

The Initiatives for Improving Traffic Congestion by Signal Control Technology



The photos of adjusting a signal light

Discussions with TCC (above),
and with TPD (below)



Technical training in Japan

(Visiting the traffic control center in Japan)

(Observational experience of signal maintenance)

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Outline of pilot projects of the traffic signal control

(1) Background

The traffic signal control system and the traffic flow simulation software have been introduced in Traffic Control Center of the Ulaanbaatar City (TCC) for the central traffic signal control system maintenance and management and traffic signal management of new installations and adjustments, etc. However, these systems are not operating properly and this improper operation is one of the causes of traffic congestion in Ulaanbaatar City. Therefore, this JICA project provided technical assistance as below to be operating properly of the traffic signal control system that has been introduced in TCC.

1. The research of specifications and operation methods of the central traffic signal control system, the traffic signals and the vehicle detectors installed at intersection, etc., and the evaluation of current systems.
2. Traffic condition survey was conducted to improve the operation methods of traffic signal control system and the necessary information for improving traffic signal control was collected by organizing the survey results.
3. Technical guidance to trainees mainly TCC engineers by the training in Japan etc.
4. Based on above the No.2 activity results, improve the operating methods of traffic signal control system (adjusting traffic signal control parameters) at typical intersections in Ulaanbaatar City.
5. The evaluation of traffic impact based on above No.4 activity.

(2) The technical training in Japan

During the period from Dec. 7 to Dec. 21, 2022, eight persons that seven TCC engineers and one TPD officer were trained in Japan for traffic signal control technology transfer.

(3) Utilization of traffic signal control technology

Through the guidance on concept of adjusting a traffic signal light with this project such as the result of adjusting a traffic signal light and the training in Japan, there was a change and improving technical capabilities in TCC engineer's approach to the traffic congestion. In the future, this project have set the goal of utilizing their abilities acquired in this project and hope that effective measures aiming to alleviate traffic congestion will be adopted and implemented by Ulaanbaatar government.

The effect by improvement operation methods of traffic signal control system

This newsletter shows the effect of adjusting a traffic signal light in Jan. 23, 2023 by comparing two results of traffic condition survey in Sep. 29, 2022 and Feb. 9, 2023.

(1) About the 13 intersections targeted for this pilot project

Base on the result of traffic count survey, TCC engineers with JICA Expert Team (JET) adjusted signal lighting durations of traffic signal at target intersections (Fig.1) by timeframe.

Initially, 13 intersections were considered for this pilot project, but 3 intersections (● symbol) were unable to reflect the proposed adjustment due to a problem with the signal controller, and the remaining 10 intersections (● symbol) had their signal lighting durations adjusted. The effect of adjusting is shown by comparing traffic volume, congestion length, travel time, and traffic signal intervention of TCC before and after adjusting.

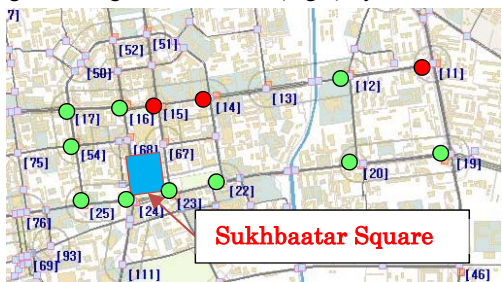


Figure 1 Target intersections

(2) The effect to traffic volume and congestion length

16 hours (6:00-22:00) traffic volume in all direction at target intersections increased in 7 out of 10 intersections, with a percentage increase of 3% across target intersections. The congestion length at target intersections decreased in 5 out of 10 intersections, with a percentage decrease of 4% across target intersections. By extension of lighting durations in direction of heavy traffic by timeframe base on the result of traffic count survey, traffic volume increased, congestion length decreased and it can be considered that traffic congestion has partially eased.

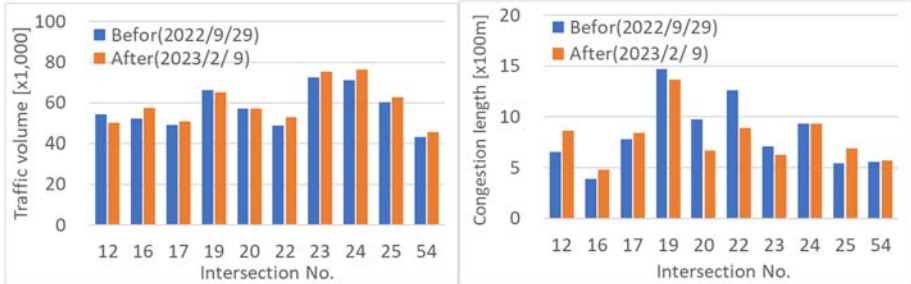


Figure 2 16 hours traffic volume and congestion length at target intersections

(3) The effect to travel time

Travel time excluding results suspected of being affected by special circumstances such as traffic control by the police decreased in 5 of the 12 routes traveled (3 time zones (morning, noon and evening), 2 routes, outward and return). Since the travel time fluctuates greatly depending on the time of travel, the travel time increased or decreased depending on the number of travel.

(4) The effect to traffic signal intervention of TCC

When detects massive traffic congestion etc. from the footage of intersection, TCC intervenes in traffic signal that extend the signal lighting durations in that direction. Traffic signal intervention at 14 intersections decreased from 340 before signal lighting adjustment to 315 after the adjustment, and the total time taken to intervene traffic signals of 14 intersections decreased from 18 hours 20 minutes 26 seconds before signal adjustment to 11 hours 40 minutes 49 seconds after signal adjustment. The average time taken to intervene traffic signals decreased from 3 minutes and 14 seconds before signal adjustment to 2 minutes and 13 seconds after signal adjustment. This improvement is a result of TCC learning through training in Japan that traffic signal intervention has an adverse effect on traffic flow, and TCC and TPD discussed in the end of January to decrease the signal intervention and to set a time limit of the signal intervention (unlimited → within 240 seconds). By signal adjustment, it is thought that the traffic signal control intervention was reduced and the traffic congestion was partially cleared.

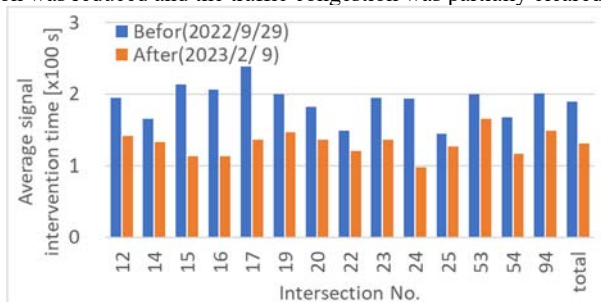


Figure 3 Average signal intervention time at target and neighboring intersections

Issues related to improving traffic conditions in Ulaanbaatar City

In this project, changes in traffic conditions before and after the signal lighting adjustment were compared in terms of traffic volume, congestion length, travel time, and signal intervention, and partial impact of signal adjustment were observed. However, the grasped traffic conditions before and after the adjustment were not only the impact resulted from traffic signal adjustment in this project, but also the reduced intervention in traffic signals implemented by (1) TCC by utilizing the technology transferred in the training in Japan,, (2) the traffic control reduction ignoring the signal by police officer, and (3) the improvement of traffic congestion in urban areas through traffic control in Zaisantolgoi area which was advised by JET.

In addition, since the traffic signals in Ulaanbaatar City are controlled by pre-timed control and not by traffic-actuated control that based on the traffic conditions, there is a limit to improvement by adjusting a traffic signal light. Since the traffic volume in the city is expected to continue to increase in the future, it is thought that the introduction of traffic-actuated /interconnected control-type signal that based on traffic conditions measured by vehicle detectors will be effective.

It should be noted that it is difficult to fundamentally improve the traffic congestion in Ulaanbaatar City only by adjusting traffic signals, and complex measures such as adjusting traffic signals, rearranging lanes, improving roads, improving public transportation systems, adjusting traffic demand, and improving traffic manners are required. It is necessary for Ministry of Environment and Tourism to take the initiative and cooperate with Ministry of Road and Transport Development and Ministry of Mineral and Heavy Industries to promote measures against sources of pollution from vehicles.

Technology transfer by this project

- The acquisition of the technology related the signal lighting adjustment is needed to operate the traffic control system and to achieve the activity related the signal control pilot project. Therefore, technology transfer will be carried out in this project, learning traffic technology in general, learning through practice about the signal lighting adjustment based on the result of the traffic condition survey, and conducting a training in Japan to acquire the knowledge and skills for operation of the future traffic control system.



Utilizing the output of this project

- This project hope to the professional agencies in Ulaanbaatar, they take the lead to carry out the signal lighting adjustment according to traffic condition based on a traffic condition survey data as like in this pilot project, appropriately, in earnest, and expand to throughout Ulaanbaatar. This project also hope that these actions will reduce air pollutants and alleviate traffic congestion.

Figure 4 Flow of future utility of signal control technology