ASSESSING THE CAUSES OF URBAN TRANSPORTATION CHALLENGES IN THE KUMASI METROPOLIS OF GHANA

Author's Detail: [1] Emmanuel Kwabena Anin (Corresponding Author)
School of Business, Kwame Nkrumah University of Science and Technology C/o Phyllis Adjei Tuffour P.O.Box 9, Jacobu-Ashanti, Ghana
[2] Jonathan Annan
School of Business, Kwame Nkrumah University of Science and Technology University Post office Kumasi, Ghana – West Africa.
[3] Otchere Fianko Alexander
School of Business, Kwame Nkrumah University of Science and Technology P. O. BOX SE 2533 Kumasi, Ghana - West Africa.

Abstract:
Due to its capacity to create place utility and contribute to time utility, both of which are necessities for economic and social development, transportation as a logistical driver of supply chain is indispensable in the contemporary world. Within the realm of supply chain, it does not only constitute one of the largest logistical costs but also and crucially, accounts for significant portion of the cost of products and services. Effective transportation system reflects in efficient logistic system and socio-economic development at large. However, it seems the reverse is the case in the Kumasi metropolis and negatively affects business and social activities within the metropolis. This study examines the factors that lead to the challenges of transportation system in the Metropolis. The study used primary data from field survey using questionnaire instrument. Both descriptive and inferential statistics were used to analyse the data. It was found that transport infrastructure appeared to be inadequate as most of the road sections have reached critical capacity, where the volume of traffic flow appeared more than the road networks can handle in some sections of the roads. Also, the traffic management system appeared less effective whilst the mass transit services were seen to be inadequate to meet travel demands contributing to the transportation challenges. It is recommended, therefore that, city authorities should improve on the existing transport infrastructure and expand the mass transit services within the metropolis.

Key words: Transportation challenges, Urban Transportation System, Transport infrastructure, Traffic Management, Mass Transit Services, Kumasi Metropolis

1. INTRODUCTION

Transportation is a vital function of human society. To a large extent, the economic and social development of nations is pivoted on transportation system. In fact the realization of global trade objectives is also hinges on transportation and that the linkage between transportation and economic development will continue to be a cutting edge for global economic prosperity. Any transportation breakdown creates a memorable hardship in human life.Underinvestment in transportation infrastructure has negative consequences on the socio-economic development of a nation (Harriet, Poku and Anin, 2013a; Kulash, 1999). Transportation creates place utility and contributes time utility both of which are necessary for economic and social development. Within the realm of supply chain, it does not only constitute one of the largest logistical costs but also, and crucially, accounts for significant portion of the cost of products and services (Grant, Lamber, Stock and Ellram, 2006).

It is predicted that the rate of vehicle ownership rate will increase from about one vehicle for every four persons in the year 2000 to about two vehicles for every five persons in 2020 (Lee, 2001). The top five of the most congested cities in North America range between 33% for Los Angeles to 25% for Tampa (table 1). In Europe, the top five most congested cities ranges from 42% for Warsaw to 32% for Paris. In Africa, Johannesburg ranks top amongst South African cities with congestion level of 32%, which represents a travel delay of 37 minutes for every hour, driven in peak hour traffic (Tom Tom congestion index, 2012).

Table – 1 Traffic Congestion Index

City	Congestion level	Average free flow/speed	Average speed at peak	Delay/hour at peak
Los Angeles	33%	62.7 km/h	54.7 km/h	40 min
Vancouver	30%	56.3 km/h	48.3 km/h	34 min
Miami	26%	67.6 km/h	61.2 km/h	29 min
Seattle	25%	61.2 km/h	54.7 km/h	35 min
Tampa	25%	69.2 km/h	64.3 km/h	28 min
Johannesburg	32%	63 km/h	56 km/h	37 min

Source: Tom Tom Congestion Index (2012)

Given these levels of congestion from developed countries, it can be expected that the situation in developing countries with lower middle- level income status like Ghana could be much worse. Indeed, the average speed in worst peak period in Kumasi is 15km/h (Urban Road, 2004). Given this picture of what seems to be a potential threat to the road transport sector in most cities, particularly Kumasi, it is imperative that the challenges facing the sector be addressed to improve on the economic activities, especially in the area of logistics and distribution system.

2.0 RELATED STUDIES

2.1 Factors Affecting Transportation System

Transport infrastructure and traffic management system are the key factors that contribute to the effectiveness of transportation system (Harriet, *et al.*, 2013a; Eddington, 2006; Puchera, Korattyswaropama, Mittala and Ittyerah, 2005; Tiwari, 2002). Adequate investment in transport infrastructure such as road network, bus stops, parking lots, transport terminals, ports and traffic lights equipment are paramount in ensuring effective transportation system. Thus inadequacy of these factors leads to challenges in the transportation system (Nadiri and Mamuneas, 1996; Yu, De Jong, Storm and Mi, 2012; Rodrique ,Comtois, and Slack 2009; Munuzuri, Larraneta, Onieva and Cortes 2005; Godwin, Hass-Klau and Cairns, 1998).

Baffour (2011) cited by Ofori-Dwumfour and Dankwah (2011) argues that inadequate transport infrastructure is key contributory factor to transportation inefficiencies. He attributes the traffic congestion situation in the city of Accra, Ghana, to inadequate road network in the city. Eddington (2006) and Purcher *et al.* (2005) delineate that the availability of transport infrastructure is crucial for effective transportation system, however, equally important is how these resources are efficiently and effectively utilized for optimum benefits. They go on to argue that management and control of the traffic ensures effective utilization of transport infrastructure. Therefore traffic management is as important as transport infrastructure. For example, malfunctioning traffic lights in the city creates build-up of traffic congestion and results in travel delays.

Again, indiscipline drivers parking at undesignated bus stops and the activities of pedestrians, particularly at the Central Business District (CBD), are also contributory factors to congestion. However, with effective traffic management in place, these situations can be prevented to ensure free flow of traffic (Godwin, Hass-Klau and Cairns, 1998). Purcher *et al.* (2005) outline some of the components of traffic management as:

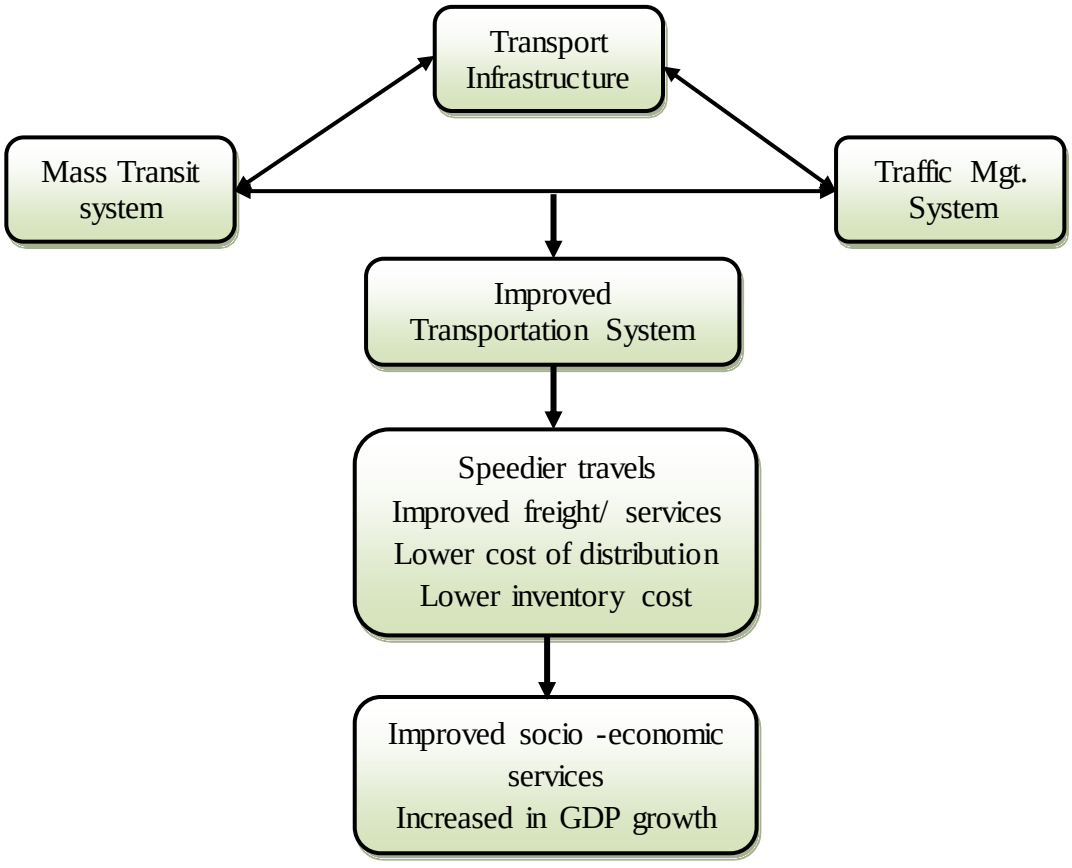
- Traffic signal management
- Drivers and pedestrians management
- Management of emergency situations i.e., vehicle breakdowns and accidents that happen on roads. These are not exhaustive though.

Besides transport infrastructural inadequacies, malfunctioning traffic lights and indiscipline of the driving public are other contributory factors of transportation ineffectiveness in Accra (Baffour 2011, cited Ofori-Dwumfour and Dankwah, 2011). In Kumasi, drivers' indiscipline is one key factor that causes congestion in the city especially at the CBD (Urban Road, 2004).

Shapiro, Hassett, and Anold (2002) assert that public transportation system is an essential factor that ensures effective transportation system especially in the urban areas. They argue that public transportation system (also mass transit) offers one of the best strategies to reducing traffic congestion and improving energy efficiency due to their high passenger occupancy rate and fuel saving potentials. To ensure effective public transportation system, buses which are the commonest form of public transportation in developing countries should be available, adequate and reliable. Figure 1 gives the conceptual model of effective transportation system and its effect on the economy (Anin, Annan and Otchere 2013).

From the model in Fig.1, transport infrastructure, mass transit system and traffic management system together contribute to effective transportation system. These result in speedier travels, improve freight and logistics system, lowers inventory and distribution and ultimately improves the socio- economic activities and Gross Domestic Products (GDP).

Fig. 1 Conceptual framework of an effective transportation system



Source: Adapted from Lakshmanan, (2011).

The mass transit services in Kumasi are not enough (Urban Roads, 2004), and have contributed to the dominant use of cars (taxis and private) in the metropolis. Cars, Sport Utility Vehicles (SUVs) and minibuses constitute about 80% of the traffic mix in Kumasi, contributing to the traffic congestion in the metropolis (KMA). Transportation challenges facing most developing countries are attributed, but not limited to:

- limited road network
- narrow roads
- primitive or non-existing traffic management system
- inadequate traffic signals and
- unsafe driving behaviour.

They concluded that ensuring effective transportation system, especially within cities, depends on the extent to which these challenges can be addressed (Gwilliam, 2003; Yildirim, 2001; World Bank, 2011; Purcher *et al*, 2005; Memedovic, Ojala and Rodrigue, 2008).

2.2 Transportation Challenges and Economic Activities

Economic activities involve movement of people and goods from places to places. Transportation, as a logistical driver, plays a crucial role in this enterprise. For example, even though time utility, which is critical value added activity, is created by inventory and storage of products until they are needed, its realization is dependent on transportation activities as it determines how fast and how consistent products and services move from one point to another. The consequences of the non-availability of products and services at the right time could lead to negative repercussions such as lost of sales and customer dissatisfaction. Therefore efficient and effective transportation management is key for ensuring socio-economic development (Harriet *et al.*, 2013a; Zhang, Mark, Vonderembse and Lim, 2005; Fawcett, 2010; Chopra and Meindle, 2007; Grant *et al.*, 2006).

Rodrigue, Comtois, and Slack (2009) say that rapid urban development across the globe implies an increased number of passengers and freight moving within cities and thus creates a demand for transport. There is a relationship between urban population increases and travel needs within cities. Therefore as population increases in urban areas through urbanization, travel needs also increase and that the increasing number of passengers are better served and managed by effective transportation system (Fawcett 2010). However, underinvestment in transport infrastructure could have dire consequences on passengers' mobility, logistic system and the entire social and economic activities (Chopra and Meindle, Lambert, 2006; 2007; Eddington, 2006; Grant *et al.*, 2006).

Passengers move within cities to satisfy a purpose such as employment, education, leisure or access to goods and services. That is to say that each time a travel need is to be satisfied, a trip is generated. Unfortunately commuters or passengers, in most developing economies, go through challenges such as discomfort, commuting related stress and delays resulting from the challenges of transportation system, i.e., ineffective and inefficient transportation systems. These stress that passengers go through can best be addressed through adequate investment in transport infrastructure which ensures effective, efficient and reliable transportation system (Rodingue *et al.*, 2009; Munuzuri, Larraneta, Onieva and Cortes, 2005). There is an assertion that sometimes congestion is a blessing in disguise since it gives an indication of vibrant economic and social development. However beyond a certain point, the delays and uncertainties commuters and goods suffer as a result of transportation challenges, such as hours in traffic jams, create economic and social burdens (Harriet et al., 2013b) Further, although the digital revolution enables twenty 21st Century industry to adopt just-in-time production distribution and inventory management system, challenges in the transportation system make it difficult to be up to the task of ensuring reliable just-in-time deliveries for enhanced productivity and competitiveness (Lewis, 2008; Naim, Potter, Mason and Bateman, 2006).

Weisbrod, Vary and Treyz, (2003) opine that, increasing traffic congestion which is a major transportation challenge, imposes cost upon travels and business operations, thus posing wide range of negative impact on people and on business economy. Advancing their argument, they affirm that the impact of traffic congestion affect quality of life due to delays in personal travels and, especially business activities, as a result of additional cost arising from delays in deliveries of logistics within cities.

This assertion is supported by the argument that the economic cost of ineffective transportation system takes the form of time wasting and unreliable delivery of goods and services, extra fuel and other related cost. Thus transportation inefficiencies bring negative impact on the economic activities by way of slow and more variable journey times which affect economic efficiency (Lewis, 2008; Poole, 1998; Tseng, Yue, Taylor, 2005).

2.3 The Study Area

The study was conducted in the Kumasi Metropolis in the Ashanti Region of Ghana. Kumasi is located in the transitional forest zone and is about 270 km north of the national capital, Accra. It is predominantly trade and commerce (service inclusive), industrial and Agriculture centre. The city has been established as the commercial hub of the northern sector of Ghana. The major economic activity points in Kumasi are the Kejetia Lorry Park, Adum shopping centre, Kaase Industrial area and Suame Magazine, the centre for second-hand car parts dealers and

vehicle repairs. The roads from some parts of the country into the city converge at Kejetia/Adum area which forms the core of the CBD (Department of Urban Roads, 2004). The unique centrality of Kumasi as traversing point from all parts of the country, and as the hub of trade and commerce within the northern sector account for the many people migrating into Kumasi and eventually put pressure on the transportation system in the metropolis

2.4 Characteristics of Transportation Situation in Kumasi

The road network system in the Kumasi Metropolis has been categorized into twenty-one (21) key road links by the Department of Urban Roads. The categorization was done in the order of congestion level. The travel speeds and congestion index of the entire road link have been quantified. Congestion index (CI) is defined as total delay divided by the free flow of travel time. The computed CIs have been used to rank the roads; the higher the value, the more the congestion. Higher CI represents worst of the averages of the peak period and directions (Urban Roads report, 2004). The key road links is presented in table 2 with their average travel speed and average CI. Mampong road is ranked the worst congestion with Cedar Avenue being the least congested road. The overall average travel speed at peak period stands at 15 km/h whilst the average travel speed for the first ten (10) major roads is 9 km/hr. This is not good for any productive venture. The low service level is attributable to the fact that the roads are under critical capacity and it is coupled with ineffective traffic management and control (Urban Roads 2004).

The CBD of Kumasi covers the land area including the Central Market, Adum, the Asafo Market and its lorry park, the Kejetia Lorry Park, the National Cultural Centre, and the Post Office/Ministry Area. The Central Market and the Kejetia Lorry Park constitute the heart of the CBD and together generate huge traffic within the Metropolis. The CBD is characterised by too many taxis and too few large buses. For example, cars and taxis together form about 80% of the traffic mix, yet they account for about 30% of all person trips. More than 60% of all trips undertaken in Kumasi end at Kejetia (Ghana Statistical Service, 2009; KMA).

Table - 2 **Key Roads in Order of Congestion Level**

Rank	Name of Road	Functional Class	Average Speed (km/hr)	Congestion Index (CI)
1	Mampong Road	Principal Arterial	5.6	13.8
2	Sunyani Road	Principal Arterial	8.4	8.9
3	Lake Road	Principal Arterial	9.8	7.6
4	Antoa Road	Principal Arterial	11.5	6.0
5	24th February Road	Principal Arterial	12.6	5.8
6	Harper Road	Minor Arterial	9.7	5.6
7	Yaa Asantewaa Road	Collector	9.1	4.9
8	Bantama High Street	Collector	9.3	4.8
9	Offinso Road	Principal Arterial	14.5	4.6
10	Odumasi Road	Collector	9.1	4.5
11	Barekese Road	Principal Arterial	14.9	4.4
12	Southern By-Pass	Principal Arterial	16.1	4.4
13	Western By-Pass	Principal Arterial	17.5	4.0
14	Hudson Road	Minor Arterial	17.0	2.9
15	Maxwell Road	Collector	14.5	2.9
16	New Bekwai Road	Principal Arterial	22.4	2.3
17	Pine Avenue	Minor Arterial	17.1	2.6
18	Kejetia Link (Pinako Road)	Minor Arterial	17.3	2.5
19	Okomfo Anokye Road	Principal Arterial	27.3	2.3

20	Old Bewkai Road	Minor Arterial	24.7	1.9
21	Cedar Avenue	Collector	27.5	1.0
	Weighted Average		**15.09**	**4.67**
Rank is based on Congestion index (CI). CI represents worst sections of the averages of the peak periods and directions.				

Source: Urban Roads Report, (2004)

3. Materials and Methods

The study is focused on three main categories of factors that affect urban transportation challenges in the Kumasi metropolis. These are

1. Physical transport infrastructure
2. Mass transportation services
3. Traffic management system

The following assumptions were made for the study that: all the three factors (Improvement in transport infrastructure, Improvement in Mass transit services and Improvement in traffic management system) will reduce urban transportation challenges. Based on these assumptions, the study postulated the following simple linear equation:

$$y = \beta_o + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \mu$$

Where y= the dependent variable (effective transportation System)

X_1= Variable One (Transport Infrastructure)

X_2= Variable Two (Mass transit services)

X_3= Variable Three (Traffic management system)

μ = Error term

$\beta_1 - \beta_3$ = Parameters to be estimated

β_0= Constant term

3.2 The Study Population and Sampling Techniques

The respondents chosen for the study were drivers of all categories of vehicles (cars, SUVs, buses, trucks and motor cycles) and commuters. Five major road links out of the twenty-one major road links in the Kumasi metropolis were selected for the study in the order of traffic congestion level as has been established by the Department of Urban Roads (table 3) and the corresponding volume of traffic flow (table 4). On the basis of the average traffic volume of 63.46 vehicles per minute, a quota of 60 drivers was selected from each of the five road links, making for a sample size of three hundred (300). The quota distribution composed of twenty-four (24) each for saloon cars and SUVs, five (5) each for buses and trucks, and two (2) motor cycles, based on the 2009 traffic mix in the metropolis as established by the Ghana Statistical Service (table 5).

In addition, 175 commuters working in the formal sectors were also involved in the study with a quota of 35 for each road. This makes a total sample size of 475 respondents. Systematic random sampling was used to select the respondents from each quota based on every fourth respondent met.

Table - 3 Key Roads in Order of Congestion Level

Rank	Name of Road	Functional Class	Study Length (km)	Congestion Index (CI)
1	Mampong Road	Principal Arterial	5.0	13.8
2	Suyani Road	Principal Arterial	3.3	8.9
3	Antoa Road	Pricipal Arterial	5.5	6.0
4	24th Feb. Road	Principal Arterial	5.4	5.8
5	Harper Road	Principal Arterial	2.5	5.6

Source: Urban Roads Report (2004)

Table – 4 Volume of Traffic Flow Analysis

Road Link	Peak Total Volume Per Hour	Peak Total Volume Per Minute
Manpong Road	5,394	89.9
Sunyani Road	4,219	70.3
Antoah Road	3,860	64.3
24th Feb. Road	3,202	53.4
Harper Road	2,148	35.8
Wtd. Average	3,764	63.46

Source: Urban Roads Report (2004)

Table - 5 Distribution of average traffic mix in Kumasi

Type of Vehicle	Average Percentage Share
Cars/SUVs	81.5%
Buses &Trucks	16. 3 %
Motor Cycle	2.2 %
TOTAL	100%

Source: Ghana Statistical Service (2009)

451 out of the 475 questionnaires sent out were returned representing overall response rate of 94.9%.The assessment of the factors affecting the challenges of the transportation system was based on three main categories. These include transport infrastructure (road network with lay-bys, parking lot and terminals and traffic lights and road sign equipment), mass transit system (availability of metro bus services, adequacy of metro bus services and reliability of metro bus services) and traffic management system (management of traffic lights and other signals, management of drivers and pedestrians indiscipline on roads and management of vehicle breakdowns and road accidents). These are considered the major factors of transportation challenges in Ghana (Ofori - Dwumfour and Dankwah, 2011; Urban Roads report, 2004). Survey was conducted on the five key road links in the metropolis.

Two different sets of questionnaires were administered. The first set was used to collect information from drivers whilst the second set was used to collect responses from commuters. Each set comprised two main sections. The first section sought to assess the relevance and importance of the pre-determined factors perceived to be affecting transportation challenges whilst the second section sought to assess the extent of effect of each factor on the challenges. For each set, closed type questions using five point likert scale, ranging from **1= Not Very Important to 5= Very Important and 1= Strongly Disagree to 5= Strongly** respectively were used.

Both self-administered and interviewer-administered questionnaires were used for the study. This allowed for responses from the respondents with varying characteristics, some of whom might require guidelines and further explanations to questions. Respondents were given the chance to tick or rank the most appropriate response(s). The questionnaires were delivered to the respondents by the researchers. In some cases, the researchers read out and explained the questions to the respondents whose literacy level were low and were unable to read and understand for relevant responses.

The researchers used descriptive and inferential statistics to analyse the quantitative data with the aid of statistical package for social sciences (SPSS). Descriptive statistics was used to analyse the relevance and relative importance of the pre-determined factors as well as their effects on transportation challenges in the metropolis whilst linear regression was used to assess the extent of the effect of each factor on the challenges. Tables 6 and7 show the results of the descriptive and regression analysis of the factors that directly affect road transportation Challenges in the Kumasi Metropolis.

4. RESULTS

Table - 6 Analysis of the factors affecting the transportation challenges.

Variables	No	Mean	SD	RII
Traffic Infrastructure				
Road network with lay-bys	451	4.79	.476	0.931
Parking lot and Terminals	451	4.21	0.5996	0.738
Traffic lights and road sign equipment	451	4.41	0.599	0.725
Adequate road network with lay-bys	451	2.40	0.817	0.600
Adequate parking lot and Terminals	451	2.09	0.778	0.419
Adequate traffic lights and road sign equipment	451	3.91	0.874	0.583
Mass Transit System				
Availability of Metro Bus services	451	4.11	0.622	0.779
Adequacy of Metro Bus services	451	4.26	0.630	0.753
Reliability of Metro Bus services	451	4.05	0.620	0.763
There is available metro Bus services	451	3.98	0.732	0.746
There is adequate metro Bus services	451	1.87	0.693	0.468
There is reliable metro Bus services	451	1.81	0.657	0.452
Traffic Management System				
Management of traffic lights and other signals	451	4.59	0.590	0.649
Management of drivers and pedestrians indiscipline on roads	451	4.20	0.649	0.801
Management of vehicle breakdowns and road accidents	451	4.12	0.655	0.781
There is effective management of traffic lights and other signals	451	3.07	0.898	0.614
There is effective management of drivers and pedestrian indiscipline	451	1.90	0.730	0.380
There is effective management of vehicle breakdowns and road accidents	451	2.09	0.708	0.417

D* Standard deviation; RII* Relative Importance Index

Source: Researchers Computation based on the field survey, 2012

Table - 7 Factors influencing urban transportation challenges

Challenges of Urban Transportation	Coefficient	Std. Err.	t	P >|t|
Transport Infrastructure				
Adequate road network with lay-bys	-0.1431	0.0268	-5.34	0.000
Adequate parking lot and Terminals	-0.0621	0.0283	-2.19	0.029
Adequate traffic lights and road sign equipment	-0.0232	0.0250	-0.93	0.354
Mass Transit Services				
Metro Bus services are available	-0.1113	0.0296	-3.76	0.000
Metro Bus services are adequate	-0.1772	0.0326	-5.41	0.000
Metro Bus services are reliable	-0.0296	0.0327	-0.91	0.365
Traffic Management System				
Mgt. of traffic lights and other signals is effective	-0.0387	0.0240	-1.61	0.108
Mgt. of drivers and pedestrians indiscipline is effective	-0.0985	0.0291	-3.39	0.001
Mgt. of vehicle breakdowns and road accident is effective	-0.1102	0.0307	-3.59	0.000
Constant	4.2794	0.2181	19.62	0.000

Number of obs.	451
F(9, 441)	9.24
Prob> F	0.000
R-Squared	0.1586
Adj R-Squared	0.1414
Root MSE	0.44076

Source: Researchers Computation based on the field survey, 2012

5.0 DISCUSSIONS

5.1 Transport Infrastructure

The results from table 1.0 show the level of importance of the factors considered to be contributing to the transportation challenges in the Kumasi Metropolis. The key factors under transport infrastructure used were road network with la-bys, parking lot and terminal and traffic lights and road signs equipment. Respondents were asked to rate the importance of the factors in terms of their effect on urban transportation. Road network recorded the highest mean value of 4.76, followed by traffic lights and road sign equipment with the mean value of 4.41 with the least being parking lot and terminals recorded 4.21 mean value. This indicates that all the factors under transport infrastructure are important in their effect on road transportation system. The Relative Importance Index (RII) ranked road infrastructure highest (0.931) whilst traffic light and road sign equipment was ranked least (0.725). In terms of their adequacy in the Kumasi Metropolis, it is discernable from the results that road network and parking lot and terminal appeared to be inadequate with the mean values of 2.40 and 2.09 respectively. However, traffic lights and road signs equipment appears to be adequate with the mean value of 3.91. The RII ranked road network highest (0.600), followed by traffic light and road sign equipment (0.580) and the least was parking lot (0.419).

5.2 Mass Transit Services

Key factors considered under mass transit service were availability of metro bus services, adequacy of metro bus services and reliability of metro bus services. All the factors were rated important with the mean values of 4.11, 4.26 and 4.05 respectively. The results indicated that, metro bus services availability was adequate with the mean value of 3.98; however, there were indications of their inadequacy and unreliability with their respective mean values of 1.87 and 1.81. The RII on the degree of importance was high for availability, followed by adequacy and reliability with the values of 0.779, 0.753, and 0.763 respectively.

5.3 Traffic Management System

The key factors considered under traffic management system were management of traffic lights and other signals, management of drivers and pedestrians' indiscipline on roads and management of vehicle breakdowns and road accidents. It could be discerned from the results that the factors under traffic management system were all rated important. Management of traffic lights and other signals rated highest with the mean value of 4.59 (RII=0.649). Management of drivers and pedestrians' indiscipline on roads as well as management of vehicle breakdowns and accidents on roads were rated with their mean values of 4.20 (RII=0.801) and 4.12 (RII=0.781) respectively. In terms of their effectiveness, the result shows that both management of drivers and pedestrians indiscipline and management of vehicle breakdowns and road accidents appear less effective with their respective mean values of 1.90 (RII=0.380) (RII=0.417) and 2.09 (RII=0.614). However management of traffic light and other signs appeared effective with mean value of 3.07.

The regression analysis was used to assess the extent to which the factors under consideration affect the transportation challenges in the Kumasi metropolis. The adjusted R-squared figure of 0.141 indicates that 14.1 percent of the proportionate changes in the dependent variable is explained by all the regresses used in the model. The regression model indicates that there is negative relationship between adequacy of road network with lay-bys and the challenges of urban transportation in the Kumasi metropolis. This implies that a unit increase in the provision of

road networks with lay-bys would bring 0.143 unit decrease in the urban transportation challenges at a statistical significant level of 1%. Similarly, the negative relation between the dependent variable and adequacy of parking lot and terminals indicates that a unit change in the provision of parking lot and terminals would bring about 0.062 unit decrease in the challenges of urban transportation in the Kumasi metropolis at a statistical significance level of 5%. Moreover, a unit increase in the provision of metro bus services would also lead to a decrease in the urban transportation by 0.111 units at a significance level of 1%. The negative relationship between management of drivers and pedestrians' indiscipline and urban road challenges also indicates that a unit increase in the management level of drivers and pedestrians' indiscipline will also bring about 0.099 unit decrease in urban transportation challenges in the Kumasi metropolis at a significance level of 1%. Finally, the negative relationship between the management of vehicle breakdowns and road accidents and urban road challenges implies that unit increase in the management of vehicle breakdowns and road accidents would bring about 0.110 units decrease in the associated urban road challenges in the Kumasi metropolis.

In the nutshell, any form of improvement in the transportation infrastructure, mass transit services, and traffic management system individually would not lead to a significant reduction of urban road challenges. However, improvement in the combination of all the three would significantly reduce urban road challenges in the Kumasi metropolis of Ghana confirming the assumptions made.

4. Conclusion and Recommendations

The factors affecting the challenges of transportation system in the Kumasi Metropolis was assessed based on three main criteria: the transport infrastructure, mass transit system and traffic management system. The transport infrastructure was assessed in terms of capacity of road network, parking lots, terminal, traffic lights and road sign equipment. These factors were seen to be inadequate as most of the road sections have reached critical capacity where the volume of traffic flow is more than the road networks can handle. The traffic management system also appeared less effective. These pose challenges to the transportation system in the metropolis. Furthermore, the mass transit services were also seen to be inadequate to meet the travel needs and this has contributed to the transportation challenges such as traffic congestion in the metropolis as a results of the dominance of too many cars (taxi and private), mini-buses providing transportation services in the metropolis. This situation has contributed to the travel delays in Kumasi and negatively affects the logistics system and commuters long wait in queues for transportation services. It is recommended therefore that the authorities of KMA should expand the road networks, bus stops, terminals and provision of bus lanes should be looked at as a medium to long term strategy to addressing the challenge. The city authorities should also improve on the mass transit services and intensify traffic management and control system within the metropolis.

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