SUSTAINABLE URBAN TRANSPORTATION PLANNING AND DEVELOPMENT — ISSUES AND CHALLENGES FOR SINGAPORE

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Abstract: Singapore has been known worldwide for its proactive aggressive approach in advance-planning and implementation of large–scale land transportation measures. Since the transportation planning has been executed as part of the overall land development master plan, considering economic, social as well as traffic operational impacts, the end results have been desirable with respect to requirements for sustainable development. This paper classifies the measures implemented in Singapore into policy measures and technological measures, and presents the issues and challenges involved.

INTRODUCTION

Singapore is a small island city state with a land area of about 700 sq. km, and a population of approximately 3.5 million. It is one of few major cities in the world that is able to maintain a smooth traffic flow within the city area at any time of the day. After more than 3 decades of strong economic growth, with commercial activities (in terms of office space and number of employments) increasing by more than 20 times since 1970, Singapore is still able to maintain an efficient land transport system, and keep its urban transportation under control. While the major concerns of the Singapore government in formulating transportation-related policies were basically economically driven, the end results have had significant positive environmental impacts in respect of transport energy consumption and vehicle emissions.

The success of Singapore in developing an efficient land transportation infrastructure must be viewed in totality from the perspective of integrated land use and transportation planning. It should be highlighted that in 1965, nearly 70% of the Singapore population of 1.8 million then was residing within 5 km radius from the Port of Singapore, which was also the city center of the young nation [Humphery 1985]. In line with the master development plan conceived by the SCP project, the government of Singapore launched the House Ownership for the People scheme in early 1970s by building affordable high-rise public housing in designated zones, complete with supporting commercial, recreational and public premises. This scheme succeeded in moving the city center dwellers to residential zones according to the master land use plan. Today, 86% of Singapore population lives in high-rise residential buildings constructed by the government in all parts of the island [MIA 2001].

The first comprehensive master development plan for Singapore, known as the 1971 Concept Plan, was drawn up in 1971 under the 4-year State and City Planning (SCP) Project commissioned in 1967 with the assistance of the United Nations Development Program (UNDP), for a planning period of 20 years with 1992 as the target year [Tan 1976]. The plan placed great importance of the need for investment to develop the island-wide transportation infrastructure in the very early stage of city development. In 1991, the Revised Concept Plan was published, complete with the Strategic Transport Plan to develop a viable land transport network that could meet the travel demand of a population of 4 million by the year 2030 [LTA 1996].

Although much has been achieved by Singapore in developing an efficient urban transportation, the citizens' expectation for better quality of transportation systems and their aspirations are growing with time. The demand for more efficient service for commuting and higher standard of life quality by the younger generation presents a constant challenge to the transportation authority and the country's leaders. This paper highlights some of the major concerns of and challenges to the transportation managers and planners of Singapore.

POLICY MEASURES FOR SUSTAINABLE TRANSPORTATION

Control of Car Population and Usage

To ensure a sustainable economic growth, Singapore planning authority has considered the control of vehicle population as a key component of its master plan of integrated urban development and transportation management, beginning with the first Concept Plan implemented in 1971, and continuing into the 21st century. Control of vehicle population has been achieved through two main measures: car ownership restraints and car usage restriction measures. Hanson [1980] had predicted that if the vehicle population control were not applied, the main arterials in Singapore would need to be 9 to 16 lanes to accommodate the traffic in the late 1980s. This is obviously unacceptable in a land-scarce city like Singapore.

Two major forms of car ownership restraints are in use in Singapore to suppress the growth of vehicles to within a tolerable level: (a) Fiscal measures to increase the costs of owning, operating and maintenance of motor vehicles. These costs include import duties, vehicle registration fees, fuel and road taxes, and compulsory vehicle inspection fees. (b) The Vehicle Quota System (VQS) that requires anyone intending to purchase a car to first acquire a Certificate of Entitlement (COE) through an open bidding system. The Vehicle Quota System (VQS) was introduced with the government's decision to cap the growth rate of car population to within an acceptable level that will not create uncontrollable congestion in the road system, and yet strong enough to sustain the economic development. Under this system, anyone who intends to purchase a vehicle and register it for use on the road must first obtain a Certificate of Entitlement (COE) through an open bidding system. Tenders for COEs are held monthly and successful bidders pay the lowest successful bid price known as the quota premium for the month. Each COE allows a vehicle to register for a period of 10 years.

The quota of the number of COE to be issued each month is set by the transport authority. This allows the government to have complete control of the growth rate of the vehicle population. For the past 12 years since the VQS was introduced in May 1990, the cap for annual vehicle growth rate has been fixed as around 3%. Records of the last 12 years of monthly COE bidding statistics have shown that the COE scheme is necessary and effective in achieving the government's goal of car ownership control. The demand for COEs has so far consistently exceeded the monthly quota by 2 times or more.

Issue and Challenges for Policy Measures

Unfortunately, even with the suppressed 3% growth of car population to match the need for economic activities, it is practically impossible to maintain the same level of service for traffic flow without other parallel measures -- car usage restraint measures in particular. Car usage restriction has been found necessary by the Singapore government to ensure smooth traffic flow in the central business district and the main arterials, including the national expressway system. Of these measures, the Area Licensing Scheme (ALS) implemented in 1975, and subsequently replaced by the Electronic Road Pricing (ERP) system are the two most well known schemes that have created significant impacts on the car usage and travel behaviors of Singapore motorists.

While many motorists and commuters are convinced that the afore-mentioned control measures are necessary, there are many others who are unhappy about such controls and feel that have been unfairly deprived of the right to own cars. The Singapore authority is seriously considering upgrading the ERP system to address the social concerns by optimizing road network flow capacity so as to allow more people to own cars. The main focus has been to expand the ERP system to cover the entire road network and transform it into a congestion pricing system. Under the proposed system, the rate that the motorists to be charged for using each road section would be dependent on the congestion level of the road section. It is hoped that such a pricing system will help to reduce the congestion level of busy road sections. It is also anticipated that motorists would travel by private cars only when necessary, and choose to use less congested road sections, thereby optimizing the utilized capacity of the road network. The Singapore government has initiated a trial project to study the feasibility of a GPS based second-generation ERP system to meet the requirements of congestion pricing. Besides the technological issues, the key challenge of putting in place an electronic congestion pricing is to have an effective road information system for drivers and charging mechanism to achieve the best results.

The car ownership restraint measures implemented in Singapore have created unhappiness among less well-off citizens who have a strong desire to own cars. One way is to relax the car ownership restraint measures to allow more people to own cars, but in the mean time raising the costs of using and maintaining passenger cars. This could have the desired outcome of discouraging unnecessary travels and car usage. It has been argued that the very high car prices have driver car owners to use their as much as possible as the road usage and car maintenance costs are too low in comparison with the prices of cars.

Another challenge is to optimizing the usage of existing cars so that more people get to drive even though the number of cars remains more or less constant. One approach that has appeared promising is the car-sharing schemes, the first of which was introduced in Singapore in 1997. There are today five car sharing vendors who provide the convenience of and access to a car 24 hours a day. Members of the schemes have been increasing at an annual rate of more than 50% in the last 7 years to about 8,000 today. The schemes today serves 81 public car-parks with a total number of 300 cars, and are expected to cover more than 600 car-parks in 3 years' time [Lianhe Zaobao 2004].

TECHNOLOGICAL MEASURES FOR SUSTAINABLE TRANSPORTATION

Use of Advanced Transportation Technologies in Singapore

Singapore has successfully applied advanced technologies to improve the efficiency and sustainability of its land transportation system. The ERP system described in the preceding section is a well-known success example. Another equally successful system is the GPS taxi dispatching system implemented in 1996. Taxis are a convenient form of public transport, yet because of their low passenger carrying capacity compared to buses and MRT, they contribute more to traffic congestion and consume higher fuel on per passenger basis. It is for this reason that the total number of taxis is controlled in Singapore. As of December 2003, Singapore has about 20,000 taxis making more than 600,000 trips per day. Since the early 1990s, through the Public Transport Council and the Ministry of Communications, the Singapore government has been putting emphasis on raising the productivity and quality of taxi services, so that the number of taxis needs not be increased unnecessarily. The GPS (Global Positioning System) taxi dispatching system introduced in 1996 is a good example.

All three taxi companies in Singapore launched computerized GPS taxi dispatching system in early 1996. The three systems are similar in operation. Incoming booking calls first go to a central computer and the GPS tracks the nearest empty taxis and dispatches calls. Passenger's pick-up point will appear on the display terminal in the taxi. The taxi driver may decide not to accept the call. If he does not, the next nearest taxi is dispatched. Passengers may place booking by using one of the following means: (a) taxi order terminals located in shopping centers, hotels and cinemas etc; (b) computer modems from offices and hotels; (c) portable taxi order terminals; or (d) telephone for an operator-assisted system. Computer will inform the customer of the taxi number and expected arrival time. Implementation of the system cost about S$5 million (about US$2.8 million) for each company. This use of GPS technology has radically changed the traditional method of taxi control and dispatch. It has increased the productivity of the taxi fleets by reducing the distances of empty cruising, and through shorter response time and higher ridership due to added convenience and ease of commuters to call for taxis. In terms of the percentage in terms of distance of empty cruising, the systems were estimated to have reduced it from about 50% to less than 40% [Lee 1998].

Road incidents such as traffic accidents, vehicle breakdowns and roadwork that cause closure of traffic lanes have been identified as the major cause of traffic congestion in Singapore. The economic losses in terms of travel delay, energy consumed and air pollution are worth millions of dollars. Early detection of traffic accidents or breakdown vehicles followed by fast response and effective clearance helps to reduce unnecessary losses. Coordinated planning of roadwork between the road and traffic departments would save road users many vehicle-hours and fuel consumption. The Expressway Monitoring and Advisory System (EMAS) was implemented in 1998 along selected sections of Singapore's urban expressway network to monitor traffic along expressways and detect incidents automatically so that emergency assistance can be dispatched quickly to remove sources of congestion [Sing 2000]. The system captures traffic situation with an array of cameras and allows real-time monitoring of incidents on the expressways. It also allows the information of the traffic situation to be disseminated to motorists. This system helps to relieve congestion in two ways: (a) It alerts motorists timely to avoid road sections that are crowded, hence reducing the degree of congestion and travel delays of travelers; and (b) It facilitates quick clearance of accidents and breakdown vehicles. Initial feedback has it that EMAS is able to reduce the average clearance time for breakdown vehicles from 13 minutes to less than 10 minutes.

Issue and Challenges for Technological Measures

Singapore's laudable efforts in adopting advanced technologies to improve the efficiency and operations of the land transport system have made its marks and created the desired results in some of the projects such as ERP, EMAS and the GPS taxi dispatching system. However, the amount of investment is high and not all projects are successful. The problems that cause projects to fail are not usually technical or technological related in nature. Some of the projects are stalled due to social issues and practical implementation difficulties.

For instance, the land transport authority embarked on a program to work with the public transport operators to implement an integrated Travel Information System (TIS) in late 1990s. It is expected to provide passengers with real-time information on the various public transport systems through the Internet, multi-media kiosks and telephone hotlines. This was one of the authority's efforts to attract commuters to use public transport by allowing them to make better-informed commuting decisions based on real-time information accessible from convenient locations of their choice. The ambitious program, unfortunately, did not materialize. A S$40.3 million project named transit.smart announced in October 2000, originally scheduled to be completed in 2.5 years with the main aim to predict bus arrival times based on GPS technology, was abandoned by the authority in February 2003 [BT 2003]. Reasons cited for the abandonment of the project include the following: the project was behind schedule and any further delay would cause cost over-run; (a) there were technical problems of implementation such as unsuitable radio communication system; (b) the adopted software could not be integrated with other software systems; (c) the proposed system was unpopular with the bus companies; and (d) implementation of the proposed system might lead to undesirable fare increases [BT 2003].

The Enhanced Integrated Fare System is another project that is facing delays due to technical and implementation problems. In Singapore, bus fare is distance based and the system is to automatically calculate bus fares and deduct from the passengers' contactless smart card. Originally scheduled to be launched in 2002, the automated bus tracking component of the system is still facing technical problems which have moved the scheduled date of implementation to end of 2004 [Popatial 2004]. Prakasam and Wang [2004] reported that the technical problems encountered were: (a) the urban canyon effect had prevented the receiving of GPS signals, and the dead-reckoning mode that took over under this situation did not produce consistent results; (b) temporary diversion of buses from the scheduled routes due to road works or traffic incidents could not be effectively handled; (c) the computed GPS co-ordinates were not accurate enough to differentiate bus stops on both sides of narrow two-way roads; and (d) the pre-entered co-ordinates of a bus stop may not match with the computed GPS co-ordinates.

CONCLUSION

Singapore has come a long way in putting in place a sustainable transportation system, and has improved throughout the years. Yet all these have been achieved not without any challenges and implementation problems. Singapore's experience suggests that both effective policy and technological measures are necessary to achieve sustainable transportation development. Appropriate policy measures involve less capital investment, and can have deep and lasting effects. However, poorly conceived or implemented policy measures could lead to wide-spread resentments and unhappiness. On the other hand, technological measures such as intelligent transportation systems are usually more costly in terms of capital investment as well as maintenance, tend to improve traffic flow and operations, although their cost-effectiveness and benefits are often difficult to be quantified.

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