A preliminary study of sustainable transport indicators in Malaysia: the case study of Klang valley public transportation

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Abstract

This research centers around the exploration of the applicability and transferability of some international/global sustainable transport indicators in an important city region in Malaysia, namely Klang Valley. The literature review highlights several important measures to identify, determine and select the relevant sustainable transportation indicators. Around 30 out of 1000 indicators were chosen to be tested in the different scenarios of public transportation in Malaysia. The research applied the snowball internet survey method, in addition, face-to-face, snail-mail, and electronic questionnaire. Samples were selected from a list of various professionals relevant to the field of transportation. They include transport planners, traffic engineers, public transport operators and managers, transportation economists, environmentalists, academician and researchers, as well as urban and regional planners. It is found that a number of indicators such as the percentage of bus passenger is suitable and relevant to Klang Valley. However, several other indicators are deemed less suitable to represent the measurement of sustainability of transportation in Klang Valley. Hence, it is suggested by the research that future selection of indicators should have a greater sensitivity to be more realistic with the country current situations, circumstances and fortune. Preliminary findings of the research are intended to be disseminated through another set of focus group discussion.

Keywords: sustainable public transport indicator; transport planning; public transport; sustainable transport.

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1. Introduction

Sustainability awareness in the provision and operation of public transportation in the urban areas has been rising. In the developed countries like Japan and the four Asian tiger economies such as Seoul, South Korea (65.1% mode share of bus and rail in 2011 compared to 60.3% in 2010), Hong Kong (71.1% mode share of bus and rail in 2009 compared to 70.6% in 2008), Taipei, Taiwan (58% of public transport mode share in 2012 compared to 57.5% in 2011), and Singapore (public transport mode share increased from 59% in 2008 to 63% in 2012), public transport shares have increased over the last few decades. Many of these public transportation operations have been consolidated under one single authority. That authority plans, develops, constructs, manages, and oversees the operations in order to be effectively and efficiently move people to their respective destinations with greater ease, seamless, and smoothness of journey makings.

Public transport as a competitive alternative to private mode of transport has several features such as: being timely, punctual, frequent and attractive. These features have also been coupled with modern design, advanced fleets and consumption of less or environmentally fuel, which are all the characteristics of a sustainable public transport. Whilst many studies and exposures have been made on the operation of the sustainable public transport in many cities of the world, less literature has dedicated its exploration on the indicators to measure the levels of so-called sustainability, especially on those public transportation systems of South East Asia region, including Malaysia. In effect, to date, there have been very limited reviews of the measures of sustainability of these public transport systems, let alone the determination of such sustainability indicators and levels.

Hence, this research focuses on the outlining the sustainable public transport indicators for Klang Valley, the most developed, prosperous and advanced city region in Malaysia.

1.1 Study Objectives

i. To characterise the current public transportation system and services provided in Klang Valley according to sustainability definitions

ii. To identify and select the most suited indicators of public transport sustainability in Klang Valley

2. Literature Review

2.1 Sustainable Transportation

Sustainability according to Tao and Hung, can be defined as the achievement of continuous transportation activities supported by the environmental, economic and social objectives at various space-based scales of operation. The measures of sustainability have been adopted and implemented on various land uses or central of population’s activity, however, assessment of movements’ sustainability has been scarcely found in literature. Various indicators have been developed and identified in light of the transportations systems evaluation. In countries such as the UK, modal shares, in particular, the number of public transport riderships has been used to assess the performance and impact of the public transport system towards the environment and community. Other European nations like Germany, France, Austria, and Switzerland have accepted the Level of Service (LOS), travel demand, and numbers of ridership, as indicators of a sustainable transport system.

In the USA, indicators such as transit accessibility, and transport affordability have been adopted. Japan has developed indicators in the transport policy framework to measure the performance of sustainable transport development under the administration of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT). Other Asian nations have subscribed to Sustainable Urban Mobility in Asia (SUMA) project where the assessment on several aspects such as access, safety, environment/clean air, economical and social, is developed as an indicators’ theme to a sustainable system. In other words, more than 300 indicators have been developed, refined and agreed upon when assessing the levels of sustainability of a particular transport system. From initial of more than 100 indicators, only 75 indicators have been formally shortlisted to be adopted in Bangkok Declaration 2020. A person’s access to transport modes may depend on the socio-demographic factors and preferential choices made by that particular person. Klang Valley, even though is more developed than many neighbouring city regions like Jakarta, Bangkok and Manila, has very limited choices of public transportation.
2.2 Sustainable Indicators

The more challenging issue in a sustainable transport planning is mostly the common goal of sustainable transportation, which is to develop appropriate indicators to measure the level of sustainability. Many of studies focus on establishing the indicators that are sometimes too technical or too general. Some indicators of the framework proposed lead to reliable and adaptable implementation issues. The suggested frameworks in summary, have classified the indicators based on the impacts of the transportation activities. In a further discussion, sustainable transportation indicators must take into account a wide range of economic, social and environmental impacts. The findings of the study suggest that the indicators should be comprehensive in all of these aspects as indicated in Table 1.

Table 1. Sustainable Transportation Indicators

| Objectives          | Indicator                                                                 |
|---------------------|---------------------------------------------------------------------------|
| Economic            |                                                                           |
| Commute access      | Average commute travel time                                               |
| Accessibility – Land use mix | Number of job opportunities and commercial services within 30-minute travel distance of residents |
| Accessibility – Smart Growth | Implementation of policy and planning practices that lead to more accessible, clustered, mixed, multi-modal development |
| Transport diversity | Mode split: portion of travel made by walking, cycling, rideshare, public transit and telework |
| Affordability       | Portion of household expenditures devoted to transport by 20% lowest-income households |
| Facility costs      | Per capita expenditures on roads, traffic services and parking facilities |
| Freight efficiency  | Speed and affordability of freight and commercial transport               |
| Planning            | Degree to which transport institutions reflect least-cost planning and investment practices |
| Social              |                                                                           |
| Safety              | Per capita crash disabilities and facilities                               |
| Health and fitness  | Portion of population that regularly walks and cycles                      |
| Community livability| Degree to which transport activities increase community livability (local environment quality) |
| Equity – fairness   | Degree to which prices reflect full costs unless a subsidy is specifically justified |
| Equity – non-drivers| Quality of accessibility and transport services for non-drivers            |
| Equity – disabilities| Quality of transport facilities and services per people with disabilities (e.g., wheelchair users, people with visual impairments) |
| Non-motorized transport planning | Degree to which impacts on non-motorized transport are considered in transportation modeling and planning |
| Citizen involvement | Public involvement in transport planning process                           |
| Environment         |                                                                           |
| Climate change emissions | Per capita fossil fuel consumption, and emissions of CO₂ and other climate change emissions |
| Other air pollution | Per capita emission of ‘conventional’ air pollutants (CO, VOC, NOₓ, particulates, etc) |
| Noise pollution     | Portion of population exposed to high levels of traffic noise              |
| Water pollution     | Per capita vehicle fluid losses                                           |
| Land use impacts    | Per capita land devoted to transportation facilities                       |
| Habitat protection  | Preservation of wildlife habitat (wetlands, forests, etc)                  |
| Resource efficiency | Non-renewable resource consumption in the production and use of vehicles and transport facilities |

In general, the key aspect of the sustainable transportation indicator framework is based on the key dimensions of sustainable development concept of economic, social and environment. To ensure that the indicators are reliable as a comprehensive measurement to assess the level of sustainability, it should practically measure the impact of transportation towards economic, social and environment. Even though indicators can have different functions with regard to different domain of use, in the aspect of sustainable transportation assessment, it should be reliable to measure the level of description, prediction of impacts, simplification and practicality. All aspects that are related and linked to the present and future impacts from the transportation activities must be considered in developing those indicators. Moreover, it is necessary to establish clear and comprehensive indicators in order to develop an assessment method to evaluate the sustainable transport as a whole system. The indicators should represent a clear description of the basis on which and how the level of sustainability can be measured. It is important to ensure that the implementation of the assessment system is practical and adaptable by all of the stakeholders, especially to the decision makers in transportation planning.

This research is propagating selected indicators to be adopted for the purpose of examining and assessing Malaysian public transport systems’ sustainability. Sustainable transport indicator is a measurement in assessing how well the current system fulfills the needs and is continuously reliable and resourceful for future. The development and implementation of indicators as measurement of sustainability took various steps and process with the involvement of stakeholders in transport system such as government agencies and transport operators.
Many organizations and agencies worldwide adopt the formation of independent bodies and focus group discussions to outline and formulate the indicators\(^{20, 22, 24, 25}\). The selection has been based on indicators related to public transport measures and factors that influence the success of a sustainable public transport system including the number of ridership, infrastructure and mode share. However, from 300 over indicators listed from the literature\(^{29, 9, 30, 5, 17}\), only 30 indicators (Table 2) are shortlisted to be examined and assessed in this study.

Even though the number of indicators is countless globally, the selection of 30 indicators from different literature as possible public transport sustainable indicators for Klang Valley was based on:

- Specification of an indicator to assess public transport (direct and indirect factor of public transport evaluation)
- That shortlisting was conducted through validation of four experts in the public transport study randomly
- As a preliminary study, whereby a list of indicators selected from the different literature has focused on Asian countries and cities as a case study, and from the successful sustainability indicators applied in the recent transportation study and the system.

### Table 2. Shortlisted Indicators \(^{6, 20, 16}\)

| No. | Indicator                              | No. | Indicator                                      | No. | Indicator                      |
|-----|----------------------------------------|-----|-----------------------------------------------|-----|--------------------------------|
| 1   | Percentage of bus passenger            | 11  | CO2 emissions from road transport             | 21  | Total expenditure on pollution prevention and clean-up |
| 2   | Percentage of all trains passenger     | 12  | N2O emissions from road transport             | 22  | R&D expenditure on “eco-vehicles” |
| 3   | Total per capita transport expenditure | 13  | Use of renewable energy sources in transport (1000 tons/GDP) | 23  | R&D expenditure on clean transport fuels |
| 4   | Motor vehicle fuel prices              | 14  | Average age of vehicle fleet (years)         | 24  | Direct subsidies to transport |
| 5   | Excise duty on road transport fuel (petrol, diesel per 1000 litres) | 15  | Average commute travel time                  | 25  | Relative taxation of vehicles and vehicle use |
| 6   | Percentage of GDP contributed by transport | 16  | Mode split: portion of travel made by walking, cycling, rideshare, public transit and telework | 26  | Annual transit ridership per capita |
| 7   | Total length roads (railways, motorways) (km of infrastructure per 1000 inhabitants) | 17  | Percentage of Single Occupancy Vehicle (SOV) Entering City Centre During Morning Peak Hour Period. | 27  | Miles of fixed-route bus service |
| 8   | Density of infrastructure (km of infrastructure per 1000 km² of surface area) | 18  | Ratio of Road Accident Cases Per 10,000 Populations. | 28  | Number of minutes between buses on scheduled routes |
| 9   | Employment in road and rail transport sector | 19  | Capital expenditure by mode                  | 29  | Percentage who perceives public transit unsafe |
| 10  | PM10 emissions from road transport     | 20  | Rail network length and density               | 30  | Cost per transit-rider trip, inflation adjusted |

### 3. Methodology

The research adopted the snowball sampling, internet, and pen-and-paper methods of questionnaire surveys, on some 100 samples of prominent and key players of transportation systems in Klang Valley. Primary data were collected from December 2013 to June 2014. During this duration, several issues regarding the methods have been encountered including limited references on Malaysia’s sustainable indicators and feedback response. Hence, there existed a few limitations and qualifications of the generalization of findings afterwards. The list of the population has been derived from the authorities related to transportation operators, managers, economists, planners, engineers, academician and related professionals. Some 500 samples have been identified, but responses have been very poor, with only 20% rate of return. Nevertheless, this small number has been commensurate with the prominence, knowledge, experiences and expertise levels demonstrated by the respondents. The survey form contained three sections:

- Section A: respondents’ background
- Section B: possible sustainable public transport indicators for Klang Valley
- Section C: factors of developing sustainable public transport indicators

Three types of survey approaches were deployed to overcome the issue of low response; face to face survey, snail-mail survey, and electronic survey as have been practiced elsewhere in other prominent research\(^{30, 31, 33}\). Qualification is adequately made on the generalized findings because of the size of the sample and the low responses.
4. Data Analysis and Discussion

4.1 Public Transportation System in Klang Valley

Public transportation development, operation, management and regulation in Malaysia Peninsular are currently under the purview of Suruhanjaya Pengangkutan Awam Darat (SPAD) or Land Public Transport Council. SPAD is a government agency directly under the Prime Minister’s Department with the functions and responsibilities of monitoring and implementing all initiatives and program on public transport development. SPAD actually gained its full authority on January 31st, 2011 with the gazetting of the Land Public Transport Act 2010. Klang Valley has been chosen as a case study for this research for the following reasons:

i. Klang Valley is a region including several cities functioning as satellites to the capital of Malaysia, Kuala Lumpur. Among the smaller cities are Shah Alam, Petaling Jaya, Subang Jaya, Rawang, Kajang, Bangi and Seremban (Figure 1). It has a population of approximately 6.3 million as of 2010.

ii. The choice of public transport in Klang Valley has been limited to road-based and rail-based (Figure 2) modes including heavy rail (KTM intercity, KTM Komuter), light rail (PUTRA, KLIA EKSPRES, KLIA TRANSIT) and monorail, as well as taxi and stage and intercity buses.

Selangor, a state in Peninsular with the majority of its districts falling under the realm of Klang Valley, has the following listed stage buses services (Table 3). The details regarding the operation and management are provided by the review of State Structure Plan, cited from the source of Suruhanjaya Pengangkutan Awam Darat (SPAD) (2014).

Table 3. Bus Operators and Respective Fleet (if applicable) in Selangor, 2012

| Company/Operator                                      | Fleet (Bus) | Operating Status                  |
|------------------------------------------------------|-------------|-----------------------------------|
| Ambang Jernih Sdn. Bhd.                              | 1           | Ceased operation                  |
| Pinggir Bandar Bus Line (M) Sdn. Bhd.                | 1           | Ceased operation                  |
| Abdullah bin Nadi dan Rakan T/A Syarikat Kenderaan Lima Sepakat | 2           | Ceased operation                  |
| Airport Coach Sdn. Bhd.                              | 2           | Active                            |
| Sri Indah Jaya Sdn. Bhd.                             | 27          | Active                            |
| Tg Karang Transportation Sdn. Bhd.                   | -           | Consolidated under Kenderaan      |
|                                                          |             | Kelang Banting Berhad (KKBB)      |
| Triton Commuter Sdn. Bhd.                            | 40          | Active                            |
| Permata Kiara Sdn.Bhd.                               | 1           | Ceased operation                  |
In 2012, some 1880 buses operated in Selangor. Based on the above Table 3, there was an increase of about 20% fleet or about 466 buses in 2012. There were limited or almost non-existence services of paratransit apart from taxis. Unlike neighbouring capital cities such as Jakarta, Bangkok and Manila, Klang Valley do not have three-wheelers public transport including bajai, tuktuk, bemo, ojek, and those pedal powered public transport such as rickshaw and trishaws. Hence, this study is rather limited in the sense that it may not be able to increase the sustainability of the public transport system based on the more environmentally modes such as three-wheelers and pedal powered modes. Nevertheless, examining and determining these indices by this research is among the first and pioneer steps towards achieving the government’s target of a balanced, i.e. 50:50 modal split share by the year 2020.

4.2 Analysis of Focus Group Survey

The majority of respondents (Table 4) are from town planning background majoring in transport planning, urban planning and environmental planning with a total of 54%. Another 19% is from an engineering background, 11% is from economic background, 8% is from intelligent transport system and 4% is from public transport development. 84% of the respondents have 1-10 years experiences and 16% of the respondents have experienced more than 11 years in their field. From their field of expertise, the respondents are classified into five categories of profession; environmentalist (4%), economist (15%), socialist (7%), planner (43%) and engineer (31%).

Table 4. Socio Demographic Profile Distribution

| Variables                        | Frequency | Percentage (%) |
|----------------------------------|-----------|----------------|
| 1 Field of Expertise             |           |                |
| Economic                         | 11        | 11             |
| Road Engineering                 | 7         | 7              |
| Environmental Planning           | 4         | 4              |
| Intelligent GIS/Transport System | 8         | 8              |
| Medical Fitness for Road Safety  | 4         | 4              |
| Environmental Science and Natural Resource Planning | 7 | 7 |
| Public Transport                 | 4         | 4              |
| Railway Engineering              | 4         | 4              |
| Town Planning                    | 28        | 28             |
| Traffic and Transport Engineering| 8         | 8              |
| Transport Planning               | 15        | 15             |
| 2 Years of Experience            |           |                |
| 1-10 years                       | 84        | 84             |
| 11-20 years                      | 8         | 8              |
| 21-30 years                      | 8         | 8              |
| 3 Profession                     |           |                |
| Environmentalist                 | 4         | 4              |
| Economist                        | 15        | 15             |
| Socialist                        | 7         | 7              |
| Planner                          | 43        | 43             |
| Engineer                         | 31        | 31             |
Findings also highlight that from 30 indicators listed in the survey, respondents place the highest priority in the issue of mode share, ridership, cost of transport and travel time. This is shown in the mean value of rating given by the respondent as summarized in Table 5.

Table 5. Mean Value of Rating on Sustainable Public Transport Indicator for Klang Valley

| Relevant as Sustainable Public Transport Indicator for Klang Valley (4.00 to 4.99) | Moderate as Sustainable Public Transport Indicator for Klang Valley (3.00 to 3.99) |
|---|---|
| No | Indicator | Mean | Rank | No | Indicator | Mean | Rank |
| 1 | Mode split: portion of travel made by walking, cycling, rideshare, public transit and telework | 4.5700 | 1 | 18 | Annual transit ridership per capita | 3.9700 | 18 |
| 2 | Percentage of bus passengers | 4.5400 | 2 | 19 | Rail network length and density | 3.9600 | 19 |
| 3 | Cost per transit-rider trip, inflation adjusted | 4.4700 | 3 | 20 | Density of infrastructure (km of infrastructure per 1000 km² of surface area) | 3.9400 | 20 |
| 4 | Percentage of all trains passenger | 4.3600 | 4 | | Percentage GDP contributed by transport | 3.9200 | |
| 5 | Number of minutes between buses on scheduled routes | 4.3200 | 5 | | PM10 emissions from road transport | 3.9100 | |
| 6 | Miles of fixed-route bus service | 4.2800 | 6 | | R&D expenditure on “eco-vehicles” | 3.8900 | |
| 7 | Motor vehicle fuel prices | 4.2400 | 7 | | Direct subsidies to transport | 3.8900 | |
| 8 | Percentage of Single Occupancy Vehicle (SOV) Entering City Centre During Morning Peak Hour Period | 4.2300 | 8 | | Total expenditure on pollution prevention and clean-up | 3.8600 | |
| 9 | Average age of vehicle fleet (years) | 4.2100 | 9 | | Employment in road and rail transport sector | 3.8200 | |
| 10 | Total percapita transport expenditure | 4.1500 | 10 | | Ratio of Road Accident Cases Per 10,000 Populations. | 3.6600 | |
| 11 | Average commute travel time | 4.1300 | 11 | | R&D expenditure on clean transport fuels | 3.5000 | |
| 12 | N2O emissions from road transport | 4.1300 | 12 | | Relative taxation of vehicles and vehicle use | 3.4000 | |
| 13 | Total length of roads (railways, motorways) (km of infrastructure per 1000 inhabitants) | 4.0900 | 13 | | Excise duty on road transport fuel (petrol, diesel per 1000 litres) | 3.3400 | |
| 14 | Use of renewable energy sources in transport (1000 tons/GDP) | 4.0700 | 14 | | | |
| 15 | Percentage of who perceives public transit unsafe | 4.0600 | 15 | | | |
| 16 | CO2 emissions from road transport | 4.0300 | 16 | | | |
| 17 | Capital expenditure by mode | 4.0200 | 17 | | | |

*Rating value given in the survey form is:

5 Most relevant  4 Relevant  3 Moderate  2 Irrelevant  1 Not Applicable

Several factors have been considered in the formulation and development of sustainable public transport indicators. Findings show that “health and safety”, “travel demand and supply”, and “finance and economy” have the highest mean of the rating from the respondents. This is followed by “environmental impact and pollution prevention”, “physical development”, “education and public participation”, “new technology and R&D”, and “stakeholder responsibility”. The least mean value of rating for the factor is that of “land and resources” category.

Table 6. Factor Influencing in Formulation and Development of Sustainable Public Transport Indicator for Klang Valley

| Factor | Mean Value |
|---|---|
| 1. Health and Safety | 4.5700 |
| 2. Travel Demand and Supply | 4.5700 |
| 3. Finance and Economy | 4.4600 |
| 4. Environmental Impact and Pollution Prevention | 4.3800 |
| 5. Physical Development | 4.3800 |
| 6. Education and Public Participation | 4.3700 |
It is found that the factors influence in determining the indicators in this research is agreeable with the other prominent research findings\(^5,6,16\) in a sustainable transportation system. However, although the result of indicators rating shows a positive feedback, there are several issues during the selection of indicators list. Issues with selection of indicators are:

i. Some indicators are difficult to be measured in the implementation stage

ii. Some indicators are impractical in the implementation stage

iii. Some indicators require a longer timeframe of data collection in the implementation stage

iv. Some indicators require data obtained from more than one agency in the implementation stage

v. Indicators are deemed unsuitable and irrelevant to represent the measurement of sustainability of transportation in the country, generally, and Klang Valley, specifically

Since not all of these indicators from the finding are consistent with the other prominent research findings\(^30,31,33,34\), the suggested indicators from this study need to be verified and validated through ground pilot study before being accepted and adopted in Klang Valley public transport system.

The generalized findings are listed below:

i. The highest mean value for possible indicator is “Mode split: portion of travel made by walking, cycling, rideshare, public transit and telework”

ii. The lowest mean value for possible indicator is “Excise duty on road transport fuel (petrol, diesel per 1000 liters)”

iii. The highest mean value of the factor of formulation and development of indicator is “health and safety”

iv. The lowest mean value of the factor of formulation and development of indicator is “land and resources used”

v. Mean values for indicator selection is between 3.3400 to 4.5700 (moderate to relevant)

vi. Mean values for the factor of formulation and development of indicator is between 4.0600 to 4.5700 (relevant)

An ongoing analysis and modeling exercise are also undertaken to further implicate these results of the existing initiatives and programs of public transport system improvements. Possible in depth analyses such as spider modeling\(^36\) and multinomial logit regression\(^35\).

5. Conclusions

The research has determined that public transport in Klang Valley is far from being globally sustainable system assessment based on both the primary data and review of existing literature. Several issues pertinent to the selection of the appropriateness of the indicators have been presented. Based on the analyses, it is suggested that the preliminary findings of the research are disseminated through another set of focus group discussion among identified stakeholders and decision makers and a pilot study conducted for validation and verification.

In conclusion, the highest mean value for possible indicator is “Mode split: portion of travel made by walking, cycling, rideshare, public transit and telework” and the lowest mean value for possible indicator is “Excise duty on road transport fuel (petrol, diesel per 1000 liters)”. These findings are agreeable with previous prominent research findings\(^5,9,30,5,17\). The possible public transport indicators selected by stakeholders and decision makers in transportation system can be applied as a benchmark for Klang Valley to achieve a 50:50 modal split share that has been promoted by the Malaysian government. The city region public transportation operation, management and structure must be supported by mature and appropriate sustainable public transport guidelines and standards, indicators and systematic evaluation process. In essence, the sustainability of public transportation in Klang Valley can be achieved by implementing an assessment of the system through consistent and coherent sustainable public transport indicators. Further recommendations are to update the list of indicators suitting the current development of sustainable public transport system with other Asian countries and the evaluation of selected indicators should be continuously implemented. Focus group discussion and working group on establishing the indicators will provide many significant benefits.
References

1. A.Hull, 2005. Integrated Transport Planning in the UK: From Concept to Reality. Journal of Transport Geography 13, Page 318-328.

2. Castillo, H., & Pitfield, D.E., 2009, ELASTIC- A Methodological Framework for Identifying and Selecting Sustainable Transport Indicators, Journal of Transportation Research Part D, 15 (2010) Elsevier Ltd. Page: 179-188.

3. Census and Statistic Department, The Government of Hong Kong Special Administrative Region, 2013. Public Transport Patronage of Hong Kong, 1999 to 2009, Hong Kong Monthly Digest of Statistics, Available at http://www.statistics.gov.hk/pub/B71/004FC2010XXXB0100.pdf

4. Christy, M.J, and Adjo, A., 2005, Addressing Sustainability in Transportation Systems: Definitions, Indicators and Metrics, Journal of Infrastructure Systems, Page 31-50.

5. Dobranskyte-Niskota, A., Perez, J., & Pregl, M., 2007. Indicators to Assess Sustainability of Transport Activities, European Commission, Joint Research Centre, Institute for Environment and Sustainability, EUR 23041 EN. ISBN 978-92-79-07802-6. ISSN 1018-5593. DOI 10.2788/54736

6. Dobranskyte-Niskota, A., Perez, J., Jesinghaus, J. and Jensen, P., 2009. Indicators to Assess Sustainability of Transport Activities: Part 2: Measurement and Evaluation of Transport Sustainability Performance in the EU27. European Commission Joint Research Centre, Institute for Environment and Sustainability, ISSN 1018-5593. DOI 10.2788/46618. Available at http://publications.jrc.ec.europa.eu/repository/bitstream/111111111/802/1/sust_transp_ind_report_final.pdf

7. Emberger, G., Arndt, W., Schaefer, T., Lah, O., and Tomaszek, J., 2010. Transport in Megacities -Development Of Sustainable Transportation Systems. 13th WCTR, July 15-18, 2010 – Rio, Brazil. Available at: http://conceptsandsolutions.ptvgroup.com/fileadmin/files_conceptsandsolutions/Downloads/4_Reference/CTR_2013_Transport_in_megacities_final_130517.pdf

8. Federal Department of Town and Country Planning, Ministry of Housing and Local Government, Malaysia, 2010. Second National Physical Plan (NPP-2).

9. Gudmundsson, H., Fukuda, D. & Eng, D.r., 2013. Indicators in the governance of sustainable transport policies in Japan, Paper submitted for presentation at TRB 2013, Session 685.

10. Government Transformation Programs, 2012 available at http://www.pemandu.gov.my/gtp/upload/GTP2_ENG.pdf

11. Greater Kuala Lumpur / Klang Valley Land Public Transport Master Plan, N.D. Suruhanjaya Pengangkutan Awam Darat (SPAD)

12. Haghsenas, H., Vaziri, M., and Gholamialam, A., 2013. Sustainable Urban Transport Assessment in Asian Cities. Current World Environment, Vol. 8(2), 221-230 (2013). http://dx.doi.org/10.12944/CWE.8.2.07

13. Hezri, A., A., 2004. Sustainability Indicator System and Policy Processes in Malaysia: A Framework for Utilisation and Learning. Journal of Environmental Management 73 (2004) 357–371. doi:10.1016/j.jenvman.2004.07.010

14. http://www.klcentral.com.my/

15. Land Transport and Authority, Singapore Government, 2013. Available at http://app.lta.gov.sg/apps/news/page.aspx?c=2&id=1b6b1e1e-f727-43bb-8688-f589056ad1c4

16. Litman, T.A., 2007, Urban Transportation Management, Chapter 9 Handbook on Urban Sustainability, N.Munier (editor), Springer. Page 353-387.

17. Litman, T. & David Burwell, D., 2004, Issues in Sustainable Transportation, Int. J. Global Environmental Issues, Vol. 6, No. 4. Page: 331-347.

18. Mohd Shariff, N., 2012. Private Vehicle Ownership and Transportation Planning in Malaysia. 2012 International Conference on Traffic and Transportation Engineering (ICTTE 2012), IPCSIT vol. 26 (2012) © (2012) IACSIT Press, Singapore.

19. National Key Results Area, 2011 available at http://www.pemandu.gov.my/gtp/Improving_Urban_Public_Transport-@-GTP_1/@/Improving_Urban_Public_Transport.aspx

20. Organisation for Economic Co-operation and Development (OECD), 1999. Indicators For The Integration Of Environmental Concerns Into Transport Policies, Available at http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?doclanguage=en&cote=ENV/EPOC/SE(98)J1/FINAL

21. Saadatian, O., Haw, L.C., Mat, S., and Sopian, K., 2012. Perspective of Sustainable Development in Malaysia. International Journal of Energy and Environment, Issue 2, Volume 6, 2012, Pg. 260-267.

22. Seoul Metropolitan Government, 2013. Seoul Public Transportation. Retrieved on 4th August 2014 and available at http://www.slideshare.net/simrc/seoul-public-transportation

23. SPAD, 2014. Retrieved on 4th August 2014 and available at http://www.spad.gov.my/about-us/profile

24. Sungwon Lee, 2013. Valuing Convenience in Public Transport in the Korean Context. Discussion Paper No. 2013-17. Prepared for the Roundtable on Valuing convenience in public transport (12-13 September 2013, Paris), The Korea Transport Institute, Goyang-si, Korea. — © OECD/ITF 2013. Available at http://www.internationaltransportforum.org/jtrc/DiscussionPapers/PD201317.pdf

25. Stanley, J., 2011. A Public Transport Development Authority for Melbourne, Available at http://www.busvic.asn.au/images/uploads/public/A_Public_Transport_Development_Authority_for_Melbourne_Jan2011.pdf

26. Tao, C.C and Hung, C.C, 2003, A comparative Approach to the Quantitative Models for Sustainable Transportation, Journal of the Eastern Asia Society for Transportation Studies, 5, 3329-3344 http://www.easts.info/2003journal/papers/3329.pdf

27. Tenth Malaysia Plan 2010-2015 available at http://www.epu.gov.my/epu-theme/RMKE10/rmke10_english.html

28. The Department of Transport (DOT), Taipei City Government, 2013. Taipei City has the Highest National Market Share in Green Transportation. Retrieved on 4th August 2014 and available at http://english.dot.taipei.gov.tw/ct.asp?xItem=55785361&ctNode=65619&mp=117002
29. United Nations Center for Regional Development (UNCRD) and Clean Air Initiative for Asian Cities Center (CAI-Asia), 2011. "Data and Indicators for Sustainable Transport under the Bangkok 2020 Declaration". Pasig City, Philippines. Final Draft presented in Sixth Regional Environmentally Sustainable Transport (Est) Forum In Asia, 4-6 December 2011, New Delhi, India in conjunction with Urban Mobility India 2011 under the Conference cum Exhibition on Sustainable Mobility, 3-6 December 2011. Available at http://www.uncrd.or.jp/content/documents/6EST-1-BGP2.pdf

30. United States Environmental Protection Agency (EPA), 2011. Guide to Sustainable Transportation Performance Measures, EPA 231-K-10-004, August 2011, www.epa.gov/smartgrowth and available at http://www.epa.gov/dced/pdf/Sustainable_Transpo_Performance.pdf

31. Whitmarsh, L., Haxeltine, A., and Wietschel, M., 2007, Sustainable Transport Visions: Expert and Non-expert Stakeholder Perspectives on Sustainable Transport, International Conference on Whole Life Urban Sustainability and its Assessment, M. Horner, C. Hardcastle, A. Price, J. Bebington (Eds), Glasgow.

32. Zegras, C. 2006, Sustainable Transport Indicators and Assessment Methodologies, Background Paper for Plenary Session 4 at the Biannual Conference and Exhibit of the Clean Air Initiative for Latin American Cities: Sustainable Transport: Linkages to Mitigate Climate Change and Improve Air Quality, Sao Paulo, Brazil, 25-27 July 2006, Page 1-16.

33. The Partnership for Sustainable Urban Transport in Asia (PSUTA). (2005). Sustainable Urban Transport in Asia Making the Vision A Reality.

34. Amiril, A., Nawawi, A. H., Takim, R., & Latif, S. N. F. A. (2014). Transportation Infrastructure Project Sustainability Factors and Performance. Procedia - Social and Behavioral Sciences, 153, 90–98. doi:10.1016/j.sbspro.2014.10.044.

35. Abdullah, A. Z. (2006). Predicting the Impact of Demand- and Supply-Side Measures on Bus Ridership in Putrajaya, Malaysia. Journal of Public Transportation, 9(5), 57–70.

36. Nijkamp, P., Bal, F., & Medda, F. (1998). SERIE RESEARCH MEMORANDA A Survey of Methodes for Sustainable City Planning and Cultural Heritage Management.