

Transporting Singapore—The Air-Conditioned Nation

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ABSTRACT *The role of a metaphor of centrally controlled air conditioning in governing Singaporean transport planning is examined, and its consequences evaluated. A modern transportation system has been put in place to link a hierarchy of central places. Tight government control has made change possible. A reliance on technical expertise at the expense of public involvement has, however, failed to develop public transport to effectively serve a range of dispersed-destination travel needs. Regulatory approaches, furthermore, have discouraged service innovation. Policies making car purchase expensive have restricted car ownership. Effective change would be facilitated by involving a highly educated public more in decision-making.*

Introduction

Lee Kuan Yew, legendary father of modern Singapore who, as a Prime Minister, led his country's nationbuilding from independence in 1965 until 1990, named the air conditioner the most important invention of the millennium because it facilitated concentration on work. Singaporean author, Cherian George, gets to the essence of the nation's soul in calling Singapore the "Air-conditioned Nation—a society with a unique blend of comfort and central control, where people have mastered their environment, but at the cost of individual autonomy, and at the risk of unsustainability" (George, 2000, p. 15).

Lee and the ruling People's Action Party (PAP) believed that people most wanted material comforts, rather than adherence to high-minded political principles, George says. The government has pushed economic growth and created a society that can enjoy the benefits. Like a centrally controlled air-conditioning system, Singapore's development model has been "a total systems approach to economic management. It is highly infrastructure-intensive, and demands fine planning and constant management". The PAP:

Does not view its role as being to respond to people's expressed preferences at any one time. "As a custodian of the people's welfare, it exercises independent judgment on what is in the long-term interests of the people

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and acts on that basis" [Singapore's second Prime Minister] Goh Chok Tong has said. This has entailed "administering bitter medicine to overcome economic challenges" and "tough policies necessary for economic development..."

Observers frequently remark at the apparent contradiction between Singapore's high level of economic progress and its illiberal, centrally planned politics. In an Air-conditioned Nation, however, there is no contradiction: comfort is achieved through control. (George, 2000, p. 18)

The belief in the government's ability to exercise sound independent judgment goes hand-in-hand with a mechanistic view of the power of science to calculate desirable outcomes for nationbuilding, which in turn relates to the heavy engineering-orientation of Singapore government. Colombo Plan scholarships, available from the mid-1960s, which were only available to study for science and engineering degrees, set in place a pattern of engineering training for Singapore's most talented public sector professionals. Their legacy is the appointment of engineers to almost all permanent secretary positions and even to a significant number of ministerial positions.

Government, while controlling, is also corruption-free. A highly paid meritocratic bureaucracy has the power to conduct technical studies and implement consequent policies with little risk of opposition. While 'feedback' has been sought from the public, the general populace has been little involved in issues of planning and design in an atmosphere dominated by the cult of expertise. As George says, the "First Law of Singapore Politics" is that "the government abhors a political vacuum. It wants to fill every space and control every agenda". The "Second Law of Singapore Politics" is that "every action by citizens invites an unequal and opposite reaction by government" (p. 127).

The government's tight control, along with a degree of honesty and commitment to service which has rarely accompanied high levels of unchallenged central power in other nations, has transformed Singapore into a modern and wealthy economy. These results have kept away effective challenges to control the integrated machine that is Singapore. As Lim writes:

Critics have continued to identify the heavy price that some individuals and the community have had to pay, particularly in the way of personal freedom and political openness. However, decades of continuous material improvement has provided sufficient compensatory benefits for the government to obtain electoral support from the majority. (2004, p. 9)

A Singaporean transportation official interviewed in research for this article explained that public interest groups were "not very active ... Historically, you have a strong government. People see things being done. Things work. When things are smooth, there is a less compelling reason to stand up". According to another official: "everyone recognizes that we do have a government that is rational, that we have unpopular but necessary policies, but they accept it".

While planning is done by the government, with projects proposed and designed on grounds of technical promise and financial efficiency, the government is becoming aware that "people are becoming more vocal, want to have a say", according to an official. The response has been to establish community

relations departments and feedback units, to hold public meetings to explain and advocate policy, and to engage in focus group discussions.

The government, however, sets the agenda for consultation activities, which often play a public relations role. Tan Cheng Bock, PAP MP, and Land Transport Authority (LTA) Board Member, explained in an interview that:

The moment ERP [Electronic road pricing] or whatever measure comes up, the Members of Parliament automatically go to the wards and do the hard sell for the government ... we will brief all the community leaders about the change, we brief all of them, we get all the expert people from the LTA [Land Transport Authority] to explain to them ... We will allow feedback of their concerns, but we don't accept all their concerns.

Opposition Member of Parliament Low Thia Kiang said in another interview: "They have feedback units all over the place, but they decide at the end of the day." While Low sees the lack of public engagement as a problem, Hong Hai, former PAP MP and former Chair of the parliamentary committee which recommended establishing vehicle rationing in Singapore, sees the government's operating manner in terms of efficiency:

It is not the style of the government to consult hundreds of opposition groups. There is a feedback group that gets opinions from people. At the end of the day, government has to make the decision. It does get things done. And there are people who are not so happy ... The role of the government is to lead, to take that solution to the public, to convince them ... A good government is one that can convince people of the sacrifice they need to make.

Singaporeans are very involved with their living, with making money, having a stable job, having income, and they would support a government that gave them some assurance and security of maintaining and improving their standard of living; and if that means they have to hand over some of their decision-making to the government, I think they can live with it.

As one government official pointed out: "In the States, there is so much public participation that you don't really get to implement what is necessary for the good of the city." Indeed, with little of the apparatus of civil society in the western sense, and most notably the almost-complete absence of public interest groups in Singapore, there have been few of the delays that often accompany project implementation in the west. Trade unions have been integrated into government, with official permits required for any strikes. The press is restrained by licensing requirements, official secrecy laws and the threat of libel actions, which have also helped keep the political opposition in check.

A key to economic growth in Singapore has been the formulation and execution of land-use and transportation problems in an integrated way, and with long-term vision. Short-term political issues, which dominate agendas in other countries in the region, have not been a problem in Singapore. In contrast to its Asian neighbours, Singapore has transformed its urban landscape into orderly commercial

and residential neighbourhoods as it has regulated and restrained traffic to enhance its environment and radically upgraded its public transport.

This article examines the development and operation of transport policy in Singapore; investigates the extent to which it has been organized in line with the principles of the 'Air-conditioned Nation'; and evaluates both the successes and shortcomings of the operation of the metaphor on the effectiveness and efficiency of the systems established and the comfort and convenience of those who use them.

Research took place during two visits to Singapore, in February and March 2004, the latter with a group of students on a field trip sponsored by the Singapore government. In addition to holding a series of meetings with government officials at the LTA, Public Transport Council (PTC), Housing and Development Board (HDB) and Urban Redevelopment Authority (URA) visits were made to public transport operators, i.e. Singapore Mass Rapid Transport Corporation (SMRT) and Singapore Bus Services (SBS) Transit and to meet a number of current elected politicians and individuals historically connected with transportation development in Singapore. Government agencies were highly cooperative in responding to data and documentation requests, and showed a willingness to engage in a balanced and reflective discourse. This article is based upon information from meetings held in Singapore and on a review of relevant documentation and literature.

Development of Singapore

Singapore has grown from a British colony established in 1819. The initial 400 acre town remains at the core of Singapore's central area. The 1824 population of 10 683 grew to over a quarter-million by 1901. By 1947, following the 1942–45 Japanese wartime occupation, it stood at 557 745. Ten years later it had increased by 68% to 938 144, with 63% of the population still concentrated in the central area (Savage, 1992, p. 18; Perry *et al.*, 1997, p. 31).

The 1950s were a time of turbulence, marked by riots, protests and strikes. Continued population increases led to unemployment and acute housing shortages (Dick and Rimmer, 2003, p. 240). In Chinatown, the population lived in shop-houses divided into cubicles. Some families even shared cubicles (Kaye, 1960). Trading spilled over into the streets, competing with traffic and pedestrians. Squatter settlements appeared on the city's periphery. As Gamer (1972, p. 17) says: "virtually the whole built-up portion of the island's 225 square miles was rapidly decaying into a wretched slum".

The PAP came into being on 21 November 1954, won city council elections in 1957, and, in 1959, won islandwide general elections. Between 1963 and 1965 Singapore was merged with Malaya, an experiment which failed and culminated in the 1965 full independence of Singapore.

The newly elected government set a priority on housing and employment policies, and put in place the beginning of the "unprecedented level of master planning" (Cervero, 1998, p. 156) that was to transform the city-state from run-down despair to a modern and prosperous economy. The HDB was established in 1960 and built over 53 777 housing units by 1965, and 63 448 over the following five years. By 2003, 84% of the Singapore population was housed in 868 774 public units in predominantly high-rise high-density housing estates. 93.9% of these flats were owned by their occupants on long-term leases (with land continuing to

belong to the government); the remainder was rental housing (HDB, 2003, p. 28, see also pp. 95–96).

Initial housing, developed in 10- to 20-storey buildings, was standardized, reducing the time and expense of construction at the cost of creating monotony (Cervero, 1998, p. 162). Subsequent designs went to 30-, 40- and even 50-storey buildings with an emphasis on quality and greater variety (URA, 1991, p. 22; HDB, 2003, pp. 48–56). Though the density may seem great, this reflects the need to house a population with an overall density of 6086 persons per square km (Phang and Toh, 2004, p. 16). Average housing density in Singapore in fact fell from five persons per room in the mid-1950s to a little over one person per room in 1995 (Willoughby, 2000, p. 6). A visit to the gallery at HDB highlights a concern for comfort and convenience, with displays stressing modernity and high-tech that are quite at odds with the notion of public housing in most other countries in the world. Staff take great pride in describing the leaps in living style the government has brought to its citizenry.

In parallel with its housing developments, the government proceeded with plans to tackle unemployment. New industrial projects were put in place outside the old port area. The Jurong Industrial Estate was created on swampland in 1963 as the site for a port, factories, and petroleum and petrochemical activities. The Jurong Town Corporation (JTC) has since built 30 industrial estates on 6000 hectares throughout Singapore (Dick and Rimmer, 2003, pp. 241–243). Tax concessions attracted foreign investors and the deployment of prefabricated infrastructure allowed foreign manufacturers to quickly start up low-cost operations (Cervero, 1998, p. 158). More recently, JTC has been planning and building science as well as business parks.

By 1980, unemployment had been all but eliminated. Gross domestic product had increased at an annual rate of 9% over the previous decade, during which manufacturing jobs had increased from 25 000 to 287 000 (Chor, 1992, pp. 29–43). By the late 1980s, the Singapore government had shifted emphasis from growth in manufacturing to attracting corporate regional and logistical functions, with an emphasis on producer and financial services. This led to further redevelopment of the central area (Dick and Rimmer, 2003, p. 249).

In 1958, the colonial government had produced a master plan which called for the development of peripheral new towns and a green belt to control expansion of the central area. The plan was not geared to high growth and was replaced with a 'Concept Plan' in 1971. This incorporated a 'Ring Plan' to structure high-density residential areas, industries and urban centres in a ring formation around the central area, linked by a high-capacity transportation network (URA, 1991, p. 8). The plan formed the basis for shaping the new towns where HDB housing was located: the airport, expressways, major roads and the MRT rapid transit system.

The 1991 Concept Plan replaced the 'ring' concept with a 'Constellation Plan' which decentralized commercial centres from the central area in a fan-like urban structure linked by the MRT (URA, 1991, p. 19) (see Figure 1). The new centres and subcentres, to be linked with hierarchical public transport connections, were to be designed with an emphasis on high-density land-use to promote public transport use. Again, the concept was growth through integrated planning, in which land-use and transportation were designed synergistically.

As Chan (1971, p. 48) says, the early years of independence were a time when "survival was adopted as a one-word political slogan as well as a main theme underlying all analyses of problems and statements of policies and intent". Urgency legitimated grand actions. Singapore was able to enact its extraordinary

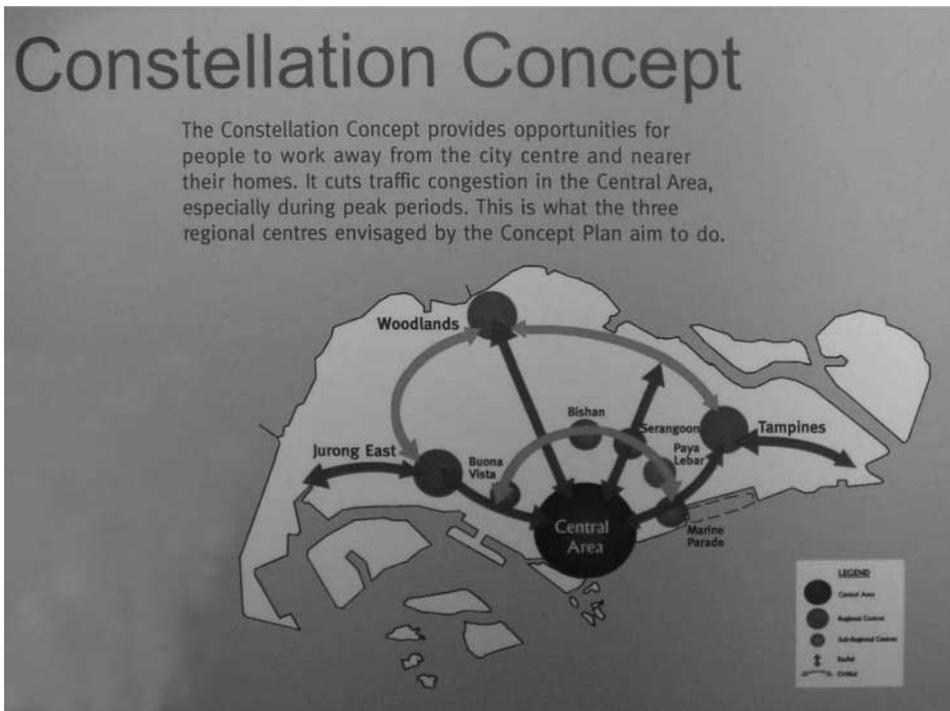


Figure 1. The constellation concept (from exhibition at Urban Redevelopment Authority).

redevelopment measures through the government's "near complete centralized control over urban development and community design" and "uninterrupted, top-down decision making" backed by a lack of citizen demands for grassroots input into decision-making (Cervero, 1998, p. 156, 160). Public ownership of four-fifths of the island, together with far ranging density and zoning regulations, cemented the control available to the one-party government (Dick and Rimmer, 2003, p. 241). The Land Acquisition Act of 1966, furthermore, empowered the state to take land for any public purpose (Cervero, 1998, p. 160).

The existence of a single-layer government has promoted effective coordination; thus, the URA, responsible for planning, is linked effectively with the HDB and the LTA to produce the conceptual integration that is the hallmark of design in Singapore.

The process of change was not without pain. Gamer describes how tight-knit Malay communities were destroyed, and the resistance the government at first faced to its clearance and redevelopment plans. Initial attempts to redevelop the Kallang Basin were slowed by opposition. However, following its 1963 election victory, the PAP deregistered the protesting Rural Dwellers Association. "After this, organized opposition to resettlement among Chinese and Indians could not easily be established, since the chief troublemakers could be hunted out and arrested" (Gamer, 1972, p. 70).

Following action to neutralize voices of opposition:

Lack of resistance from the grassroots enabled the political leadership to undertake an unprecedented, deliberate act of *tabula rasa* culminating in near total urban destruction in later years ...

[S]ystematic cleanup and rebuilding destroyed much of Singapore's urban fabric. Critics have with mounting frequency lamented that the visual environment of Singapore has in fact no context, landscape, scale nor history...

In the urban landscape, planners have systematically removed and destroyed unprotected city areas and historical sites that had acted as containers of history, values and cultures...

The devastating effects of modernist planning, major re-housing and re-development have left Singapore with little more than a manufactured, over-regulated, glossy and tidy image of a city. In the process, it was stripped bare of the vitality, complexity and chaos which make neighboring Asian cities like Bangkok, Tokyo and Shanghai appear much more vibrant and exciting. (Lim, 2004, pp. 1–10)

Only one traditional kampong community remains standing on the main island of Singapore. It is tucked away, near to, but out of sight of, the new development of Sengkang. A place of rickety huts and mud paths, its occupants can be found lazing around on a weekend. It is friendly and easy to get into conversations away from the hectic pace and anonymity that dominates life in so many other parts of Singapore.

It turned out that most of the inhabitants also have HDB flats, and come to the kampong only for weekend relaxation. It was nice to have a quaint holiday home, but they didn't want to do without the cleanliness and comforts, the appliances and—above all—the air-conditioning, in the homes the Singapore government had built for them, according to a number of them, interviewed during a weekend visit.

Public Transport Development and Management

An exhibition on Singapore's transport at the URA carries the banner 'The integrated transport system—a well oiled machine' (see Figure 2). The metaphor is of efficiency and reliability, of a perfectly engineered mechanism that pumps flows of people unflinchingly around the island on their business and for leisure.

Transport took place in a much more haphazard way in the early days of Singapore. In fact, until the arrival of the *jinriksha* (a human-pulled conveyance) in 1880, most people walked in the relatively compact urban built-up area. In 1885 a steam tram began operation on a 3 km route, but failed in 1894 under competition from the rickshaws. Electric trams were introduced in 1905, but the rickshaws continued in operation because they picked up and dropped off anywhere, saving passengers the need to get access to and from the fixed tram stops. The tram company was afflicted by financial problems related to both fraud and the inability of low fares to cover costs, and these worsened under competition from seven-seater 'mosquito' buses. Efforts were made to restrict the operations of rickshaws and mosquito buses, but these failed, and the trams terminated operations in 1926, to be replaced by a 31 km trolley bus system, later supplemented by gasoline buses.

As competition from 11 Chinese gasoline bus companies intensified, the trolley buses ran at a loss, and they ended operations in 1962. Bus services at that stage were of low quality and had to compete with pirate taxis which provided better service to slum dwellers relocated to public housing outside the city centre. Not



Figure 2. The integrated transport system—a well oiled machine.

only were buses dirty, dingy and poorly maintained, but an average of about 800 out of 1500 buses broke down daily, leaving schoolchildren stranded at stops as late as 8 pm. There was also evidence of sabotage of buses by crew and connections to gangsterism (Phang and Walder, 1999, pp. 3–4; Dick and Rimmer, 2003, pp. 237–240).

The transport element of planning the new Singapore took longer to get off the ground than housing and industrial development initiatives but, in 1968, the Ministry of Communications was formed to address inadequacies in transport services and to move towards creation of an integrated land-use transport system (Dick and Rimmer, 2003, p. 240).

A new highway system was needed to meet the dispersion of residential and industrial areas. Initially, inner and outer ring roads were constructed around the central area. Since 1968, road development has produced 150 km of expressways encircling the island to serve new nodes of development in addition to radial highways.

Between 1971 and 1978, the bus industry was reorganized and modernized. In 1973, the private bus companies were amalgamated into the government-owned SBS, and services and operations were improved. To reduce operating costs per passenger carried, one-man operation was introduced in 1975 and double-deckers in 1977 (Phang and Walder, 1999, p. 4).

Building Singapore's Rail System

A state and city planning study to assess land-use transportation needs was completed by the Singapore government and the United Nations Development

Programme (UNDP) in 1971. The study forecasted the need for a rail transit system by 1992, and predicted that it would be physically impossible as well as environmentally unacceptable to build all the roads needed, assuming unchecked growth in private automobiles (Mass Rapid Transit Corporation, 1988).

A three-phase Mass Transit Study (MTS) was conducted by consultants Wilbur Smith between 1972 and 1980 to “assist Government in formulating a transportation programme and policies that will contribute to achievement of the Republic’s development goals”. The study’s primary emphasis was on “public transport and particularly the role of high-speed, high-capacity mass transit service” (Wilbur Smith *et al.*, 1974, p. 1). “Systems using small motor vehicles (such as subsidized taxis, jitney taxis and dial-a-ride service) make relatively heavy demands on road space and do not afford high capacity for line-haul service,” according to the consultants (Wilbur Smith *et al.*, 1974, p. 4).

The Phase I study considered rail- and bus-based alternatives as well as the impacts of doing nothing. The ridership forecasts for the bus and rail alternatives were almost identical, at 3.2 million passengers forecast for 1992 (Wilbur Smith *et al.*, 1974, p. 9). A benefit-cost analysis found greater advantages to rail, however, particularly in terms of ‘producers’ benefits’ such as those related to operating costs, although one of the busway alternatives was found to produce the highest potential for time savings for transit passengers (pp. 13–15). Given the higher operating costs said to be associated with busway operation as well as the greater bus circulation on central area streets, said to stretch capacity, a rail alternative was recommended (pp. 16–18).

Phase II considered rail and bus options in more detail and reached similar conclusions, recommending a bus–rail system combining 44.5 km of rail transit with a bus system to feed the railway and serving areas beyond the rail network. The study emphasized the advantages of rail transit in relieving central area congestion (Wilbur Smith *et al.*, 1977, p. 12, 15, 36). The following statement is, however, included on the front page of the Phase II summary report:

UNDP financed the study with the World Bank acting as executing agency, responsible for supervising the consultants. In discharging this responsibility, the Bank has reviewed the consultants’ data, analysis, forecasts, estimates and recommendations. From this review, it is the Bank’s opinion that the consultant’s estimates of the bus operating costs are high and their estimates of the rail construction costs are low. Further, it is the Bank’s view that if the costs were adjusted to be in conformation with the Bank’s opinion, the Bus-Rail system would be uneconomic. (Wilbur Smith *et al.*, 1977)

The Phase III study (Mott *et al.*, 1980) provided preliminary engineering design.

The Singapore government retained a team from Harvard University to review these studies. The Harvard team echoed the concerns of the World Bank, and concluded that “the case for building an MRT is not compelling ... The recommended (Phase II, Phase III) MRT is at best a marginal investment for Singapore” (MRT Review Team, 1980, p. 1).

The Harvard team found that a restructured all-bus system using expressways would result in dramatically increased bus travel speeds and also alleviate the central street capacity problem cited by the MTS as justification for the MRT.

A comparable service level to that of MRT could be produced at capital and operating costs that were 66% of those of the proposed full MRT, they said. Frequent non-stop express buses could connect new towns with concentrations of jobs in the central area. The proposed routes would target specific parts of the central area, rather than circulating throughout it, in order to minimize the congestion which the MTS had said would be caused by expanding bus operations. While trip times between the new towns and the central area would be comparable to those on MRT, travel times between several new towns would be better than on MRT.

The team said that the MTS mistakenly assumed that extensive growth in the Singapore central area was inevitable and desirable, and provided recommendations to encourage decentralization which would complement the all-bus proposal. The team also recommended route revisions, re-equipment and operational changes to improve bus services whether or not the MRT was built (MRT Review Team, 1980, pp. 1–11).

Wilbur Smith replied to the critique, saying that the Harvard team had been unrealistic about problems with large numbers of passengers boarding buses in the central area and had assumed unattainable speeds for bus services. Because of these unrealistic assumptions, bus trips would not be as fast as those by MRT, and bus fleet requirements and therefore costs would be higher than stated by the Harvard team, Wilbur Smith maintained (Wildermuth, 1980a, pp. 4–6).

In conclusion, the Hansen [Harvard] Team has designed an alternative all-bus system which, it is conceded, differs from earlier all-bus designs. It can be implemented if we want to. The resulting bus services will, however, be characterised by bus stops in the Central Area having very large volumes of people waiting for buses, by delays at these bus stops, by commuters having to pay higher fares for less frequent services and having to transfer buses more frequently. In other words, it will not be more comfortable or more reliable than what exists today. In addition, it would mean less road space for other road users. It will certainly not provide a modern and convenient public transport system that would offer an attractive alternative to either the private cars or the proposed MRT. This all-bus system with crowded buses at infrequent intervals will be no different from what exists today in Bangkok, Jakarta, Manila and other Asian cities. (Wildermuth, 1980a, p. 8)

The Harvard team responded that the points raised by Wilbur Smith in rebuttal of their report were 'incorrect', 'highly misleading', 'difficult to follow' and 'phoney'. Wilbur Smith had painted 'horror pictures' and 'doomsday scenarios' to frighten readers of the Harvard report, team leader Kenneth Hansen stated (Teo, 1980).

Both teams wrote letters which were published in the *Straits Times*. Kenneth Hansen restated that the all-bus system scored over MRT in benefit-cost analysis and was feasible (Hansen, 1980). Bruno Wildermuth, writing for Wilbur Smith, stated that:

The true choice is whether Singaporeans, who are expected to reach an increasingly higher level of competence and responsibility in high technology service and industrial positions, will continue to travel in

overcrowded, hot buses at unreliable frequencies subject to stop and go speeds dictated by congested traffic conditions, or whether they will have the choice of a modern rail system operating air-conditioned trains at frequent intervals on its own fully separated right-of-way...

Continuation of the all-bus transport system will cost money and inconvenience.

The proposed MRT will initially cost more to implement but will provide the convenience and reliability necessary to support the high density development of Singapore in a manner that will further enhance the effectiveness of the urban structure and the attractiveness of Singapore as a modern international centre. (Wildermuth, 1980b)

A further round of studies took place, which added little to the previous positions of opposing teams. By this point a Provisional Mass Rapid Transit Authority had already been established and, in 1982, the government gave the go-ahead for MRT construction to begin, with a budget of S\$5.3 billion (S\$1 = US\$0.63 as of 21 May 2006). As Tan Cheng Bock, MP, said in an interview for the current study, the Singapore government took a perspective to "go for the long term", for which rail had greater appeal. Rail "fitted into the development plan for Singapore. For Singapore to remain competitive, we need good infrastructure". As a senior member of rail operating staff also interviewed summed up the decision-making, the MRT was "not built for transport, but as an urban development project".

A new Mass Rapid Transit Corporation was established on October 23, when groundbreaking took place on 67 km of MRT with 42 stations on north-south and east-west lines (Mass Rapid Transit Corporation, 1988). Initial service commenced in late 1987, operated by the SMRT, initially a wholly government-owned company. SMRT was expected to provide service on commercial principles, but without the expectation of having to pay for capital cost recovery except for operating assets (such as trains), and with the advantage of tax-exempt status (Phang and Walder, 1999, p. 5).

The full 67 km initial system was completed in July 1990, ahead of schedule and on budget. Initial ridership fell short of the projected 800 000 average weekday passengers during the first year, but reached that level by 1995. The first addition to the original network, a 16 km line to Woodlands on the north coast opened the following year (Willoughby, 2001, p. 127).

A World Class Land Transport System

The next major step in transportation system development took place in 1995, with the merger of agencies involved in planning, development, implementation and management of land transport into a new LTA, followed shortly afterwards by publication of a government white paper on 'A World Class Land Transport System', which was to be implemented by the LTA.

The white paper put a priority on the integration of land-use and transport planning. It called for concentrating the highest density developments around major transport nodes such as MRT stations, with developments structurally integrated with MRT and other transport modes (see Figure 3). Where possible, the

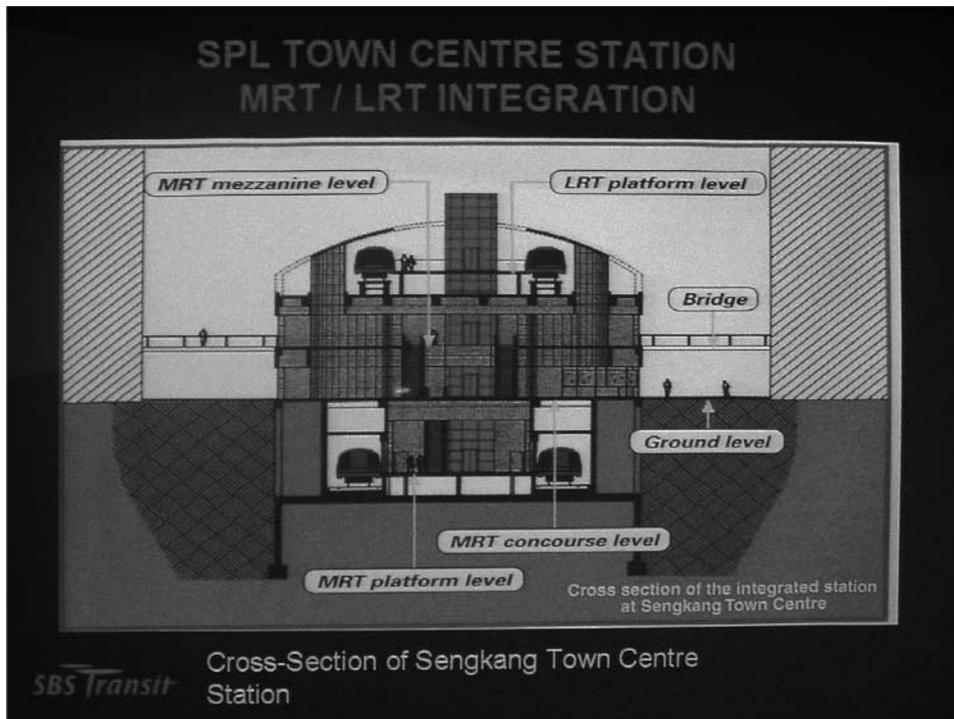


Figure 3. Example of land-use—transportation integration in Singapore.

paper said, developments should be built on top of or adjacent to MRT stations. HDB estates should also be integrated with transport, with Light Rail Transit (LRT) services circulating through areas of housing and providing connections to MRT hubs (LTA, 1996, pp. 14–18). The white paper planned for building up the public transport network to provide access to services within walking distance. Where public transport was not actually integrated with building developments, footpath links were to be provided to make walking more pleasant (p. 8).

The white paper called for the provision of “a comprehensive range of public transport services, each being developed to the highest quality commensurate with the fares charged, and which are so well-integrated that for the commuter, it offers a seamless journey”. Services were conceived of in a hierarchy, with:

MRT to serve heavy transit corridors; LRT systems to serve as feeders to the MRT network; [and]; Buses to continue serving the less heavy corridors to complement MRT-LRT network; Premier bus services like BusPlus to provide higher grade of bus service; and Taxis to provide car-like services. (LTA, 1996, pp. 6–7)

The paper outlined a number of desirable improvements to bus services, but put a greater emphasis on expanding the rail system.

While an efficient and comprehensive bus network is adequate to serve the lighter corridors, buses cannot be the solution for a compact city like Singapore. This is because their service levels deteriorate sharply once demand exceeds a certain threshold. For compact cities, the only acceptable

solution is a good rail network. Only rail can offer services with high frequency, reliability, speed and comfort. (p. 44)

The paper gave plans for extending the 67 km MRT system to 160 km of MRT and LRT, with LRT to serve as feeders to the MRT network. "The LRT's comparative advantage over buses is the capacity for higher frequencies, greater reliability and the sense of permanence although it is more costly" (p. 46).

The white paper established a financing policy "based on the concept of partnership. The Government provides the transport infrastructure, commuters pay for the operating cost, while operators extract efficiency dividends within the service standards and fare structure approved by the PTC" (p. 58). The market test for deciding whether to proceed with projects, once benefit-cost analysis had shown that social benefits were expected to exceed total government lifecycle costs, would be a project's ability to at least break even on operating costs. "The LTA will implement projects so long as they meet this hurdle rate" (p. 59).

A change of policy on operating asset replacement (for items such as rolling stock) was announced. Operators would now have to pay for only the historical costs of replacing assets, instead of the full costs, with government providing for inflationary cost increases. This change would moderate fare increases and "will also render viable some rail projects which under the existing terms are just short of being viable ... LTA will review the outstanding rail projects, especially the North East Line, in the light of this revision, and implement those which are now viable" (p. 61).

The white paper described the government's intention to spend S\$1.1 billion over the next five years to expand the road network by 225 km, to include new expressways, expansion of major arterial roads and upgrading of key junctions (p. 20). It also gave a commitment to retaining quota controls on car ownership (to be described below), to be accompanied by the introduction of extensive Electronic Road Pricing (ERP).

As of 2006, S\$11.8 billion had been spent to build a 109 km MRT network. Three housing estate circulator LRT loop systems, opening in 1999, 2003 and 2005 and connected to MRT stations at Choa Chu Kang, Sengkang and Punggol, respectively, cost an additional S\$1279 million in capital costs, and added an additional 29 km of route (*Source: LTA*).

The most controversial of the projects was the S\$4.6 billion 20 km 16-station North East Line, opened in 2003, following repeated delays due to problems with automation systems. The line features automated driverless trains which cannot operate on the remainder of the MRT system. It was constructed ahead of expected housing and commercial development. Average ridership and revenues have been below expectations, and insufficient to cover operating costs due to a lack of demand for housing, and resultant slow progress in developing land close to MRT stations. Additionally, the project has been ineffective in getting cars off the roads: only 5% of ridership consists of former drivers, with the vast bulk of passengers former bus riders.

Figure 4 shows the MRT and LRT systems open as of May 2006, together with further new projects under development.

Operating Public Transport Services

The PTC was established in 1987 as an independent regulatory authority to approve bus services, regulate bus service standards and approve bus and train

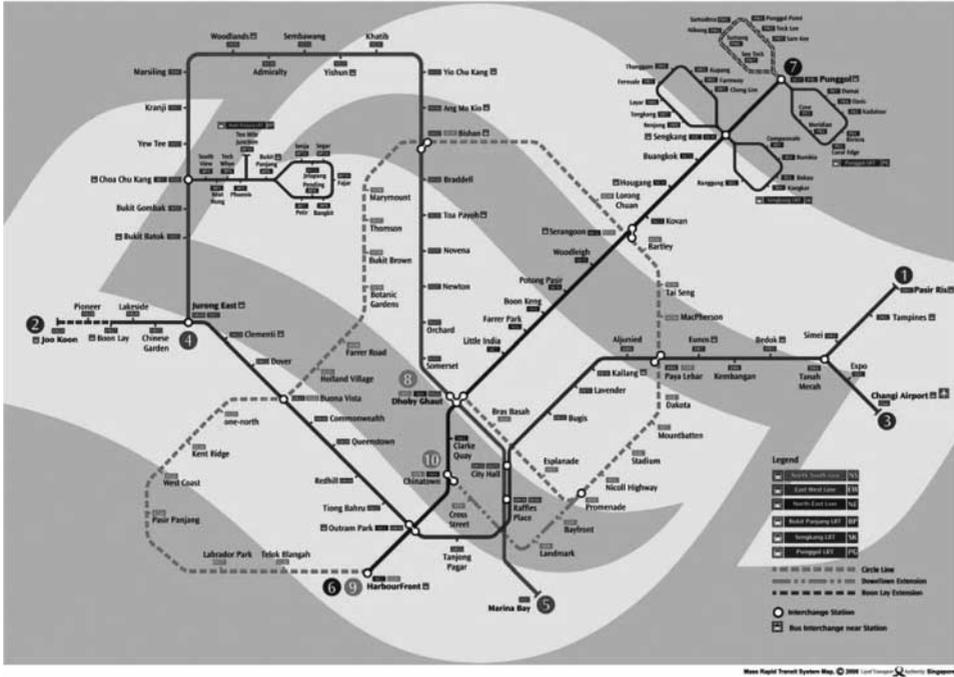


Figure 4. MRT and LRT systems as of May 2006.

fares. The council's fares policy has counted on cross-subsidization, with regular bus service required of operators even when ridership is low, and fares on low-density routes restrained. Bus service standards are applied using 19 attributes in six areas: reliability, maximum loading, safety, availability of service, service integration in HDB towns and passenger information.

As of 2006, the basic bus system comprised 256 routes operating over 1900 route km (PTC, 2006a, pp. 20–21). The PTC requires direct connections to link HDB towns to the three major central corridors. With few exceptions, all developments in Singapore must be served by a bus service within 400 m. Service must be provided between HDB neighbourhoods and a nearby bus interchange or MRT station. Loadings must not exceed 95% of total bus seating and standing capacity. Service, even on low-demand routes, must operate at least every 30 minutes, and many other quality standards apply (PTC, n.d., a).

There are currently two multimodal operators licensed by the PTC. SBS Transit operates the new North East MRT line and connecting light rail services, while SMRT operates the remainder of the MRT and LRT services. Each company also provides extensive bus services in separate operating territories, with duplication of services not allowed as a form of compensation for the non-market conditions on fares and services applied by the PTC. SMRT is a publicly listed company in which the government holds a controlling share. SBS Transit is a subsidiary of Comfort DelGro Corporation, whose other businesses include taxi services, vehicle inspection, insurance brokerage and outdoor advertising (Comfort DelGro, n.d.).

Over the period 1997–2004, daily travel demand increased by 10%. Overall public transport ridership increased at a much lower rate, 0.7%, while private travel in Singapore increased by 26%. The overall public transport mode share fell

Table 1. Public Transport Ridership, 2006

	Average daily ridership in thousands
Rail services	
SMRT	1182
SBS North East Line	226
MRT subtotal	1408
LRT	74
Rail total	1482
Bus services	
SMRT	746
SBS	2087
Bus total	2833
Public transport total	4315

Source: LTA.

from 63% to 58%, and the am peak mode share fell from 67% to 63%. Table 1 summarizes public transport ridership in 2006 (Source: LTA).

Analysis of public transport policy in Singapore. Singapore has achieved remarkable results in transforming its public transport system from a set of dilapidated and mismanaged buses to a modern, high-quality operation. In addition to building a high-comfort, high-service level MRT, its bus fleet has been modernized to provide air-conditioned comfort and reliability.

The fact that with almost S\$12 billion of investment in rail systems, almost double the number of passengers were carried by bus services as on rail in the year 2006 is, however, notable. While rail services play an important role in transporting passengers in the most dense transport demand corridors, the bus system provides mobility for a far greater variety of trips dispersed throughout the main island of Singapore. Yet, despite the government investment in rail systems, bus systems have been seen as the responsibility of bus-operating companies, and the lack of comparable public support shows in continuing unmet needs, which remain best served by taxi or private automobile transport.

The starting point of the MTS study was a design emphasis on 'high-speed' and 'high-capacity' for carrying principal work-related heavy volume flows, and not on directly serving the multitude of more dispersed personal trips for which the private car is particularly convenient. The subsequent decision-making over building MRT versus bus-system development was staged as a theatrical fight between opposing teams of technical experts. The rail system appeared to offer the certainty of reliability and control, while the experts backing rail evoked the threat of buses having trouble handling crowds and causing congestion in the central area, leading to a loss of control.

In comparing the proposed "modern rail system operating air-conditioned trains" which would "support the high density development of Singapore" to "overcrowded, hot buses at unreliable frequencies", Wilbur Smith framed the debate as one of progress as against obsolescence, of nationbuilding as against decay, and insisted that the bus system proposed by the Harvard critics "will not be more comfortable or more reliable than what exists today". Given the only available imagery of buses in Singapore coming from the existing deficient

system, it was hard to argue that a system with more buses, however different the service, could be the equal of a new state-of-the-art rail system.

Arguments on the inherent superiority of rail spilled over into the 1996 white paper. By that stage, however, Curitiba, Brazil, had instituted its high-volume bus rapid transit service on exclusive lanes and with service characteristics similar to heavy rail, but at substantially lower public investment costs. The argument between rail and bus was over more than just service, however. The white paper referred to the 'sense of permanence' of rail—it is as if a rail network supplies a series of physical conduits to funnel traffic in disciplined ways which reinforce the functionality of the urban hierarchy, while a bus system lacks physicality in its presence, its very lack of rigidity a risk that it might go away. Rail has thereby been seen as a development tool to connect desired centres of concentration. In this way, the North East Line could be justified in the absence of current demand: its placement would facilitate and stimulate the development to come in the future.

However, a great many new towns were in place well before MRT construction was started, and land-use control and development powers available to the Singapore government were more than sufficient to lay the pattern for new regional and subregional centres without the necessary requirement of rail.

That rail is also seen as a symbol of a high-tech 'Smart Singapore' is clear from the decision to choose a driverless technology for the North East Line. As one industry expert close to Singapore rail decision-making commented, not only was the new technology—which was favoured at senior levels at the LTA—more expensive to build than a conventional system and incompatible with the rest of the MRT, but also it required far more rules and procedures and was "very complicated, very difficult to maintain, doesn't give you flexibility in operation".

The LRT (actually driverless people mover) technology, which provides circulation services around HDB estates, also has a modern image, but, for many trips, delivers services inferior to those offered previously by buses. Running on elevated fixed loops around estates, services are more frequent, but less direct, and require greater walking to gain access than forerunner bus services which were discontinued. Loss-making LRT services have replaced profitable bus operations, although some of the bus services have, in fact, since been restored due to public protests. Connections between LRT and MRT, and to provide access to and egress from the MRT, also require considerable amounts of walking, as compared to what might have been achieved with an alternative bus system.

A 2004 LTA-stated preference survey found that the need to transfer between LRT and MRT made the journey seem 7 minutes longer than it really was, while someone having to transfer both between MRT trains and from the second MRT train to LRT experienced a time penalty of 11 minutes. Transferring between buses was found to add four minutes to perceived journey time; from bus to MRT five minutes; and from bus to MRT and to bus again, an extra nine minutes compared to the actual journey time. The results indicate the negative impact on the attractiveness of public transport journeys when transfers are required (*Source: LTA*).

The decision to provide capital support for MRT but regard buses as mostly an operating company responsibility has had repercussions. Bus coverage in Singapore is wide, compared to service in neighbouring Asian countries; some



Figure 5. LRT service through housing estates.

buses provide service via expressways, an extensive network of bus lanes and bus signals helps speed bus services.

Bus operations have also benefited from upgraded interchanges with MRT, which have been provided at government expense, as are all-bus stops and bus bays. Most bus operations nonetheless retain the traditional pattern of local all-stop services. An emphasis is placed in feeding MRT systems with improved access to central Singapore at the cost of less convenient peripheral connectivity. Despite the availability of some cross-island bus services, innovations to bring new direct and limited-stop bus services have generally been lacking. Exclusive busways and bus rapid transit have not been developed, while more extensive use could be made of expressways for bus operations.

Compared to journeys generally funnelled efficiently towards the urban core by the hub and spoke system, trips between suburban points by public transport often require complicated transfers, are lengthy and indirect. Opposition Member of Parliament, Low Thia Kiang, said in an interview: "My question is, will you provide a transportation system that is convenient enough to travel without owning a car? It is inconvenient. Many a time you do not have direct access. You have to take a bus to the terminal."

Tan Cheng Bock admitted that "My constituents are grumbling because bus routes are diverted, but that is to meet the rationalization of the system." His views were echoed by a different LTA official: "You cancel one bus route, and a few hundred people will cry. The government has to find the solution that is best for the country." The official said that he personally drove to work because the trip by public transport was not direct: "I don't like to take the MRT because you have to change." These statements reveal the Singaporean emphasis on a conception of system efficiency over convenience, of benefits to society rather than to individuals.

System efficiency, in turn, is conveyed in mechanistic terms of physical design as demonstrated by the 'well oiled machine' exhibit. Light rail efficiently offloads passengers onto MRT to be conveyed at high capacity, as flows of oil moving rapidly through a system of pipelines, where the convenience of a particular molecule of oil does not really matter so long as it ultimately arrives at its required destination. The hierarchical structure of the system has an obvious appeal in terms of efficiency and control, yet it pays little attention to the complexity of travel demands on an island where only one in ten people (about a third of households) owns a car.

Had the decision been made to go, at least initially, with an improved all-bus approach using expressways and bus-priority facilities wherever possible, the bus system might have been reformulated and upgraded with a pattern of high-quality islandwide direct point-to-point connectivity. The goal of channelling as much travel as possible via the highest density corridors has instead created many indirect journeys, requiring transfers and extending total travel times. With a strong bus system in place, MRT might well have still had a role, but the system would have been smaller than the one built, and MRT would have been focused on the highest density corridors, with a higher return of social benefits to government investment costs.

Singapore's urban structure is deliberately tied to the MRT. While HDB estates have their own shopping centres to try to remove the need for any motorized transport for basic daily shopping, an emphasis on links to the nearest regional activity centre is designed to focus both employment and commercial activity locally and, in turn, encourage further travel reduction. A 2001 study of households in the East Region, of employers and employees in the Tampines Regional Centre and of shoppers in that Regional Centre and three town centres, however, showed that labour and trade catchments were islandwide. "The planners' vision of a one-to-one worker-resident population match on a regional basis is an ideal that could not be realistically attained, given the extensive cross-country movement in a country that is small and where the transportation system is good and inexpensive" (Malone-Lee *et al.*, 2001, p. 52, 54).

A priority given by the HDB to building up relatively distant settlements together with bureaucratic restrictions on housing resale and relocation had the effect of increasing average commuting distances (Phang, 1992). Keeping more people in the Central Area and placing relocated households nearer to the Central Area would have reduced the volume of longer distance journeys (Willoughby, 2001, p. 133).

Given the reality of islandwide transport demands to reach employment or shopping, to visit family or friends, and to gain access to educational, health and entertainment facilities, development of bus services emphasizing point-to-point connectivity would have made public transport relatively more attractive for dispersed trips. The MRT is seen as an instrument of control: to shape and restrict opportunities, rather than providing choices between them. But giving such a control function to public transport means encouraging the use of private transport for journeys that are not well-served by the controlling mechanism or imposing inconvenience on those who have no choice but to use public transport.

The PTC is made up of a panel of selected professional members (some with expertise in transport, others more broadly selected) which meets privately, and with little input from the public which might lead it to change its emphases or carry out major reforms. The standards enforced by the PTC, furthermore, have

permitted the operation of lower quality services by buses than by rail. The PTC loading standard, for example, leaves operators free to design service with excessive peak hour crowding, rather than encouraging them to think about how to design a service likely to be attractive to the widest base of customers.

Service frequency on many lines of 15–20 minutes means long waits, and such waits are extended by a lack of reliability in operations. The PTC requires no more than 85% of departures from terminals to be more than five minutes off-schedule, but does nothing to require timekeeping while en route. Timekeeping is therefore often poor (a survey by the Consumers Association of Singapore conducted at 338 bus stops found that 25% of services did not adhere to scheduled frequency), and the bus operators have a disincentive to publish timetables which could be benchmarked to provide evidence of their inadequate performance (*Source: Consumers Association of Singapore*).

Information on services offered to the travelling public is fragmented both because of competitive pressures between the two operators, who fail to provide information about each other's services, and because of a lack of effectiveness of the Transitlink service, jointly owned by the operators and required to provide integrated information.

The lack of geographical overlap for much of the operations of the two bus-operating companies has removed the discipline of competition. Reluctance on the part of the PTC to increase fares, together with the requirement for each operator to provide service within 400 m of every development, has created loss-making services, furthermore. With profitable trunk bus lines subject to compulsory discontinuance when they compete with new MRT services, the



Figure 6. High-tech driverless trains for the North East Line.

negative financial impact of the requirement imposed on operators to support loss-making services from profitable ones has intensified.

Cost-cutting to meet the burden of such losses, rather than experimenting with innovative services, has therefore become the number one corporate priority. As one individual connected with operations said: "Most of the innovation in public transport is where people try to reduce costs. For every dollar that we save, we get all of it. We try to achieve low-cost leadership." As an example of cost-saving innovations, bus operators have invested in fleet management systems which enhance the efficiency of operations.

As long as a bus reaches within 400 m of every development, and service connecting to MRT is provided, there need be little concern about the range of other destinations served. This has resulted in a focus on connections through Singapore's central place hierarchy, and trips which require transfers between buses and MRT, rather than the development of extensive direct operations.

The rigidity of the PTC's service standards serves to deter innovation. The PTC did announce tendering for additional operators to provide services to HDB estates on an experimental basis in 2004, but it also required applicants to meet the same universal service standards as the existing major service providers. Not permitted to offer services to simply fill in existing gaps, rather than to reach within 400 m of every residence, no applications to provide additional service were filed with the PTC.

A recent new initiative, effective February 2007 (PTC, n.d., b), however, allows for the operation of 'premium bus services' which may duplicate basic routes so long as all passengers are provided a seat and fares at least 1.5 times higher than on regular routes are charged. This is currently attracting far more interest from operators (with 81 applications as of June 2007, with 26 approved), although services implemented and under development are of low-capacity and constrained in their attractiveness by service hours which are often limited (frequently just a few runs) and by the high-fare requirement.

A bus passenger satisfaction survey conducted by the PTC in 2006 found that 80% of respondents were satisfied with basic bus service (PTC, 2006b). SBS has conducted its own passenger satisfaction surveys, which have consistently shown the importance of passengers of keeping down travel time and a preference for avoiding the need to transfer (*Source*: SBS). All of these surveys, however, focus on passengers already using bus services rather than on those who decide to travel by car and for whom the indirect and slow nature of most bus service is an inherent detraction. For car-owning households, car-use made up 66% of mode share in 2004. The average speed of a car trip in that year was 24.5 km/h, compared to 14.8 km/h by rail and 9.1 km/h by bus (*Source*: LTA).

Change is needed if the currently falling modal share of public transport is to be reversed. Perhaps the key to bringing about such a reversal is to learn how public transport can be given the characteristics that make car-use attractive. Small vans and minibuses at regular fares could potentially offer attractive dispersed services not tied to the urban hierarchy (from one housing estate directly to another for example, or from a housing estate on one side of the island to a centre on the other), and could also have a role in providing relief for and supplementing loss-making buses, but such innovations would require a relaxation of the current protectionist regulatory system.

The Singaporean policy that government should pay the capital costs of what then become self-sustaining rail systems has led to a misallocation of resources.

The principle has already been breached by the decision to cover the inflationary elements of operating asset replacement. Even before consideration of this additional unanticipated government cost, however, the policy implies an erroneous belief that operating funds are somehow intrinsically different from capital cost investments. To economists, money spent in any way has an opportunity cost: devoting resources to constructing rail is a real decision not to make them available to other projects which might require operational support. Effective economic decision-making should take account of the full set of lifecycle costs and benefits of all options, and not exclude lower capital-cost options merely because their operation might require an element of government support.

A classic example of the failure of government financing and regulatory policy comes in the decision to discontinue direct MRT service from the airport to the central area. SMRT argued that it was losing money on the service, and was therefore permitted to replace it with a shuttle link, requiring a transfer between trains at a suburban station, and inconvenience to airport passengers. The financing system did not permit the government to offer a subsidy to the rail operator to maximize use of a facility in which the government had made a substantial investment.

The delay to open the Buangkok station on the Northeast MRT, completed in 2003, provides a further illustration. The operator, SBS Transit, was allowed to keep the station closed despite the government investment in making the station possible, on the basis that they could not cover their operating costs in the absence of enough commercial or residential developments within 400 m of the station. In a rare humorous public protest, eight cut-out cardboard white elephants were placed on the road to the station to coincide with a visit to the neighbourhood by a government minister. The police investigated this action as a violation of the Public Entertainment and Meetings Act, adding to the newsworthiness of the protest, which succeeded in securing the opening of the station in January 2006, if not in convincing the police that humour was acceptable: the police once more intervened, to warn a group of 16-year-old schoolgirls trying to sell t-shirts decorated with white elephants and the words 'save the white elephants' for charitable fundraising at a carnival celebrating the station's opening, that they needed a fundraising permit and that wearing of t-shirts en masse could be misconstrued by some as an offence under the Miscellaneous Offences (Public & Order and Nuisance) (Assemblies and Processions) Rules (Channelnewsasia, 2005; Wikipedia, n.d.).

Beyond these examples in the rail sector, the Singapore government's departure from classic economic systems of evaluation and decision-making has kept public funding from supporting bus operations which might have promised a higher social rate of return than more costly capital investments. Not only do operators have little incentive to take risks using their own resources, but government subsidies are not available for operational innovations, such as the introduction of direct-service vans and minibuses on a wide range of low-density routes or for experiments with new types of expressway services. Instead, if new services an operator might put on trial prove to be financially insolvent, they promise to become a liability to the company, should the PTC forbid discontinuance.

The bias of the LTA financing model to capital as against operating expense subsidization, and its failure to be equally applicable to all modes of public transport, puts low-cost but potentially high-return innovations out of reach. The result has been both an overinvestment in rail services and inadequate support

for the bus services used by almost double the number of passengers who travel by rail.

Restraining Traffic in Singapore

Beginnings—The Area Licensing Scheme

Singapore has 3100 km of well-maintained roads and 150 km of grade-separated expressways, and has put a greater emphasis on road-building than would now be found in many European cities (May, 2004, p. 89), but its population of 4.2 million, as of 2003, owned only 400 000 cars (*Source: LTA*). This level of motorization is typical of countries with one-third to one-half of the income levels prevailing in Singapore (Willoughby, 2001, p. 125). Low-car ownership is a result of the nation's quota system that restricts the volume of vehicles licensed to use Singapore's roads to sustainable levels which keep away the traffic and environmental problems that plague so many other major cities in the region. In addition to policies to restrict ownership, electronic pricing helps manage the volume of vehicles present on the road system at any one time to prevent congestion building up.

The use of pricing to restrain car ownership and use began with the Additional Registration Fee (ARF), introduced by the colonial government in the late 1950s to bring in revenue. The new Singapore government increased the ARF rate in the 1970s with the new goal of discouraging car purchase, and the rate reached 100% of vehicle market value in 1975, the year in which the Area Licensing Scheme (ALS) was introduced (Willoughby, 2001, p. 126).

The ALS was the product of deliberations of the Road Transportation Action Committee (RTAC) formed by the government in 1973 and consisting of representatives of relevant ministries. RTAC concluded that congestion would increase seriously by the 1990s unless measures were taken to impose restraint, reviewed a number of options and chose a relatively simple approach that could be implemented quickly (Gómez-Ibáñez and Small, 1994, p. 14).

ALS required purchase of an area licence, available on either a monthly or daily basis, to enter the central area during the morning peak (it was later extended to cover all weekday entries from 7:30 am to 6:30 pm and Saturdays from 7:30 am to 2 pm). Manual enforcement was instituted, with observers monitoring vehicles passing each entry point. The initial daily rate was S\$3, with cars carrying four or more passengers exempted (a concession which was later dropped).

The initial fall in traffic entering the central area during the morning peak was 44% compared to the expected 25–30% decrease. In fact, speeds during the peak rose to levels higher than the off-peak following introduction of ALS, with congestion shifted to just before and after the peak, a problem addressed by extension of the hours of ALS applicability and the introduction of lower cost off-peak licences (Toh and Phang, 1997, p. 25; Lew and Yong, 2000, pp. 4–6; Willoughby, 2000, p. 10, 2001, p. 131).

The share of bus ridership for trips to work in the charging area increased from 33% before licensing implementation to 46% in 1976, while the share of journeys by car fell from 56% to 46% over the same period. While traffic speeds in the charging area increased by 22% to about 30 km/h, ring road speeds, affected by traffic using them to avoid the charging area, fell by 20% to 19 km/h (Gómez-Ibáñez and Small, 1994, p. 16; Lew and Yong, 2000, p. 5).

In 1989, the scheme was extended from its focus on car traffic to include all classes of vehicles, including goods vehicles and motorcycles (but excluding buses and emergency vehicles) in order to curb increasing traffic (Lew and Yong, 2000, p. 5). A 1991 survey showed that 46 000 vehicles were entering the central zone, compared to 74 000 prior to project inception (Yap, 1993, p. 41), a period in which the vehicle population increased by 93.4% (Foo, 1998, p. 29). Capital costs for the initial ALS in 1975 came to S\$6.6 million, with revisions in 1989 adding an additional S\$.17 million. Revenues from the sale of area licences came to S\$47 million in fiscal year 1993, with expenses coming to only 9% of revenues, and a substantial surplus contributed to government general funds (Phang and Toh, 2004, p. 20).

Fine tuning took place several times during the duration of ALS, which ended in 1998 with the introduction of ERP. The charging area was redefined, and the definition of vehicles subject to charging, hours of operation and pricing were all changed (the daily charge for cars was increased at one point to S\$4, then to S\$5 and restored to S\$3 at a later point) as government planners received data on the impacts of the project in progress and sought to eliminate deficiencies and ensure its continuing success. A new bypass expressway was also built to help relieve increased traffic on ring roads.

Thus we see the power of a talented technocratic bureaucracy to strive for maximum performance unfettered by the need to undertake politicized and potentially highly disruptive processes of public discussion. It should be noted that 'feedback' from the public was obtained at various stages and resulted, for example, in institution of park-and-ride shuttle bus services (Lew and Yong, 2000, p. 4). But the feedback was just that: input to smooth the operation of a project instituted by the government on the basis of technical efficiency, rather than to shape the nature of policies that bring about government action.

In June 1995, the Road Pricing Scheme (RPS) was introduced as an experiment with expressway pricing and extended to two further expressways in 1997. An LTA survey in 1997 showed that about 16% of prior users of the three facilities stopped using them, although increased congestion was experienced elsewhere (Goh, 2002, p. 32).

Other policies to discourage car usage during the first period included increases in central area parking costs and the imposition of high gas taxes, enforced with a law requiring cars leaving for Singapore to Malaysia to have their tanks at least half-full, changed later to three-quarters. Later on the same day that this rule was imposed, Parliament passed another law making it illegal to drive a motor vehicle with a faulty gas gauge (Toh and Phang, 1997, p. 27).

Electronic Road Pricing

As of 1 September 1998, Electronic Road Pricing (ERP) was introduced to replace both the ALS and RPS. The system provides for regulating access to controlled areas, with charging gantries at entrances to pricing zones. It also prices linear passage on roads and highways.

The system has four principal advantages compared to ALS: (1) it is easier to assign different rates to different vehicles; (2) it is easier to change rates and permits charges to be readily changed by time of day, depending on congestion level; (3) it is easier to change the hours of operation; (4) and it is relatively easier

to include more areas under pricing, by simply adding an extra gantry to target new localized congestion (Menon, 2000, p. 41).

Under the ERP regime, each driver is required to have a charging device, into which a smart-card is inserted and from which charges are deducted. Only fire engines, police cars and ambulances are exempted from ERP charging. The charges are modest and set so that there is neither congestion nor underutilization of roads (Menon, 2000, p. 42).

Assisted by a Nanyang Technological University Study (Centre for Transportation Studies, 1995), the LTA determined that expressways should operate optimally at 45–65 km/h and arterials at 20–30 km/h. Speeds are measured at half-hourly intervals for roads in the central area and for other priced roads. If the speed exceeds the upper limit of the speed range desired, the ERP charge for cars is reduced by 50¢ for the half hour in question. If the speed falls below the lower end of the range, an increase of 50¢ is imposed. Charges are adjusted every three months. There are some half-hour periods when there are zero charges, and ERP in the central area has been abolished on Saturdays (Menon, 2004, p. 64).

In almost all cases, ERP results in lower charges than would have been paid under ALS (Menon, 2000, p. 42), with charges as of 2003 ranging from 50¢ to S\$3 per gantry passed (Menon and Chin, 2004, p. 64). Monthly revenues from ERP fell to about 60% of those under the ALS/RPS schemes (Lew and Yong, 2000, p. 12), while the daily reduction in vehicles entering the central area after one year of operations on August 1999 was 15%, and the reduction for the morning peak period was 16% (Menon, 2000, p. 42). For the month of September 2003, there were a total of 6.07 million ERP transactions.



Figure 7. Buses pass under an ERP gantry. Cameras for violator detection are visible.

System installation charges in 1998 came to S\$200 million. Annual operating costs as of 2003 were about S\$16 million, while revenue came to S\$80 million. Revenue goes to government general funds and is not hypothecated for transportation (Menon and Chin, 2004, p. 63).

The ERP system has the major advantage of making costs transparent. As one of the lead developers of the system for the LTA commented, each time drivers go under a gantry “they feel the pain because they hear the beep”. As Goh (2002, p. 33) says, from a welfare economics perspective, ERP is a rigorous technical mechanism for imposing charges. It taxes away the consumer surplus of those who find the time advantage of car-use less important to permit those who place the greatest value on a rapid journey to travel on a high-performance road system exactly when they wish to, while also minimizing environmental externalities imposed by road vehicle use.

With ERP seen as an exercise in pure economics, buses and taxis are required to pay ERP charges on the basis that they occupy road space and should pay for its use along with everyone else. As one LTA official explained: “we are quite clinical about it. Anybody who uses road space contributes to congestion”. This practice has the effect, however, of driving up the cost of using alternatives to the private car, even though they provide social benefits in terms of carrying people who might otherwise drive alone, benefits which are not included in the charging equation.

This insistence in imposing a rule according to a theoretical principle, while neglecting the larger picture, provides an example of the problems of the rigid imposition of mechanistic principles. It can equally be argued that the existence of bus services results in less congestion and therefore lower ERP fees needed to restrain congestion than were no bus services to be in operation. This is an economically rational argument, in fact, for using ERP fees collected to take account of these reductions by subsidizing the bus services which make them possible.

There have been public outcries from those to be affected whenever new gantries have been installed. “A lot of publicity and feedback sessions have been necessary with the affected users and other motorists before any new ERP gantry was put up” (Menon and Chin, 2004, p. 64). Nonetheless, ERP has improved traffic flows in the CBD, speeds on expressways, and the distribution of traffic throughout the day. Perhaps most importantly, the pricing system achieves efficient use of road space with the imposition of relatively low tolls on motorists, a feature which marks it out from the high-cost Vehicle Quota Scheme (VQS).

The Vehicle Quota System

“When buying a car in the United States, all we need to do is choose a model, complete some forms, and sign a check,” writes Toh (1994). Whereas in Singapore, “when buying a new car, one has to decide well in advance when and where to drive, what size car to purchase, and whether it should carry a private or corporate license plate. Then one bids for the license to own a car, waits for the results of the auction, and, if successful, pays upwards of S\$60 000 for a sub-compact! And ten years later, one probably has to undergo the same gut-wrenching experience all over again” (Toh, 1994, p. 68).

While the ALS project restrained traffic in Singapore’s Central Area, it did not sufficiently deter increasing car ownership. Rising ARF fees, together with import

duties and registration fees, did not prove a deterrent either, and the Singapore government sought next to ensure that the vehicle population was controlled to a sustainable level through the imposition of quotas on car purchase. On 4 August 1989, a Member of Parliament with a PhD in Economics, Hong Hai, who came to be known popularly as 'Dr. Quota', was the first to raise the possibility of vehicle quotas in Parliament. The same day a Select Committee on Land Transportation was appointed by Parliament (Phang *et al.*, 1996, p. 147).

The committee held hearings during which the majority of views supported usage restraint, such as ERP. However, a report for the committee by two economists from the National University of Singapore proved to be most influential. This study computed that the income elasticity of demand for cars was around 1.0, compared to a price elasticity of -0.45 ; in other words, a 10% increase in income would stimulate a 10% increase in car purchases, while a 10% increase in price would result in only a 4.5% fall in demand (Phang and Chin, 1990).

The committee felt that ownership control was essential (Olszewski and Turner, 1993, p. 358). As Hong Hai, who chaired the committee, said in an interview for the current study, the objective was to "restrict the number of vehicles to a level commensurate with the capacity of the roads. The simple way to do this was to see how many new cars we felt should be added to the road population, and have people bid ... The idea is that you have a limited supply [of road space] and you have to pay a market price" for the privilege of owning a car to use on the road system.

The committee recommended requiring Certificates of Entitlement (COEs) in order to purchase a car, the level of car purchases available each year to be set by the government and to be competed for through a bidding system. "It was the simplest method," said Hong. "It achieved what we wanted." Under the quota system, all vehicles except scheduled and school buses and emergency vehicles were subject to quotas to be allocated by auction. The auction system was thought most equitable because the vehicles would go to owners willing to pay the most for them, thus maximizing economic measures of societal social welfare (Toh and Phang, 1997, p. 28). Winners all pay the lowest successful bid tendered, and receive a COE, valid for ten years. Seven categories of certificate were established to cover different vehicle types and engine capacities. The system came into effect as of 1 May 1990.

Problems occurred during the first years of quota implementation, including speculative activities as quota prices headed upwards, and undue control of the market by dealers who sold cars as investments: they assured customers that a new car would have even more value when sold used two years later as a result of quota price increases. In late 1994, COE premiums for two categories of cars exceeded S\$100 000 for the first time, leading to a strong public perception that dealers were manipulating the COE market.

The Minister of Communications announced in parliament that two experiments would be conducted to address problems with the COE. A 22-member 'Committee to Discourage Double Transfers' was established, precipitating a plunge in all COE prices. On the subsequent recommendations of the committee, a set of measures to curb speculation, including a total ban in transfers within three months after the registration of a car, was introduced effective 1 April 1995 (Phang *et al.*, 1996, pp. 149–150; Toh and Phang, 1997, pp. 28–29).

Willoughby summarizes the impacts of increases in acquisition taxes in the 1970s and 1980s and then, additionally, of VQS in the 1990s. The price of a typical

medium-sized car rose from 130% of the cost, insurance and freight value of the car in the early 1970s to 400% and above in most of the 1990s (Willoughby, 2001, p. 127).

An Audit Panel, reporting in 1997, Hasegawa *et al.* (1997) suggested reducing controls on car ownership while implementing more intensive control of car usage (May, 2004, p. 86). In February of the following year, the government announced a review of the VQS following implementation of ERP, and appointed a Parliamentary Vehicle Quota System Review Committee to perform the task. The committee noted that VQS had kept vehicle growth to the government-planned 3% per annum, compared to the average of 6.8% in the three years prior to implementation as a result of which "traffic would have grounded to a halt and our economic development and quality of life would have been severely affected" (Vehicle Quota System Review Committee, 1999, p. 2).

Looking at alternative possible policies, the committee found that restricting parking or making it more expensive would bring problems such as illegal parking or excessive cruising by drivers searching for a parking place. The committee also rejected ERP as an alternative to VQS:

... if the VQS were to be discarded and we were to rely only on road pricing to manage traffic congestion, ERP charges would have to be very much higher than today's rates (about \$20 per day) in order to achieve the same level of traffic restraint. A much more extensive coverage of ERP would also be needed. These would have an adverse effect upon businesses, especially transportation or freight forwarding companies and retail businesses in the Central Business District (CBD). Being recurrent and charged on a daily basis, high ERP charges may be more unacceptable than a one-time high upfront ownership cost. (Vehicle Quota System Review Committee, 1999, p. 9)

The VQS should be retained as an effective tool to control the growth of the vehicle population in Singapore. It complements other measures such as the ERP in ensuring that our roads, which are the economic arteries of Singapore, continue to be relatively free flowing for the efficient movement of people and goods. (Vehicle Quota System Review Committee, 1999, p. 4)

The results of a stated preference survey conducted by the LTA in 2004 suggested, however, that much lower increases in ERP than the committee believed necessary could replace the VQS. The survey found that it takes an ERP of \$8 to shift a motorist to public transport. With a 50% reduction in car ownership costs, motorists were found to become more sensitive to ERP, with an increase in ERP charges of only \$4.50 required to offset the total purchase cost reduction and maintain the same impact on shifting a car user to public transport (Source: LTA).

The quota system remains in place, with car prices fluctuating according to a variety of market and taxation conditions. In January 2006, COE prices fell sharply due to a reduction in demand reflecting higher interest rates and the desire of existing owners to hold on to lower interest loans rather than trade-in their cars and face interest hikes. With the fall in COE prices, the value of second-hand cars also falls, furthermore, meaning that many would-be buyers owe more

on their existing cars than they are worth. This creates a substantial barrier to disposal of the vehicle and purchase of a replacement (Onemotoring.com, n.d.).

Following the 2 January 2006 tender, a new Totota Corolla Altis 1.6 sold for S\$56 988, including 20% import duty, a flat registration fee of S\$140, 110% ARF, and a COE premium of S\$8009, a 52-week low. The 52-week high on COE premiums on small cars for the previous 12 months was S\$20 654. Overall car prices had in fact fallen below pre-quota implementation levels for a number of reasons in addition to COE price drops, including increased competition between manufacturers, with Japanese models now made at reduced costs in Thailand; reductions in other tax elements; and increases in total usage costs restraining the demand for car purchase (Phang, personal communication, 2006).

Toh has criticized the price uncertainty caused by the fluctuation of COE prices and, more fundamentally, its effect on pricing a large part of the population out of the market. "The quota system should be abolished ... because it is administratively cumbersome for the government and inconvenient to the car owning public, and is such a drastic curtailment of legitimate middle class aspirations for car ownership" (Toh, 1992, p. 314).

The 1990 Parliamentary Committee chaired by Hong Hai recognized that "[T]he situation acquires social and political dimensions as increasing numbers of Singaporeans view the ownership of cars as an integral part of middle class aspirations" (Committee on Land Transportation Policy, 1990). However, Hai said in an interview:

We didn't think there was an equity issue—if there is only so much available, there is a market price. It is not like schooling, where you are denied a place. Ownership of a car in a land-scarce place like Singapore is a bit of a luxury. If the poor cannot afford a car, the poor can take a taxi ... there are no particular moral or social issues involved. There is only so much space. Not everyone can own a car.

Willoughby analysed the relationship between overall government revenues and expenditures for the road transport sector between 1961 and 1993. He found that total revenues represented about 3% of GDP through the 1980s, when they rose sharply to 5% of GDP, a level more than double the contribution to GDP made by property taxes. The road revenues were at three or four times the level of road expenditures, in some years up to six times, and higher still since 1989 (Willoughby, 2001, p. 130). There is an obvious disincentive to government to relinquish such a substantial revenue stream, available for general use, rather than set aside specifically for transportation purposes. As opposition MP Low Thia Kiang commented: "I think they look at infrastructure as investment, one way of milking money from the people." More accurately, perhaps, the high charges may be seen as a consequence of technical calculation to optimize use of the road system; the benefits to the government from the high revenues, once created, make it hard to let go of them.

It might be easier to relax taxes other than remove COEs from the charging regime, furthermore, because the COE is now built in to the value of cars. Some relaxation has already occurred, with a 20% reduction in road tax in 2002 (Phang and Toh, 2004, p. 23). Abolishing COEs in one go would cause owners of cars bought on credit substantial losses of value and potential financial problems. Any ultimate removal of COE would therefore probably have to be gradual.

Conclusion and Some Recommendations

“Mr. Lee Kuan Yew talks of knuckledusters and nation-building with equal aplomb. If the PAP were to develop and market a computer game, it would be a cross between SimCity and Street Fighter,” wrote the author of *Singapore: The Air-Conditioned Nation* in a *Straits Times* column (George, 2005). ‘Calibrated coercion’ is a source of the PAP’s strength, he said, along with “its outstanding record in delivering the goods, its internal discipline and its ability to win genuine freely-given loyalty from the majority of Singaporeans”. The two concepts go hand-in-hand. Because the Singapore government has provided the island’s inhabitants with an extraordinary degree of material comfort, its role of providing central control has gone largely unchallenged.

Singapore’s land-use—transport policy has created an ordered urban hierarchy of activities. Housing, though high density, is comfortable by design. A modern rail network operates at a high level of service. Policies on road pricing and quota controls on car purchases give Singapore almost free-flowing roads and clean air, making the city-state the antithesis of the polluted, traffic-choked cities common elsewhere in Asia.

Singapore has achieved these results with a civil service genuinely engaged with problem-solving. And while government personnel have powers of control, they are exercised in a climate of professional ethics and public service. The machine-like metaphors of the Air-Conditioned Nation, which have conditioned the functioning of a Singapore bureaucracy heavily rooted in technical analysis, nonetheless impose limitations both in terms of system designs which result from its assumptions and in service to a public which has at best a peripheral role in decision-making.

Because efficiency is sought, an emphasis has been put on technical principles which have been enshrined as planning orthodoxy, as well as on the belief that problems can be solved through physical design and calculation. This has led to a strong belief in the power of expertise to produce optimal solutions. An integrated transport system has thereby been created as ‘a well oiled machine’, but one lacking the human element. Though excellent in many ways, it fails to respond to a range of transport needs.

The rail-based hierarchical system imposes a need for transfers and results in indirect journeys that might not be of consequence were freight being conveyed, but which does not reflect the majority of travel needs. Overinvestment in a rail system to follow the desired physical development of Singapore has been accompanied by underinvestment in bus-system development.

The Singapore government has applied a principle that operations of both trains and buses are to be left to the private sector. An air-conditioning system can be designed to meet predicted needs and then expected to regulate itself to operate with little further outside attention, but this has not held true for transport systems, where a regulated but essentially *laissez-faire* approach to operations has left many unmet needs.

Research is needed to characterize the nature of passenger trip flows in Singapore, including those made by private as well as public transport; to determine public desires for alternative service patterns, both for those poorly served or not currently attracted to public transport; and to design for network changes to provide services closer to the point-to-point connectivity of the private car.

Given the lack of an integrated bus route system, or one which responds effectively to point-to-point demands, a case can be made for centralizing all-route planning and scheduling functions, and putting specified routes and service levels out for tender, as is done in London, for example.

Subsidy-based contracts could be offered by competitive tender to operate low-density services where costs cannot be fully recovered but social needs are served. Such new operations could potentially be offered by contractors operating smart minibuses or vans with service attributes coming close to the private car, and offering a realistic substitution for driving in ways not possible with a network requiring transfers between modes and imposing extended journey times. Such service types could also potentially replace loss-making bus operations, and remove cross-subsidization pressures affecting existing operators.

While much can be accomplished with reformed approaches to bus service delivery, there is also a case for capital expenditures to provide busway and bus rapid transit systems, both as trials for future rail (with the potential to be converted once a certain volume is attained) and as long-term lower cost solutions which would integrate well with improved islandwide bus offerings.

For such desirable changes to take place, fundamental revisions in appraisal and subsidy policy are needed to allow the potential benefits of all projects to be equally evaluated on their aggregate merits without the prohibition of operating cost subsidization which penalizes potentially highly productive low-capital cost projects. Using revenues from sources such as ERP to pay such costs can be justified on economically rational grounds, furthermore, on the basis that public transport services benefit motorists by reducing the congestion and therefore the congestion charges they have to pay.

Road system management has been seen as a technical problem of attaining control over traffic. Unlike the case of public transport, where the answer was seen in creating a system which was expected to thereafter be self-regulating in providing subsidy-free service for the future, pricing roads and cars has been understood as an experimental process. There have been many adjustments made in the operations of both road pricing and vehicle quota systems. The power to make so many changes with such little consultation would likely be available in few other countries.

ERP is a flexible charging system which makes motorists directly aware of costs incurred, and provides a high degree of control with relatively low toll charges. Small changes in prices are effective in controlling demands to use the road system and keep congestion away. In fact, lower prices for ERP have been more effective in controlling congestion than higher prices charged for the previous ALS. The system holds the promise of extension throughout the island as an appropriate means of making all motorists aware of the congestion and environmental costs they impose in real time.

The VQS has been more controversial and remains so. The control mechanism has, by definition, limited the car population of Singapore, but it has encountered many operational difficulties, requiring frequent adjustments and inconvenience to the public. The government, as usual, has put a great weight on technical expertise rather than public opinion in deciding how to proceed on an issue understood as one of a market allocation of scarce resources rather than a social issue. However, there are social consequences from setting prices so high that they restrict car ownership by a large part of the population, particularly when dispersed personal trips are not well-served by public transport. There is an



Figure 8. Loading a North East Line train.

equity issue to be considered, but the government has ignored it by casting the problem in terms of regulating market mechanisms.

Evidence from the recent LTA stated preference survey suggests the Vehicle Quota System Review Committee overestimated the increase in ERP that would be necessary to replace the VQS. In fact, as Phang suggests, increasing the relative role of usage as against car purchase costs, may in itself control demand for purchasing cars as well as for using them. This subject requires further research, as does the potential for the Singapore government to take the risk of letting go of an institutionalized taxing system which provides an absolute guarantee that the car population will not increase beyond the level prescribed, and which additionally provides a great deal of government revenue.

This is an issue which the government might use as a key to changing its relationship with the public. The government has many 'feedback units' to monitor public opinion, which act akin to a rise in temperature adjusting the output of an already-installed air-conditioning system, allowing the hot air to be quickly forgotten. For example, LTA sees the necessity of allowing the public to vent their concerns and to provide publicity explaining planned installation of new ERP gantry charging devices; the meetings are not, however, in place for decision-making purposes: the decision has already been made on technical grounds. The public are treated as young children by a parent: to be looked after well, to be disciplined when they fall out of step, and as too immature to provide useful advice.

Given a highly educated public that is respectful and supportive of the government, Singapore might find its own maturity growing, were it to treat its population as partners in decision-making, rather than subjects required to obey its

policies. The possibility of extending ERP nationwide and reforming or eliminating VQS to permit lower car prices could be widely discussed, with the likelihood that the majority of the public would agree on the need to preserve Singapore's un-congested roads and attractive environment.

Other issues that could do with public airing include the potential to marry revenues from motorists to expenditures on public transport and even, perhaps, to jumpstart the creation of a fleet of shared cars on each HDB estate (see Foo, 2000), to be charged for with the same card as is used to pay ERP tariffs, and which could prove to be sufficiently attractive for occasional personal trips as to make purchase of a sole-ownership vehicle unnecessary. To add an effective consultative to a calculative approach, however, may require a shift in staffing values, to bring more individuals with diverse social science, managerial and humanities educations to civil service leadership positions.

In the end, the obsession with control, and with technical formulas from technical experts, often narrowly and dogmatically applied, has got in the way of improving Singapore's transport system. Transport systems have become machine-like because the humans who use them have been left out of the design. The cult of expertise has put apparent efficiency before usability.

While nobody wants the air-conditioner to fail, as happens in so many Western contexts where excessive processes of public consultation impede useful action, Singapore is in a position to draw in the public and strengthen an already-disciplined process, and to be a more successful as well as more mature country that operates as a team, rather than as a hierarchical family with spoiled but obedient children.

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