An Integrated Model to Enhance the Transportation Methods in Malaysia: Review Paper

[1]Ali A.J Adham, [1]Khaled Abdul Rahman Jomaa, [2]Mohammed Hayyan Alsibai

[1]Senior Lecturer, Faculty of industrial Management, University Malaysia Pahang, 26300, Pahang, Malaysia.
[1]Ph.D Student, Faculty of industrial Management, University Malaysia Pahang, 26300, Pahang, Malaysia.
[2]Senior Lecturer, Faculty of Engineering Management, University Malaysia Pahang, 26300, Pahang, Malaysia.

ARTICLE INFO	ABSTRACT
	In this study, we plan to construct a Simulation Model (SM) in corporate with the Road Network Design Method (RNDM), Genetic Algorithm system (GAs), and Optimization method. In order to elicit a general diagnosis for the traffic congestion problem in the main urban areas in Malaysia, and to find out the optimal solutions for transportation system problems in Malaysia. The problems of the transportation system in Malaysia are generally unsatisfactory to many of the customers due to be inability to connect different place. The country requires a better transportation system that could provide multi options to customers travel among the many places that might minimize the traffic congestion in the main urban areas. The results of this study will be reported and used to suggest and apply optimal transportation policies with the aim of providing useful insights on critical issues about the impact of such policies, and to help as a guide for the Malaysian decision makers to elaborate the optimal transportation policies.

INTRODUCTION

The world has experienced two hundred years of unprecedented advances in vehicle technology, transport system development, and traffic network extension. Technical progress continues, but seems to have reached some limits. Congestion, and increasing costs have created, in some parts of the world, a climate of hostility against transportation technology (Rodrigue, Jean-Paul, 1998), many areas are facing serious urban transport problems, as a result of both natural and population increase and the transportation management failure.

Traffic congestion continues to remain a major problem in most cities around the world, firstly, the worse effect of traffic is the pollution that it causes to the environment. The smoke combined with the noise that the vehicles produce causes health issues to the people travelling in traffic. Secondly, the traffic congestion increases the amount of time spent by individuals in commuting to their destinations.

Transport in Malaysia started to develop during British colonial rule, and the country's transport network is now diverse and developed. Malaysia's road network is extensive, covering 63,445 km, including 1,630 km of expressways. The main highway of the country extends over 800 km, reaching the Thai border from Singapore. The network of roads in Peninsular Malaysia is of high quality, whilst the road system in East Malaysia is not as well developed. The main modes of transport in Peninsular Malaysia include buses, trains, cars and to an extent, airplanes. Malaysia has six international airports. The official airline of Malaysia is Malaysia Airlines, providing international and domestic air service alongside two other carriers.

Most of the major cities are connected by air routes. The railway system is state-run, and covers a total of 1798 km, in Peninsula Malaysia only (Yahaya, 2010).

Malaysia's road network covers 144,403 kilometers (89,728 mi), of which 116,169 kilometers (72,184 mi) are paved, and 1,821 kilometers (1,132 mi) are expressways. The longest highway of the country, the North-South Expressway, extends over 800 kilometers (497 mi) between the Thailand border and Singapore. The road systems in Sabah and Sarawak are less developed and of lower quality in comparison to that of Peninsular Malaysia. Driving on the left has been compulsory since the introduction of motor vehicles in Federated Malaysia States in 1903 during the British colonial era.

The railway system is state-run, and covers a total of 1,849 kilometers (1,149 mi). 1,792 kilometers (1,113 mi) of it is narrow gauge, while 57 kilometers (35 mi) are standard gauge. 438 kilometers (272 mi) of narrow

Corresponding Author: Khaled Abdul Rahman Jomaa, Ph.D Student, Faculty of industrial Management, University Malaysia Pahang, 26300, Pahang, Malaysia

gauge tracks and all of the standard gauge tracks are electrified. Relatively inexpensive elevated Light Rail Transit systems are used in some cities, such as Kuala Lumpur.

A market research on 1,227 respondents in Kuala Lumpur – as a one of the most affected by traffic congestion- has revealed that 41% of the respondents ranked traffic jam and congestion as their number one frustrations, higher than Asia-Pacific's average of 35% and global average of 29% (Frost and Sullivan, 2014).

A market research by Frost and Sullivan on 1,227 respondents in Kuala Lumpur has revealed that 79% of residents depend on private transportation such as cars which is significantly higher than the average 54% of the global average, while 8% depend on public transportation, comparing with 26% the global average; another 11% use a combination of public and private transportation, while the other 2% are non-motorized, while the global average is 13% for combined transportation, and 8% for non-motorized (Frost and Sullivan, 2014).

The average GDP growth in Kuala Lumpur in 2010-2013 equal to 10.6%- 7.2%, while the average annual population growth rate equal to1.3% - 1.1% (Department of Statistics, Malaysia Official Website, 2010-2013), this rapid economic and urban population growth in recent years caused a rapid motorization in Malaysia which increased traffic congestion, accidents, and added pressure on the road and rail infrastructure in terms of capacity.

In this paper, we identify the traffic congestion problem in the main urban areas in Malaysia especially in Kuala Lumpur.

We plan to construct a SM in corporate with the RNDM, GAs, and Optimization method. In order to elicit a general diagnosis for the traffic congestion problem in the main urban areas in Malaysia, and to find out the optimal solutions for transportation system problems in Malaysia

In the current study we expect to apply the new ideas, to enhance the traffic congestion problem, and to help the decision makers to make optimal transportation policies in order to increase efficiency of public transportation, also we expect that this study will help as a guide to organize and develop the public transportation in Malaysia which can help to avoid some limits (Congestion, pollution, less accidents), and to make public transportation more economically, as a result of this study is expect to give a beneficial ideas that make Public Transportation more acceptable and more comfortable which can increase public transportation demand that might encourage both the private and public sectors to build more transport companies and facilities (Train, Ship, Taxis, and Buses).

Literature views:

According to the importance of Simulation model, Road Network Design Method, Genetic Algorithm Method, and Optimization method, diverse studies used them separately as important methods for solving transportation problems in many areas all around the world, but no one has constructed an integrated model using the previous models together to solve congestion problems.

Here we will present the main recent studies that focused on the congestion problem using one of the models previous mentioned.

A Microscopic Traffic Simulators (MITSIM) had been developed in this study for modeling traffic networks with advanced traffic control, route guidance and surveillance systems, in order to simulate integrated traffic networks supported by the advanced traffic control and surveillance systems. The authors used a probabilistic route choice model to capture drivers' route choice decisions in the presence of real time traffic information provided by route guidance systems (Qi Yang &Haris N. Koutsopoulos, 1996). In this study an optimal control problem of traffic light duration had been considered, and a traffic noise level had been introduced as a state variable in a dynamical optimization problem. The authors designed a closed loop control system which innocence's the green duration of the lights according to the equivalent noise level. This control policy decreased the noise levels at intensive traffic intersections. The traffic lights adapted their duration according to the noise pollution. Simulation and experimental results showed a decrease in pollution from the vehicles in densely populated urban areas (Stoilova, K. and T. Stoilov, 1997). a simulation model for evaluating freeway lane control signing had been developed in this study, to decrease vehicle speed upstream of existing traffic congestion and incidents to prevent vehicles from having to brake suddenly and risk causing more accidents. The simulation results show that lane control has little influence on congestion. However, the region between heavy and medium traffic flow is sensitive to lane control.U. Hanebutte, *et al.,* (1998). The following study developed a terrific simulator to investigate highway traffic under various degrees of automation. The simulator included a component of a global and a local Expert Driver Model, a human factor study, and a graphical user interface. The model simulates vehicle maneuvering in a multilane highway traffic system and allows the use of an Automated Intelligent Cruise Control (Hanebutte, U., *et al.,* 1998). This study purposed to establish a quantitative relationship between network congestion and travel-time reduction benefits of a real-time route guidance user service. By implementing the Integration traffic simulation model and network. The results from this study indicated that the route-guided vehicles benefit regardless of the level of congestion, however, the amount of trip time savings achieved was highly dependent on network congestion conditions (Wunderlich, K., 1998). The following study developed a time-dependent Transit traffic model for the

evaluation of a performance index, which was weighted combination of the estimated delay and number of stops. The authors employed group based specification of signal timings for the traffic model. They also employed a medium size signal-controlled network from the Shatin, New Town in Hong Kong as a numerical example to illustrate the effectiveness of the heuristics the results showed that with the proposed heuristics, a remarkable improvement over the average flow scenario is obtained, and when compared with the signal plans from independent analyses, a good improvement was found (Wong, S.C. *et al.*, 2002). The followers study-have created an algorithm to minimizing total travel time and weighted number of stops in a network subject to the traffic-light constraints that simulate the operations of a practical light control, in order to find a minimum total time path to simulate the operations of traffic light control in a city.Halim Ceylan (Chen, Y.L. and H.H. Yang, 2003). The authors in this study proposed a genetic algorithm (GA) approach to solve upper-level problem for a signalized road network under congestion. They applied stochastic user equilibrium (SUE) traffic assignment at the lower-level. the authors applied SUE assignment by way of the Path Flow Estimator (PFE) and TRANSIT traffic model at upper-level to obtain network performance index (PI) and hence fitness index (Halim Ceylan, Michael G.H. Bell, 2005). This study considers described a decentralized car traffic control simulation with re-routing and propagation of messages among traffic nodes (road intersections and traffic lights). The values of the parameters governing the simulations were identified through the use of a genetic algorithm (Martin Kelly, Giovanna Di Marzo Serugendo, 2007). Author in this study developed and tested a new model for traffic signal optimization based on the combination of three key techniques: 1) genetic algorithms (GAs) for the optimization task; 2) cellular-automata-based micro simulators for evaluating every possible solution for traffic light programming times; and 3) a Beowulf Cluster, which is a multiple-instruction–multiple-data (MIMD) multicomputer of excellent price/performance ratio. They simulated a set of congested scenarios for "La Almozara" in Zaragoza, Spain. The results show that increasing the incoming volume of vehicles entering the traffic network get better performance (Javier, J., Sánchez, *et al.*, 2010). This study proposed genetic algorithm based optimization approach which allows signal timing parameters such as offset, cycle time, green split and phase sequence to be optimized with the objective of minimum delay and better traffic fluency. The proposed GATSTM system has the ability to handle and manage the dynamic changes of the traffic network condition by calibrating the system parameters accordingly (Chin, Y.K., K.C. *et al.*, 2011). The followers study developed A mathematical model representing the traffic control stochastic environment. They determined The optimum/near optimal traffic signal timing values through the application of a genetic algorithm that feeds these values into a developed simulation model to obtain the corresponding queuing parameters. The generated signal timings significantly enhance the traffic performance and alleviate the choke points over a multiple-junction urban network. The authors applied The development approach to a network consisting of two consecutive junctions in Alexandria, Egypt using actual field data. The optimization results show that the proposed model can improve the queuing parameters of the vehicular flow.

In our study we will try to produce a comprehensive study using unique integrated model using Simulation model, Road Network Design Method, Genetic Algorithm Method, and Optimization method to gather in order to investigate the traffic congestion problem in Malaysia and to find the optimal solution for such problem, which might be helpful for Malaysian decision makers to put in place a sustainable public transportation policy.

Discussion:

     Malaysia has achieved a remarkable development most of productivity fields, but this development had to be associated with a similar development in the field of services and most importantly in the transport sector. The transport system in Malaysia is still suffering from some difficulties such as: Traffic congestion, increasing costs and pollution.

     Transport in Malaysia started to develop during British colonial rule, and the country's transport network is now diverse and developed. Malaysia's road network is extensive, covering 63,445 km, including 1,630 km of expressways, The inter city, countrywide, traditional KTMB rail network and the inner city, light rail transit network are the two types of the train network in Malaysia. The KTMB service serves the entire country of Malaysia by travelling between major cities and also up in Thailand. The main highway of the country extends over 800 km, reaching the Thai border from Singapore. The network of roads in Peninsular Malaysia is of high quality, whilst the road system in East Malaysia is not as well developed. The main modes of transport in Peninsular Malaysia include buses, trains, cars and to an extent, air-planes

     In Malaysia, road constructions began before independence. Before 1957, there has been a road system linking Johor Bahru in the south with Kangar in the north and Kota Bharu in the East Coast, connecting main states with other states. After the country gained independence in 1957, efforts to improve the road system have been done properly and through the rapid development planning, especially the Malaysia plan every five years, which was launched by the Federal Government (Dean, D.J., 1997; Kirkpatrick, S., *et al.*, 1983; Malaysia". 2010).

Airline:

Malaysia has six international airports. The official airline of Malaysia is Malaysia Airlines, providing international and domestic air service alongside two other carriers. Most of the major cities are connected by air routes. The railway system is state-run, and covers a total of 1798 km, in Peninsula Malaysia only.

Railway:

The intercity railway network in Peninsular Malaysia consists of two main lines: The West Coast Line between Singapore and Padang Besar, Perlis, on the Malaysian-Thailand border, and the East Coast Line between Gemas in Negeri Sembilan and Tumpat in Kelantan. There are also several branch lines - between Kuala Lumpur and Port Klang, Batu Junction and Batu Caves, Bukit Mertajam and Butterworth, Tapah Road and Teluk Intan, Kempas and Tanjung Pelepas, Kempas and Pasir Gudang, and between Pasir Mas and Rantau Panjang. The entire 1,699 km network uses 1,000 mm (3 ft 3 3⁄8 in) meter gauge tracks.The network is linked with the Thai railway network at Padang Besar and Rantau Panjang ("Kulim 2010).

A total of 332 km of the network is double track and electrified. They include portions of the West Coast Line between Seremban and Ipoh and the entire Kuala Lumpur-Port Klang branch line as well as the stretch between Kuala Lumpur and Sentul - Batu Caves branch line. The double-track and electrified portions between Kuala Kubu Bharu and Seremban and the Port Klang to Kuala Lumpur branch lines are used as the commuter train services. However, the train transportation in Malaysia still doesn't cover all states which effect to the facility of the transportation system in Malaysia.

Malaysia has 7,200 kilometers (4,474 mi) of waterways, most of them rivers, of this, 3,200 kilometers (1,988 mi) are in Peninsular Malaysia, 1,500 kilometers (932 mi) are in Sabah, and 2,500 kilometers (1,553 mi) are in Sarawak (Malaysia" 2010).

Waterways:

The waterways method in Malaysia as well as still not available among the states that is effective to increase the government income (Malaysia" 2010). This study will focus to increase the using this method among the states which are located on the sea.

Transportation System Problems:

Malaysia's means of transportations and network roads still not satisfactory to cover all categories among the states as well as the network road still need for new network and system design.

The main problems which effect on efficiency of transportation in Malaysia are:

a.   Higher population growth, with depending of the majority of readers of private transportation.

b.   Public transportation as a one of the most important transportation systems fields is still below the level needed to provide better services to keep pace with economic and social development in Malaysia.

c.   Unavailability of some transportation methods in some areas such as train in the east areas.

The previous problems make the traffic congestion get worse and more complicated.

The Aims of This Study:

According to the importance of developing transportation system in a developed country as Malaysia, it is very important to analyze such an activity, in order to find strengths and weaknesses, and to find the optimal policies that improve the performance and quality of local transport services.

The main objective of this study is to present an integrated transportation model to generate futuristic public transportation in Malaysia, which can help to find innovative solutions to the current congestion problem.

Among its detailed objectives, the study aims to a chive the follows objectives:

a. To identify the traffic congestion problem in the main urban areas in Malaysia.

b. To identify the public transportation system, and its management system in Malaysia.

c. To design an efficient modern transport system in Malaysia, to meet the increasing in transportation demand, and to minimize the transportation problems.

Methodology:

In this study, both analytical and quantitative approaches are utilized. The analytical approach is utilized to analyze the performance of the Malaysian public transportation system. The quantitative approach is used within an integrated transportation model framework.

The case study plan is to do the research in two steps:

a.   Collecting database, through: Observation, Survey, interview with those who are in charge of the system.

b.   Descriptive analysis on the transportation system problem through: Constructing and using a SM in corporate with the RNDM, GAs, and Optimization method.

Simulation model aims are to design the transportation system of an efficient infrastructure and service to meet our needs for accessibility and mobility. The simulation experienced a few tremendous innovative and progressive steps forward. Interestingly, these key innovations are from non-engineering fields, but very often transferred and applied to transportation systems analysis and simulation by engineers (Ahmed, A., Ezzat, *et al.*, 2014; Castillo, J.M.D., F.G. Benitez, 2012; Ceder, A., *et al.*, 2013; Chung, J. and K.G. Goulias, 1997; Ettema, D., *et al.*, 1996). Road Network Design Method (Neural network): Neural Network NN provide a method to characterize synthetic neurons to solve complex problems in the same manner as the human brain does (Awasthi, A., *et al.*, 2006) NNs are biologically inspired systems consisting of a massively connected network of computers "neurons," organized in layers. By adjusting the weights of the network, NNs can be "trained" to approximate virtually any nonlinear function to a required degree of accuracy. NNs typically are provided with a set of input and output exemplars. A learning algorithm (such as back propagation) would then be used to adjust the weights in the network so that the network would give the desired output, in a type of learning commonly called supervised learning.

NN is a powerful data modeling tool that is able to capture and represent complex input/output relationships and characteristics, such as associativity, self-organization, generalizability, and noise- and fault-tolerance (Ceder, A., *et al.*, 2013; Mody, Ashoka, 1997). Along with the development of computing science, the modern information processing technologies, such as genetic algorithm, expert systems, etc., ANN technologies have developed fast. ANN has been extensively used in many transportation studies and proven to be an effective solution to problems too complicated to be represented and optimized by conventional mathematical methods (Bradley, M. and J. Bowman, 2006; Chung, J. and K.G. Goulias, 1997; Ettema, D., *et al.*, 1996; Henson, K., *et al.*, 2006; Mohammad Motamedi). Therefore, we propose to use ANN for capturing the complicated relationships between single-loop measured variables and classified vehicle volumes under various traffic conditions.

The method developed in this study for designing a forest road network with two different road standards (main access road with a high standard and single access road with a low standard) consists of the following two steps (Chung, J. and K.G. Goulias, 1997):

1) Optimizing main access road location using GAs. SM is used to generate initial solutions for the GAs process.

2) Optimizing the location of a single stand access road for each harvest unit using SM.

Optimum method: For several decades, both mathematical models and optimization algorithms have played a key role in tackling a considerable number of optimization problems in the day-to-day activities. The optimization method becomes one very fames method in the transportation area to solve any problems and to achieve the optimum solution.

In this study the optimum method will use to achieve more than one objective at the same time by using (Multi Objective Model, Mathematic Model, and schedule method) (Awasthi, A., *et al.*, 2011; Badami, M.G., M. Haider, 2007; Bradley, M. and J. Bowman, 2006; Kirkpatrick, S., *et al.*, 1983).

Genetic Algorithms system: is an optimization and heuristic search technique based on the principles of genetics and natural selection. GA is routinely used to generate useful solutions to optimization and search problems.

Genetic Algorithms (GAs) were developed by Prof. John Holland and his students at the University of Michigan during the 1960s and 1970s. Essentially, they are a method of "breeding" computer programs and solutions to optimization or search problems by means of simulated evolution. Processes loosely based on natural selection, crossover, and mutation are repeatedly applied to a population of binary strings which represent potential solutions. Over time, the number of above-average individual's increases, and highly-fit building blocks are combined from several fit individuals to find good solutions to the problem at hand.

A GA consists in a number of strings containing information about how to behave in their environment and some operators, changing the strings. After "behaving", the strings are evaluated by a fitness function, representing their environment, and the better adapted strings get higher scores. These in turn are important for the probability to be chosen by a selection operator that determines which strings are allowed to reproduce. The chosen strings, then undergo a procedure of crossing-over and mutation, and the so built "offspring" forms next periods generation that undergoes the same operations.

The features inherent in genetic algorithm play a critical role in making them the best choice for practical applications, namely optimization, computer aided design, scheduling, economics and game theory. It is also selected because it does not require the presence of a supervisor or an observer (Badami, M.G., M. Haider, 2007).

Results:

The results of the current study are expected to be as follows:

a. Apply the new ideas, to enhance the traffic congestion problem, and to help the decision makers to make optimal transportation policies in order to increase efficiency of public transportation.

b.   Organizing and developing the public transportation in Malaysia which can help to avoid some limits (Congestion, pollution, less accidents), and to make public transportation more economically.

c.   Making Public Transportation more acceptable and more comfortable this can increase public transportation demand that might encourage both the private and public sectors to build more transport companies and facilities (Train, Ship, Taxis, and Buses). This research is expected to be very important and beneficial for Malaysia.

Conclusion:

In this study, a Simulation Model incorporate with the Road Network Design Method, Genetic Algorithm Method, and Optimization method will be constructed. In order to elicit a general diagnosis for the traffic congestion problem in the main urban areas in Malaysia, and to find out the optimal solutions for transportation system problems .The results of this study will be reported and used to suggest and apply optimal transportation policies with the aim of providing useful insights on critical issues about the impact of such policies, and to help as a guide for the Malaysian decision makers to elaborate the optimal transportation policies.

REFERENCES

"Kulim to have LRT system and airport by 2020". Retrieved 2011-05-06.

Ahmed, A., Ezzat, *et al.*, 2014. Development of a Stochastic Genetic Algorithm for Traffic Signal Timings Optimization, Proceedings of the 2014 Industrial and Systems Engineering Research Conference.

Awasthi, A., S.S. Chauhan, H. Omrani, A. Panahi, 2011. A hybrid approach based on SERVQUAL and fuzzy TOPSIS for evaluating transportation service quality. Computers & Industrial Engineering, 61: 637-646.

Badami, M.G., M. Haider, 2007. An analysis of public bus transit performance in Indian cities. Transportation Research Part A 41: 961-981.

Bradley, M. and J. Bowman, 2006. A Summary of Design Features of Activity-Based Microsimulation Models for U.S. MPOs. Conference on Innovations in Travel Demand Modeling, Austin, TX. May 21-23.

Castillo, J.M.D., F.G. Benitez, 2012. A methodology for modeling and identifying users satisfaction issues in public transport systems based on users surveys. Procedia–Social and Behavioral Sciences, 54: 1104-1114.

Castillo, J.M.D., F.G. Benitez, 2012. A methodology for modeling and identifying users satisfaction issues in public transport systems based on users surveys. Procedia–Social and Behavioral Sciences, 54: 1104-1114.

Ceder, A., S. Chowdhury, N. Taghipouran, J. Olsen, 2013. Modelling public-transport users' behavior at connection point. Transport Policy, 27: 112-122.

Ceder, A., S. Chowdhury, N. Taghipouran, J. Olsen, 2013. Modelling public-transport users' behavior at connection point. Transport Policy, 27: 112-122.

Chen, Y.L. and H.H. Yang, 2003. Minimization of travel time and weighted number of stops in a traffic-light network. European Journal of Operational Research, 144: 565-580.

Chin, Y.K., K.C. *et al.*, 2011. Multiple Intersections Traffic Signal Timing Optimization with Genetic Algorithm, 2011 IEEE International Conference on Control System, Computing and Engineering. Harbaoui Dridi, et. al, "Multi-Objective Optimization for the m-PDPTW: Aggregation Method With Use of Genetic Algorithm and Lower Bounds" , Int. J. of Computers, Communications & Control, ISSN 1841-9836, E-ISSN 1841-9844 Vol. VI (2011), No. 2 (June), pp. 246-257.

Chung, J. and K.G. Goulias, 1997. Travel demand forecasting using microsimulation: Initial results from a case study in Pennsylvania. Transportation Research Record, 1607: 24-30.

Chung, J. and K.G. Goulias, 1997. Travel demand forecasting using microsimulation: Initial results from a case study in Pennsylvania. Transportation Research Record, 1607: 24-30.

Dean, D.J., 1997. Finding optimal routes for networks of harvest site access roads using GIS-based techniques. Can. J. For. Res., 27: 11-22.

Ettema, D., A. Borgers and H. Timmermans, 1996. SMASH (Simulation Model of Activity Scheduling Heuristics): Some Simulations. Transportation Research Record, 1551: 88-94.

Ettema, D., A. Borgers, and H. Timmermans, 1996. SMASH (Simulation Model of Activity Scheduling Heuristics): Some Simulations. Transportation Research Record, 1551: 88-94.

Frost and Sullivan, 2014. Survey finds KL road users' frustration with traffic jams highest in the, the Malaysian Insider.

Halim Ceylan, Michael G.H. Bell, 2005. Genetic algorithm solution for the stochastic equilibrium transportation networks under congestion, Transportation Research Part B 39: 169-185.

Hanebutte, U., *et al.*, 1998. Simulation of Vehicle Traffic on an Automated Highway System, M&l. Comput. Mode&rag, 27(9-11): 129-141.

Henson, K., K.G. Goulias and R. Golledge, 2006. An Assessment of Activity-based Modeling and Simulation for Applications in Operational Studies, Disaster Preparedness, and Homeland Security. Paper presented at the IATBR conference, Kyoto, Japan.

Henson, K., K.G. Goulias and R. Golledge, 2006. An Assessment of Activity-based Modeling and Simulation for Applications in Operational Studies, Disaster Preparedness, and Homeland Security. Paper presented at the IATBR conference, Kyoto, Japan.

Javier, J., Sánchez, *et al.*, 2010. Traffic Signal Optimization in "La Almozara" District in Saragossa Under Congestion Conditions, Using Genetic Algorithms, Traffic Microsimulation, and Cluster Computing, IEEE Transactions On Intelligent Transportation Systems, 11(1).

Kirkpatrick, S., C.D. Gelatt, Jr., M.P. Vecchi, 1983. Optimization by simulated annealing. Science 220:671-680.

Kirkpatrick, S., C.D. Gelatt, Jr., M.P. Vecchi, 1983. Optimization by simulated annealing. Science, 220: 671-680.

Malaysia". Cia.gov. Retrieved 2010-10-26.

Martin Kelly, Giovanna Di Marzo Serugendo, 2007. Decentralised Car Traffic Control using Message Propagation Optimized with a Genetic Algorithm, 2007 IEEE Congress on Evolutionary Computation.

Mody, Ashoka, 1997. Infrastructure strategies in East Asia: the untold story. Washington D.C.: The World Bank. P: 35. ISBN 08213-4027.

Mody, Ashoka, 1997. Infrastructure strategies in East Asia: the untold story. Washington D.C.: The World Bank. P: 35. ISBN 08213-4027.

Mohammad Motamedi, Mehdi Vatanparast and Vahid Doltabadi, Network passages directions and prevail wind blow direction in urban areas case study: Shirvan City.Journal of Applied Science and Agriculture, 9(5) Special, pp: 2042-2048.

Qi Yang &Haris N. Koutsopoulos, 1996. A Microscopic Traffic Simulator For Evaluation Of Dynamic Traffic Management Systems, Trunspn, 4(3): 113-129.

Rodrigue, Jean-Paul, 1998. "Urban Transport Problems" Hofstra University, New York, USA.

Schaefer, L., J. Upchurch and S.A. Ashur, 1998. An evaluation of freeway lane control signing using computer simulation. Mathematical and Computer Modelling, 27(9-11): 177-187.

Stoilova, K. and T. Stoilov, 1997. Traffic Noise And Traffic Light Control, Transpn Res.-D, 3(6): 399-417.

Wong, S.C. *et al.*, 2002. Group-based optimization of a time-dependent TRANSYT traffic model for area traffic control, Transportation Research Part B 36: 291-312.

Wunderlich, K., 1998. A Simulation-Based Assessment of Route Guidance Benefits under Variable Network Congestion Conditions, Matht. Comput. Modelling, 27(9-11): 87-101.

Yahaya, N.Z, *et al*, 2010. A Review of Carbon Dioxide (CO2) in Malaysia: Current status and Challenges,University Malaysia Terengganu.