CHAPTER 22

PUBLIC TRANSPORT PATRONAGE SUCCESS – THE ROLE OF PARK'N'RIDE

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INTRODUCTION

It takes only a moment's reflection to recognise the significance of Park'n'Ride (PnR) in shaping Boomtown. When the Perth transport axis was changed from east–west to north–south, the success of the new corridor depended largely on the PnR phenomenon. This composite mode of transport has enabled the freeway to perform effectively by encouraging car drivers to shift to the trains rushing past them on the parallel railway. The train patronage has exceeded expectations and the railway offers substantial reserve capacity.

PnR is seen as an attractive transit alternative because it combines the efficiency of a mass transit system with the flexibility of a car (Holguín-Veras, Reilly, Aros-Vera, Yushimito & Isa, 2012). For residents of low-density suburbs, PnR provides a fast and flexible access mode. The journey to and from the railway station is not constrained by the infrequent timetable of local buses. PnR is also beneficial for communities as it takes advantage of the scale economy offered by public transport and reduces congestion on arterial roads. Hole (2004) found that effective PnR in the United Kingdom persuaded commuters to use more environmentally friendly public transport modes. This was later confirmed by Dijk and Montalvo (2011) for other European cities, where PnR facilities discouraged car use. White (2008) has presented a general review of related planning issues.

The growth of PnR can be attributed largely to the level of car ownership. In Perth, almost every working adult has the use of a car, with the result that a car is no longer a scarce resource to be shared between family members. However, the practice of parking and riding the train in Australian cities is not new and goes back to the 1930s when a few cars could be seen parked all day on vacant railway land or in other suitable places in Sydney suburbs, while the owners made their daily work trips by train to the city.

Park'n'Ride is encouraged by city rail operators (Public Transport Authority, 2012, p. 49) which benefit not only from the train patronage, but also from travellers arriving early to ensure a parking place. The latter outcome tends to spread the peak to an earlier time. Nevertheless, there is the inherent problem that scarce land around stations is being put to a low-yield use. If multi-level parking stations were built, then the cost per bay would be about $30,000. It is assumed that the buildings would be amortised over forty years, which is at the upper end of the range currently used by railways (Queensland Rail, 2011), but these are long-lived buildings. Amortised over forty years at 4 per cent per annum, on the assumption of 250 operating days per year, the daily financial cost would be about $6.00 to which operating costs could be added. Thus, given that the Public Transport Authority wants to encourage PnR, it is reasonable to assign $6.00 per day rental value to each existing ground-level parking place. In 2014, a daily charge of $2.00 was set for the previously free places and a greater charge may be envisaged.

Developers have been informally encouraged to present proposals for multi-level parking stations, but there has been little interest. Although Perth railway network expansion offers opportunities for retail and service developments at or near train stations, the amount of development has been modest. In an April 2009 intercept survey at Esplanade, Murdoch and Cockburn Central stations on the Perth–Mandurah line, which was opened in 2007, 72 per cent of the 544 respondents said that they would like to see more shops at the train station (Daban, 2009). Of these respondents, 43 per cent drove a car to the station. Some respondents (numbers in brackets) also indicated that they would like to see the following facilities: supermarket (191), coffee shop (189), bank (124), pharmacy (110), restaurant (77), internet café (72) and medical centre (44). There is a demand for services that could be provided as an adjunct to a multi-level parking station. Nevertheless, a joint development with consumer facilities is unlikely to be profitable so long as the authorities price their parking spaces substantially below a reasonable market rate of about $6.00 per day needed to cover capital and operations.

In this chapter we deal with the current conditions and the ways in which commuters deal with them. The implications for policy are then discussed. A car driver who finds no available parking place at the station does have the option of driving to work but parking at the destination may be difficult or costly. Parking in Perth CBD may cost up to $20 per day. There is also the experience of freeway congestion that is avoided by parking and riding.

The peak spreading effect on train travellers results primarily from pricing the spaces below their economic value. Instead of paying more, a traveller can simply arrive at the station early – often before 7:30am. Thus this market is not in economic equilibrium but gives favourable treatment to relatively low-income travellers or those who are in a position to go to work early.

THE PHYSICAL ENVIRONMENT

The greatest impact of PnR has been in the north–south corridor extending from Butler in the north through Perth CBD to Mandurah in the south. There are about a million people living in this corridor, making about 75,000 rail trips daily. Less than 5 per cent of the people in the catchment live within 800 metres walking distance of a station. About 45 per cent of all day boardings are in the morning peak, of which 64 per cent are in the peak hour – i.e., up to 29 per cent of the all day arrivals can come within one hour (Martinovich, 2011). Approximate system statistics for station access are

- arrivals by car – 48 per cent
- bus arrivals – up to 34 per cent
- other, including walking and cycling – 22 per cent

The population density in the southern part of the rail corridor varies from 5 to 19 per hectare (Olaru, Smith, & Taplin, 2011a) due largely to the high proportion of reserved or undeveloped land. Martinovich (2007) has noted that land-use is constrained by large deposits of underground potable water extending parallel to the coast, which supply a large proportion of Perth's drinking water. These reserves are protected, as are low-lying environmentally significant water and flora systems.

A major factor promoting PnR is that the majority of the north–south rail line has been constructed in the median of the north–south freeway. In the whole corridor, Butler to Mandurah, PnR is a major access mode; there are a total of almost 14,000 parking bays provided at nineteen stations, several having more than 1,000 bays available. On the Fremantle line (west) PnR is limited to an average of thirty bays per station and on the Midland and Armadale corridors (east) the maximum is 500 bays and the average is 120.

The catchment area of Warwick, a major northern line station, is approximately 35 square kilometres and over 90 per cent of the commuters using this station live beyond walking range. In 2007 there were more than 4,000 train boardings each weekday, 26 per cent being PnR, 25 per cent dropped off by car, about 39 per cent by bus and 10 per cent by other means (Martinovich, 2007).

The relationship of PnR to settlement patterns is somewhat ambiguous. Although PnR contributed heavily to the success of the southern extension of the Perth rail network (opened in 2007) by giving access to residents in low-density areas living far from a station, it was found by Olaru et al. (2011a) that proximity to a station on the new line was a major influence on choice of residential location. Every minute (walking) closer to a station, on the average, added $3,800 to the perceived value of a residential block. This appears to indicate a desire to get closer to a station, bringing more residents within walking distance of the train.

Olaru, Smith, Xia and Lin (2014) have indicated that the consequences of PnR can be both positive and negative and that a full assessment would need to deal with both short and long-term reactions, as well as the distribution of effects over the population. PnR offers residents living far away from railway stations the option of combining car with public transport. The result is less car travel, lower congestion and increased public-transport revenue. However, PnR uses substantial space near stations, where there could be compact development. It also discourages walking and may be visually unappealing.

CHOICES FACING COMMUTERS

The availability of PnR gives added freedom of choice to a car owner, but a choice means making a decision. The commuter with a car faces uncertainty on two fronts, the first being variable congestion on arterials or freeways. Thus choosing to drive to work may entail leaving early to minimise the risk of severe congestion; Hess, Polak, Daly and Hyman (2007) found clear evidence that choice between times of departure needs to be taken into account as well as choice between modes. Under present arrangements, the second uncertainty, the chance of finding a parking place if PnR is chosen, can also be minimised by leaving early. Most of these commuters would depart later if they were sure of securing a parking bay (Nurul Habib, Day & Miller, 2009). The parking charge is also an important determinant of whether PnR will be chosen. Results on this question are considered in the following sections. It is noted that a possible response to an increased parking charge is the substitution of another access mode to the station (Khandker, Mahmoud & Coleman, 2013).

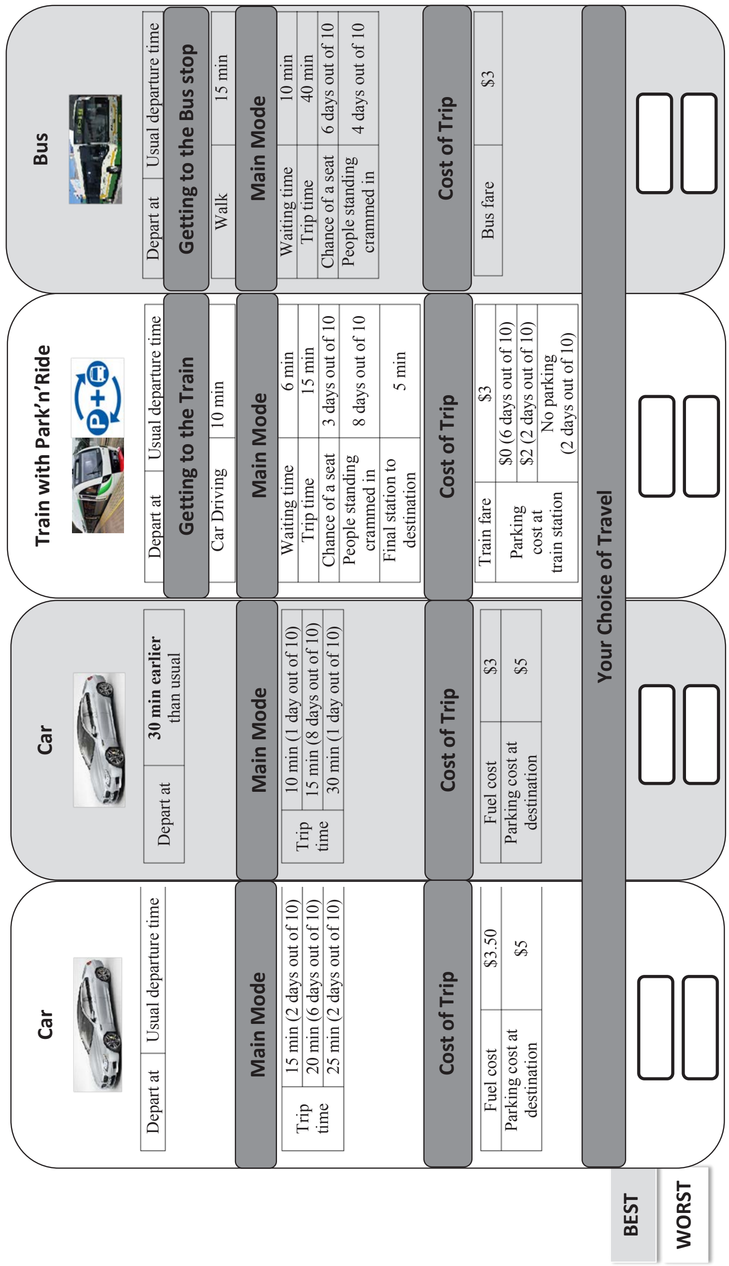

Figure 1: Stated preference choice scenario.

CHOICE MODELLING

The choice modelling results are based on revealed and stated choice surveys conducted by The University of Western Australia between September 2013 and April 2014 (Huang, Smith, Olaru & Taplin, 2015). Households in the catchment areas of seven train stations with PnR facilities (Warwick, Greenwood, Murdoch, Warnbro, Midland, Cannington and Claremont) were randomly sampled to collect data on commuters' transport-mode choices. The catchment areas were split into three zones by access distance (0 to 3km, 3 to 6km, >6km) in order to capture the various access modes – walk, cycle, bus or private motor vehicle. None of the respondents arrived by taxi, but thirteen were dropped off at the station.

Households were contacted by mail with mail-back or online response options. The first step was to ask respondents for information about their circumstances and current or recent trips to work. The second step was to use the travel information in each individual response as the basis around which varying alternatives were constructed so that the original respondent found the alternatives reasonable in terms of his or her own experience. In the first-round survey there were 625 valid revealed preference answers and 215 of these respondents completed the subsequent stated preference survey.

The attribute levels for the stated preference were pivoted on the revealed preference responses and the scenarios elicited the most preferred (Best) and the least preferred (Worst) options in combinations of four labelled alternatives. Each respondent received six sets of choices such as the one shown in the choice scenario example in Figure 1. An efficient design (Rose & Bliemer, 2008) was developed and optimised using a genetic algorithm (Olaru, Smith & Wang, 2011b).

The choice sets included the respondent's current mode with an earlier or later departure time alternative, pivoted on the current time of departure. The purpose of including a time-of-day alternative was to present attributes conditioned by the greater or lesser degree of uncertainty faced when travelling within or outside the peak. Charges for parking associated with probability of finding a parking bay are presented in Figure 1; the latter addressed the uncertain parking availability, which is heavily determined by the arrival time at railway stations.

The results presented here come from the Best only choice observations for 122 commuters (out of the 215 second-round respondents) with flexible working schedules. Based on the revealed preference component of the survey, respondents are identified as current car drivers, PnR users and public-transport commuters.

Modelling Results

Results given in Table 1 are estimated by the error component mixed logit method (ECM). The focus is on early or late departure and on its relationship to travel-mode choice. The coefficients in the first three lines under '*Error Component Values*' indicate that car drivers are more willing to change their departure time (2.966) than to switch their mode. This indicates a limitation to the potential adoption of PnR and partly results from a need to use the car during the day, often for work purposes. Even where there may be a shift away from the car, there is greater willingness to change to bus (2.033) than to PnR (0.932). Moving to the next two lines, the coefficient (3.301) indicates that PnR users are marginally more likely to change to earlier departure time than to change mode (2.986). The last two lines indicate that non-PnR public-transport users are very willing (4.067) to shift to an alternative public mode (not PnR) – such as a bus traveller changing to car drop-off at the train station ('kiss-and-ride') – as well as being willing (2.596) to change to an alternative departure time.

The expected parking cost at railway stations is a key factor in the choice of PnR; this is indicated by the significant (t=-3.50) coefficient of -0.446 at the top of Table 1. The 'standard deviation' item indicates that the random parameter model captures significant price response heterogeneity among PnR users. Results under 'non-random parameters' indicate that both travel time and travel cost are important factors affecting commuters' choices.

Variable	Coefficient	t-ratio
Mean for random parameter		
Expected cost for PnR	-0.446	-3.50
Standard deviations for random parameter		
Expected cost for PnR	0.375	2.61
Non-random parameters (constants omitted)		
Travel cost ($)	-0.206	-5.85
Interaction of cost for public transport (PT; $)	-0.273	-3.42
Expected travel time by car for the whole trip	-0.052	-2.10
Access time for PT (PnR, feeder bus, walk or car drop to train)	-0.031	-1.30
In-vehicle travel time for public transport	-0.053	-2.26
Crowding on public transport	-0.026	-1.62
Early departure time for car drivers (whole trip)	-0.726	-1.96
Late departure time for car drivers (whole trip)	-2.493	-4.96
Early departure time for PnR	0.932	0.68
Late departure time for PnR	-3.666	-1.82
Gender (Female) for car drivers (whole trip)	0.750	2.07
Age (young) for car and PnR (Reference category: seniors)	5.352	2.52
Age (middle) for car and PnR	3.593	4.35
Error Component Values – as indicators of substitutability		
Between departure times for car drivers (whole trip)	2.966	6.36
Car to bus (car drivers)	2.033	4.98
Car to PnR (car drivers)	0.932	2.55
Between departure times (PnR users)	3.301	2.47
PnR to other PT including change in access mode (PnR users)	2.986	2.47
Mode shift to another PT excluding PnR (other PT commuters)	4.067	3.03
Departure time switch (other PT commuters)	2.596	4.70
Number of observations (from 122 respondents)	716	
Information Criterion: AIC/N	1.706	
Log-likelihood	-579.597	
pseudo r^2	0.386	

Table 1: Substitution estimates from ECM

PNR PARKING POLICY AND CHOICE PARAMETER ESTIMATES

From a Park'n'Ride point of view, the strong evidence that those who currently make the entire work trip by car are reluctant to change to PnR is a negative indicator. The estimates suggest that as road congestion deteriorates car drivers avoid the worst of it by changing departure time; those who do not need their cars during the day would be even more likely to change to bus than to PnR. However, there are many PnR users and the proportion using this travel mode can be expected to at least stay constant as the work force grows.

A strong indication of the behaviour of PnR users is their willingness to change departure time, but they are also flexible with respect to the mode of access to the station. However, their strong objection to late departure (-3.666 in the non-random parameters) is undoubtedly coloured by the need to leave early in order to find parking. If this were to be relaxed then even staunch car-only travellers might move to PnR – but greater availability of parking would come at a cost.

The major change in PnR parking policy has been the introduction of a basic $2 per day parking charge. Initially parking places filled more slowly, but subsequently there has been more concern about the payment procedure and technology while concern about the parking charge itself appears to have dwindled. This is consistent with an inelastic demand response to price.

As mentioned in the Introduction, development of multi-level parking stations would begin to be viable at a daily parking charge of about $6.00, with the revenue of developers being augmented by the rents received from business tenants. The direct elasticity of demand averaged over the simulated distribution of respondents is estimated to be -0.248. In approximate terms, this is the percentage decrease in number parking after a 1 per cent increase in parking charge.

Applying the elasticity estimate to a $4.00 increase over the basic $2.00 charge is somewhat hazardous because demand elasticity is not necessarily constant over a large price range; nevertheless, it does give a first approximation. Using the differences of logarithms method, a hypothetical increase in the charge from $2.00 to $6.00 is calculated to result in a 24 per cent decrease in PnR parking patronage. If the increase – possibly as a first step – were to be made to $4.00 then the resulting decrease in parking is estimated at 16 per cent.

POLICY IMPLICATIONS AND THE WAY FORWARD

Judging by the heavy demand for parking places, PnR has been a resounding success in Perth's north–south expansion and has become a critical element in the transport system of this extensive metropolitan area. The required expansion of transport capacity, for a population projected to reach three million or more, is likely to involve substantial increases in PnR parking capacity at rail stations. The catch is that key stations are already surrounded by the bitumen deserts used for parking; extension of these would be an unacceptable environmental intrusion and, in any case, the cost of the land to do so would be prohibitive.

Thus we return to the point made in the Introduction, that construction of multi-level parking stations has been inhibited by the low level of the general all-day parking charge. As shown in the preceding section, using choice survey modelling estimates, if the authorities were to introduce an economically viable charge then this would reduce PnR use. The estimated reduction of 24 per cent following a hypothetical parking fee increase from \$2.00 to \$6.00 could be made less formidable by taking a first step to \$4.00, with a potential 16 per cent reduction. However, such a step might not be enough to make parking stations for PnR sufficiently viable in financial terms to induce developers to build them.

A qualification of these estimates is with regard to the apparent reluctance of car-all-the-way commuters to change to PnR. Survey respondents taking account of the hypothetical values, such as those in the Figure 1 example, were also bearing in mind their own travelling experience. Thus the known difficulty of finding PnR parking after 7.30am would have influenced car drivers. In the theoretical situation that this constraint could be lifted in future, the drivers who regarded PnR as an unacceptable travel mode might well be prepared to change to using PnR at a comfortable or even late hour and pay the associated fee – a possibility that they are unlikely to have entertained when responding to the survey. This hypothesis would require further investigation, but if it is true then a new sector of the travelling population would be added to the existing PnR users, with the result that the fall in patronage following a rise in the parking fee would be moderated or even eliminated.

Should the critical step be taken to induce developers to begin the construction of parking stations there would be two additional benefits, both improving the amenity of train station precincts. One would be the inclusion of shops and other facilities in the parking station developments and the other would be reduction of the amount of land covered in bitumen. Jointly, these two effects would at last move Perth towards the people-friendly transit-oriented developments (TOD) originally envisaged for the new rail lines. This design principle would be reflected in Activity Centres at stations in the freeway median, as discussed in chapter 17, and the TOD concept would be reinforced at some stations by high-rise residential developments which would certainly promote train patronage.

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