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

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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.

(Source: Stats NZ, 2018)
Background
Travel Behavior: Modal Share

Driving declines to around 60-65 percent of mode share and walking and passenger mode share time increases.

Source: MoT (2017)
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>Regular</th>
<th>Irregular</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public</td>
<td>Non-Public</td>
</tr>
<tr>
<td>Public line transport</td>
<td>Non-public line transport</td>
</tr>
<tr>
<td>Urban transport</td>
<td>Employees</td>
</tr>
<tr>
<td>Pupils</td>
<td>Para-transit</td>
</tr>
<tr>
<td>Rural Transport</td>
<td>DRT</td>
</tr>
<tr>
<td>Shared taxi</td>
<td>Cab</td>
</tr>
<tr>
<td>Carpooling</td>
<td>Organized traveling</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/](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
Case Study: Thames, Waikato

- 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
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><strong>294</strong></td>
</tr>
<tr>
<td>Super gold card users (users aged 65 plus)</td>
<td>577</td>
<td>517</td>
<td>509</td>
<td>657</td>
<td>597</td>
<td>611</td>
<td><strong>578</strong></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><strong>872</strong></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><strong>66%</strong></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><strong>19</strong></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)

\[
\begin{align*}
Pr(U_1 > U_2 > \cdots > U_j) &= Pr(U_1 > U_j, j = 1, 2, \ldots, J) \\
&= \left[ \frac{e^{v_1}}{\sum_{j=1}^J e^{v_j}} \right] \left[ \frac{e^{v_2}}{\sum_{j=2}^J e^{v_j}} \right] \cdots \left[ \frac{e^{v_{J-1}}}{e^{v_{J-1}} + e^{v_J}} \right] = \prod_{j=1}^{J-1} \left[ \frac{e^{v_j}}{\sum_{m=j}^J e^{v_m}} \right] \\
Pr\left(U_1 > U_2 > \cdots > U_K, K \leq J\right) &= \prod_{j=1}^K \left[ \frac{e^{v_j}}{\sum_{k=j}^K e^{v_k}} \right]
\end{align*}
\]

- ROL model can be estimated by SAS® 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%

**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%
- Moanataiari: 13%
- East of Rolleston Street: 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>Shopping</td>
<td>1.91</td>
<td>1</td>
</tr>
<tr>
<td>Medical</td>
<td>0.32</td>
<td>5</td>
</tr>
<tr>
<td>Social (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>Total Average Trip</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>Own vehicle</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>Walking</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>

![Graph showing the comparison between male and female usage of different travel modes]
The main reason you stopped driving (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>
Analysis: Travel behavior

- 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><strong>Health reasons (poor eyesight etc)</strong></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** (constraints)

<table>
<thead>
<tr>
<th>Alternative Mode</th>
<th>Weighted Average (%)</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Accessibility (getting to the stop)</strong></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><strong>Public transportation is too expensive</strong></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>

![Graph showing access, boarding, seat, crime, cost, destination for male, female, 65-75, over 75 categories.]
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
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%
- ½ hour prior: 25%
- 1 hours prior: 16%
- 1 to 6 hours prior: 9%
- Over 6 hours prior: 9%
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
Limitation & Research Direction

- 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