The development of demand responsive transport service for older people in NZ rural areas: Preliminary Case Study in Thames

Chan Kim / MSc, PhD
Waikato Institute of Technology
Introduction

- Research Background:
  - Trend of elderly population in NZ
  - Travel behavior (Modal share and trip purpose)
- Demand Responsive Transport Service
- Case Study: Thames, Waikato
  - Survey method and sample
  - Analysis
- Conclusion & Research Direction
The number of people aged 65 and over is **increasing**

At the June of 2018, **747k people** were aged 65-plus

Those aged 65 years and older will roughly **double** in 2046 with 1.3 - 1.5 million

Or **23%** of the total population, up from 12% in 2016.
Driving **declines** to around 60-65 percent of mode share and walking and passenger mode share time **increases**.

Source: MoT (2017)
Background
Travel Behavior: Time Spent Travelling

► After age 65, the number of hours travelled per week *drops* dramatically

Source: MoT (2017)
Background
Travel Behavior: Trip Purpose

- Trip Purpose: **Shopping** and **Social** trips are **major components** of trip.

Source: MoT (2017)
Demand Responsive Transport Service (DRTS) (aka, demand responsive transit)

- **Flexible routing** and scheduling, Small or medium vehicles (shared-ride mode), **Door-to-door** (pick-up and drop-off location)
- Provide a PT service for areas of **low passenger demand**, **special needs** passengers
- May fully funded or partially funded
  - U.S.: 1500 rural + 400 urban system
  - Switzerland: Publicar – operated in sparse populated areas (under 100 person/km²)
  - U.K.: pick up at ‘meeting point’
  - And many countries including, Australia, Canada, Japan, etc.
  - In NZ, available in Katikati and Te Aroha (aka., Community vans)

Source: Elder Transportation Service
https://eldertransportaustin.com/demandresponsetransport/
Demand Responsive Transport Service (DRTS)

**Mass Transport Service: Transport Categories**

<table>
<thead>
<tr>
<th></th>
<th>Public</th>
<th>Non-Public</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Public line transport</td>
<td>Non-public line transport</td>
</tr>
<tr>
<td></td>
<td>Urban transport</td>
<td>Pupils</td>
</tr>
<tr>
<td></td>
<td>Employees</td>
<td></td>
</tr>
<tr>
<td>Irregular</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rural Transport</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shared taxi</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DRT</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Para-transit</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Carpooling</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Organized traveling</td>
<td></td>
</tr>
</tbody>
</table>

**Example**
- Train (minimally)
- Long distance bus
- Line bus
- Special line transport
- Ordered bus
- DRT
- Cab
- Individual transport

Source: Elder Transportation Service
https://eldertransportaustin.com/demandresponsetransport/
Case Study: Thames, Waikato

- The gateway to the **Coromandel Peninsula**
- Approximately **1 to 1.5 hours’** drive from Auckland, Hamilton, and Tauranga
- **Cheaper** housing and living costs, an attractive location to retire to
- The population for people aged 65 and over in Thames is **increasing**
- PT in Thames is not adapting fast enough to meet future demand due to the growing elderly population.
Case Study: Thames, Waikato

Thames has a growing elderly population.
Few PT options available currently (Taxi and Thames Connector Bus*)

Due to steep topography some forms of transport are not suitable for all people (50/50 Flat to steep)

Current public transport is either too expensive, schedule based (buses) and not all door to door

*6 month trial service + one year contract, urban service only

Case Study: Thames, Waikato

Percentage of Thames Population

<table>
<thead>
<tr>
<th>Year</th>
<th>2001</th>
<th>2006</th>
<th>2013</th>
<th>2018</th>
<th>2023 (Year)</th>
<th>2028</th>
<th>2033</th>
<th>2038</th>
<th>2043</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>30%</td>
<td>35%</td>
<td>40%</td>
<td>45%</td>
<td>50%</td>
<td>5%</td>
<td>10%</td>
<td>15%</td>
<td>20%</td>
</tr>
</tbody>
</table>

Year 2006: 30%
Year 2018: 43%
RECAP: Travel Behavior of Elderly

- Jansuwan et al. (2013)
  - Make more frequent short trips
  - Travel mode for social or recreational trips
  - High reliance on private vehicles (help from family)

- Rahman et al. (2016)
  - Most preferred mode use option: volunteer driver with the shuttle bus
  - Least preferred mode use option: pre-paid taxi and bus

- Schwarzlose et al. (2014)
  - High willingness-to-pay for a flexible PT service
RECAP: Thames PT service

Thames Connector Bus 6-month Trial User Data

<table>
<thead>
<tr>
<th>Month:</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Avg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non super gold card user</td>
<td>287</td>
<td>366</td>
<td>247</td>
<td>218</td>
<td>361</td>
<td>282</td>
<td>294</td>
</tr>
<tr>
<td>Super gold card users</td>
<td>577</td>
<td>517</td>
<td>509</td>
<td>657</td>
<td>597</td>
<td>611</td>
<td>578</td>
</tr>
<tr>
<td>(users aged 65 plus)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Number of users</td>
<td>864</td>
<td>883</td>
<td>756</td>
<td>875</td>
<td>958</td>
<td>893</td>
<td>872</td>
</tr>
<tr>
<td>% of users over 65 in age</td>
<td>67%</td>
<td>59%</td>
<td>67%</td>
<td>75%</td>
<td>62%</td>
<td>68%</td>
<td>66%</td>
</tr>
<tr>
<td>Avg. number of 65+ /day</td>
<td>19</td>
<td>17</td>
<td>18</td>
<td>21</td>
<td>20</td>
<td>20</td>
<td>19</td>
</tr>
</tbody>
</table>

% of users over 65 in age (2016-17: Horizons Regional Council)

- Palmerston North: 4.8% (50,668)
- Whanganui: 26.4% (38,396)
- Feilding: 9.9% (8,686)
- Ashhurst: 12.1% (676)
Research Questions & Methodology

Research Question

- Investigate the **modes of transport available** to the aging population in NZ medium/small town and rural
- Explores the **requirements** to complete the Transport for the Elderly
- Determine the most **effective methods of transport** for people aged over 65

Methodology

- 2 surveys: Revealed Preference, Stated Preference
- **Econometric Modelling**
Methodology: Rank-ordered logit (ROL) model

- Extended from conditional logit model (McFadden, 1974; Beggs et al., 1981; Hausman and Ruud, 1987; Pundj and Staelin, 1978; Chapman and Staelin, 1982; and Allison and Christakis, 1994)

\[
Pr(U_1 > U_2 > \cdots > U_j) = Pr(U_1 > U_j, j = 1, 2, \cdots, J)
\]

\[
\cdot Pr(U_2 > U_j, j = 3, 4, \cdots, J) \cdot \cdots \cdot Pr(U_{J-1} > U_J)
\]

\[
= \frac{e^{V_1}}{\sum_{j=1}^{J} e^{V_j}} \cdot \frac{e^{V_2}}{\sum_{j=2}^{J} e^{V_j}} \cdot \cdots \cdot \frac{e^{V_{J-1}}}{e^{V_{J-1}} + e^{V_J}} = \prod_{j=1}^{J} \left[ \frac{e^{V_{J-j}}}{\sum_{m=j}^{J} e^{V_m}} \right]
\]

\[
Pr\left(U_1 > U_2 > \cdots > U_K, K \leq J\right) = \prod_{j=1}^{K} \left[ \frac{e^{V_j}}{\sum_{k=j}^{K} e^{V_k}} \right]
\]

- ROL model can be estimated by SAS\textsuperscript{®} statistical analysis software
Revealed Preference Survey: Sample Data

- **Gender**
  - Male: 60%
  - Female: 37%
  - No answer: 3%

- **Age**
  - 75 to 89: 40%
  - 70 to 74: 17%
  - 65 to 69: 34%
  - 90 to 94: 5%
  - No answer: 4%

- **Residence Type**
  - Own home: 59%
  - Retirement Village: 26%
  - Rental: 14%
  - No answer: 11%

- **Income**
  - <$20,000: 14%
  - $20,000 to $40,000: 46%
  - $40,000 to $60,000: 13%
  - $60,000+: 16%
  - No answer: 11%
Revealed Preference Survey

LOCATION OF RESIDENCE

- Thames Central: 33%
- Parawai: 20%
- Tararu: 14%
- Totara: 4%
- East of Rolleston Street: 13%
- Moanataiari: 13%
- No answer: 3%
## Analysis: Trip Pattern

### Trip Destination

<table>
<thead>
<tr>
<th>Destination</th>
<th>Trip/week</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Shopping</strong></td>
<td>1.91</td>
<td>1</td>
</tr>
<tr>
<td>Medical</td>
<td>0.32</td>
<td>5</td>
</tr>
<tr>
<td><strong>Social</strong> (Family/Friend/church)</td>
<td>1.55</td>
<td>2</td>
</tr>
<tr>
<td>Recreation</td>
<td>0.42</td>
<td>3</td>
</tr>
<tr>
<td>Other</td>
<td>0.35</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total Average Trip</strong></td>
<td>4.54</td>
<td></td>
</tr>
</tbody>
</table>

### Use of Mode (Overall)

<table>
<thead>
<tr>
<th>Mode</th>
<th>Trip/week</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Own vehicle</strong></td>
<td>4.03</td>
<td>1</td>
</tr>
<tr>
<td>Bus</td>
<td>0.32</td>
<td>3</td>
</tr>
<tr>
<td>Taxi</td>
<td>0.13</td>
<td>5</td>
</tr>
<tr>
<td><strong>Walking</strong></td>
<td>0.52</td>
<td>2</td>
</tr>
<tr>
<td>Cycling</td>
<td>0.04</td>
<td>7</td>
</tr>
<tr>
<td>Mobility Scooter</td>
<td>0.15</td>
<td>4</td>
</tr>
<tr>
<td>Friend and Family</td>
<td>0.07</td>
<td>6</td>
</tr>
</tbody>
</table>
Analysis: Travel behavior

- Use of the **Alternative Mode**: Non-vehicle Owner

<table>
<thead>
<tr>
<th>Alternative Mode</th>
<th>Weighted Average (%)</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking (include Mobility scooter)</td>
<td>36.9</td>
<td>1</td>
</tr>
<tr>
<td>Friend/Family support</td>
<td>26.0</td>
<td>2</td>
</tr>
<tr>
<td>Bus</td>
<td>19.6</td>
<td>3</td>
</tr>
<tr>
<td>Taxi or Companion driver service</td>
<td>13.7</td>
<td>4</td>
</tr>
</tbody>
</table>
The main reason you **stopped** driving is **(vehicle and road factors)**

<table>
<thead>
<tr>
<th>Alternative Mode</th>
<th>Weighted Average (%)</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating costs of owning a vehicle</td>
<td>26.5</td>
<td>1</td>
</tr>
<tr>
<td>Dealing with traffic congestion</td>
<td>18.0</td>
<td>3</td>
</tr>
<tr>
<td>Poor road conditions</td>
<td>18.9</td>
<td>2</td>
</tr>
<tr>
<td>Lack of parking/ difficulty parking</td>
<td>11.3</td>
<td>4</td>
</tr>
<tr>
<td>Design and comfort of your vehicle</td>
<td>3.3</td>
<td>5</td>
</tr>
</tbody>
</table>

![Chart showing cost, congestion, road condition, parking, and vehicle factors by age group 65-75 and Over75.](chart.png)
The main reason you **stopped** driving (physical factors)

<table>
<thead>
<tr>
<th>Alternative Mode</th>
<th>Weighted Average (%)</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worried about getting lost</td>
<td>22.7</td>
<td>2</td>
</tr>
<tr>
<td>Concerned with other driver’s behavior</td>
<td>13.7</td>
<td>4</td>
</tr>
<tr>
<td>Health reasons (poor eyesight etc)</td>
<td>23.6</td>
<td>1</td>
</tr>
<tr>
<td>Confidence with driving</td>
<td>8.1</td>
<td>5</td>
</tr>
<tr>
<td>Traffic moves too fast</td>
<td>15.6</td>
<td>3</td>
</tr>
</tbody>
</table>
## Analysis: Travel behavior

### Perception for use of the Public Transport

<table>
<thead>
<tr>
<th>Alternative Mode</th>
<th>Weighted Average (%)</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accessibility (getting to the stop)</td>
<td>20.7</td>
<td>1</td>
</tr>
<tr>
<td>Difficulty boarding</td>
<td>16.6</td>
<td>3</td>
</tr>
<tr>
<td>Being able to get a seat</td>
<td>15.9</td>
<td>4</td>
</tr>
<tr>
<td>Being worried about crime</td>
<td>17.9</td>
<td>2</td>
</tr>
<tr>
<td>Public transportation is too expensive</td>
<td>14.1</td>
<td>6</td>
</tr>
<tr>
<td>Public transportation doesn’t go where I need to go</td>
<td>15.3</td>
<td>5</td>
</tr>
</tbody>
</table>

![Bar chart showing differences across various factors](chart.png)
Analysis: DRPT Service

Perception for the **use of Demand Responsive PT service**

Example of Trip:
From Tararu to the Thames Civic Centre on Mary St.
- Total Distance: 3.7 km
- Travel Time: 5 minutes

- **YES** 72%
  - $5 75%
  - $7.50 21%
  - $10 2%
  - $15 2%

- **NO** 28%
  - $5 75%
  - $10 21%
  - $15 2%
  - $7.50 2%
Analysis: DRPT Service

**System Requirements** for the Demand Responsive PT service

**Booking Method**

- By phone call: 60%
- Website or email: 20%
- Mobile phone application: 20%

**Minimum Booking Time**

- No minimum: 41%
- Over 6 hours prior: 9%
- 1 to 6 hours prior: 9%
- 1 hour prior: 16%
- ½ hour prior: 25%
Conclusion

- Preliminary Survey Analysis shows that the majority of people surveyed would consider using a **DRPT service**, if they could no longer drive their own vehicle.

- There will be a greater need for more **flexible PT** options in small towns as the population ages.

- **Accessibility** is one of the biggest reasons why existing public transport needs to be improved to meet the growing demands for public transport for people aged over 65.

- ‘**Tailored**’ operational plan required regarding
  - Operation hours, booking time, etc
Sample size, the location of sample collected

Discrete choice (Behaviour) models allow researchers to analyse and predict how people's choices are influenced by their personal characteristics and by the alternatives available to them.

Apply operational options to estimates the demand changes in comparison with the 'do-nothing' policy.

- Decreasing service fare for DRPT (or Increasing subsidies)
- Increasing service frequency (or service area)

Measure Willingness-to-pay (WTP) to evaluate elasticity of elderly demand based on new service.
Thank you

QUESTIONS OR COMMENTS