Establishing Logical Framework For Nairobi ITS Establishment & Junctions Improvement Project

Summary

Industrial-Academic Cooperation Foundation
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Chapter 1
Project Background Survey

1. Project Overview

1) Background and Necessity of the Project

○ In Nairobi, i.e. the capital city of Kenya, the number of registered vehicles increases annually despite the limited road network, resulting in severe traffic congestion at the center of the city. Moreover, increases have been seen in delays and transit time at intersections, casualties and injuries owing to traffic accidents, and air pollution emissions attributable to automotive exhaust gas.

○ In Nairobi, traffic congestion at the city's center occurs due to roundabouts. Such road system allows smooth traffic flow when there is no signal wait time with a low traffic volume. However, when traffic volume is high, the delay time in the intersection becomes prolonged, resulting in the interruption of traffic flow. In addition, intertwined traffic flows frequently often lead to collisions, thereby increasing air pollution emissions owing to traffic delays.

○ To solve this problem, the Kenyan government plans to remove the roundabouts and build the Intelligent Transportation System (ITS) on major arterial roads in Nairobi. Furthermore, the Korean government intends to support the ITS project of the Kenyan government. For the success of the ITS project in Kenya, it is necessary to complete the "Establishing Logical Framework for Nairobi ITS Establishment and Junctions Improvement Project."

2) Scope of Project

○ This study is an advance analysis of whether traffic flow can be improved by building the ITS on major arterial roads in Nairobi, compared to the current roundabouts. It also analyzes (i) whether the incidence of air pollution and traffic accidents will decrease for the mid- to long-term result (i.e. impact) and (ii) whether delays and transit time at intersections will be improved in terms of the short-term result (i.e. outcome). Thus, the scope of consultation is the determination over whether the ITS project in Nairobi is appropriate.

○ Through a literature review, this study investigates the general situation of Kenya including Nairobi, the Kenyan National Spatial Plan, the Nairobi Metropolitan Development Plan, and the Nairobi Metropolitan Spatial Development Plan to understand the project's background.

○ The field survey in Nairobi will help identify the status of road traffic in the city as well as the demand of project beneficiaries in order to establish a framework for the ITS project in Kenya.

2. Transportation Status in Nairobi, Kenya

1) Arterial Road Status of Nairobi

○ The urban arterial road crosses the south–north axis and the east–west axis around the intersection adjacent to the Nyayo National Stadium. The Mombasa Road to the south and the Uhuru Highway to the north form the south–north axis; the Lusaka Road to the east and the Langata Road to the west constitute the east–west axis.

○ In the north of the Uhuru Highway, the Meru-Nairobi Highway forms a T-shaped connection and leads to Ruiru city located in the northeast of Nairobi.

○ The most complex intersection in Nairobi is the University Way Uhuru Highway Roundabout near the Kenya Methodist University where the Uhuru Highway and the University Way intersect.

○ Nairobi's arterial roads which were mostly developed during the British colonial period are in an irregular linear type, not a lattice type. Most vehicles pass through the center of Nairobi since there are no beltways around the outskirts of the city.

2) Road Traffic Status of Nairobi

○ According to the 2011 Commuter Pain Survey (i.e. Traffic Congestion Index) conducted by IBM regarding the 20 major cities, Nairobi, Kenya, was ranked fourth, as one of the most crowded cities around the world.

○ Reportedly, the Kenyan government suffers an economic loss of USD 580n thousand per day and USD 220 million per year due to heavy traffic congestion in downtown Nairobi.

○ According to the "Kenya ITS Feasibility Study Report (2017)" by the World Bank, the daily number of vehicles passing through the major arterial roads in Nairobi was the highest—49,500—between the Mombasa Road and the Uhuru Highway, forming the south–north axis and the second highest—48,500—on the east–west axis of the Meru–Nairobi Highway.

○ In Kenya, the number of new car registrations has been increasing annually, amounting to approximately 1.3 million vehicles. In Nairobi alone, the number of private vehicle registrations is approximately 480,000 vehicles, accounting for about 37% of the total car registrations in Kenya.

○ In Nairobi, the penetration rate of automobiles has rapidly increased, while the road supply rate falls short of it. It is predicted that traffic congestion will continue to become more severe in Nairobi.

3) Increased Used Vehicles and Air Pollution

○ Reportedly, 80% of the entire 1.3 million vehicles in Kenya are used automobiles as old as 15 years on average.

○ Exhaust gas emitted from used automobiles with older model years has been pointed out as one of the major air pollution sources in Kenya. The United Nations Environment Programme (UNEP) has claimed in the "Global Fuel Initiative Survey" that the automotive exhaust gas accounts for 40% of urban air pollution.

4) Traffic Congestion and Traffic Accidents

○ Traffic accidents are up every year in proportion to the increasing number of vehicles and traffic congestions. According to the Kenyan National Transport and Safety Authority (NTSA), the casualties attributable to traffic accidents from January to October in 2018 were 2,441—a 10.8% increase compared to 2,203 during the same period in 2017.

3. Appropriateness of Project Design

1) Problems of Roundabouts in Nairobi

○ Roundabout have the advantage of smooth traffic flow because there is no signal wait time when traffic volume is low. However, when traffic volume is high, roundabouts interfere with traffic flow and this serves as a major cause of collision.

○ Numerous vehicles enter each roundabout and exit it in different directions, entangled, leading to traffic congestion. Vehicles frequently collide with each other within the intersection.

○ Vehicles have difficulty in entering the intersection on account of the lack of methods to go through the roundabout and many drivers' unwillingness to make concession, resulting in the congestion of vehicles in the rear.

○ At a roundabout, traffic congestion becomes worse owing to a complicated mixture of entering and exiting vehicles. Therefore, it is determined that it is inappropriate to build roundabouts in urban areas with heavy traffic.

2) Necessity of Intelligent Transportation System (ITS)

In Nairobi, roads need to do the following:

○ Make interconnections between transportation system components as well as a real-time monitoring system based on collected information.

○ Provide the best transportation operation and/or management services that actively respond to traffic situations and simultaneously improve mobility and safety.

○ Have a real-time traffic information system to support users' decision-making for passing in case of recurring and non-recurring traffic congestion.

○ Have an advanced safety support and/or management system for roads and vehicles to rapidly prevent and mitigate traffic congestion before and after unexpected events.

○ Offer intelligent, safety-oriented traffic services that are customized for passers' characteristics and behavior, including the mobility handicapped (e.g. the elderly and children).

○ Improve the sustainability of traffic system that provides traffic alternatives and detour information during traffic congestion and induce dispersed traffic as well as balanced road networks.

○ Build an active eco-driving traffic management system based on cutting-edge technologies to reduce fuel consumption and CO_2 emissions.

3) Anticipated Effects of Intelligent Transportation System (ITS)

○ The ITS in the road transportation area is a system to maximize the efficiency of transportation operation and management by applying advanced technologies to components of the road transportation system (e.g. transportation facilities).

○ The ITS can be regarded as the future-oriented transportation system that improves user convenience and safety and further reduces fuel consumption and air pollution emissions.

○ As for the mid- to long-term result (i.e. impact), the ITS will reduce air pollution as well as the number of traffic accidents. When it comes to the short-term result (i.e. outcome), the ITS will reduce delays and transit time on major roads.

Chapter 2
Establishing Logical Framework for Nairobi ITS Establishment and Junctions Improvement Project

1. Mid- to Long-Term Result (Impact)

1) Reduction of Air Pollution

○ On the urban roads in Nairobi, the level of air pollutants emitted from old diesel vehicles is very severe. When a vehicle stops and starts during delays, more air pollutants are discharged than its normal operation.

○ When the ITS is completed, air pollution emissions will decrease because of smooth traffic movement.

2) Reduced Number of Traffic Accidents

○ At the roundabouts of major arterial roads in Nairobi, traffic congestion is commonplace because numerous vehicles seek to enter them. Numerous vehicles in roundabouts frequently lead to collision accidents, being entwined in the course of exiting them in different directions. Many pedestrians jaywalk on major roads in Nairobi due to lack of crosswalks and traffic lights. Under such circumstances, the risk of vehicle-to person accidents is high.

○ As the ITS prevents the entry of vehicles into an intersection, collisions within the intersection can be prevented to the extent that the traffic signals are observed. Once the number of vehicle-to-vehicle collisions is reduced, the casualties and injuries due to traffic accidents will decrease.

2. Short-term Result (Outcome)

1) Reduction of Intersection Delay Time

○ The intersections of major arterial roads in Nairobi lead to severe traffic congestion all day long. Particularly, delays of vehicles passing through intersections trigger traffic congestion on the roads in different directions.

○ The ITS allows traffic to flow in one direction in accordance with the traffic signal. Thus, the delay time within the intersection will be lessened.

2) Improvement of Traffic Time at Major Transportation Corridors

○ In Nairobi, roundabouts malfunction on account of traffic congestion. Instead, passers communicate with each other by traffic signals or traffic police's hand signals at the roundabouts. This is why it takes a long time to wait for the next signal.

○ Once the delay time is shortened at an intersection, traffic flow in each direction will be smooth; as a result, traffic flow will be improved across the city.

3. ITS Result Management Framework (Logical Framework)

Design Summary	Result Targets/Indicators	Data Sources	Assumptions/Risks
Impact[1)] Reduced social losses due to traffic congestion	1. Reduction in the number of traffic accident - Death: (Jan. 1 through Dec. 28 in 2017) 286 persons → less than 229 persons - Serious injury: (Jan. 1 through Dec. 28 in 2017) 389 persons → less than 311 persons	NTSA* statistics	**(Assumptions)** - Improved awareness of traffic laws by the general public - Sustainable ITS operation & management
	2. Reduction of 10% from air quality measurement results (2016) - TSP: 344㎍/㎥→ less than 310㎍/㎥ at point A1** 115㎍/㎥→ less than 104㎍/㎥ at point A2** - NOx: 41㎍/㎥→ less than 37㎍/㎥ at point A1 38㎍/㎥→ less than 34㎍/㎥ at point A2 - SO_2: 4㎍/㎥→ less than 3.6㎍/㎥ at point A1 3㎍/㎥→ less than 2.7㎍/㎥ at point A2 - CO: 1,160㎍/㎥→ less than 1,044㎍/㎥ at point A1 484㎍/㎥→ less than 435㎍/㎥ at point A2	KURA Air Pollution Statistics	**(Risk)** - Rapid growth in the number of vehicles - Lack of experience in ITS operation by the PEA
Outcome[2)] •Enhanced	1. Reduced average waiting time*** at junctions 19,20,24, and 25****:	Detector Data	**(Assumptions)** Strong support for the proposed project

urban mobility in Nairobi through the development of ITS	(2018) average waiting time per vehicle = 340 sec. → (1 year after completion) average waiting time per vehicle = 220 sec.		by the general public
	2. Reduced travel time *** from junction 19 to junction 25: (2018) 24 min. (08:22 to 08:46) → (1 year after completion) less than 19 min.	- Detector Data - Field Measurement	Rapid growth in the number of vehicles
<u>Output</u>[3)] • ITS Facilities provided	1. Construction of TMC - Construction of a new TMC building - Provision of ITS devices • Hardware and software for measuring traffic volume, controlling traffic signals, real-time monitoring system, etc. 2. Improvement of junctions - Structural improvement • Upgrade of junction configuration to meet the adequate capacity for traffic demand - Installation of ITS field equipment • Traffic signal, signal controller, CCTV, above ground detector, VMS, street light, etc.	Project Completion Report 4)	**(Assumptions)** - Continued strong willingness of the Government for the project - Timely land acquisition **(Risk)** - Risk of delayed project implementation due to weak project management by the PEA - Increase in project costs compared to costs estimated in appraisal due to implementation delays and additional works

<u>Activities with Milestones</u>

1. Employment of Consultant
 (3 months after the effective date of the Loan Agreement)
2. Detailed Design and Preparation of Bidding Documents
 (6 months after Employment of Consultant)
3. Supplier Selection
 (3 months after Detailed Design and Preparation of Bidding Documents)
4. Construction & Installation, Software Development, and Commissioning
 (24 months after Supplier Selection)
5. O&M support
 (24 months after Commissioning)

<u>Beneficiary</u>: Drivers and Pedestrians

<u>Inputs (USD 1 thousand)</u>

• EDCF (87.6%): 61,000
• Government of Kenya (12.4%): 8,629

<u>Measurement Method</u>

* National Transport and Safety Authority
- Statistics data: Total number of traffic accidents that occur in Nairobi
 [Total number of traffic accidents that occur in Kenya * 10% (ratio is based on a portion of Nairobi population in Kenya)]

**The location of point Al and A2
- A1: In front of the Wakulima Market, 200 meters away from junction No. 11
- A2: Residential area in Railway St., 100 meters away from junction No. 12

*** Travel time can be measured by the above ground detector.
**** Junction No. 19, 20, 24, and 25 are along the Mombasa Road, the most congested and important route in Nairobi