線接工事の現地作業分含む／2023 年 8 月

b) 信号据付工事

2023 年 9 月 24 日に信号柱、灯器の調達等を含む信号据付工事を Norak と契約。当初、工事期間 2023 年 10 月~2024 年 2 月一杯（制御機の完成時期が 2024 年 1 月末）を予定。

2023 年 10 月 2 日に工事関連組織（カンボジア電力公社（EDC）や プノンペン上水道公社（PPWSA）など）への工事説明会を実施。プノンペン知事の工事許可レター取得が若干遅れたのとプチュンバン（日本のお盆：10/12～10/16）があったため工事は、2023 年 10 月 17 日より開始した。信号灯器や制御機の調達に時間を要するため、主に配線工事や集水桝設置を含む基礎工事を開始させた。

全工事の完了は、信号機材の半導体を含む機器調達の遅れもあり、2024 年 3 月前半までずれ込んだ。

c) 無線連絡工事

住電と Forval（Norak の協力会社）が担当した。住電は全体の調整・管理と TCC 側へ#201 - #206 の情報をセットする作業を実施した。Forval は無線連絡と道路側の機器設置を行った。

2023 年 12 月に Forval 分の道路側の機器の設置が完了した。2024 年 1 月前半には住電の TCC 側への情報セットと無線接続の確認作業も完了した。(技術作成資料 Book2：ハンドブック参照)

2.4.5 活動 3-5：信号設計の修正に対する影響を評価する

パイロットプロジェクトで実施した交差点改良計画を評価するために事前(2023 年 4 月)・事後(2024 年 4 月）の交通調査を行った。評価項目は交通量、旅行速度、渋滞長、交通違反者数の 4 項目である。

2023 年と 2024 年のプノンペン都心の交通量の伸びは約 2%であったが、2 年間の旅行速度はいずれも約 13 ㎞/時で変化が無かった。これは、交通量の伸びをハード（信号改良や道路改良）・ソフト（交通安全教育の実施）対策で道路環境が改善され旅行速度を保つことができたと考えられる。

渋滞長や交通違反者数は 15%～20%減少し、信号交差点の改良計画はプノンペンの都市交通環境改善に寄与したと想定される。（Annex 6 参照）

2.4.6 活動 3-6：信号改良に関する計画から実施評価までの手順をハンドブックに纏める

信号交差点の改良に関するパイロットプロジェクトの計画から実施・評価までの手順をハンドブックにまとめた。作成の趣旨は、TCC スタッフが今後信号交差点の新設・改良時に使えるようなものとした。JICA 専門家が共同で仕上げたものではあるが、大きな役割分担は、パイロットプロジェクトの計画段階と評価は両者の協働、実施については主に TCC スタッフが主導して作り上げた。(術作成資料 Book 2 参照)

2.5. 成果４に係る活動

成果 4 は、「プノンペン都職員の交通管制システム拡充計画策定能力が向上する」である。2018 年末に完成したプノンペンの交通管理システムは、プノンペン都心の交通環境改善に大きく寄与してきた。プノンペン都の郊外部の市街化も進んでいることから、それに対応する交通管制システム拡張計画の役割も大きい。

2.5.1 活動 4-1：プノンペンの都市化動向、主要交差点の交通状況、交通管制システムの特性を考慮し、交通管制システムの拡充計画を策定

プノンペンの都市化動向について文献調査及び現地踏査を実施し都市開発を含む市街化動向と道路交通状況を把握した。また、関係者との面談によりプノンペン都の主要交通インフラ整備について情報収集を行い整理した。

2.5.2 活動 4-2：交通管制システムの拡充計画を策定

交通管制システムの拡充計画は、市街化が急で市街化の状況、道路ネットワークが都心部とは異なる郊外部を中心として検討された。

2024 年 1 月 25 日に開催された PPTMTC 交通管制システム拡張計画調整会議では、PPTMTC 専門家と TCC スタッフがまとめたプノンペン都の新たな信号交差点計画案を関係者（PPCA、DPWT、警察、地区（カーン）代表）と意見交換し、下図の拡張計画対象交差点が承認された。

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**	

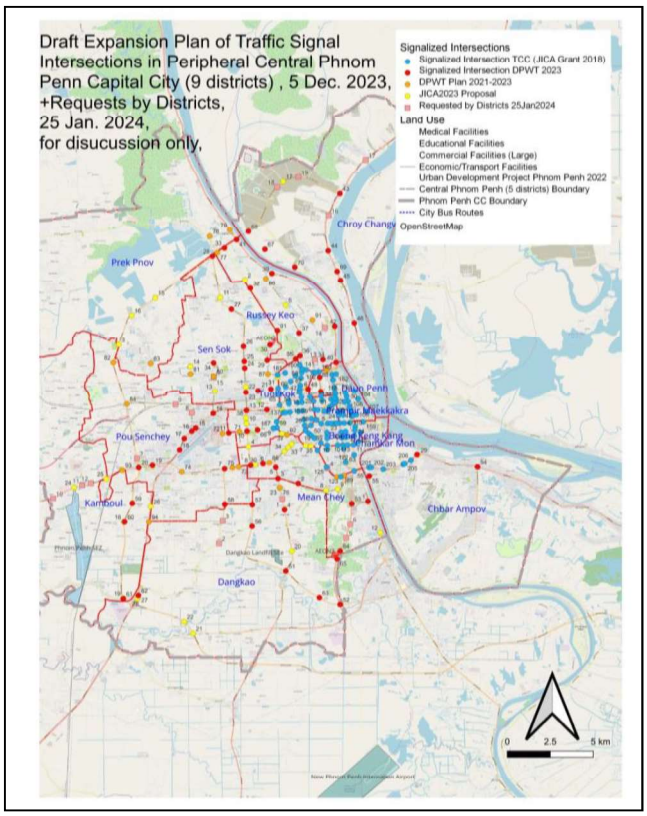


図 2.5-1　交通管制システム対象交差点図（2024 年 1 月 31 日現在）

この拡張計画の対象信号交差点に基づき、交通管制システム、通信システム、交差点改良計画、保守管理体制などについて TCC スタッフと議論しながら策定した。(技術作成資料 Book 3：交通管制システム拡充計画参照)

2.6.　成果５に係る活動

2.6.1　活動 5-1：プノンペンの交通管理システムを補完する、交通法規遵守等のためのツール・機材を検討

交通管制システムのみならず、プノンペンが直面している都市交通管理分野の課題、特に駐車対策や公共交通の活性化のために、プノンペンの交通管理対策を担当・連携する都市交通関連機関（MPWT、DPWT、交通警察や大学）との面談等をとおして意見交換や情報収集を行った。意見交換時などに PPTMTC 都市交通管理計画専門家が用意した資料等は Parking Management や City Bus Authority (CBA) Update などである。

一方、交通法規順守等のためのツール・機材については、プノンペン警察と内容の打合せを行った。その結果、ツール・機材も重要であるが、日本の交通取締に対する取り組みの歴史や内容を共有して

プノンペン警察の取締りに役立てたいとの要望があった。そこで、元警視庁交通規制課長経験者の交通取締講師による日本の交通取締の経験をプノンペン交通警察と国家交通警察へ講義と、パイロットプロジェクトの交通安全キャンペーン時に現場での交通取締演習を実施した。これらの内容は、後述の活動 5-3 で述べる交通取締・交通安全教育マニュアルとしてまとめた。（技術作成資料 Book 4：交通管制システム拡充計画参照）

2.6.2 活動 5-2：PPTP の過去の交通取締り実績や課題をレビューし、交通取締りに関する実地研修を実施

パイロットプロジェクトの信号制御パラメータや交差点幾何構造の変更後（3Es の E1 : Engineering）道路利用者のへ交通安全教育（E2 : Education）や交通取締（E3 : Enforcement）を取り入れた交通安全キャンペーンを 2024 年 3 月に実施した。このうち交通取締（E3）では、講師に警視庁交通規制課長を歴任した元交通警察官を招き実地研修を行った。

2.6.3 活動 5-3：交通取締り、交通安全教育マニュアルを作成

交通取締マニュアルの対象者はプノンペン交通警察の交通警察官で、内容は元警視庁交通規制課長経験者の交通取締講師による日本の交通取締の経験と内容をプノンペン交通警察と国家交通警察へ講義と、パイロットプロジェクト取締時に現場での交通取締講師による交通取締演習を実施した。これらを纏めたのが交通取締マニュアルである。

交通安全教育マニュアルの対象者は、プノンペン交通警察と DPWT 交通安全課に向けて作られた。最新の交通事故データから、交通事故率が高いのは性別、年齢層及び車種を総合すると 16 歳から 40 歳までの男性バイク運転者であった。そこで、プノンペン都の交差点を利用するプノンペン都民のうち、特に成人男子の交通ルール遵守に向けて製作された。（技術作成資料 Book 4 参照）

2.6.4 活動 5-4：マスメディアおよびワークショップ／セミナーを通して本プロジェクトの成果／活動を国民に広める

PPTMTC プロジェクトの成果・活動は、以下の方法によりプノンペン都民を中心としたステークホルダーに伝えた。

(1) プロジェクトの活動を紹介したクメール語・英語・日本語のニュースレターをプロジェクト期間中 4 回にわたって発行。
(2) パイロットプロジェクトの交通安全キャンペーン時の①バナーの設置、②カンボジア赤十字学生ボランティアによるパンフレットの配布、③交通警察の交通取締の実施。以上に加えて、⑤プノンペン都のウェブサイトや SNS を活用した交通安全ビデオクリップ（プノンペン都庁舎（PPCH）の X のフォロアーは約 50 万人、PPTMTC の 2 つのビデオクリップのウォッチャーは合計で約 12 万人）の発信、⑥FM102 のインタビュー対応を実施。
(3) 都市交通関連ステークホルダー約 170 人が参加したプロジェクトセミナーでのプロジェクト

紹介。

2.7. 本邦研修の実施

第１グループ（研修員７名）が 2024 年１月 31 日～2 月 10 日、第２グループ（研修員６名）が 2024 年２月 14 日～27 日の期間で、東京・広島・京都を含む日程で本邦研修を実施した。各グループの代表者が本プログラムでの纏めとしてプレゼンテーションを実施し、JICA 本部プロジェクト担当者・本邦研修担当者を含めた発表・評価会・業務完了証明書授与式・閉会式を行った。主の訪問先や受講先は以下のとおりである。

表 2.7-1 本邦研修の概要

テーマ(ねらい)	研修候補先	研修内容等
日本の交通管理に関する政策や計画	大手町・丸の内・有楽町地区駐車場対策協議会	東京駅周辺のまちづくりと駐車対策
	東京都庁訪問	プノンペンと同様、首都の東京都庁を訪問
日本の街づくりを含めた都市交通管理施策を学ぶ	交通事故総合分析センター	センターの役割・概要説明
	警視庁交通管制センター	交通管制センターの視察
	広島市	公共交通計画、広島駅南口再開発視察、広島バスセンター視察
	京都市	観光交通管理政策や計画立案の仕組み、取り組み内容
	新宿バスタ	日本最大のバスターミナル
最先端な技術を含む日本のITS技術を学ぶ	尾崎晴男教授	日本のITS技術の講義
	住友電気工業	光ケーブル切断修復講習
日本文化を学ぶ	東京タワー	日本で第二位の高さの電波塔
	お台場	東京湾埋立地区の東京臨海副都心の中心商業地区
	金閣寺	京都の寺院、世界遺産に指定
	平和記念公園	広島市の平和記念公園は、原爆死没者の慰霊と世界恒久平和を祈念して開設された都市公園

東洋大学の尾崎教授から「データに基づく道路計画と ITS を活用した行政管理」を学ぶ

東京の警視庁交通管制センター（TCC）を訪問する

第3章　投入実績

3.1.　JICA 専門家派遣実績

JICA 専門家の派遣実績は以下の通りである。

表 3.1-1　JICA 専門家派遣実績（現地業務）

計画（PDM　Ver.0）		派遣期間	実際
古藤 政人[METS] 総括/交通管理政策	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	15.33MM
古藤　政人[METS] 【町田後任】 道路設計 1／パイロット事業工事監理	-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	3.63MM
古藤　政人[METS] 【望月分移動】 交通管制システムソフトウェア	-MM	2024/8/2-2024/8/31	1.00MM
古藤　政人[METS] 【枝松分移動】 交通管制システムハードウェア／ 信号機器	-MM	2024/12/20-2024/12/28	0.30MM
菅沼 敦[SET] 交通管制システム計画	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	10.00MM
高橋 君成[IDCJ]	9.00MM	2022/4/25-2022/5/25 2022/9/6-2022/9/26	9.00MM

計画（PDM　Ver.0）		派遣期間	実際
交通管理計画		2023/12/1-2023/12/30 2023/3/30-2023/4/30 2023/8/3-2023/9/3 2023/10/11-2023/11/7 2024/1/12-2024/2/10 2024/4/19-2024/4/30 2024/5/1-2024/6/3 2024/8/24-2024/10/10 2024/11/30-2024/12/30	
洪 性俊[PCKK] 交通信号設計及び運用	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	5.50MM
Ramon S. Ona [RSO] 交通信号維持管理	6.00MM	2021/3/10-2022/4/10 2022/7/16-2022/8/27 2022/11/1-2022/11/30 2024/6/15-2024/7/17 2024/9/28-2024/11/8	6.00MM
飯尾 彰敏[METS] 道路及び公共交通計画	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	6.00MM
近藤 道子[PCKK] 通信システム	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	4.06MM
町田 親彦[METS] 【前任】 道路設計／パイロット事業工事監理	9.00MM	2022/8/16-2022/9/14 2022/11/7-2023/12/6	2.00MM
前田　英男[METS] 【町田後任】 道路設計 1／パイロット事業工事監理	-MM	2023/5/10-2023/6/8 2023/9/21-2023/10/10 2023/11/6-2023/11/29 2024/2/4-2024/2/23 2024/12/9-2024/12/19	3.50MM
前田　英男[METS] 【枝松分移動】 交通管制システムハードウェア／ 信号機器	-MM	2024/2/24-2024/3/4	0.33MM
山田 薫[OCG] 交通調査及び分析	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	7.87MM

計画（PDM　Ver.0）		派遣期間	実際
		2024/4/1-2024/4/28 2024/8/19-2024/9/15 2024/10/21-2024/11/13	
Kong Sovann [INDRADAVY] 交通取締り・交通安全	4.50MM	2023/11/16-2024/1/29 2024/6/1-2024/6/15 2024/9/9-2024/10/23	4.50MM
玉懸 光枝[IDCJ] 能力開発及び訓練（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	5.50MM
望月 裕二[SET] 交通管制システムソフトウェア	5.00MM	2022/8/1-2022/9/14 2023/5/28-2023/7/11 2024/5/22-2024/6/20	4.00MM
枝松 克巳[METS] 交通管制システムハードウェア／ 信号機器	2.50MM	2022/6/15-2022/6/29 2023/8/1-2023/8/19 2024/8/5-2024/8/26	1.87MM
秋元 亜矢子[METS] 能力開発及び訓練（２）／広報	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	3.00MM
合　　計	94.00MM		93.27MM

表 3.1-2　JICA 専門家派遣実績（国内業務）

計画（PDM　Ver.0）		派遣期間	実際
古藤 政人[METS] 総括/交通管理政策	0.50MM	2022/12/27-2023/1/11	0.50MM
古藤 政人[METS] 【後任】 道路設計 1／パイロット事業工事監理	-MM	2023/10/23-2023/10/27 2023/12/21-2023/12/26 2024/6/17-2024/6/28	1.00MM
町田 親彦[METS] 【前任】 道路設計／パイロット事業工事監理	1.50MM	2022/12/27-2023/1/11	0.50MM
菅沼 敦[SET] 交通管制システム計画	0.50MM	2022/12/27-2023/1/11	0.50MM
高橋 君成[IDCJ] 交通管理計画	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	0.50MM
山田 薫[OCG]	-MM	2023/6/16-2023/7/3	0.63MM

交通調査及び分析		2024/6/4-2024/6/6 2024/6/26-2024/6/26 2024/12/16-2024/12/24 2025/1/8-2025/1/9	
近藤 道子[PCKK] 通信システム	-MM	2024/9/13-2024/10/4	0.43MM
秋元 亜矢子[METS] 能力開発及び訓練（２）／広報	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	3.00MM
合　　計	6.00MM		7.06MM
総　　計	100.00MM		100.33MM

成果 3 に係る活動　パイロットプロジェクトにおける供与機材

パイロットプロジェクトにおける供与機材を表 3.2.1 に示す

表 3.1-3　パイロットプロジェクトにおける主な供与資機材

No.	使用した資機材	設置箇所	設置目的	備考
1.	複合機（カラー）	JICA プロジェクト事務所内（プノンペン都市役所新庁舎 4F）	PPTMTC プロジェクトに関わる資料を印刷するため	実施機関に譲与に移管
2.	LEVEL5 基盤	パイロットプロジェクト対象交差点＃201～206	パイロットプロジェクトにおける対象交差点に信号機設置する際に必要な重要な内部基盤のため	〃
3.	Type A 信号柱＋アーム 1 本	パイロットプロジェクト対象交差点＃165, #166 & #167	パイロットプロジェクトにおける対象交差点に信号機設置する際に必要な信号柱のため	〃
4.	Type C 信号柱＋アーム 2 本	パイロットプロジェクト対象交差点＃166	〃	〃
5.	Type P 歩行者用信号柱	パイロットプロジェクト対象交差点＃166, #167	パイロットプロジェクトにおける対象交差点に信号機設置する際に必要な歩行者用信号柱のため	〃

6.	車両用信号灯器	パイロットプロジェクト対象交差点＃165, #166 & #167	パイロットプロジェクトにおける対象交差点に信号機設置する際に必要な車両用信号灯器であるため	〃
7.	歩行者用信号灯器	〃	パイロットプロジェクの対象交差点に信号機設置する際に必要な歩行者用信号灯器であるため	〃
8.	交通信号制御機 J 交通信号制御機	パイロットプロジェクト対象交差点#166	パイロットプロジェクトにおける対象交差点に信号機設置する際に必要な交通信号制御機であるため	〃
9.	交通信号制御機R 交通信号制御機	パイロットプロジェクト対象交差点＃165,　#167	〃	〃
10.	補助ケース	パイロットプロジェクト対象交差点#165, #166 & #167	パイロットプロジェクトにおける対象交差点に信号機設置する際に必要な補助ケースであるため	〃
11.	小型融着接続機	JICA プロジェクト事務所内（TCC/プノンペン都市役所新庁舎 9F）	断線された光ファイバーケーブルを小型融着接続機を使用することで接続が可能となり、今後の問題箇所修復に役立つ機材であるため	〃
12.	光パルス試験機（OTDR）	JICA プロジェクト事務所内（TCC/プノンペン都市役所新庁舎 9F）	光ファイバの特性評価に使用される光エレクトロニクス機器。断線された光ファイバーケーブルを特定する際、光パルス試験機を使用することで断線箇所を発見することが可能となり、今後の問題箇所修復や保守点検に役立つ機材であるため	〃
13.	小型トラック	プノンペン都市役所新庁舎駐車場内	TCC スタッフが現場に駆け付ける際や保守・点検等の緊急を要する移動時に修復機材を乗せた車で早急に対応が可能となるため	〃

第4章　PDM の変遷

4.1.　PDM の変更履歴

PDM の変更履歴を以下に示す。

表 4.1-1　PDM の変更履歴

Version	日時	PDM の変更履歴
Version 00 4.2 の(1) 参照	2022/02	Original (Described in R/D)
Version 01 4.2 の(2) 参照	2024/07	[Objectively Verifiable Indicators との変更と数値の追加] **<u>Overall Goal</u>** 1. Travel speed of the main road after the project increases by 5% compared to before the project. 理由：無償資金協力による交通管制システム完成前後のモニボン通りの旅行速度調査の結果は 11.34km/時（2017 年）と 15.23km/時（2018 年）で、34.3%改善した。技プロと無償の工事に対する投資額の比は 1.00：4.25＝1：4.25。以上から、旅行速度の改善目標を 8.0% (=34.3*0.24)と設定した。 2. Number of interviewees who understand tragic rules/regulations increases.から Number of interviewees who answered "Better" for the comparison traffic conditions between 2023 and 2024.に変更した。 結果として、2023 年より 2024 年の交通状態は回答者の 69%の人が「改善した」と回答。 **<u>Project Purpose</u>** 1. Traffic control system の Key Performance Indicator （KPI）を Accident repair time of traffic control system から Availability of the traffic control system に変更。加えて改善目標を 95%と設定した。 2. Number of traffic violators の減少率を 8%と設定した。 **<u>Output 2</u>** 2-2 Target score of the evaluation test for TCC staff (55 points) は日本の国家資格の第一種・第二種電気工事士の合格点を参考に 55 ポイント以上を合格ラインとした。 **<u>Output 3</u>** 3-2 Queue length at the target major intersections の減少率を 8%と設定した。 .

4.2. 各バージョンのプ PDM

各バージョンの PDM を、以下に示す。（変更や追加があった部分のみを示す。）

(1) Version 00 (R/D に記載の PDM)

表 4.2-1 Version 00 の PDM (R/D に記載の 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			

(2) Version 01 (4th JCC で了承された PDM)

表 4.2-2 Version 01 の PDM (第 4 回 JCC で承認された PDM)

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

[凡例]
赤字: C/P との議論を踏まえ修正された内容

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)

第5章　合同調整会議（JCC）及びワーキンググループ（WG）

5.1.　JCC 及び WG の位置づけ

JCC 及び WG の構成を図 5.1-1 に示す。JCC は、PPCA の知事を議長とし、WG は基本的には DPWT 局長とするが、課題により TCC 主任やプノンペン警察署長が議長として開催された。

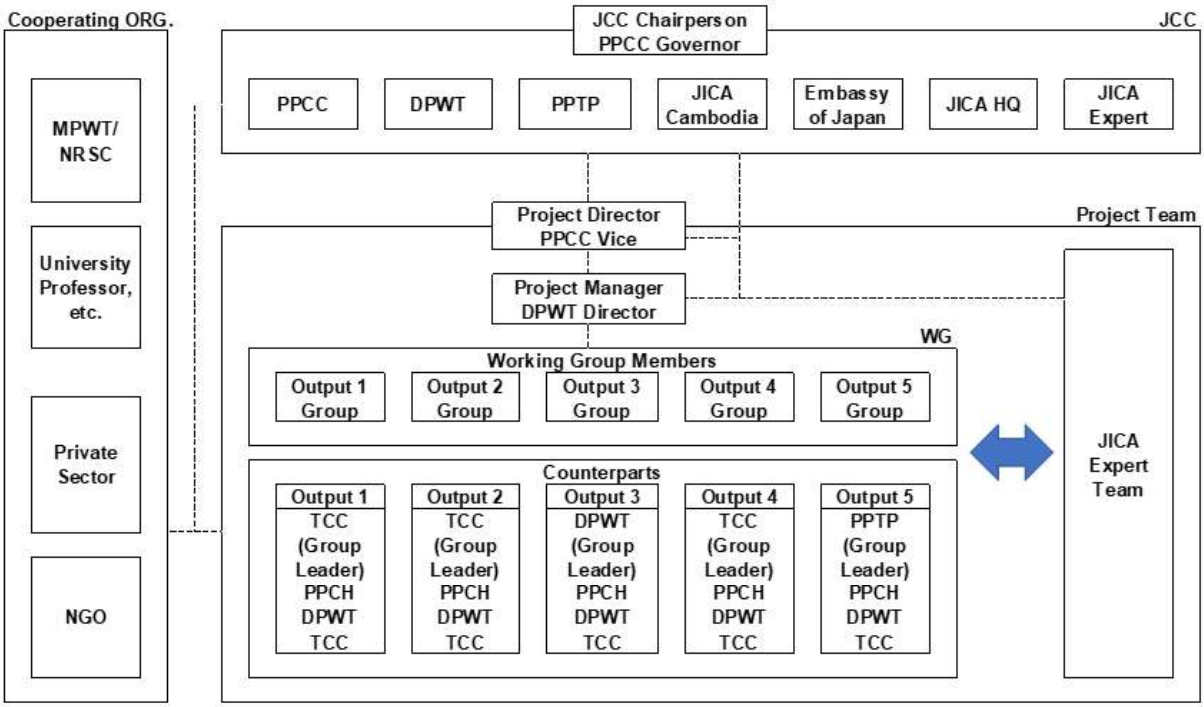


図 5.1-1　WG 及び JCC の構成

5.1.1　JCC

JCC は、プロジェクト全体の方向性の確認、パイロットプロジェクトの実施計画、工事等の承認、及び PPTMTC プロジェクト実施で発生した問題の解決に向けた意見交換等を行うために設置された。JCC のメンバーを以下に示す。

表 5.1-1　JCC メンバー（メンバーのみならず、JCC 参加者）

	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

WG は、技術レベルの問題／課題を解決するために設置された作業部会である。WG メンバーは多岐にわたる。議長は多くの WG 会議を DPWT 局長が務めた。

5.2. JCC 及び WG の開催概要

合同調整会議（JCC）及び ワーキンググループ（WG）の開催概要は下記のとおりである。JCC の出席者・協議内容等詳細については、英文 Annex11 参照のこと。

5.2.1 JCC

表 5.2-1 JCC の開催概要

会議名	開催日	出席者	議題	協議概要
キックオフ	2022/2/17	36 名	1. インセプションレポートの説明と協議 2. TCC の組織について	1) インセプションレポートについて協議し、全会一致で承認 2) TCC の組織については基本的に承認 3) JCC メンバーが正式に承認されていなかったので、実質第 1 回 JCC 会議であったが、名称はキックオフ会議となった。

会議名	開催日	出席者	議題	協議概要
第 1 回 JCC	2022/7/22	36 名	1. TCC の組織について 2. 2022 年 8 月実施予定の PPTMTC の研修計画について	1) TCC の組織については継続協議 2) 2022 年 8 月実施予定の PPTMTC の研修計画については内容を承認
第 2 回 JCC	2023/2/22	36 名	1. TCC の組織について 2. TCC と交通警察との協力について 3. SEA ゲームとパイロットプロジェクトの交通調査について 4. パイロットプロジェクトの機材の調達について 5. パイロットプロジェクトの瑕疵検査について	1) TCC 組織の提案は承認するが、財務部門の設置や DPWT 公共照明課との関係性についても今後議論していく必要がある 2) 機器を近隣諸国から廉価で調達というプロジェクトチームの提案は承認するが、質の確保は不可欠である 3) 瑕疵検査期間の提案は、DPWT 局長と協議する。
第 3 回 JCC	2023/8/14	40 名	1. パイロットプロジェクト実施への協力要請 2. 新しい道路へのバス路線導入について 3. MPWT の駐車場法やパラトランジット対策について 4. ヌンパロット副知事より日本への要請 ① 駐車管理計画の実行可能性調査の技プロ実施要請 ② Smart bus shelter F/S(国交省案件)の続きを要請	1) パイロットプロジェクト実施への協力を承認。ただし、3 Es の基本を忘れずとの副知事のコメントあり
第 4 回 JCC	2024/7/23	35 名	1. パイロットプロジェクト総括 2. 本邦研修報告 3. 交通管制システム拡張計画について（中間報告） 4. 2024 年 8 月開催予定の PPTMTC セミナーについて	1) PDM の変更が承認された 2) 成果 1、成果 2 及び成果 3 の活動の完了が承認された 3) 2024 年 8 月開催予定の PPTMTC セミナー実施が承認された 4) プロジェクトの残作業として以下のものを 2024 年中に完了させること ① PPTMT セミナー ② プロジェクト事後交通調査と分析・評価 ③ 保守管理マニュアル等の DPWT 局長の承認
第 5 回 JCC	2024/12/25	35 名	1. PPTMTC プロジェクトの総括 2. 交通管制システム拡張計画について 3. 瑕疵検査の完了 4. 交通安全技プロとの合同セミナー	1) PPTMTC プロジェクトの完了を承認 2) 交通管制システ拡張計画の承認ハンドブック、マニュアル、交通管理計画の内容について承認 3) 瑕疵検査完了の承認

5.2.2 WG

WG はプロジェクトを進めるための技術的な提案や課題に対して協議する会議で、主に成果 3、成果 4 及び成果 5 に関する WG 会議を行った。主要な会議だけでも 23 回に上った。成果毎の会議の概要を表 5.2-2 にまとめた。

表 5.2-2 WG 開催概要

成果	開催日	開催回数	WG の種類	協議概要
成果 3：パイロットプロジェクトに関する WG	2023/6/1 ～ 2024/3/24	11 回	1. パイロットプロジェクトのキックオフ会議及び地下埋設物確認会議（各 1 回） 2. パイロットプロジェクトの隔週定例会議（6 回） 3. パイロットプロジェクトの交通安全キャンペーン関係者会議（3 回、うち 1 回は PP 交通警察署で開催）	1) パイロットプロジェクト関連機関の出席のもとでパイロットプロジェクトの工事期間、内容の説明とともに工事への協力依頼と問題課題の整理等の協議 2) 工事スタート後の隔週定例会議は、工事中の進捗状況と問題課題の解決にむけた意見交換
成果 4：交通管制システム拡張計画に関する WG	2023/8/24 ～ 2024/1/25	7 回	1. DPWT 公共照明・交通信号室との会議 2. 交通管制システム拡張計画の関係機関会議 3. 2024 年 1 月 25 日の交通管制システム拡張計画調整会議	1) 拡張計画に関連する DPWT 公共照明・交通信号室などと現状についての意見聴取 2) 関係機関と PPTMTC プロジェクトチーム作成の提案信号交差点の説明と意見交換 3) 2024 年 1 月 25 日の交通管制システム拡張計画調整会議で提案信号交差点の承認
成果 5：3Es (E1:技術 E2:取締 E3:教育)に関する WG	2023/8/25 ～ 2024/1/25	5 回	1. MPWT や DPWT との駐車、公共交通、パラトランジットに関する関係機関との会議 2. 主に交通安全キャンペーン時に DPWT 交通安全課や PP 交通警察との調整会議	1) 交通管理施策（駐車対策、公共交通活性化、パラトランジット対策）や交通取締や交通安全教育に関する資料の作成・プレゼンと関係機関との意見交換 2) 交通安全キャンペーン時に DPWT 交通安全課や PP 交通警察と実施内容、時期、参加交通警察官を含めた関係者数の確認と取締方法の意見交換・調整

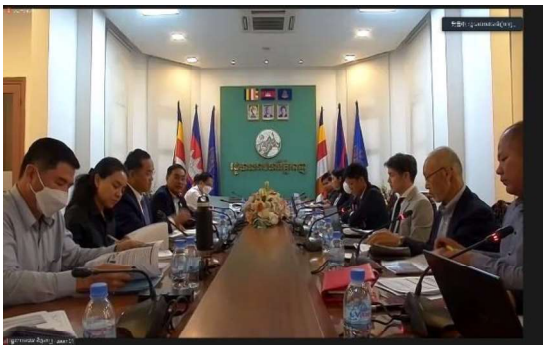
	
第 1 回 JCC 会議	第 3 回 JCC 会議

図 5.2-1　JCC の様子

	
パイロットプロジェクト地下埋設物関係者会議	パイロットプロジェクトの工事説明会議
	
パイロットプロジェクトの安全対策会議	パイロットプロジェクトの定期隔週会議

図 5.2-2　WG の様子

第6章　プロジェクト実施運営上の課題、工夫、教訓

6.1. 受け入れ機関の状況と問題点

本プロジェクトのカウンターパート機関は、交通管制センター（TCC）を含む公共事業運輸局（DPWT）であり、カンボジアの首都プノンペン都（PPCA）傘下の一部局である。DPWT は中央政府の公共事業運輸省の下にも位置づけられるが、予算のほとんどはプノンペン都の豊富な財源を拠り所にしているので、活動の多くはプノンペン都知事のもとにある。

DPWT は、プノンペン都の道路交通インフラ（道路、水運）、治水（洪水対策）、交通管理施策（公共照明、信号、交通安全、車両登録）に加え公園緑地なども所管する組織である。

DPWT の正規職員数は 297 名である、このうち 73 名(24.6%)は技術系職員、女性職員は 88 名(29.6%)である。この他非正規職員が 570 名所属している。DPWT はカンボジアの首都の多岐にわたる業務内容（交通インフラ等）に対して十分な予算配分がなされているとはいえない。このため、特に郊外部では、信号灯器が統一されていないことや、故障した灯器がそのまま残されていることや、道路マーキングが消えかかっている区間や交差点が多く見受けられる。局舎は都心から 3.5km 北側の国道 6 号線沿線にあり 2016 年に都心から現在の場所へ移転した。業務と組織の拡大とそれに伴う職員数の増加、加えて業務の特性上リフトトラックなど多くの大型機材があり面積の拡大が必要になったためである。

TCC は、DPWT の国際課・公共照明・交通信号課を含む運輸部の直下にあり、日本の支援で 2019 年運用を開始し都心の 118 信号交差点を運用･維持管理している。交通管制システムのメインサーバーを含むTCC はプノンペン都新庁舎 9 階にあり、TCC の職員数は 13 名、このうち管理部門の 5 名は PPCA や DPWT からの兼任で、8 名が TCC の専任となっている。

TCC の専任 8 名（うち主任は DPWT 職員）のうち 7 名は非正規職員である。交通管制システムはカンボジアで初めて導入された信号システムで、それまでの信号は全てスタンドアロンタイプであったため、これに対応できる技術者が DPWT にいなかった。そこで、交通管制システム開発に関わった日本人技師のもとで働いたカンボジアスタッフが TCC に移籍し、その後の運営・維持管理に携わっている。

プノンペンの交通管制システム拡張計画でもみたように、今後都心部のみならず郊外部にも拡大していくことは避けられないので、直接関係する DPWT 公共照明・交通信号課と TCC の統合については迅速な調整が求められる。

表 6.1-1　プノンペン交通管制システムの歴史と課題

6.2. 事業関連分野の現状と課題

以下は、PPTMTC プロジェクトに直接的・間接的に関連するカンボジア国、PPCA、DPWT 及び交通警察、電力公社、大学などの関連部局である。このうち、①～③は、プロジェクト全体に大きな影響力を与えたが、直接プロジェクトに参画しなかった組織、④～⑥は、PPTMTC の主な活動であるパイロットプロジェクトなどのハード分野で直接関連した部局、及び⑦～⑪は、パイロットプロジェクトの交通キャンペーン等ソフト分野に直接関連した部局である。

① プノンペン都国際協力課

プノンペン都の国際協力を調整する部局であり、日本などドナーの支援プロジェクトの窓口である。PPTMTC プロジェクトに関しては JCC の事務局機能を持つとともに、JCC の議長を務める知事や副知事の仕事をサポートする組織である。同時に ODA プロジェクトで調達した機器を無税で通関するための承認機関である CDC への窓口でもある。

② プノンペン都都市計画局

プノンペン都の都市計画を管理する部門であり 2009 年のフランスの支援で作成した White Paper は 2030 年の都市計画マスタープランである。その後、都市計画局自身で都市計画マスタープランの改訂作業に入ったが今だ道半ばである。PPTMTC プロジェクトで作成した交通管制システム拡張計画には将来の土地利用計画などについて PPTMTC チームと都市計画局主任との意見交換を行った。

③ プノンペン都財務局

TCC の人件費や保守管理費用はプノンペン都の IT 部門の費用の一部として纏められ、知事の承認の後、経済財務省（MEF）で承認されて予算化される。予算化までのプロセスは比較的順調に進んでいるが、予算の執行には常に想定より時間がかかり交通管制システムの不具合に早急に修繕できないケースが多々あった。予算化のみならず、予算の執行プロセスの迅速化を実現したい。

④ DPWT 公共照明・交通信号室（PLTSO）

無償資金協力プロジェクトでプノンペン中心部 30km^2 の 109 信号交差点と TCC が結ばれ交通管制システムが完成する 2018 年末まで、プノンペン都全体の信号設置は、DPWT 公共照明・交通信号室が担っていた。交通管制システム完成後は、中心部を TCC が、郊外部を DPWT 公共照明・交通信号室がそれぞれ分担してきた。今後交通管制システムの拡張計画に合わせた両組織の統合は喫緊の課題である。

⑤ DPWT 公共事業室（PWO）

プノンペン都の道路整備を担う組織であり、市街化が進行中の郊外部の信号交差点を検討する場合、必ず調整が必要になる。プノンペン都に起終点をもつ国道 6 路線はプノンペン郊外部の幹線道路であるが、これらの交差点については DPWT のみならず公共事業運輸省（MPWT）との調整も必要となる。

⑥ カンボジア電力公社（EDC）

プノンペン中心部の 118 信号交差点に電源を供給している組織であるとともに、EDC の電柱の一部は交通管制システムの通信手段である光ファイバーケーブルの架空区間の配線に利用されている。なお、光ケーブルの幹線道路沿道の配線はプノンペンの都市美化計画に沿って地中化されている。

⑦ MPWT 国家交通安全委員会（NRSC）

公共事業運輸省の傘下にありカンボジアの交通安全を担っている。現在、道路交通事故の死傷者を 2030 年までに今後 10 年で 50%減少させることを目標に「国家道路交通安全 10 年アクションプラン 2021 – 2030」を実施中である。NRSC は交通事故データの年報である RCVIS も公表している。これはカンボジアで唯一の交通事故データベースであり、カンボジアの事故のトレンドや特性を知ることができる。PPTMTC プロジェクトでも RCVIS のデータを交通安全キャンペーンの計画と実施に活用した。

⑧ DPWT 道路交通安全室（RSO）

プノンペン都の道路交通安全を担う DPWT 傘下の組織である。知事の要請で交通安全活動を行っているが、定期的な交通安全週間などの活動は行われていないが、今回のパイロットプロジェクトの交通安全キャンペーンには積極的に参加していただいた。道路交通安全室から DPWT 局長に対して交通安全キャンペーン実施の企画書を提出しているが、資金面の制約から実現されるケースは少ない。今回のパイロットプロジェクトでは、カンボジア側で定期的に年 2 回の交通安全キャンペーンが行えるように資金面でも無理のない計画を実施して道路交通安全室とその情報を共有した。

⑨ プノンペン交通警察（PPTP）

プノンペン都警察本部の傘下にあり交通取締を担っている。人口約 230 万人のプノンペン都に対し交通警察官の数は 600 人であり、日本と比較すると少ない。今回のパイロットプロジェクトの交通安全キャンペーンには交通取締分野で延べ 70 人（6 交差点）の交通警察官を積極的に参加していただいた。

⑩ カンボジア赤十字（CRC）

CRC は人道主義的事業支援の役割を持つカンボジア政府に公的に承認されている組織である。交通安全活動にも積極的で、パイロットプロジェクトの交通安全キャンペーン時には CRC の学生ボランティア（高校生）の参加を要請した。信号交差点でのバナーの設置、運転者へ拡声器による交通安全の呼びかけやチラシの配布などを積極的に行った。

⑪ カンボジア工科大学（ITC）

プノンペン都の唯一の国立工科系大学であり、都市交通分野も最近設置されたばかりである。JICA の都市交通関連プロジェクトの交通調査時の調査員やプロジェクトの技術アシスタントには欠かせない人材がそろっている。日本の国立工科系大学の都市交通分野で学んだカンボジア人講師は JCC のメンバーの一人である。

6.3. プロジェクト実施運営上の課題、工夫、教訓

2 章～5 章及び 6.1～6.2 で記載した「プロジェクト実施運営上の課題」を克服するために実施された工夫（対策）とそのプロジェクト評価 6 項目への影響を、表 6.3-1 に示す。

表 6.3-1　プロジェクト実施運営上の課題とそれを克服するための工夫、教訓

プロジェクトの課題	課題に対する工夫（対策）	プロジェクト評価 6 項目						効果、教訓
		妥当性	整合性	有効性	効率性	インパクト	自立可能性	
不具合の明確化	PPTMTC 以前は、交通管制システムの不具合を月報で報告するだけであったが、不具合を分類して表にまとめ分析した。			✓			✓	その後の保守管理に活かした。
予算確保の手順の確立と迅速な予算執行	予算の承認は比較的スムーズに進むが、予算の執行に時間を要するケースが多々あった。そこで、予算承認から執行までの詳細なフローチャートを作成した。				✓		✓	関係者と共有し議論した（どこが問題であるか、処理を早める方法など）
交通管理を中心とした関係機関とのコラボレーション	プノンペンにおいても縦割行政が組織間の意思疎通のネックとなっていたが、PPTMTC では、WG の構成を柔軟に対応することにより各関係機関間のコラボレーションが保たれた。		✓			✓	✓	TCC、DPWT 道路安全室、PPTP、カンボジア赤十字及び NRSC との協働によるパイロットプロジェクトの交通安全キャンペーンの計画と実施は、この良い例である。
交通関連データの蓄積とデータの利用しやすさ	PPTMTC 以前は、プロジェクト毎にデータ収集分析してプロジェクトの終了とともにデータは分散していた。ビデオイメージから AI を使って数量化する技術(DataFromSky)で、PPTMTC プロジェクトは定点観測（2 地点、交通量、車、種構成など）により、TCC にデータの蓄積が可能になった。			✓	✓		✓	今までは、プロジェクト毎に交通調査を実施し、実施期間が保有していた。今後はこのデータを使い、どの組織でも経年分析等が可能になった。
大きな円ドル為替変動に対して	プロジェクト 2 年目から大きな円安に直面し、コストの想定外の増大でパイロットプロジェクトを交通管理施策全体から交通管理システム施策に絞った。			✓	✓			交通安全キャンペーンを 2 度実施するなど、中身の深化に努めた（今後、カンボジア側自身で年 2 回定期的に交通安全キャンペーンをできるように）
半導体の世界的不足による機器調達の遅れ	当初、パイロットプロジェクトは 2023 年と 2024 年の 2 回に分けて実施する予定であったが、半導体の世界的不足による機器のプノンペン到着の遅れなどから、パイロットプロジェクトの工事を 2 期（2023 年と 2024 年から 2023-2024 年の 1 期にまとめた。			✓	✓			機器の調達の遅れは、当初計画していた「パイロットプロジェクトを 2 期に分けて行う」から 1 回で行うことで、全体スケジュールの遅れを回避することができた。
交通管制システムの組織の在り方について	現在、都心部の信号システムは TCC が、郊外部は DPWT の公共照明・交通信号室がそれぞれの運用・維持管理している。今後、交通管制システムが郊外に拡張することになれば、両組織の統合は不可避である。		✓		✓		✓	2030 年頃までに、TCC と DPWT 公共照明・交通信号室の統合を提案している。
交通管制システムの持続性について	現在の交通管制システムの有効活用と寿命などを考慮して、現在の交通管制システムのリプレイスを拡張計画のなかで提案した。	✓	✓			✓	✓	拡張計画の中ではリプレイスまでのロードマップを、3 つのステージに分けた。 2025 年-2030 年：準備期間 2030 年-2035 年：移行期間 2,035 年以降：リプレイス完了

6.4. 評価 6 項目によるプロジェクトの評価

6.4.1 妥当性（Relevance）

(1) カンボジア国家開発政策との整合性

カンボジアのフン・マネット新首相が 2023 年 8 月に発表した「五角形戦略」は、25 年にわたる長期社会経済戦略で 5 期に分けて実行される。第 1 期は 2023～2028 年の 5 年間である。「五角形戦略」の５つの概念は、成長、雇用、平等、効率性、持続可能性であり、5 つの重点戦略は人材、道路、水力、電力の構築と開発の強化にある。また、「5 角形戦略」の第 1 期では、具体的に目指すべきカンボジアの未来について、政府の制度能力の促進、経済と社会開発に適した環境の創造、人材育成、経済多角化と競争力の向上、民間企業の発展と雇用創出、適応性のある持続的で包括的な開発の促進、デジタル経済社会の発展が述べられている。

「5 角形戦略」の 5 つの重点戦略の一つに「道路」が、また、目指すべき未来について「経済と社会開発に適した環境の創造」が述べられていることから、カンボジアで経済及び社会開発をけん引するプノンペン都市交通改善に寄与する我々の PPTMTC プロジェクトは、まさにカンボジア国の国家開発政策と整合する。

(2) 日本の援助政策との整合性

外務省の対カンボジア国別開発協力方針（2024 年 4 月）の基本方針では、大目標に同国が目指す 2030 年までの高中所得国入りの実現に向けた産業振興の支援とともに、カンボジアが、複雑かつ多様化する国際社会の諸課題に対応し、持続的かつ自立的な成長と活力あふれる社会を実現できるよう支援する、としている。

また、3 つの重点分野のうち、「(1) 経済成長をもたらす産業の変革と発展」では、産業振興や投資促進に向けた基盤整備のために、物流（道路、港湾など） の円滑化による連結性強化を述べており、「(2) 持続的で公平な成長の実現」では、国民生活の更なる質の向上のために、都市交通や ICT 等を活用した都市マネジメントなど、都市生活環境整備に資する分野の支援を 行うとも述べており、PPTMTC プロジェクトの日本の援助政策との整合性は高い。

6.4.2 整合性（Coherence）

カンボジアの首都であるプノンペンは、近年の人口集中とそれに伴う交通量の増大により交通問題が深刻化してきている。プノンペン都民のモビリティ向上に向けて、13 路線の都バスがプノンペン都全域（680km2：東京 23 区と概ね同じ広さ）をカバーしている。しかし、時刻通りにバスが来ない、バス停の環境やバス停までのアクセスの問題などで利用者は低迷しており、プノンペンの交通問題の切り札にはなっていない。このため当面の対応として、既存の交通インフラを改変することなく最大限に利用する交通管理施策は、現在のプノンペン都市交通問題解決には非常に大きな役割を担っている。2014 プノンペン都市交通マスタープラン（PPUTMP）で提案した、①交通管制システム整備を起爆剤とし、②交差点改良、③歩行者信号と横断歩道整備、④細街路の一方通行化、⑤一方通行路の路

肩に路上駐車スペースの整備（路上駐車の車をこのスペースへ）、⑥歩行者ネットワークの整備、及びこれらを確実に実施するための⑦交通取締と交通安全教育の実施は、プノンペン都心のドラスティックな交通改善に資するものではないが、一定の効果を与えてプノンペンの都市交通を改善する現実的な方策である。

そのため交通管制システムをカンボジア側自らが運用、保守管理できるようになるためにサポートしている PPTMTC プロジェクトはプノンペンの都市交通状況に整合した内容である。

6.4.3 有効性（Effectiveness）

(1) 成果の達成状況

ここでは、プロジェクト計画概要表（PDM）に設定された成果の達成状況と、その指標に基づくプロジェクト目標の達成度を評価する。

成果 1（交通管制システムの保守管理体制が確立される）の達成状況

1-1 交通管制システム運用開始後に発生したトラブルのリストが作成される

本技術協力プロジェクト以前は、交通管制システムにおいて発生したトラブルは日報と月報に記録されただけであった。PPTMTC プロジェクトとのスタートとともに TCC スタッフは JICA 専門家のトレーニングやその後の意見交換により、「日々の活動記録（トラブル発生時や保守管理作業で活動した回数）」まとめられた。トラブルで最も多かったのが光ファイバーケーブル（OFC）の切断であった。OFC は、TCC とプノンペン中心部の 112 交差点を架空と地下でネットワークされている重要な通信システムであり、本邦研修での切断修復講義や融着接続機・光パルス試験器（OTDR）の調達は、交通管制システムを安全に維持するためにはきわめて有効であった。

1-2 提案された保守管理体制が DPWT Director に承認される

TCC スタッフの意見を取り入れた保守管理体制を含む TTC の組織が第 1 回及び 2 回 JCC で議論され条件付きで承認された。これは、TCC 組織の提案は承認するが、財務部門の設置や DPWT 公共照明課との関係性について将来の交通管制システム拡張計画なかで議論していく必要があるということであった。

1-3 作成したマニュアルが DPWT の Director に承認される

保守管理マニュアルは、2024 年 12 月の第 5 回 JCC で承認されたが、内容が多岐にわたり当初の完成目標である 2022 年を大きく遅れ 2024 年までずれ込んだ。

保守管理マニュアルは、TCC の使命、目標、目的を達成するために実行される政策、計画、手順、およびその他のサポート活動をまとめることを目的として作成された。マニュアルは 10 章で構成され、保守担当者のみならず、運転者、歩行者、一般市民の交通安全についても説明している。また、マニュアルでは、システムのさまざまなコンポーネントの機能と、それらが全体としてどのように連携するかに焦点当てている。 また、システム運用の生命線である正確なデータベースを構築するため

のシステム コンポーネントの在庫管理も、最も重要なトピックの 1 つに含まれている。

成果 2（TCC の運用に関する TCC 職員の能力が向上する）の達成状況

2-1　研修を通じて TCC 職員自らが問題交差点を分析し修繕設計ができるようになる

パイロットプロジェクト時において、信号パラメータの信号現示については、システムに設定する場合、交通管制システム提供会社のブラックボックスであるが、信号現示設計やタイミング設定等は JICA 専門家のサポートを受けながら TCC スタッフ自ら実施した。

2-2　TCC 職員の評価テストで目標スコアが達成される

PPTMTC 研修は 2022 年 8 月 24 日から 9 月 23 日までほぼ 1 カ月間 4 つの分野（５セッション）：保守管理、運用（基礎編と運用編）、通信システム、交通管理について行った。研修は主にプノンペン都庁新館の会議室で行われたが、定期点検の演習や実際の交通流を観察する運用訓練などの実地研修も実施された。各セッションの最初と最後には技術習得具合を評価した。最後に PPTMTC 研修全分野に対する総合評価を行った。

その結果、4 つの分野の総合評価に関しては、研修実施前が 21.0 ポイント、実施後が 57.2 ポイントとなった。研修前後で 2 倍以上の変化となった。など、合格ラインは日本の国家資格である 1 級及び 2 級電気工事管理技術士の試験結果から 55.0 ポイントと設定した。

2-3　光ファイバーケーブル（OFC）切断に対して TCC が独力で迅速に修繕できるようになる

無償資金協力プロジェクトの工事期間中に、プノンペン都は都市美化強化プログラムを発表し、都心の特に架空の使われていないケーブル類の撤去に踏み切った。無償資金協力プロジェクトと都市美化強化プログラムの最高責任者はインフラ担当の副知事が同じであったにもかかわらず、OFC も使われていない架空ケーブルとともに多くの区間で切断された。その後、多くの調整会議を経て OFC が誤って切断されるケースは大きく減少したが、この経験で TCC スタッフは数多くの OFC 修繕機会を得た。Fusion Splicer（融着接続機）や OTDR の本法研修とその後の調達は、OFC 修繕の迅速化に寄与した。

成果 3（信号機改良のパイロットプロジェクトを通じた信号設計の実施能力が向上する）の達成状況

3-1　TCC 職員が自ら評価項目を設定して信号修正設計が必要な交差点を選定できるようになる

プロジェクト開始前は、日本人専門家が信号パラメータの見直しを行っていたが、無償資金協力プロジェクト後、TCC が立ち上げられ、技術協力プロジェクトが計画された。しかし、COVID-19 の発生などの予期せぬ中断により、TCC スタッフは 2019 年から 2021 年の 3 年間、交通管制システムの運用と保守を自ら行わなければならなかった。信号メーカーやコンサルタントからの支援は受けたものの、TCC スタッフ自身が 3 年間の管理期間を経験したことで、その後のトレーニングがより効果的になった。

3-2　パイロット事業が実施され対象主要交差点の渋滞長が 8%減少する

パイロットプロジェクトで実施された交差点の平均渋滞長は施工前の 40m から施工後は 34m と 15.4%の減少であった。

3-3　計画から実施評価までのパイロットプロジェクトハンドブックがカウンターパートを中心としてまとめられる

PPTMTC プロジェクトのパイロットプロジェクトハンドブックは、8 章で構成され個性あふれる各専門家がこのハンドブックを利用する主に TCC スタッフの特性を考慮して作成されている。同時に TCC スタッフの意見を取りいれた内容となっている。

このハンドブックは、近年に都市交通問題が顕在化しているカンボジア地方都市（シエムレップやシアヌークビル）の信号設置は「交差点設計マニュアル」、とともに「パイロットプロジェクトハンドブック」にまとめられ、PPCH、DPWT および交通管理に関わる組織に配布され、パイロットプロジェクトエリア以外の地域における開発プロジェクトの手引きとなることを共有した。

成果 4（プノンペン都（PPCA,DPWT,TCC を含む）職員の交通管制システム拡充計画策定能力が向上する）の達成状況

4-1　市街地拡大状況や信号処理が必要な交通状況を分析できるようになる

拡張計画の前提となるプノンペンの市街化の動向、交通網の特徴、郊外部の信号交差点の問題課題などを TCC スタッフと JICA 専門家が、既存データの収集、GIS の活用、現地調査、加えて交通管制システムが先行している近隣諸国であるフィリピンの事例などを参考に拡張計画の現状と問題課題としてまとめた。

4-2　交通管制システム拡張計画が DPWT の Director に承認される

交通管制システム拡張計画は 2024 年 12 月に DPWT 局長に承認されたが、内容を要約すると以下のとおりである。

プノンペンの交通管理システムの持続性を担保する拡張計画は、現システムの有効利用と寿命を考慮して作成された。有効利用の視点ではシステム稼働以来大きな事故もなく 5 年を経過していているので少なくとも今後 10 年は現システムの稼働を継続する。ただし最初の 5 年以内は、現在市街化が急な郊外部西側の問題交差点の改良をカンボジア側が主体となって実施する。同時に、15 年後の新しい次世代交通管理システムへの完全移行に向けた準備期間とし、新しいシステムのコンセプトや整備のスキーム、概算費用などを検討する。その結果を受けて、10 年後に新しいシステムへの移行の工事に入り、15 年後までに完全移行を目ざす。

成果 5(プロジェクト持続化のための都市交通関連機関の交通管理対策の能力が向上する)の達成状況

5-1　交通取締りに関する実施研修が 2 回以上実施される

交通取締に関する実施研修には、東京都警視庁の交通取締課で多くの経験をもつ専門家を日本から

招聘した。プノンペン交通警察への研修のなかで日本の経験を伝えるとともに、交通安全キャンペーン実施前の準備期間と実施中の 2 回のパイロットプロジェクト交差点の交通取締に関する現場での研修が実施された。なお成果 5 については、交通取締や交通安全教育以外の都市交通関連機関の交通管理対策にも対応するため、① 駐車対策、② ツクツク等のパラトランジット対策、及び③ バス公社の活性化なども公共事業運輸省の担当者と議論された。

5-2　交通取締り、交通安全マニュアルが作成され交通警察に承認される

交通取締マニュアルについてはプノンペン交通警察の要望により、上述の警視庁出身の専門家の講義内容（日本の 50 年にわたる交通安全と取締りの歴史と経験）をまとめたものとした。また、交通安全教育マニュアルは、MPWT 国家交通安全委員会（NRSC）が毎年公開している RCVIS（道路事故年報）の最新版に基づいた道路交通事故の分析結果から、主にプノンペン交通警察と DPWT の道路安全課に向けた交通安全教育マニュアルを作成し、DPWT 局長と交通警察署長に承認された。

5-3　ワークショップ/セミナーが 2 回以上開催される

PPTMTC プロジェクトのセミナーは 2024 年 8 月 8 日に、都市交通関連関係者 170 名を招き、概要と日々の TCC の活動内容の発表を中心に実施され、質疑応答とアンケートが行われた。「2023 年に比べ 2024 年のプノンペンの交通状況はどのように変化したか」という質問には約 70%の参加者が「良くなった」とこたえた。その理由として、「交通量は若干増えたがプノンペン都のハード（信号設置やフライオーバーなどの建設）やソフト（交通安全教育の普及）の努力」があげられていた。

2024 年 12 月 3 日は主にカンボジアの交通安全を考えるセミナーで、国道 5 号交通安全技プロとの合同セミナーとなった。PPTMTC プロジェクトからは主にパイロットプロジェクトでの交通安全キャンペーンについての発表を行った。

(2) プロジェクト目標への達成度

「交通管制システムの運用、維持管理能力向上を通じ、プノンペン都における交通管理対策（交通安全対策を含む）が改善される。」がプロジェクト目標であるが、これら以下の 3 つの指標で達成度を検証した。

PP-1：交通管制システムの稼働率が 95%以上になる

PDM version０の PP-1 は、「事故発生から修繕完了までの時間が XX%短縮される」であったが、PPTMTC プロジェクトでは、重要システム評価指数（KPI）としてシステム稼働率を採用した。成果２で 2022 年に実施した 5 科目に渡る PPTMTC 研修の成果と必要スペアパーツの調達でシステム稼働率は 2023 年 3 月までの平均 83.2%から、目標の 95%に若干到達しなかったが 4 月以降は 94.4%に改善された。

PP-2：主要交差点データの分析結果が月報に示される

幹線道路単路部の 2 地点（モニボン通りフランス大使館前とロシア通りベカゼ交差点近く）に CCTV

を設置して AI を活用した画像解析（チェコの DataFromSky）により交通量として集計できるようになった。この結果、定点観測結果を経年で収集でき、TCC の月報への掲載のみならず、他の組織においても都市交通分野の計画に使用できるようになった。

PP-3：主要交差点の交通規則を守らない違反者数が 8%減少する

3Es（E1：技術、E2：交通安全教育及び E3：交通取締）によるパイロットプロジェクトの実施は、対象エリア交差点の交通違反者の数（1 交差点当たり）を実施前の 1,592 人から 1,256 人と 21.1%の減少となり、目標の 8%を大きく上回った。

6.4.4 効率性（Efficiency）

PPTMTC プロジェクトの短期専門家の投入は計画通り（計画 100.00MM に対し 100.33MM）であった。一方、プロジェクト期間中には、①プロジェクトスタート時は COVID-19 の最盛時であり、行動が非常に制限されていた、②円安（プロジェクトスタート時 : 1 ドル約 109 円が、2023 年夏頃は約 160 円まで）が進み、機器の調達や再委託に大きな影響が出た、また③世界的半導体不足に見舞われ、半導体が不可欠の交通管制システム関連機器の調達が遅れた。それにもかかわらず、激動の 3 年間（2022 年 - 2024 年）を①当初の計画通りの専門家の投入と②再委託・機器調達費は当初予算内で効率よくプロジェクトが遂行できた。

6.4.5 インパクト（Impact）

(1) プノンペンの交通管理システムの運用・保守管理を担う TCC スタッフに対するインパクト

PPTMTC プロジェクトがスタートする前は、無償プロジェクトの短期トレーニングで交通管制システムの運用・保守管理の技術を学んだ。その後の実践では、信号パラメータのタイミングの変更や市中の民間電機通信会社に発注や機器レンタルで頼りながら運用・保守管理を行ってきた。PPTMTC プロジェクト以降は、パイロットプロジェクトによる信号設置工事時の施工監理を経験して、今後新たな新号設置時の技術を身につけたのみならず、融着接続機や OTDR の調達により TCC スタッフ自身が OFC の切断時などに迅速に補修に対応できるようになった。すなわち、PPTMTC プロジェクト以降は、信号パラメータのうち信号現示設定以外の TCC としての必要な運用・保守管理活動に対応できるようになった。

(2) DPWT、PPCA、PPTP、NRSC 等 C/P メンバーへのインパクト

パイロットプロジェクトでは、整備された交差点を安全、スムーズに利用してもらうために、また、その実施の効果を確かなものにするため、技術的な信号設置工事（Engineering）のみならず、プノンペン交通警察と DPWT 道路安全課・カンボジア赤十字の学生ボランティアの協力を得て交通取締（Enforcement）と交通安全教育（Education）の 3Es の概念を取り入れた交通安全キャンペーンを実施した。従来のカンボジアにおける交通安全キャンペーンは、各国のドナー機関が不定期にそれぞれのプロジェクト期間に実施するのが一般的であった。PPTMTC では日本の経験から年 2 回の交通安全

キャンペーンの実施（3 月末のクメール正月前と 9 月末のプチュンベン（カンボジアのお盆）前）を目指した。

この背景には、日本では交通事故死者数が 1970 年の約 16,800 人から 2022 年の約 2,600 人と約 50 年で 85%減少した。この間春と秋の全国交通安全週間を実施し、この交通死者数減少に一定の貢献をしたことが知られている。

今回実施した第 2 回交通安全キャンペーンでは、プログラム自体は概ね第 1 回と同じであったが、費用を極力抑え今後カンボジアが実施しやすいよう配慮した。

将来、プノンペンの交通事故が減少した暁には、その要因の一つとしてプノンペン都が毎年 2 回行っている交通安全キャンペーンにあると都民に感じてもらえれば、継続することで小さなコストでも大きなインパクトが得られることをこのプロジェクトが示したことになる。

(3) プノンペン都民、学生等交通管制システム受益者へのインパクト

無償資金協力プロジェクト実施時の 2017 年と 2018 年に、プノンペン都心の南北主要コリドーであるモニボン通りの都庁 – 毛沢東通り間訳 3.4km の交通速度を計測した。結果は、モニボン通りに交通管制システム下の信号交差点が整備する前（2017 年）の旅行速度が 11.34km/時が整備後（2018 年）には 15.23km/時と 34.3%も増加した。国民経済的にはモニボンを利用する都民の旅行時間の削減効果が年間 2.5 百万ドルに達した。また、パイロットプロジェクトの評価に関しては PPTMTC パイロットプロジェクトセミナー出席者に質問表で「プノンペンの 2024 年の交通は 2023 年に比べどう変化したか」の回答として約 70%の出席者が「良くなった」と答えた。

以上の結果は、プノンペン都民・学生にとっての日々の生活で大きな変化が実感できるものでは無いが、長い目で見てプノンペン都民に浸透していくのではと想定される。

6.4.6 自立可能性（Sustainability）

カンボジア側の自立可能性を計るのは以下の３つがカンボジア側自身でできるかである。

(1) 交通管制システムの拡張計画

交通管制システムの拡張計画は、大きなプロジェクトでありカンボジアのみならず日本を含めた近隣諸国との協働も時には必要になるが、過去の経験と PPTMTC プロジェクトで培った交通管制システムの運用・維持管理の技術を十分活用して、図 6.4-1 の橙色の期間をカンボジア側自ら運営・保守管理する必要がある。図 6.4-1 の 2019 年～2021 年は当初、無償資金協力プロジェクトで交通管制システムを完成させ、引き続き技術協力プロジェクト（TCP）を実施する予定であったが、COVID-19 などの影響で TCP の実施が遅れた。この間は、TCC スタッフは信号メーカーのサポートを受けながら TCC 自身で交通管制システムを運用･維持管理してきた。この経験を今後も十分活用できる可能性がある。

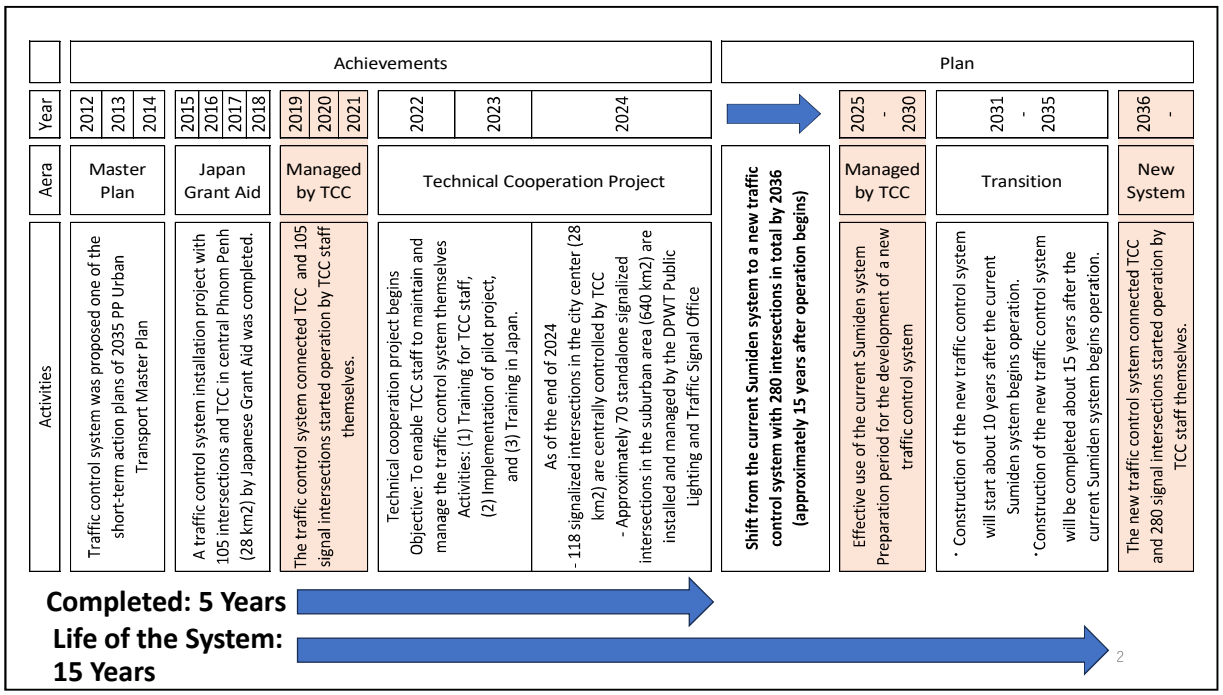


図 6.4-1 プノンペン交通管制システムの歴史と計画

(2) 総合的交通管理施策の実施

6.4.2 で述べた 7 つの施策からなる総合交通管理施策（下図 6.4-2 参照）の実施は、少ない投資コストに対して比較的大きな効果が得られる都市交通施策である。

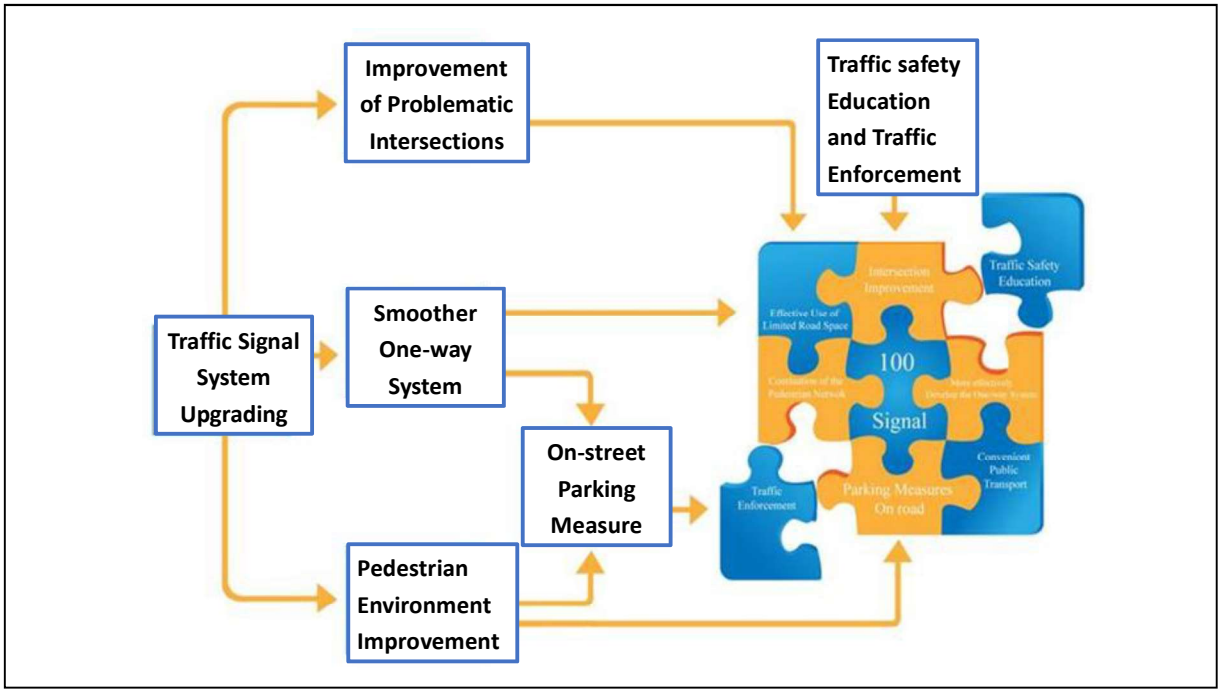


図 6.4-2 PPUTMP で提案された総合交通管理施策の概念（プノンペン都都心）

(3) 年 2 回の定期的な交通安全キャンペーンの実施

6.4.5 インパクトの(2)で述べた年 2 回の交通安全キャンペーンは、実施組織の柔軟な判断で実施できるもので、定期的・持続的に行うことが最も重要である。2023 年 8 月に発表されたカンボジアの国家戦略である「五角形戦略」も 25 年後の 2050 年には高所得国になるという目標を掲げていることから、少なくとも今後 25 年（日本の歴史の半分）間、年 2 回の交通安全キャンペーンを続けることができれば高所得国にふさわしい交通安全環境を形成することは不可能ではない。大事なことは、交通安全キャンペーンの実施に必要な費用は柔軟に対応できる（少なくてもできる）ということである。

6.5. プロジェクトの結論と次のステップへ

6.5.1 プロジェクトの結論

PPTMTC プロジェクトの上位目標は「プノンペン都の交通管制システムの効果的な運用を通じ、持続可能な都市交通環境が形成される」ことである。PPTMTC プロジェクトの中間年次 2023 年 8 月にカンボジア政府フン・マネット首相より発表された目標年次を 2050 年とする国家戦略である「五角形戦略」は、2050 年にカンボジアが高所得国入りを目指している。「五角形戦略」の中では 5 つの重点戦略の一つに「道路」が、また、目指すべき未来について「社会と経済開発に適した環境の創造」が述べられていることから、カンボジアで経済及び社会開発をけん引するプノンペンの都市交通改善に寄与する PPTMTC プロジェクトはカンボジア国の国家開発政策とタイミング良く整合することとなった。

また、プロジェクト目標は「交通管制システムの運用、維持管理能力向上を通じ、プノンペン都における交通管理対策（交通安全対策を含む）が改善される」ことであり、PPTMTC プロジェクトで実施した交通管制システムも運用・維持管理や交通取締・交通安全教育をはじめとするプノンペンの交通管理施策の計画と実施を幅広く行えた。プロジェクト目標を支える各成果の結論は以下のとおりである。

成果１：交通管制システムの維持管理については、交通管理システムスタート以来の活動実績を分析・評価することと、2022 年の研修をとおして、TCC スタッフの活動実績を分析・評価することにより、維持管理に関する問題課題を図表にまとめ問題課題の傾向が明らかになったこと。一方、交通管制システムを管理する組織については、将来のシステム拡張時を考えると組織の成立ち、スタッフの背景、日々の活動が異なる TCC と公共照明・交通信号室の 2030 年までの統合が不可避となっている。DPWT 局長はこの課題に全力で立ち向かうとの表明をいただいた。

成果２：今までプノンペン都の都市交通データは、プロジェクトごとに収集分析し、使われ、それぞれの実施機関が保管していて、プノンペン都に一本化されることは無かった。しかし、CCTV 画像から AI を使って数値化できるソフトを使い、限界はあるがプノンペン都の主要道路 2 地点の継続的なデータ（30 分交通量と車種構成）の経年的なデータが収集可能になり、図表化するとともに関係機関と情報共有することができた。

2022 年に実施した PPTMTC 研修は、交通管制システムや交通管理施策全般に関するものであり、実施後交通管制システムの運用・維持管理に大いに貢献し、パイロットプロジェクトの計画から工事や評価に至るまでの活動がスムーズに行えた要因といえる。

成果３：パイロットプロジェクトは、TCC スタッフにとって、過去の経験や PPTMTC プロジェクトで実施された研修の成果を表す場となった。現交通管制システム機器の導入民間企業のプロジェクト途中での撤退や COVID-19、大きな為替変動など当初想定しなかった問題課題に直面したが、TCC スタッフ＋JICA 専門家＋交通管理関連ステークホルダーの協働で乗り越えることができた。

成果 4 : プロジェクトの持続性を担保するために最も重要な交通管制システム拡張計画を TCC スタッフと JICA 専門家が中心になってやることと、TCC マネージの期間と TCC と民間を含む関連機関との協働を交互にやっていく。「次のステージへ」のロードマップを作成した。

成果５：持続的な都市交通環境形成に大きく寄与する、プノンペン都民への交通安全教育の一端として交通安全キャンペーンを実施して、関連する全てのステークホルダーの参加（①TCC、②JICA 専門家、③プノンペン都庁舎（PPCH）国際協力・広報課、④DPWT 道路安全室、⑤プノンペン交通警察、⑥国家道路安全委員会、⑦カンボジア赤十字）により実施できた。

6.5.2　次のステップへ

PPTMTC プロジェクト完了後（2025 年 – 2035 年）のステップとしては、当面の課題に向き合いつつ、本プロジェクトで作成した交通管理システム拡張計画の実行があげられる。現交通管制システムの寿命 (約 15 年) を考慮して、開始から大きな問題も無く 5 年間稼働している。そこで今後 10 年間で新しいシステムに移行していることが望ましい。そのためには、

1) 2025 年 – 2030 年

現在すでに交通混雑が顕著な都心に隣接するプノンペン郊外西部の信号交差点の改良(PPTMTC プロジェクトでは「問題 10 スタンドアロン信号交差点の改良」として提案済み) を TCC の技術と PPCA の資金で進めることを提案。信号設置だけでなく、周辺環境の改善、特に交差点改良も同時に進めることが重要である。これは、パイロットプロジェクトの実践であるが、通信システムの検討は含まれない。

交通管制システム拡張計画の実行に関しては、① 今後 5 年以内に拡張計画の詳細を詰める (自国財源を利用するのか、ドナーの支援を受けるのか)等、② 2030 年頃には工事をスタートさせる。

2) **2030 年 – 2035 年**

現交通管制システムから新しいシステムへの移行期間であり、2035 年に次のシステムへの完全移行が望ましい。図 6.5-1 は、PPTMTC プロジェクトの結論と次のステップへまとめたものである。

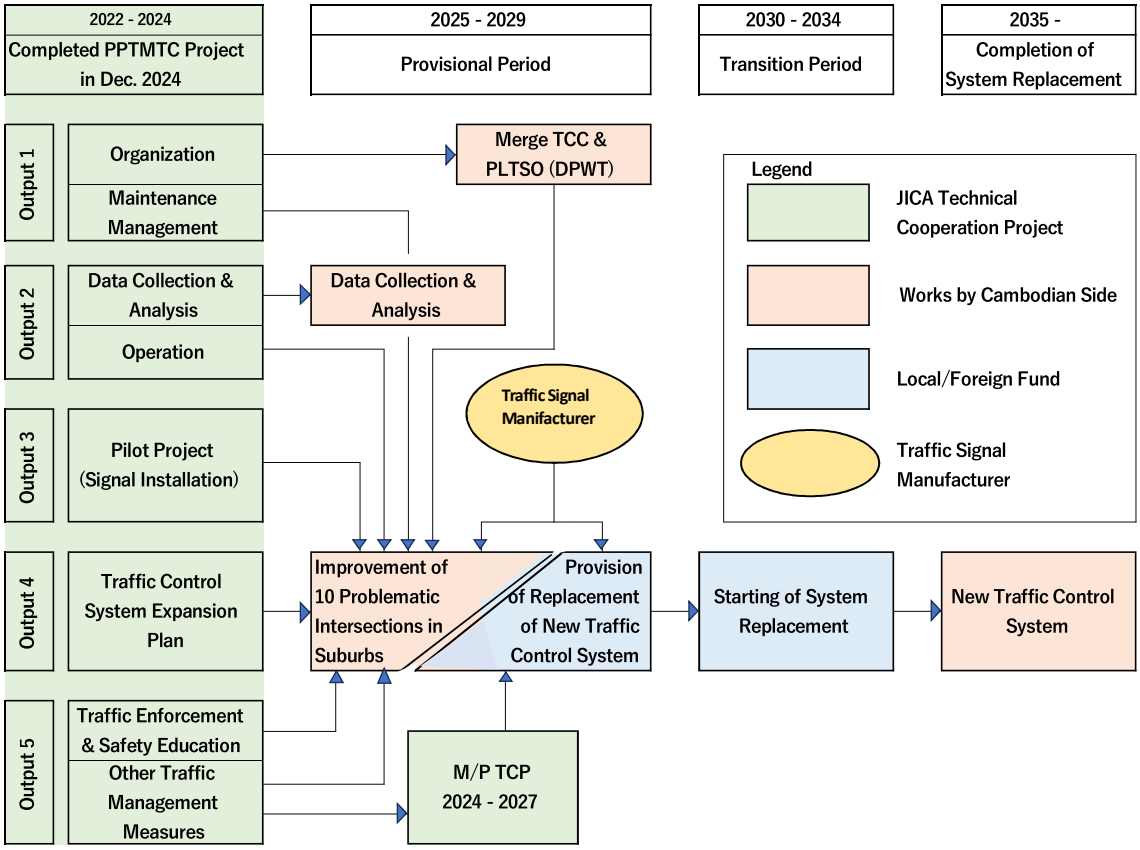


図 6.5-1 プロジェクトの結論と次のステップへ

6.6. 今後の協力実施にあたっての教訓、提言等

6.6.1 プロジェクトに与えたプラスの教訓

(1) データのダッシュボード化

交通管制システムの運用と維持管理には多くのデータが必要であり、TCC スタッフは基本的に日報や月報でそのデータを記録してきた。PPTMTC プロジェクトにおいては、これらのデータをダッシュボード化（基本的には日報や月報の数値を図表化してより見やすく理解しやすい形にすること）により TCC のみならず他の機関ともデータをリアルタイムで共有してプノンペンの都市交通状況の現状分析を行うことができるツールを作成できた。これらは TCC スタッフの活動実績や AT を使った交通量等の定点観測結果などにみることができる。

(2) TCC 関係予算の実行プロセスや供与機材の免税手続きのフローチャート化

TCC 関係予算の実行プロセスや供与機材の免税手続きについては非常に複雑であるため、実際の行動と多くの関連機関へのヒアリングなどをとおしてフローチャート化した。特に、TCC 関連の予算の

実行は運用・維持管理費用に直結するため、このフローチャート作成は重要であった。

実際の手続きがフローチャート作成と並行して行われたため、PPTMTC プロジェクトへの直接裨益なかったが、今後発生する事案に対応できることになる。

(3) 多くの関連機関を巻き込んだパイロットプロジェクト及びその交通安全キャンペーンを実施

カンボジアで実施される交通安全キャンペーンはドナーとその C/P 機関が中心になって行われ、今回のように多くの関連機関を巻き込んだケースは非常に稀である。今回ケースは、DPWT 道路安全室（RSO）の積極的な参加（今までは、道路安全室が DPWT 局長に交通安全教育活動の提案を出しても予算の制約から多くが実施できなかった）や、プノンペン交通警察の柔軟な対応（警察に交通安全キャンペーンなどの活動に参加を依頼するためには PPCA、プノンペン交通警察、内務省など多くの関係機関との調整が必要）、MPWT 国家交通安全委員会（NRSC）の最新かつ詳細なデータの提供、カンボジア赤十字（CRC）や NGO の積極的な参加などで、今後の定期的かつ広範な交通安全キャンペーンを DPWT 道路安全室が主体的に進めていくことの基礎をつくった。

(4) TCC スタッフの自主性が形成されたプロジェクト期間中 4 回にわたって実施された数多くの OTJ を含むトレーニング

①Stage 2 のソフトコンポーネントの実施から、②2019 年に交通管制システムがカンボジア側に移管され、その翌年には誰も予測しえなかった COVID-19 により、TCC スタッフ自ら交通管制システムを運営維持管理するより他に方法が無かった時期(Stage 3)の経験(On-the-Job Training)を経て、③PPTMTC プロジェクトで(Stage 4)の 5 分野にわたる詳細な JICA 専門家とシステム提供会社技師のトレーニングを経験した。以上の豊富な技術移転のトレーニングは④Stage 4 のパイトットプロジェクトの信号設置活動(OJT)の多くを TCC スタッフが担い成功に導くことに繋がった。

(5) 交通管制システムのカンボジア他都市への展開

ADB プロジェクト実施中の 2019 年 6 月にローカルスタッフをとおしてシアヌークビル州知事から「シアヌークビル中心部の交通信号設置を含めた交通管理計画を策定したい。ついてはプノンペンの都市交通マスタープランの内容を説明してもらえないか」という非公式の依頼が PPTMTC プロジェクトのチーフコンサルタントにあり、州庁舎でプレゼンを行うとともに中心部を視察した。人口約 31 万人とプノンペンの 1/7 位の都市であり、中国からの投資により多くのホテルが建設中で都心部は交通ルールを守らないドライバーも相まって交通混雑は想定以上であった。

都市化が進む地方都市、特に上記のシエムレップやカンボジア最大の観光都市であるシエムレップ(人口：14 万人)については、プノンペン都心部の面的制御を主体とする交通管制システムの導入までは必要無いとしても、交通流に合わせた信号現示の設定やコリドー制御などを導入して中心部の交通混雑低減に結びつける方策は有効である。計画にあたっては、TCC スタッフの現地への派遣や PPTMTC プロジェクトで整備したパイロットプロジェクトハンドブックの活用は推奨される。

6.6.2　プロジェクトに与えたマイナスの教訓

プノンペン交通管制システムのO&M費用の確保のうち、TCCスタッフの人件費とスペアパーツの費用は何とか対応できたが、システム提供会社の定期的出張（システム維持管理）は予算化されたが実行されなかった。

交通管制システムの信号現示パラメータの設定などはシステム提供会社の範疇であるため、システム設置初期の段階では、システム提供会社が定期的にプノンペンを訪れシステム全体をチェックする機会を設けることが重要である。しかし、PPTMTCプロジェクトではオンラインでのチェックも可能であったため、システム提供会社技師の出張予算は実行されなかった。

このような、IT関連システムの整備に関しては特に将来、民間企業を巻き込んだ運用・保守管理の在り方を充分検討しておく必要がある。日本の場合、システム設置後の維持管理活動はシステム提供企業の継続的な収入源であるとともにシステムの持続性担保に大いに貢献していると考えられる。IT関連分野の日々の進歩は目を見張るものがあり簡単に将来を見通せないが、通常約15年といわれる交通管制システムの寿命を考慮した次世代交通管制システム整備までのロードマップ作成は必要である。ただ、民間企業側もドナーに全てを委ねてプロジェクトに参加するだけではなく、自ら積極的にカンボジア側関係機関、特にDPWTとの密接なコミュニケーションを図る努力は必要である。

6.6.3　提言等

カンボジア側の自立を確かなものにするため、現在直面している課題である市街化が急な都心縁辺西部の「スタンドアロン信号交差点の改良」をカンボジア側自ら実施することである。この際、PPTMTCプロジェクトで培った交通管制システムの運用・保守管理技術を十分に活用しつつ、プロジェクト全体をカンボジア側で管理することが重要である。また、今後郊外部の信号も中央システムに取り込むため郊外の特性把握には、TCCスタッフとDPWT公共照明・交通信号室（PLTSO）スタッフの協働が必要であり、将来の組織統合への道筋をつけることは不可欠である。

都市交通環境を総合交通管理施策の実施で改善する試みは、今後も多くのステークホルダーを巻き込みながら継続していく必要がある。いくら美しくても歩道上は不法駐車であふれている都市をスマートシティとは誰もよばない。

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

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

Version 00

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.	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.
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			**Pre-Conditions**
3-2 To collect and analyze traffic data related to target intersections.			N/A
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			**<Issues and countermesures>**
5-4 To disseminate the Project's outputs/activities to the public through the mass media and workshop/seminar			

ANNEX 2: TCC による

交通管制システムへの事故対応

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

［技術作成資料］

ANNEX 3: 保守管理マニュアル

［技術作成資料］

ANNEX 4: 交通管制システム拡充計画

ANNEX 5: PPTMTC 研修報告書

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.

TABLE OF CONTENTS

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.

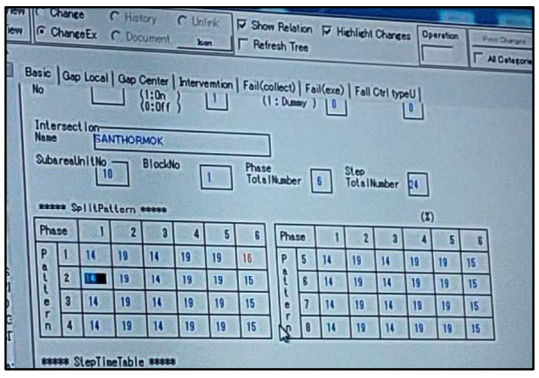
・Procedure for changing signal control parameters

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.

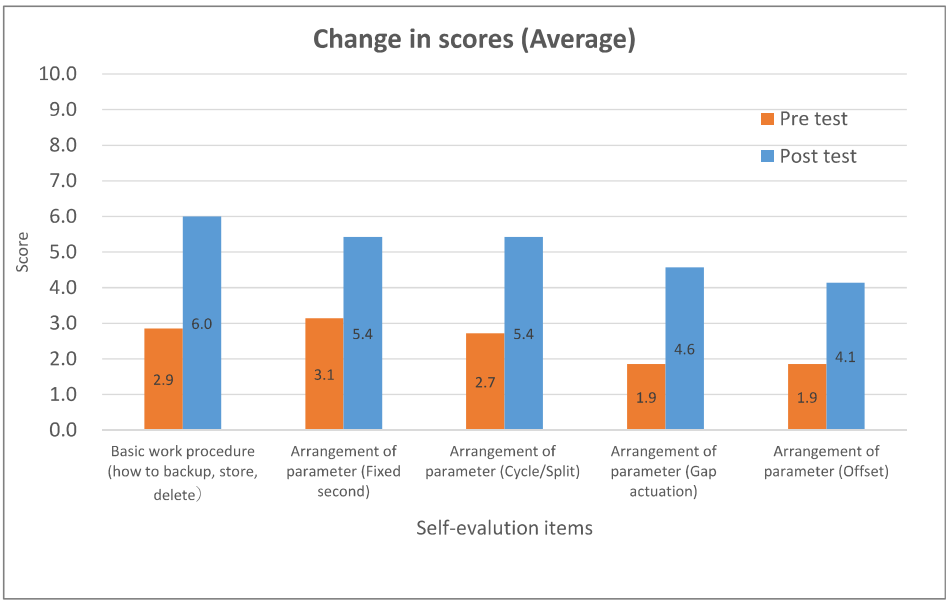
The content of both the pre-test and the post-test is the same, with five items rated on a scale of 1 to 10. The content of the five items is as follows:

- 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.

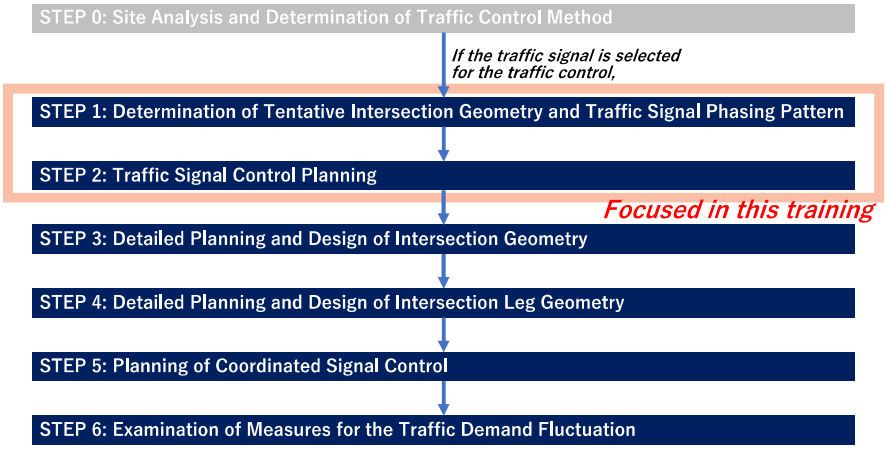


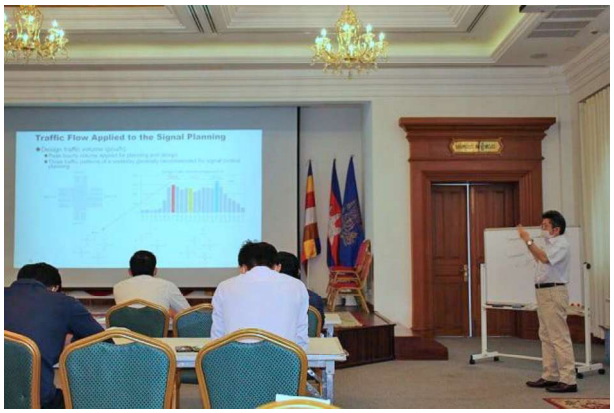
Figure 1 General Procedures of Signalized Intersection Planning and Design

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.

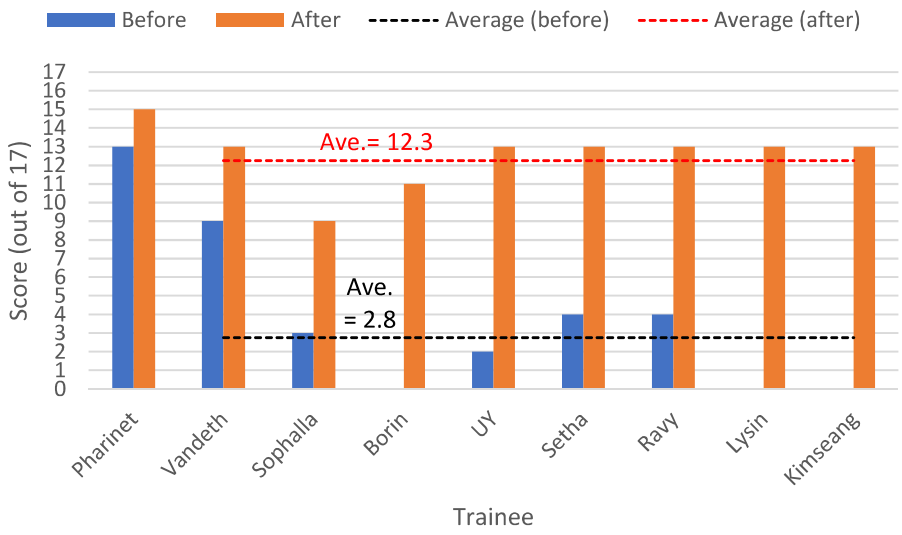


Figure 2: Test Results of Traffic Signal Control before and after the Training

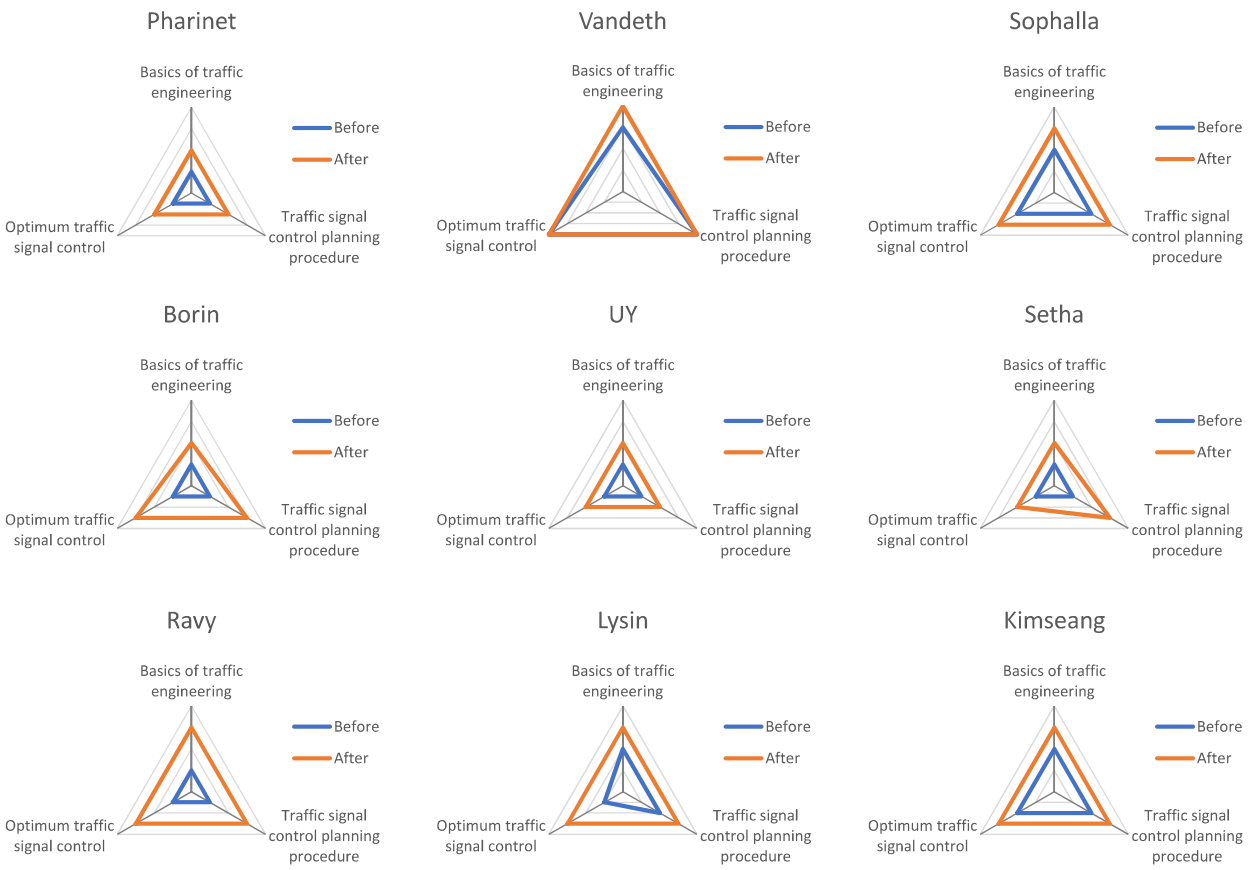


Figure 3: Self-Evaluation Results on Traffic Signal Control (Individual)

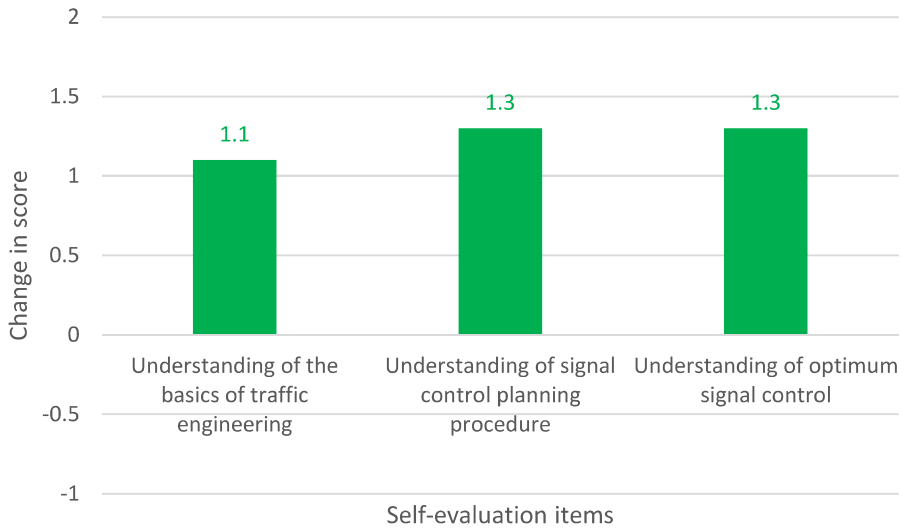


Figure 4: Average of Change in Self-Evaluation Score after the Traffic Signal Control Training

➢ <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:

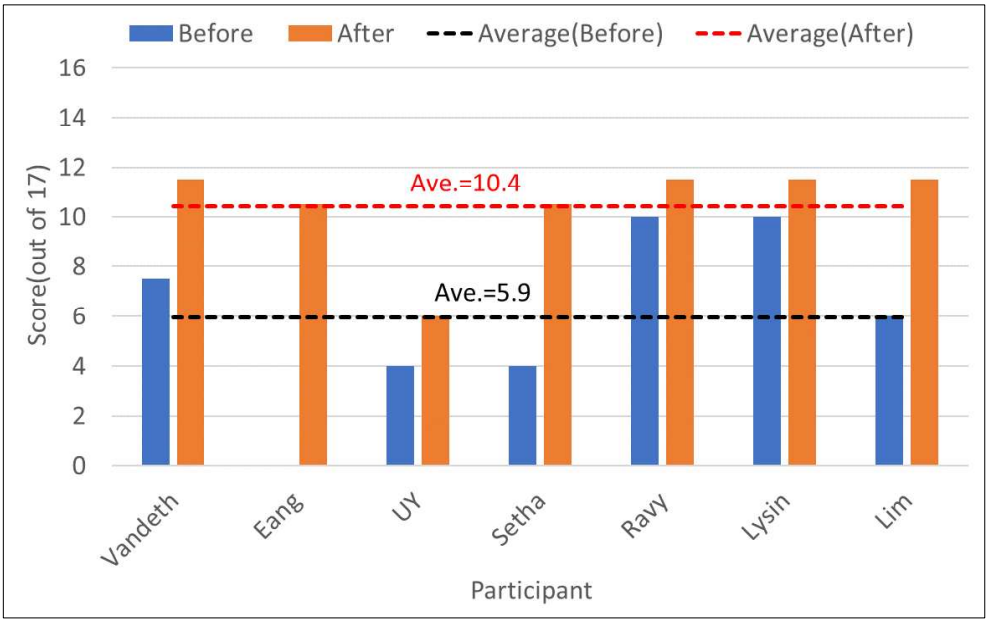


Figure 5 Test result before and after Communication System Training

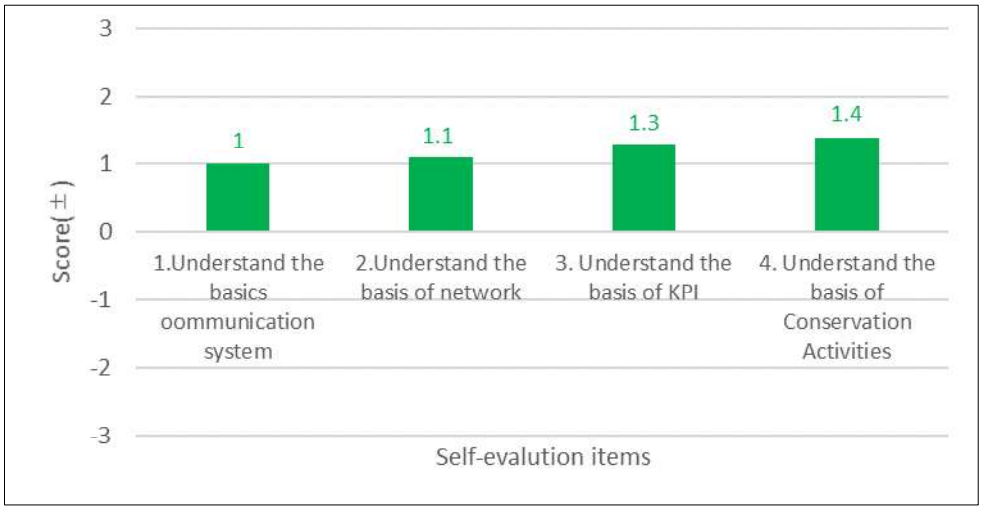


Figure 6 Self-evaluation result After training to Before training

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

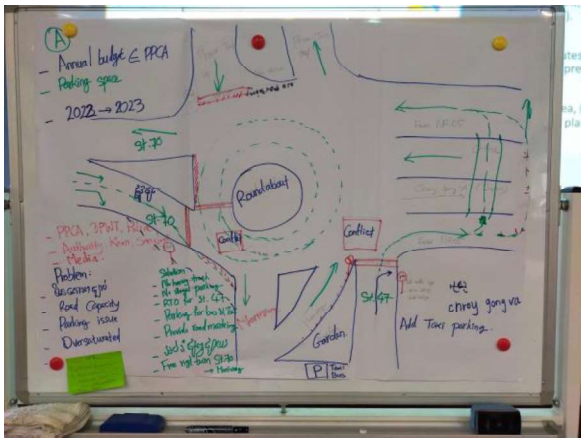
B. Parking Management Training (Day 2): The contents of training include the following:
1. Objective of JICA PPTMTC
2. Expected goals of today's training
3. Situation analysis on parking
4. Parking management interventions
5. Institutional and legal framework
6. Issues and benefits of parking management
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

- <u>Groupwork (Day 1)</u>

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:

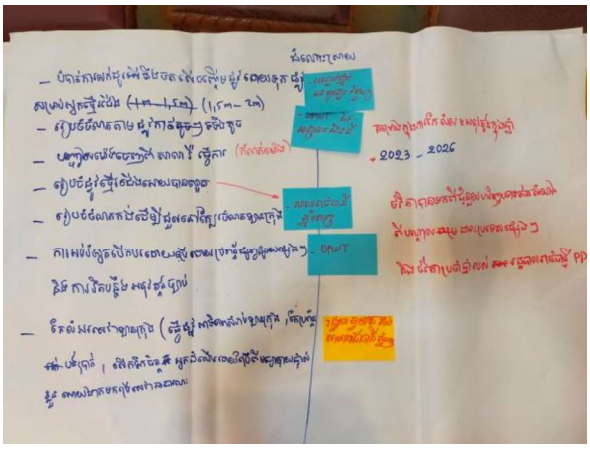
You are tasked by PPCA Governor to plan the pilot project to implement a comprehensive Traffic Management scheme to address the urban transport problem in a designated area of Phnom Penh (e.g., CBD, Central Market, Central Station).
Select the area applied to traffic management and draft a one-page pilot 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.

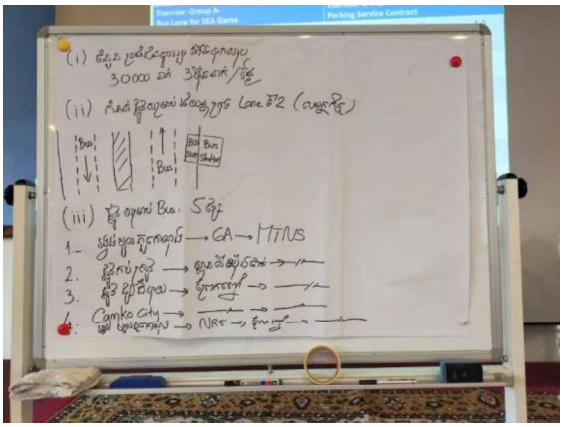
Presentation: (i) Existing traffic condition and expected traffic demand for SEA Games, (ii) Justification of bus lane, (iii) Route plan/design of bus lane, (iv) Operation plan and necessary cost, (v) Implementation schedule

Exercise: Group B- Parking Service Contract

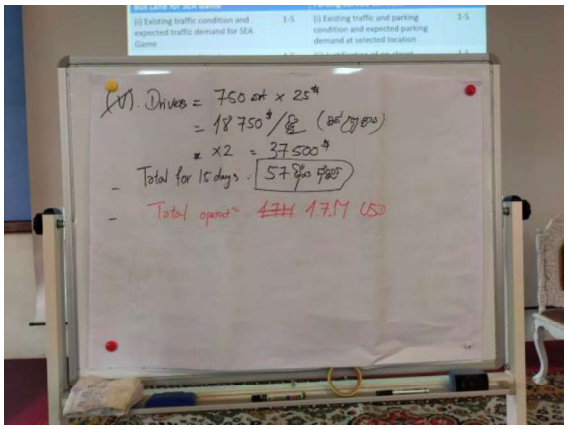
You are tasked by PPCA Governor to draft an on-street parking service contract at an optimum location and a dissemination campaign plan for the affected persons.

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.

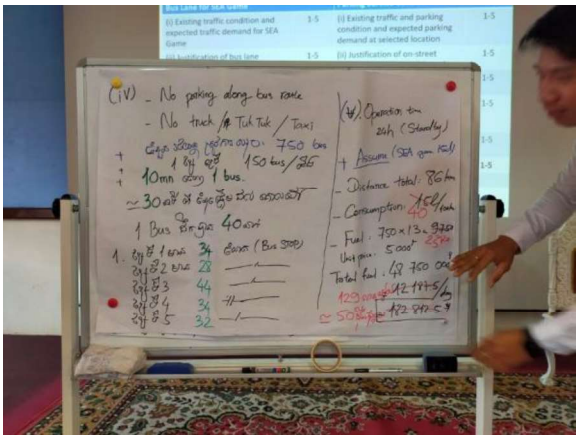
Time: 30 minutes for discussion, 30 minutes for preparation of presentation, 15 minutes presentation for each group (presentation), 15 minutes Q&A per group



Presentation by Group A

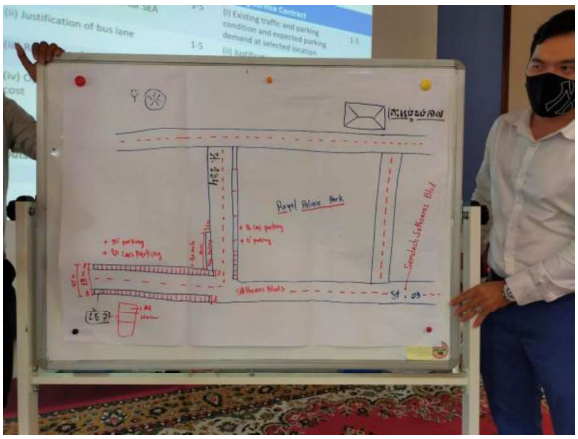


Presentation by Group A



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.

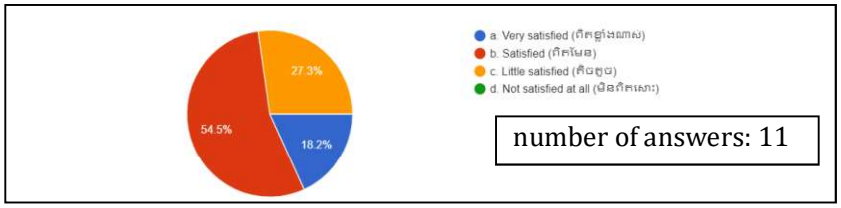
Name	Area of Responsibility	Background
Ramon Ona	Maintenance Management	He has been involved in Phnom Penh's signaling system since the soft component of the grant aid and is familiar with the capabilities of each engineer. He pointed out the importance of periodic inspections from an early stage through 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%)

Lecture
Onsite Training

(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%)

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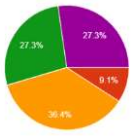
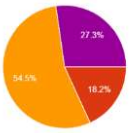
<td> 

① Maintenance Training</td>
<td> 

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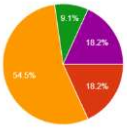
<td> 

③ Traffic Signal Control</td>
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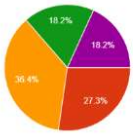
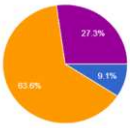
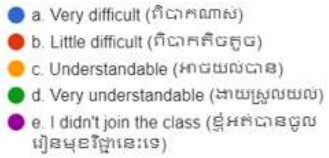
<td> 

④ Communication System Training</td>
<td> 

⑤ Traffic Management Training</td>
<td> 
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(4) Willingness to apply to Daily Work

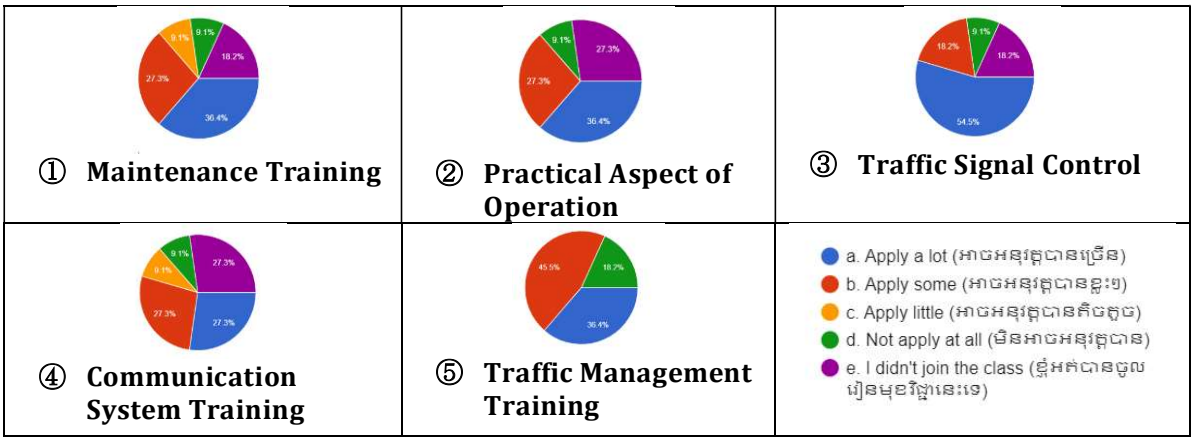
The result of willingness to apply what they learned to daily work is presented below.
It shows that the participants of ⑤ Maintenance Training have the highest "willingness to apply" to daily work. The breakdown of self-evaluations is as follows:

"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

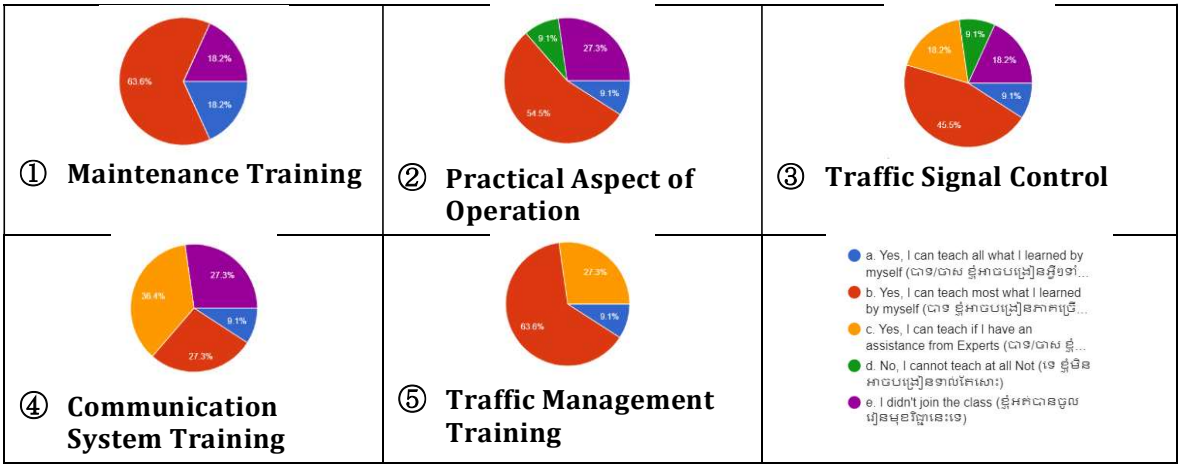
The result of "willingness to knowledge sharing" of trainees is presented below. (number of response is 11)

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.

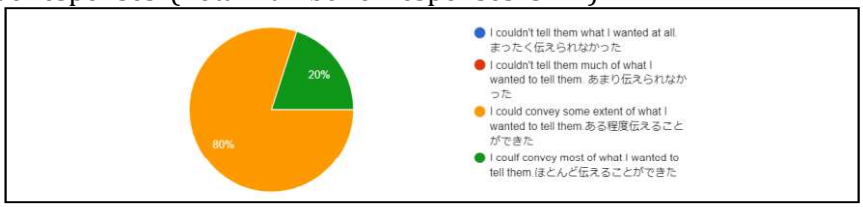
"I can teach all what I learned by myself" : 1 person (9.1%)
"I can teach most what I learned by myself" : 7 persons (63.6%)
"I can teach if I have an assistance from Experts" : 2 persons (18.2%)



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.)

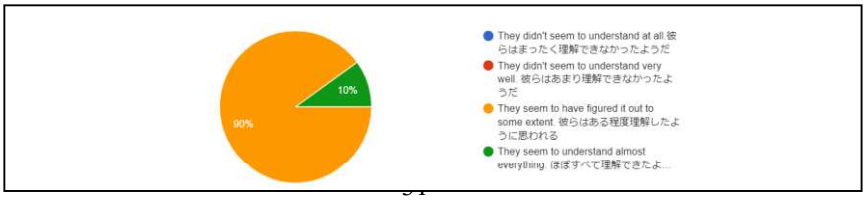


The result of free text messaging about each training contents is shown below.

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.)

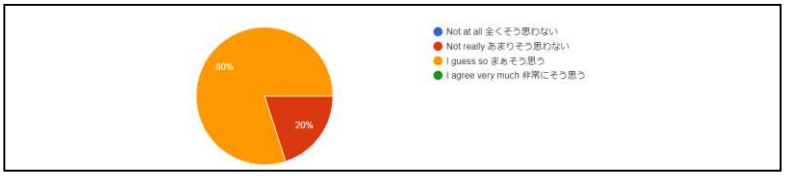


The result of free text messaging about each understanding level by lecturers is shown below.

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.

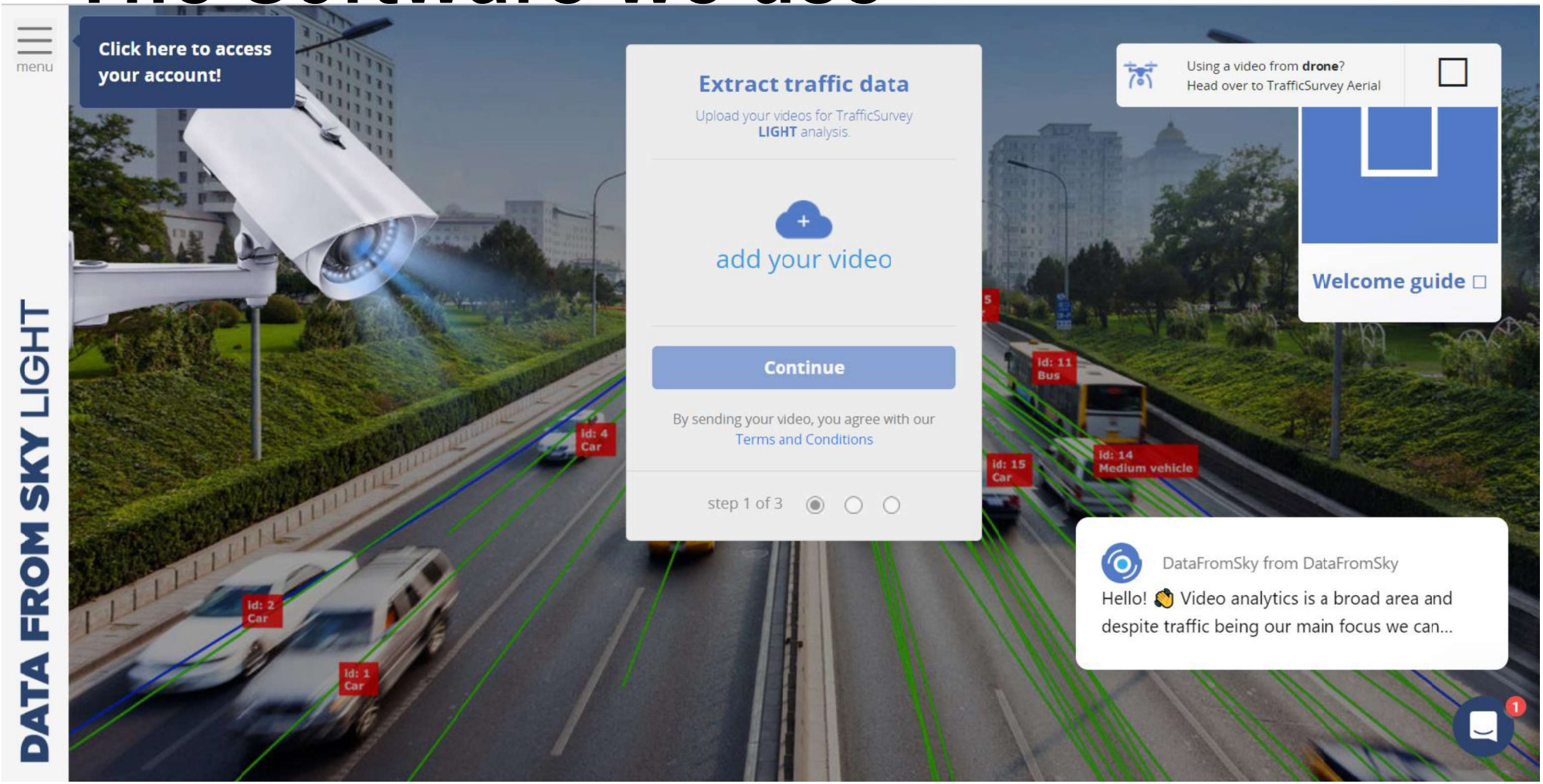
Considering these results above, JICA expert team can evaluate and conclude that training programs this time were all organically linked to the whole project and conducted successfully.

ANNEX 6: TCC 交通調査とデータ

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

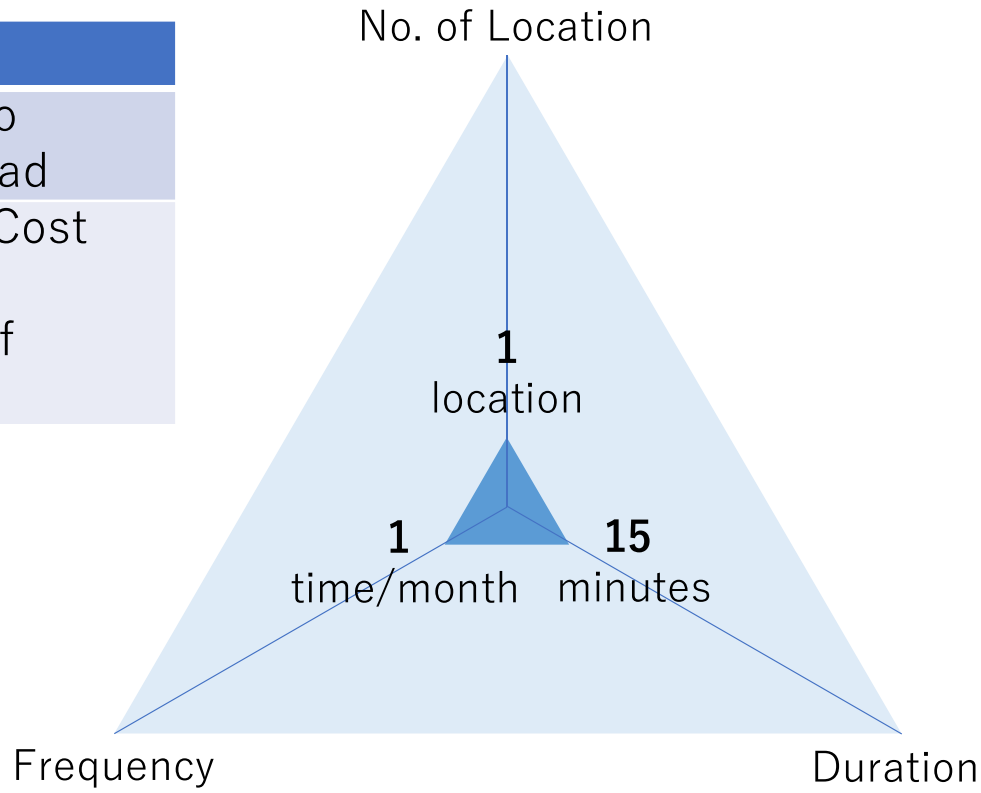
Options of Computing system

	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.

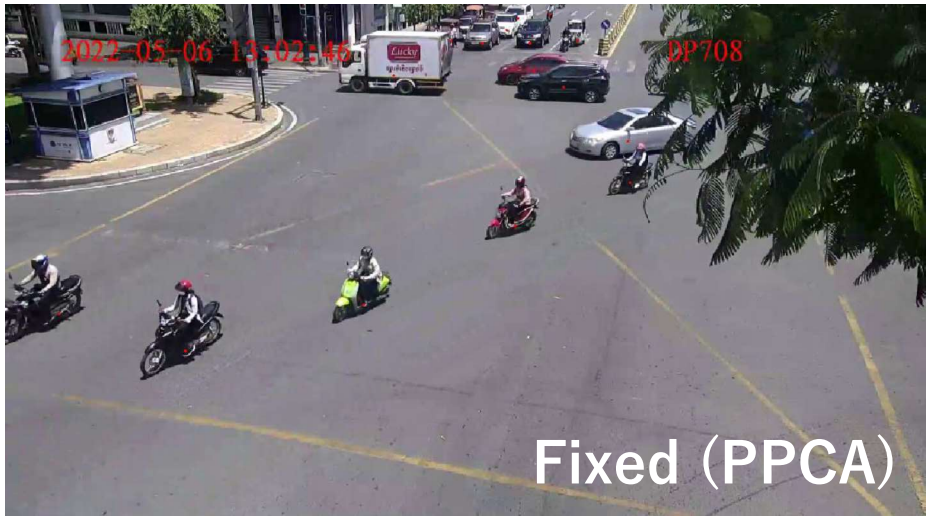
Start small and grow big.

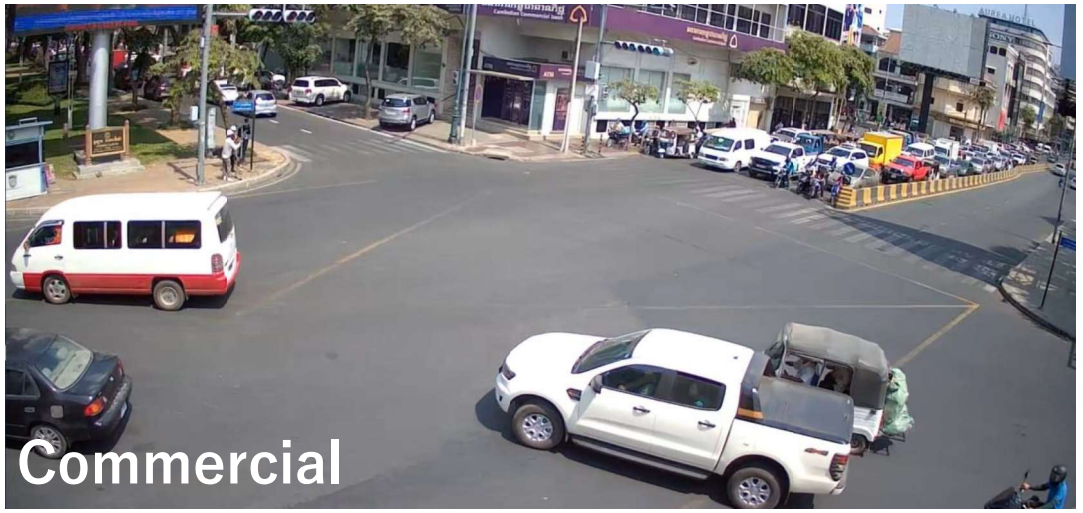
Location:
Frequency:
Duration:



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)

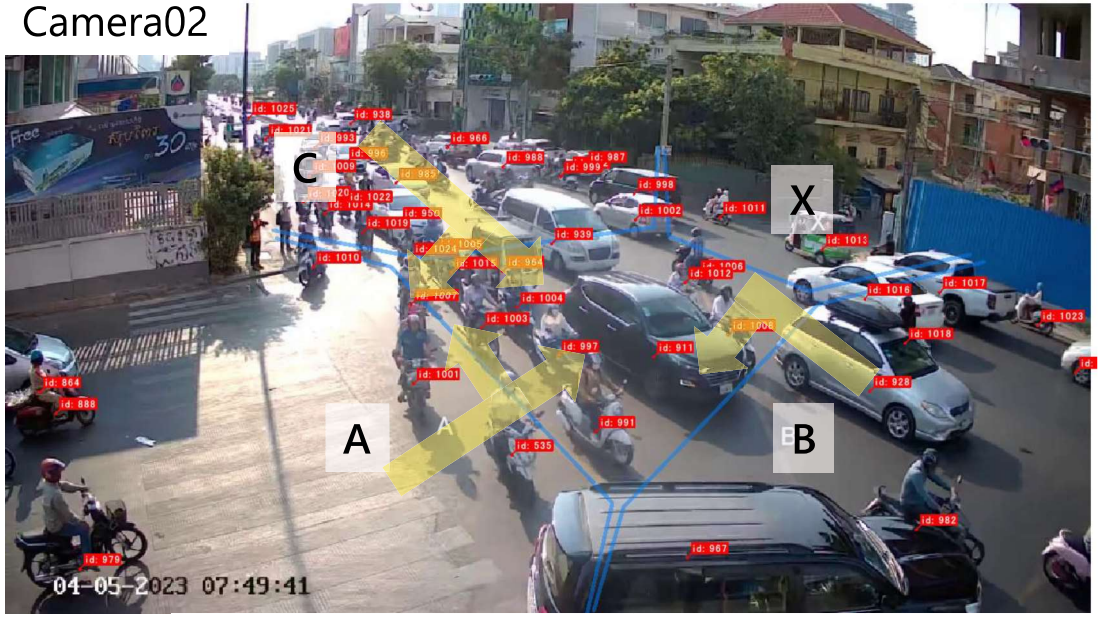
#28 (IS-3) Morning Peak (7:45~8:00)

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



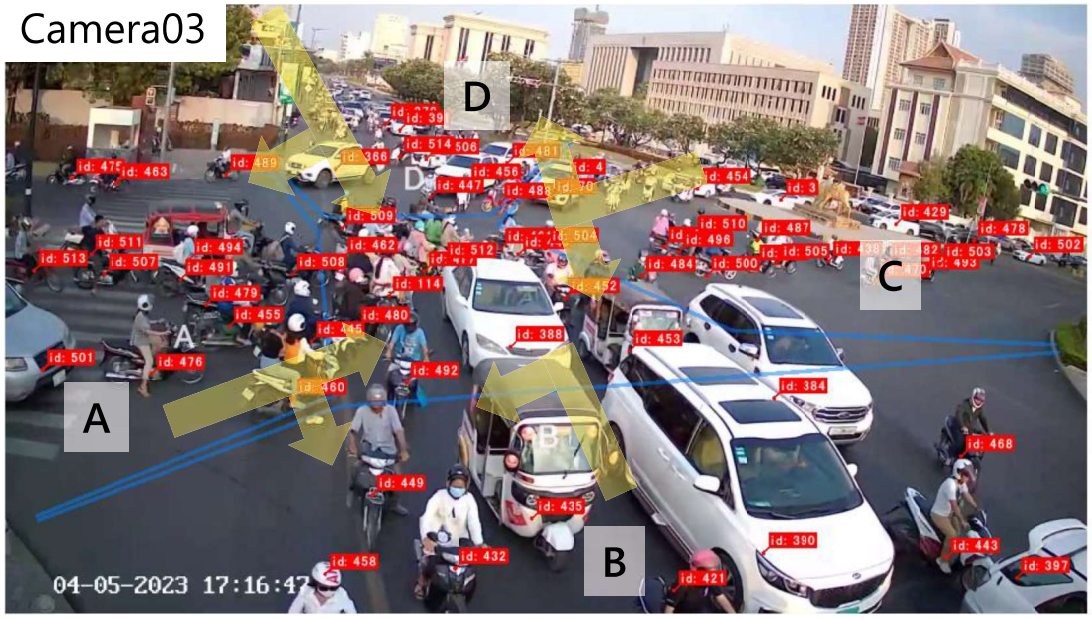
Accuracy of the DFS in PNH (Inflow & Outflow)

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

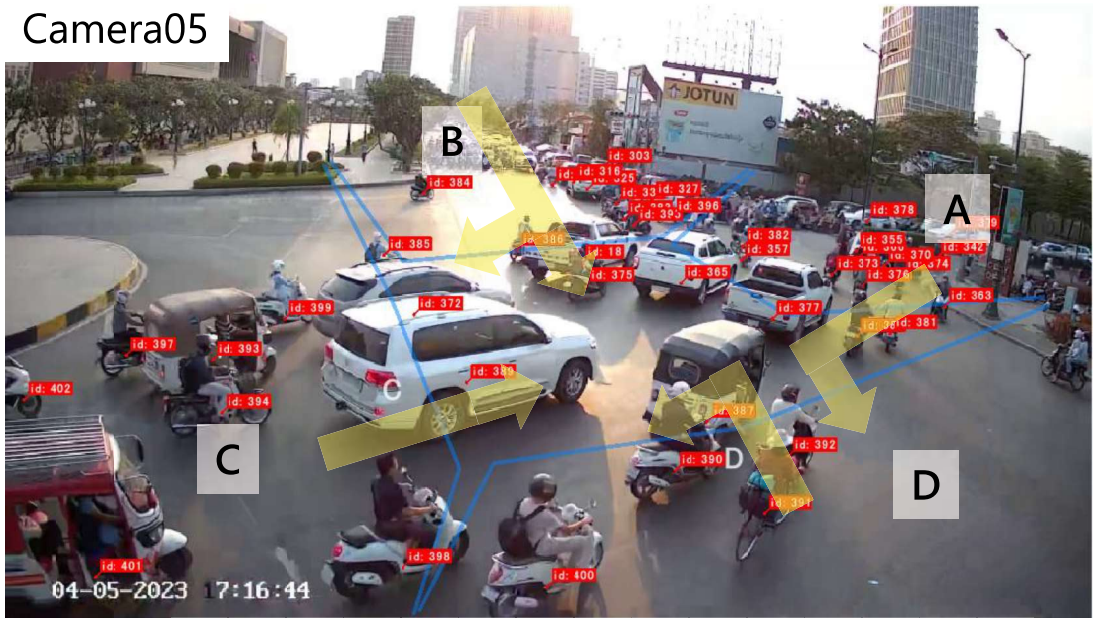
#126 (IS-4) Evenign Peak (17:15~17:30)

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

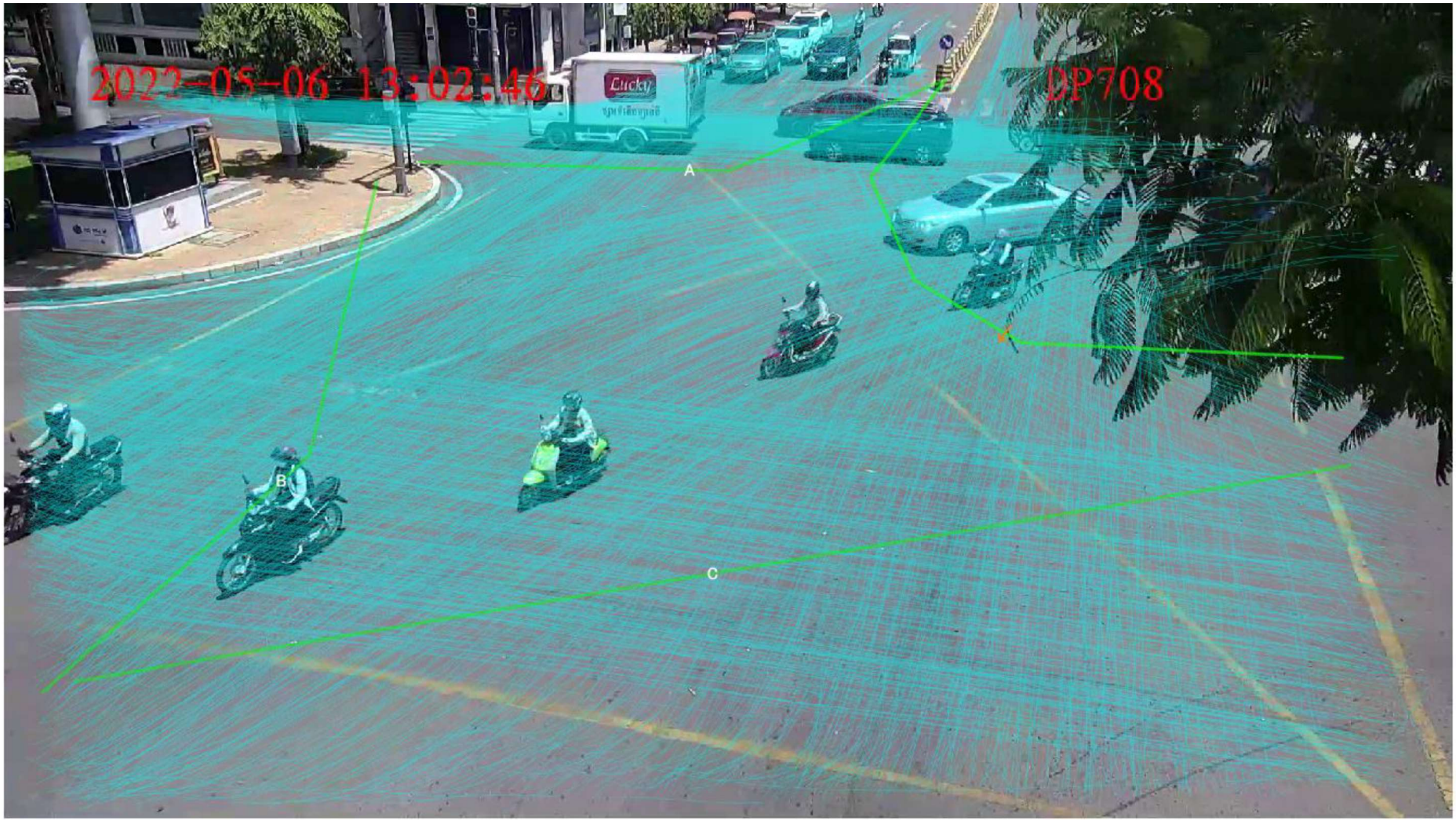
1. Set camera angle

Not required

Cut tip of the bran
if possible…

Required

4. Determine the “gates” for each inflow direction

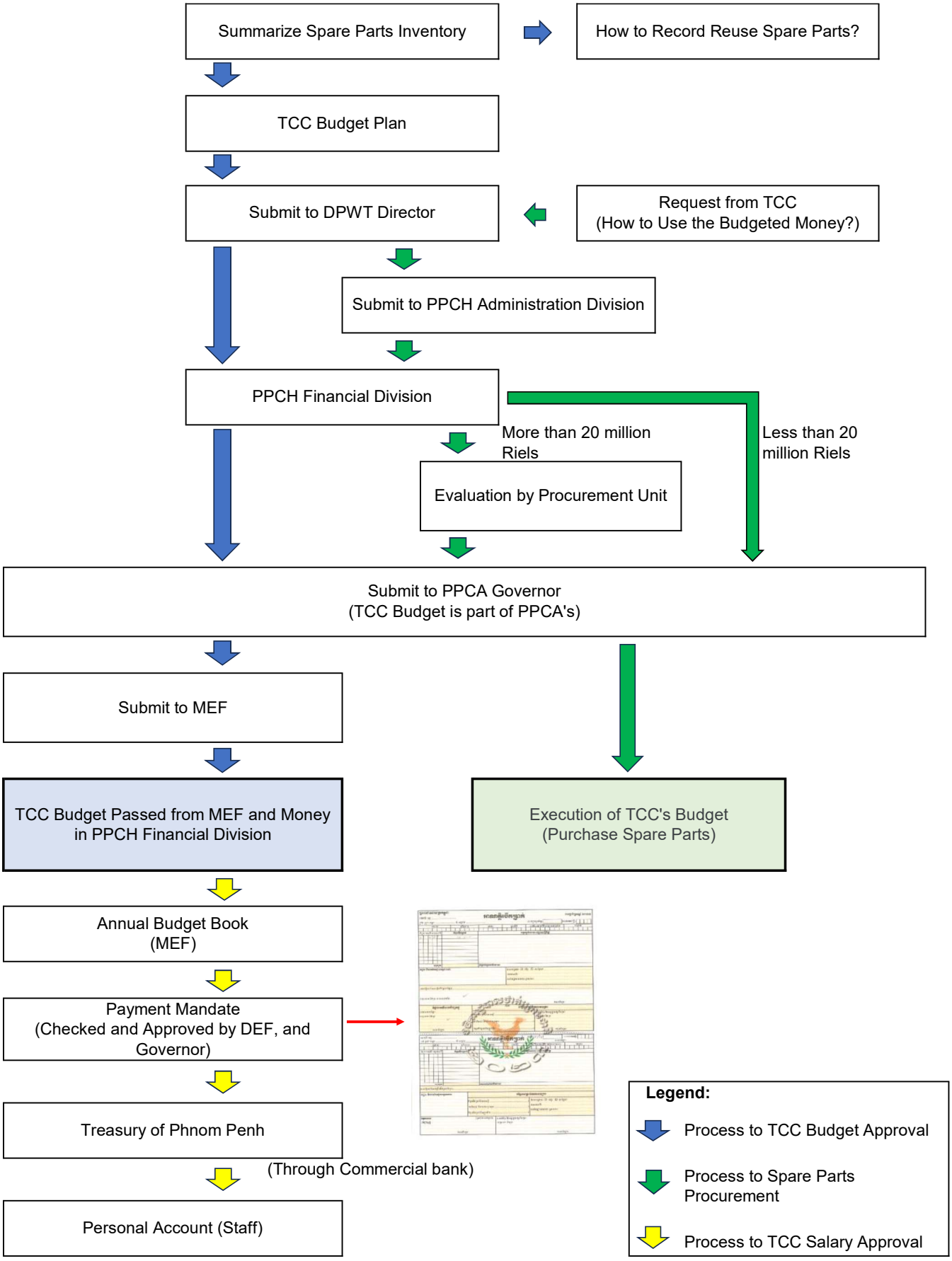


［技術作成資料］

ANNEX 7: 交通違反取締り
交通安全マニュアル

ANNEX 8: TCC の承認された予算をどのように実行するか

Annex 9: HOW TO USE TCC BUDGETED MONEY?



ANNEX 9: ピックアップトラックの免税手続きに必要な書類と手続き

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

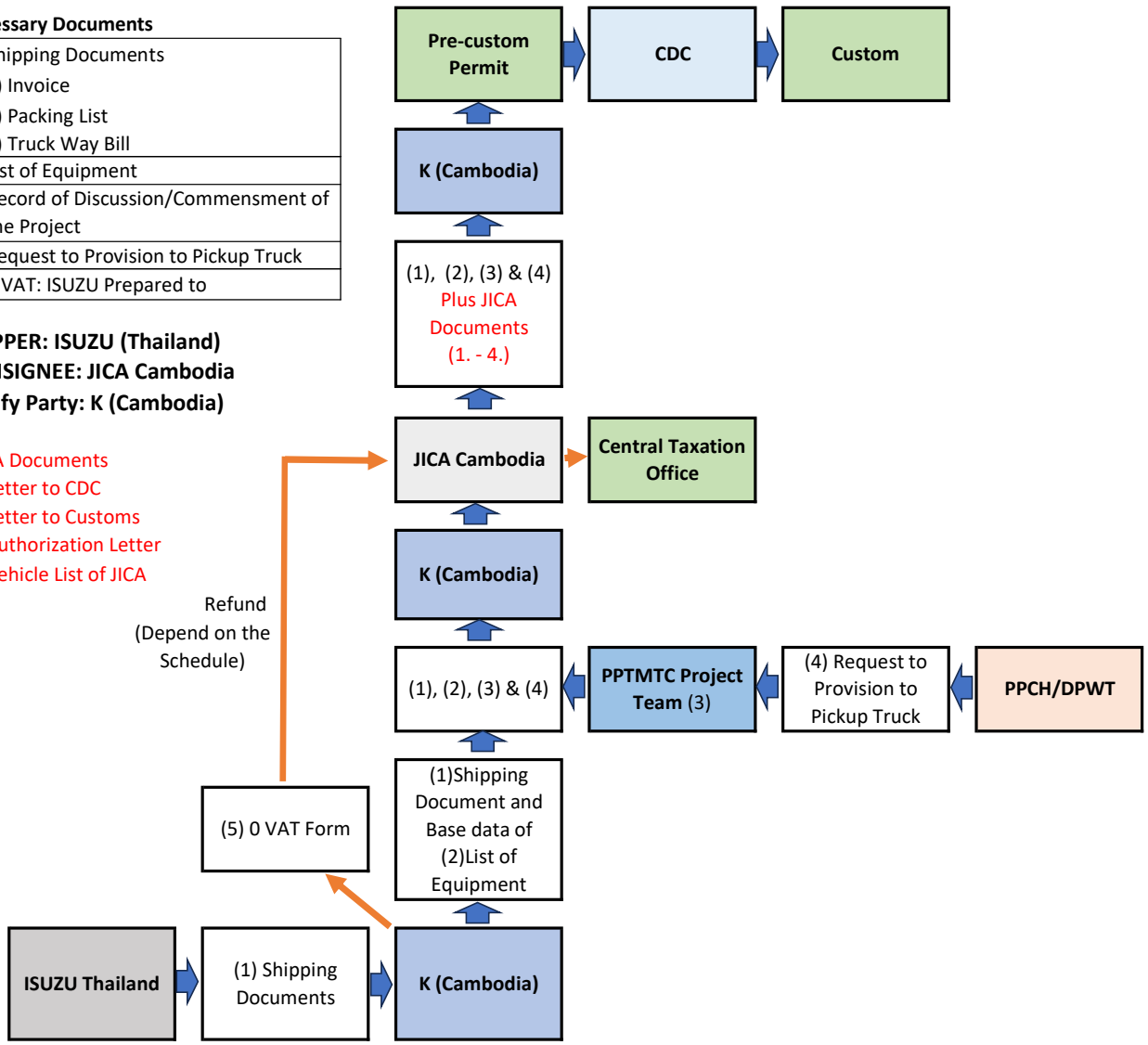
Prepared by JICA PPTMTC Project Team

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



［技術作成資料］

ANNEX 10: 信号機改良手順書（ハンドブック）

ANNEX11-0: JCC Kick off Meeting

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

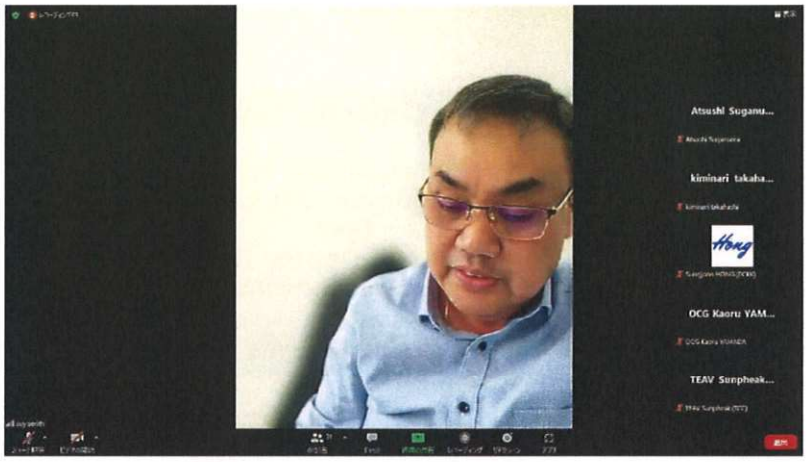
JCC Members

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

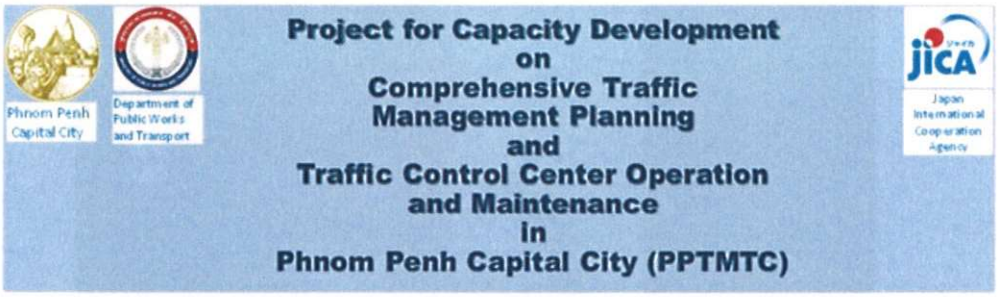


HE Suy Sareth, Vice Governor, PPCC

Mr. Tomohiro Kozano, Representative, JICA Headquarters

Mr. Chou Kimtry, Deputy Director, DPWT

4. Presentation Material



Kick-off Meeting
17 February 2022

METS
IDCJ
OC GLOBAL

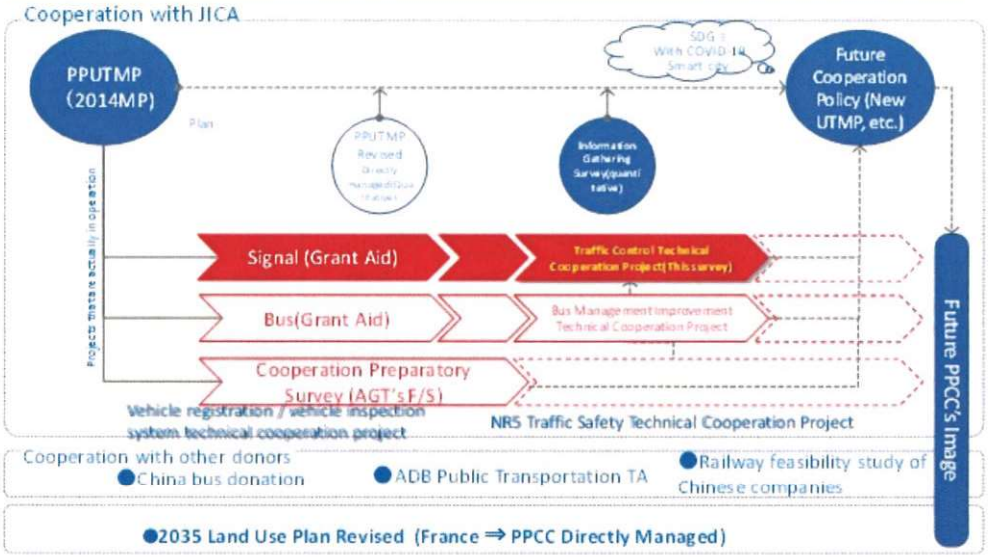
METS RESEARCH & PLANNING, INC.
INTERNATIONAL DEVELOPMENT CENTER OF JAPAN
ORIENTAL CONSULTANTS GLOBAL Co., Ltd.

1

1. Background of the Project

2

1. Background of the Project (2)



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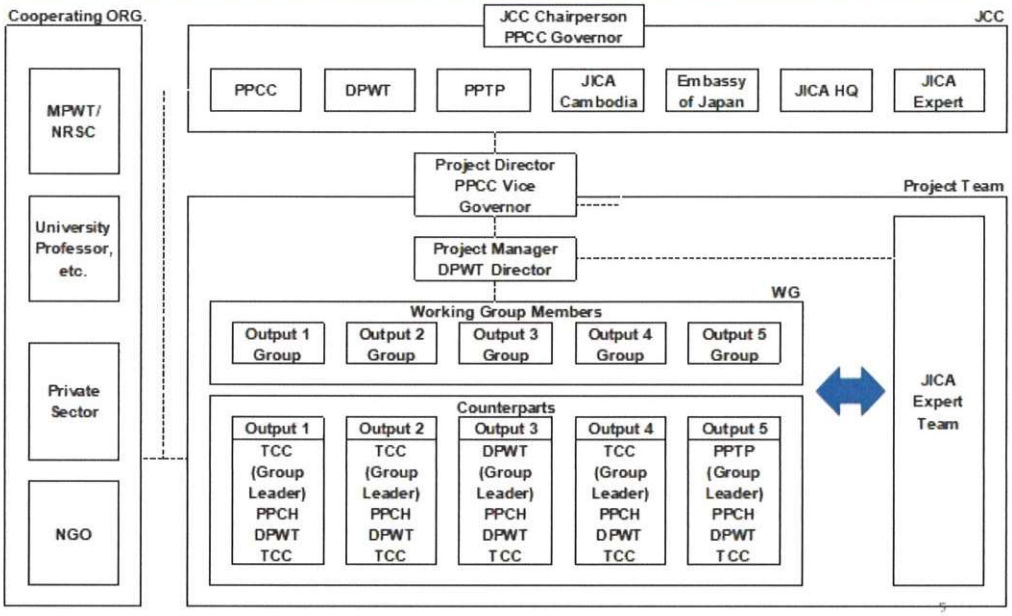
2. Outline of Project

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

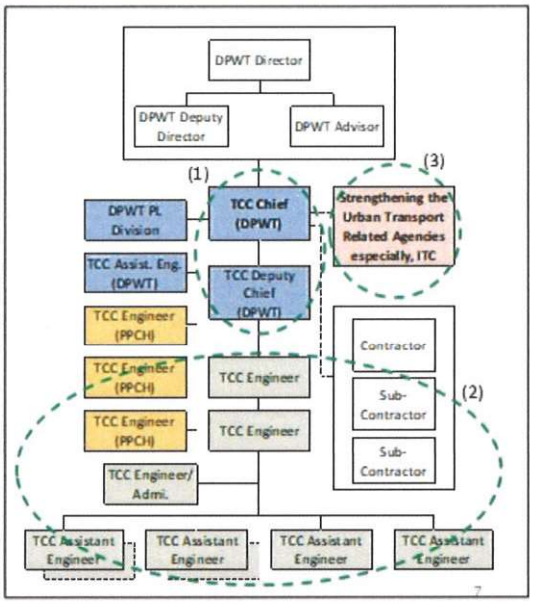
Establishment of TCC that is sustainable and maximize the organizational strength

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	TRACDUR E	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	?

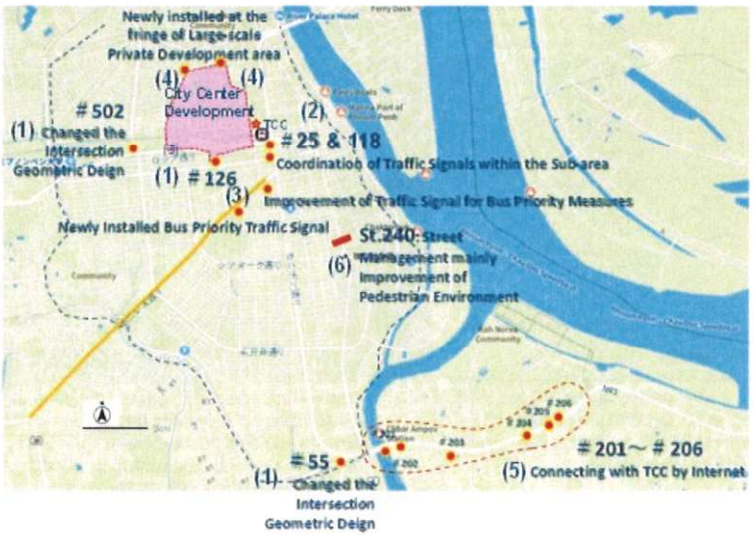
Most of them are made in developed countries and are mainly 4-wheeled vehicles, so it is difficult to recognize 2-wheeers. LUMA has many issues, but automatic counting of 2- and 3-wheel vehicles is possible at a certain level, and there is a high possibility of collaboration with this project.

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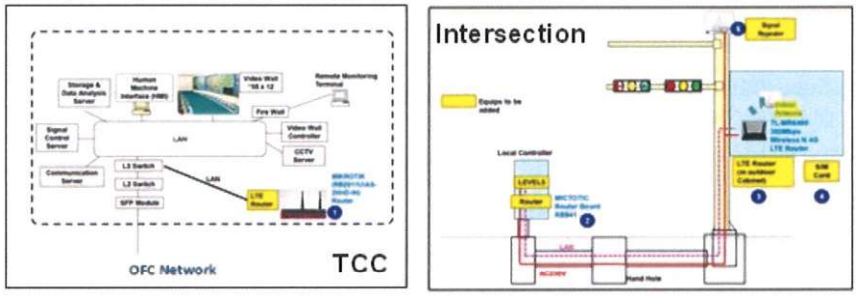
Basic Direction 3: Implementation of Pilot Projects and Support for Formulating Traffic Management Plans from the Perspective of 3Es

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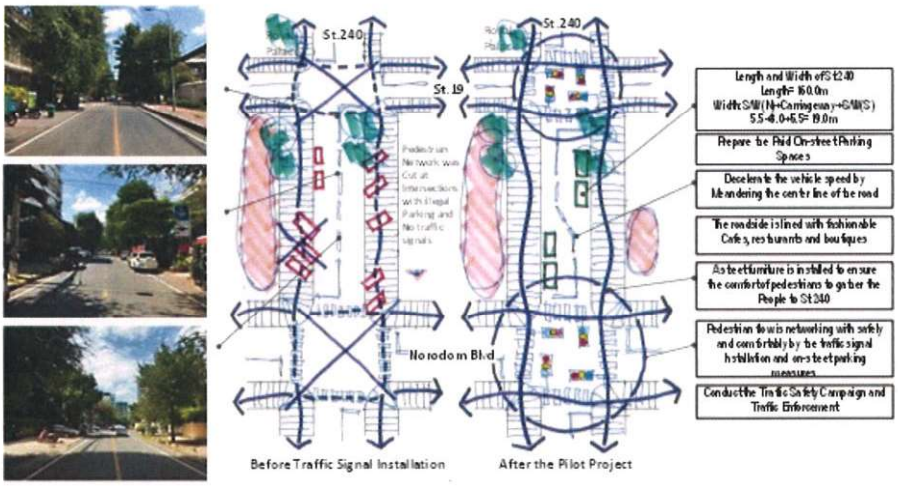
Basic Direction 3: Implementation of Pilot Projects and Support for Formulating Traffic Management Plans from the Perspective of 3Es

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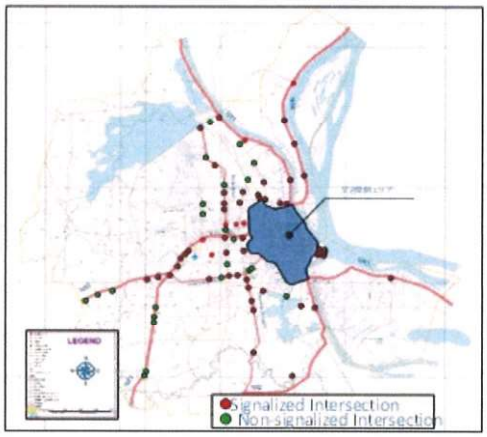
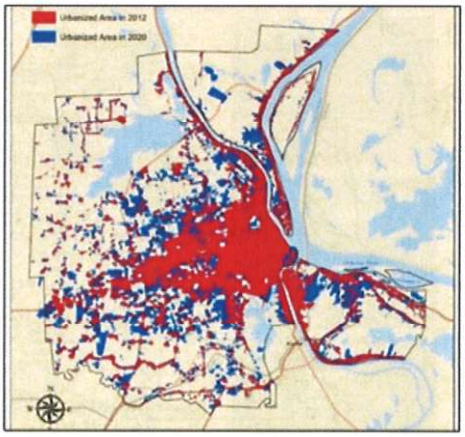
Basic Direction 4: Building a Safe and Comfortable Urban Transport Environment by Expanding the Traffic Control System throughout Phnom Penh

Signalized and Congested Non-signalized Intersections in the Suburban Area



Built-up Area in 2012 and in 2020



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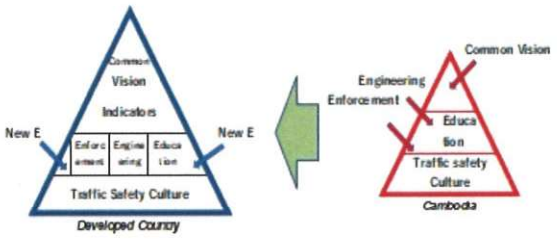
Basic Direction 5: Enlightenment of Traffic Safety Education Rooted in Social Mores and Culture, and Strengthening of Traffic Enforcement

- 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

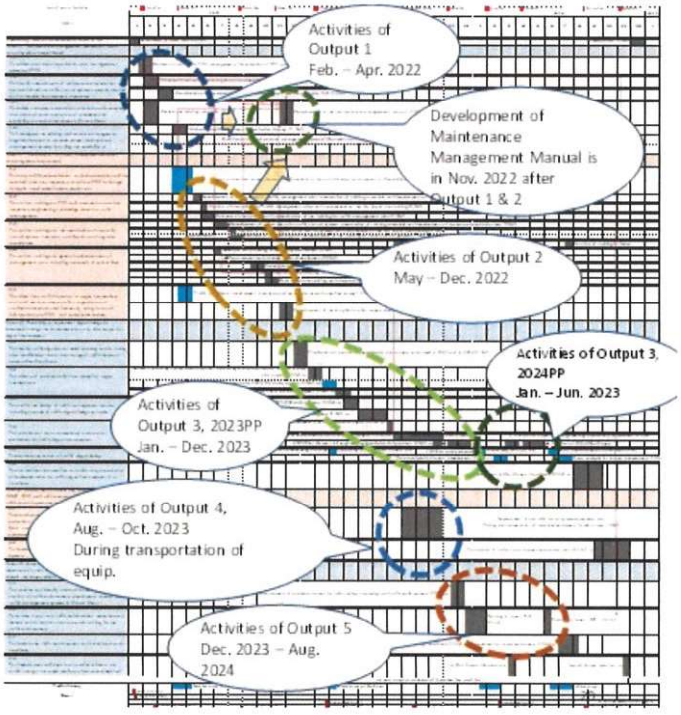
6. Project Schedule

◆ 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

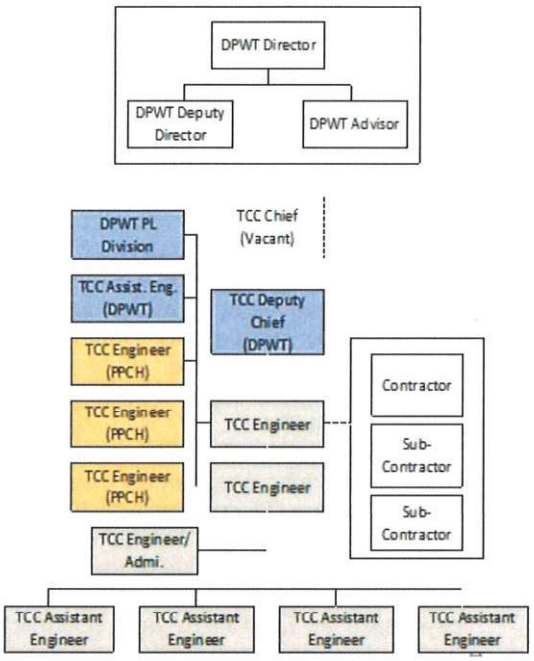


7. Current Situation of Traffic Control Center

(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	Traffic Volume along Monivong	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	After Signal System	Before Signal System	After Signal System		
	(USD/hr.)	(veh./24hr.)	11.34 km/hour	15.23 km/hour				
	①	②	③Travel Time	④Travel Time	⑤=①*②*③	⑥=①*②*④	⑦=⑤-⑥	⑧=⑦*300days
			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

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

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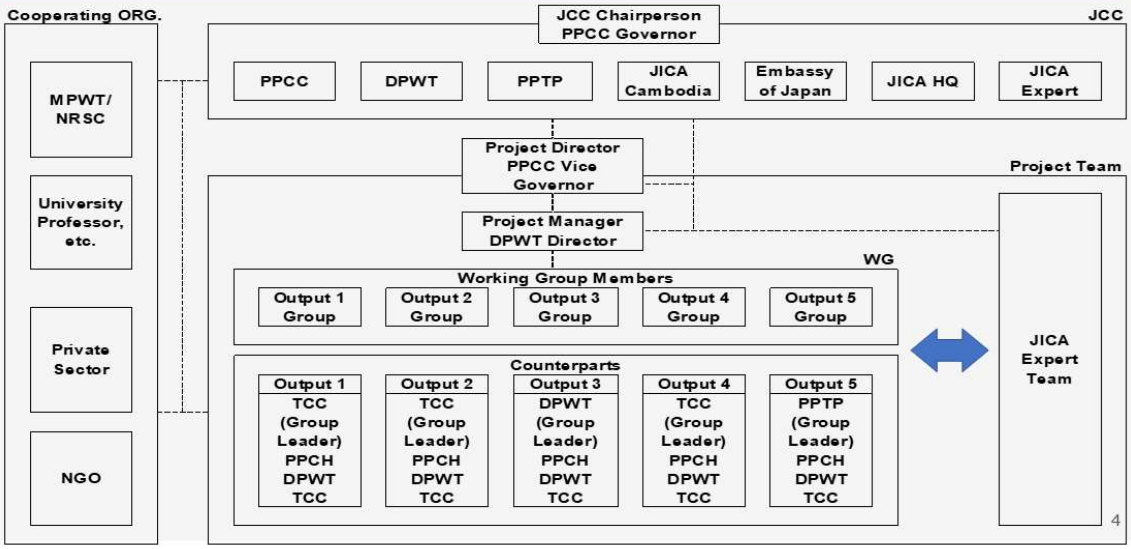
2. Joint Coordinating Committee and Project Organization



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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.

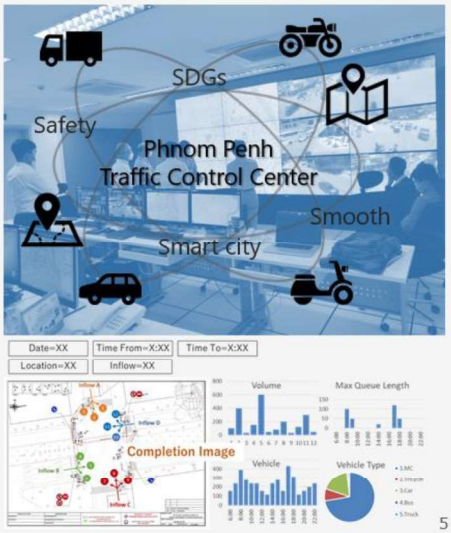
(1) Changes in people's awareness of road use

(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	Section of Monivong = 3.575km: After Signal System 15.23 km/hour	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
			③Travel Time	④Travel Time				
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).

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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.

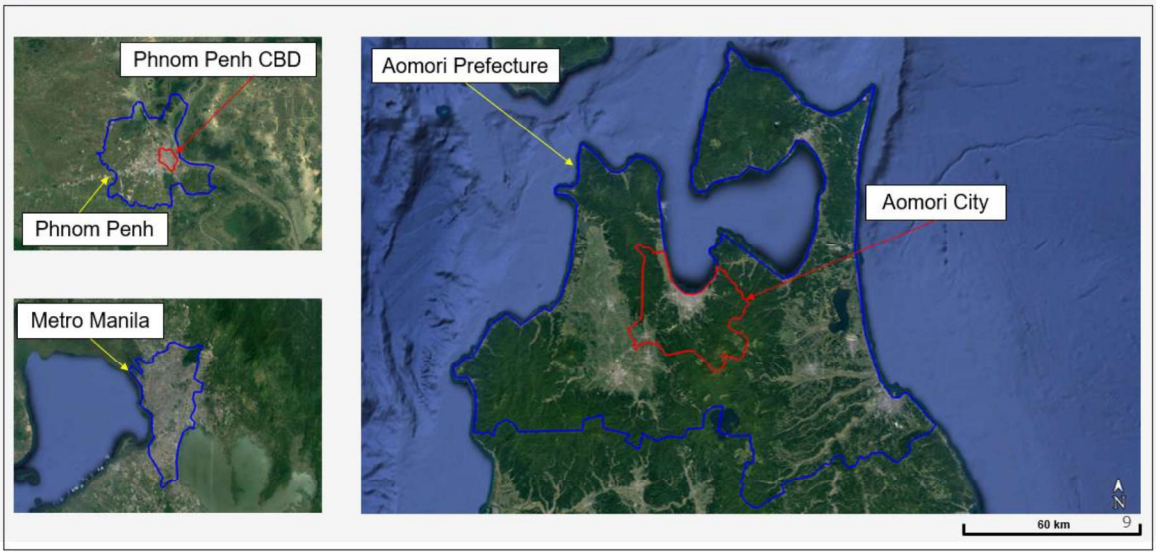
4. Metro Manila's TCC (Traffic Engineering Center: TEC) covers a wide range of fields such as civil engineering at intersection, public lighting and disaster prevention, as well as traffic control; and almost all activities are in-house; in addition, the staff of the traffic control center work in three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

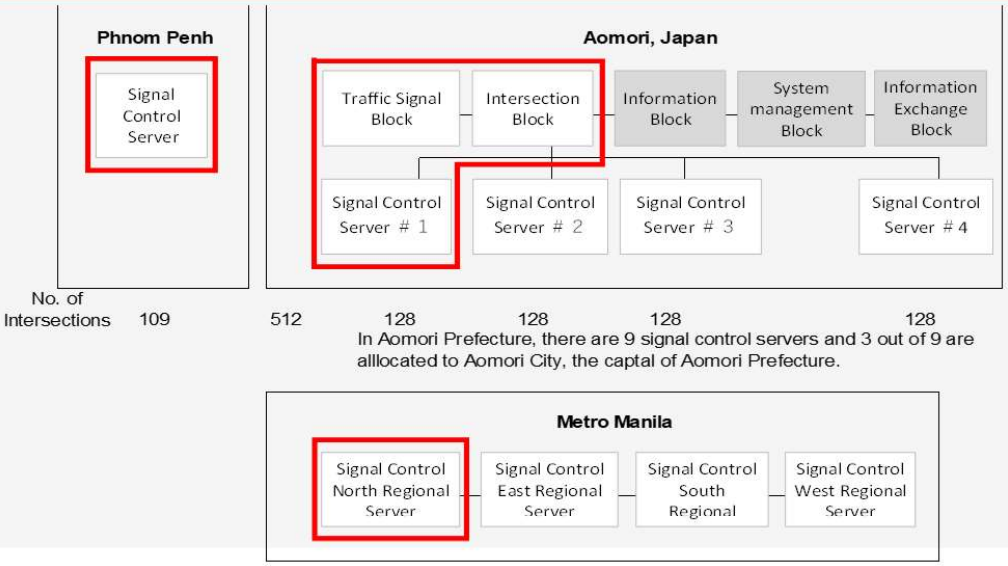
4.2 Comparison Table of TCC between Phnom Penh, Aomori and Metro Manila

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



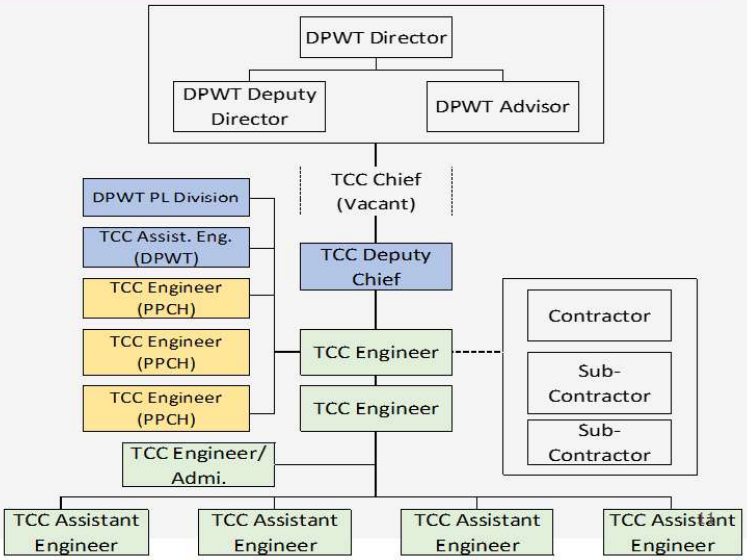
4.4 Basic Traffic Control System in the 3 Cities



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

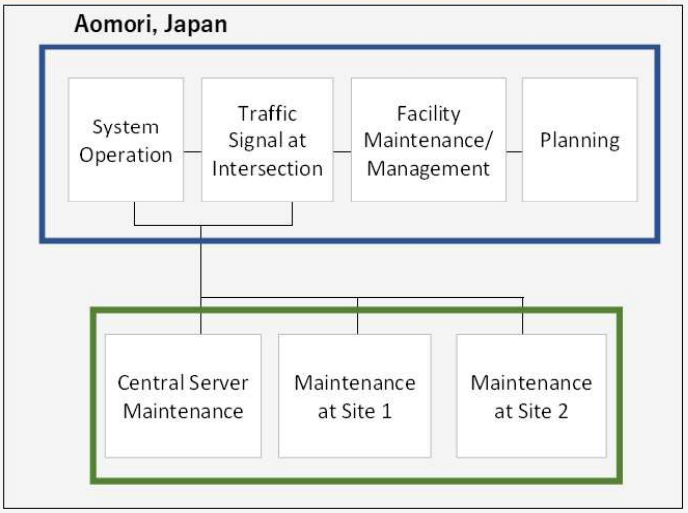
・Traffic Signal at Site: Installation and Improvement of traffic Signal at Intersection

・ Facility Maintenance/ Management: Details are not known

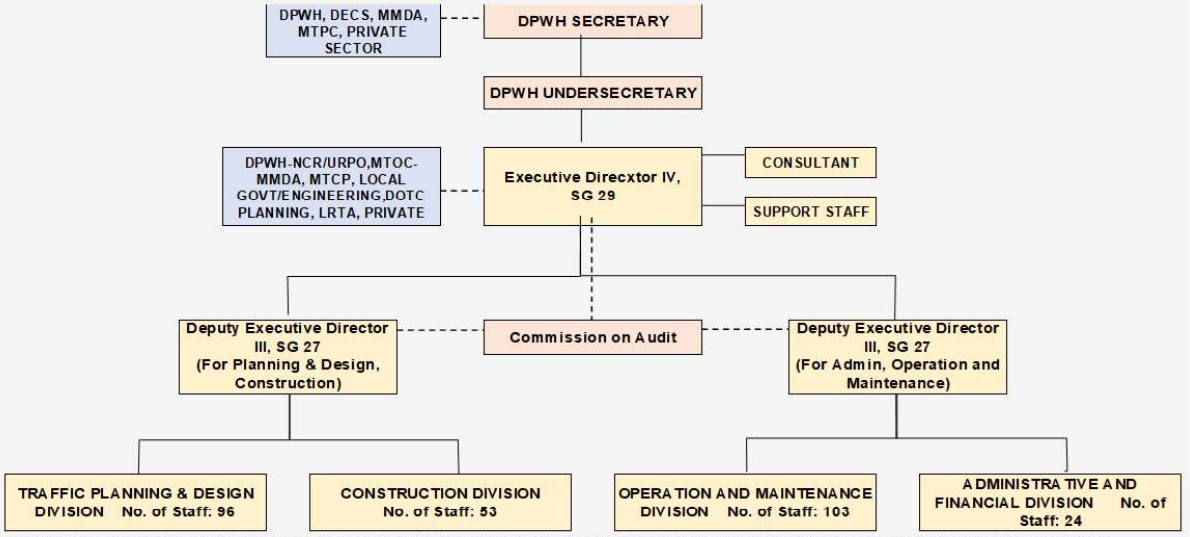
・Planning: Details are not known

Outsourcing

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



4.7 Organization Chart of TEC in MMDA in the Philippines

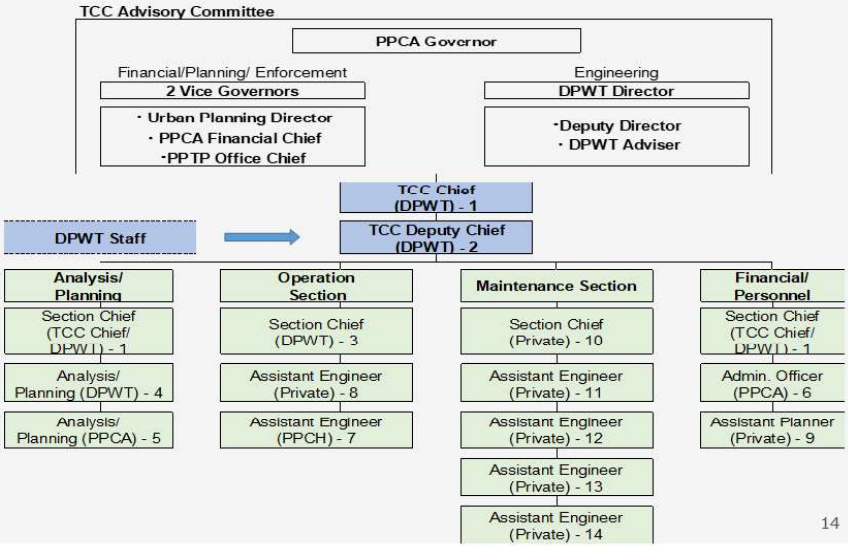


Note: Number of staff is including not only 3-shift of Operation/Maintenance Section but also Public Lighting and Disaster Prevention activities.

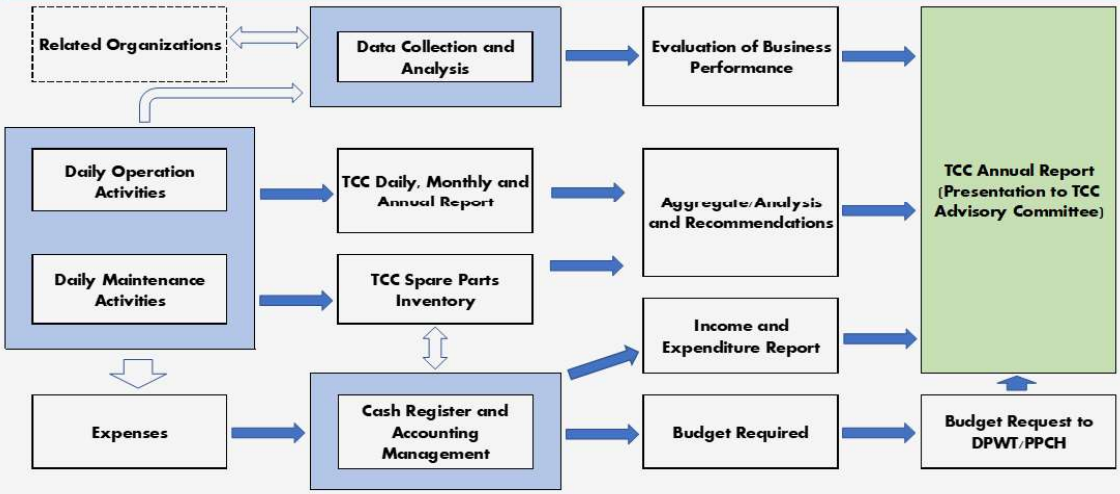
4.8 Proposed Organization of the Traffic Control Center

(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.

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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)		

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(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)

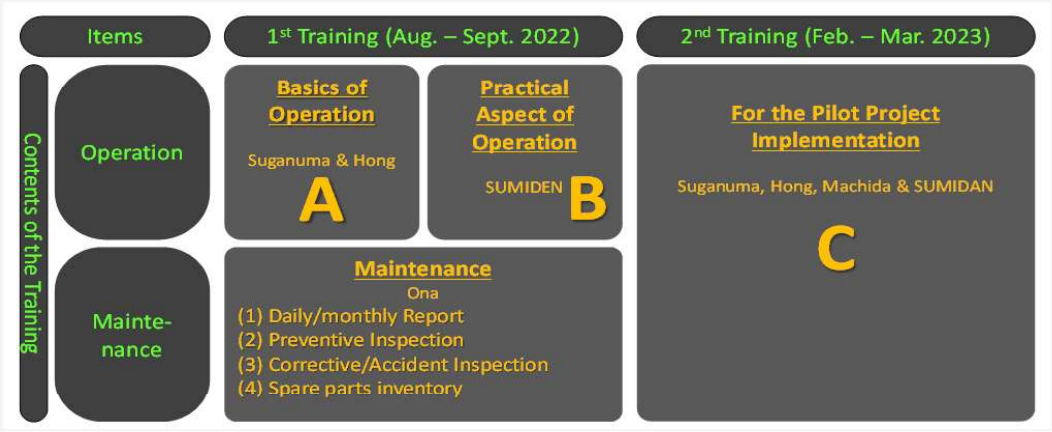
Intensive Training: Learn good practices of traffic management exercise in developed and developing countries and examine applicability of these practices into Phnom Penh
OJT: Prepare instruments to examine some of traffic management measures
Pilot Project: Test these instruments thru implementation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



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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

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

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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

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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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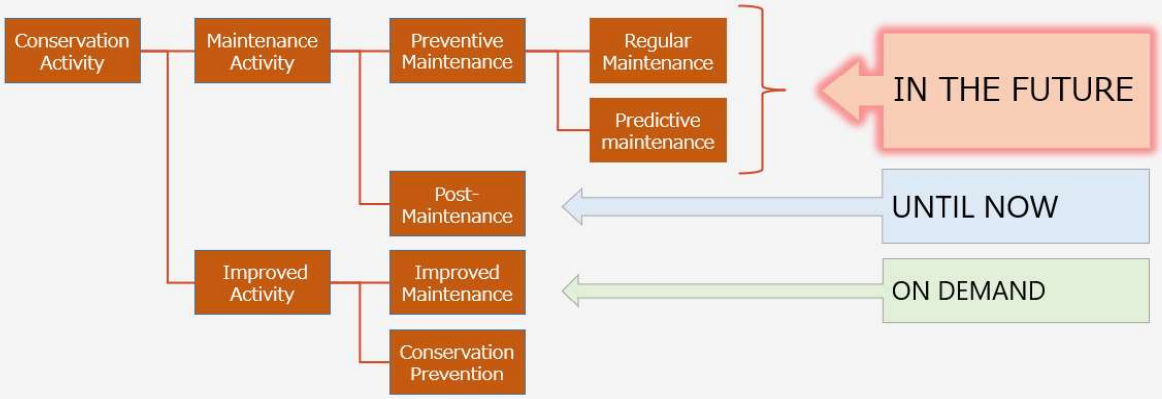
1) What is Conservation Activities?



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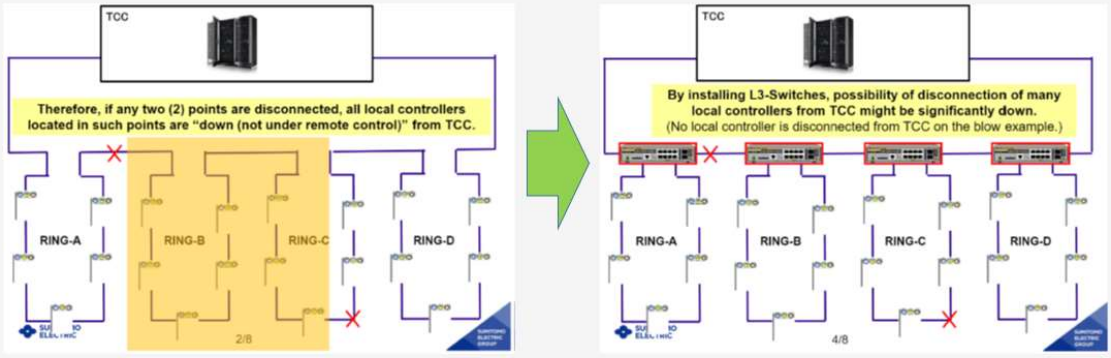
1) -1 Type of Activities and Description

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 (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)	Nos of Days	Nos of Days System Uptime	Nos of System Downtime
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 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	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 0 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 0 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
- More than 24 hours
- Less than 24 hours

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

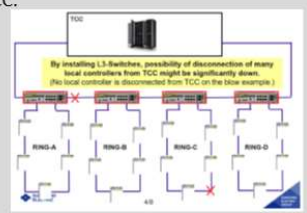
Current Issue

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.

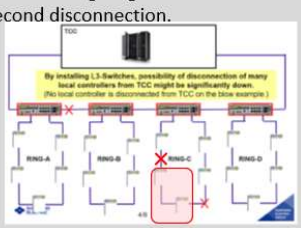
Countermeasures to current issue

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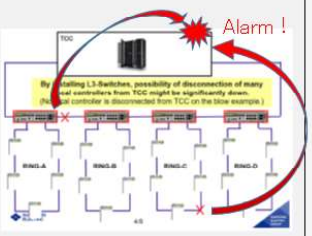
2)-3 How to perform Conservation Activities (Case Study)

Countermeasures in Current Issue

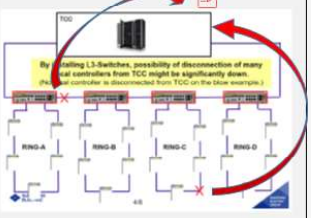
Alternative 1



Alarm sounds at TCC when the OFC is disconnected.

Alternative 2

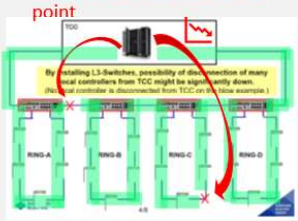
Automatically generates log



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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