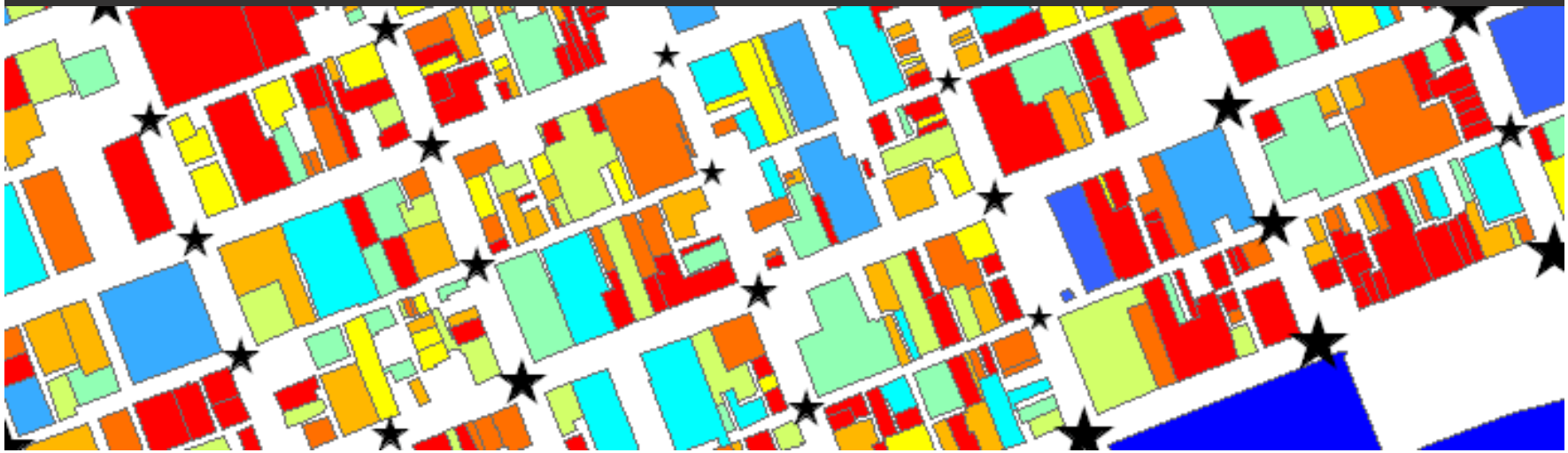
MONASH University
Injury Research Institute

Factors driving intersection pedestrian crash risk in concentrated urban environments

Hafez Alavi, Judith Charlton, Stuart Newstead, Jeffery Archer



Aim

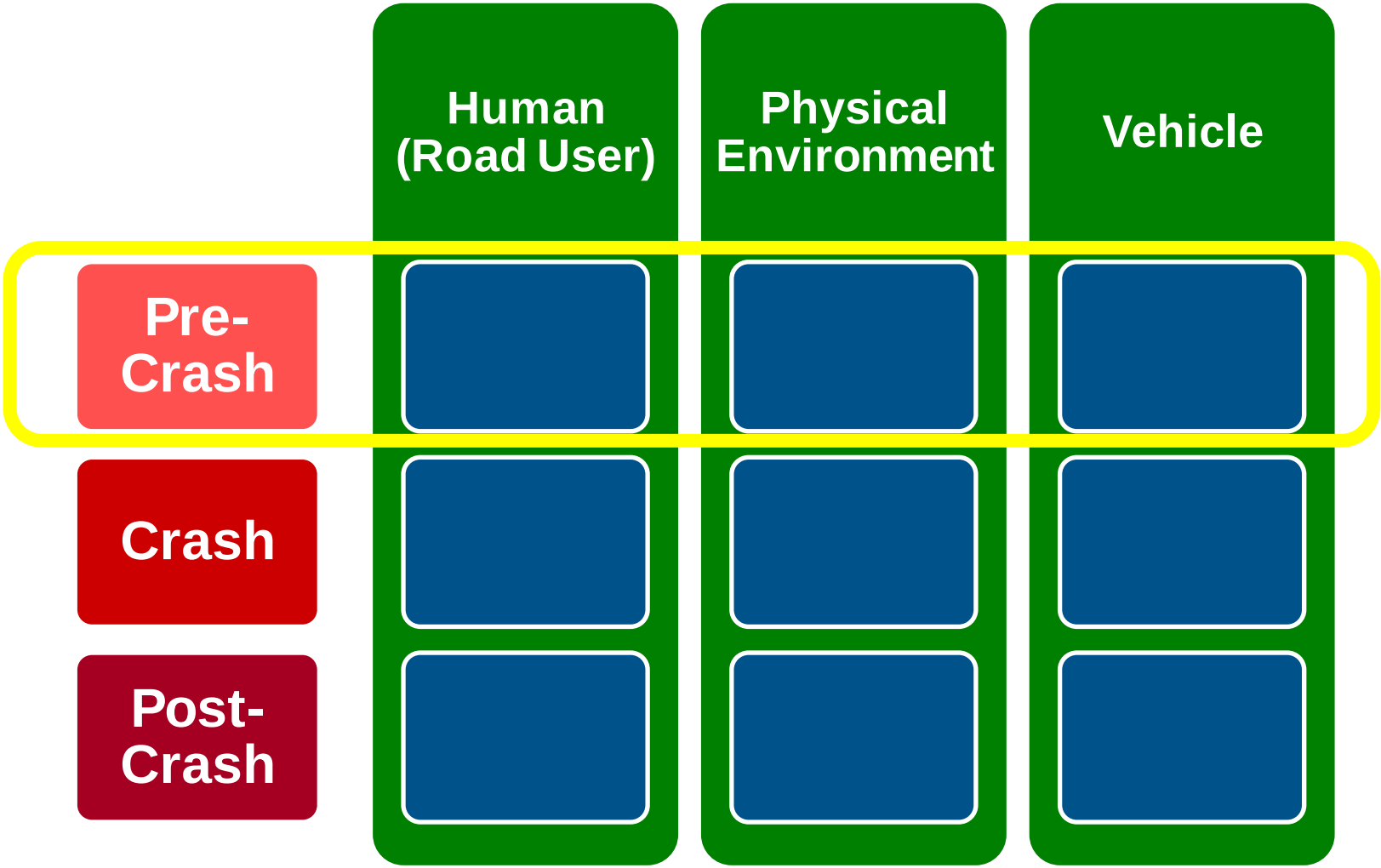
What factors are associated with pedestrian crash risk at intersections in concentrated urban environments?

Road Trauma Chain

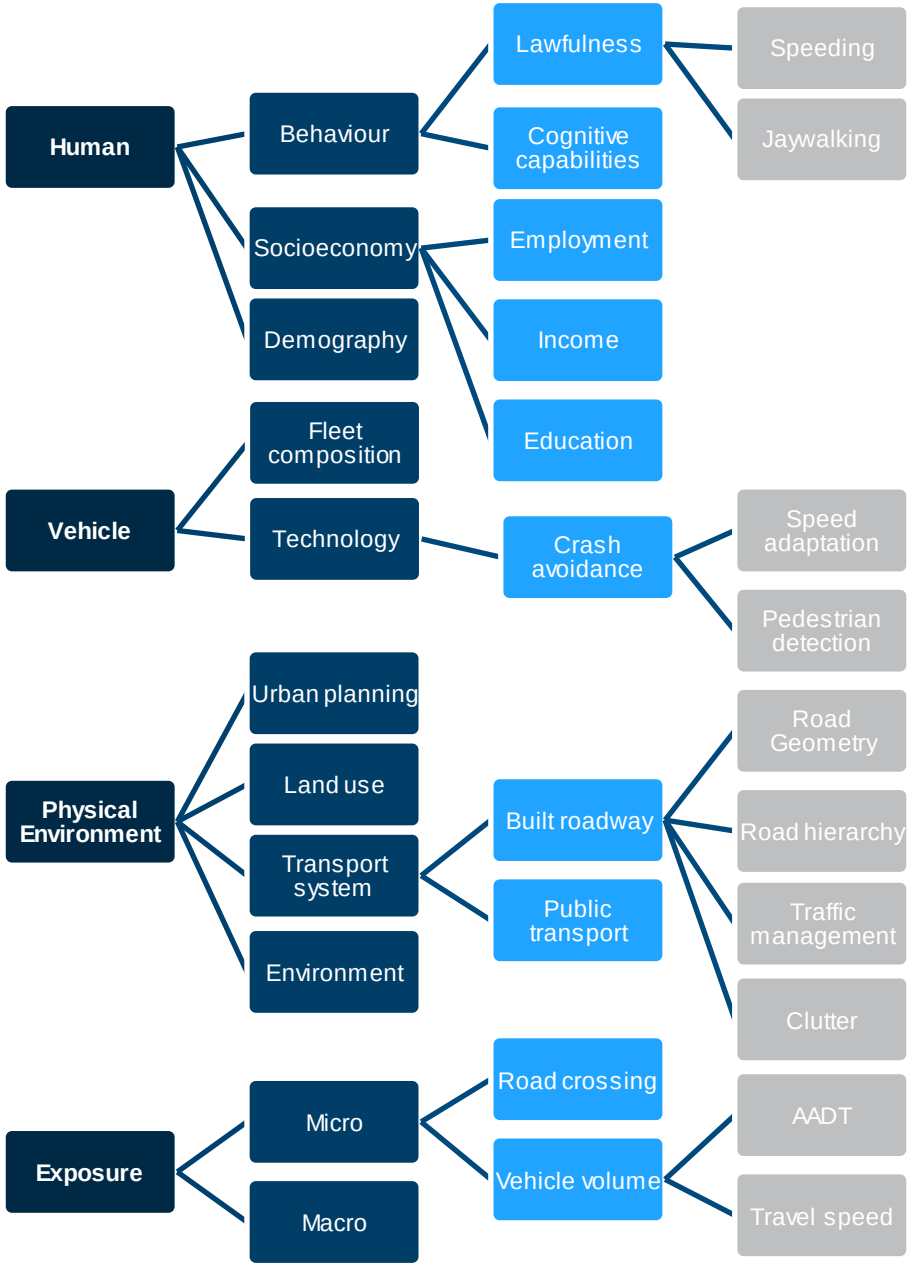
ENTITIES	ELIGIBILITY	ROAD USE	ENERGY	CRASH
Humans	Licensed	Crossing	Speed	Hazards
Vehicles	Registered	Travel	Mass	System failure
Roads	Roads opened	Distance		Human error
		Time		

PEDESTRIAN CRASH RISK
ROAD USE EXPOSURE

Haddon Matrix



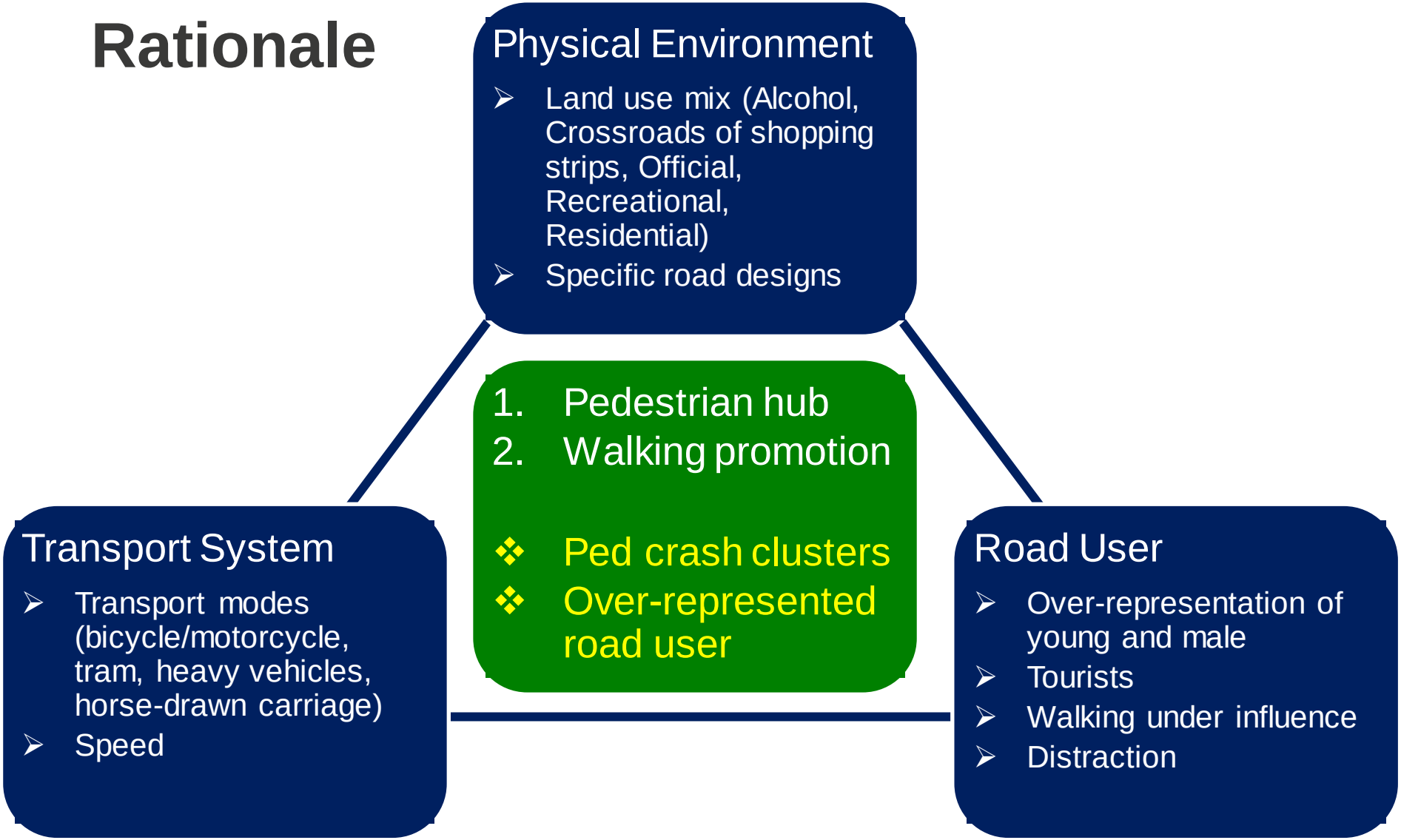
Hierarchy of pedestrian data needs



Pedestrian Data Needs Matrix

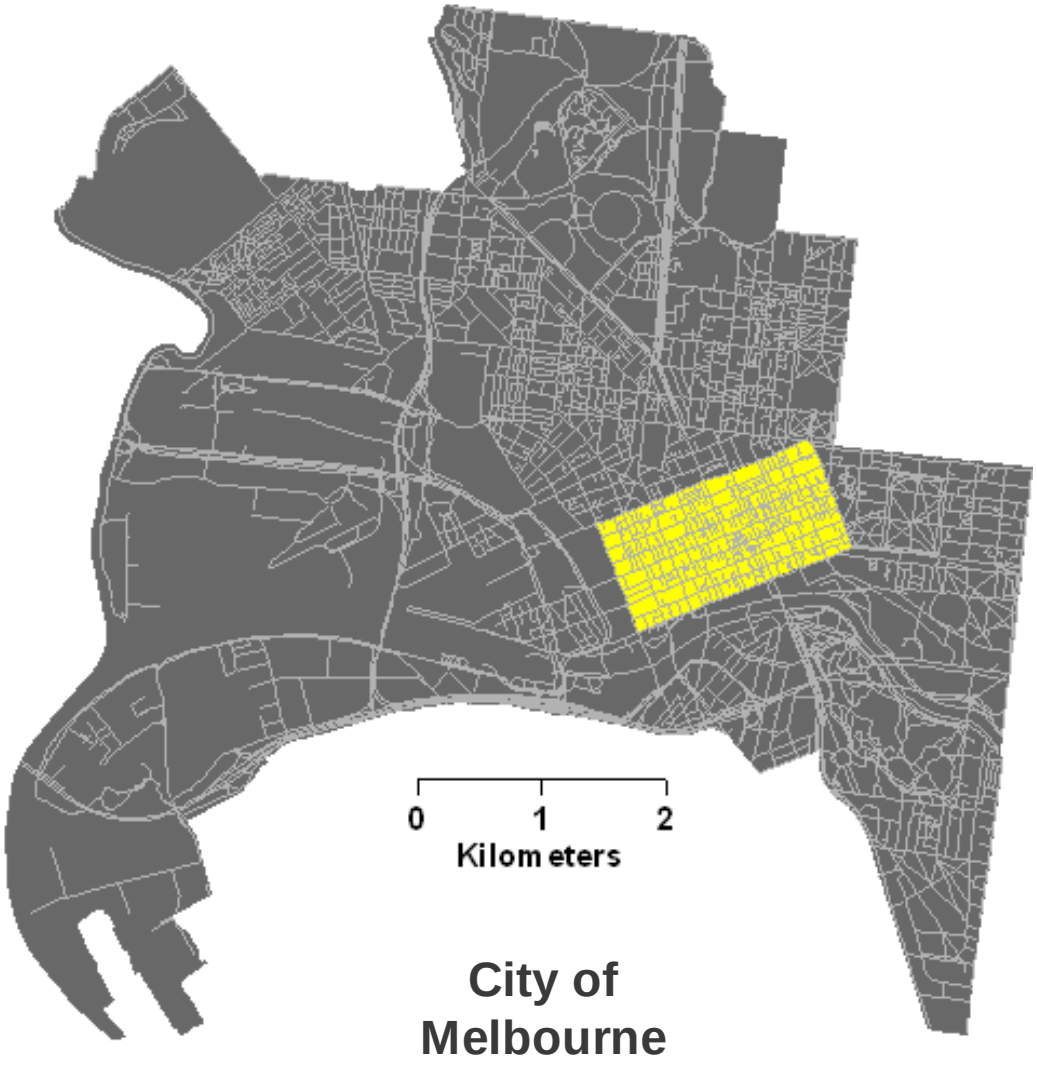
Human			- Behaviour, e.g. Illegal Behaviours - Cognitive and Physical Capabilities - Safety Awareness - Population (Numbers, Density, Mix) - Employment and Income Level - Education & Ethnicity
Vehicle & Equipment			- Vehicle Fleet Composition - Vehicle design and technologies
Physical Environment	Urban Planning		- Neighbourhood Type - Specific Designs for Vulnerable Road Users - Motorisation Level
	Land use		- Space and Capacity of Land Uses - Land Use Mix
	Transport System	Built Roadway	- Road Hierarchy - Road Geometry (Intersection, Roundabout) - Geometric Design Variables - Posted & Travelling Speed - Measures of Clutter
		Public Transport	- Public transport supply (stops, routes) - Facilities characteristics
	Environment		- Light Conditions - Atmospheric Conditions
Exposure	Micro		- Volume - Duration and Distance of Road Use
	Macro		- Trips (Duration and Distance) - Population-based Measures

Rationale


Physical Environment
Land use mix (Alcohol, Crossroads of shopping strips, Official, Recreational, Residential)
Specific road designs
1. Pedestrian hub
2. Walking promotion
Ped crash clusters
Over-represented road user
Transport System
Transport modes (bicycle/motorcycle, tram, heavy vehicles, horse-drawn carriage)
Speed
Road User
Over-representation of young and male
Tourists
Walking under influence
Distraction

Case study

Central Business District (CBD) of Melbourne



Dependent variable

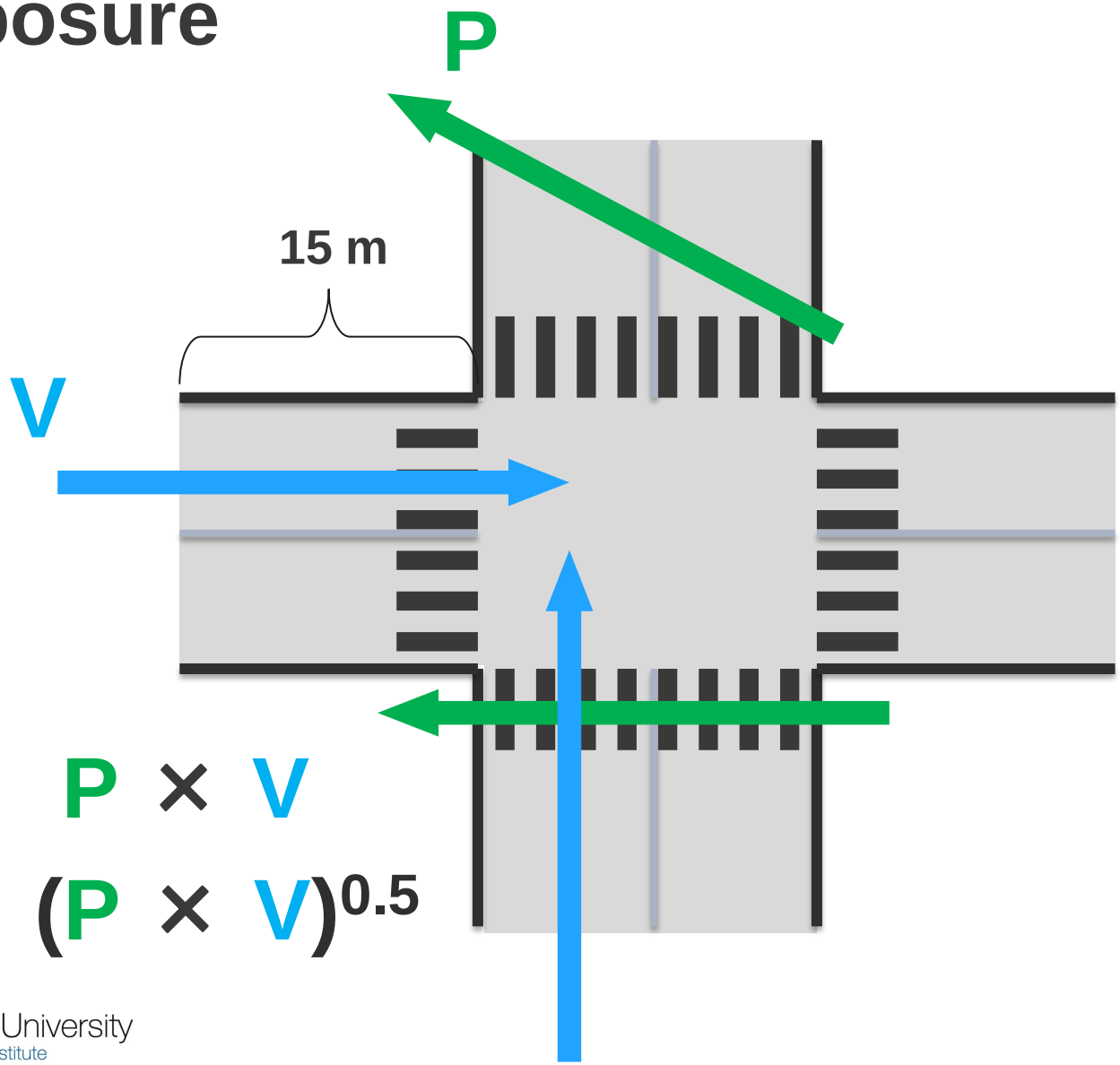
1 CBD intersection crashes (2000-2009)

2 Weekday crashes

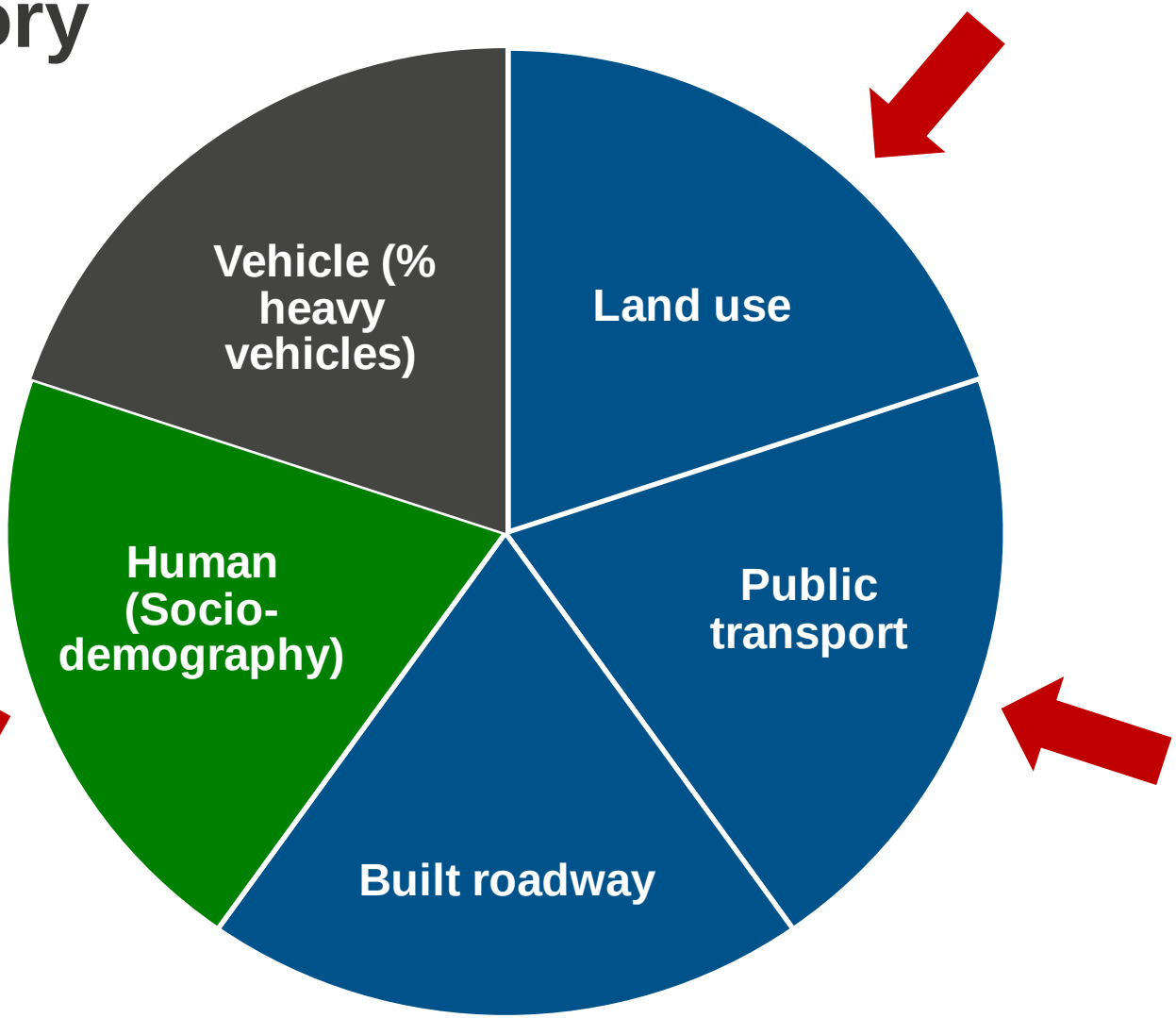
3 Daytime (07-18)

4 Hours of darkness (19-06)

Exposure

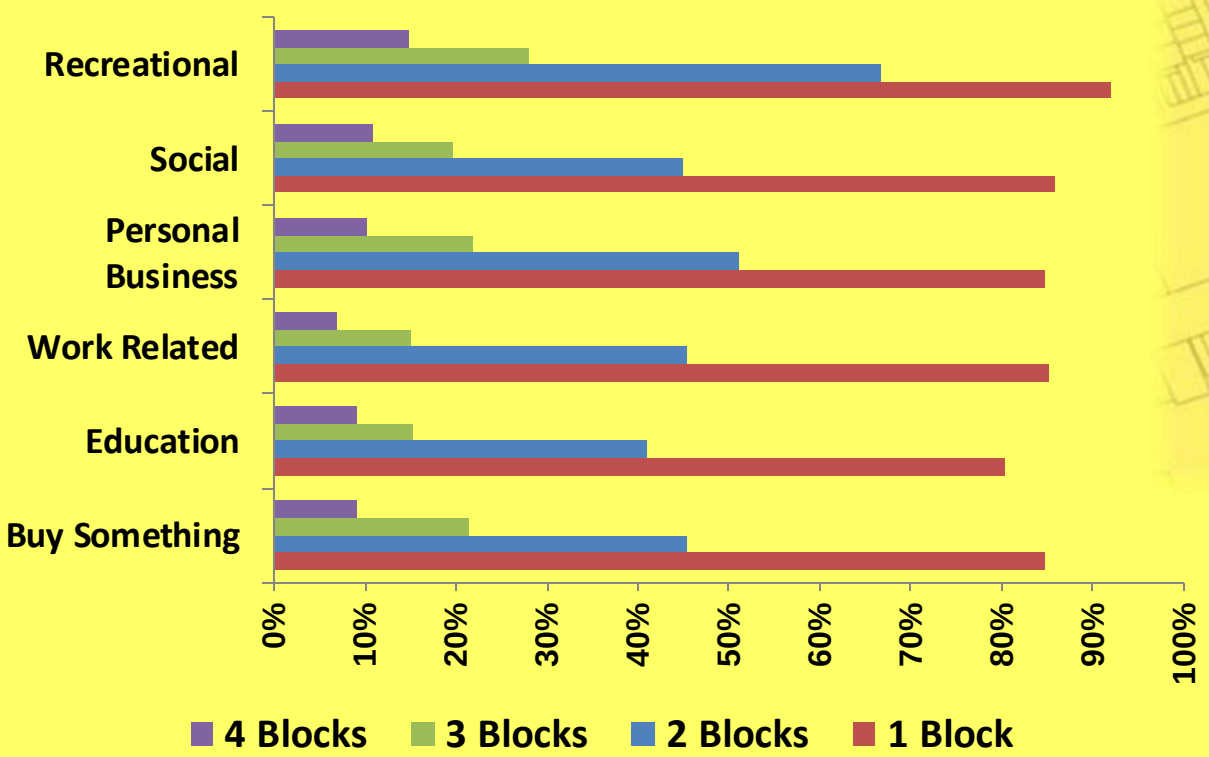


Explanatory Variables

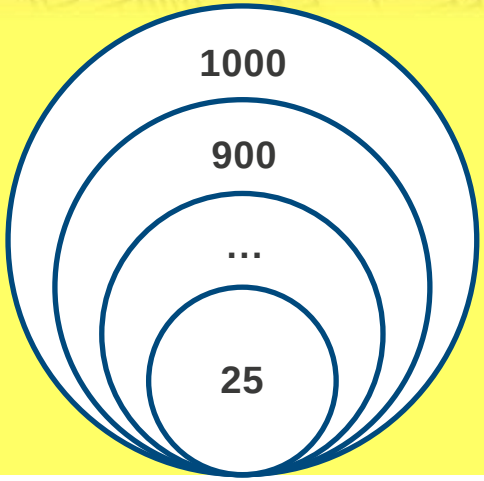


Spatial

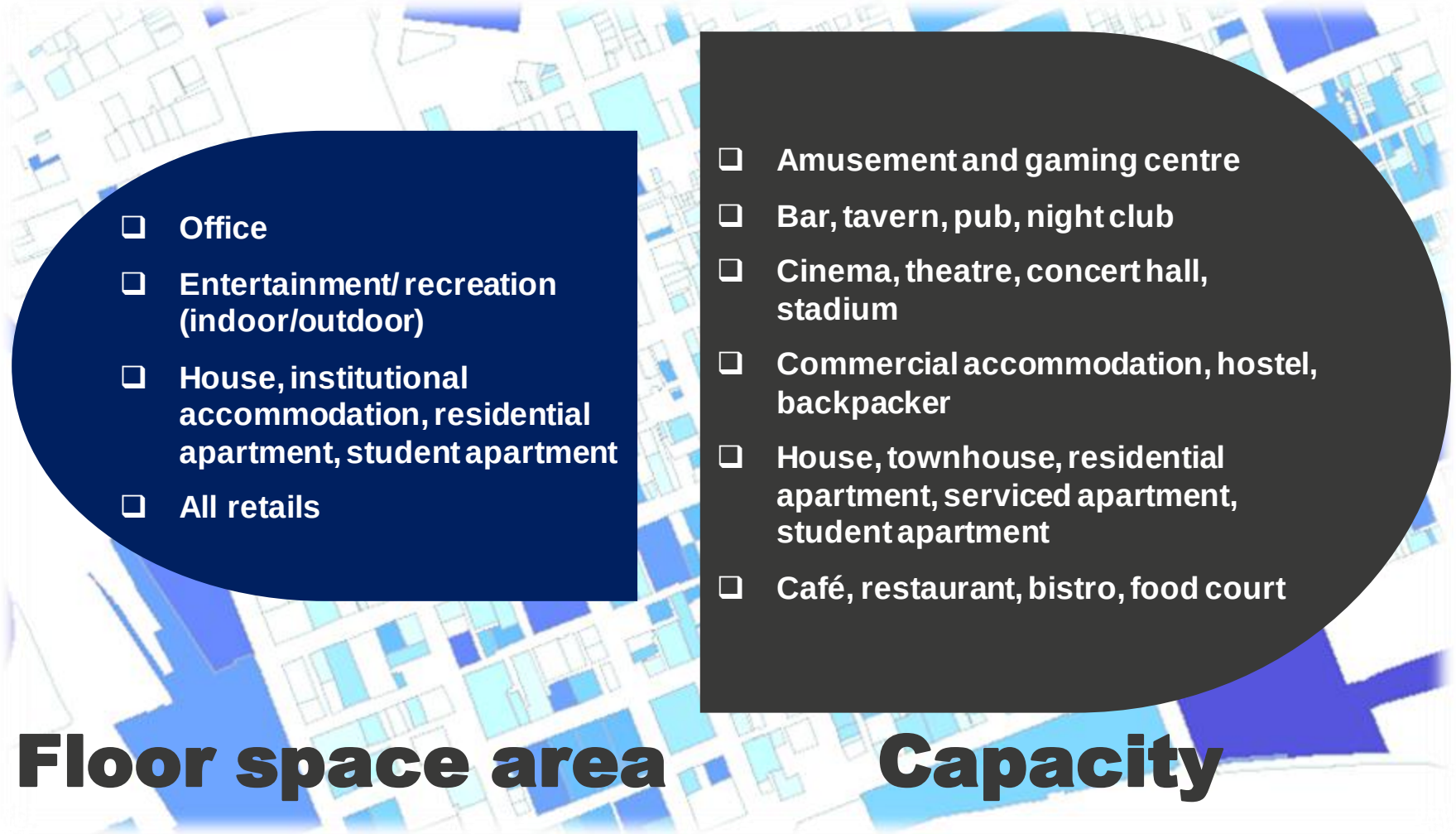
Spatial data



Distance walked for different purposes
Victorian Integrated Survey of Travel and Activity (VISTA)



Land use



- Office
- Entertainment/ recreation (indoor/outdoor)
- House, institutional accommodation, residential apartment, student apartment
- All retails

Floor space area

- Amusement and gaming centre
- Bar, tavern, pub, night club
- Cinema, theatre, concert hall, stadium
- Commercial accommodation, hostel, backpacker
- House, townhouse, residential apartment, serviced apartment, student apartment
- Café, restaurant, bistro, food court

Capacity

Public transport

Bus/Tram

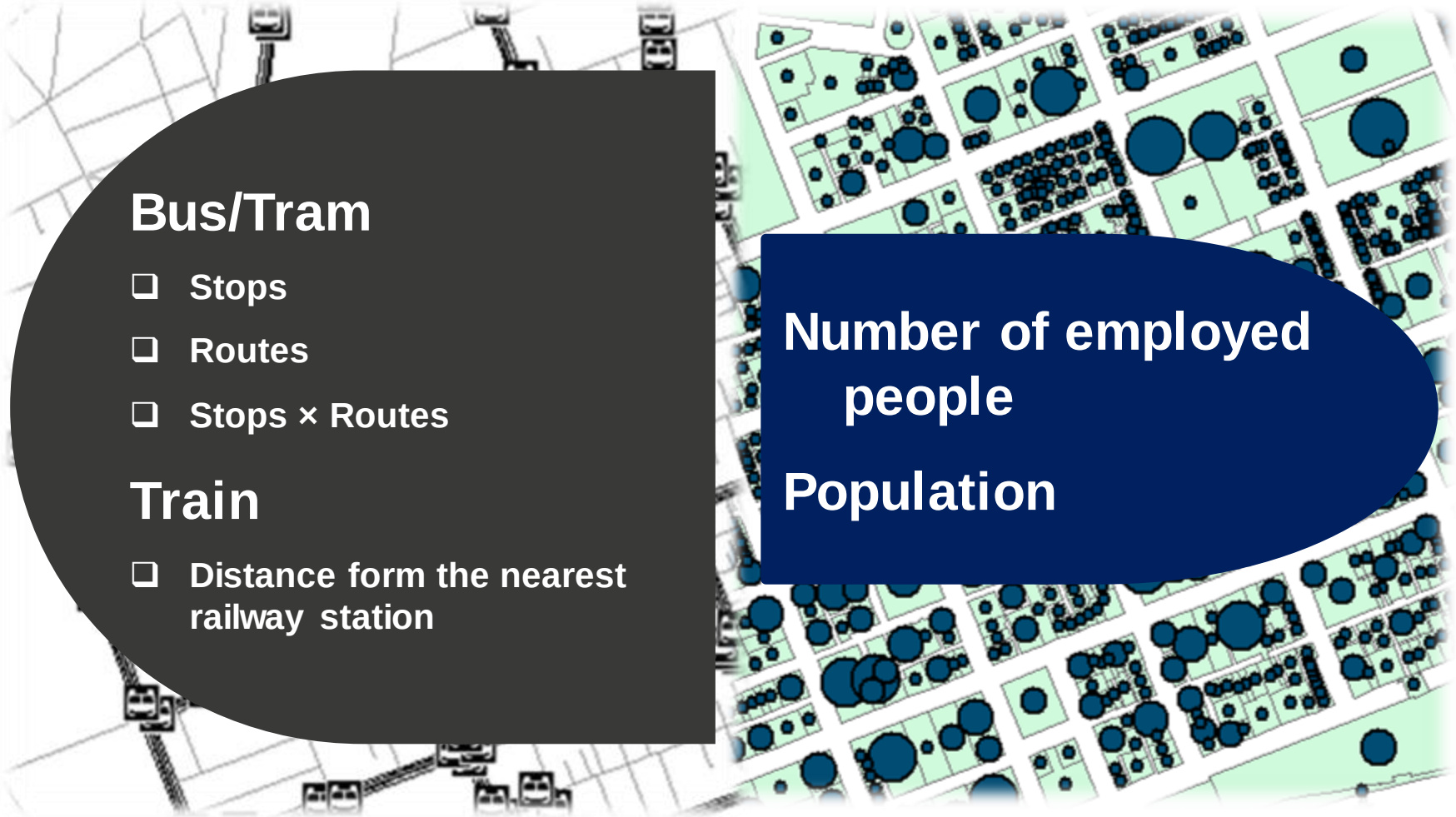
- Stops
- Routes
- Stops × Routes

Train

- Distance form the nearest railway station

Sociodemography

- Number of employed people
- Population



Built roadway

Geometric design

Lanes (major/minor)

Left/Right turn lanes

Grade

Divided/undivided

Tram tracks

Road hierarchy

Major/Minor intersection

Number of ways

Clutter

Number of street signs

Legs fronted with shops

Traffic management

Clearance distance of on-street car parks

Exclusive bus/bicycle lanes

Hook-turn possibility

Posted speed (major road)

Method

1 Standard Poisson/Negative Binomial

2 Entering exposure (rate; fixed; normal)

3 Forward stepwise (Likelihood ratio)

4 Zero-inflation (ZIP; ZINB; Vuong's test)

5 Akaike Information Criterion (AIC)

6 Spatial autocorrelation

CBD: Moran's I; Semiovariogram

Corridor: Generalised Estimating Equations (GEE)

Results

Vehicle	–	–
Land Use	1. Restaurant, café, bar, pub, club (FS - 800m)	1. Restaurant, Café, bar, pub, club (FS - 100m) 2. Accommodation (C - 150m) 3. Cinema, theatre, concert hall (C - 300m) 4. Amusement and gaming areas (C - 900m)
Built Roadway	1. Minor intersections 2. Non-divided 3. Hook-turn possibility 4. More legs fronted with shops 5. More left-turn movements (%)	1. Minor intersections 2. Non-divided
Public Transport	1. Bus routes (500m) 2. Distance from the nearest main railway station (Closer INTs)	–
Socio-demography	–	–

Key messages

1 Temporal and spatial variety of risk

2 Blanket interventions and Safe System

3 Interventions: concentrated v area-wide

4 Risk factor types: immediate/future developments planning

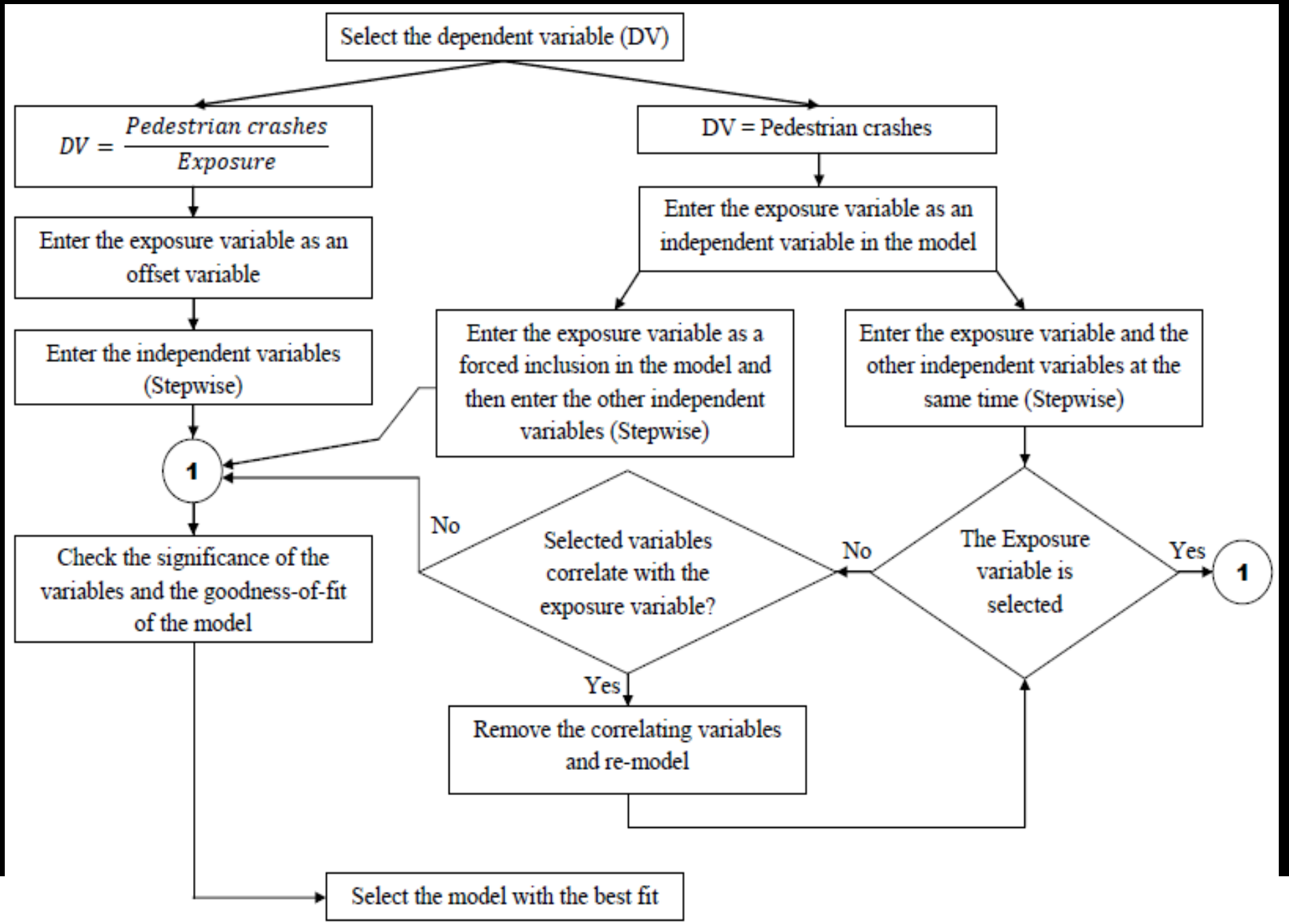
Further research

1 Human/vehicle factors

2 Serious (MAIS3+) injuries

3 Spatial/temporal validations

Questions?


Select the dependent variable (DV)
$DV = \frac{Pedestrian\ crashes}{Exposure}$
DV = Pedestrian crashes
Enter the exposure variable as an offset variable
Enter the exposure variable as an independent variable in the model
Enter the independent variables (Stepwise)
Enter the exposure variable as a forced inclusion in the model and then enter the other independent variables (Stepwise)
Enter the exposure variable and the other independent variables at the same time (Stepwise)
1
No
Selected variables correlate with the exposure variable?
No
The Exposure variable is selected
Yes
1
Check the significance of the variables and the goodness-of-fit of the model
Yes
Remove the correlating variables and re-model
Select the model with the best fit


N