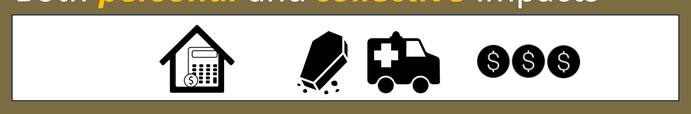
Developing a Model for the Safety Impacts of Mode Shift

Dr Glen Koorey, Director & Principal Transportation Engineer *ViaStrada Ltd, Christchurch, New Zealand*

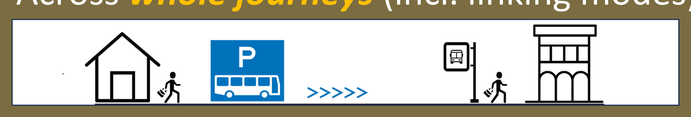
NZTA knowledge gap to address:

*What are the actual and potential **safety** impacts of:*
***Mode shift** from private motorised vehicles to public transport, active modes and micro-mobility?*

- *Both **personal** and **collective** impacts*



- Across ***whole journeys*** (incl. linking modes)



1: Literature review – topics explored…

108
DOCUMENTS REVIEWED

Travel mode casualty data
- Sources of data
- Under-reporting Levels
- Splits by urban area, age group, ethnicity, etc

Relative risk per travel mode
- Previous studies
- Modal crash/casualty rates
- Differences by urban area, age group, ethnicity, etc

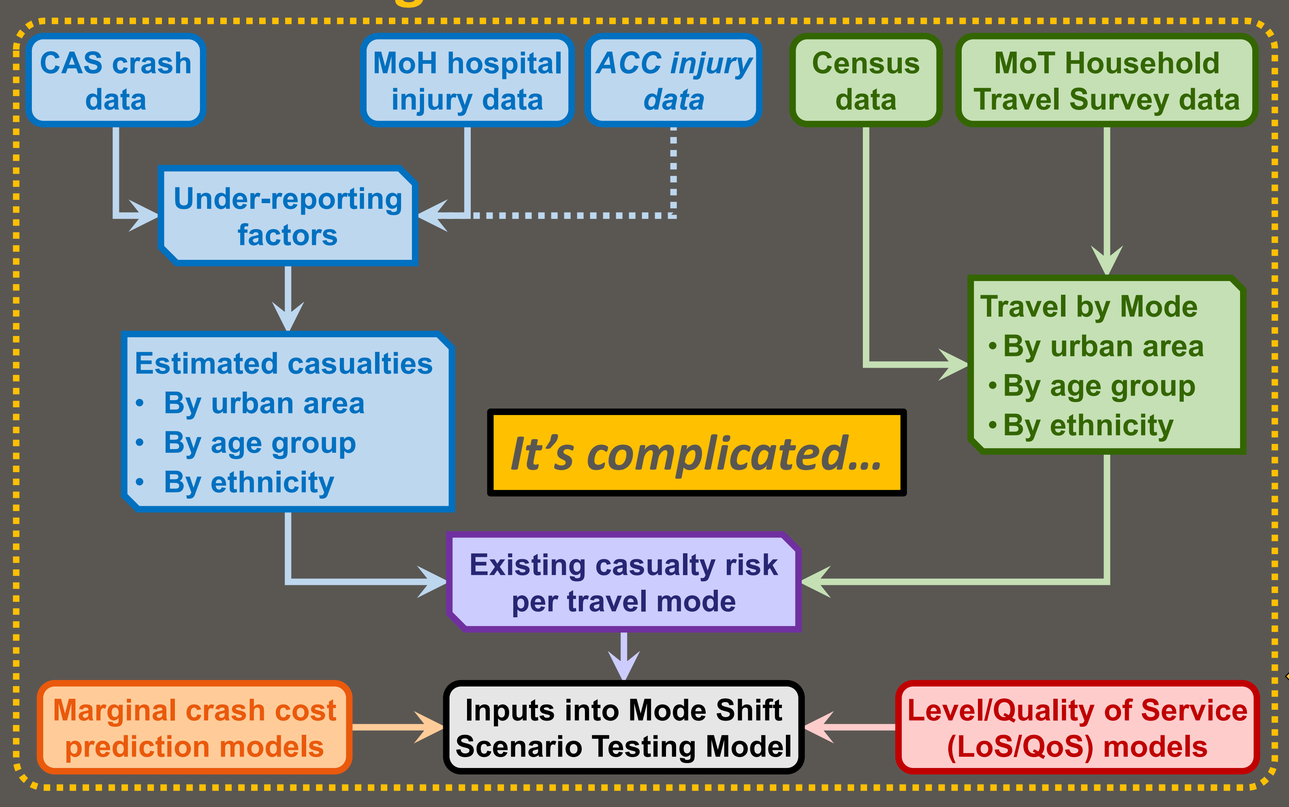
Travel mode usage data
- Measuring travel mode use
- Trip-chaining multiple modes
- Splits by urban area, age group, ethnicity, etc

Travel mode changes
- Crash prediction models
- Effects of travel cost changes
- Marginal crash cost models

Mode shift impacts on safety
- Previous studies
- Previous models
- Policy implications

Quality of modal facilities
- Measuring facility quality (QoS)
- Level of service (LoS) models
- Effects on modal safety
- Effects on mode shift (elasticity)

2: Building the Mode Shift Model…



Current Mode Shift Model

- Relationships that have been incorporated into the model:
  - Factor in potential changes to **overall** trip numbers (up/down)
  - Change in **pedestrian/cycle crash rates** with mode shift
  - Additional **first/last-mile modes** when changing PT trips
  - Usage effects of improved **cycleway QoS** or **additional cycleways**
- Some features are ***placeholders*** for further research:
  - Safety effects of improving **pedestrian access to bus/train**
  - Usage/safety effects of improving **general pedestrian LoS**
  - Safety effects of improving **cycleway QoS**
  - More accurate **e-scooter/device crash rates**

3: Final Spreadsheet Model produced…

Select urban area and various demographic sub-groups

Existing travel usage and DSI risk by mode

Adjust future mode usage (and overall travel change)

Test improving pedestrian, PT, and cycle facilities

Estimated future travel usage and DSI risk by mode

MODE SHIFT MODEL v3

*Note: the values below are **absolute** percentage point changes*

Select AREA to model	Select AGE GROUP to model	Select GENDER to model	Select ETHNICITY to model
Auckland	All AGES	All GENDERS	All ETHNICITIES

*Note: only **one** demographic group (age, gender, ethnicity) can be selected at a time*

Existing mode usage/yr

	'000 km/yr	%kms	'000 hrs/yr	%hrs
Cars/Light Vehs	13,565,911	92.2%	430,534	82.5%
Trucks	26,851	0.2%	1,226	0.2%
Motorcycles	36,193	0.2%	958	0.2%
Buses	479,856	3.3%	24,153	4.6%
Trains	220,549	1.5%	7,855	1.5%
Ferries	52,623	0.4%	1,461	0.3%
Cycles/E-bikes	102,746	0.7%	7,029	1.3%
E-scooters, etc	14,758	0.1%	442	0.1%
Pedestrians	207,899	1.4%	48,389	9.3%
TOTAL	14,707,385		522,047	

Existing mode DSIs/yr

	DSIs	per Bn km	per Bn hrs
Motor cars	375.5	27.7	872.2
Trucks	9.8	366.2	8,022.2
Motorcycles	93.8	2,592.6	97,930.8
Buses	2.2	4.5	89.7
Trains	0.7	3.0	84.9
Ferries	-	-	-
Cycles/E-bikes	55.0	535.3	7,825.2
E-scooters, etc	41.0	2,778.1	92,855.3
Pedestrians	454.2	2,184.6	9,385.8
TOTAL	1,032.2	70.2	1,977.2

Future mode usage

	Base Usage	Change ->	New	'000 km/yr	'000 hrs/yr	Pct Diff
Cars/Light Vehs	91.1%	(Abs %)	85.1%	12,270,099	389,409	-9.6%
Trucks	0.2%	+ 0.0% =	0.2%	26,314	1,201	-2.0%
Motorcycles	0.2%	+ 0.0% =	0.2%	35,469	939	-2.0%
Buses	3.4%	+ 2.0% =	5.4%	771,334	38,824	+60.7%
Trains	1.5%	+ 1.0% =	2.5%	360,270	12,832	+63.4%
Ferries	0.4%	+ 0.5% =	0.9%	123,637	3,433	+134.9%
Cycles/E-bikes	1.1%	+ 1.0% =	2.1%	298,688	20,432	+190.7%
E-scooters, etc	0.2%	+ 0.0% =	0.2%	22,232	665	+50.6%
Pedestrians	2.0%	+ 1.5% =	3.5%	505,195	117,585	+143.0%
		Overall travel change (km): -2.0%		14,413,238	511,606	-2.0%

Future mode DSI/yr

	Estimated DSIs	Abs Diff	per Bn km	per Bn hrs	Pct Diff
Motor cars	326.6	-13.0%	26.6	838.8	-3.8%
Trucks	9.1	-7.3%	346.6	7,592.1	-5.4%
Motorcycles	87.0	-7.3%	2,453.6	92,679.6	-5.4%
Buses	3.0	+37.8%	3.9	76.9	-14.3%
Trains	0.8	+19.0%	2.2	61.8	-27.1%
Ferries	-	N/A	-	-	N/A
Cycles/E-bikes	62.2	+13.0%	208.1	3,042.6	-61.1%
E-scooters, etc	40.6	-0.9%	1,827.8	61,090.4	-34.2%
Pedestrians	575.9	+26.8%	1,139.9	4,897.6	-47.8%
	1,105.2	+7.1%	76.7	1,888.2	+9.3%

Improve Facilities/LoS?

Improve Bus ped'n access?	YES
Decrease ped'n DSIs by:	-2.2% *
Improve Train ped'n access?	NO
Decrease ped'n DSIs by:	0.0% *
Improve Cycle Network	
Existing Network Length (km):	858.63
Additional Cycle Facilities:	
Painted cycle lanes (km)	50
Separated infrastructure (km)	50
N'hood Greenways (km)	50
*Go Dutch?**	YES

**Assumes all cycleways meets full best practice guidance*

Increase cycling trips by:	+48.2%
Decrease cycling DSIs by:	-5.9% *
Improve Ped'n LoS by:	+5%
Increase ped'n trips by:	+25% *
Decrease ped'n DSIs by:	-5% *

First/Last-Mile Trips with extra PT

Increase car trips by:	+0.8%
Increase bike/scoot trips by:	+3.9%
Increase ped'n/scoot trips by:	+16.8%
Increase bus trips by:	+2.7%

*NB: * indicates that these estimates are provisional*

Instructions | FrontEnd | BackendCalcs | +

Further research

This is a first-cut model – more improvements needed!

- Impact of **trip chaining** on safety
- **External vs Internal risk** in crashes of multiple parties
- **Cycling QoS** prediction models for various facility types
- Explore relationships between **QoS and crashes**
- **Bike-only or pedestrian-only** crashes
- Relationships between **demographics, travel, and crashes**
- **Occupancy** of private vehicles and increased ridesharing
- Changes in **VKT travelled** with mode shift change
- Adding **system safety** to the model (e.g. lower speeds)
- Factoring in the safety impacts of **congestion**

*Ultimately, **which** methods of achieving VKT reduction or modal shift result in the best **safety** outcomes?*

Reference: ViaStrada (2024), "Mode-shift impacts on safety", NZTA research report #728

For further information, contact Glen Koorey
E: glen@viastrada.nz P: +64-27-7396905

2025 Australasian Road Safety Conference
20 - 23 OCT - PERTH, WESTERN AUSTRALIA

VIASTRADA
TRANSPORT PLANNING AND DESIGN