Author name: C. Carroll

Date of submission: Thursday, July 23, 2015

Submission: I studied this as my capstone (thesis) project as part of my undergraduate civil engineering degree. I have attached a high level poster outlining some of the findings of my thesis. I am able to provide a full copy of my project if requested.

AN EVALUATION OF MULTI-MODAL FARE INTEGRATION FOR PUBLIC TRANSPORT IN SYDNEY

CLAIRE CARROLL A14-148

INTRODUCTION

Public transport fares in Sydney are calculated separately for buses, trains, ferries, light rail and multi-modal travel (i.e. travel that involves more than one type of transport). While the introduction of the Opal card has brought about an integrated ticketing system, these separate ways of calculating fares are still used for each mode.

Under an **integrated fare system**, one method of calculating fares is used across all public transport modes with the fare depending only on the origin and destination of a journey. Consequently, the mode(s) used to make a journey do not affect the fare charged.

The objective of this project is to evaluate multi-modal fare integration for public transport in Sydney by assessing the impacts of implementing an integrated fare system.

SYDNEY'S CURRENT FARE SYSTEM

A fare system is the system that determines how much a passenger has to pay to use public transport, and how they pay this fare.

Ticketing system

Ticketing systems include the actual tickets used as well as the infrastructure and processes used for purchasing and validating tickets. Sydney currently uses two separate ticketing systems:

» **MyZone:** MyZone is the brand name given to the paper ticketing system used in Sydney, with individual ticket brands of MyBus, MyTrain, MyFerry and MyMulti. Tickets are generally purchased in advance and use magnetic strips for validation.

» **Opal:** The Opal card is Sydney's smartcard ticketing system. Smartcards are plastic cards that store some of a passenger's money, which is spent on public transport fares when they are placed on a reader. The Opal card commenced rollout in late 2012, and is now valid on all ferries, all trains and most buses. The rollout will be extended to all bus routes and light rail early next year.

Fare structures

Fare structures are the way in which fares are calculated. Common fare structures include:

» **Flat fare:** A constant fare is charged regardless of distance travelled.

» **Zone fare:** A public transport network is divided into zones with the fare dependent on the number of zones a passenger travels through.

» **Sectional fare:** Each public transport route is divided into sections with the fare dependent on the number of sections a passenger travels through.

» **Distance band fare:** Bands of distances (e.g. 0 – 5km, 5 – 10km) are used to calculate fares. The distance travelled can either be calculated as the route distance or straight-line distance.

» **Distance fare:** Fares are calculated using the exact distance travelled. Again, the distance travelled can either be calculated as the route distance or straight-line distance.

The fare structures used in Sydney are listed below.

Mode	MyZone fare structure	Opal fare structure
Train	Distance band (Route Distance)	Distance band (route distance)
Bus	Sectional (unique to route)	Distance band (straight-line distance)
Ferry	Distance band (route distance)	Distance band (straight-line distance)
Light rail	Zone	N/A
Multi-modal	Zone	N/A

Criticisms

There are a number of criticisms of Sydney's fare system, including:

» **Complexity:** Sydney uses eight separate fare structures, each with a number of ticket products available, making Sydney's fare system very complex. This makes it difficult for passengers to understand which ticket they need to purchase.

» **Multi-modal travel:** Passengers that make multi-modal journeys (i.e. use more than one type of transport) have to pay a separate fare, unless they are using the MyMulti ticket. The MyMulti is only available as a weekly paper ticket, so is not suitable for infrequent passengers and is not available to passengers with Opal cards

QUALITATIVE EVALUATION

There would be a number of impacts of moving to an integrated fare system:

» **Reduced complexity:** The eight separate fare structures would be replaced with a single fare structure. This would reduce informational cost and may encourage new patronage.

» **Increased equity for multi-modal passengers:** Passengers that change mode would not have to pay a separate fare.

» **Forwards compatibility with public transport projects:** Both the North West Rail Link and Sydney Light Rail extension will replace buses with rail. When these transport projects are completed, some passengers will be forced to transfer from their bus to rail. Under the current differentiated fare system, these passengers would also be forced to pay an additional fare. Under an integrated fare system, they would pay the same fare as the equivalent bus-only journey.

» **Change in travel patterns:** The price of fares will change for some passengers, causing some passengers to change their travel patterns in response to this. According to the price elasticity of demand equation, if fares increase, less passengers will use public transport, and vice versa.

» **Change in overall ridership and revenue:** The values for ridership and revenue will change as a result of changes in travel patterns.

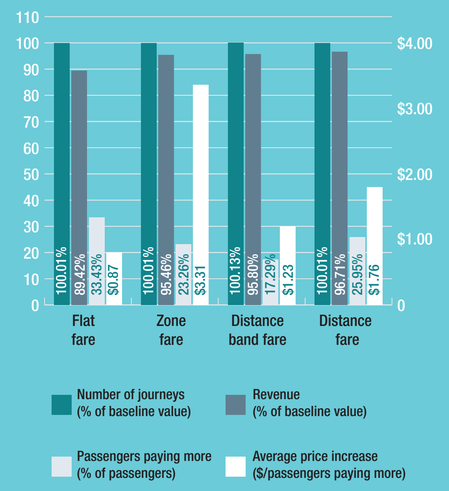
QUANTITATIVE EVALUATION

A computer model was developed to predict impacts to ridership and revenue under flat, zone, distance and distance band fare structures. The model, based in MATLAB, incorporated data from the Household Travel Survey in an economic analysis. The model was used to identify the pricing scheme for each fare structure that best met the following criteria:

1. The number of journeys under the integrated fare structure must be greater than or equal to the current number of journeys.
2. Revenue under the integrated fare structure is maximised.
3. The number of passengers paying more is minimised.

The results of the model for best pricing scheme for each fare structure are shown right for comparison.

It is evident that **distance band fares** produced the best results. Firstly, a flat fare is not suitable since a third of passengers had to pay a higher fare and revenue was only 89% of current revenue.



Zone, distance and distance band fares all achieved comparable levels of revenue, however under the distance band fare structure, less passengers had to pay more and the average price for these passengers was lower.

The distance band fare structure that gave the above results is summarised below. It was developed using existing Opal fare structures.

Ticket	Adult	Child/ Concession	Pensioner
0 – 3km	$2.10	$1.05	$1.05
3 – 9km	$3.30	$1.65	$1.65
9 – 17km	$4.10	$2.05	$2.05
17 – 28km	$4.70	$2.35	$2.35
28 – 50km	$6.30	$3.15	$2.50
50kms+	$8.10	$4.05	$2.50
Daily cap	$15.00	$7.50	$2.50
Maximum cost per week	$60.00	$30.00	$10.00

RECOMMENDATIONS

Based on the qualitative and quantitative evaluation, the following recommendations have been formed:

1. **An integrated fare system should be implemented.**
   The advantages of implementing an integrated fare structure, such as reduced complexity, increased fairness, and forwards compatibility with public transport projects, far outweigh the drawbacks of having some passengers paying more for their fares and an estimated small reduction in revenue.
2. **A distance band fare structure should be used for the integrated fare system.**
   Distance band fares produced the best model results and are also the most common current fare structure used for calculating fares in Sydney.
3. **Further modelling should occur.**
   There were a number of limitations in the mode, and as such the model should be further developed to confirm the above results.