

Valuing Ferry Service Quality using a Combined Rating & Stated Preference Survey

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Abstract

The paper describes a 2014 survey to estimate passenger values for NSW ferry quality using Stated Preference (SP) and Rating surveys. The SP survey estimated willingness to pay values for service frequency, onboard ferry time, fare, ferry quality and wharf quality. The rating survey determined the relative importance of ferry and wharf attributes.

The most recent survey had been undertaken 15 years earlier in 2001. An SP survey was used with a 'Priority Evaluator' survey. The paper compares the surveys and finds the 2014 values of time to be lower than the 2001 survey after factoring for wage growth whereas the values of service interval, wharf and vessel quality were similar. The 2014 values were also compared with similar estimates for bus, rail, LRT and car taking into account income and fare concession usage.

The 2014 survey used questionnaires completed on-board which had the advantage of 'contextualising' the values of time and quality to the trip being made. The surveys were also self-completion which made them cost-effective in comparison to the interview led survey in 2001.

1. Introduction

This paper describes a 2014 survey into the trade-off between ferry price and quality for 2,557 Sydney and Newcastle passengers surveyed in September - October 2014.

Section 2 reviews the previous survey of Sydney ferry quality undertaken in 2001.

Section 3 provides an overview of the 2014 survey. Section 4 summarises the sample, Section 5 presents the passenger ratings of the Sydney ferry fleet and section 6 the wharf ratings.

Section 7 describes the SP survey and presents the key results. Section 8 uses the results to calculate a generalised cost measure for ferry travel. Section 9 compares the ferry valuations with bus, rail, light rail and car.

Section 10 compares the 2014 results with the 2001 survey and section 11 makes some concluding remarks.

2. Literature Review

The most recent similar survey of Sydney ferry passenger values was undertaken in 2001 by Booz Allen Hamilton (BAH) and Douglas Economics (BAH, 2001).

The study involved SP and Priority Evaluator surveys undertaken by interviewers with printed show cards.

The SP survey presented respondents with a series of pair-wise journey choices. Two sets of choices were presented: PT versus PT and PT versus car with a respondent doing one of

the sets. PT was either ferry, bus or ferry and bus (i.e. involving a transfer). Altogether 829 SP interviews were undertaken (662 ferry users and 207 bus users).

The attributes included onboard time, fare, walk access time, service interval (minutes between departures) transfer penalty. The PT v car also included car drive time and car cost (analysed as the difference in fare minus car petrol plus parking cost).

Table 1 presents the estimated values of travel time and quality estimated by the SP survey.

Table 1: 2001 Sydney Ferry Valuations

| Time Period SP Design Respondents | Peak | | | Off-Peak | | | All [^] | | |
|---|------------------|------------|-----------------|------------------|------------|-----------------|------------------|------------|-----------------|
| | Ferry v Ferry | Bus Bus | PTvCar Ferry | Ferry v Ferry | Bus Bus | PTvCar Ferry | Ferry v Ferry | Bus Bus | PTvCar Ferry |
| Value Std Fare | 11.87 | 5.96 | na | 12.62 | 6.81 | na | 12.33 | 6.49 | na |
| of IVT Concession | 2.65 | 2.76 | na | 2.59 | 3.72 | na | 2.61 | 3.35 | na |
| \$/hr Average | 11.41 | 3.49 | 11.58 | 11.42 | 4.52 | 17.84 | 11.42 | 4.13 | 15.46 |
| Ferry v Bus (mins) | 18 | -3 | na | 32 | -4 | na | 27 | -4 | na |
| Ferry v Car (mins) | Na | na | -29 | na | na | -43 | na | Na | -38 |
| Ferry/Bus Trsf (mins) | 11 | -3 | 20 | 20 | 7 | 18 | 16 | 3 | 19 |
| Walk / IVT | 0.84 | 1.30 | 0.58 | 1.05 | 1.15 | 0.93 | 0.97 | 1.20 | 0.80 |
| Service Interval / IVT | 0.25 | 0.55 | 0.39 | 0.30 | 0.32 | 0.30 | 0.28 | 0.41 | 0.33 |
| Reliability / IVT | 2.1 | 7.8 | 13.3 | 2.4 | 0.3 | 5.1 | 2.3 | 3.2 | 8.2 |
| Car Drive / Ferry IVT | Na | na | 1.52 | na | na | 0.61 | na | Na | 0.96 |

38% off-peak and 62% weighting

[^] Source Booz Allen Hamilton & Douglas Economics (2001).

Ferry respondents valued travel time three times higher than bus respondents (\$11.42/hr to \$15.46/hr versus \$4.13/hr) and they also had a strong preference for travelling by ferry rather than bus worth 27 minutes. Bus respondents by contrast had a small preference for travelling by bus which was worth 4 minutes. Ferry respondents also had a higher transfer penalty worth 16 minutes compared to 3 minutes for bus respondents. Ferry respondents who completed the PT v car SP had a strong preference for travelling by car rather than ferry worth 38 minutes.

Walk access was valued similar to ferry time which contrasts with the usually weighting of double onboard time. Service interval was valued at 30% of onboard time which was relatively low and was considered to reflect timetable inconvenience rather than waiting time. It may also reflect the ability at terminal wharfs such as Circular Quay and manly to 'wait' for some of the time onboard on the ferry rather than at the wharf such as Circular Quay or Manly.

Reliability (probability of being X minutes late) was valued between 2 and 3 times greater than in-vehicle time in the ferry v bus SPs and 8.2 times greater in the PT v car SP.

Car drive time was valued similarly to ferry time overall. There were differences by time period however with a higher valuation of car time by peak respondents and a lower valuation by off-peak respondents.

To value potential wharf and ferry quality improvements, a Priority Evaluator survey was undertaken in which respondents were asked to allocate ten points to indicate which five improvements would most improve their journey. The exercise was undertaken separately for wharf and for vessel improvements.

Table 2: 2001 Sydney Ferry Valuations of Vessel & Wharf Improvements

| Vessel Improvement | Vessel | Wharf Improvement | Wharf |
|-------------------------------------|--------|----------------------------------|-------|
| Onboard security cameras | 8% | Brighter lighting | 8% |
| Help point & emergency phone | 6% | Security cameras | 9% |
| Real time Information Display | 9% | Help point & emergency phone | 11% |
| Clearer onboard announcements | 5% | Clear wharf announcements | 5% |
| No delay boarding/alighting | 13% | Computerised real time info | 8% |
| Outdoor seat always available | 4% | Ticket vending machines | 11% |
| Indoor seat always available | 2% | More car parking at wharf | 5% |
| Better air conditioning and heating | 7% | Secure bike rack | 2% |
| No engine fumes in seating area | 14% | Weather protected waiting area | 6% |
| Food, drinks, news kiosk open | 6% | More seating in waiting area | 8% |
| Onboard ticket vending machine | 7% | Well maintained toilets | 10% |
| Cleaner graffiti free seats | 2% | Clean no rubbish graffiti free | 6% |
| Cleaner well maintained toilets | 8% | Repainted, refurbished wharf | 11% |
| Refurbished ferry interior | 6% | | |
| Refurbished ferry exterior | 2% | | |
| Total Percent | 100% | Total Percent | 100% |
| Package Value Cents | 23 | Package Value Cents | 28 |
| Package value / Av Fare (\$3.50) | 7% | Package value / Av Fare (\$3.50) | 8% |
| Package value Mins of IVT | 1.2 | Package value Mins of IVT | 1.5 |

There was a wide spread across the vessel improvements. 'No engine fumes in the seating area' was most important accounting for 14% of the package followed by 'no delay in boarding/alighting' (13%) 'onboard real time information displays' (9%), cleaner toilets (8%) and onboard security cameras (8%).

The most important wharf improvements were help point and emergency phones (11%), ticket vending machines (11%), repainted, refurbished wharf (11%) and well maintained toilets (10%).

A second Priority evaluator asked respondents to allocate ten points between their wharf improvement package, their vessel improvement package and a perfectly reliable ferry. By using the relative valuation of reliability estimated by the SP survey, the wharf and vessel improvements were able to be valued in equivalent travel time and fare. The values are shown at the bottom of Table 2. The wharf improvements were estimated at 1.5 minutes of onboard ferry time or 28 cents per trip and the vessel improvements 1.2 minutes or 23 cents

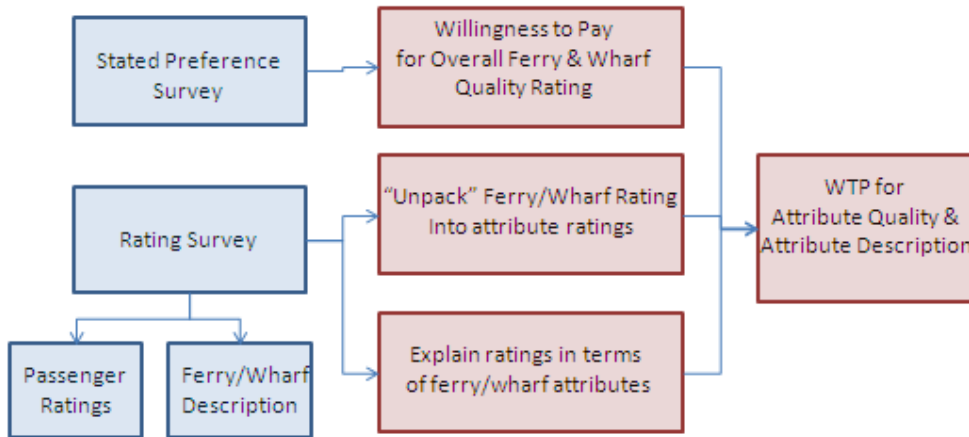
By multiplying the package value by the percentage share, the value of particular improvements can be determined. Clearer onboard announcements for instance would be worth 1.15 cents (5% of 23 cents) or 0.06 minutes of onboard ferry time.

3. Overview of 2014 Ferry Survey

The 2014 survey combined a SP with a rating survey using an approach developed for urban bus and rail passengers in New Zealand, Douglas (2016). Unlike the 2001 survey, the SP included wharf and vessel quality alongside travel time, service interval and fare.

The Rating survey benchmarked the quality of ferries and wharfs perceived by ferry passengers and enabled the overall vessel and wharf ratings to be explained in terms of individual attributes such as cleanliness. Figure 1 shows how the two surveys were combined.

Figure 1: Combination of Quality SP & Rating Surveys



4. Survey Details

The survey was a self-completed questionnaire handed out and collected onboard ferries by surveyors. In total, 2,557 passengers completed a questionnaire with similar numbers of Rating and SP surveys completed as shown by Table 3.

The Manly, Inner Harbour and Parramatta rating surveys were undertaken in September 2014 with the Fast Ferry and Newcastle rating surveys undertaken in October 2014. The Stated Preference (SP) surveys were undertaken in October 2014.

Ferry services were classified into five service groupings: Manly (MAN), Inner Harbour (INH), Parramatta (PAR), private fast ferries to Manly (FF) operated by two companies (Sydney Fast Ferries and Manly Fast Ferries) and the Newcastle-Stockton ferry (NEW).

Peak was defined as weekday AM (trips before 9.30am) plus PM peak trips (after 4.30pm). Off-peak was interpeak, evening and weekend.

Table 3: Ferry Sample Sizes by Ferry Service & Type of Survey

| Survey | Period | Service | | | | | Total |
|-------------------|----------|---------|-----|-----|-----|-----|-------|
| | | MAN | INH | PAR | FF | NEW | |
| Rating | Peak | 74 | 83 | 76 | 143 | 77 | 453 |
| | Off-Pk | 253 | 234 | 281 | 71 | 42 | 881 |
| | Total | 327 | 317 | 357 | 214 | 119 | 1,334 |
| Stated Preference | Peak | 50 | 94 | 57 | 79 | 68 | 348 |
| | Off-Pk | 274 | 229 | 261 | 61 | 50 | 875 |
| | Total | 324 | 323 | 318 | 140 | 118 | 1,223 |
| Total | Peak | 124 | 177 | 133 | 222 | 145 | 801 |
| | Off-Peak | 527 | 463 | 542 | 132 | 92 | 1,756 |
| | Total | 651 | 640 | 675 | 354 | 237 | 2,557 |

The survey included a number of questions to describe the profile of the sample and help explain the response to the SP and rating questions. A summary is provided in Table 4. A set of weights were developed to correct for differences in the profile of the sample with profile data provided by TfNSW.

Table 4: Summary Profile of Ferry Users

| Profile | Statistic | Comment |
|--|--|--|
| Sample Size | 2,557 onboard self-completion questionnaires | 1,334 Rating (52%) and 1,225 SP (48%). Surveys undertaken on 5 ferry routes: Manly 651, Inner Harbour 640, Parramatta 675, Newcastle 237 and Fast Ferry 354 in Sept/Oct 2014. |
| Peak / Off-Peak Response | 801 Peak | Surveys undertaken on weekday AM Peak, interpeak and PM Peak and Saturdays (treated as off-peak). Peak surveys accounted for 31% and Off-Peak 59% compared to ferry patronage of Peak 38% & Off-Peak 62%. A set of weights were developed to factor response by time period and route. |
| | 1,756 Off-Peak | |
| Trip Purpose | 33% to/from work | Profile varied by time period. 72% JTW in peak & 16% off-peak. Entertainment/holiday trips important in off-pk (49%). Company business trips small 3% share. |
| | 38% entertainment/holiday | |
| | 29% other | |
| Gender | 52% Female : 48% Male | Reasonably even with higher female share in Peak (56%) than off-peak (50%). |
| Age | Average age of 43 | Off-peak tended to be older than peak (44 versus 40). Few under 18s surveyed (market research protocol not to survey under 12s).29% aged 25 to 34 with 19% 35 to 44 and 15% ≥65. |
| Employment | 69% Employed | Varied by time period: 85% employed Pk & 69% Off-Pk. Low student share (9%) with high retired share in Off-Pk (24%). |
| | 17% Retired 9% Student | |
| Income | Av. Income \$71,000 per year | Peak users averaged \$86k per year compared to off-peak \$62k. Peak Fast Ferry respondents averaged \$103k compared to standard Manly ferry \$54k. |
| Trip Frequency & Resident/ Visitor use | 47% >use ferry >1/week | Less than half used ferry regularly (i.e. >1/week) with infrequent (>1/year) share of 29% and occasional (e.g. 1st time) Share of ferry use by visitors twice as high in off-peak (38%) as peak (15%). |
| | 71% resident & 29% visitor | |
| Service Interval & Wait Time | 31 minute service interval | Half hourly services, more frequent in peak (27 mins) than off-peak (34 mins) |
| | 8 minute wait | |
| Onboard Ferry Time | Av 24 minutes | Varied by route from 5 mins Newcastle to 42 Parramatta Off-Pk. Fast ferry 19 mins compared to 30 mins for std Manly ferry. |
| Satisfaction | 84% satisfied | 84% satisfied with onboard time with 15% wanting it to be shorter & 1% longer. Fast ferry users most satisfied (97%) and Manly least satisfied (33% Peak). |
| Fare | \$6.54/trip | Newcastle fare lowest at 2.30/trip & fast ferry highest \$7.95/trip. |
| Concession | 22% Entitled | Concession use higher in off-peak (29%) than peak (11%). Low use on fast ferry ≈2%. |
| Access Mode | 58% walk | Higher walk share in peak (65%) than off-peak (53%). 23% used bus/rail and 11% car. Shares varied by wharf with 30% using rail at Circular Quay. |
| | 23% bus/rail | |
| | 11% car | |

Profile statistics weighted in accordance with patronage / sample shares

5. Ferry Vessel Ratings

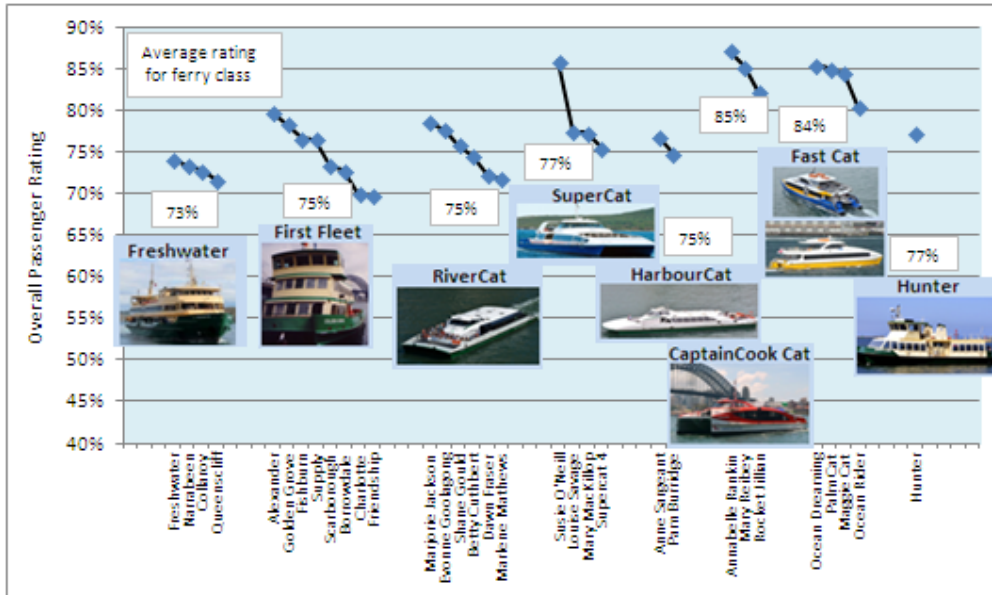
The Rating survey featured a list of ferry and wharf attributes. Passengers were asked to rate the attributes on a 9 point scale (1 very poor and 9 very good).

The SP survey asked respondents to give an overall rating of the vessel they were surveyed on and the wharf they had boarded at. A five star scale (1 star very poor to 5 stars very good) was used. The ratings for both surveys were combined by converting them to percentage scales (0% very poor and 100% very good).

Ferries rated relatively highly scoring an overall rating of 77% (i.e. slightly better than a 'good' (75%) rating).

Eight of the nine types of ferry operating at the time were surveyed (see Appendix for fleet details). There was a 12% point difference in rating across the eight vessels surveyed. The privately operated catamarans, which were also the newest vessels, rated the highest at 85%. The lowest rated at 73%, were the thirty year old Freshwater ferries operating the Manly service. As can be seen from Figure 2, the ratings of individual ferries varied which reflected variability in individual sailings and sampling variability.

Figure 2: Overall Ferry Vessel Ratings



A model was fitted to explain the overall ferry rating in terms of the class of ferry and the profile of passengers. Manly Freshwater ferries were found to rate 1.6% points lower than 'other ferry types' (75.1%) with Captain Cook Charter Catamarans (CCAT) and Fast Cats (FCAT) rating 8.7% points higher. Respondents making holiday or entertainment trips rated 2.1% points higher lower than commuters and passengers making other types of trip with students rating 2.8% lower.

Table 5: Regression Model of Overall Ferry Vessel Rating

| Parameter | β (%) | t | $\pm 95\%$ CL |
|------------------|-------------|------|---------------|
| Constant | 75.1% | 134 | 1.1% |
| Freshwater Class | -1.6% | -3.1 | 1.0% |
| CCAT+FCAT | 8.7% | 9.1 | 1.9% |
| Hol/Ent Trips | 2.1% | 2.9 | 1.4% |
| Students | -2.8% | -2.3 | 2.4% |

Obs 2,393

The two attributes that were rated the highest at 80% were 'ease of on-off' and 'cleanliness'. Most of the other attributes rated between 73% and 79%. Only 'environmental impact' (68%) and 'ability to connect to the internet' (61%) scored lower than 70%.

A linear regression model was fitted to explain the overall rating in terms of the individual attribute ratings. The model was fitted without a constant (which meant that that if all the attributes rated zero, the overall rating was zero) and likewise, if all the ratings rated 100% (very good) the overall rating was 100%.

$$R_{ALL} = \beta_i \sum R_i \dots(1)$$

where: R_{ALL} = overall ferry rating and R_i = attribute rating

Those respondents who failed to give an overall rating were omitted whereas those who did not rate an individual attribute were treated as giving it a 0% rating. In other words, the attribute was assumed to have zero importance.

Table 6 presents the resultant attribute importance 'shares'. 'Ease of on-off' was the most important attribute explaining 21% of the overall rating so in this regard, the survey was somewhat similar to the 2001 Priority Evaluator which attributed 12% to 'no delays in boarding/alighting', second only to no engine fumes in the seating area, in terms of importance.

Next important was outside appearance (14%) followed by cleanliness (12%), seating (12%) and smooth/quietness (10%). Relatively unimportant were WIFI (2%), environment (4%), information (4%), food/drink (5%) and space for bags (5%). Generally, attributes that were 'important' tended to rate more highly whereas lesser important attributes (such as WIFI) also rated lower, as can be seen from Figure 3.

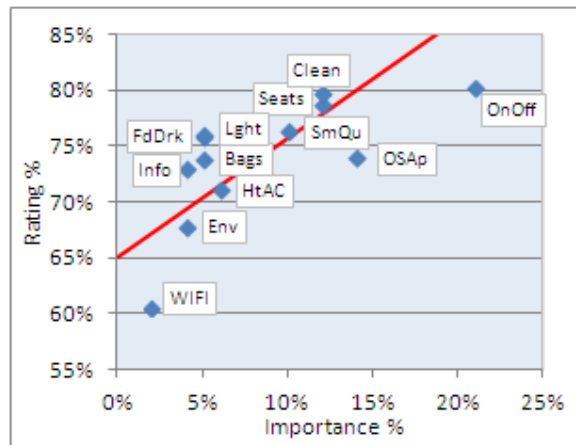
Table 6: Ferry Attribute Importance

| Attribute | Share* |
|-------------|--------|
| Outside App | 14% |
| On-Off | 21% |
| Seats | 12% |
| Bags | 5% |
| Smooth/Q | 10% |
| Heat/AC | 6% |
| Lighting+ | 5% |
| Cleanliness | 12% |
| Information | 4% |
| WIFI | 2% |
| Environment | 4% |
| Food/Drink^ | 5% |
| Total | 100% |

+ Manly estimate. ^ Fast Ferry estimate.

* Constrained to sum to 1.0.

Figure 3: Ferry Attribute Importance & Rating



6. Wharf Ratings

Ferry wharfs rated at 74% with the ratings ranging from 48% at Darling Point to 84% at Milsons Point. Circular Quay scored 73%, Manly 76% and the two Newcastle/Stockton wharfs averaged 75%.

The variation in the overall wharf rating was explained in terms of passenger profile and ferry service using linear regression. The best fit model is shown in Table 7. The 'base' wharf rating was 72.9% and refers to Circular Quay, Newcastle and Stockton wharfs and non entertainment/holiday trips.

Inner Harbour wharfs (excluding Circular Quay) rated 6.5% points lower with Manly and Parramatta River wharfs rating 1.5 to 1.7% higher. As with the ferry vessel ratings, respondents making holiday/entertainment trips tended to rate higher (2.9%) than commuters and respondents making other types of trip.

Figure 6: Wharf Ratings by Wharf & Route

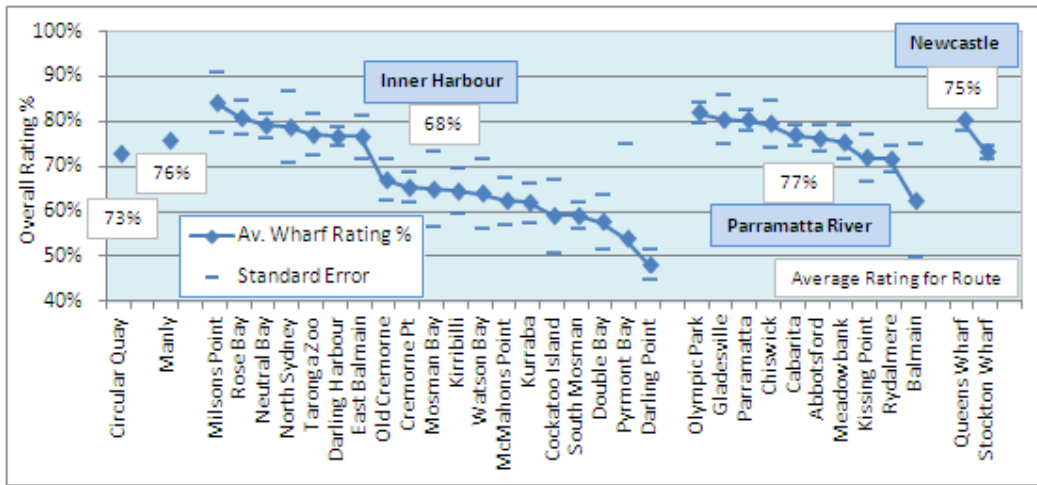


Table 7: Regression Model of Overall Wharf Rating

| Parameter | β (%) | t | $\pm 95\%$ CL |
|------------------|-------------|------|---------------|
| Constant | 72.9% | 167 | 0.9% |
| Manly | 1.7% | 2.2 | 1.5% |
| Inner Harbour | -6.5% | -7.7 | 1.7% |
| Parramatta Route | 1.9% | 2.1 | 1.8% |
| Hol/Ent Trips | 2.9% | 3.6 | 1.6% |

In terms of wharf attributes, 'ease of on and off' at 81% scored highest followed by cleanliness (78%) and lighting (76%). Car access facilities (57%), retail facilities (60%) and 'toilet availability and cleanliness' (56%) rated lowest.

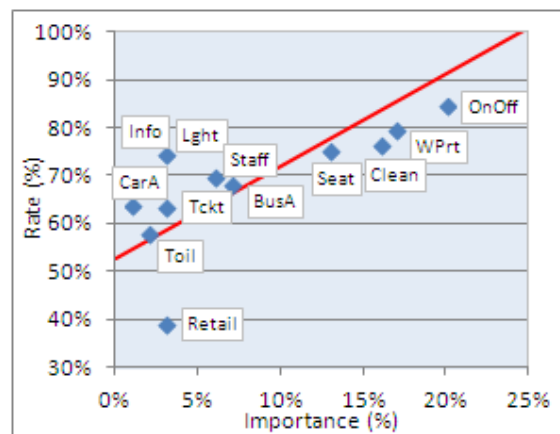
The most important attribute in explaining the overall wharf rating was 'ease of on-off' (20%). Next important was cleanliness / graffiti (17%) followed by weather protection (16%) and seating (13%).

'Important' attributes rated highly. For example, 'ease of on-off' had the highest rating (84%) and was the most important (20%) whereas 'retail' rated lowly (39%) and was unimportant (3%). Figure 7 shows the correlation.

Table 8: Importance of Wharf Attributes

| Attribute | Regression Model β | t | Attribute Importance % |
|---------------|--------------------------|------|------------------------|
| Weather Prot. | 0.174 | 9.8 | 16% |
| Seating | 0.141 | 8.0 | 13% |
| On-Off | 0.211 | 10.8 | 20% |
| Information | 0.093 | 5.7 | 9% |
| Lighting | 0.029 | 1.6 | 3% |
| Cleanliness | 0.205 | 11.0 | 17% |
| Toilets | -0.022 | -1.8 | 2% |
| Staff | 0.062 | 4.3 | 6% |
| Retail | 0.032 | 2.9 | 3% |
| Ticketing | 0.035 | 2.6 | 3% |
| Car Access | 0.012 | 1.1 | 1% |
| Bus Access | 0.071 | 5.8 | 7% |
| Overall | 1.042 | na | 100% |

Figure 7: Wharf Attribute Importance & Rating



7. Stated Preference Survey

The SP survey presented ferry users with a series of pair-wise choices in which they were asked to 'trade-off' ferry vessel quality, wharf quality, travel time, service frequency and fare. Figure 8 presents the first SP question in the booklet which included an explanation of the task. The subsequent choices only presented the choice.

Wharf and ferry vessel quality was described by a five star system ranging (very poor, poor, average, good and very good).

Figure 8: Example Stated Preference Show Card

We would now like to you to choose between two ferry services in 9 different situations. Please complete all nine situations by ticking box A or box B shown below each choice.

16. In the situation shown below, for service A there is a ferry every 30 minutes, you rate your wharf quality as average, your ferry takes 10 minutes, you rate the quality of your ferry as very good and you pay \$8 per trip (\$4 concession). Whereas in service B, there is a ferry every 10 minutes, you rate your wharf as very good, your ferry takes 20 minutes, you rate the quality of your ferry as average and you pay \$4 per trip (\$2 concession). Assuming everything else such as reliability and the time it takes to get to and from the wharf would be the same for both services, would you use service A or service B for the trip you are now making?

| 16 | A | OR | B |
|----|---|----|---|
| | Service every 30 mins | | Service every 10 mins |
| | Wharf quality is average ★★★☆☆ | | Wharf quality is very good ★★★★★ |
| | Ferry takes 10 mins | | Ferry takes 20 mins |
| | Ferry quality is very good ★★★★★ | | Ferry quality is average ★★★☆☆ |
| | You pay \$8 per trip \$4.00 Concession | | You pay \$4 per trip \$2.00 Concession |
| | <input type="checkbox"/> Tick this box if you would use A | OR | <input type="checkbox"/> Tick this box if you would use B |

Each attribute took one of five 'levels' i.e. differences in time, cost and quality. The times and costs were customised into four designs (Manly, Inner Harbour, Fast Ferry and Newcastle).

The 25 experiments were split into two sets of 8 and one set of 9 choices.

Three quarters of respondents varied their choice (sometimes choosing the quicker option and sometimes the cheaper option). The quarter that didn't 'trade-off' were reasonably well balanced between those who always chose the quicker option (13%) and those who always chose the cheaper option (11%). The shares varied across the ferry groups however. For fast ferries, 34% always chose the quicker option with only 1% choosing the cheaper option. For the short distance Newcastle ferry, 21% always chose the cheaper option and 15% the quicker option (which reduced the percent trading off to 64%).

A logistic function was fitted (using maximum likelihood) to explain the response data (1 if service A was selected and 0 if B was selected) as presented in equation 2. The mirror image of the wharf and vessel quality variables was used (by subtracting the quality rating from 1) so that all the attributes had negative sign. A power function was applied to ferry and wharf quality to allow for a greater sensitivity to poor than good quality with a value of 0.7 adopted based on analysis of the response data. The value of 0.7 has the effect of transforming a 50% rating to 62%.

$$Pa = \frac{\exp Z}{1 + \exp Z} \text{ where:}$$

$$Z = \left\{ \begin{aligned} &\alpha + \beta_f \Delta F + \beta_{fc} \Delta F.C + \beta_t \Delta T + \beta_{si} \Delta SI + \beta_{tvq} \left\{ (1 - VQ_A^{\phi_{vq}}) - (1 - VQ_B^{\phi_{vq}}) \right\} \\ &+ \beta_{sq} \left\{ (1 - SQ_A^{\phi_{sq}}) - (1 - SQ_B^{\phi_{sq}}) \right\} \end{aligned} \right\} \dots\dots(2)$$

- F = Fare difference (A-B) in dollars (taking account fare concession (1/2ΔF))
- C = Concession entitlement (1 if entitled to a concession else zero)
- T = Difference in ferry time (A-B) in minutes
- SI = Difference in service interval (A-B) in minutes
- VQ = Ferry quality transformed by quality power function $\phi = 0.7$
- SQ = Wharf quality transformed quality power function $\phi = 0.7$
- α, β_i = Parameter estimates

Five models are shown in Table 9 with the ‘basic’ model shown on the left. None of the four alternative formulations affected the estimated parameters markedly however. The preferred model labelled ‘No constant*’ is shown on the right.

Table 9: Alternative SP Models

| Parameter | Basic Model | | SP Balanced | | TradeOffs | | No Constant | | No Constant* | |
|------------------|-------------|------|-------------|------|-----------|------|-------------|------|--------------|------|
| | β | t | β | t | β | t | β | t | β | t |
| SI | -0.029 | 14.5 | -0.029 | 14.5 | -0.033 | 16.5 | -0.029 | 14.5 | -0.032 | 16.0 |
| IVT | -0.082 | 16.4 | -0.082 | 16.4 | -0.098 | 19.6 | -0.081 | 27.0 | -0.088 | 22.0 |
| Fare | -0.307 | 18.1 | -0.308 | 18.1 | -0.382 | 19.1 | -0.309 | 20.6 | -0.321 | 21.4 |
| Fare Conc | -0.683 | 19.0 | -0.684 | 19.0 | -0.597 | 14.2 | -0.685 | 19.6 | -0.706 | 19.6 |
| Stop Quality | -0.895 | 12.8 | -0.899 | 13.0 | -0.973 | 12.3 | -0.896 | 13.0 | -0.900 | 12.9 |
| Bus Quality | -1.061 | 9.2 | -1.066 | 9.3 | -1.036 | 7.8 | -1.048 | 10.1 | -1.119 | 10.7 |
| Constant | -0.022 | 0.3 | -0.021 | 0.2 | 0.019 | 0.2 | - | - | - | - |
| VOT - Std \$/hr | 16.03 | 12.1 | 15.97 | 12.2 | 15.39 | 13.7 | 15.73 | 16.4 | 16.45 | 15.3 |
| VOT - Conc \$/hr | 4.97 | 12.4 | 4.96 | 12.4 | 6.01 | 12.0 | 4.89 | 15.9 | 5.14 | 14.8 |
| VOT - Av \$/hr | 13.59 | 13.2 | 13.55 | 13.2 | 13.33 | 15.1 | 13.34 | 17.7 | 14.19 | 16.5 |
| SI/IVT | 0.35 | 10.9 | 0.35 | 10.9 | 0.34 | 12.6 | 0.36 | 12.8 | 0.36 | 12.9 |
| Stop Quality/IVT | 10.9 | 10.1 | 11.0 | 10.2 | 9.9 | 10.4 | 11.1 | 11.7 | 10.2 | 11.1 |
| Bus Quality/IVT | 12.9 | 8.0 | 13.0 | 8.1 | 10.6 | 7.3 | 12.9 | 9.4 | 12.7 | 9.6 |
| Constant/IVT | 0.3 | 0.3 | 0.3 | 0.2 | -0.2 | 0.2 | - | - | - | - |
| Concession % | 22% | | 22% | | 22% | | 22% | | 20% | |
| Income \$kpa | 69 | | 69 | | 68 | | 69 | | 73 | |
| IVT mins | 26 | | 26 | | 26 | | 26 | | 23 | |
| SI mins | 32 | | 32 | | 32 | | 32 | | 31 | |
| Wait mins | 8 | | 8 | | 8 | | 8 | | 7 | |
| Obs | 8,830 | | 8,831 | | 6,877 | | 8,830 | | 8,830 | |

* weighted by set 4 weights

Balancing the number of responses to the 25 SPs had negligible effect (‘SP Balanced’).

Excluding respondents who did not trade-off (either selecting the slower but cheaper choice or alternatively the expensive but faster choice) improved the accuracy of the IVT parameters despite the reduction in sample size but had little effect on the parameter estimates.

The size and sign of the constant indicated a slight preference for the cheaper, slower and lower quality option which resulted in a constant of 0.3 minutes (‘Basic Model’). The

constant was highly insignificant. Omitting it ('No Constant') has next to impact, reducing the value of time very slightly.

The preferred model ('No Constant *') is shown on the right and was estimated without constant and with observations weighted to reflect ferry patronage data. The value of time was \$14.19/hr. Standard fare payers had a much higher value (\$16.45/hr) than concession fare respondents (\$5.14/hr) who were able to 'buy' the time savings on the show cards at half the fare.

A series of models were fitted that segmented the sample by ferry route, trip purpose, occupation, income and gender.

The value of time was similar for Manly, Inner Harbour, Parramatta and Newcastle respondents with an average of \$11.84/hr (Figure 10). Fast ferry users had a significantly higher value of time of \$30.39/hr which raised the overall average to \$14.19/hr. The valuation of service interval was consistent across the ferry routes at around 0.36. Wharf and ferry quality was valued similarly by Manly, Inner Harbour and Parramatta respondents but lower by Newcastle and fast ferry respondents.

Figure 10: Value of Time by Route

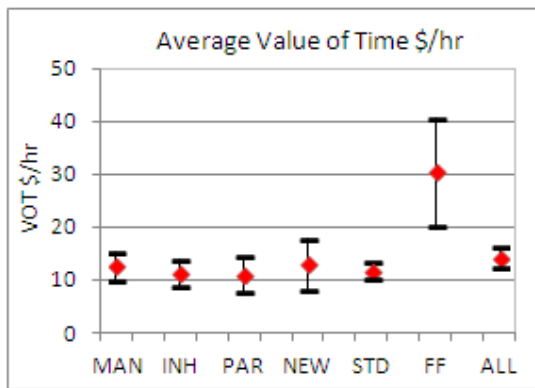
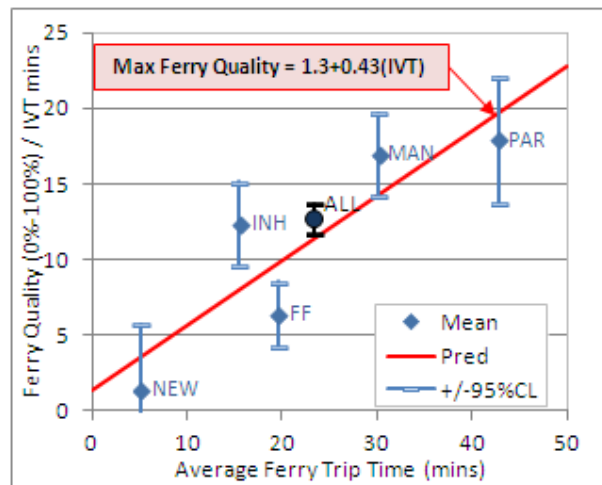


Figure 11: Ferry Quality (VP-VG) with Trip Length



The value of vessel quality increased with trip length (Figure 11) at a rate of 0.43 minutes per minute of onboard ferry time from a 'flag fall' value of 1.3 minutes. Thus for a 20 minute trip, the maximum value of vessel quality (0% to 100%) was 10 minutes. Newcastle respondents, who had the shortest trip (5 minutes) valued ferry quality the lowest at 1.4 minutes. Parramatta and Manly respondents who had the longest ferry rides (44 and 30 minutes) valued ferry quality highest at 18 and 17 minutes respectively.

Travel time was valued higher by peak respondents at \$20.02/hr than off-peak respondents at \$11.20/hr. The higher peak value reflected a lower concession share (10% versus 27%), higher incomes (\$88k versus \$64k), high commuting shares, a greater share of fast ferry users (33% versus 5%) and a lower share of sightseers.

Peak respondents valued wharf and ferry quality less than off-peak respondents. For wharf quality, peak respondents valued the maximum range in quality at 8.5 minutes compared to 13 minutes for off-peak respondents. For ferry quality, the valuations were 17 minutes and 7 minutes respectively.

In terms of trip purpose, company business had the highest value of time (\$21.20/hr) with work commuting trips (JTW) second on \$18.50/hr, Figure 12. Shopping trips (\$16/hr) also valued travel time highly but with a wide range in the estimate. Education trips valued travel time lower at \$9.50/hr reflecting the effect of concession entitlement. The value of time for

holiday/entertainment trips (accounting for a third of the ferry market) was \$10.70/hr. There was less variation in the valuation of service interval. In terms of quality, shopping trips, Visiting Friends and Relatives (VFR) and entertainment/holiday valued differences in wharf and vessel quality higher than JTW and education trips.

In terms of socio-economic status, employed respondents had a value of time of \$17/hr (41% of the average hourly income of \$41.50/hr (\$83,000 divided by 2,000 hours)). The estimate was precise reflecting the large sample. The value of time for non employed respondents was lower with students \$8.60/hr, house persons \$6.80/hr, retired \$3.50/hr and unemployed \$7.40/hr. The lower values reflected higher concession use, lower incomes and proportionally more 'discretionary' trips.

The value of time increased with income from \$8.69/hr for incomes under \$30k to \$18.20/hr for incomes over \$120k. The predicted relationship was for the value of time to increase by \$0.08/hr for each extra \$1,000 of annual income from \$7.80/hr at zero income, Figure 13.

Figure 12: Value of Time & Journey Purpose

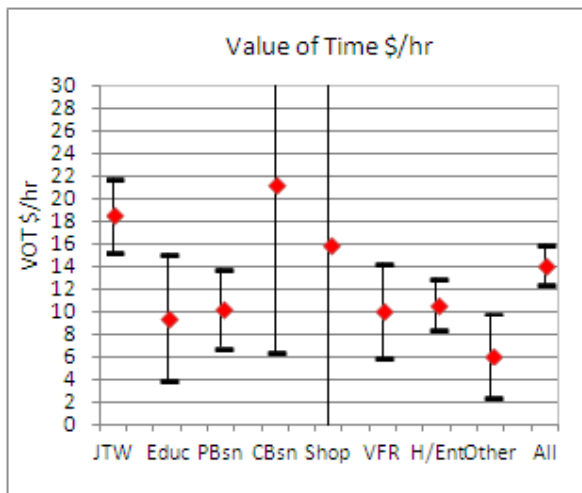
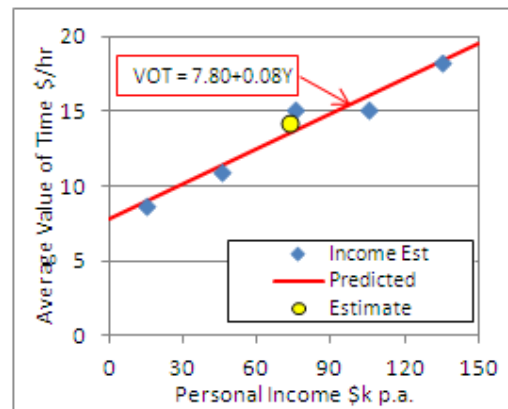


Figure 13: Income & Value of Time



In terms of gender, females valued travel time higher than males (\$15.80/hr compared to \$12.80/hr). Albeit statistically insignificant (95% CL), the higher value for females was despite lower personal incomes (\$65k versus \$82k). Had females and males had the same income of \$73k, the values of time would have been \$16.40 for females and \$12.10/hr for males using the predicted income relationship (\$0.08 per \$1,000 of personal income). Income adjusted, the difference of \$4.30/hr was statistically significant at the 95% confidence level (t=2.34). There was no significant difference in the value of service interval, wharf and ferry quality between males and females.

8. Generalised Cost of Ferry Travel

The estimated valuations can be used to calculate generalised cost measures that unlike conventional measures include stop and vehicle quality, Table 10 and Figure 14 present the estimates calculated for the 'average' ferry trip departing every 34 minutes, taking 21 minutes and costing \$6.54 and for wharfs and ferries rated at 74% and 77%.

$$GT = sSI + IVT + 60 \frac{Fare}{VOT} + sqb(1 - SQR^{0.7}) + sqa(1 - SQR^{0.7}) + vq(1 - VQR^{0.7}) \dots(3)$$

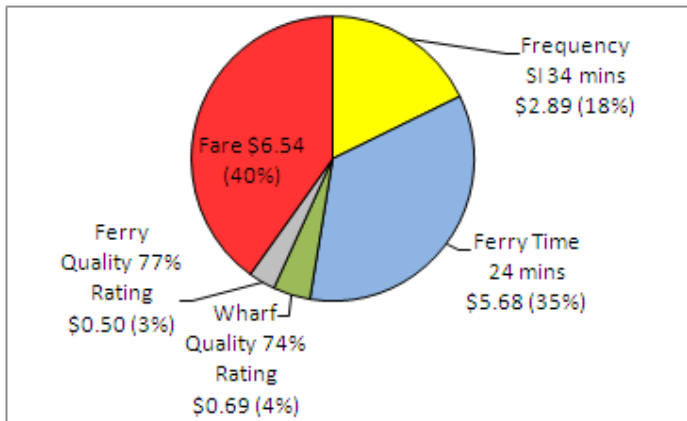
$$GT = VOT \frac{GT}{60} \dots(4)$$

Table 10: Generalised Cost of Travel

| Trip Component | Average Value | Relative Valuation | Generalised Time mins | Generalised Cost \$ | GC Share % |
|-------------------------------------|---------------|--------------------|-----------------------|---------------------|------------|
| Frequency - Service Interval (mins) | 34 | 0.36 | 12 | 2.89 | 18% |
| Onboard Ferry Time (mins) | 24 | 1.0 | 24 | 5.68 | 35% |
| Board Wharf Quality (Rating %) | 74% | 10.2 | 1.9 | 0.46 | 3% |
| Alight Wharf Quality (Rating %)^ | 74% | 5.2 | 1 | 0.23 | 1% |
| Ferry Quality (Rating %) | 77% | 12.7 | 2 | 0.50 | 3% |
| Average Fare \$/trip | 6.54 | 14.19/hr | 28 | 6.54 | 40% |
| Total | | | 69 | 16.30 | 100% |

^ 51% of board valuation (see Table 5.6). Average Time T3.11 Av SI T3.10.1 & Av Fare T3.15.

Figure 14: Generalised Cost of Travel



Fare at \$6.54 accounted for 40% of the generalised cost (GC) of \$16.30. Onboard ferry time (24 minutes) accounted for 35%. The cost of the service interval was calculated by multiplying the average service interval (34 minutes) by the service interval valuation of 0.36 which gave an equivalent onboard time of 12 minutes (\$2.89) which was 18% of the GC.

The cost of quality was calculated relative to 'very good'. For wharf quality, the 'cost' of the average wharf rating of 74% was worth 1.9 minutes [$10.2(1 - 0.74^{0.7})$] or 46 cents. For the alighting wharf, the value of the same rating quality was worth 1 minute (23 cents).

For ferry quality, the 77% rating converts to a value of 2.12 minutes. If the ferry time was appreciably different from the average, the formula in Figure 11 ($6 + 0.3IVT$) can be used.

Thus based on the average passenger ratings, wharf and ferry quality impose a relatively small cost on passengers amounting to \$1.19 or 7% of the generalised cost.

9. Comparison of Modal Ratings & Service Valuations

Table 11 compares the vehicle and wharf for ferry with the ratings obtained for bus, LRT and rail in similar surveys undertaken at the around the same time. Ferry rated higher in terms of the vehicle rating (77%) than buses and trains but lower than LRT. In terms of 'stops', ferry wharfs rated joint top (74%) with LRT. Train stations and bus stops tended to be rated lower.

Table 12 compares the SP values for ferry, bus, LRT and rail with all models weighted to reflect patronage by market segment and time period.

Table 11: Comparison of Ferry with Bus, LRT and Rail Ratings

| Rating | Statistic | Bus | Ferry | LRT | Rail | All |
|-------------------------|-----------|------------|-----------|---------|-----------|---------|
| Vehicle | Average | 70% | 77% | 80% | 65% | 68% |
| | Range | 60% - 85%* | 70% - 86% | na^ | 48% - 73% | 48%-86% |
| Wharf/ Stop/ Station | Average | 61% | 74% | 74% | 66% | 64% |
| | Range | 43% - 66%* | 48% - 84% | 63%-81% | 44% - 88% | 43%-88% |

* All weighted 43% B, 3%F, 1%L & 53%R. Range is by bus route (sample ≥10) ^ only one LRT type (Variotram)

Table 12: Comparison of PT Values of Service Quality

| Parameter | Bus | | Ferry | | LRT | | Rail | | All | |
|---------------------|--------|------|--------|-------|--------|-------|--------|-------|--------|-------|
| | β | t | β | t | β | t | β | t | β | t |
| SI | -0.041 | 47.0 | -0.032 | -16.0 | -0.061 | -20.3 | -0.047 | -47.0 | -0.043 | -55.0 |
| IVT | -0.066 | 23.7 | -0.088 | -22.0 | -0.081 | -13.5 | -0.069 | -23.0 | -0.068 | -41.3 |
| Fare | -0.392 | 32.2 | -0.321 | -21.4 | -0.225 | -9.8 | -0.289 | -22.2 | -0.332 | -44.5 |
| Fare Conc | -0.360 | 14.5 | -0.706 | -19.6 | -0.208 | -3.9 | -0.307 | -12.3 | -0.355 | -25.1 |
| Stop Quality | -0.687 | 12.1 | -0.900 | -12.9 | -0.954 | -8.5 | -0.965 | -17.9 | -0.836 | -26.1 |
| Vehicle Quality | -0.747 | 7.5 | -1.119 | -10.7 | -0.328 | -2.0 | -0.845 | -10.4 | -0.811 | -17.0 |
| VOT - Std \$/hr | 10.10 | 19.0 | 16.45 | 15.3 | 21.60 | 7.9 | 14.33 | 16.0 | 12.37 | 30.0 |
| VOT - Conc \$/hr | 5.27 | 14.3 | 5.14 | 14.8 | 11.22 | 4.9 | 6.95 | 12.5 | 5.98 | 24.3 |
| VOT - Av \$/hr | 8.36 | 22.9 | 14.19 | 18.2 | 20.69 | 8.3 | 12.33 | 18.4 | 10.45 | 35.0 |
| SI/IVT | 0.62 | 19.8 | 0.36 | 12.9 | 0.75 | 11.2 | 0.68 | 20.7 | 0.64 | 32.9 |
| Stop Quality/IVT | 10.4 | 11.5 | 10.2 | 11.1 | 11.8 | 7.2 | 14.0 | 14.1 | 12.2 | 21.9 |
| Vehicle Quality/IVT | 11.3 | 9.1 | 12.7 | 9.6 | 4.0 | 1.9 | 12.2 | 9.5 | 11.9 | 15.7 |
| Concession % | 36% | | 20% | | 9% | | 27% | | 30% | |
| Income \$kpa | 44 | | 73 | | 65 | | 51 | | 49 | |
| IVT mins | 23 | | 23 | | 13 | | 34 | | 29 | |
| SI mins | 18 | | 31 | | 12 | | 18 | | 18 | |
| Wait mins | 7 | | 7 | | 6 | | 7 | | 7 | |
| Observations | 13,285 | | 8,825 | | 3,598 | | 14,462 | | 40,147 | |
| Patronage Weight | 43% | | 3% | | 1% | | 53% | | 100% | |

Models weighted by patronage data

The value of onboard ferry time at \$14.19/hr was higher than rail (\$12.33/hr) and bus (\$8.36/hr) but lower than LRT (\$20.69/hr). After weighting for mode share (bottom row), the overall value for public transport travel time was \$10.45/hr.

The values of time for the different modes are graphed with income and concession share in Figure 15. Also shown is the value for car driver and passenger time that was estimated at \$15.48/hr using similar SP surveys. The values can be seen to increase with income. For ferry, the predicted value of time for ferry at an income of \$73k was \$18.04/hr which is nearly \$4/hr higher than the estimated value of \$14.19/hr.

The valuation of service interval for ferry was also lower at 0.36 than the PT average of 0.64 (Table 12).

At 10 minutes, the maximum value of wharf quality was the same as bus stop quality and slightly less than LRT quality (11.8 mins) and rail station quality (14 mins).

Ferry quality (12.7 mins) was valued similar to train quality (12.2 mins) but higher than bus and LRT quality.

Figure 15: Values of Time by Mode by Concession Share & Personal Income

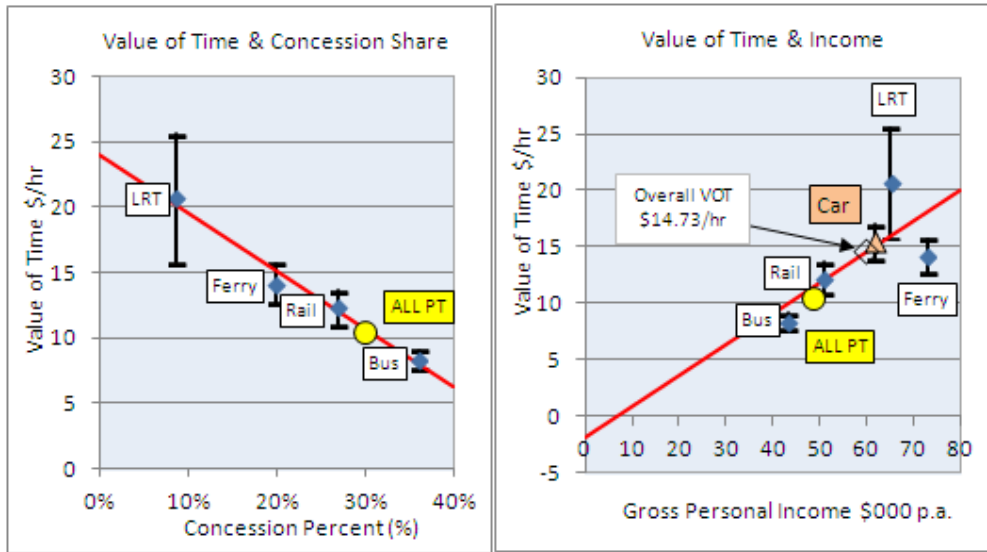


Table 12: Comparison of Values of Time by Mode

| Mode | Mode Share (%) [^] | Personal Income \$k p.a. | VOT \$/hr |
|-------|-----------------------------|--------------------------|-----------|
| Car | 85% | 62.0 | 15.48 |
| Bus | 6.5% | 43.5 | 8.36 |
| Ferry | 0.5% | 73.0 | 14.19 |
| LRT | 0.2% | 65.2 | 20.69 |
| Rail | 8.0% | 50.8 | 12.33 |
| PT | 15.0% | 48.7 | 10.45 |
| ALL | 100% | 60.0 | 14.73 |

[^]Based on a car share of 85% (BTS 2014/15 ests)

10. Comparison with 2001 Study

The 2014 survey compared fairly well with the 2001 survey in terms of the estimated value of travel time and service quality as Table 13 shows.

Table 13: Comparison of 2001 and 2014 Studies

| Attribute | BAH/DE 2001 | DE 2014 |
|------------------------|-------------------|---------|
| Service Interval | ≈0.30 | 0.36 |
| Value of Time \$/hr | 17.82* | 14.19 |
| Vessel Quality \$/trip | 0.46 [^] | 0.50 |
| Wharf Quality \$/trip | 0.52 [^] | 0.69 |

* \$11.42/hr factored by growth in weekly earnings 2001-2014 (1.56)

[^] based on average fare in 2014 of 6.54/trip

Service interval was valued similarly at 0.36 in the 2014 survey versus 0.3 in the 2001 survey. Both values were lower than for bus and train which was considered to reflect the

lower cost of timetable inconvenience rather than waiting time (which can also be often spent on the ferry rather than at the wharf).

Wharf and ferry quality were also valued similarly by the two surveys. The average value around 50 cents a trip for a package of either ferry or wharf improvements in 2001 (updated to 2014 based on average fare) or for achieving a 'very good' rating rather than that observed in 2014. Again the valuations were relatively low when compared to train and bus which reflected high satisfaction/rating with current wharf and ferry quality.

There was a bigger difference in the value of travel time. The 2001 survey estimated a value of \$11.42/hr which was factored up to \$17.82 for 2014 based on a 56% increase in nominal wages. By comparison, the 2014 survey estimated a value of \$14.19/hr which was a fifth lower.

11. Concluding Remarks

The survey used a Rating and a Stated Preference self-completed questionnaire and together, a set of ferry valuations referenced to passengers' 'on the day' travel experiences was able to be estimated in a cost-effective way.

At \$14.19/hr, the value of vehicle time for ferry passengers was higher than for rail and bus users which partly reflected higher personal incomes. The value also varied by market segment with fast ferry users valuing travel time nearly three times higher than 'standard' ferry users (\$30.39/hr versus \$11.84/hr). Company business (\$21.20/hr) and work commuters (\$18.50/hr) also had values of time twice those of holiday/entertainment trips (\$10.70/hr).

The value of service interval at 0.36 was relatively low reflecting the cost of timetable inconvenience rather than waiting time (often spent on ferries at 'terminal' wharfs).

The value of wharf and vessel quality was also relatively low which reflected high passenger satisfaction with ferry services.

The previous survey of ferry users in Sydney was undertaken 15 years previously in 2001. It also used Stated Preference techniques but with the choices comparing ferry with bus and car travel. To value quality, a Priority Evaluator was used with the valuations linked via reliability rather than the simple rating survey used in the 2014 study. The values of service interval, wharf and ferry quality were similar but with the value of time being lower in 2014 than in 2001 which probably reflected the absence of confounding modal preferences which were present in the 2001 design.

12. References

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Appendix - Details of Ferry Fleet in 2014

| | | | |
|---|---|---|--|
|  | <p>Freshwater Class 4 Vessels operating Manly service. Freshwater 1982, Queenscliff 1983, Narrabeen 1984, Collaroy 1988. Stats: Pax capacity 1100, length 70 metres Displacement 1140 tonnes, crew 6, speed 18 knots, fuel Passenger rating 73%</p> |  | <p>HarbourCat 2 HarbourCats provide back-up on Inner Harbour. Anne Sargeant 1998, Pam Burridge 1988. Cap 150, length 27.1 metres, displ 34t, crew 2, speed 22 knots, fuel 45L/hr. Passenger rating: 75%</p> |
|  | <p>Lady Class 2 vessels operate Mosman Bay & Taronga Zoo. Lady Herron 1974 Capacity 552. Lady Northcott acquired 1974 Capacity 811. Lady Northcott stats: 43.8 metres, Displacement 383 tonnes, Crew Passenger rating - not surveyed</p> |  | <p>Captain Cook Catamarans 4 contracted catamarans operate Paramatta River. Rocket Jillian 2013 Cap 152, Elizabeth Cook, Annabelle Rankin & Mary Reibey 2014 Cap 200. E. Cook stats: 23.9m, disp 28t, 20knts, fuel 50L/hr, crew 2. Passenger rating: 85%</p> |
|  | <p>First Fleet Catamarans 9 single-ended 'First Fleet Class' catamarans. Operate inner harbour: Supply aquired 1984, Sirius 1984, Alexander, 1985, Borrowdale 1985, Charlotte 1985, Fishburn 1985, Friendship 1986, Golden Grove 1986, Scarborough 1986. Stats: Cap 396 pax, length 25.4 m, disp 83t, speed 12 knots, fuel 51L/hr, Passenger rating 75%</p> |   | <p>Private Fast Ferry Catamarans When surveyed in 2014, Manly - Circular Quay fast ferries operated by two companies: Manly Fast Ferries - Ocean Dreaming & Ocean Rider (blue boat) and two Sydney Fast Ferries - Palm Cat & Maggie Cat (yellow). Maggie Cat Stats: length 31.7m, cap 300 pax, speed 28 knots. Passenger rating: 84%</p> |
|  | <p>RiverCat Class 7 low wash catamarans named after Australian sportswomen. Operate Parramatta River. Betty Cuthbert 1992, Dawn Fraser 1992, Shane Gould 1993, Marlene Mathews 1993, Marjorie Jackson 1993, Evonne Goolagong 1993, Nicole Livingstone 1995. Stats: length 35m, disp 58t, speed 22knts, fuel 87L/hr, Crew 3. Passenger rating: 75%</p> |  | <p>Newcastle-Stockton Ferry 2 catamarans operate estuarine ferry service (3-5 minute) between Stockton and Newcastle. Two catamarans are Hunter (top photo) and Shortland (bottom) acquired 1985 and with passenger carrying capacity of 200. Passenger Rating 77%</p> |
|  | <p>SuperCat Class 4 catamarans primarily serving Eastern Suburbs. Saint Mary MacKillop 2000, Susie O'Neill 2000, Louise Sauvage 2001, SuperCat 4 2001. Capacity 275 (326 daylight hours), length 34.2m, disp 60t, speed 24 knots, Fuel 97L/hr, crew 3-4. Passenger rating: 77%</p> |  | |