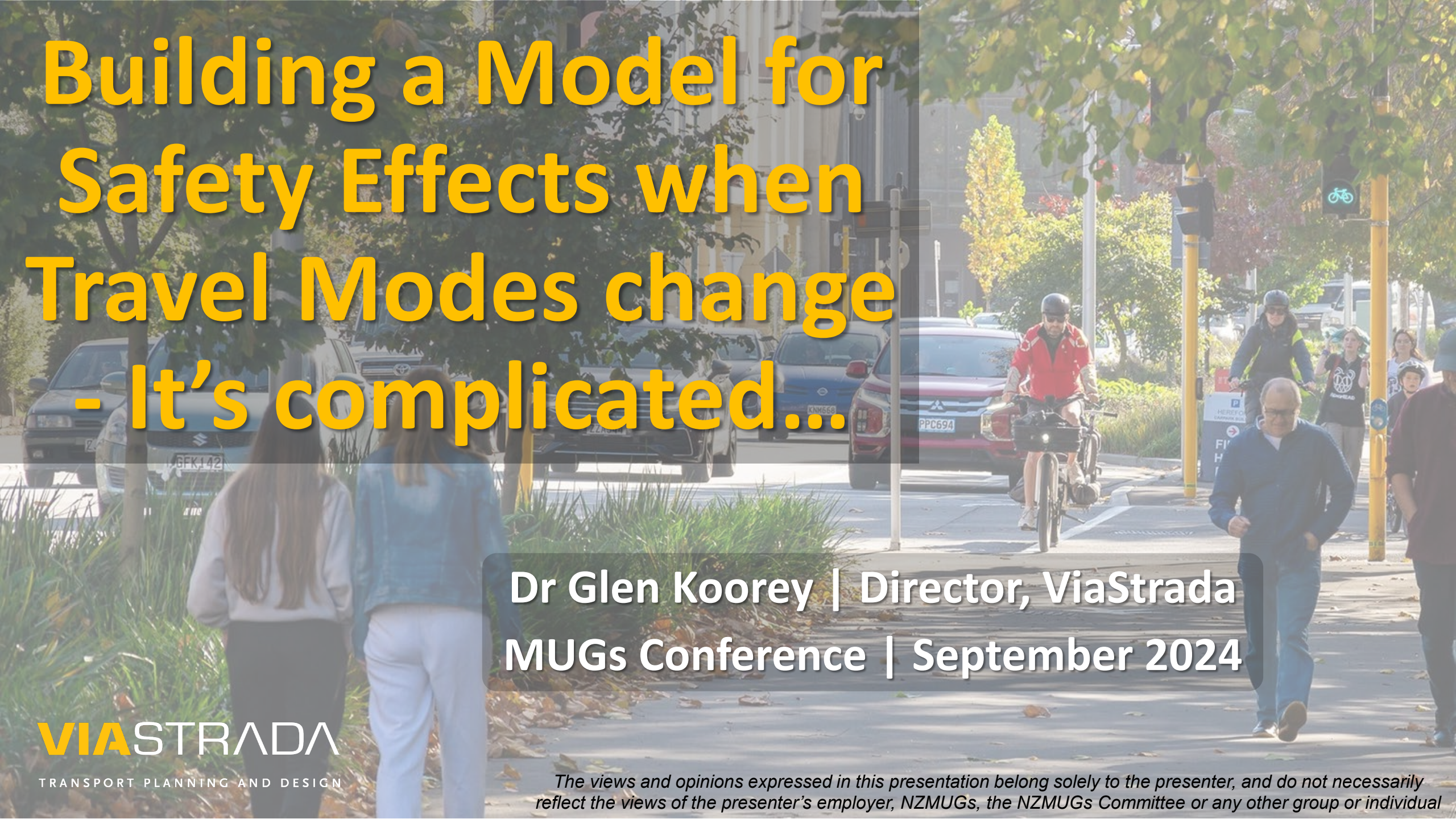
Building a Model for Safety Effects when Travel Modes change - It's complicated...



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VIASTRADA

TRANSPORT PLANNING AND DESIGN

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Presentation Outline

- Background
  - What is mode shift?
  - How could mode shift impact road safety?
  - What is the knowledge gap?
- Developing a Mode Shift model
  - Factors to consider
  - Literature review topics to explore
  - Model data inputs
  - Relationships between factors
- Where to next
  - Limitations of current model
  - Further research needed

What is Mode Shift?

- Changing from one mode of transport to another

*Mode shift from **Private motorised vehs** to **Public Trpt, Active modes and Micro-mobility** is the particular focus of this exercise*

Mode shift & safety

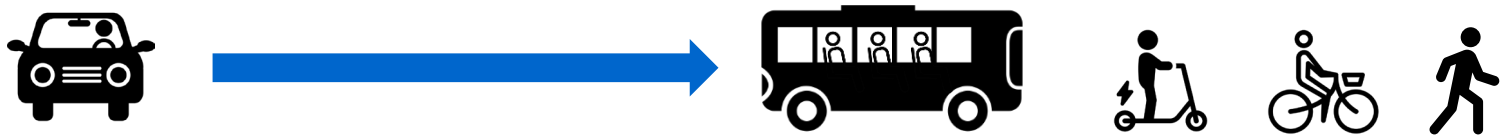
- Evidence shows that mode shift has an impact on safety
  - Safety implications of each mode broadly understood in simplistic terms
  - The actual and potential impact of *changing* modes is a knowledge gap
- When determining benefits of mode shift:
  - Evaluation focuses on **emissions** & **health**
  - **Travel time** often considered too
  - Could **safety** impacts of mode shift be added?

Knowledge gap to address

Forthcoming NZTA research

*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)

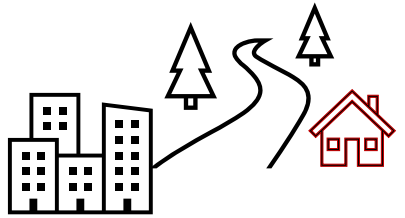
Personal & Collective Safety Impacts

- To understand these impacts we will require:
  - ***Existing*** crash/casualty risk rates (per km or hour travelled)
  - Models of ***risk changes*** with mode shifts
- This will require several data sources:
  - Existing **crash/casualty** data (scaled for under-reporting)
  - Existing **travel mode usage** (kms or hours travelled)
  - Predictions of how risks change by **exposure** (marginal cost models)
  - Predictions of how risks change with **improved environments** (LOS)

Some Factors to consider

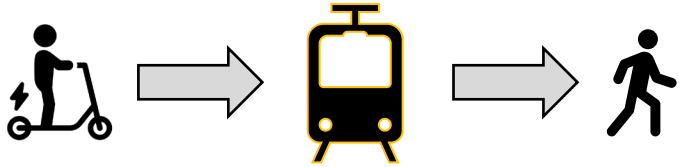
- Level of **under-reporting** of crashes in CAS
  - Depends on Travel mode, Severity, Motor veh involvement

- Risk differences in different **road/path environments**
  - "Average" crash rates nationally may not reflect location of travel

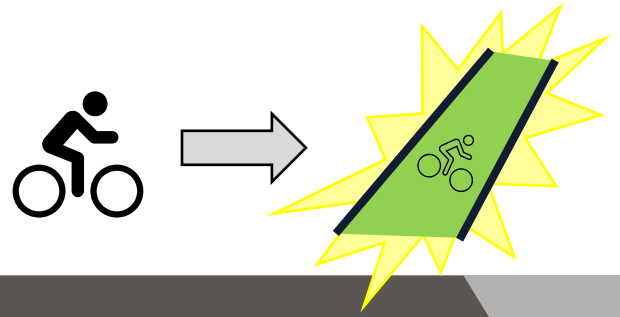


- Differences within/between **populations**
  - Different age/gender/ethnicity/ability groups may have different risks

- Risk associated with **linking** journeys
  - e.g. walking/cycling/wheeling to or from public transport



- Effect of **changes** to transport facilities/environments
  - What if improvements are also made when mode shift occurs?



Literature review – Topics to explore

Travel Mode Casualty Data
- Sources of Data
- Under-reporting Levels
- Splits by Area, Road Type, Age Group, Ethnicity, etc

Travel Mode Usage Data
- Measuring Travel Mode Use
- Trip-Chaining Multiple Modes
- Splits by Area, Road Type, Age Group, Ethnicity, etc

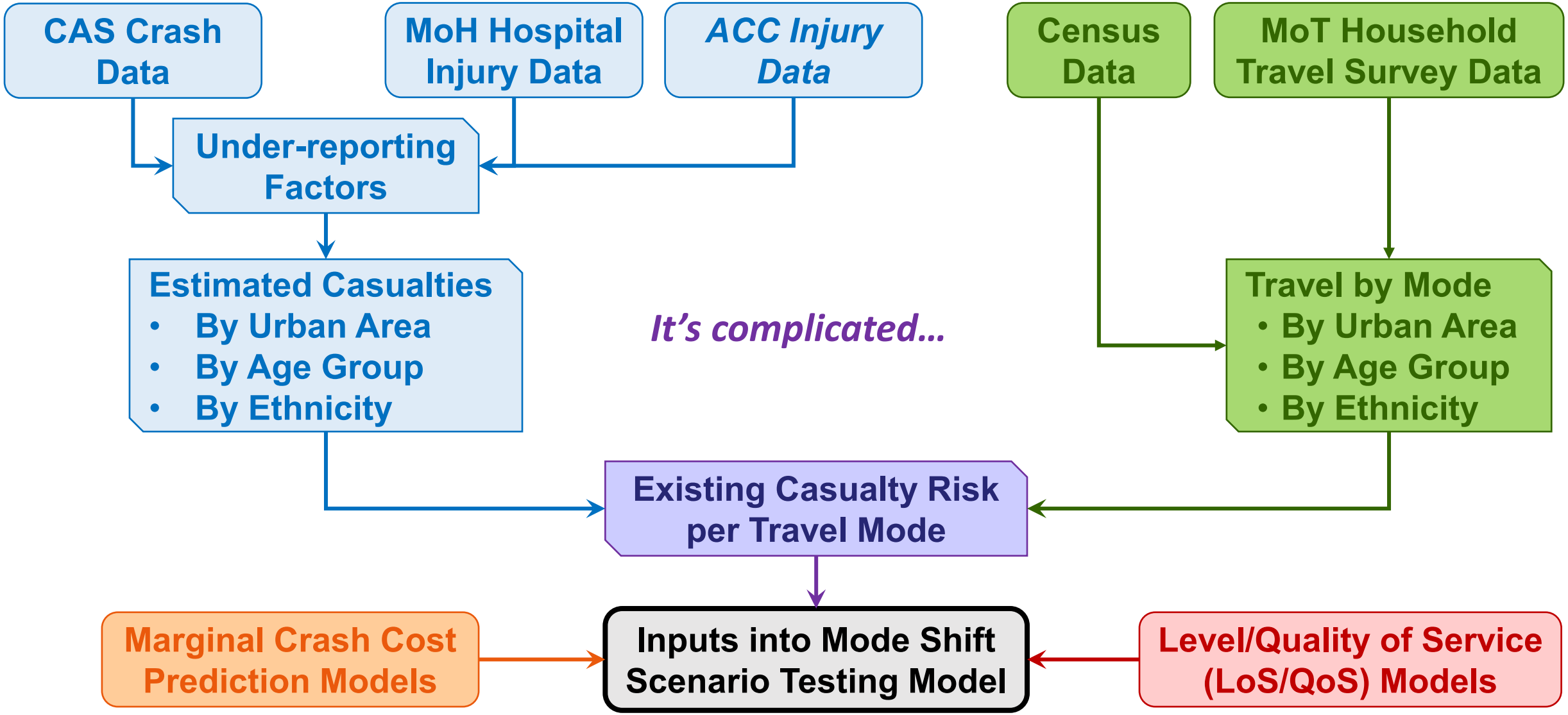
Relative Risk per Travel Mode
- Previous Studies
- Modal Crash/Casualty Rates
- Differences by Area, Road Type, Age Group, Ethnicity, etc

Quality of Modal Facilities
- Measuring Facility Quality (QoS)
- Level of Service (LoS) Models
- Effects on Modal Safety
- Effects on Mode Shift (elasticity)

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

A theoretical Mode Shift Model

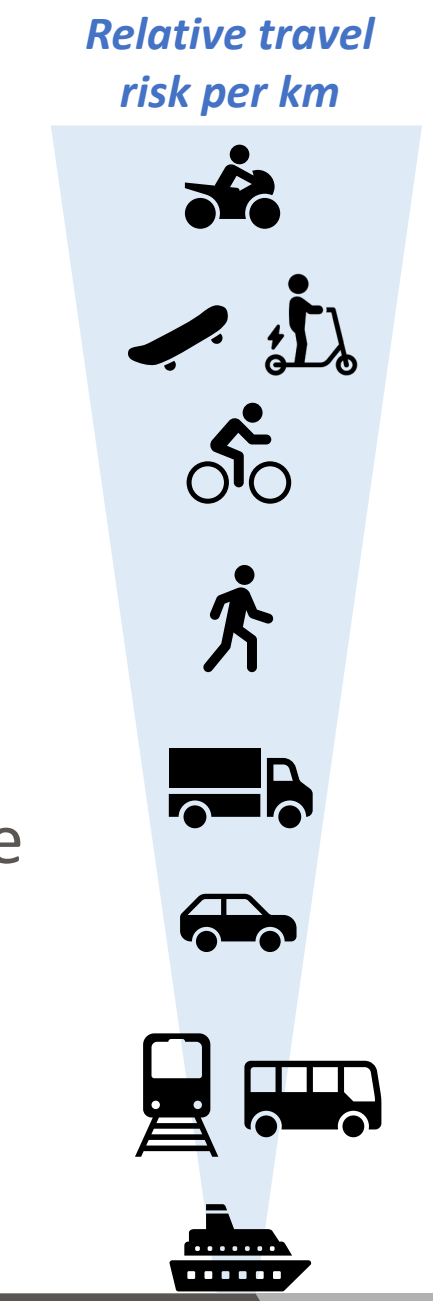


Relative risk per travel mode

Which travel modes are considered the riskiest?

Based on travel mode casualty and usage data (MoH, MoT):

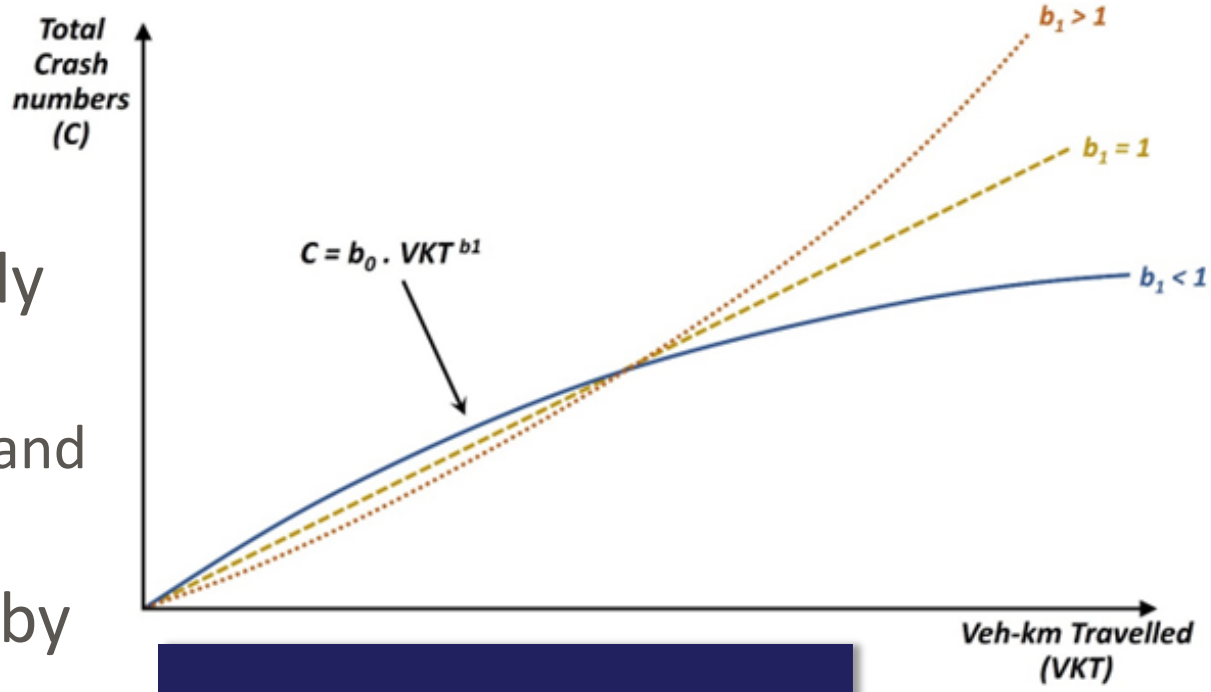
- Least safe travel modes: **motorcycle**, **wheeled devices**, **bicycle** →
  - Micro-mobility is newer, datasets are just developing
  - If considering *external* risk, motor vehs have the worst safety outcomes
- Safest modes tends to be **public transportation**
- While walking and cycling have higher per-km or per-hr risk, mode share increase correlates strongly with better safety outcomes
  - "Safety in numbers" effect (lots of evidence)
  - Parallel improvements to street environments → safer facilities
  - Reduced exposure to motorised traffic with mode shift
  - Reduced distances travelled using active modes instead of motor vehs

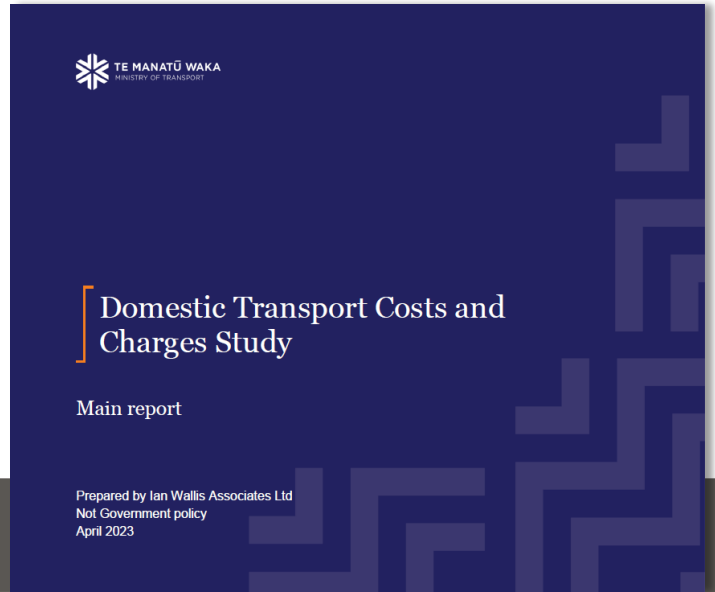


Marginal crash costs

*What is the effect of shifting **1 VKT** from one mode to another?*

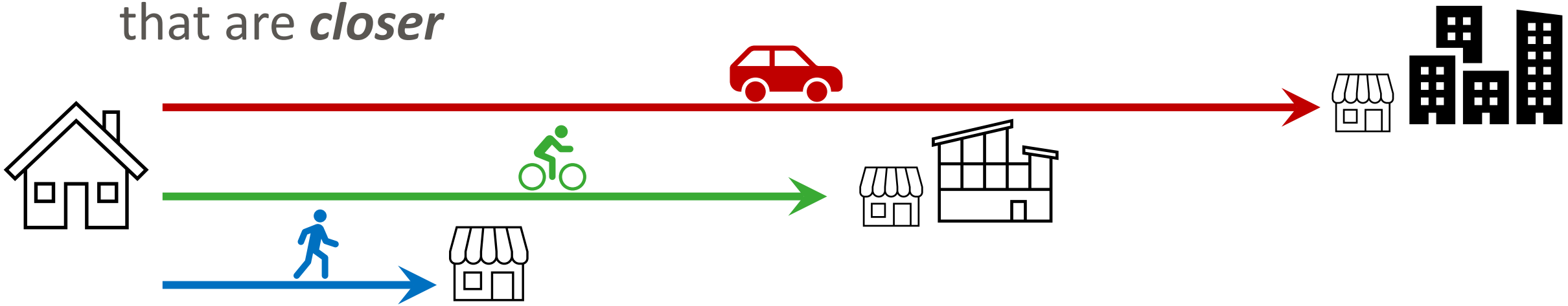
- Mode casualty numbers are not linearly related to usage
  - **Crash prediction models** help to understand these relationships for each mode →
- Average severity/cost per crash varies by
  - Speeds
  - Intersections / mid-block
  - Congestion
- Previous MoT's DTCC Study used VKTs as a key input for modelling crash costs →





Mode shift ≠ a straight switch

- Substituting modes can lead to travelling to new destinations that are ***closer***



- Some evidence that we can adjust VKT when modes change
  - Often related to relative change in *travel speeds*

E.g. **10** VKT driving → **5** VKT biking or **1** VKT walking

  - Leads to differences in likely safety outcomes

Initial mock-up of Mode Shift Model

▼ Select area to model

- **ALL** of New Zealand
- All **Tier 1** Cities
- Auckland
- Hamilton
- Tauranga
- Wellington
- Christchurch
- etc…

▼ Select population

- TOTAL Population
- Male vs Female
- By Age Group
- By Ethnicity
- etc…
  - ALL Ethnicities
  - NZ European
  - Māori
  - Pasifika
  - Asian
  - Other

Existing mode usage {'000 km/yr}

Motor vehicle	52643	73.1%
Buses	4321	6.7%
Trains	2987	4.3%
Pedestrians	8093	11.2%
Cyclists	1903	2.8%
E-scooters, etc	1256	1.9%
TOTAL	71203	

Future mode usage

	69.1%	49663
– +	6.7%	4385
– +	5.3%	3737
– +	13.2%	9688
– +	3.8%	2619
– +	1.9%	1274
Overall travel change:		+1.5%

Improve Fac/QOS?

Improve PT access
Bus ☐ Train ☒

Path/Xing QOS
1 2 3 4

Cycleway QOS
1 2 3 4

Existing mode DSIs/yr {per M.km}

Motor vehicle	4563	26.4
Buses	27	2.5
Trains	5	0.5
Pedestrians	671	37.1
Cyclists	806	60.8
E-scooters, etc	93	39.3
TOTAL	6165	24.3

Future mode DSIs/yr {per M.km}

4276	27.6
26	2.4
6	0.5
725	32.6
818	54.5
90	37.1
5941	23.7

Current Mode Shift Model

- Relationships that have been incorporated into the model:
  - Factor in potential changes to **overall** trip numbers (up/down)
  - Change in **ped'n/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 model 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**

Model limitations

Still lots of potential improvements could be made to initial model

- Weighting factors based on **2018 Census** data
- Urban **geographic boundaries** from 2018 used
- MoH Hospital crash data categorised by patient's **residence**, not location of incident
- **Vehicle types** are categorised differently between data sets – need consistency
- Cycling QLoS involved **open-source data** and assumptions about facility type/quality
- Haven't split DSIs **involving Motor Vehs or not**

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 motor vehs 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*

Conclusions

A variety of different interacting components – yep, it's complicated!

- Most previous studies only considered a few modes and didn't explore *multiple* relationships
  - Many failed to consider interactive effects, such as external risks to other travellers or change in VKT
- Transport mode crash numbers do not typically operate *linearly* relative to usage
  - "Safety in numbers" is a common effect
  - Increased PT trips also increase first/last mile trips
- We've developed a preliminary mode-shift model
  - But needs further research & refinement

Ngā mihi | Thank You!

Patai | Questions?

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