

Research Article

An Overview of Urban Transport in Sana'a (Yemen)

¹Aows N. Altef, ²Mojtaba Zourbakhsh, ¹Foad Shokri, ¹Mohammad Hesam Hafezi,

¹Amiruddin Ismail and ¹Riza Atiq O.K. Rahmat

¹Sustainable Urban Transportation Research Centre (Sutra), Department of Civil and Structural Engineering, Faculty of Engineering and Build Environment, University Kebangsaan Malaysia, 43600 UKM Bangi, Selangor Dural Ehsan, Malaysia

²Department of Civil Engineering, Islamic Azad University, Estahban Branch, Estahban, Iran

Abstract: Due to enhance of number of motor vehicles, the amount of consuming of the world's oil supply is increased and it is the major source of pollution to the surroundings. Base on this, it is vital to use different techniques to provide more opportunities to identify strategies that can help to utilize more efficient from the current transport resources. In Yemen, the rapid increase in the use of the private vehicles has resulted in increased traffic congestion, accidents, inadequate parking space and air pollution, among other problems. Base on these problems, this study attempts to focus on some factors which lead to rise in private vehicle ownership, motorcycle related concern, demand of more public transport, traffic congestion, parking, road safety and air pollution. Hence, this study tries to rectify the major concerns of traffic congestion and other environment hazards. When the mentioned elements are addressed efficiently, the effective contribution can make successful urban development.

Keywords: Mode choice, public participation, sustainable transport, transportation planning, travel time

INTRODUCTION

Nowadays, increased urbanization was due to the population that was increased by the number of urban and suburban trips (Shokri *et al.*, 2012a; Ismail and Hafezi, 2011a). Hence delay time as a part of traveling period has a significant impact on travel time calculation (Shokri *et al.*, 2010; Altef *et al.*, 2013; Hafezi and Ismail, 2012b). Traffic congestions lose billions hours and money. In order to reduce these losses, it is required to create an efficient method to resolve traffic congestion and reduce the delay time (Hashimoto, 1990; Hafezi *et al.*, 2012a). Vehicle fuel consumption increases approximately 30% under heavily congestion (Hafezi *et al.*, 2012c; Ismail *et al.*, 2012a). Jennifer and Oliver (1996) found that the availability of the pre-trip information to the driver enhances drivers' self-belief to use the best route and allow commuters to make better-informed transit choices Travelers information and guidance saves travel time and helps a traveler to avoid congestion on the other hand it can improve traffic network performance and it's more efficient than paper maps or written instruction (Ismail *et al.*, 2012b, c, e). There is now a strong need to make our route travel as efficient as possible (Shokri *et al.*, 2009a; Ismail *et al.*, 2012f, 2013). Several studies have been carried out examining

roadway congestion in term of lost productivity and waste fuel (Shokri *et al.*, 2012b; Ismail *et al.*, 2012d); e.g., in 2003 it has been estimated that 8.7 billion liters of fuel were wasted due to congestion in the USA (Schrank and Lomax, 2005; Hafezi and Ismail, 2011b). Transport system provides many benefits, but it also causes many problems (Shokri *et al.*, 2009b, Hafezi *et al.*, 2012a). It serves non-drivers poorly, distributes benefits and costs inequitably; financially burdensome to households, governments and businesses, increasingly inefficient due to traffic congestion and dispersed land use, a major cause of death and disability, contradicts environmental and quality of life objectives and relies on non-renewable resources that may become scarce in the future (Litman, 2003; Hafezi and Ismail, 2011c). This study attempts to identify the major concerns of traffic congestion and other environment hazards in the study area (Hafezi and Ismail, 2011d). When the mentioned elements are addressed efficiently, the effective contribution can make successful in urban development.

STUDY AREA AND URBAN POPULATION

In Sana'a (Fig. 1) capital city of Yemen the number of moving vehicles 300000 per day, register own car and taxi increased from 4812 in 2001 to 16834

Corresponding Author: Foad Shokri, Sustainable Urban Transportation Research Centre (Sutra), Department of Civil and Structural Engineering, Faculty of Engineering and Build Environment, University Kebangsaan Malaysia, 43600 UKM Bangi, Selangor Dural Ehsan, Malaysia

This work is licensed under a Creative Commons Attribution 4.0 International License (URL: <http://creativecommons.org/licenses/by/4.0/>).



Fig. 1: The location of Sana'a (WHO, 2009)

Table 1: The population of Sana'a

Year	Population	Year	Population
1911	20000	1975	134600
1921	23000	1981	280000
1931	25000	1986	427505
1940	80000	1994	954448
1963	100000	2001	1590624
1965	110000	2005	1937451

in 2010. Consequently but after 2008 the government of Yemen tried controlling to register of taxes therefore the numbers of taxes decrease (TMOCCS, 2009). The number of populations (Table 1) Sana'a are 1747627 in 2009 and area of Sana'a 1604 km² making it Yemen's largest city (TMOCCSR, 2010).

Yemen is a developing country which suffers the consequences of explosions in both human and motorization. This has been accompanied by a heavy toll of deaths and economic cost. There is currently little public transportation (buses) and no rail or metro network but one will also be built. The public transport system in Yemen is very poor and hence, the private transport increase was observed in private transport. Generally, non-motorized transport means to walk or use bicycles, (Ryley, 2006).

TRANSPORT SYSTEM

In Yemen, the car, due to its inexpensive cost, has been a popular mode of transport in it. Consequently, casualties among car users constitute a high portion of total fatalities in these countries. The people are less non-motorized transport users, motorcycles increased in Yemen, it use large of motorcycles in the cities. Motorcycle users are more vulnerable to fatalities and injuries (Beck *et al.*, 2007; Hafezi and Ismail, 2011a). The motorcycles are allowed in highways; safety measures like compulsory wearing of helmet and exclusive motorcycle lane are not prevalent in Yemen. More than half of total traffic fatalities are death related to motorcycle accidents (Kulanthayan *et al.*, 2000).

Table 2: The numbers of car in Yemen in 2007 and 2008

Year	Private car	Taxi	Other vehicles	Total
2007	273,867	97,766	250,521	622,154
2008	302,892	107,915	259,530	670,337

(Central Statistical Organisation (CSO), 2011)

Table 3: The registered vehicles in Sana'a in 2001 to 2010

Year	Own car	Taxi and bus	Truck	Total
2001	3462	1350	1997	6809
2002	2039	532	453	3024
2003	1958	448	257	2663
2004	7866	2031	514	10411
2005	14002	3588	774	18364
2006	8641	1872	2886	13399
2007	9336	2305	9180	20821
2008	13811	2878	3752	20441
2009	14150	1550	4563	20263
2010	16454	380	3401	20239
Total	91719	16934	27777	136434

Motorcycle is popular in Yemen and use it as a taxi especially at peak time of congestions, the number of motorcycle registers at 2008 are 10769 and the numbers of motorcycles not register more than this number (Central Statistical Organisation (CSO), 2011). The increasing numbers of motor vehicles in Yemen, all kinds from own cars, private transport, taxis, motorcycles, trucks and heavy equipments as indication of the severity of congestion on major roads between main and interior cities. Almselati *et al.* (2011) Table 2 refers to the number of private car, taxi and other vehicles in 2007 and 2008 in Yemen.

The best way around the Sana'a cities is Dababs, which are like minibuses holding about 10 people. Taxis are also a very common in Sana'a and in recent years where in 2003 the total numbers of taxis 257 but in 2007 the number increasing to 9180 in Sana'a Yemen. Table 3 illustrates the registered vehicles in Sana'a in 2001 to 2010. Yemen has started using higher quality cars and companies are starting to take over the taxi business (TMOCCS, 2009).

Yemen is one of the most affected countries of the traffic accidents, the number of fatalities due to

Table 4: Presented the cost of road traffic accident for main cities in Yemen on 2010

City	Accident	Fatalities	Seriously injured	Minor injury	Loses RY
Sana'a	4889	478	2453	2466	1052930000
Aden	1053	90	532	341	235095000
Taiz	1897	377	1046	1361	645370000
Hadramoot	321	53	151	304	80249000
Alhodeidah	1262	484	1383	596	442680000

(Central Statistical Organisation (CSO), 2011)

Year	Accident	Fatalities	Seriously injured	Minor	Loses RY
2001	3451	208	952	1356	414906500
2002	3762	233	1132	1439	426053480
2003	4158	245	1247	1492	481364000
2004	4977	295	1374	1915	637182500
2005	5033	319	1453	2119	689448000
2006	4969	277	1517	2061	640590000
2007	5812	340	1981	2297	1033870000
2008	5958	366	2280	2610	1233150000
2009	5218	337	2019	2168	1168625000
2010	4889	478	2453	2466	1052930000

accidents of cars between deaths and injuries in 2009 are 22034 (WHO, 2009), the social and economic impacts of traffic accidents are very large annual losses of money in addition to the losses and the high proportion of social orphans and the disabled. Table 4 presented the number of accident, fatalities, serious and minor injuries and cost for main cities in Yemen such as Sana'a, Aden.

Table 5 presented the cost of Road Traffic Accident from 2001 to 2010 in Sana'a city. Road traffic risk may be defined as the probability of accident, injury, death and damages for a given amount of activity or exposure. Accident There is reason to believe that the risk increase for young car drivers is connected to the increased risk at night or weekend days. Accidents by young drivers are typically single accidents especially at night during weekends (Ismail and Elmloshi, 2011b). Road accidents were the main reasons cause of all deaths in Yemen as example Sana'a city the death, injuries and road accident as below in Table 5 (TMOCCSR, 2010).

Base on the mentioned literature, the rapid increasing car users in Yemen and especially in Sana'a has resulted in congestion, accidents and casualties has prompted to undertake various studies to address this problem one of these studies was the shift of transportation mode from private car to public transportation in Yemen. This study made an attempt to determine whether car users switch to public transportation mode if the Public Transportation (PT) is improved by decrease the travel time cost of PT and analysis the elements which are interfere to the travellers' decision for mode choice such as travel time, cost, convenient, safety and traveller habits.

CONCLUSION

This study attempts to select and review the potential factors that have a high impact on travel mode

shift from car to public transportation mode. To motivate the traveler to switch to the public transport mode, the potential factors that discourage car use and incentives for using public transport will be identified. By identifying and understanding the factors likely to encourage the shift, a model for mode selection can be developed. Furthermore, the likely proportions of car/public transport use were estimated after hypothetical improvements in public transport. Data will be collected from a survey in selected areas of SANA'A (City Center and main sides of the city), because the crowd of those selected areas seem to come from all over SANA'A and districted area of that. The independent (explanatory) variables to be included in the models are demographic details, socioeconomic characteristics of individuals, trip characteristics and mode attributes.

REFERENCES

- Almselati, S.I., A.O.K.R. Riza and A.O. Jafar, 2011. An overview of urban transport in malaysia. *Medweel J.*, 6(1): 24-33.
- Altef, A.N., S.F. Ismail and R.A.O.K. Rahmat, 2013. Switching model for private vehicles to public transportation system in case of sana'a. *Res. J. Appl. Sci. Eng. Technol.*, In press.
- Beck, L.F., M.D. Ann and E.O. Mary, 2007. Motor vehicle crash injury rates by mode of travel. *Epidemiol*, 166: 212-218.
- Central Statistical Organisation (CSO), R.O.Y., 2011. *Statistical Year Book 2010 Republic of Yemen*. Central Statistical Organisation (CSO), Sana'a.
- Hafezi, M.H. and A. Ismail, 2011a. Study behaviour of passengers on transit operation. *J. Appl. Mech. Mater. Adv. Transport.*, 97-98: 1154-1157.
- Hafezi, M.H. and A. Ismail, 2011b. Interaction between bus stops location and traffic on bus operation. *J. Appl. Mech. Mater. Adv. Transport.*, 97-98: 1185-1188.

- Hafezi, M.H. and A. Ismail, 2011c. Balancing between headway and frequency scheduling for bus service. *J. Appl. Mech. Mater. Adv. Transport.*, 97-98: 669-673.
- Hafezi, M.H. and A. Ismail, 2011d. Bus scheduling model for adjustment headway of bus carriers. *J. Appl. Mech. Mater. Adv. Transport.*, 97-98: 911-915.
- Hafezi, H., A. Ismail and F. Shokri, 2012a. A comparative analysis between bus rapid transit and regular bus operation. *Aust. J. Basic Appl. Sci.*
- Hafezi, M.H. and A. Ismail, 2012b. A comparative analysis of fare collection system on bus operations. *J. Appl. Sci.*, 12(4): 393-397.
- Hafezi, M.H., A. Ismail, R.A. Al-Mansob and K.S. Omran, 2012c. Comparative analysis on bus operation duration light and rush traffic period. *Int. J. Eng. Technol.*, 4(1): 97-102.
- Hashimoto, K., 1990. Monitoring road traffic congestion in Japan. *Trans. Rev.*, 10(2): 171-186.
- Ismail, A. and M.H. Hafezi, 2011a. Analyzing of bus operation to obtain regular frequency for neo-mission. *Australian J. Basic Appl. Sci.*, 5(11): 1275-1284.
- Ismail, A. and A.E. Elmloshi, 2011b. Introducing public transport system to improve travel time and road safety in tripoli, Libya. *Aust. J. Basic Appl. Sci.*, 5(6): 563-569.
- Ismail, A., M.H. Hafezi and F. Shokri, 2013. Bus scheduling model user interface. *Aust. J. Basic Appl. Sci.*, in press.
- Ismail, R., M.H. Hafezi, R.M. Nor and K. Ambak, 2012a. Passengers preference and satisfaction of public transport in Malaysia. *Australian J. Basic Appl. Sci.*, 6(8): 410-416.
- Ismail, R., M.H. Hafezi and R.M. Nor, 2012b. Passengers preference and satisfaction of public transport in Malaysia, Part I: A comparative analysis of LRT and bus network. *Aust. J. Basic Appl. Sci.*, in press. ISI listed and Scopus indexed (Q2).
- Ismail, R., M.H. Hafezi and R.M. Nor, 2012c. Passengers preference and satisfaction of public transport in Malaysia, Part II: A comparative analysis of komuter and LRT network. *Res. J. Appl. Sci. Eng. Technol.*, in press. ISI listed and Scopus indexed (Q3).
- Ismail, R., M.H. Hafezi and A. Ismail, 2012d. Implementing specific lane length on bus route for operation delays reduction. *J. Appl. Sci.*, 12(19): 2077-2081.
- Ismail, A., M.H. Hafezi, F. Shokri and R. Ismail, 2012e. A comparative analysis between bus rapid transit and regular bus operation. *Australian J. Basic Appl. Sci.*, in press. ISI listed and Scopus indexed (Q3).
- Ismail, A., M. Ganji, M.H. Hafezi, M. Shokri and R.A.O.K. Rahmat, 2012f. An analysis of travel time in multimodal public transport. *Australian J. Basic Appl. Sci.*, 6(12): 165-172.
- Jennifer, N. and S. Oliver, 1996. Intelligent transportation systems field operational test cross-cutting study: Advance traveller information system. Intelligent Transplantation System Joint Program Office. Federal Highway Administration. United State Department of Transportation, Washington, DC, Rep. FHWA-JW-99-038.
- Kulanthayan, S., R.S. Umar, H.A. Hariza, M.T. Nasir and S. Harwant, 2000. Compliance of proper safty helmet usage in motorcyclists. *Med. J. Malays.*, 55(1): 40-44.
- Litman, T., 2003. The online TDM encyclopedia: Mobility management information gateway. *Trans. Policy*, 10: 245-249.
- Ryley, T., 2006. Use of non-motorised modes and life stage in Edinburgh. *Trans. Geogr.*, 14: 367-375.
- Schrank, D. and T. Lomax, 2005. The 2005 Urban Mobility Report. Texas Transportation Institute, Retrieved from: http://tti.tamu.edu/documents/mobility_report_2005.pdf, (Accessed on January, 2007).
- Shokri, F., A. Ismail and R.A. Rahmat, 2010. Route choice decision based on real time information. *J. Appl. Sci.*, 10(19): 2304-2309.
- Shokri, F., M. Chu, Y. Mokhtarian, H.R. Rahmat and R.A.O.K. Ismail, 2009a. A. best route based on fuel economy. *Eur. J. Sci. Res.*, 32(2): 177-186.
- Shokri, F.M.H., A. Ismail and R.A.O.K. Rahmat, 2009b. Comparing the design of roundabout and intersection with aaSIDRA software. *Eur. J. Sci. Res.*, 40(2): 239-246.
- Shokri, F., A. Ismail, R.A.O.K. Rahmat and M.H. Hafezi, 2012a. Determination of lag acceptance and effects for left turning movements at intersections. *Aust. J. Basic Appl. Sci.*, 6(10): 115-121.
- Shokri, F., A. Ismail, H.R. Mokhtarian, M. Ganji, O. Kohzadi and R.A.O.K. Rahmat, 2012b. Predicting travel time system in case of bandar baru bangi. *Aust. J. Basic Appl. Sci.*, 6(10): 106-114.
- TMOCCS, 2009. (ABTMS) Annual's Book for Traffic Management Office for Capital City Sana'a for 2009. 8th Edn., Traffic Management Office for Capital City Sana'a, TMOCCS.
- TMOCCSR, 2010. (ABTMS) Report of Annual's book for Traffic Management Office for Capital City Sana'a for 2010. Sana'a Yemen.
- WHO, W.H.O., 2009. Eastern Mediterranean status report on road safety. Cairo