

Traffic Congestion Problem and Possible Solution in Kabul City

Sayed Abdul Rahman Sadaat, Nsenda Lukumwena

Abstract—Traffic congestion is a worldwide issue, especially in developing countries. This is also the case of Afghanistan, especially in Kabul-the capital city, whose rapid population growth makes it the fifth fastest growing city in the world. Traffic congestion affects not only the mobility of people and goods but also the air quality that leads to numerous deaths (3000 people) every year. There are many factors that contribute to traffic congestion. The insufficiency and inefficiency of public transportation system along with the increase of private vehicles can be considered among the most important contributing factors. This paper addresses the traffic congestion and attempts to suggest possible solutions that can help improve the current public transportation system in Kabul. To this end, the methodology used in this paper includes field work conducted in Kabul city and literature review. The outcome suggests that improving the public transportation system is likely to contribute to the reduction of traffic congestion and the improvement of air quality, thereby reducing the number of death related to air quality.

Keywords—Air quality, Kabul, Afghanistan, public transportation system, improvements, traffic congestion.

I. INTRODUCTION

KABUL is the capital of Afghanistan with 4,461.6 km² area and 15 districts. It is situated within coordinates 34, 31 N and 69, 11 E. Kabul had nearly 4.6 million population in 2015 [1], and 65.6% of them live in urban area. During three decades (1989~2001) of civil war and revolution in Afghanistan, Kabul as a capital province lost almost everything. All infrastructures including transportation system have been completely destroyed. After 2001, a new administration has been established. The new government which is supported by United States of America (USA) started the reconstruction along with the international community and other donors' financial support. However, the rapid economic growth, urbanization, and population growth created some social issues. Traffic congestion can be considered the most important one among these issues.

Road traffic congestion is a major problem in most countries around the world, especially in developing countries, of which Afghanistan is an apart. Afghanistan's capital city Kabul as a fifth fastest growing city in the world [2] has been suffering from this social and economic issue for sixteen years. There are a bunch of reasons behind traffic congestion in this small city. The sudden increment of private vehicles

within last two decades has become a major contributor to traffic congestion in Kabul city. According to statistics provided by relevant authorities annually, 30 to 35 thousand vehicles newly enter Kabul city while the mayor's office had estimated that there are already 700,000 vehicles on the narrow streets of Kabul which can only accommodate about 30,000" [3]. Most of the excessive vehicles which are private cars impacted the environment and cause the air pollution and economic losses. Traffic congestion and traffic jam become a never-ending challenge for the residence of the city.

This paper will attempt to address traffic congestion and will prove that public transportation improvement along with other possible solutions seems to reduce traffic congestion in Kabul city.

II. OVERVIEW OF PUBLIC TRANSPORTATION IN KABUL CITY

Kabul city currently has only one mode of public transportation as a system, which is The Millie Bus Service (National Bus Service). The Millie Bus Company had been established by Ministry of Finance in 1975 and was soon put under the supervision of Ministry of Transportation. The company subsidies come from the government, whereas the buses are donated by donor countries [4].

According to the information of Millie Bus Authorities, the company has a total of 100 buses. These buses are operating in 52 municipal lines. The large buses have the capacity of 42 passengers, whereas the small ones can only hold 32 passengers. The company had 450 buses in 2007 [4].

III. AIM OF THE STUDY AND METHODOLOGY

A. Research Objectives

- Investigation of the causes and negative impacts of traffic congestion in Kabul city.
- Finding the possible ways for improvements of existing public transit system in Kabul city.
- Reduction of traffic congestion and air pollution in Kabul

B. Methodology

The methodology used for this study includes field work conducted in Kabul city and literature review based on traffic congestion causes, impact on environment and possible solutions.

IV. PROBLEM STATEMENT AND ANALYSIS

The causes to traffic congestion are described in this section, and these have been categorized according to their characteristics, infrastructure capacity, systemic and

Sayed Abdul Rahman Sadaat is with the Kobe Institute of Computing, Department of Information Technology, Japan (e-mail: eng.sadaat@yahoo.com).

Nsenda Lukumwena is PhD, architect, urban planner, designer Associate professor at Kobe Institute of Computing, Department of Information Technology, Japan (e-mail: nsenda@kic.ac.jp).

behaviors.

A. Infrastructures

1) Insufficient Transportation Infrastructures

The first and foremost cause of traffic congestion is the insufficiency of transportation infrastructures such as railways, expressways, subways, streets, parking lots, terminals, stations, stops, sidewalks, traffic lights, traffic monitoring devices, and traffic signs. The rate of vehicles newly entering the city is greater than the growth of newly constructed

transportation infrastructures.

B. Systems

1) Poor Traffic Management System

The existing traffic management system is human based. A traffic police can control the traffic flow on each square and intersection manually. A few intersections are equipped only with traffic lights. The traffic is not monitored in an intelligent way due to lack of monitoring cameras, sensors, and detectors.

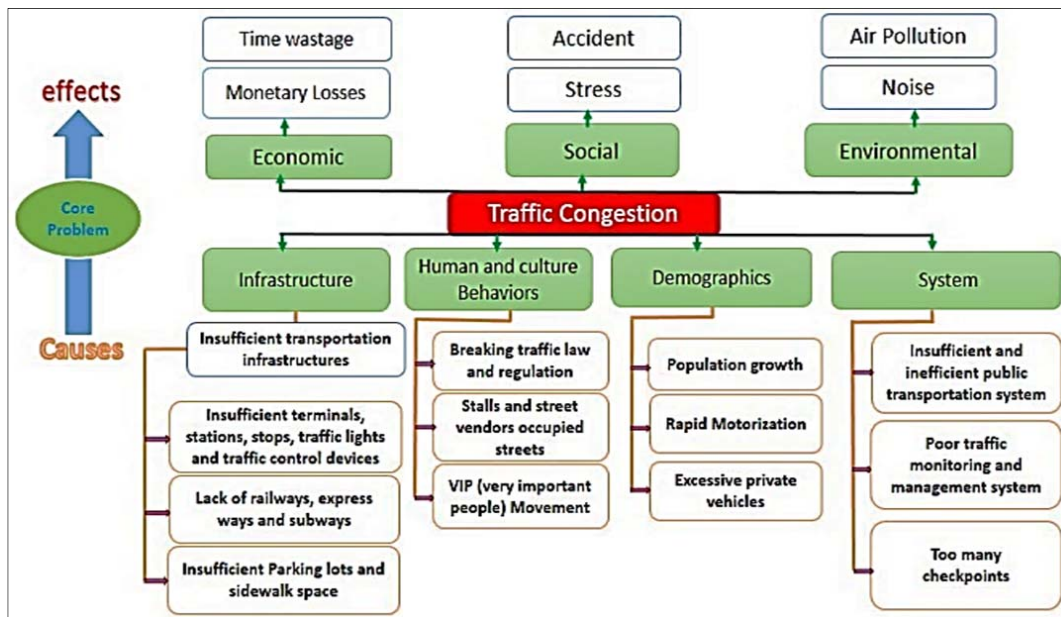


Fig. 1 Analysis of Traffic Congestion Causes and effects in Kabul

2) Insufficient and Inefficient Public Transportation System

Millie Bus is the only mean of public transportation in Kabul as already described in introduction section.

3) Too Many Security Checkpoints

There are a lots of security checkpoints in the city. These checkpoints impact traffic flow and speed of running vehicles.

Roads are being narrowed for security reason, even some roads and street being blocked and the traffics are re-routed for security concerns.

C. Human and Culture Behaviors

1) VIP (Very Important People) Movement

VIP movement causes traffic jam in city. An entire line has been blocked when some government officials or political leaders are moving on the road. It can be due to security concern and culture behavior

2) Breaking Traffic Law and Regulation

Divers in Kabul city do not respect the traffic regulation and law. One of the most disappointed situation is that traffic regulations have been broken by governmental officials and lawmakers

3) Stalls and Street Vendors Occupied Streets

On-street selling is another main contributor to traffic congestion and jam. Most parts of the sidewalks, road- side-parking area have been occupied by street vendors in the city. Pedestrians have to use the road for walking because sidewalks have already blocked by stalls and vendor hawker.

D. Demographics

1) Population Growth

The population growth rate of Afghanistan was 2.36% in 2017. Around five million people live in Kabul, which makes 980 p/km² density [1].

2) Rapid Motorization

It is estimated that approximately more than one million vehicles are operating in Kabul city [6]. It means that one out of every five people has a car. The percentage of ownership is 20% [5].

3) Excessive Private Vehicles

Excessive private vehicles are one of the main cause of traffic congestion in Kabul city. According to Kabul Vehicle Census, 341,047 vehicles are registered in 2005. Around 66%

of them were small cars. United Nation Regional Information Network (IRIN) has estimated 1,224,000 vehicles for 2010[6], [5]. Private cars potentially contribute to the volume of traffic in Kabul city. People usually use their own cars for commuting. Private cars have less capacity. Most of the time one passenger uses one car for a trip. Table I shows the average number of passengers for public and private transportation.

TABLE I
AVERAGE NUMBER OF PASSENGER FROM SCREEN LINE SURVEY [7]

Traffic Volume	Public Transport	Private Transport
Traffic volume (veh/12h)	40,759	64,676
Trip volume (person/12h)	382,893	126,014
Average number of passenger	9.4	1.9

V. DISCUSSION

A. Environmental Impact of Traffic Congestion on Health in Kabul

Traffic congestion has a lot of negative effects such as monetary losses, wasting time, air pollution, accident, noise, stress, and so on. In this section, the air quality as a negative effect of traffic congestion has been described. In the case of Kabul city, air pollution among from other effects is the most dangerous and threatens the life of Kabul citizens.

1) Air Pollution

Air pollution is the combination of gases solid particle in the air. This mixture includes of car emission, the chemical from factories, dust, pollen, and mold. Gas (Carbon di Oxide, Carbon mono Oxide, Radon, etc.) is a major part of air pollution. It produced by the burning of fossil fuels, the coal, and petroleum used in Automobile and energy production. One of the main sources of air pollution is automobiles such as cars, buses, planes, trucks, and etc. Air pollution causes health effects like respiratory diseases, cardiovascular disease, and even death [8].

Ministry of Health has conducted a research in 2009. The research result showed that the blood sample of 80% of some 200 Kabul residents contained lead. Air pollution is the bigger killer than the war in Kabul city. According to National Environmental Policy Act (NEPA) report in 2009, 3000 people die each year because of polluted air in Kabul city [9], [11].

Kabul city is one of the polluted cities in the world. It is mentioned in introduction section that there are 700,000 vehicles operating in Kabul city [3]. Traffic congestion is one of contributor to air pollution. Most of vehicles are old and fuel is poor quality. The used engines contribute to produce most emission and carbons which are harmful to the health of Kabul residents [9].

Kabul has most-polluted air among neighboring capitals and one of the worst in the region, NEPA [10]. CNN has conducted an investigated report about five worst capital for air pollution, the report included a figure indicates that, Kabul is the third worst capital among five capitals in the world for air pollution [15]. The Institute for Health Metrics and

Evaluation (IHME) estimation indicated that air pollution caused death numbers in 2010 from 187 countries. According to estimation, Afghanistan has deaths and causes of deaths as indicates in Table II [12].

TABLE II
ANNUAL DEATH RATE IN AFGHANISTAN DUE TO AIR POLLUTION [13]

Country	Cause	Annual deaths
Afghanistan	Ambient PM pollution	18,510
	Household air pollution	41,164
	Ambient ozone pollution	207
	Radon	152
	Lead	5,294
	Second-hand smoke	4,330
	Occupational air pollution	399

B. Impacts of Public Transportation

1) Role of Public Transit in Reducing Traffic Congestion

Public transportation has a significant role in reducing traffic congestion. A large bus with 60 passengers' capacity can reduce 60 private cars with only one driver into 59 cars. From train to mini bus each of them can decline the number of operating vehicles in a city. Fig. 2 shows the impact of public transport in reducing the traffic congestion on the road.

2) The Role of Public Transportation in Reducing Air Pollution

It is clear that when the number of vehicles decreases the air pollution may also decline. The public transportation has the core role in reducing greenhouse emission and CO₂ production in outdoor as well as in indoor. According to UK Department of Environmental Food and Rural affairs, travelling by train and other public transportation such as bus is significantly less carbon intensive than travelling by car or plane [14].

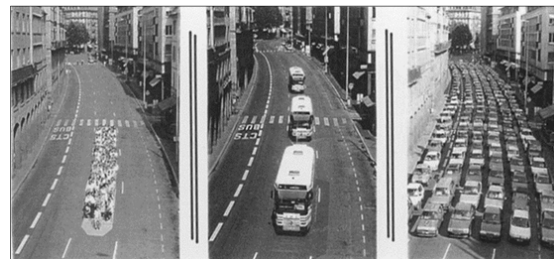


Fig. 2 Role of public transportation in reducing traffic congestion [16]

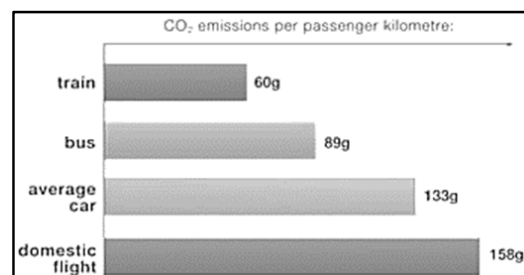


Fig. 3 CO₂ emission per passenger kilometre in varies transport modes [14]

VI. POSSIBLE SOLUTION TO TRAFFIC CONGESTION IN KABUL CITY

There are many ways to reduce the traffic congestion in Kabul city. Public transportation improvement can be considered as a sustainable and effective way to decrease traffic congestion. Public transportation has the key role to decline traffic congestion, fare cost, air pollution and human stress. In this part of the paper, the possible ways to public transportation have been suggested. Since Mille Bus is the only mean of public transportation in Kabul city, all the proposed solutions have been considered for this current operating service in Kabul.

In order to improve public transit service and encourage transit ridership, it is important to follow up the following ways.

- ✓ Increase service: increase more routes, trip frequency and operating hours
- ✓ Improve transit priority: create bus lane, queue-jumper lane, bus- priority traffic signals
- ✓ Improve stops and stations: construct shelter for cooling and heating, washrooms, refreshment, internet service, onboard information.
- ✓ Lower fare and discount.
- ✓ Convenient fare payment. Onboard or pre-board. Electrical payment system
- ✓ Improve rider information: real-time information
- ✓ (Transit Oriented Development (TOD) for increasing walkability chance
- ✓ Bike and transit integration system: constructing bike and bicycle parking lot near the station [17].

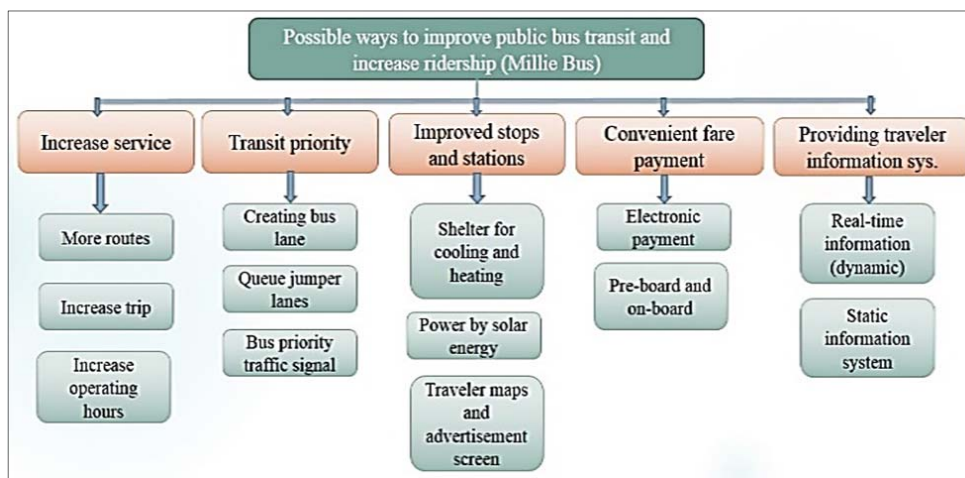


Fig. 4 All Possible ways for public transportation improvement in Kabul city

In the case of Millie Bus Service in Kabul city, all above-mentioned improvements are required. It is impossible to explain all those improvement with details. Here, some of the significant improvement briefly explained based on some logical and theoretical arguments.

A. Increasing Service: (Trip Frequency and Operating Hours)

1) Current Situation

Millie Bus Company has only 100 buses with the average capacity of 37~40 passengers. If the buses are operated with average 8 trips per day. It can hold around 3200 passengers/day [18], [19]. Table III shows the trip volume of passenger rate per day in 2008. 382,893 p/12h were by public transport and 126,014 p/12h private transport, whereas the Millie Service only was held 144,000 passenger/day with 450 buses at that time. In Table I, it has been calculated that the trip by private transport will be increased from 126,014 to 1,840,665 and public transportation trip will be increased up to 3,754,956 trips/day [7].

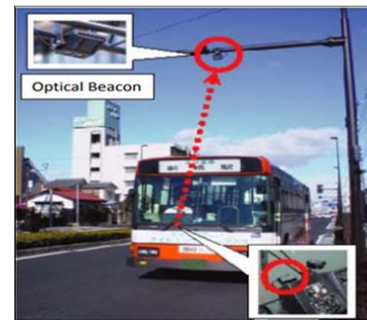


Fig. 5 Public transportation priority system in Japan [20]

TABLE III
MODAL CHOICE OF TRANSPORTATION BETWEEN 2008 AND 2025 [7]

Year	Walk	Public	Private	Total
2008	1,077,683	1,634,652	583,333	3,295,668
(Except walk)	32.7%	49.6%	17.7%	100.0%
	-	73.7%	26.3%	100.0%
2025	1,767,038	3,754,956	1,840,665	7,362,658
(Except walk)	24.0%	51.0%	25.0%	100.0%
	-	67.1%	32.9%	100.0%
2025-2008 (Point)	-8.7	+1.4	+7.3	-

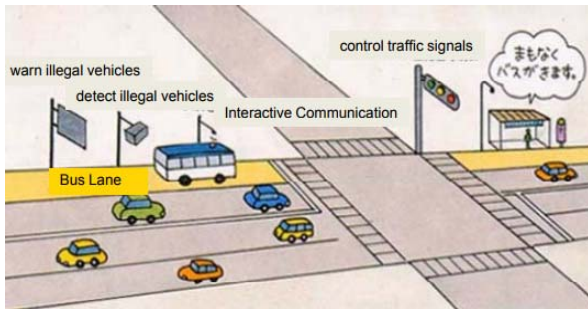


Fig. 6 Typical public transportation system concept [20]

2) Possible Solution

In order to respond traffic demand in 2025, it is considered to increase the number and operating hours of Millie Bus Service in Kabul city. Roughly 3,754,956 trips public/day+ 500,000 trips from private/day=4,254,956 trips/day. To supply this demand of trips Millie Bus Company needs to extend the operation hours to 16 hours and increase the trip frequency to average of 4 round trips per bus per route. Regardless the traffic congestion, route length and bus speed, it is estimated that, almost 500 vehicles with 8 one-way trips and an average capacity of 65 passenger/bus on 33 lines in a 16 hours operation will likely to reduce 500,000 private cars and replace around 400,000 private-public transportation such as minibus micro bus and taxi. If some taxis and minibuses simultaneously operate with Mille Bus Service, these transportation modes will impact the predicted number of Millie Bus at all. It can be concluded that more Millie vehicles are required to increase the frequency and operation hours of Millie Bus Service in Kabul city.

B. Improvement of Transit Priority System

1) Current Situation

All mode of traffic including Millie Bus Service vehicles are being operated as a mixed traffic flow. There is no any priority for public transit at an intersection. One of the main reasons of discouraging people to use public transit is slow flow and delays that caused by mixed traffic operation.

2) Possible Solution

In order to prioritize public transportation to pass the intersection, traffic signals need to be equipped with intelligent transportation devices. Sensors, detectors and digital camera need to be installed in the intersection like the Public Transport Priority System (PTPS) in Japan. This system controls and allows public transit to pass through the intersection [20].

C. Bus Stops and Bus Station Improvement

1) Current Situation

Kabul Municipality specified 430 bus stops on 33 routes in Kabul city for Millie Bus Service.

Currently The bus stop signed by small board and pole. Municipality of Kabul aimed to build shelter for each bus stop [19].



Fig. 7 Bus stop sign in one of the street in Kabul city [19]

2) Possible Solution

The existing bus stop should be replaced with a new bus stop which has the following elements and structures.

- ✓ Shelter for heating and cooling.
- ✓ Seats for passengers and disabled people to rest until bus arrive.
- ✓ Sustainable energy system based on solar power.
- ✓ Bicycle parking if enough area is available, to allow a park ride system
- ✓ Advertisement screen which can be powered by solar, allowing the bus stop to generate income

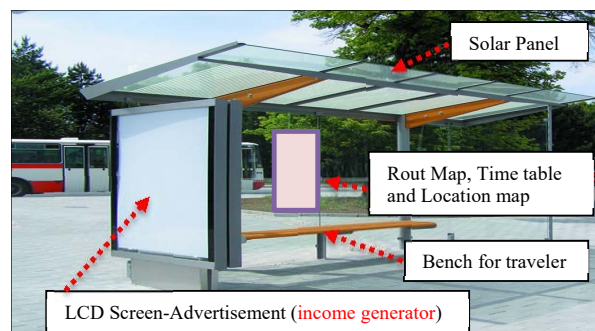


Fig. 8 A typical concept of design of a bus stop which is powered by renewable energy and generating income. A sustainable energy-based bus stop shelter [21]

D. Convenient Fare Payment

1) Current Situation

The payment system is a manual and very old system. A man is responsible to collect the fare from passengers in the bus or other public transportation modes. The collector man has to move on the bus which discomforts passengers and sometimes conflict between passengers and the collector while advising sometime waste of time and loss of money.

2) Possible Solution

Installing an automatic electrical on board and pre-board system is an easy way for fare payment system. It may have a high initial cost, but it is a very effective way to reduce waiting time and travel delay.

E. Improvement of Rider and Traveler Information System

1) Current Situation

Basically, there are two kinds of information for traveler on bus stops and stations; the first is static information, such as bus schedule, maps, and route information. The second type of information is dynamic or real-time information, such as LCD display on the bus stop and real-time information application and websites [23]. Millie Bus Service as an only means of transportation mode in Kabul city does not have any information for traveler and riders in station even in bus stops.

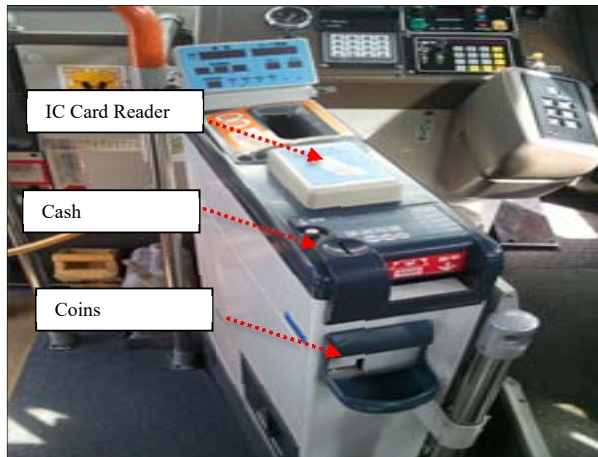


Fig. 9 Electrical payment system in a bus in Japan [22]

2) Possible Solution

Both static and dynamic traveler information systems should be provided for riders. It needs to create route maps, bus schedules, and install them on the bus stop and bus stations. Secondly, if it is possible to build the entire intelligent bus system to provide the real-time information for passengers

VII. CONCLUSION

This paper highlighted, that traffic congestion is a serious social issue in Kabul city. The main cause of traffic congestion is the excessive number of vehicles on Kabul city streets. In order to decrease the number of these vehicles, it is required to improve the current public transportation. Most commuters and travelers in Kabul city are supposed to use public transportation instead of private cars and private transportation if the cost, numbers, capacity and service quality of existing governmental subsidies public transportation are improved.

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