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Expert System on Selection of Mobility Management Strategies towards Implementing Active Transport

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Abstract

Background: This paper presents the development of an expert system designed to train the young professional to implement mobility management strategies in order to influence a shift from passive to active transport choice which is cycling and walking. One of the processes involved in knowledge acquisition of active transport strategies is to capture the views of transportation experts regarding the most appropriate strategies with regards to the shift from motorised transport to active transport. There are eight (8) main transportation planning objectives to be achieved in organising an active transport system, such as congestion reduction, road and parking cost reduction, consumer cost reduction, crash risk reduction, air and noise pollution reduction, energy conservation, economic development benefits and liveable communities. Furthermore, apart from the main objectives, specific objectives on mobility management strategies are divided into four (4) major categories according to how they affect travelling, including improvements in transport option, land use management, price incentive and other implementation programs. Based on these, an expert system shell is developed to achieve the purposes highlighted above by using Visual Basic.NET as a tool and MySQL as a supporting tool. The expert system would finally provide an advice on the best strategy to be implemented based on the selection of the main objective and the specific objective by the user.

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Keywords: Mobility management, active transport, expert system

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1. Introduction

Car ownership is increasing rapidly, resulting to more congested roadways, more uses of energy and more damages to ecological system. Developing countries such as Malaysia, Indonesia and Thailand have limited resources in structuring transport systems as usual physical reserves of the streets are narrow and crowded, especially during peak hours. The use of private vehicles is seen to be no longer relevant to accommodate traffic congestion levels as the population continuously expands. In most developing countries, the private vehicle is the main transport mode which causes the rate of private car ownership to escalate in these years. To cope with this, attention and actions from the government are required in addressing the problem of traffic congestion, which in turn leads to the emission of carbon monoxide that interferes with the quality of life. This paper aims to outline the application of mobility management strategies towards implementing tactical steps in shifting from passive to active transportation. Active transportation which is also known as the non-motorised way of travelling encompasses walking, riding bicycles, and other variants like skating, as well as the use of wheelchairs or electric motorised wheelchairs and handcarts (Broaddus et al., 2009) Active transportation performs a crucial role in mobility management. When the number of vehicle is reduced, many trips are thus replaced with walking and riding bicycles, either totally or in conjunction with ridesharing and utilising public transit. Here, active transport (cycling and walking) are both identified as environmentally healthy and easy ways of transportation. Walking and cycling can contribute to significant participation towards sustainable transportation objectives, leading to healthier lifestyle, better and more maintainable areas, as well as reduction of traffic and pollution.

2. Literature Review

2.1 Mobility Management Strategies

Mobility management which is also known as Transport Demand Management (TDM) is a strategy employed in determining the use of a more efficient transport system. It is made up of different approaches and techniques that change travel behaviour in the increasing and growing number of transportation system performance (VTPI, 2012). Mobility management is progressively applied to play a role towards numerous planning objectives (FHWA, 2004). In this paper, a number of selected objectives in mobility management strategies are categorised into three (3) major groups based on how they will impact travelling. The particular objectives identified are those that help to improve transport options, land use management and price incentives.

'Transportation options' represents the quantity and top quality of available options which are accessible to an individual or groups of people in a community by considering their particular demands and capabilities (TDM Encyclopaedia, 2012). Improved transportation options are able to reduce traffic congestion, cost of facility, road risk, consumer costs and environmental or ecological effects (Mansyur, 2011). According to the Institute of Transport Engineers (2010), the community should supply transportation services for all, including those with different needs and capabilities, such as through the improvement in quantity and quality of transport system, as well as increased efficiency in the walking and cycling connection, transportation services and accessibility of land use pattern, built pedways that surround city pathway networks which link buildings or structures and transportation terminals to set up more comfortable areas and create more pedestrian-oriented streetscapes. For instance, in Germany, the Public Bike System (PBS) program has raised the utilisation of public transport like trains and buses, along with the use of more bicycles through initiatives such as the With Smart Card and OV-Fiets rental public transport bicycle system supplied at 156 Dutch rail stations and Call-a-bike rentals at 16 train stations(J. Puecher & Buehler, 2008).

'Land use management' includes another mobility management strategy which impacts the change from passive to active transportation. An active transport utilisation can contribute to gain different strategic and ideal land use planning objectives by declining the quantity of land use that has to be applied for building roads, streets and parking facilities, thus motivating more compact development patterns.

The 'price incentive' strategies allow commuters' sources to decrease as their vehicle trips are reduced due to the offering of more effective alternative ways to travel. When driving disincentives such as Parking Pricing decreases vehicle travel, typically 10 to 35 percentage of the reduced trips shift to walking and riding bicycles. When costs go up, mobility comes down. Hence, changing of the price can have different effects on travel (FHWA, 2004).

Table 1 : Mobility management strategies to implement active transport

Improved Transport Option		**Price Incentive**		**Land Use Management**	
1.	Transit Improvement	1.	Congestion Pricing	1.	Smart Growth
2.	Pedestrian Improvement	2.	Distance-based Pricing	2.	Location-efficient Development
3.	Cycling Improvement	3.	Employee Transportation Benefits	3.	Parking Management
4.	Bicycle Parking Facilities	4.	Parking Cash Out	4.	Transit Oriented Development
5.	Bicycle-Transit Integration	5.	Parking Pricing	5.	Car Free Planning
6.	Guaranteed Ride Home	6.	Pay-as-you-drive (PAYD) Vehicle Insurance	6.	Traffic Calming
7.	Restrict Automobile Travel	7.	Fuel Tax Increases	7.	Streetscapes Improvement
8.	Public Bike Systems/Rental	8.	Price Incentive		
9.	Address Security Concern	9.	Congestion Pricing		

3.0 Methodology

3.1 Research Goal

The aim of this study is to define the best strategies to be applied in implementing non-motorised modes of transportation system by using mobility management strategies. The selection of three best strategies among those highlighted in the study's questionnaires can help in determining the planning of mobility management strategies towards non-motorised modes of transportation from the perspective of practitioners and non-motorised expert. The selection of best strategies based on their experience can provide better understanding to assist in the process of planning towards adoption of active transport. In order to achieve this objective, a set of questionnaires was answered by the experts.

3.2 Knowledge Acquisition for Expert System

Knowledge acquisition was obtained from various sources in transportation field. The main source is obtained through the domain experts and also from other sources such as guidelines, textbooks and encyclopaedias such as the Victoria Transport Policy Institute (VTPI). The multiple sources provide many advantages in decision making until the expert systems are fully developed. The principle source of knowledge is derived from the expert transportation system and city planning officials who are directly involved in the planning of TDM for active vehicle and bicycle facility design. Information was collected through interviews with domain experts who are experienced in Malaysia of which the domain experts for TDM planning module for active vehicle were obtained from government and private bodies involved in the planning and implementation of TDM such as the National Physical Planning Department of Town and Country Planning Peninsular Malaysia, Department of Planning Physical in Kuala Lumpur City Hall (DBKL) as well as others involved specifically in TDM planning for active vehicle. They have been selected as their knowledge and perceptions about the technology to be adopted can be used to make decisions for implementing new technologies (Rogers & Everett, 1983). The factors that are identified previously from the literature then were analysed by comparing the perspectives and opinions of these experts.

3.3 Analysis and Results

The results of the study were obtained from seven (7) experts and the item was analysed by weighing the chosen strategies. From dozens of proposed strategies, experts only chose three (3) best strategies for the implementation of TDM towards implementing active transport use. There are eight (8) main transportation planning objectives to be achieved in organising active transport system: congestion reduction, road and parking cost reduction, consumer cost reduction, crash risk reduction, air and noise pollution reduction, energy conservation, economic development benefits and livable communities. Based on these elements, the experts chose the best strategies by considering the main objectives that were further categorised into specific objectives. The specific objectives were divided into four (4) major categories according to how they affect the travelling, including the improvement to transport option, land use management, price incentive and other implementation programs.

The final results of the study yielded three (3) best strategies that can be implemented in Mobility Management towards the implementation of active vehicles. The example of one of the best strategy chosen under one of the main objective is congestion reduction, which is shown in the table below.

Table 2 : Reduction from the perspective of Improvement of Transport Option

		Expert 1	Expert2	Expert3	Expert4	Expert5	Expert6	Expert7	Total
High Density Urban	Bicycle Parking Facilities	1	1				1		3
	Bicycle Transit Integration	1	1	1	1		1	1	6
	Guaranteed Ride Home					1			1
	Restrict Automobile Travel			1	1	1		1	4
	Pedways	1	1				1	1	4
	Non-motorised Transport Planning			1	1	1			3
Medium-density urban/suburban	Bicycle Parking Facilities		1		1		1	1	4
	Bicycle Transit Integration		1	1	1	1	1	1	6
	Guaranteed Ride Home			1		1			2
	Restrict Automobile Travel								0
	Pedways				1		1		2
	Non-motorised Transport Planning	1	1	1		1		1	5

Table 3 : Congestion Reduction from the perspective of Land Use Management

		Expert 1	Expert2	Expert3	Expert4	Expert5	Expert6	Expert7	Total
High Density Urban	Smart Growth	1	1	1	1	1		1	6
	Location-efficient Development	1	1	1	1	1	1	1	7
	Parking Management	1	1				1		3
	Car Free Planning			1	1	1		1	4
	Traffic Calming						1		1
Medium-density urban/suburban	Smart Growth	1	1	1	1	1		1	6
	Location-efficient Development	1	1	1	1	1	1	1	7
	Parking Management						1		1
	Car Free Planning					1			1
	Traffic Calming	1	1	1	1		1	1	6

Table 4 : Congestion Reduction from the perspective of Price Incentives

		Expert 1	Expert2	Expert3	Expert4	Expert5	Expert6	Expert7	Total
High Density Urban	Congestion Pricing		1	1	1	1		1	5
	Distanc-based Pricing			1					1
	Employee Transportation Benefits				1	1			2
	Parking Cash Out						1		1
	Parking Pricing	1			1				2
	Pay-As-You-Drive (PAYD) Vehicle Insurance								0
	Commuter Financial Incentives	1	1	1				1	4
	Speed Reduction						1		1
	Vehicle Restriction	1	1			1	1	1	5
Medium-density urban/suburban	Congestion Pricing								0
	Distanc-based Pricing								0
	Employee Transportation Benefits	1	1	1		1		1	5
	Parking Cash Out						1		1
	Parking Pricing		1		1	1			3
	Pay-As-You-Drive (PAYD) Vehicle Insurance			1					1
	Commuter Financial Incentives		1	1		1		1	4
	Speed Reduction	1			1		1	1	4
	Vehicle Restriction				1		1		2

2.2 Development of Expert System

The expert system as an advisory unit developed to provide advice and consultation to user, particularly in providing assistance and solutions to problems. Normally these issues are solved by human experts who form the body of the expert system (Forslund 1995). Both advisory and expert systems are problem-solving packages that mimic human experts in a special area. Meanwhile, Gregg & Walczak (2006) stated that the advisory system is designed to support decision making with no single correct answer in more unstructured situations. The knowledge acquisition processes are composed from guidelines, procedures, encyclopaedia, research publication and expert individuals in transportation field as part of the expert domain. The expert system is developed by using Visual Basic.NET as a tool and MySQL as a supporting tool.

The expert system is focused on the implementation of active transport in urban and suburban areas. There are three (3) modules in the expert system: i. Planning, ii. Design, and iii. Successful Implementation. This paper focuses on the planning module. The planning module outlines three suggestions (3) based on the type of area, main objective and specific aim in order to achieve the Mobility Management Strategies' objectives.

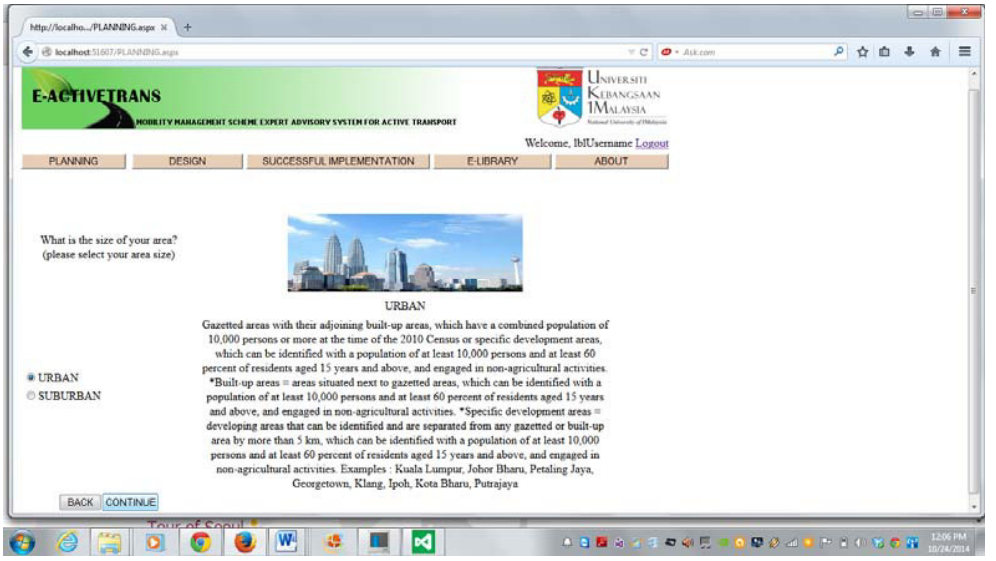

Figure 1: User interface for the selection of type of area

Figure 2: User interface for the selection of main objective

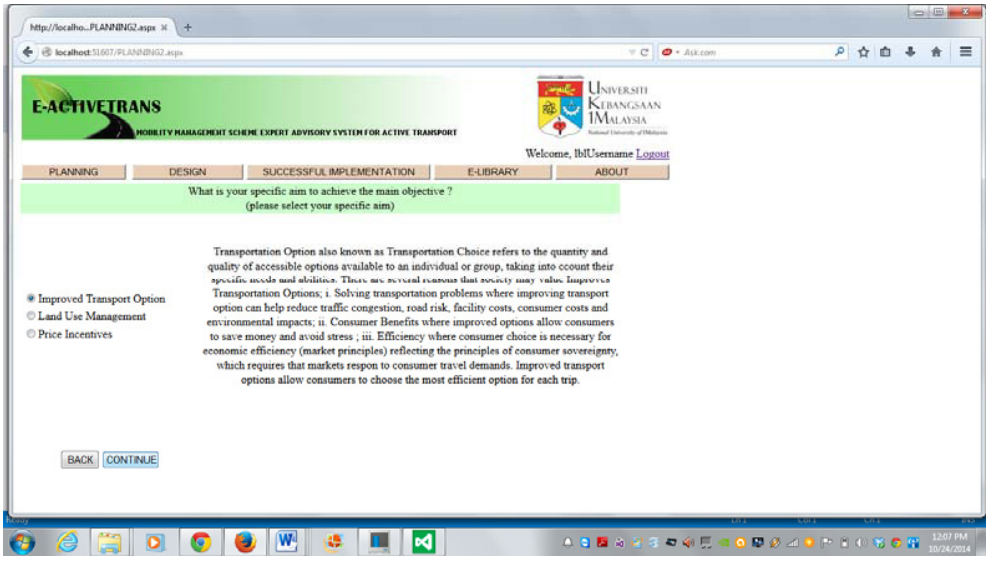

Figure 3: User interface for the selection of specific aim

Final results of the study are to identify the three (3) strategies that can be implemented in the TDM plan towards implementation of active vehicles. The example of the result from the expert system is shown in Figure 4 below.

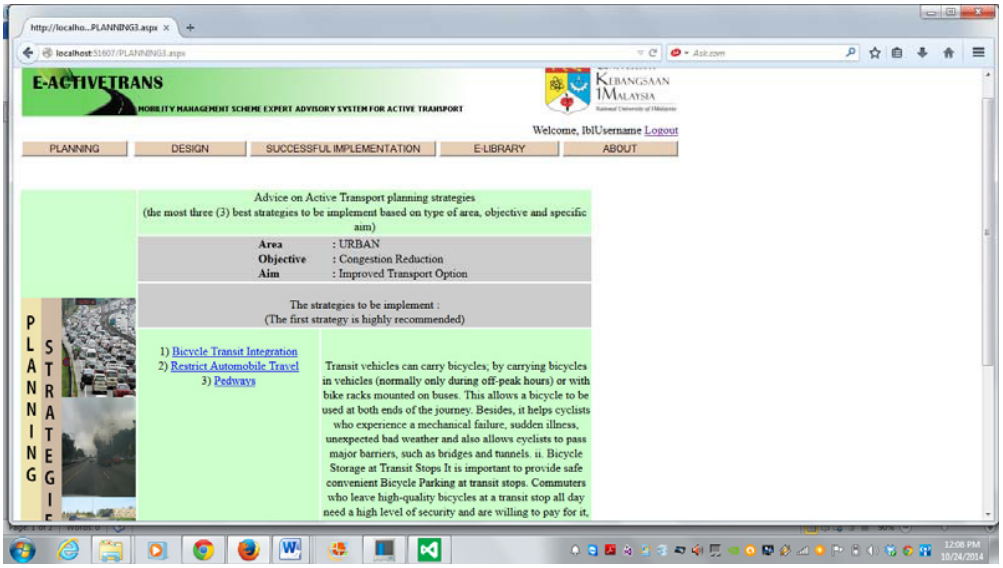

Figure 4 : The best strategies to be implemented in planning of TDM towards implementing active vehicles

4.0 Conclusion

This paper which covers the concept of how knowledge-based solutions derived from various documented publications could be used for urban transport planning focusing on active transport. The advice strategy in the expert system can be used to facilitate young engineers to spearhead their efforts towards the implementation of active transport planning. Without referring to any urban transport experts, the expert system is hoped to be able to help young professionals in making decisions before they decide to implement the active transport in their transportation system.

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References

Broaddus. A, Litman .T & Menon.G,(2009) Transportation Demand Management, *Sustainable Urban Transport Project Training document.* (www.sutp.org) and GTZ (www.gtz.de)

FHWA (2004), Travel Demand Management, *Office of Operations, Federal Highway*

G.D. Gregg & S. Walczak. (2006) Auction Advisor: an Agent-Based Online-Auction Decision Support System. *Decision Support Systems* 41, 449– 471. *Elsevier.IntelliCorp, Inc. Kappa*-PC Ver. 2.4

G. Forslund, (1995). Toward Cooperative Advice-Giving Systems. *IEEE Expert: Intelligent Systems and Their Applications,* 10/ 4, 56-62, *IEEE Educational Activities Department Piscataway, NJ, USA.*

Puecher & R. Buehler, (2008). Sustainable Transport that works :Lesson from Germany. *World Transport Policy and Practice* 15 (2) : 13-46, 20

Institute of Transport Engineers (ITE), (2010). Designing Walkable Urban Thoroughfares: A Context Sensitive Approach, Recommended Practice, *Institute of Transportation Engineers* (www.ite.org); at www.ite.org/emodules/scriptcontent/Orders/ProductDetail.cfm?pc=RP- 036A-E.

R. Mansyur, (2011) Development of an expert advisory system for strategy implementation in transport demand management (E-ASSIST).*PhD Thesis, Department of Civil and Structure Engineering, Universiti Kebangsaan Malaysia* (UKM).

R. Mansyur, (2011b) Decision Support System for Transport Demand Management : Object Oriented Approach Using KAPPA PC 2.4 Expert System Shell, *ARPN Journal of Engineering & Applied Science, 6/2.*

Rogers, E. M., & Everett, M. (1983). Diffusion of Innovation, Third Edition (3rd ed.). New York, NY: *A Division of Macmillan Publishing Co., Inc.*

Transport Demand Management (TDM) Encyclopedia, (2012) Non-Motorized Transportation Planning, *Victoria Transport Policy Institute.*