

# A Theoretical Review on Sustainable Transportation Strategies: The Role of Park and Ride Facility as a Generator of Public Transport Mode Shift

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**ABSTRACT:** Transportation plays an important role in achieving sustainable development. However, it has been regarded as one of the most arguable but least implemented concept in urban and transportation planning. The increasing dependence on private vehicles for various trip purposes has indeed put enormous pressure on the capacity of the road infrastructure, thus resulting in regular occurrence of unending traffic jams within the Centre Business District (CBD) and even outside CBD especially during peak hours. The occurrence of congestion has even extended to outside peak hours in the recent past. Traffic congestion today is seen as a major transport problem affecting people who live in urban areas. The effect of congestion in many major cities has also resulted in decrease in travel speed, increase in travel time, air pollution and other environmental damages. Promoting public transportation is commonly seen as a strategy to reduce the use of private cars in urban areas and thus decreasing the adverse impacts of transportation especially on environment. Consideration of various forms of public transportation, increase in coverage, high passenger ridership, and affordable fare structure is seen as measures to increase the use of public transportation. Park and ride scheme is seen as a transportation demand management strategy to increase the use of public transportation. The provision of park and ride facility at major public transportation terminals, eventually, encourages car users to shift to public transport modes for their trips, especially to CBD, and thus help to reduce reliance on private vehicles. Park-and-Ride facility also facilitates to maximize the efficiency of the transportation system providing commuting options for travelers. The purpose of this paper is to discuss on the role of park and ride facility as a travel demand management strategy in promoting the use of public transport. This paper mainly focuses on the analysis of literature on various aspects of park and ride facility to ascertain the extent in which it help to achieve and promote sustainable transportation aspect.

**Keywords:** park and ride, public transport mode shift, traffic congestion, travel demand management measures, sustainable transport

## 1. INTRODUCTION

Motorization is soaring virtually everywhere. The number of motor vehicles in the world is expected to reach about 1.3 billion by 2020, more than doubling today's number. The fastest growth is in Latin America and Asia (Sperling and Clausen, 2002). In transport, mobility is defined as the ability to move from place to place and is measured by the number of trips made by a person per day (Vasconcellos, 2001) whilst 'personal mobility' refers to the use of personal transport; a car or a motorcycle or other non-motorised transport. Mosseley et. al (1977) define accessibility as 'mobility for opportunities', that is mobility which allows the person to get to the desired destinations. That is why accessibility is not just the ability to overcome space but the ease with which one reaches destination merit for its own sake. Whilst many journeys are necessary and many of them are too far for walking or cycling, they need to be made with mechanical transport (Tseu, 2006).

There is an emerging trend of thought today that there should be a distinction between mobility and accessibility (Tseu, 2006). For instance, too much attention had been put on mobility when it is accessibility that should be the primary concern, for accessibility is more about the ability to reach employment centres and work places. Mobility is mostly associated with having a vehicle to move along a road. The use of cars by people leads to more traffic and more congestion on the road which affects accessibility. If mobility is emphasized rather than

accessibility, the solution is to provide more roads. There is therefore a greater need for transport planners to focus more on moving people and goods than on accommodating vehicles. However today, private vehicles have become the main means of travel of urban living not only in the west but also in developing countries (Tseu, 2006).

The second half of the 20<sup>th</sup> century saw the rapid growth of vehicle ownership and its use leading to transport problems in the urban areas of the developed world (Cairns, 1997; Turton and Knowles, 1992). This is followed by the growth of urbanization and motorized transport, leading to the issue of traffic congestion (R.D.M. Cotsgrove, 1998). The increase in the use of vehicles particularly that of cars has, to some extent, limited the efficient supply of parking spaces in the city centres. The increase in the use of vehicles particularly that of cars has given rise to traffic accidents, difficulty to pedestrians and limiting the efficient supply of parking spaces in the city centres (Norlida et al., 2008). The same scenario can be said for the developing countries whereby congestion is endemic in its cities (Gwilliam, 2003).

The scarcity of land in urban areas together with the issue of limited availability of financial resources have forced urban transport planners now to resort to a more effective and efficient land use planning strategy in order to be able to balance between the increasing demands for better mobility and accessibility as well as the demands for spatial development (Norlida et al., 2004). Promoting public transportation is a way to reduce the use of private cars in urban areas and thereby reducing the adverse impacts of transportation (Banister, 2000). Increase of transit use is definitely associated with overall sustainability. One such strategy that is widely applied towards countering such problem is the implementation of the park and ride scheme which is seen as a transportation demand management strategy to increase the use of public transportation. Park and ride facility has been introduced to minimize private car into the CBD area where its main objective is to reduce congestion during morning/evening peak hours (Muhamad Nazri et al., 2011).

The provision of park and ride facility at major public transportation terminals, eventually, encourages car users to shift to public transport modes for their trips, especially to CBD, and thus help to reduce reliance on private vehicles traveling towards city centre. By encouraging shifts to transit and ridesharing, park and ride facilities reduce urban highway traffic congestion and worksite parking demand. These benefits can be significant since park and ride tends to be most effective where traffic congestion and parking problems are worst. Park and ride facility also facilitates to maximize the efficiency of the transportation system providing commuting options for travelers. The purpose of this paper is to discuss on the role of park and ride facility as a travel demand management strategy in promoting the use of public transport. This paper mainly focuses on the analysis of literature on various aspects of park and ride facility to ascertain the extent in which it helps to achieve and promote sustainable transportation.

## **2. SUSTAINABLE TRANSPORTATION SYTEMS**

### **2-1 The Need for Sustainable Development**

The need for a sustainable society has already been expressed in the early seventies with the publication of several articles such as “A blueprint for survival” (quoted in Haq, 1997). Since the seventies, several articles (Newman and Kenworthy, 1999; Nijkamp et al., 1998; Cervero, 1998; Haq, 1997) have discussed sustainable development and it has been the main theme of a number of international and world conferences (such as the establishment of the Intergovernmental Panel on Climate Change in 1988, the UN Rio 1992 Earth Summit, the 1995 European Conference of Ministers of Transport, and the 1997 Kyoto Convention on Climate Change). One of the often-cited definitions of sustainable development is the definition stated in the report of the World Commission on Environment and Development, also called the Brundtland report after its chairman. Brundtland Commission, (1987, as cited in Shiftan, Kaplan, & Hakkert, 2003) defined sustainable development as “development which meets present needs without compromising the ability of future generations to achieve their own needs and aspirations”. This definition contains the concern for natural resources and the well being of human society as well as the recognition of the uncertainties encompassed by the time dimension and future resources, technologies and human values.

Nowadays, there is growing interest in the concepts of sustainable development and then on sustainable transport. Sustainability reflects one of the most fundamental human desires virtually supported by all philosophies and religions: to create a better future world. It provides guidance for long-term, strategic decision-making. Referring to the main accepted definition of sustainable development it meets the needs of the present without compromising the ability of future generations to meet their own needs (Brundtland Commission, 1987)

and, thus, of sustainable transport a sustainable transport system is one that is accessible, safe, environmentally-friendly and affordable (Shiftan, Kaplan, & Hakkert, 2003).

## **2-2 Sustainable Transportation System**

Transportation plays an important role in sustainable development, since transport activities tend to be highly resource intensive and have numerous external costs. For example, the transportation sector consumes more than 60% of all petroleum products globally, despite efforts by many governments to encourage the substitution of other fuels (Leong et.al, n.d). The concept of sustainable transport system covers variety of issues. Banister (2000) in his report addressed seven key issues as a result of transportation activities. They are as follows:

- i. Congestion - An average, speeds in some cities have been decreasing by 5% per decade (EFTE, 1994).
- ii. Increasing air pollution - According to the standard recommended by WHO (1997), air quality in many cities have been exceeded.
- iii. Traffic noise – It is estimated that about 15% of the population in developing countries are exposed to high levels of noise (Leong at.al, n.d).
- iv. Road safety – Around the world, there are 250, 000 deaths and 10 million of injuries resulted from accidents (Downey, 1995).
- v. Degradation of urban landscapes.
- vi. Use of space by traffic.
- vii. Global warming – Transport accounts for 25% of CO<sub>2</sub> emissions.

There are many definitions on sustainable transportation. A sustainable transport system as defined by the Centre for Sustainable Transportation (Gilbert and Tanguay, 2000) is as follows:

- Allows the basic access and development needs of individuals, companies and societies to be met safely and in a manner consistent with human and ecosystem health, and promotes equity within and between successive generations.
- Is affordable, operates fairly and efficiently, offers choice of transport mode, and supports a competitive economy, as well as balanced regional development.
- Limits emissions and waste within the planet's ability to absorb them, uses renewable resources at or below their rates of generation, and uses non-renewable resources at or below the rates of development of renewable substitutes while minimizing the impact on the use of land and the generation of noise.

The progress of sustainable transportation is in fact very unsatisfactory (Ziestman et al., 2003). The concept has been regarded as one of the most arguable but least implemented concept in urban and transportation planning (Lindquist, 1998). Among the problems identified are inadequate understanding and recognition of increasingly important social, economic, environmental and public policy issues, short of quantified measures that can be used for monitoring and decision making as well as lacking of co-ordination between decision-makers, planners and other stakeholders (Ziestman and Rilett, 2000). The key variables embrace in sustainable transportation concept are accessibility for all, social equity (the poor and the disadvantaged) and ecological sustainability.

## **3. PARK AND RIDE FACILITIES**

### **3-1 Overview of Park and Ride Concept**

The provision of park and rides emerged from the 1930's as a means of increasing and maintaining public transport patronage, set against a background of city urban sprawl and the all American dream of owning ones own home. Park and ride facilities have been in existence in the North America for over 30 years (Spillar, 1997) while few noted that park and ride began in United Kingdom during the 1960s (Cairns, 1997). Roberts et al. (1996) refer to how in many of the historic towns and cities of the UK, park and rides are increasingly seen as conserving the environment, improving accessibility and providing an alternative to the car as a means of travel for whole trips.

Interest in park and ride facilities has continued to grow in most western world nations (Ginn, 2009). France had its park and ride facility fully operational as early as late 1970s (Walmsley and Perrett, 1992). For the city of Calgary in Canada, their bus-based park and ride became part of the downtown transportation strategy in the early 1970s while their rail-based park and ride became an integral component of the city light rail transit system later in 1981 (Bolger et al., 1992). Scotland experienced the first permanent daily park and ride scheme opened in Paisley in June 1994 but subsequently abandoned (Cairns, 1997). However, the schemes at other parts

of Scotland have been successful such as park and ride at Inverkeithing, Fife and Drem, East Lothian (Norlida et al., 2004). On the East Asian region side, for countries such as Malaysia, the park and ride concept only begun to emerge in the transportation industry around 1994 while Hong Kong on the other hand, started the scheme in 1998 (Lam et al., 2001).

One proposed solution related with traffic problems could be to replace long car trips with combination of car and public transport, consisting of one short car trip and one longer trip by public transport – hereinafter called park and ride (Muhamad Nazri et al., 2011). Park and ride facilities are often introduced to expand the catchment area of public transport and to attract car commuters to more sustainable transport modes (Bolger 1995; Noel 1988). This is particularly important in suburban or outer-urban areas where residential densities are too small to support adequate feeder services on their own (Hamer, 2010). Ginn (2009) mentions one of the major reasons for growth in outer suburban park & rides would appear to be to satisfy the demands of families keen to purchase an affordable home to bring up a family, which was beyond their affordability in inner city areas, whilst still requiring access to the CBD for work purposes. The opportunity to access park and ride station facilities in these outer suburbs has encouraged these families to abandon the car commute to the city. Park and rides have an effective record of helping to facilitate demand for public transport and help reduce the general travel demand management of a region (Ginn 1998).

According to Ferreira and Ginn (1994), the trend in residential development has been away from the central business core. More and more people have moved into the suburban fringe to access larger family blocks often at a cheaper price than inner city living, yet the vast majority of these people travel to work alone. Ginn (2009) agrees that this trend has led to greater travel times to work, more vehicle miles traveled per year, more congestion along major travel corridors, greater consumption of fossil fuels and an increase in air pollution. This has increased the importance of providing commuters with an alternative to traveling by car to work. The park-and-ride is a viable alternative to increased peak time congestion along our approach roads to the CBD (Ginn 1998).

Park & Ride will help to reduce the volume of motor vehicle travel into the central area, ease the contradiction between traffic supply and demand caused by individual traffic growth such as traffic congestion and lack of parking spaces (Ying and Xiang, 2009). Lam et al. (2001) and Runkel (1993) suggested that the implementation of the park and ride schemes has been viewed as part of the answer towards reducing congestion in the urban areas particularly that of the city centre. Simpson (2000) stated, there are several likely transport objectives to which it might be hoped that park and ride would contribute:

- reduction in car travel
- reduction in town centre road traffic congestion;
- reduction in environmental damage in town centres and along some of radial roads leading to them;
- increase in the number of people gaining access to the town centre and commercial effects of this;
- maintenance of higher densities in town centres than would be compatible with transport by the private car
- relief of problems caused by unofficial park and ride such as around suburban railway stations

### **3-2 Definitions of Park and Ride**

Park and ride means that providing a large number of low-cost parking facilities in rail transit station areas outlying city, so as to enable the car travelers some means of parking and transfer into the public transport to the central area (Ying and Xiang, 2009). O’Cinneide and Casserly (2000) define park and ride as parking at a custom built car park and transferring to public transport to travel onward to one’s destination. It is a fundamental part of many city transport systems since it is a more acceptable alternative to the car than conventional public transport for many car users, particularly for city centre trips originating from outside built up areas. Noel (1998) describes park and ride as an operation in which commuters, travel by private vehicle, either as drivers or as passengers, gather at a common site that enables them to transfer to higher-occupancy vehicles. These higher-occupancy vehicles may be automobiles, vans, commuter trains or buses, or urban public transit.

The main purpose of park and ride is to encourage the transfer of transportation mode, and to attract travelers shift from car users to bus passengers by providing good service (Muhammad Nazri et al., 2011). Pickett and Gray (1993) and O’Flaherty (1997) both simply defines park and ride as the act of parking at a custom-built car

park and transferring to public transport to travel onward to one's destination. Lam et al (2001) defines a park and ride's principal objective is to encourage modal shifts on the transport network. The facility should attract private vehicles with a low occupancy level and transfer their trip makers to a high occupancy mode such as trains, bus, or van-pool vehicle. Turnbull (1995) sees the intent of park and ride is to provide a common location for individuals to transfer from a low to a high occupancy travel mode. Park and ride lots are often oriented toward providing parking spaces for automobiles connected with bus or rail stations and frequent transit services. Individuals may also access the facilities by walking, cycling or being dropped off.

Conclusively, in a park and ride scheme, the related facilities, the parking spaces and the public transport service that acts as the main mode of transportation into the CBD (be it rail or bus), are provided exclusively for the use of motorists that would have made the same trip by private vehicle, rather than that for the general travelling public, including other public transport users (Norlida et al., 2004). Park and rides function as a transfer facility for car drivers and their passengers to leave their cars at a rail station or bus stop, or to be dropped off, and then join a heavy rail/light rail passenger or bus line haul service into the CBD by providing at grade or elevated parking areas. Park and ride facilities also provide bicycle racks for cyclists (Ginn, 1998).

### 3-3 Classifications of the Park and Ride Facilities

Turnbull (1995) breaks down park and rides into locational, use and design categories. Under the locational category there are:

- **Remote** locations where the park and ride is relatively far from a major centre, usually offering a change of mode for residents in outer suburban areas or satellite communities.
- **Local** park and rides situated at the end of localised bus routes or short rail lines near the CBD.
- **Peripheral** park and rides located near the edge of the CBD to intercept CBD bound traffic.

The classification of park and ride facilities under locational by Young-Jong (2001) is somewhat similar to that of Turnbull (1995) in that there are three main types of the facility namely urban type, mid-area and suburban type. Each has an average distance of 15 km, 15 – 25 km and over 25 km from the centre of the CBD respectively.

Furthermore, under the category of use, Turnbull (1995) suggested that there are:

- **Exclusive** park and rides that are planned and designed specifically to service a transit function.
- A **shared facility** where parking offered by a shopping centre, educational facility, sports venue, etc., very near to a transit interchange may officially or un-officially operates as a park and ride.

Design categories may vary according to the adequacy of parking provided, safety, road access, landscaping, shelters, pedestrian connections to the interchange, and support facilities like lighting and public telephones.

### 3-4 Park and Ride Case Studies

Park & Ride has been applied in many developed countries and cities as a means of transportation demand management and have achieved some results.

#### *United Kingdom*

According to Woods (2006), park and ride systems have, over recent years, received significant support from the UK central government, and there has over the past 15 years been a major expansion of the number of park and ride systems across the UK. These systems are principally bus-based systems, but rail-based and tram-based systems are also present. The most common systems are the bus-based park and ride systems, with a range of parking stations located on the periphery of a town or city. Most systems still only have a very small number of parking stations, but some are now getting a full suite of sites around the urban edge with some 5-7 sites. Each site usually has a capacity of several hundred parking spaces and some are close to 1000, resulting in some systems providing a total of many thousands of spaces (5000+ in Cambridge, 4000 in Norwich). In addition, these systems usually have dedicated bus services operating between the parking station and the town centre at relatively high frequencies (<10 minutes during peaks, and about 15 minutes off-peak).

The purpose of most UK systems is to try and capture traffic travelling into the town centre from surrounding areas outside the urban area, and to a lesser extent some trips of the townspeople living near the periphery stations. In some instances the Saturday usage is in fact higher than the weekday patronage (for example, Oxford between 1992 and 1999). Thus the stations are generally located adjacent to the key access roads and arterials entering the urban area (such as Cambridge, Oxford, Norwich, Nottingham and York). They do not

appear to have a unique purpose of targeting commuter travel, as most operate 6 or 7 days per week (Woods, 2006).

Many of the studies into park and ride have focussed on the bus-based park and ride schemes in small UK cities such as Oxford and York (Parkhurst, 1996). In an early study of the Oxford park and ride scheme (Papoulias & Heggie, cited in Parkhurst 1996), it was found that a majority of park and ride users had formerly driven to the centre, while only 8% of users had travelled to the centre by bus. A review of subsequent studies into bus-based park and ride schemes in the UK (Parkhurst, 1996 and WS Atkins, 1998) suggests that, on weekdays, 61% of users previously drove to the city centre, while 21% previously used other public transport options. A further 18% of users either travelled by a different mode or did not previously travel to the city centre, but the studies do not provide a further break down of these trips.

Woods (2006) mention that a number of cities in the UK have also re-introduced tram (light rail) lines in recent years, and integral with the development of these tram lines have been associated park and ride systems. These are arranged differently to the bus-based systems noted above, in that they are set up more like rail-based, corridor-focussed park and ride systems with a number of parking stations along the route. This can be seen in the tram systems in Nottingham (the NET with 4 parking stations) and in Sheffield (the Super Tram). Heavy rail-based park and ride also exists in many locations throughout the UK (for example Glasgow, Edinburgh, Manchester, Sheffield and London). Sheffield has park and ride operating on 3 rail lines coming into its city centre, although the parking facilities do not provide large amounts of parking (line one with 7 stations and 160+ spaces, line two with 6 stations and 320+ spaces, and line three with 3 stations and 170+ spaces).

#### ***Bristol, UK***

Robinson (1994) comments that Avon County Council in England has launched a plan to introduce 12 facilities to ring and serve the city of Bristol, providing approximately 12,000 spaces for daily commuters and visitors. The first facility at Brislington was opened in 1994, providing a 1,300 bay facility connecting patrons with buses that deliver a direct ten-minute peak and twelve-minute off peak service into the city (Robinson 1994). Since the inauguration of Brislington, 6,000 passengers per week have used the service exceeding the County Council's predicted demands. The use of well landscaped parking areas and paving has helped minimise environmental impacts and promote public use (Robinson 1994).

#### ***Melbourne, Australia***

In Melbourne, cheap all-day parking is proposed to entice motorists onto the tram network. Existing inner city park and rides are offered at Colonial Stadium, Melbourne Museum, Melbourne and Olympic Parks for \$8.50. According to the Yarra Trams Chief Executive, the new park and rides proposed for the middle and outer suburbs will be dependent on tram service upgrades and great priority for trams when street running with cars to reduce time delays. These improvements are seen as a critical part of attracting new car-based patronage to the proposed park and rides (Lally 2000). There are around 23,000 carparks also available in Melbourne in association with the heavy rail network.

#### ***Portland, USA***

Middleton (1990) comments that Tri-Met has constructed some 60 free park and ride facilities through out the Portland Metropolitan Region along its various transit routes. Along the eastern MAX line 1,800 bays prevail which in part has helped attract 6,300 new transit riders per day. On Portland's LRT, approximately 25 percent of light rail users use the facilities. The new western line extension will have 3,500 spaces.

#### ***Hong Kong***

In 1997, a trial park and ride scheme was launched in Hong Kong at SheungShui on the KCRC rail network. The 170 park and ride facility was an open air car park located 3 minutes walking distance from the train station. The ShueungShui trail park and ride scheme proved itself successful within Hong Kong's New Territories in helping to increase station patronage and reduce road network demands into Hong Kong Island and CBD. The Hong Kong Transport Department sees "park and rides as a viable non-fiscal means of controlling the number of vehicles on the road network" (Lam et al 2001). The provision of an open air car park, 3 minutes walk from the station, is seen however as not an ideal arrangement in Hong Kong where most patrons are seeking air conditioned links to station to avoid the humid climate.

#### **4. PARK AND RIDE AS A TRANSPORTATION DEMAND MANAGEMENT STRATEGY TOWARDS REALIZING SUSTAINABLE TRANSPORTATION AGENDA**

Park and ride facilities are perceived as a Transportation Demand Management (TDM) strategy towards realizing sustainable transportation agenda. It encourages mode shift from car-only modes to more sustainable transport modes. The purpose of TDM is to reduce the number of single occupant vehicles using the road system while providing a variety of mobility options. TDM measures increase the carrying capacity of the transportation system without the expense and inconvenience of adding new roads. Subsequently, park and ride systems can help promote sustainable travel patterns at local and strategic levels (ODPM, 2000) and have been seen as a cheaper alternative to road building for addressing congestion problems (Council for the Protection of Rural England (CPRE), 1998). The Knowledgebase on Sustainable Urban Land use and Transport (KONSULT) (2009) suggested that the primary reason for implementing park and ride is to reduce congestion in and around City Centres. A study by Atkins and the DETR (1998 cited on KONSULT, 2009) found that there were benefits in terms of traffic reductions and overall vehicle-kilometres travelled with park and ride schemes. A well designed and well located park and ride facility can attract the users to utilize the facility and use the public transport for their trip.

Various studies have provided evidence of established relationship between the park and ride facility and users travel characteristics. It provides reassurance that park and ride can have traffic-reduction benefits by increasing the use of the public transport in daily trips. As in most studies relating to travel characteristics, 'trip purpose' was considered as an important variable towards understanding the travel characteristics of the trip makers. Smith G.C. (1993), Lam et al (2001), Kwon, Y. (2001) and Foo, T.S. (1997) all identified the home-based work trip makers as the main group of users of the park-and-ride facilities in their respective studies. The study by Sharifah Adibah Alyia and Abdul Azeez (2011) on the utilization pattern of the park and ride facility in Putrajaya Sentral has revealed that the majority of the park and ride users was traveling for 'work' purpose (67%), and found parking at the facility 'frequently' from Monday to Friday (57%). The average parking duration at this park and ride facility was 11 hours and 6 minutes indicating that most of the users were long term parkers. A study conducted by Norlida (2009), has stated that the overall utilization rate of Shah Alam park and ride station was 95.1% (a total of 135 parkers) while Seremban was 97.5% (with a total of 198 parkers). These scenarios reflect the relatively high demand for the use of the park and ride facility during weekdays. These findings also showed the positive implications of the park and ride facility at the fringe of the urban area such as Shah Alam and Seremban. Norlida et.al (2008) has also stated that the parking utilization in Rawang Komuter park and ride station was found to be high. About 94% of the regular park and ride users at the park and ride facility had suggested providing more parking spaces, due to the insufficient number of parking spaces, to cater for high demand from the users. This is evident from the relatively high number of double parking vehicles being seen at the station.

Moreover, this study also divulged on 'parking duration' at these park and ride facilities which found about 55.6% of the park and ride users were parked more than 8 hours in Shah Alam, 81.8% in Seremban (more than 8 hours). This finding on the parking behavior of the long-term parkers was found to have similarities with those of the parking facility users of the Seoul Metropolitan Area (SMA). Nearly 53% of the park and ride users in SMA were parked on an average of 8 hours per day (Kwon, 2001). The findings on parking behaviour of the users at Metro car park showed about 60% of the users at this station were expected to be long term parking users (more than 4 hours) (Pickett et al. 1986). The high percentage of long term parkers indicates that there is a keen interest to use the facility particularly among the commuters of the suburban population who perform 'work trip' (Norlida, 2009). A recent audit on parking use at metropolitan stations in Melbourne has revealed that the total number of parked cars was more than the number of parking spaces by approximately 50% (Department of Transport 2008a) with overflow parking occurring along local residential streets.

Moreover, several studies have identified the importance of public transport and park and ride facility as the intermodal transfer facility. Based on Palmer & Donnison (2003), the parking survey conducted at Surrey Hills Railway Station, found that, if the car park was full upon their arrival, only 4% of drivers would drive to their final destination with 48% preferring to park in a nearby street. Similar preferences were shown in the event that the parking facility was closed; 46% of drivers would either park in a nearby street or at the next station with only 5% of drivers preferring to drive to their final destination. Similarly, the study by Sharifah Adibah Alyia and Abdul Azeez (2011) has showed that 49% of the respondents were willing to drive to the next nearest parking facility. Similarly, the findings from Norlida et.al (2008) showed that 36.5% of the respondents were given the same reason that they chose to travel by rail by parking at the next nearest station if such facility is no

longer available at the current station. This indicates the importance of the parking facilities at the public transportation terminal.

In order to improve the future planning of the park and ride facility, factors influencing the demand for the park and ride facility is significant. Numerous local and international studies concerning on this scope have been identified. The study by Sharifah Adibah Alyia and Abdul Azeez (2011) has found that avoiding traffic congestion was the main reason for the commuters to use the park and ride facility and shift to public transport. The study also identified that the commuters were found convenience to travel with public transport where the services are reliable and comfort. Additionally, the other significant reasons for the use of the park and ride facility were commuters felt 'less stress' traveling by public transport and paying 'expensive parking charges' at the destination. The study by Ying, H. and H. Xiang (2009) has found that the most important reason why respondents had accepted park and ride was because of traffic congestion problem, lack of parking at destination and expensive parking fee. A report by WS Atkins and the DETR (1998) studied the effects of Park and Ride systems in Brighton, Cambridge Coventry, Norwich, Plymouth, Reading, Shrewsbury and York found that cost, convenience, reliability, frequency, difficulty in parking and faster journey time were the reasons given by users for switching to park and ride whereas for non-users, the reasons being perceived speed, ease of driving directly to the city centre, proposed length of stay and limited mobility. Of these factors, 'cost' and 'journey time' were most likely to influence their decisions on whether to switch to park and ride or not. Lam et al (2001) has concluded that the main factors attracting the users to use park-and-ride schemes were monetary and time savings. With regard to total time savings, time taken to walk to the station was also considered as an integral part of time savings. Bolger(1992) also stressed that the attractiveness in using the facility would also depends on the walking distance from the parking area to the rail boarding area and that the maximum desirable and maximum walking distance should be 125m and 250m respectively.

Park and ride facility can contribute significantly in promoting sustainable transportation agenda if it encourages many commuters for public transport mode shift. This situation can contribute to the positive impact on the social, economic and environment aspect. Findings by Norlida et. Al (2007) revealed that a high percentage (82.8% and 78.8%) of the total users was found parking at the final destination (city centre) difficult and expensive respectively. Economically, by using the park and ride facility, it can reduce the total travel cost by avoiding the expensive parking space at the city centre. Besides, it also contributes to time saving in searching for parking spaces at the city centre. Bolger et al (1992), Niblett and Palmer (1993), O'Flaherty (1997) and Kwon, Y.(2001) also highlighted that 'time' and 'cost' savings were the important factors to be considered when choosing between car and the public transport system.

## **5. CONCLUSIONS**

This paper has discussed the significance of park and ride facility as a transportation demand management strategy in realizing the concept of 'sustainable transportation'. The term 'sustainable transportation' is rather very broad in its objectives and aspects which need to be dealt with by studying many elements related to transportation system. Preserving land spaces, realizing the use of public transport, non-motorized transport or private transport using renewable energy, cutting down air and noise pollution are few among them. Encouraging the use of public transport through park and ride facility is a well-known concept in realizing sustainable transportation agenda. However, the planning of park and ride facility with better accessibility, frequency and services of public transportation system, attractive public transport fare, affordable parking charges at park and ride facility, are some of the many elements which require careful attention for achieving high parking utilization at the park and ride facility.

This paper is an attempt to highlight on the literature related to the topic of sustainable transportation and park and ride facilities. Literatures related to sustainable transportation, park and ride facilities and few case studies are highlighted in this paper. The goal of realizing sustainable transport through various transportation strategies and initiatives, though, appeared to be largely accounted for in many developed countries, however, it is rather a long path ahead in many developing countries. To help realize the sustainable transportation agenda in many developing countries, careful planning and policy initiatives in controlling the growth of private vehicles are very much required and imminent. On the other hand, drastic improvement in the planning and provision of public transportation to cater for high demand of travel is, rather, more than essential in the present era. If these two initiative and changes can go hand in hand, then it is expected to foresee substantial positive changes on the use of transportation system and thus realizing the goal of sustainable transportation.



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