Future Building Performance Factors towards Energy Efficient Travel Plan in Regional Development

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Abstract

Preliminary research shows short coming of Building Performance field of research to measure outdoor performance of building manly EETP factors. Accordingly, this research aimed to Proposing future building performance toward Energy Efficient Travel Plan based on user friendly EETP factors. The research methodology engaged three research phase. 'Phase I' was to identify user friendly EETP factors. In this phase after a literature review, fix-format self reporting interview survey was conducted among experts in Travel Plan implementation in Malaysia. 'Phase II' was to investigate effective Building performance factors on user friendly EETP, within which literature review conducted on building performances followed by brainstorming with 5 experts in building management field of research. Final phase was to validate purposed building performance towards EETP in a futuristic cross-impact scenario study. In summary, research is concluded to introduce three main out comes, first: list user friendly EETP factors, second: EETP building performance factors and Third: future Building performance factors towards EETP based on futuristic cross-impact analysis. In conclusion, study introduced list of new innovative future building performances including; BCS (Building communication system), BEEM (Building Energy Education Management), EETP (Energy Efficient Travel Plan), BRc.S (Building recycling system), and BAgr. (Building agriculture) investigated as future building performance factors.

1. Introduction to Energy Efficiency Travel Plan

The idea of Energy Efficient Travel Plan (EETP) is under the umbrella of Travel Plan (TP) introduced science late 90's. Traditionally, TP provides policy planning to reduce transportation impact. Enoch and Ison (2010) defines TP as "a long-term management strategy for an organisation and its various sites or business park that seeks to deliver transport objectives through positive action and is articulated by a document that is regularly reviewed".

Wake et al. (2010) defines TP as "… is a package of actions implemented to manage travel generated by a workplace. Primarily, travel plans seek to reduce car trips and encourage the use of lower impact alternatives, such as walking, cycling, public transport and telecommunications."

Rye (2002) sates TP in UK is known as company (workplace) travel plan, while in Europe is known as mobility management, and in US is known as transportation demand management (TDM). Albeit, the three concepts are addressing one issue, this study used TP and EETP as refereed in report. Table 1.1 addresses some of measures in TP Adopted from Rye (2002).

In TP mostly the main concern is measuring, monitoring and reducing Carbon Foot Print of all the residents under issue of TP. TP is proposed normally in 'organizational bases'. Tyler et al. (2006) sates "….Initially, travel plans were required by regulation in the US. The 1990 Clean Air Act Amendment required employers with 100 or more employees to implement trip reduction".

The travel sector is a large and diverse issue, which is encompassing travel by land and the movement of both passengers and vehicles. But passenger vehicles, used for the daily travel of households, are the primary source of CO2 emissions within the travel sector. The controversial argument is that many technological innovations with the potential to reduce transportation emissions from passenger vehicles are possible but it needs more research and investigations. However, consensus is growing that technological innovations alone will not be enough to reach targeted reductions in CO2 emissions: changes in human behaviour are also essential (Rajan 2006; Lutsey and Sperling 2009). TP address this aim in principles.

Table1.1: Travel plan measures (Adopted from Rye, 2002)

Mode	Measure
Overall for whole plan	–Travel coordinator (member of staff) –Promotion and publicity –Implementation process, e.g. steering group
Walking	–Improved lighting and walkways –Incentives for walkers –Crossings in/adjacent to site –Changing/shower facilities
Cycling	–Pool cycles –Bicycle loan scheme –Good, secure parking provision –Discount purchases of cycles and equipment –Provision of PT information at workplace
Public transport	–Access to rail planner –Discounted season tickets, paid for by operator –Liaise with local operators to operate new services –Pay for new services –Pay for subsidies for fares on existing bus services –Staff travel survey to identify potential sharers –Priority parking spaces for car sharers –Guaranteed ride home (taxi)
Car share	–Reduce parking supply –Ration parking through permit allocation –Charge for parking –Flexi-time –Telecommuting/working
Parking	–Company car initiatives (phased out/ altered

2.0 Problem Statement

This section to explain the rational to study is divided to twofold; Gap in research on building performance factors to consider EETP, Need in practice for EETP.

2.1 Gap in Research on Building Performance Factors to consider EETP

This research tries to introduce consequences of Energy Efficient Travel Plan (EETP) on Building Performance factors, as Future Building performance factors. Mohammad (2012) states totally there are 15 building performance criteria to be considered as Building Performance Factors. He reviewed on POE (Preiser, 2008), POE (Minnesota Univ., 2004), Building Quality Assessment (BQA), ISO 6241 Performance standards for buildings, Orbit 2.1, Facilities Performance Evaluation (FPE) and some other researchers efforts and concludes in total 15 different evaluation criteria. Including; Health, Safety, Security, Functionality, Efficiency, Social, Environmental Psychology, Aesthetics, Operations, Comfort, Durability, Economic, Flexibility and culture. Study observes that all the mentioned performance factors are related to the building indoor and close out door of building, and no one is to consider performance of building in area, specially, with the responsibility of EETP. Besides, Intelligent Building concept for more than thirty years has been change the building performance criteria, but with the direction of Energy Efficient Travel Plan (EETP) seems that it can play more to help the travel behavior, and it can introduce new performance criteria to its designers and users.

2.2 Need in Malaysia to consider EETP

It is a common importance among all countries to improve Human development Index (HDI) as a measure of human Quality of Life. The increase in HDI will effect on higher energy consumption. Figure 1 is highlights correlation between HDI and Energy consumption contrast within various countries and shows the critical position of Malaysia. This confirms Malaysia has to foresee the future energy consumption and optimize its energy consumption in sustainable building design framework towards improving quality of life.

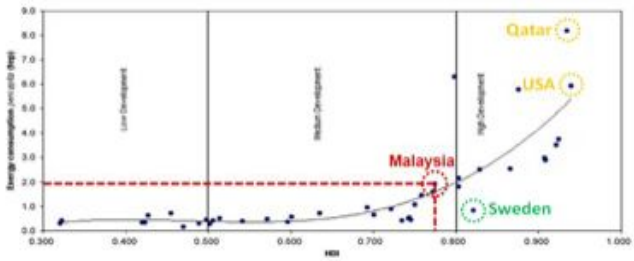

Fig.1: HDI versus Energy consumption within various countries (Adopted from Dias et al., 2006)

This momentum is obvious by Malaysian governments. The key Malaysian ministry and agency involved are the Ministry of Energy, Green Technology and Water, Energy Unit of Economic Planning Unit of Prime Minister's office, The Energy Commission of Malaysia, and Persatuan Tadika Malaysia (PTM). Furthermore, agendas have been sets for the different mentioned Malaysian ministry and agency by five year bases Malaysian plans. The Malaysian government in Ninth Malaysia Plan concerns strongly on Energy efficiency programs while, sustaining the quality of life for the needs of the population and at the same time to manage Malaysia's resources (Ninth Malaysia Plan 2006-2010). Furthermore, greater emphasis has been considered on energy efficiency under the Tenth Malaysia Plan (2011-2015).

In Malaysian building construction industry; environmental concerns, energy crisis, and technology advances, have brought up Energy Efficiency as the agenda for building performances since 80's. In 1989, the Malaysian Ministry of Energy, Water and Communication (MEWC) had introduced the Guidelines for Energy Efficiency in Non-Domestic Buildings. The guidelines were revised as the Malaysian Standard MS 1525:2001 which aimed to encourage the application of energy efficiency in new and existing buildings whist maintaining comfort, health and safety of the building-users. Best practices as stipulated in the Malaysian Standard MS 1525:2007 "Code of

Practice on Energy Efficiency and the Use of Renewable Energy for Non-Residential Buildings" have been adopted as guiding principles.

However, MS 1525:2007 in line with some internationally well-known standards (such as ASHRAE standard 55-2010, and ISO 7730:2005) does not support all requirement of building user in the energy efficiency. Indeed, updating and improving MS 1525:2007, with existence of complimentary tools and framework is considerably needed that ensures continues 'moving forwards' in energy efficiency standards of buildings in Malaysia.

Building based TP has potential towards energy efficiency. The behaviours underlying transportation foot print are complex. Vehicle-Miles-Travelled (VMT) is the direct result of a series of behavioural choices shaped by the physical environment and policy context over different time frames. The rate of emissions per mile is also fundamentally a function of behaviour, both the choice of vehicle type and the style of driving. As obviously location and function of building have direct effect on this CO2 emission.

Therefore, with investigating effect of Building Performance on Sustainable Travel Plan in future urban mobility, we will have new feature in term of opportunity of building to be part of EETP to eliminate and minimize the travel. Relatively, the research question is as followed:

"What would be the future of Building performance factors towards enhancing Energy Efficient Travel Plan?"

3. Aim, Objectives and Scope of Study

This research project aims to propose future building performance factors toward Energy Efficient Travel Plan. To address this aim, the following objectives were defined; First: To identify user friendly EETP factors, Second: To investigate effective Building performances (BP) towards user friendly EETP, and Third: To establish future Building performances (BP) factors towards user friendly EETP. Several area were investigated as scope in this study, including; building functionality, which was limited to cover only office buildings, Malaysia from other possible regions, and the building performance investigated was limited to those with direct effect on EETP.

4. Significant of Study

This study has been formulated the relation of BPs from EETP perspective. This investigation is fundamental for futures buildings to be more Green and Sustainable. Currently, construction building industry is practicing sustainable building assessment (SBA) tools to benchmark sustainability in building. One of key shortcoming of SBA stated by Lützkendorf and Lorenz (2005) "… it must be noted that social aspects and considerations related to sustainable buildings are not yet fully explored due to the complexity of the issue. For example, social aspects also include the interrelation between single buildings and community-level issues like urban design quality, social segregation, urban sprawl, etc." Significance of the current research is to propose future BPs in EEB. Indeed, such BPs will open insight in building construction R&D also towards building sustainable development. Introduction of BPs in this study is fundamental for R&D sector for further development of means to apply the BPs.

5. Research Methodology

This study was developed three research phases corresponding to the three objectives of study. In total, this study is to conduct using four steps. Which first step conducted prior to step 2, 3, and 4. The list below describes each step.

Phase I: (to fulfill requirement of first Objective)
Step 1: Literature review: A review of relevant literature was conducted by focusing on the following key words: EETP factors, user friendly EETP factors, Energy efficient Life styles.
Step 2: Expert input (data collection and data analysis): To validate the results of the literature

review an expert input session implementing Delphi close group discussion.

Phase II: (to fulfill requirement of second objective)
Step 3: Brainstorming (data collection and data analysis): To investigate effective BPs towards user friendly EETP factors in a Synectics session.

Phase III: (to fulfill requirement of third objective)
Step 4: Close Group discussion-CGD (data collection and data analysis): To implement futuristic study method on finding of second objective in an expert CGD session, implementing Delphi close group discussion.

6. Data Analysis

This section is to brief data analysis and discussion on first, second, and third objective. Mainly data analysis was conducted based on three answer presented for three questions corresponding to each objective in different interviews. Questions include;

Q1) It is a as user friendly EETP factor.
Q2) What you can propose as Effective BP to consider this factor?
Q3) There is a need in future on proposed BP based on the four mentioned scenarios.

For question 1 and 3, the research conducted expert input session by means of Delphi structured close group discussions. Thus study used five-point rating scale based on 1 for 'unacceptable' to 5 for 'Acceptable'. Respondent(s) perception collected based on each life style or TP measure, where investigated in literature review. Further explanation on data collection is presented in chapter 3.

As data analysis method WSM is used in this study. The formula (1) applied for each validation aspect. And formula (2) applied for validation conclusion. Table 1 indicates a sample-result of WSM.

$$\boldsymbol{WSM(a_i) = (\sum_{j=1}^{n} w_j)\, a_i,} \quad for\ i = 1,2,3,\dots,m \qquad (1)$$

Where,
'w_j', referred to assigned weight by decision maker in close group discussion for sub-issue of discussion by participants number 'j'
' a_i', is sub-issue of discussion with the given ordering number of 'i',

$$\boldsymbol{WSM(a_i)\ /\ WSM(a)_{max}} \textbf{ = Consensus in \%} \qquad (2)$$

Where,
$WSM(a)_{max}$ *, refers to maximum sum of possible weight can be given for one sub-issue*

Formula (4) indicts the consensus calculation. Albeit, consensus where accepted if more than % 70 consensuses were observed. One example is presented to calculate consensus using WSM (Table 2).

Table 2: Example of WSM process in the clacualtion of concenses

Validation Aspects	w_1	w_2	w_3	w_4	w_5	w_6	w_7	$WSM(a_i)$	$WSM(a)_{max}$	Cons. %
factor 1	3	4	5	5	5	np	5	27	30	90

Note **. np:** refers to cases where participants didn't assigned the weight to the sub-issue, **Cons.:** refers to consensus calculated based on furmula (4).

Question 2 is to address finding of 2nd objective. And Question 3 is based on futuristic analysis on final finding of question 2. The amount of production in supply side has correlation with demand. Thus, to conduct the futuristic study we must consider this correlation. It is to insure the common acceptable finding. It is a common trend in futuristic study to consider restrictions in study. Thus to consider clean Electricity& clean fuel as restriction there are four possible scenarios (in timely manner):

1st scenario: Current Electricity& fuel (not enough not clean)

2nd scenario: Production of Energy (in the form of clean electricity) will cover the needs and also more

3rd scenario: Production of fuel (in the form of clean fuel) will cover the needs and also more

4th scenario: Production of Energy (in the form of clean Electricity& fuel) will cover the need

In summary of data analysis applied in all three phase of research Table 3 is presenting the result. According to results of Table 3, BCS (Building communication system), BEEM (Building Energy Education Management), EETP (Energy Efficient Travel Plan), BRc.S (Building recycling system), and BAgr. (Building agriculture) were investigated as future building performance factors.

Table 3: Content analysis to identify 'user friendly EETP' based on adopted list of life styles from Leonard-Barton (1981)

Life styles and TP measures		Q1	Q2	Q3
Life style	Bike for exercise	61		
	Bike on errands	33		
	Bike on retail purpose	24		
	Change oil in car	60		
	Get instruction to increase self-reliance	72	**BEEM**	78
	Exchange goods or services	40		
	Grow vegetables	78	**BAgr**.	87
	Recycle paper	75	**BRcS**	87
	Recycle glass	34		
	Recycle cans	46		
	Buy second-hand clothes	24		
	Buy at garage sales	65		
	Make gifts	78	**EETP**	74
	Make clothes/furniture	73	**BES**	64
	Plan meatless meals	67		
	Have compost pile	63		
	Contribute to ecology organizations	85	**BEEM**	78
	Belong to a cooperative	83	**BEEM**	78
Plan	Travel coordinator	74	**BEEM**	78
	Promotion and publicity	65		
	Implementation process	73	**BEEM**	78
Walking	Improved lighting and walkways	56		
	Incentives for walkers	74	**BEEM**	78
	Crossings in/adjacent to site	56		
	Changing/shower facilities	36		
Cycling	Pool cycles	56		
	Bicycle loan scheme	62		
	Good, secure parking provision	75		
	Discount for purchasing and equipment	68		
	Provision of PT information at workplace	75	**EETP**	74
Public transport	Access to rail planner	32		
	Discounted tickets	45		
	Liaise with local operators for new service	74	**BEEM**	78
	Pay for new services	54		
	Pay for subsidies of existing bus services	83	**BEEM**	78
	Staff travel survey	74	**BEEM**	78
	Priority parking spaces for car sharers	79	**BEEM**	78
	Guaranteed ride home (taxi)	90	**EETP**	74
Car share	Reduce parking supply	87	**EETP**	74
	Ration parking through permit allocation	93	**BEEM**	78
	Charge for parking	93	**BEEM**	78
	Flexi-time	-		
	Telecommuting/working	98	**BCS**	95
Parking	Company car initiatives	78		

7.Discussion

This section is to briefly discuss findings of each objective in this study. First is to present finding of the first objective. Next is to discuss findings of second objective and finally it will address findings of the third objective.

Findings on first objective: The first objective of this study was to identify user friendly EETP factors. Based on literature review 'life style and TP measures' presented to the expert to validate acceptability of them as user friendly EETP. The data analysis of expert input conducted using WSM. Based % 70 saturation study resulted in list of user friendly EETP criteria as presented in Table 2.

Findings on second objective: The second objective of this study was to investigate effective Building performances (BP) towards user friendly EETP. Thus, based on findings of fist objective, user friendly EETP factors presented to the expert in a brain storming session. It was to propose the effective BPs. The data analysis of expert input conducted using WSM. Based % 70 saturation study resulted to list of effective TPs towards EETP as presented in Table 2.

Findings on third objective: The third objective of this study was to validate findings of second objective in a futuristic study. Thus, based on findings of second objective, BPs presented to the expert in a futuristic cross-impact analysis having four scenarios. The data analysis of expert input conducted using WSM. Based % 70 saturation study resulted to list of future effective TPs towards EETP as presented in Table 2.

8. Conclusion

In reference to Table 3 BCS (Building communication system), BEEM (Building Energy Education Management), EETP (Energy Efficient Travel Plan), BRc.S (Building recycling system), and BAgr. (Building agriculture) investigated as future building performance factors.

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