SUSTAINABLE TRANSPORT PLANNING IN ASIA: THE SINGAPORE STORY

Sun Sheng Han
The Australian Centre for Governance and Management of Urban Transport (GAMUT)
sshan@unimelb.edu.au

BIO

Dr Sun Sheng Han is associate professor in urban planning, the University of Melbourne. His research expertise includes Pacific-Asia urban studies and spatial analysis. Dr Han was trained in the programs of B.Eng. in landscape architecture (Tongji U, China), M.Sc. in urban planning (AIT, Thailand) and Ph.D. in urban and regional development (SFU, Canada). In his career Dr. Han worked as town planner for China's Ministry of Construction (Beijing), UN Researcher for the United Nations Centre for Regional Development (Nagoya), and Associate Professor for the National University of Singapore. He is author of 120 publications in the forms of refereed journal articles, edited books and journals, monographs, and conference papers. His current research include "Sustainable transport planning in Asia" supported by the Volvo Research and Education Foundation (Sweden), "Peri-urban development and environmental sustainability: examples from India and China" supported by the Asian-Pacific Network for Global Change Research (Japan), and "Integration of land use and transport in China" supported by the Lincoln Institute of Land Policy (USA).

Abstract

This paper makes a connection between the Singapore story of land transport development and the pathway towards sustainable transport planning. In particular, the paper contends that a parrellel growth between motorization and public transit is a sustainable transport development model. This model grows out from the Asian reality of socioeconomic and political complexities, but has wider implications to both developed and less developed urban settings.
Keywords: sustainable transport, motorization, planning, Singapore

Introduction

At the core of sustainable transport is a balance between the current well being of a society and its future opportunities to maintain and improve the current status. This has led to many interpretations as the aspects of discussion and the scope of a society change. From a resource perspective, the balance is between the transportation and resource needs of the current and the future generations (Black 2000; Steg and Gifford 2005; Richardson 2005). This may include the use of fuel reserves, the capacity of absorbing greenhouse gas emissions, and land resources (Black 2000). A balanced success across social, economic and environmental dimensions of development in both space and time is the key to sustainable transport development (Barter 2008, 98).

A major threat to sustainable transport is car dependence. Motor vehicles are a main source of fuel consumption, environment pollution, and urban sprawl. In car dependent countries, a recent policy debate is about how to build a functioning public transit system and encourage commuters to use it. GAMUT conceptualizes this trend as a shift from a car dependent transport model 1 to a public transport dominated model 2 (GAMUT 2006). A modal shift has been advocated by researchers to reduce private car based motorization and increase public transport, and even better, ‘zero carbon’ walking and cycling (Waterson et al 2003; Chapman 2007).

Past experience shows that a shift from private car dominated transport system to a public transport system is against the trend of commuting behaviour. Black (2000, 145) finds that 'there (is) no clear indication that anyone in the US or elsewhere wants to follow this strategy’. Cervero (1998) showed that the share of journeys made by public transit declined in the late 20th century in both US and European cities. Public sector transport expenditure continues to focus on highway provision as a solution to transport problems, whilst among individuals car ownership and usage are the preferred choice. Hence, two intellectually and practically challenging questions are whether it is possible to re-balance motorization and public transport, and how the current un-sustainable transport systems can be transformed into a sustainable form.

This paper explores the connection between the Singapore story of land transport policy development and the way it handled the seemingly contradictory planning approaches to motorization and sustainable transport. Singapore's effective transport management allows users to choose their mode of transportation, subject to a range of well-coordinated policies to control car population and usage, and at the same time to provide high quality public transport facilities. This experience offers a valuable reference to other Asian countries where developmental states can utilize their political legitimacy and economic pragmatism in public policies; it is relevant to countries beyond Asia where improved supply of public transit has become a major policy objective (Kirchhoff 1995; Bresson et al 2003; Walle and Steenberghen 2006).

The Singapore story demonstrates a solution for managing motorization and fostering sustainable urban transport with a vision, an approach, and a set of coordinated policies.

Singapore's vision of integrated land use and transport planning

The public transport network and the road system are designed in an integrated way with land use through careful coordination in physical planning, with macro level coordination between Mass Rapid Transit (MRT) lines and new towns, and micro level integration around MRT stations (Cervero 1998; Newman and Kenworthy 1999). The physical networks of public transit are integrated using a hub-and-spoke structure (LTA 2008). The hubs or town centres are linked by the MRT, while Light Rapid Transit (LRT) and buses connect the housing estates to the MRT stations.

The first concept plan which was endorsed in 1971 served as a cornerstone of Singapore's integrated land use and transport development. This plan was formulated with the help of planning experts from the United Nations Development Program. Main features of the Concept Plan 1971 include the organization of land use into high density groups which are connected through their centres by a planned transportation network. A network ring around the central catchment reservoir, accompanied by the east-west lines, was envisaged to link land use for industrial development and residential new towns (Han 2005). This ring concept plus the east-west line were implemented as the

first MRT lines linking the city centre to Woodlands and further to Jurong East in the west, and from Boon Lay to Tampnies.

Two updates were made since the 1971 concept plan was in place, in 1991 and 2001. But the fundamental principle of integrated land use and transport development remains. The consistence of the plan itself, together with a solid law-enforcement system, guaranteed the implementation of the development vision (Han 2005).

Singapore's approach of parallel development between motorization and public transit

The Singapore story was told and re-told by many authors, representing various viewpoints from which the Singapore experiences are looked at and interpreted. This paper articulates the much discussed management tools, policies and approaches, into a story about an innovative strategy that includes a controlled motorization and public transit development. The balance between the two, rather than a lopsided approach on either motorization or public transit, represents the Singapore model that has wider implications to cities in Asia and beyond.

Controlled motorization

Singapore's control over motorization began with a recognition of the space limit as a constraint for the growth of vehicle population rather than environmental concerns (LTA 1996). The control over car ownership is necessary in order to achieve efficiency in moving people and goods. For the same reason of efficiency, the Government invested heavily on highways and road networks. Policies on car ownership are known to researchers as demand management tools which cause unhappiness of the public and are probably unfair "in the sense that all motorists must pay them regardless of how much their particular usage patterns contribute to congestion or other impacts" (Barter 2005, 527). It is less known though that the Singaporean government has facilitated the increase of the vehicle to population ratio all the time. From 1980 to 1996 the ratio increased from 1:15 to 1:10. In other words, car ownership increased from 67 cars per thousand people to 100 cars per thousand people. This trend is expected continue so that in 2010 the ratio will be 1:7 or 143 cars per thousand

people. As a result of this policy, the car population increased 45% in the period 1986-1996. From 1996 to 2006, the car population increased from 341052 to 421904, or about 24% (LTA 2007).

Rapid increase of car population was enabled by heavy investment on the road network. From 1986 to 1996, the road surface area increased 27%. $3 billion was invested in the period 1996-2000 to construct a further 300 lane-km roads. $570 million was used in the period 2001-05 for further road extensions. The LTA forecasted that in the next 15 years, road space growth will slow down. The growth of car population has to slow down accordingly, from the current 3% per annum to 1.5% per annum (LTA 2008, p 57).

In 2007, Singapore's road network extends over 3297 km and covers 12% of the land area. It includes eight expressways with a total length of 153 km. The average speed during peak hours was 62 km per hour on expressways and 27 km per hour on arterial roads. The average annual km travelled per private car was 20800 (LTA 2008b)[1]. This high usage of cars is captured by another statistic, i.e., the car population grew by 10% between 1997 and 2004, but the number of car trips increased by 23% (LTA 2008, p 7)

The public transport network

A 'world class' transport system includes a high quality public transport network that occupy the least of land but share a major portion of rider ship (LTA 1996). Singapore's public transport infrastructure includes the mass rapid transit (MRT) as the backbone of the system, the Light Rapid Transit (LRT) and buses as feeder services to the MRT, and taxis as high end services. Singapore's MRT covers 109 km with 66 stations. The LRT network has 29 km with 33 stations. The MRT and LRT networks form Singapore's Rapid Transit System (RST). By 2020, LTA plans to double the RST network from 138 km today to 278 km by adding new lines and extensions (LTA 2008, p 6). The average bus fleet operated in 2007 was 3255, and the number of bus routes in operation was 325 (LTA 2008b). This represents a 36% increase from the number of bus services in 1996 (i.e., 239 services) (LTA 2008 p 16). In 2007, there were 24446 taxis in operation, a 45% increase from the taxi numbers in 1996 (ibid).

Singapore's MRT network was built after a ten-year debate between consulting teams representing the pro-MRT and the pro-bus ideas, with a main

focus on the cost-benefit associated with the proposed MRT (Richmond 2008). A decision was made by the government to launch the rail based MRT in 1982. This system was consequently built and put in operation in 1987. At the present, it has three lines in operation and the fourth line in construction (LTA 2008, p 6).

The LRT system is smaller in scale and area coverage. Its function is to increase the catchments area of MRT by providing a feeder service. The 8 km Bukit Panjang Light Rapid Transit (BPLRT) system is the first light rapid system in Singapore. It has 14 stations. Most of the apartment blocks at Bukit Panjang and Choa Chu Kang are within 400 m from these stations. The Sengkang LRT system (with its East Loop and the West loop) and Punggol LRT system connects to the North-East MRT Line.

A set of coordinated policies for land transport development in Singapore

These policies include control over car ownership and usage, and promotion of public transit infrastructure and efficiency. Car ownership control is accomplished by the vehicle quota system; usage control is achieved by road pricing. Promotion of public transit is achieved by building a public transport hierarchy in which service varieties offer fast and comfortable travel experiences to a range of travel needs.

Vehicle Quota System (VQS)

The Vehicle quota system is an innovation by the Singapore Government for managing the vehicle population. It was introduced in 1990 after recognizing that early measures, such as building new roads, improving traffic management, and imposing high import taxes, registration fee and road taxes, could not solve the congestion problem (Chin and Smith 1997).

Under the VQS scheme, state planning and market mechanisms work together to allocate vehicles to users. The government plans for a rate of growth of the vehicle population according to the prevailing traffic condition and road capacity. This rate is translated to the number of new vehicles to be added to each of the vehicle categories (such as cars with engine capacity of less than 1.6 cc; cars with engine capacity of 1.6 cc and greater, taxis, motor cycles etc), taking into consideration the existing vehicle population and the number of

vehicles to be deregistered at the end of the preceding year (Koh and Lee 1994). This determines the supply of the quota. On the demand side, all purchasers of new vehicles are required to bid for a license known as Certificate of Entitlement (COE). A public tender is held twice a month by the Registry of Vehicles (ROV)[2]. The willingness to pay determines the price of a COE. One COE lasts for ten years. For early deregistration, a COE rebate will be awarded[3]. This rebate is calculated according to the COE premium that the owner paid, prorated by the number of months remaining of the ten years (Phang, Wong and Chia, 1996).

Road Pricing

Singapore's road pricing began in 1975 when the Area Licensing Scheme (ALS) was introduced. ALS was implemented to solve the congestion problem in the Central Area. It applied to a restricted area which was about 725 ha. This includes Singapore's CBD and its commercial and retail corridor along the 'famed Orchard Road' (Foo 1997). This is an area with high concentration of jobs, services, and tourists. In 1990, there were about 315000 jobs in the catering, shopping and tourism sectors located within the restricted zone. High concentration of activities and jobs can generate huge traffic demand and traffic congestion. Road pricing basically introduces a user-pay system in order to reduce this traffic demand by charging all vehicles except ambulances, fire engines, police vehicles and public buses for entering the zone. In operation, all vehicles must purchase and display a special permit in order to enter the zone.

Electronic road pricing (ERP) was introduced to replace the permit system in 1998. The main advantage of ERP is convenience and flexibility. This system uses a sophisticated combination of radio-frequency, optical-detection, imaging and smart-card technologies to implement the charges. An in-vehicle unit which can be detected by a road sensor is installed to all vehicles. This unit can process a cash card so that charges are automatically deducted each time the vehicle passes a sensor. The latter is installed on gantries which are visible as entry or exit points of a charging area/road. The ERP technology is advanced enough to handle multiple vehicles travelling at high speeds (i.e., 120 km per hour or faster).

An efficient public transport system with service varieties

The Singapore Land and Transport Authority recognizes the needs of basic and high end services in the public transport system. Low fare in the mass transit lines ensures that the ordinary people can afford to use the public transport. Premium buses cater to commuters 'who are prepared to pay a higher fare for a higher level of bus service' (LTA 2008, 36). These services are planned for a more direct journey with guaranteed seats. At the top end of the public transport system is the taxi, which provides more personalized services.

In addition, the diverse needs of commuters are met by physical and social accessibility. LTA works with 'the relevant organizations such as the Handicaps Welfare Association and the Singapore Association for the Visually Handicapped to identify the barrier-free road facilities required' (LTA 2008 71). Barrier-free access is provided on MRT trains and public buses. The low income commuters are assisted by the 'many helping hands' approach, with the Government, the communities and the public transport operators all extending their helps in various forms such as government income redistribution schemes, and transport vouchers (Ibid 74).

MRT and LRT

One policy to promote public transit use is to increase the coverage area by MRT and LRT. The integrated planning of land use and transportation is a good start as MRT links all the new town centres. New addition of LRT lines increased the catchment area of MRT lines. A comfortable ride is also emphasized by increasing frequencies of train services, so that trains will be less crowded.

Buses

The quality of bus service is emphasized in managing buses. This includes service standard, efficiency and low cost of travel. The Public Transport Council (PTC) sets up standards to guide the two main bus operators: the SBS Transit Ltd and Trans-Island Bus Services Ltd (TIBS). Since 1994 the bus companies are audited every year to check on their performance to these standards.

The LTA has put in place a number of rules and mechanisms in order to improve bus services. These include giving priority to buses at more traffic light junctions by having more traffic lights fitted with a special bus "B" signal, installing intelligent traffic lights to detect approaching buses and turn green automatically, and introducing more bus lanes (LTA, 1996). The 'B' signal comes on before the green light for other vehicles which gives buses a head start and allows bus drivers to filter across lanes. In addition, the LTA recognizes scheduling problems associated with transfers and has proposed that the LTA takes over the role of central bus network planner in 2009, and to improve the frequencies of buses and trains so that the waiting time for a transfer will not be more than 10 minutes (LTA 2008, pp 28-31).

Taxis

The taxi is a significant form of public transport in Singapore. This mode of transport carries about 1 million passengers per day (May, 2004)[4]. Taxis play a key role in providing high end, personalized services, and bridging the gap between private and other public transport (i.e., bus, MRT/LRT). The taxi fare in Singapore is very cheap by international standards[5], as a result of lower vehicle taxes and lower fuel taxes (LTA, 1996).

Discussion and Conclusion

Sustainable transport needs a balance between motorization and public transport. However, the economic, psychological, and behavioral considerations associated with motorization make it very difficult to switch models. In Asia, motorization has been welcomed by governments and planners for its benefits associated with mobility and economic growth. The resource and environmental implications of this trend, however, causes serious planning concerns. Experiences in the US, Europe and Australia shown that car dependent trips increased whilst the use of public transit decreased (Cervero 1998; Newman and Kenworthy 1999). This also happened in Singapore as 'the public transport mode share during the morning peak hours has declined from 67% in 1997 to 63% in 2004 (LTA 2008, 4). The local implications of uncontrolled motorization include traffic congestion, traffic fatalities and injuries, and land sprawl. On the

global scale, motorization has an aggregate effect on the finite fuel reserves and climate change.

The Singapore experience has shown that it is possible to have an increase in car ownership, but with cautious controls and careful plans in car population and usage levels. These involve a public transit system built with careful attention to land use, which shares a heavy load of the ridership[6]. The Singapore government allows its people to express their wealth in car ownership and pursue their dreams of being car owners, though the usage of their cars is discouraged by road pricing. The public majority is offered a high quality functional and comfortable public transport system at low cost. By carefully assessing the road and land capacities, the Singapore transport system satisfies the need of the current generation with minimal use of the limited land.

Nevertheless, Singapore is often referred a special case because of its unique physical and socio-political setup. Indeed, land constraint in Singapore is rarely seen in other cities; the one-tier, strong and clean government is also unique to Singapore. Does its experience have a reference value to other countries? One answer to the above question acknowledges the strength of the interventionist approach which is widely used in political and economic management in many Asian countries. These are the developmental states (e.g., Japan, South Korea and Taiwan) discussed in Johnson (1982) and Wade (1990). A discussion of the development state literature or a review of the institutional setups in Asia is out of the scope of this paper. However, it is possible that the similarities in institutional setup and management mindset among some Asian countries (e.g., China and Vietnam) could facilitate an immediate change by learning from the Singapore approach in managing transport development. In countries that have weaker central control, more political corruption, and little tradition of planning (e.g., Thailand, Indonesia and the Philippines) the Singapore model may introduce broader changes not only in the transport sector but also in politics and economy.

The Singapore experience may also have some relevance in non-Asian countries that are keen to create innovative management policies in response to sustainability concerns. In introducing congestion charges, London and Stockholm made reference to the Singapore experience. Docherty et al (2004)

observed that in recent years there is now a retreat from neo-liberal ideas and a re-engagement with government in delivery of transport services. The Singapore experience shows that strong government intervention can work together with the market. A switch from car-dependence to public transport is proven a hard task even if the government is willing to intervene. But a great deal can be done to the switch if the vision, proper policies and mechanisms are in place. The Singapore model is based on good understanding of the principles and various factors. The latter include the different views, such as those from anthropological, political, psychological, economic perspectives, and from the viewpoint of social reproduction (Vasconcellos 1997), and an array of factors that shape the demand for public transport services, such as quality of the service, price level, waiting and walking time in a trip (Kirchhoff 1995; Bresson et al 2003; Walle and Steenberghen 2006). It is on these factors that Singapore innovations have focussed, so that Singapore's experiments with the various models and policy mechanisms can be useful to other countries.

This paper provides a new perspective for looking at the Singapore story of sustainable transport planning and management. Attributes of an Asian model emerge from the discussion. These include a double-track planning policy that recognises the importance of motorized private car and public transport in sustainable transportation policy development. A range of coordinated policies in favour of public transportation development is in place, and a strong government intervention is the key. This model is distinctive from the US and Australia models in which policy initiatives emphasize a switch from a car dependent system to a public transit system. Instead, both motorization and public transit need to be facilitated in Asia. The model is different from European experiences (e.g., those observed in German cities) as an Asian model needs to follow a different pathway and to be developed in a shorter time span. As such, this research provides a new focus for policy thinking, acknowledging coordinated growth of both car population and public transportation. Fast developing countries are at a crossroad in transport policy development. Banister (2005, 208) recognizes that "there is a great opportunity for the poorer countries to become much more efficient in their use of transport through the rapid adoption of best practice in terms of appropriate technology and innovative ideas." If aspects of the model developed in Singapore are not

recognized, many countries will repeat some of the undesirable pathways that many developed western countries are now trying to change.

References

Banister D 2005. Learning from cities with low levels of motorization. In Unsustainable transport: city transport in the new century, 191-210. London: Routledge.

Barter P 2005. A vehicle quota integrated with road usage pricing: a mechanism to complete the phase-out of high fixed vehicle taxes in Singapore. Transport Policy 12 (2005) 525 - 536.

Barter, P. 2008. 'Singapore's Urban Transport: Sustainability by Design or Necessity?' in Wong, Tai-Chee; Yuen, Belinda; Goldblum, Charles (Eds.) 'Spatial Planning for a Sustainable Singapore' Springer, Dordrecht, pp. 95-114.

Black W R 2000. Socio-economic barriers to sustainable transport. Journal of Transport Geography, 8: 141-147.

Bresson, G., Joyce Dargay, Jean-Loup Madre, Alain Pirotte 2003. The main determinants of the demand for public transport: a comparative analysis of England and France using shrinkage estimators. Transportation Research Part A 37 (2003) 605–627.

Cervero R 1998. The transit metropolis. Washington D C: Island Press.

Chin A; Smith P, 1997. Automobile ownership and government policy: the economics of Singapore vehicle quota scheme, Transportation Research. Part A: Policy and Practice, 31 (2): 129-140.

Docherty, Iain, Jon Shaw, Matthias Gather 2004. State intervention in contemporary transport. Journal of Transport Geography 12 (2004) 257–264.

Foo T S 1997. An effective demand management instrument in urban transport: the area licensing scheme in Singapore, Cities, 14 (3): 155-164.

GAMUT (Australian Centre for Governance and Management of Urban Transport) 2006. GAMUT summary statement.

http://www.abp.unimelb.edu.au/gamut/pdf/gamut-summary-zero-six.pdf Accessed on 19 July 2008.

Han S S 2005. Global city making in Singapore: a real estate perspective. Progress in Planning 64 (2): 64 – 175.

Johnson C 1982. MITI and the Japanese miracle: the growth of industrial policy., 1925-1975. Stanford: Stanford University Press.

Kirchhoff P 1995. Public transit research and development in Germany. Transpn. Res.-A. Vol. 29A, No. I. pp. 1-7, 1995

LTA (Land Transport Authority), 1996. A world class land transport system: white paper. Singapore: LTA.

LTA, 2007. Singapore Land Transport Statistics in Brief 2007. LTA.

LTA 2008. Land Transport Masterplan. Singapore: LTA.

LTA 2008b. Facts and Figures.

Newman P and Kenworthy J 1999. Sustainability and cities: overcoming automobile dependence. Washington DC: Island Press.

Phang Sock-Yong; Wong Wing-Keung and Chia Ngee-Choon, 1996. *Singapore's experience with car quotas : Issues and policy processes*, Transport Policy, 3 (4): 145-153.

Richardson B C 2005. Sustainable transport: analysis frameworks. Journal of transportation Geography, 13: 29-39.

Richmond J E D 2008. Transporting Singapore - the air-conditioned nation. Transport Review, 28 (3): 357-390.

Steg L and Gifford R 2005. Sustainable transportation and quality of life. Journal of transportation geography, 13: 59-69.

UNDESA (United Nations Department of Economic and Social Affairs) 2008. World urbanization prospects, the 2007 revision. N.Y.: UN.

Vasconcellos E A. 1997. The demand for cars in developing countries *Transpn Res.-A,* Vol. 31, No. 3, pp. 245-258.

Wade, Robert. 1990. Governing the Market: Economic Theory and the Role of Government in East Asian Industrialization. Princeton: Princeton University Press.

Walle, S V, Therese Steenberghen. 2006. Space and time related determinants of public transport use in trip chains. Transportation Research Part A 40 (2006) 151–162.

[1] If the average annual distance travelled per private car accounts for the population size, the number is low because of the low car ownership rate (14.3% car ownership is still a target for the year 2010). However, the high usage of private cars sent a signal to policy makers, i.e., if people own cars, they will use them (probably extensively). In other words, traffic volumes cannot be controlled by using policies that discourage car usage alone. Car ownership policy is an important means to regulate car traffic.
[2] An Open Bidding System was introduced in 2001. This new system intends to reduce the volatility of the COE price by enabling bidders to make more informed bids (LTA 2008 p 14).
[3] From 1 September 2008, car owners are allowed to encash the Preferential Additional Registration Fee (PARF) and Certificate of Entitlement (COE) rebates. This option was not available before as car owners could only use the rebates to off-set their new car purchase. This change was to encourage car owners to shift to public transport users (LTA 2008c).
[4] In 2007, taxis carried 927,000 passengers per day (LTA 2008b).
[5] LTA statistics show that taxi fare in Singapore is about $9.29 per 9 km during AM peak hours. The same measurement is $12.35 in Hong Kong, $24.56 in London, and $14.62 in New York (LTA 2008, 17).
[6] The daily MRT ridership was 1.5 million passengers in 2007 (LTA 2008b).