

Household Interview Surveys from 1997 to 2008 – A Decade of Changing Travel Behaviours

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Abstract

The Land Transport Authority (LTA) conducts the Household Interview Travel Survey (HITS) every four to five years to give transport planners and policy makers insights into residents' travelling behaviours. About one percent of all the households in Singapore are surveyed each time, with household members answering detailed questions about their trips. A decade of such travel surveys has provided vital insights about the commuting behaviours of Singapore's residents and their evolving travelling patterns. The analyses from 1997 and 2004 HITS (which was subsequently confirmed by the 2008 HITS results) were helpful in understanding some of the challenges and policy issues that Singapore's transport landscape faces going forward. An ambitious Land Transport Masterplan (LTMP) was consequently unveiled in 2008 to address these challenges.

Introduction

Travel is an integral part of life. People choose to travel for various reasons – work, education, recreation, leisure and other social activities. However, travel behaviour is strongly influenced by a country's social and economic development, and understanding the way people travel and their reasons for travelling is vital for transport professionals to formulate transport strategies and policies. Thus, the Household Interview Travel Survey (HITS) is an important information-gathering tool of the Land Transport Authority (LTA) to acquire feedback on the travel behaviour of Singapore residents.

HITS is an intensive process of studying the travel behaviour of every member above the

age of four in the households surveyed. It is conducted regularly, once every four to five years¹, with about one percent of Singapore households distributed across the island surveyed each time.² Detailed questions about the characteristics of trips made in a typical day are asked and these include questions on transport mode, frequency of trips, travel purpose and time of travel, along with other questions pertaining to the respondents' socio-economic characteristics.

Though the HITS is a time consuming exercise, it provides essential information for the transport planners and policy makers in their ongoing work. The information gathered from the surveys gives feedback about residents' travel needs and the adequacy of

the existing infrastructure, and helps transport professionals understand travel behaviour. Analysis of the results gives insights as to how the travel behaviours evolve and allows planners and policy makers to develop strategies and policies to meet these challenges.

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This paper presents a decade of travel survey results from the HITS and highlights some of the changes in Singapore residents' travel behaviour that have been observed. We will conclude with a review of the Land Transport Masterplan which was unveiled by LTA in 2008 and highlight how the earlier survey results influence the development of the master plan and how it addresses some of the challenges arising from the changing travel behaviours.

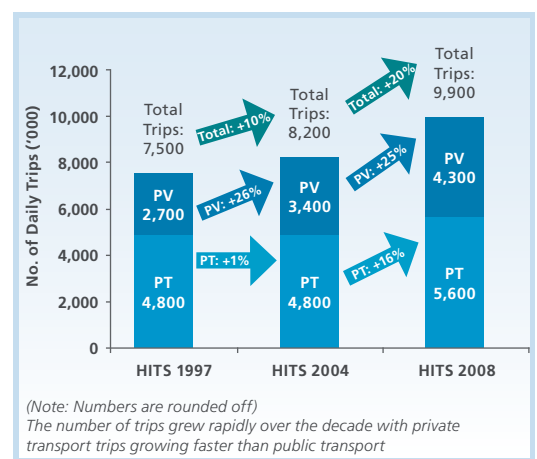
Singapore Residents' Travel Behaviours

Trip generation

With an expanding economy and increasing population in Singapore, it is not surprising to see that travel demand had increased tremendously over the past decade (*Figure 1*). In 2008, an average of 9.9 million trips were generated daily – a growth of 32 percent from 1997, which saw only 7.5 million daily trips. Between 1997 and 2004, the growth rate was only 10 percent (1.3% per annum), while 2004 and 2008 saw a growth rate of 20 percent (4.8% per annum), suggesting accelerated growth in travel demand.

In the same figure, the growth rates of different transport modes were given. Private transport (PV) trips grew steadily; from 2.7 million daily trips in 1997 to 3.4 million in 2004, and 4.3 million in 2008 – an average growth rate of 25 percent between survey years. In the same period, public transport (PT) trips did not as grow much; PT trips grew marginally between 1997 and 2004, and grew by 16 percent between 2004 and 2008. The overall impact of the different growth rates is that PT mode share has actually declined over the past decade.

Figure 1: Daily Trips Generated



There are many reasons for the rapid growth in trips. Key factors affecting trip generation are the pace of Singapore's economic development and the growth in population. According to *Table 1*, Singapore's population had grown from 3.8 million to 4.8 million between 1997 and 2008, a 26 percent increase. Economic activity also grew tremendously during the period, as seen from the second and third columns of *Table 1*. More significantly, Singapore's real GDP per capita

Table 1: Singapore Population, GDP per Capita, Economic Activities and Daily Trips Made

Year	Population (mil)	GDP per Capita (\$'000 at 2000 prices) [^]	Resident Unemployment Rate [*]	Daily Trips (mil)	Daily Trips Per Capita
1997	3.8	36.2	3.5% [*]	7.5	1.98
2004	4.2 (11%)	44.2 (22%)	4.4%	8.2	1.97
2008	4.8 (14%)	48.3 (9%)	3.2%	9.9	2.18

(Note: Numbers are rounded off; figures in brackets refer to the change from the previous period.)
[^] From Singapore Department of Statistics' website (<http://www.singstat.gov.sg/>)
^{*} From Ministry of Manpower's website (www.mom.gov.sg)
⁺ This is 1998's unemployment rate as the 1997 figure is not available.

grew by 33 percent between 1997 and 2008, matching the growth rates in trips, suggesting that there is a close relationship between economic development and travel demand.

However, the increase in trips generated cannot be attributed to economic activities alone. It is found that in 2008, each person made an average of 2.18 trips on a typical day (Table 1), an increase from previous survey years when the trip rates were 1.98 and 1.97 trips per person in 1997 and 2004, respectively. Taking into account Singapore's unemployment rates during the survey years, trip rates below 2.0 are to be expected. This explains why the trip rate dropped slightly in 2004 as unemployment rose. However, as the employment situation improved in 2008,

the trip rate overshot the 2.0 benchmark, suggesting that individuals were making more discretionary trips that were driven by social and leisure activities.

Based on the questions on trip purpose, it is possible to better understand the reasons for travelling. As seen from Table 2, most of the journeys generated are to and from homes and workplaces and for personal business and educational purposes – together they accounted for close to 80 percent of all the daily trips. This result had not changed drastically for the decade. However, a trend observed is that more private vehicle trips were made in servicing passengers³ (pick up or drop off) as the proportion of such trips had increased from 6 – 7 percent (about 500,000

Table 2: Purpose for Travelling (Forward Trips Only)

Purpose	HITS 1997	HITS 2004	HITS 2008
Go home	43%	45%	45%
Go to workplace	25%	23%	21%
Part of work (Travelling on business)	4%	3%	2%
Go to school	8%	8%	10%
Home/Work/School Sub Total	79%	79%	78%
Personal business	4%	5%	3%
Recreation/Social, Shopping and Eating	10%	10%	10%
Other Reasons Sub Total	14%	15%	14%
Serve Passenger (eg: pick up/drop off)	7%	6%	8%

(Note: Numbers are rounded off.)
The proportion of work/education related trips remained stable while there is a growing trend of more trips servicing passengers

daily trips) to 8 percent (775,000 daily trips) (Table 2).

The growing number of passenger servicing trips should raise a red flag to transport planners as they are usually first-and-last mile trips that could have been completed on the PT network and thus avoided entirely. Growing demand for passenger servicing will put additional pressure on the road network. Already, Singapore cars are clocking very high mileage annually⁴ because car-owners tend to use their cars even for very short journeys. If such short journeys could be avoided, the demand on road space would lessen and there would be less pressure to expand existing road infrastructure, especially in the residential developments and key transport facilities.

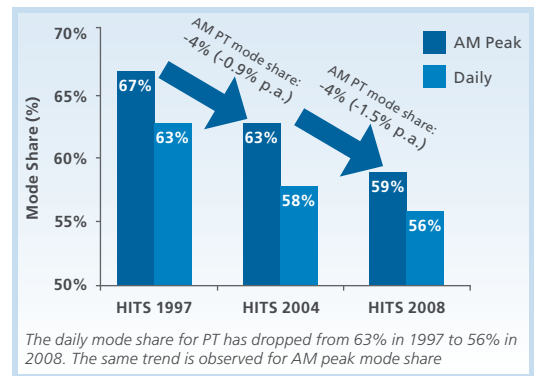
As the economy develops, we can expect more social or leisure (discretionary) trips, thus, there is a need to alter the current trend of making these trips by private transport. Commuters need to be persuaded to use alternative modes of transport, such as, PT or cycling or walking, for short trips, so that there can be better utilisation of PT resources and less demand on the limited road space. In land-scare Singapore, such outcomes are desirable.

Mode share

We have seen earlier that the daily PV trips had grown much faster than PT trips. This resulted in the daily PT mode share dropping consistently for the past decade, from 63 percent in 1997 to 58 percent in 2004, and even lower to 56 percent in the 2008 survey (Figure 2). Though the rate of decrease has fallen, the trend, if

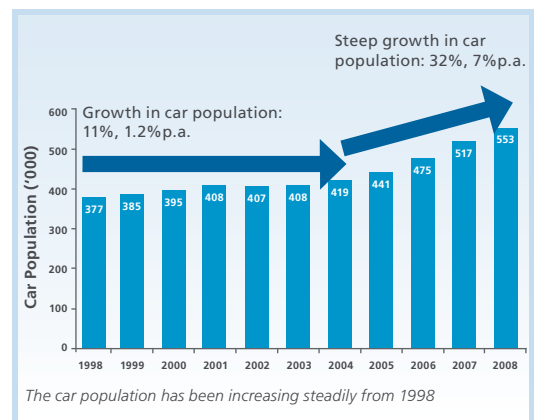
it continues, is not a sustainable one because of the corresponding increasing reliance on private vehicles.

Figure 2: PT Mode Share



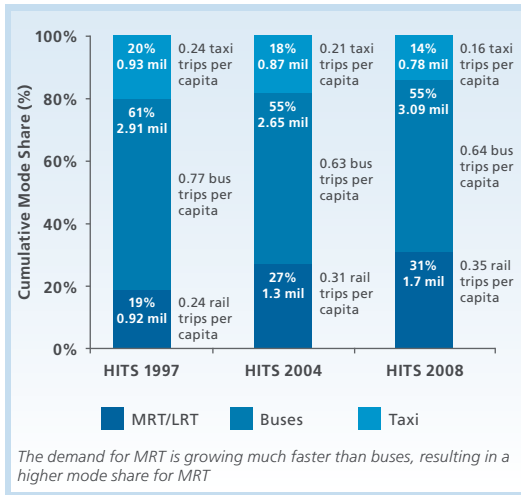
One of the reasons for the fall in PT mode share is the increase in car population per capita. Figure 3 shows that the car population had grown significantly by 47 percent between 1998⁵ and 2008, faster than the population growth rate of 26 percent. As a result, more people are owning cars now and the ratio for the number of persons per car has changed from 10 persons per car in both 1997 and 2004 to 8.8 in 2008. As discussed earlier, Singapore car owners used their cars rather intensively,

Figure 3: Car Population



thus, a rapid increase in car population would dampen the growth in PT trips.

Figure 4: Market Share Within the PT Sector

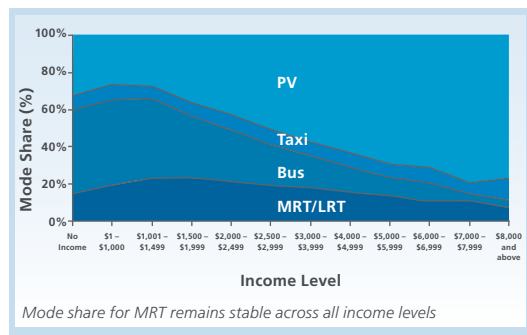


Within the PT sector, the mode share is currently dominated by buses. However, from Figure 5, we observe that most of the increase in PT trips is from the increase in demand for mass rapid transit (MRT). Figure 4 shows that 0.93 million daily MRT trips (0.24 trips per capita) were generated in 1997, growing to 1.3 million (0.31 trips per capita) in 2004, and 1.7 million (0.35 trips per capita) in 2008 – almost doubling in ten years. The market share of MRT within the PT industry has risen by 12 percentage points to stand at 31 percent, with the bulk of the increase arising due to decanting from bus ridership, which consequently saw a gradual drop in market share.

Factors affecting PT demand

To better appreciate the factors affecting demand for each mode of transport, Figure 5 gives the share breakdown of various transport modes against income levels.

Figure 5: PT mode breakdown by income levels



It shows that MRT mode share remained constant over the various income levels. At each income level, the MRT mode share was above 10 percent and rose to as high as 20 percent for the middle-income group (\$2,001 – \$3,999). The mode share for buses was highest for the low-income group but quickly tapered off for those with incomes higher than \$2,000. Taxis played an important mode of travel across all income bands because of Singapore’s relatively low car ownership levels.

Figure 6: Mode share vs distance from MRT Station

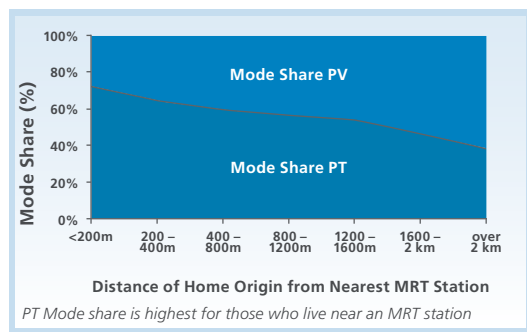


Figure 6 gives a different perspective of how the PT mode share changes with the proximity of residence to the MRT stations. It shows that the PT mode share was high (more than 70 percent) for people living within 200m of an MRT station, but the further people live from

the MRT station the lower the mode share. The PT mode share drops by a rate of 1.6 percent per 100m distance from the MRT station, and reaches a low of about 40 percent for people living 2 km from the station.

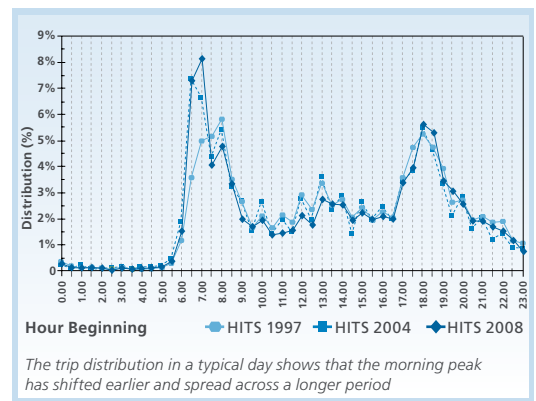
The observation bodes well for transport planners. With the opening of the entire Circle Line (CCL) in 2011 and Downtown Line (DTL), Singapore residents will have greater accessibility to the rapid transit system (RTS)⁶ network. The LTMP also indicates a strong commitment to double the RTS network which implies that the likelihood of the population taking the PT will be higher for more people.

Time of travel (Trip distribution)

Time of travel (trip distribution) is of interest to the transport planners because it provides vital information for the planning of future transport infrastructure. The method employed to analyse the time of travel is based on the mid-trip time (the average of start and finish time of the trip). It gives a better indication of the distribution of travel demand on the transport network because at the mid-trip time, the trip makers are more likely to be actually present on the transport network than at the time of departure (Chandrasekar et al. 1994).

Over the ten years, it is observed that the peak of the morning peak had shifted earlier by an hour, and correspondingly the morning peak period had lengthened (*Figure 7*). The change could be due to the twin effects of the electronic road pricing (ERP) system and the introduction of flexible work times.

Figure 7: Trip distribution in a typical day



The ERP was introduced in 1998 to price congested expressways and arterial roads.⁷ Its primary objective is to make road users more aware of the true cost of driving and the impact to traffic conditions if they choose to drive. With road pricing, road users are more likely to make conscious decisions about the need to drive, the time to make the trip and the route to take. One of the behaviour changes implied by the shift in the peak hour is that some drivers had begun to leave home earlier to avoid paying the ERP charges.

Fundamental changes in work practices, such as, widespread telecommuting, that could eliminate work trips will likely reduce the peak period demand.

Similarly, flexible work arrangement for employees meant that workers could reach their office within a stipulated time belt instead of precisely on the hour⁸. This relieves the pressure on the transport infrastructure as employees stagger their arrival times at work. The scheme was introduced by the Civil

Service in the 1970s, but it only took off in the late 1990s/early 2000s when there was greater emphasis on work-life balance. The impact we observed is a wider morning peak.

It should be noted that even with the shift in PT trips during the morning peak, traffic conditions have not improved significantly. Fundamental changes in work practices, such as, widespread telecommuting, that could eliminate work trips will likely reduce the peak period demand.

Addressing the Evolving Travel Behaviours

In 2008, the Land Transport Authority came up with a bold and ambitious transport master plan that sets out the vision for the land transport system in 2020. The Land Transport Masterplan (LTMP) contains many policies and initiatives and some of them resulted from a better understanding of travel behaviours from past HITS. The 2008 HITS which came out after the review further confirmed some of the trends and highlighted the pressing need for timely implementation of the initiatives in the LTMP. In this section, we briefly review a few of these initiatives, namely, increasing the use of ERP to manage travel demand, reducing the population of cars and making PT a choice mode.

Managing travel demand through ERP

From the HITS results, we can see the effectiveness of the ERP. Firstly, city-bound traffic (private vehicles going into the restricted zones) grew only 15 percent compared to

the island-wide vehicular journeys which grew 25 percent between 2004 and 2008. This suggests that traffic demand had been suppressed for areas that were priced by the ERP. Secondly, the trip distribution had also started to widen in the morning peak hours because of the imposition of the ERP and other policy changes. Therefore, the ERP has been effective in managing travel demand and ensuring better use of limited road resources.

Table 3: Growth Rates of Traffic Volumes

	City-bound Traffic	Island-wide Traffic
Growth in Traffic Volumes (Between 2004 and 2008)	15%	25%
<i>City-bound traffic going into the restricted zones grew less than the island-wide traffic</i>		

Though ERP has been useful, the growing affluence of Singapore residents has led to a greater propensity to drive, which in turn has caused a significant increase in traffic volumes. With more cars on the road, congestion is now more prevalent, particularly during the peak periods. In the LTMP, LTA is committed to ensuring that the ERP remains effective in managing congestion. This includes refining the method of measuring traffic speeds to trigger ERP rate changes, changing the pricing structure and introducing more ERPs around the island to manage congestion in the city area.

An important change is the restructuring of the ERP pricing mechanism. Instead of having many small adjustments, LTA will make larger rate increments so that the ERP charges can remain effective in influencing motorists' behaviour. Instead of raising the incremental ERP charge

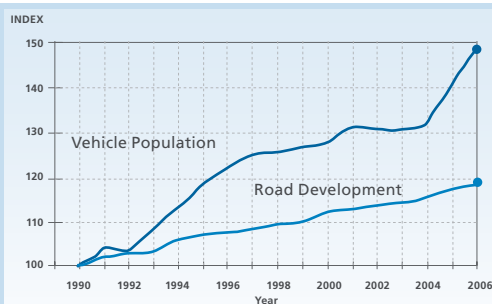
by \$0.50, LTA will raise the incremental charge to \$1.00. In addition, the starting charge for a new ERP gantry point will be increased from \$1.00 to \$2.00. These changes will improve the effectiveness of the ERP system, such that each time the ERP rates are adjusted, motorists who still choose to drive on priced roads will enjoy tangible improvements in traffic flows.

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Reducing car population

Land in Singapore is scarce and building more roads is not a sustainable approach to managing traffic congestion. Therefore, LTA has to manage the growth in the car population. The Vehicle Quota System (VQS) was introduced in 1990 to restrict vehicle population growth, and the vehicle population growth was set at 3 percent per annum. Over the past 15 years, the rate of total vehicle population growth has outstripped road development (*Figure 8*).

Figure 8: Growth of Roads and Vehicle Population Index



The growth in vehicle population has outstripped the pace of road development

The road growth rate has been only 1 percent per annum in the last 15 years and will drop to about half a percent per annum over the next 15 years. Therefore, it is necessary to further limit the growth of the car population.

HITS revealed the behavioural tendency of car owners to drive than use the PT even for short, discretionary trips. This trend has resulted in the rapid growth of PV trips. Therefore, in managing travel demand, LTA has to further restrict the growth of private vehicles to complement the ERP measures, so that the increasing demand for private trips may be arrested. In light of this, the vehicle quota growth has been reduced to 1.5% per annum from 2009 onwards, subject to further review in 2011.

Making public transport a choice mode

The initiatives with regards to private transport are only effective in suppressing the choice for PV mode. Overall demand for transport is still a derived demand, which means that as population grows and the economy develops, trip generation will not slow down. Thus, more needs to be done to avoid a choked transport system. Hence, the most important strategy is to make the public transport a choice mode for most of the population's commute.

As seen from *Figure 5*, the MRT is increasingly becoming a popular mode of transport. It is fast, efficient and good for long-distance commute. Even people in the high-income groups do not mind commuting on the MRT because of the comfort and speed. Therefore,

expanding the RTS is the right strategy going forward to attract more people to use public transport.

LTA will also spend resources to improve the bus system for better integration between the PT modes and ensure the success of Singapore’s ‘hub-and-spoke’ public transport network.

In the LTMP, the Government announced that it will commit over \$20 billion to double the existing 138 km of rail network to 278 km. This will increase the RTS density from 31 km per million population today to 51 km per million population, comparable to cities like New York and London, and surpasses RTS densities in Hong Kong and Tokyo today. Within the city centre, commuters will be able to access an RTS station within a 400 metre radius, or a five-minute walk. As seen earlier in *Figure 6*, this improvement in the accessibility to the MRT will have positive impact on the mode share and create better utilisation of the PT facilities.

To complement the RTS network, LTA will also spend resources to improve the bus system for better integration between the PT modes and ensure the success of Singapore’s ‘hub-and-

spoke’ public transport network. Initiatives, such as, building integrated transport hubs and creating integrated fare structures, will enhance seamless bus-rail transfers. In addition, more bus priority schemes and premium bus services will greatly enhance the experience of bus passengers, thus improving the overall attractiveness of the PT system. In a nutshell, LTA is adopting a holistic approach to make the PT a choice mode for Singapore residents.

Conclusion

A decade of HITS has provided Singapore transport professionals with vital feedback about the travel behaviours of Singapore residents. The results have helped in making decisions about the types of transport infrastructure to be provided and the policies needed to make Singapore a liveable city. However, the observations on behaviour also presented many challenges in building a sustainable transport system. The solutions to some of the challenging transport issues have been provided in the Land Transport Master Plan. By adopting both pull and push measures, such as the expansion of the MRT network, reducing the car population and refining the ERP system, LTA aims to address the falling PT mode share and create a sustainable transport system for future generations of Singaporeans.

Notes

1. There is a longer gap between 1997 and 2004 surveys because the HITS was conducted only after Northeast Line (NEL) was opened in 2003.
2. The sampling rate is kept constant so to be comparable across surveys. It is also consistent with the recommended home interview sampling rate of 1.5% to 0.5% for a population above 1 million. For HITS 2008, about 10,500 households were interviewed.
3. Passenger servicing trips refer to trips made by motorists in picking-up or dropping-off passengers who are on their first/last mile. These motorists will

usually return to their place of origin and are not en-route to work/home.

4. On average, cars in Singapore clock 20,000 km per year, comparable to cars in Chicago City. However, Singapore's physical land mass is only 25 km long and 48 km wide, so the statistics suggest that Singapore cars are driven excessively.
5. The data for car population growth starts from 1998 because a new road tax structure was implemented on 1 September 1998.
6. The Rapid Transit System (RTS) refers to the Mass Rapid Transit (MRT) and Light Rail Transit (LRT) systems.
7. ERP was introduced in September 1998 to replace the manual Area Licensing Scheme (ALS) for the restricted zones (mainly in the Central Business District). At the same time, the road pricing scheme was also expanded to price major expressways when

they are congested. In September 1999, the ERP was extended to some of the key arterial roads beyond the restricted zones.

8. The Civil Service Flexi-hour is between 7.30 am and 9.30 am.

Acknowledgement

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