

PLANNING A GREAT CITY, **TO**GETHER

# Narrower Lanes, Safer Streets



Complete Mobility  
@DewanMKarim

**Dewan Masud Karim**

June 8, 2015

## DISCLAIMER

- The views expressed in this article are those of the author and do not necessarily reflect the views of the City of Toronto or the Toronto's Planning Department.

# Passion for Lane Width Investigation

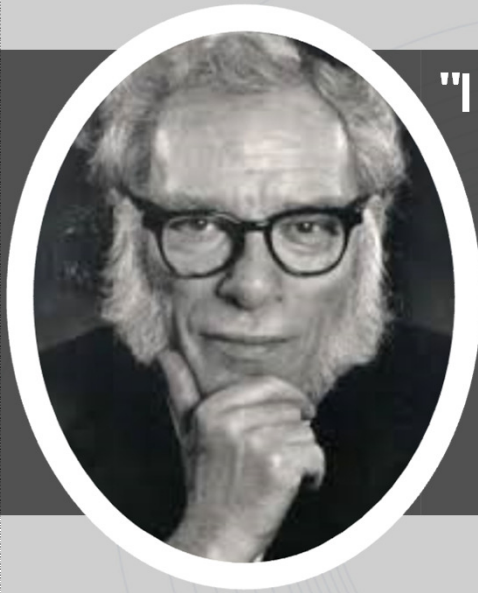


Leonard Nimoy,  
Interview at MIT

“Find out what it is that touches you most deeply. Pursue it, learn about it, explore, expand on it. Live with it and nurture it. Find your own way and make your own contribution.”

Objective of This Research is Contribute to  
the “Scientific Approach of Lane Width

# Practicing Engineering with Evidence



**Isaac Asimov,  
Science Fiction Writer**

**"I believe in evidence. I believe in measurement, observation and reasoning confirmed by independent observers. I will believe in anything, no matter how wild or ridiculous, if there is evidence for it. The wilder and more ridiculous something is, however, the firmer and more solid the evidence will have to be."**

# Standards will Shield Engineers from Liability

"Who will guard the guards themselves?"



**"The more we run from a problem, the more we're actually running into it"**

**Pico Iyer: British-born  
essayist and novelist  
of Indian origin**

# Imminent Change of Safety Culture



**Dr. Ezra Hauer,  
Leading Contributor of  
Highway Safety Manual**

“A change from a system of road-safety delivery rooted in **opinion, intuition, and folklore** to one that is founded in science and based on factual knowledge is underway”

# Complex World of Safety Culture

## Actual Crash Rates



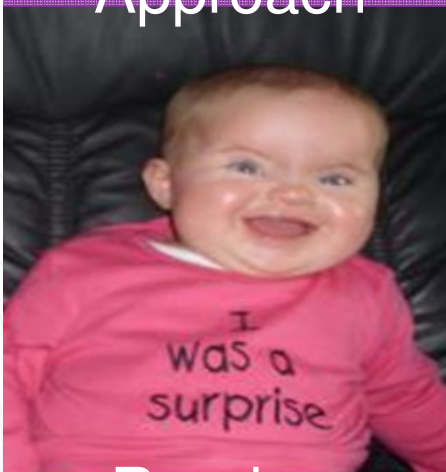
Crash



## Human Feeling



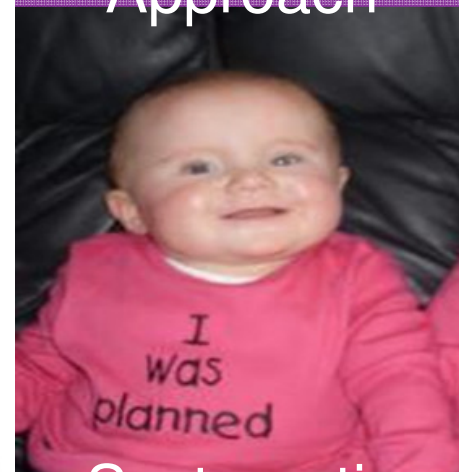
## Reactive Approach



## Random Error

- "Accidents"
- "Safer Streets"
- "Wider is

## Proactive Approach



## Systematic Error

- "Collisions"
- "Safer Streets"
- "Narrower is

# Implications of Unnecessary Wide Lanes

## Imbalanced Distribution of Street Space Among the Multimodal Users

### Very Wide Curb Lane



**Unused space of very wide lane creates extremely narrow and unsafe lane**

### No waiting area for Pedestrians



**Narrower and substandard sidewalk width next to very wide lane**



# Very Wide Lanes: Overdesign is Safe?

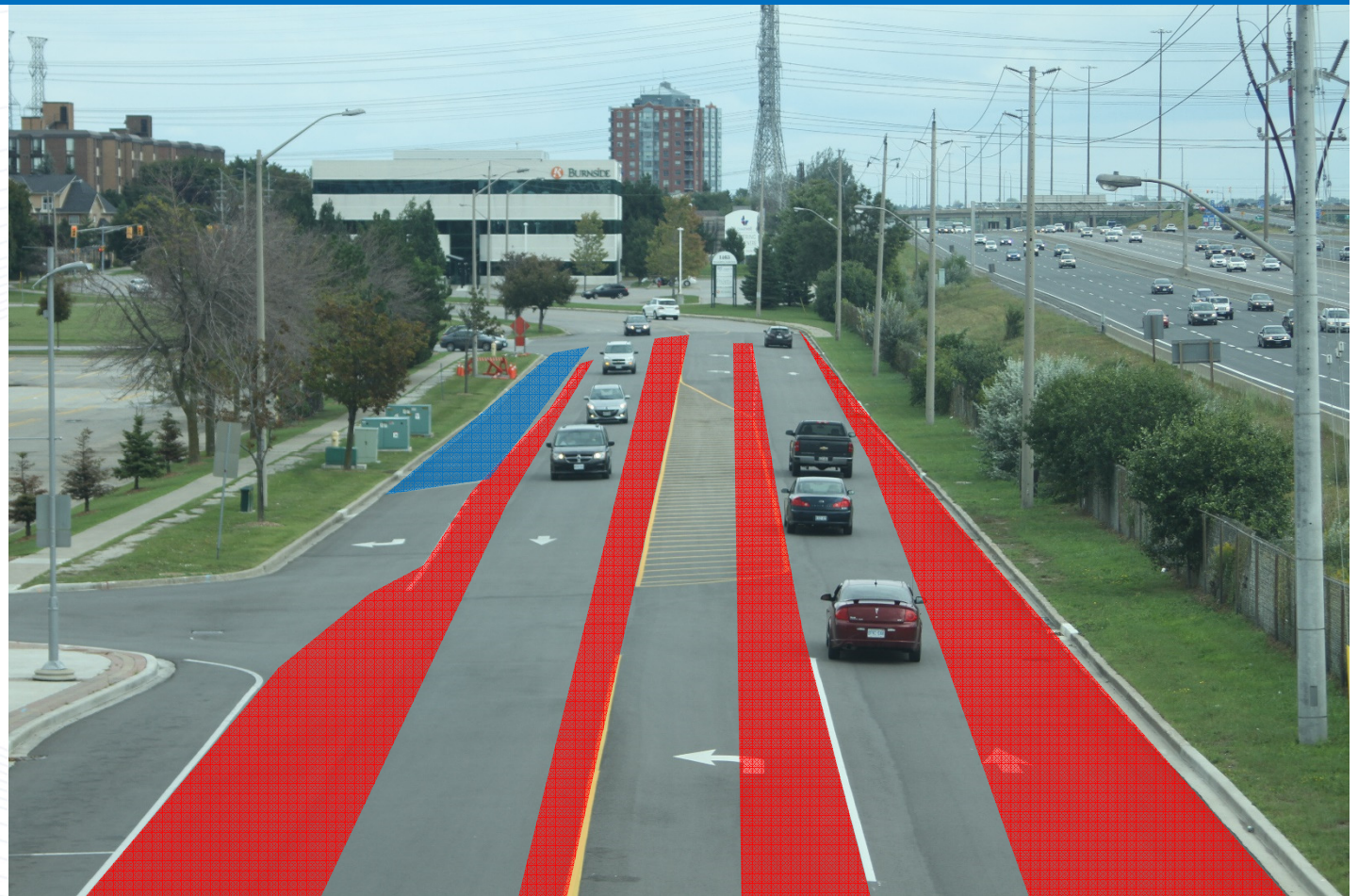
Where are even current standards?

Lack of Public Space Distribution and How to Use Current /new Standards



## Very Wide Lanes: Lack of Safety Knowledge?

**Recent Resurfacing  
Example, Pickering  
Parkway**



**Removed Bike  
Lane to Install  
>5.0m Travel Lane?**

# Human Scale and Infrastructure Limits

Delicate Sense of Human Scale: Size Varies Based on Demand but Limiting Scale



Product of Inca Civilization Engineering

## Cost of Congestion vs. Safety

“Perhaps, if the travelling public knew the extent of ignorance about safety with which roads are created and operated, the requisite pressure would materialize.” – Dr. Ezra Hauer

Social Cost of  
Collisions  
In Ontario

**\$18 Billion**

Congestion  
Cost in  
Ontario

**\$3.3~6.0 Billion**

Toronto  
Urban Area  
Collision  
Cost

**\$2.0 Billion**

Source: 1. Vodden K., Smith D., Eaton F., Mayhew D. (August 2007). Analysis and Estimation of the Social Cost of Motor Vehicle Collisions in Ontario, Final Report, Ministry of Transportation.; 2. Transport Canada (April 2006). The Cost of Urban Congestion in Canada, Environmental Affairs.3. City of Toronto (2013). Strategic Plan, Transportation Services.

## Previous Research Clues: Detrimental Range of Lane Width



“A persistent **myth** that seems to be rooted within the profession is that all vehicular lane widths must be 12 ft.”

**Dr. Hillary Isebrands,  
Dr Tracy Newsome,  
Frank Sullivan**

## Previous Research Clues: Detrimental Range of Lane Width

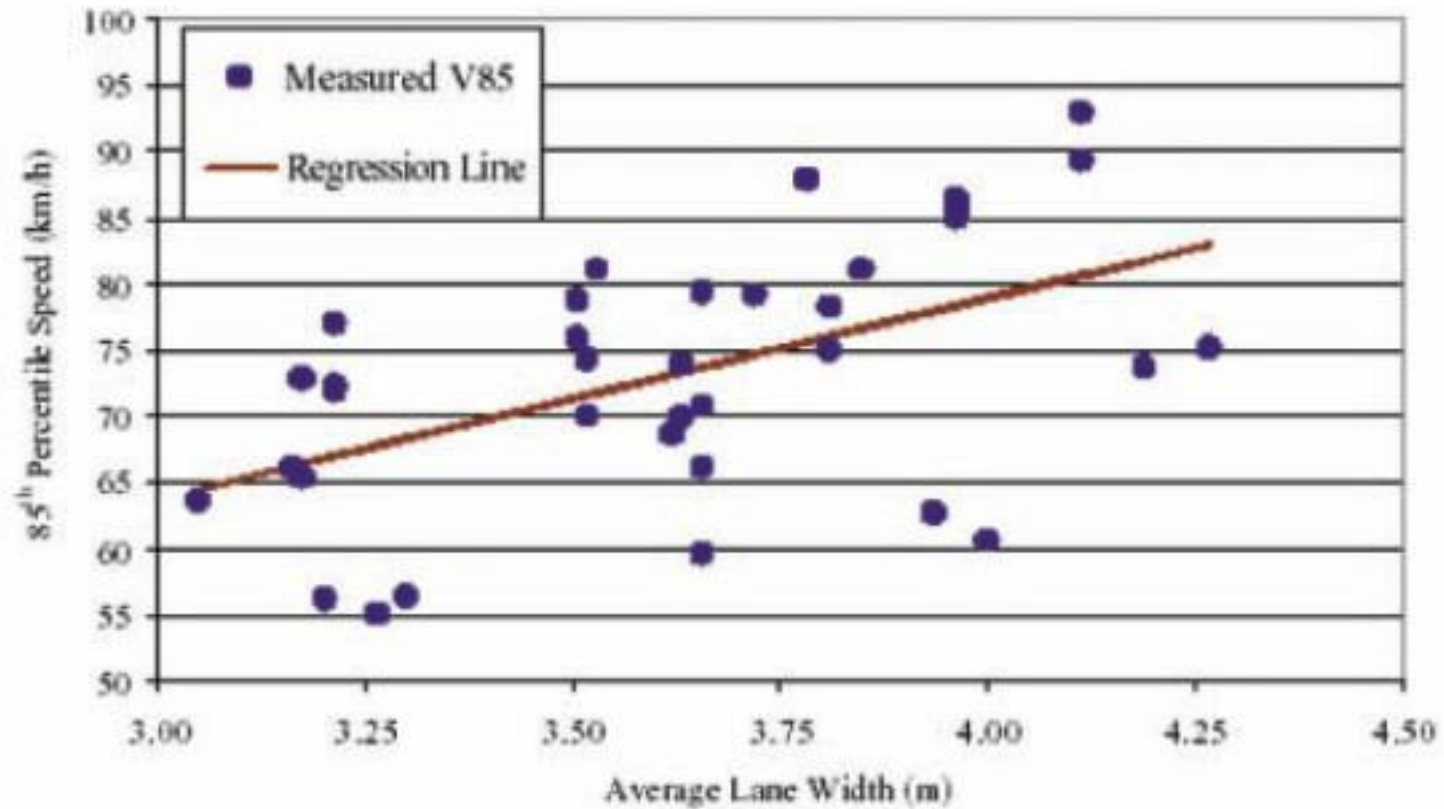


**Dr. Ezra Hauer,  
Performed Historical  
Background Research  
on Lane Width**

“The relationship between lane width and crash experience is non-linear with optimal safer range of lane width **bottoms out**” ...when it crosses a boundary limit (such as, widening lanes beyond 12 ft or 3.6m may be detrimental to safety).

Source: Hauer E., (August 13, 2012). Lane Width and Safety, unedited draft, available at <http://ezrahauer.com/2012/08/13/lane-width-and-safety/>.

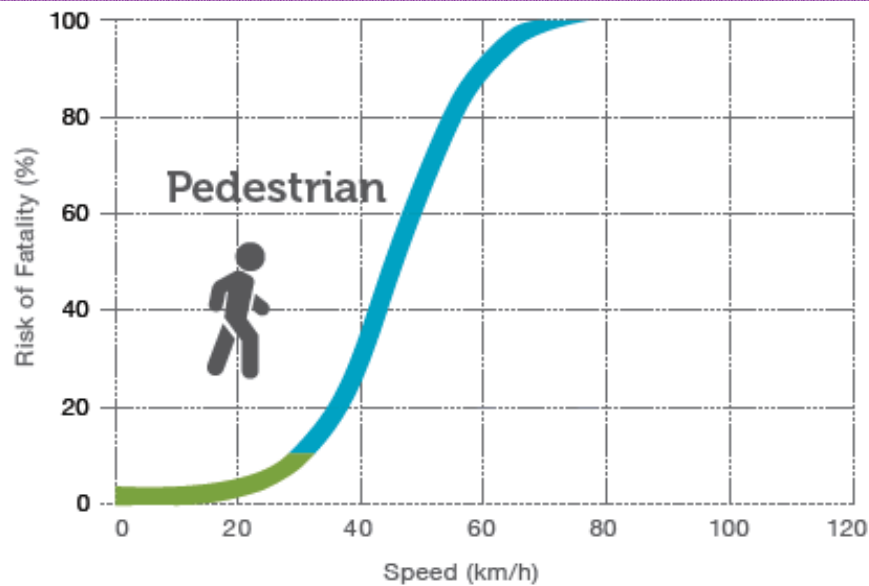
## Previous Research Findings: Speed and Lane Width



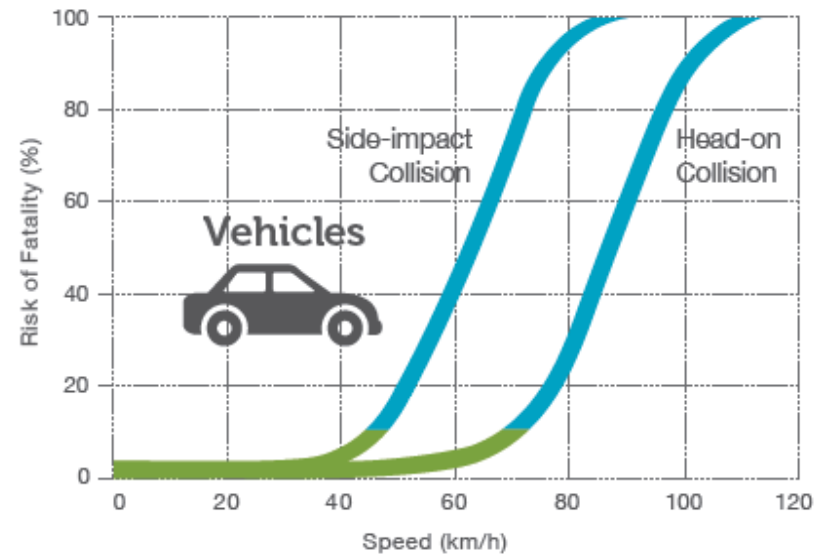
Source: Fitzpatrick K., Carlson P., Brewer M., and Wooldridge M., (2001). Design Factors That Affect Driver Speed on Suburban Streets. Transportation Research Record, Vol. 1751, pp. 18-25.

# Previous Research Findings: Speed and Crash Experiences

## Impact on Pedestrians



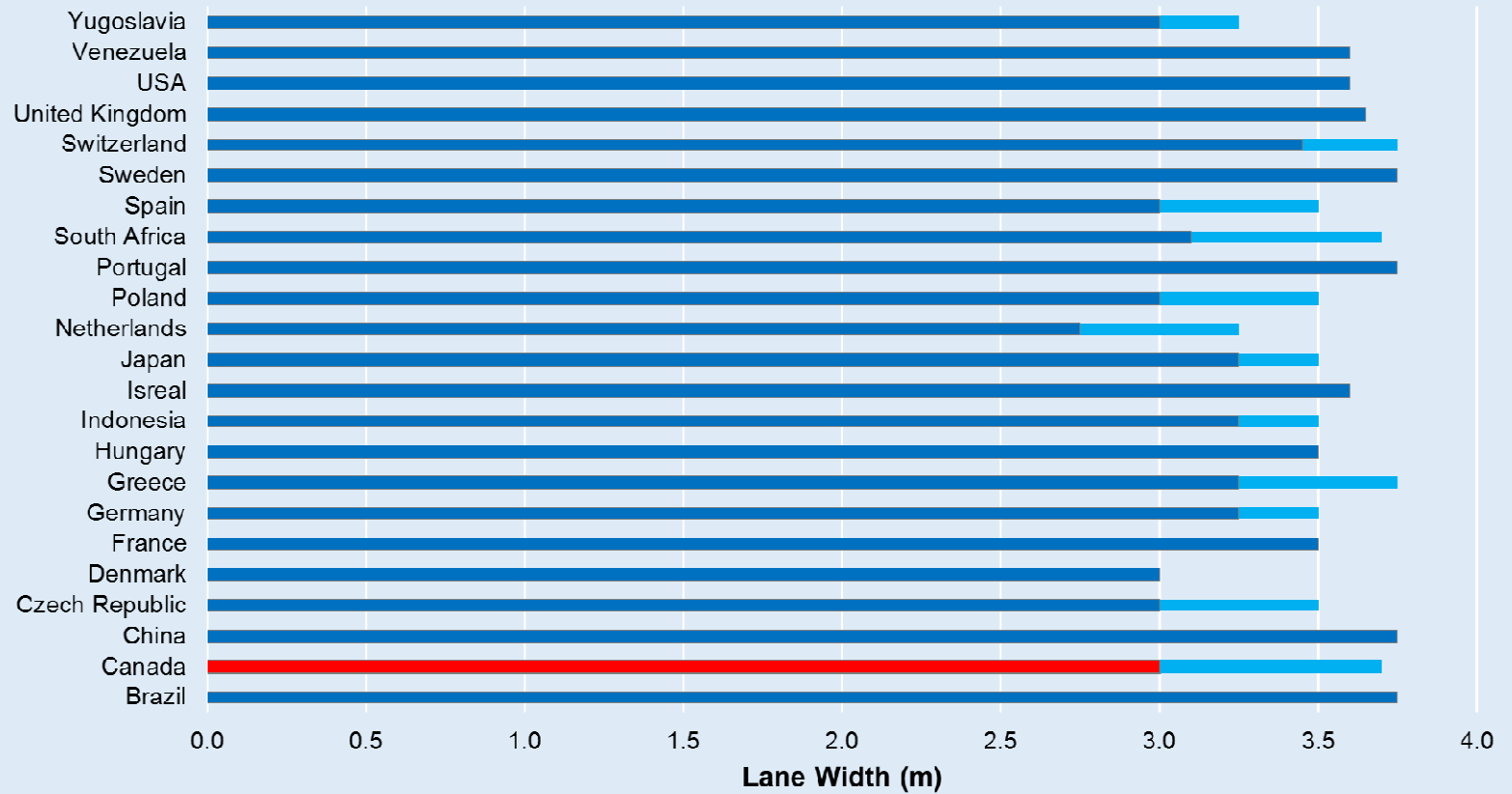
## Impact on Vehicle Users



The traditional belief of “wider is safer” is highly questionable and contradictory to this logical sequence.



# Current Status of Lane Width: International Comparison



## Major Arterial Roads

Source: Hall, L, Powers, R, Turner, D, Brilon, W and Hall, J (1995). Overview of Cross Section Design Elements. International Symposium on Highway Geometric Design Practices, Boston, Massachusetts, available online.

## Research Data



### **Toronto Database:**

70 Signalized Intersections (1999 to 2004) + Few Project Examples (2013~)



### **Tokyo Database:**

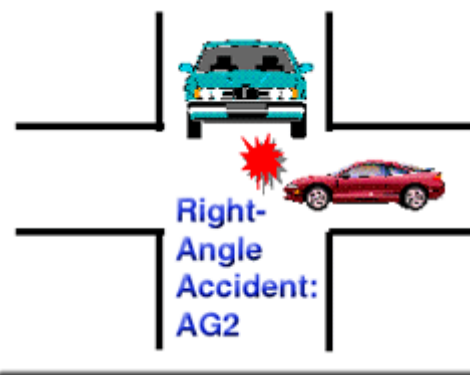
190 intersections in Tokyo (1992 to 1995)

# Types of Crashes in Database

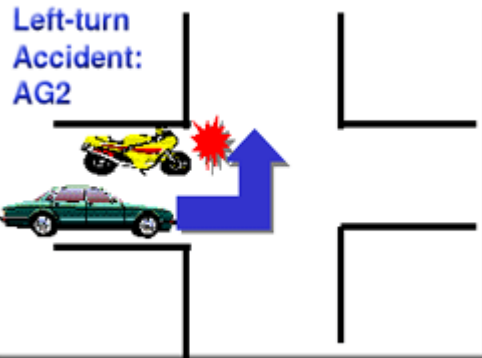


Angle Accident

Side-Impact  
Crashes

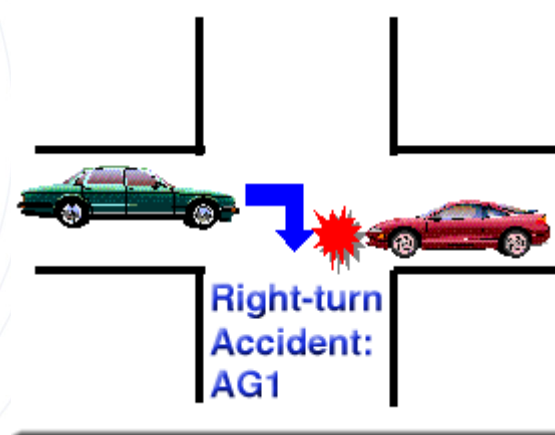


Right-Angle  
Collisions



Left-turn  
Accident:  
AG2

Left-turn  
Collisions



Right-turn  
Accident:  
AG1

Right-turn  
Collisions

# Prototype Styles of Road-safety Delivery Practice

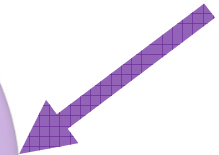
## Pragmatic Style

- Based on Lay Beliefs & Self-interest Organizations
- Require no Knowledge of Fact
- No Need for Results of Actions

## Rational Style

- Based on Expected Consequences
- Need Factual Information
- Learns from Experience

Approach of  
This Study



# Research Approach

Creating Framework for Scientific Approach of Lane Width Selection Among the Transportation Practitioners

Key  
Focus



Safer **Lane Width** Zone



Large Vehicle **Considerations**



Pedestrian & Cycling **Impact**



**Intersection** Design Principle



**Congestion & Capacity** Impact

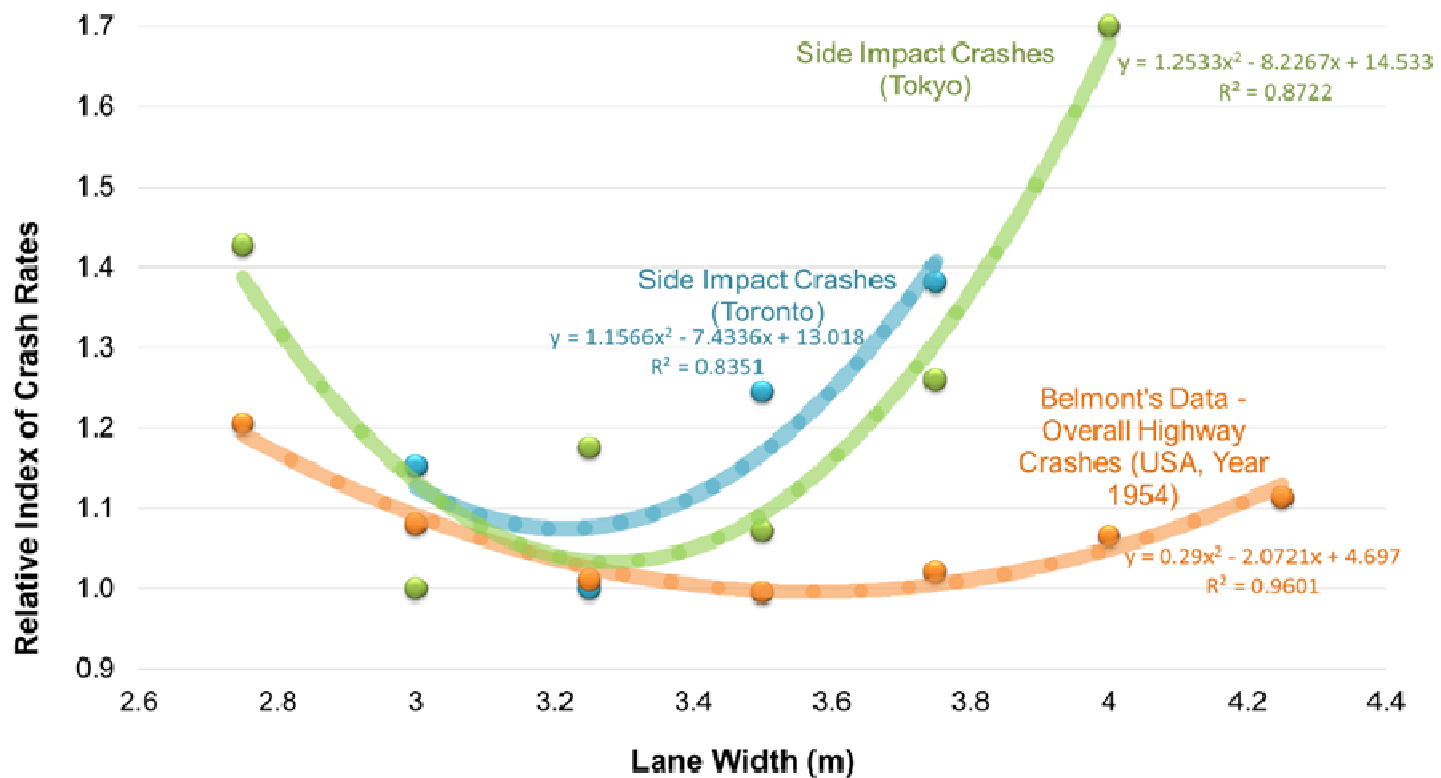


**Reallocation** of Public Space



## Key Findings: Lane Width and Crash Frequency

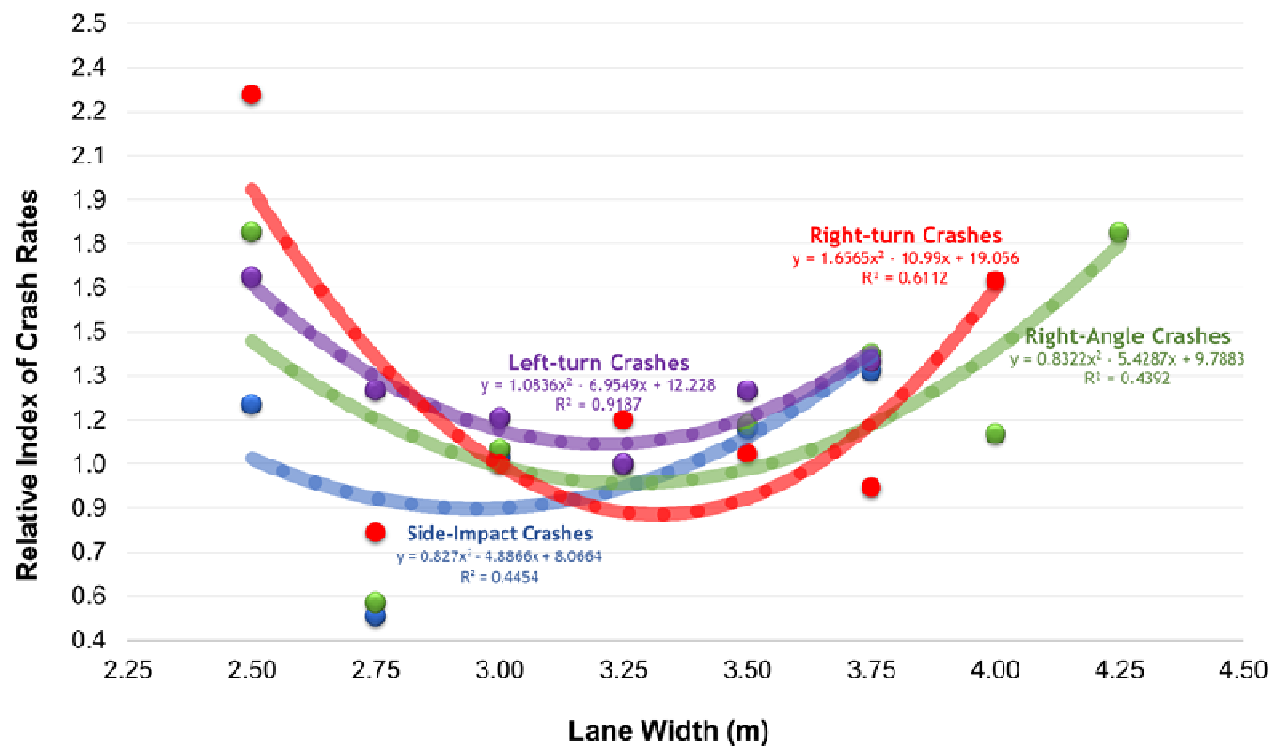
### Shape of Functional Relationship between Lane Width and Crash Rates



**Findings:** Safer Range of Lane Width is 3.0~3.3m

## Key Findings: Behaviour of Crash Types

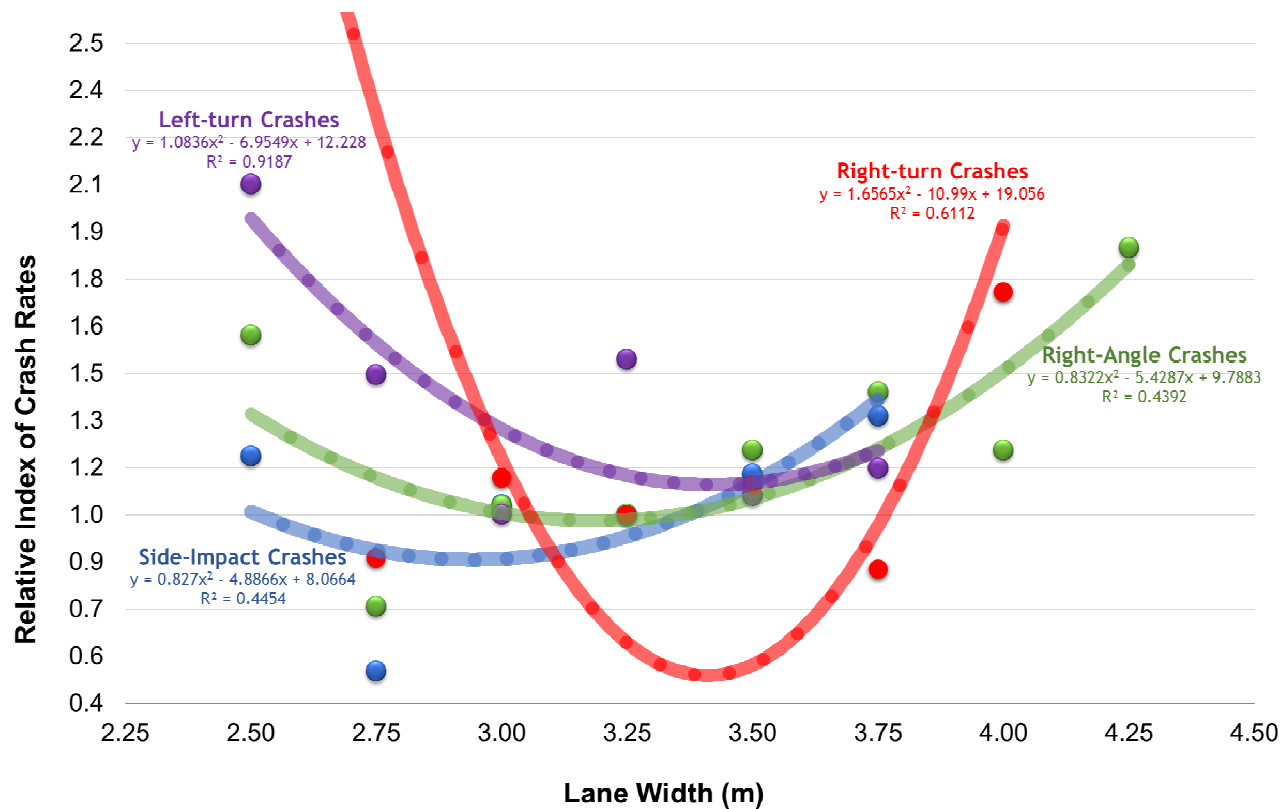
Shape of Functional Relationship between Lane Width and Crash Rates for Different



**Findings:** Safer Range of Lane Width is 3.0~3.3m

# Key Findings: Behaviour of Crash Types

Shape of Functional Relationship between Lane Width and Crash Rates for Different



**Findings:** Safer Range of Lane Width is Varies with Types of Lane



# Implications of Unnecessary Wide Lanes: Case Study

## Very Wide Curb Lane



## Consequences of Very Wide Lane



Illegal Drop-of-pick-up



Illegal Taxi, Delivery



Unofficial Bus Stop



Narrow, Sub-standard Boulevard

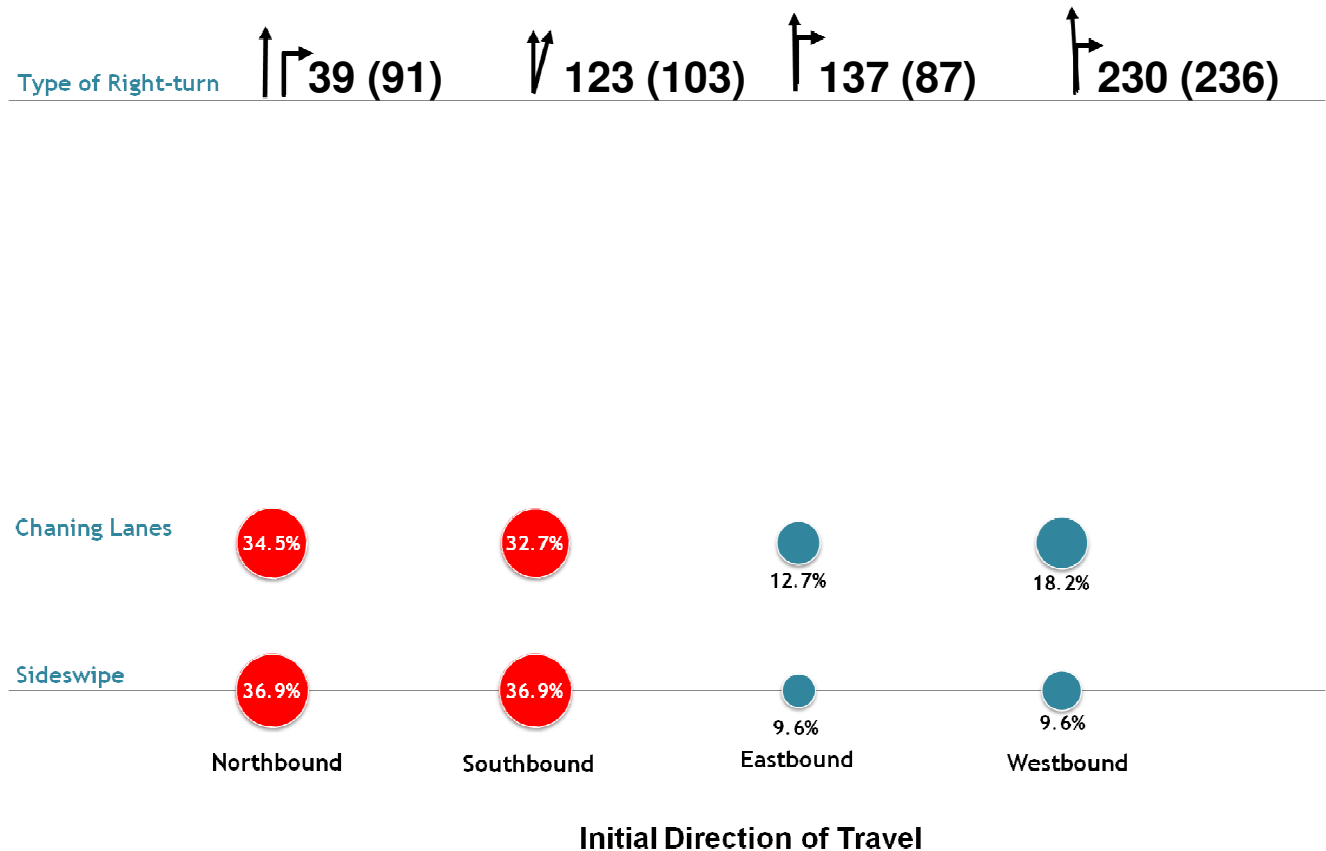
# Implications of Unnecessary Wide Lanes: Case Study

## Safety Consequences of Very Wide Lane Comparison Types of Collisions by Initial Direction of Travel

### Key Findings:

- 1) Extremely high right-turn collision rates in southbound direction
- 2) Higher Sideswipe and changing lanes collision in North & southbound directions
- 3) **Despite high volume, shared right-turn is safest form of turning facility**

Percent of Collision/ Collision Rates



# Implications of Unnecessary Wide Lanes: Right-turn

- Key Findings:** 1) Shared Right-turn lane experiences best safety records  
 2) RT lane with island is most dangerous form turning facility

Crash Records of Various Types of Right-turn Lane

## Crash Rates

Number of Right-Turn  
Crashes per yer per mil veh

0.43

0.37

2.66

## Crash Rates (Georgia DOT)

Number of Right-Turn  
Crashes per Approach  
per Year

0.81

1.57

0.31

0.63

## Crash Rates (Texas DOT)

Number of Right-Turn  
Crashes per Approach  
per Year

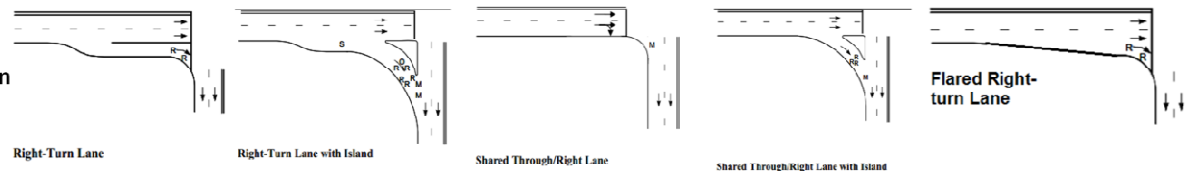
0.11

0.21

0.04

0.67

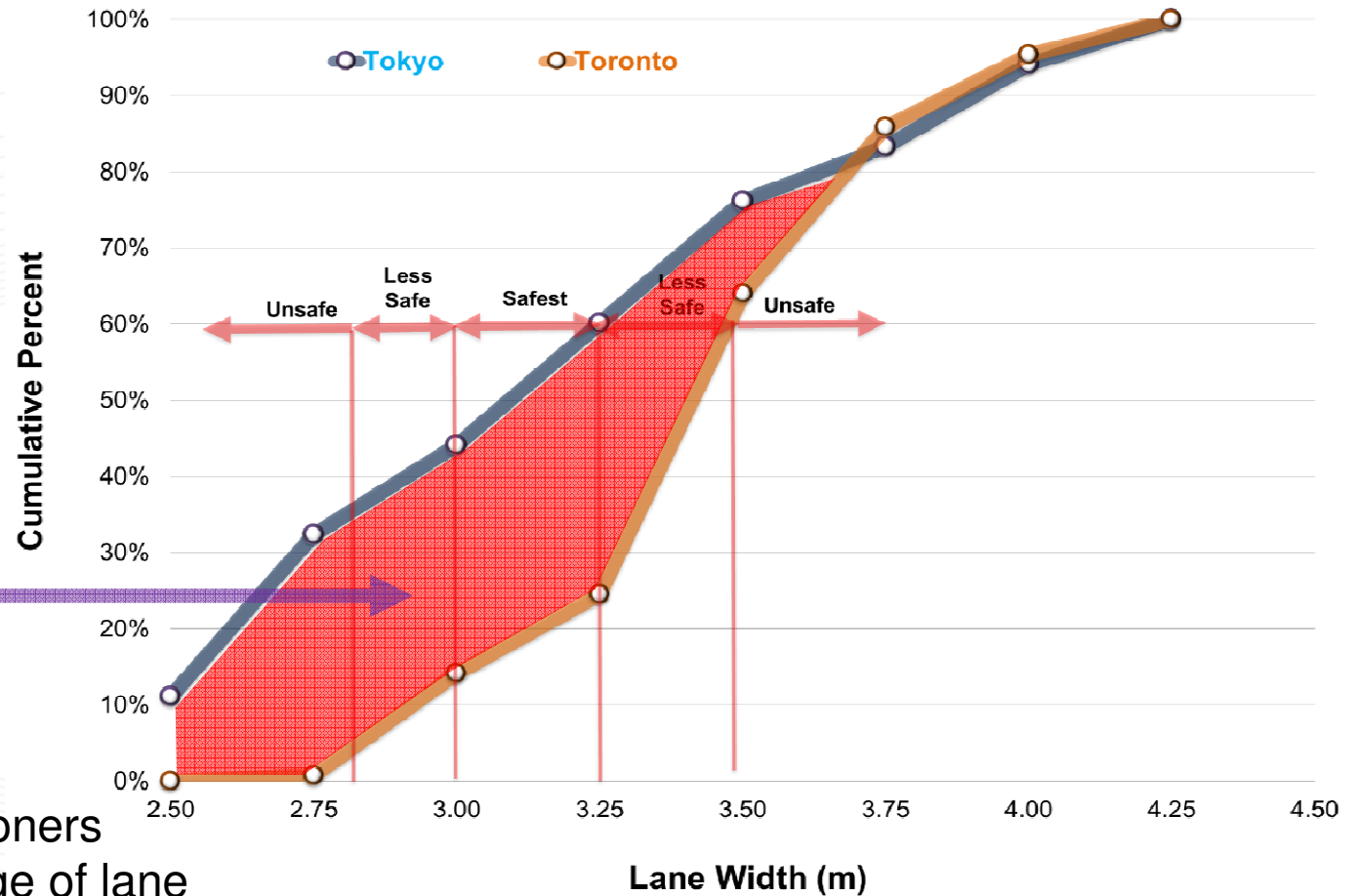
## Type of Right-turn Lane Design



# Key Findings: Culture of Lane Width “Practice”

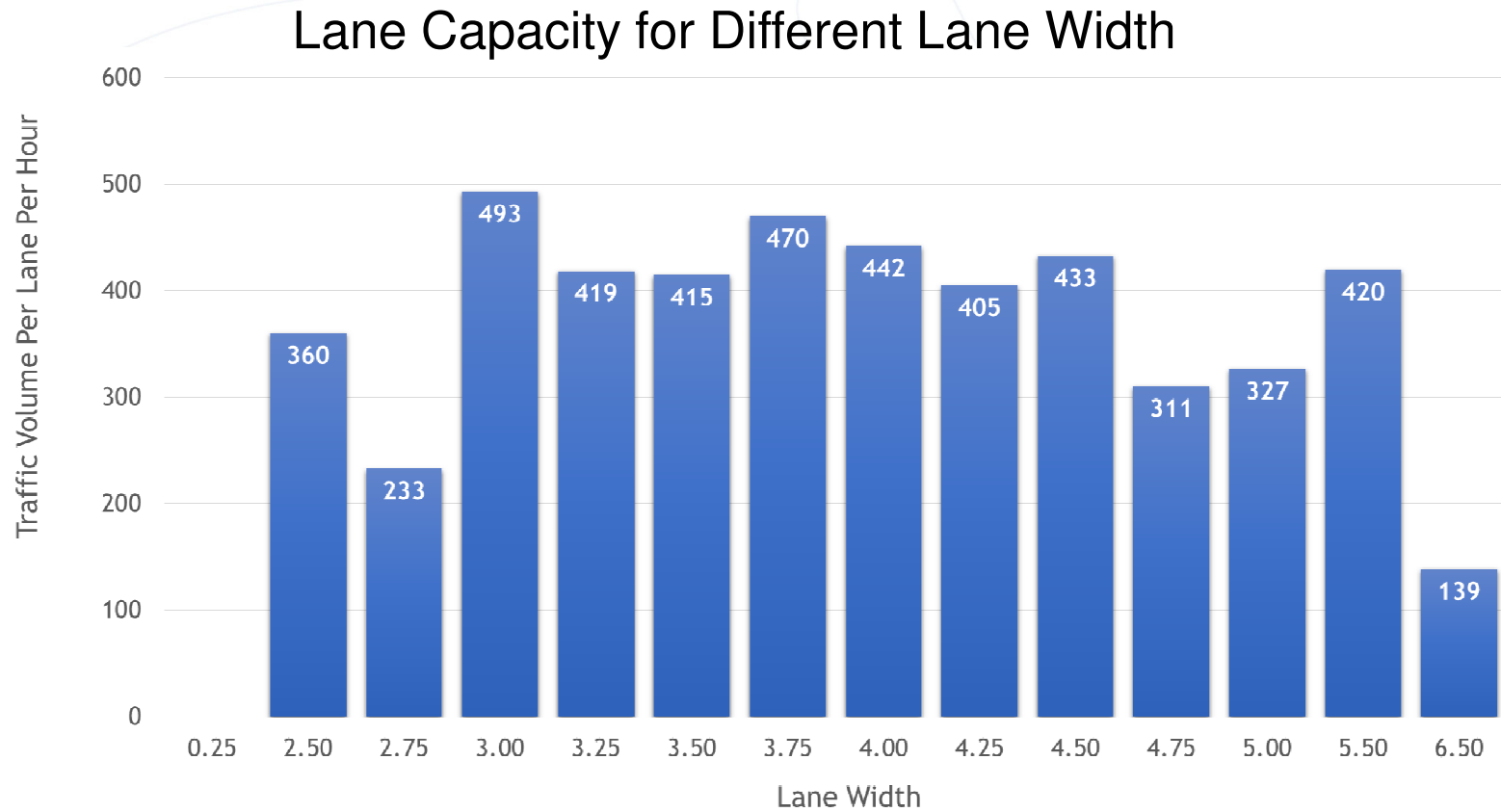
Distribution of Lane Width

Gap in Practice



**Findings:** Tokyo practitioners uses relatively safer range of lane

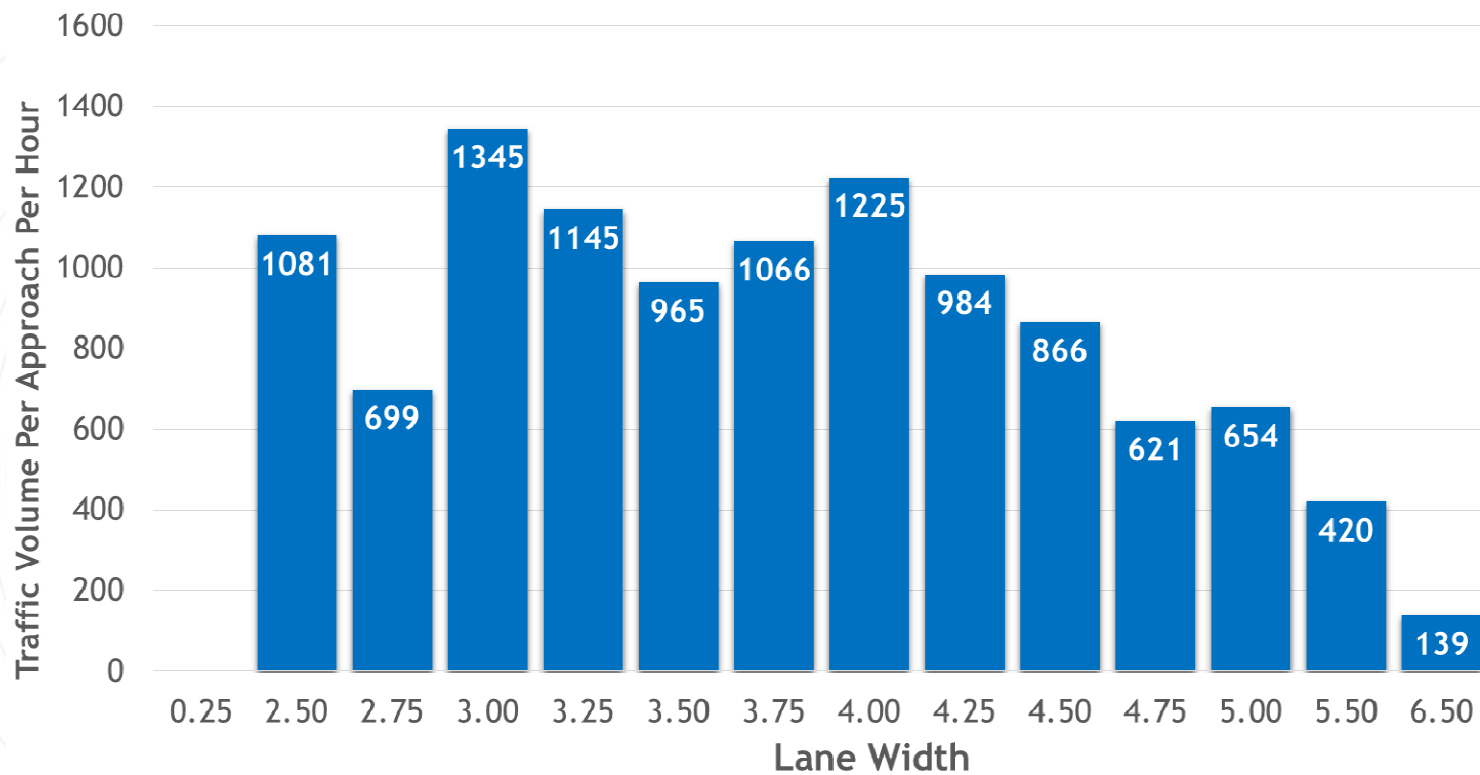
## Key Findings: Narrower Lanes Impact on Congestion



**Findings:** Safest Range of Lane Width Carries Highest Volume of Traffic

## Key Findings: Narrower Lanes Impact on Congestion

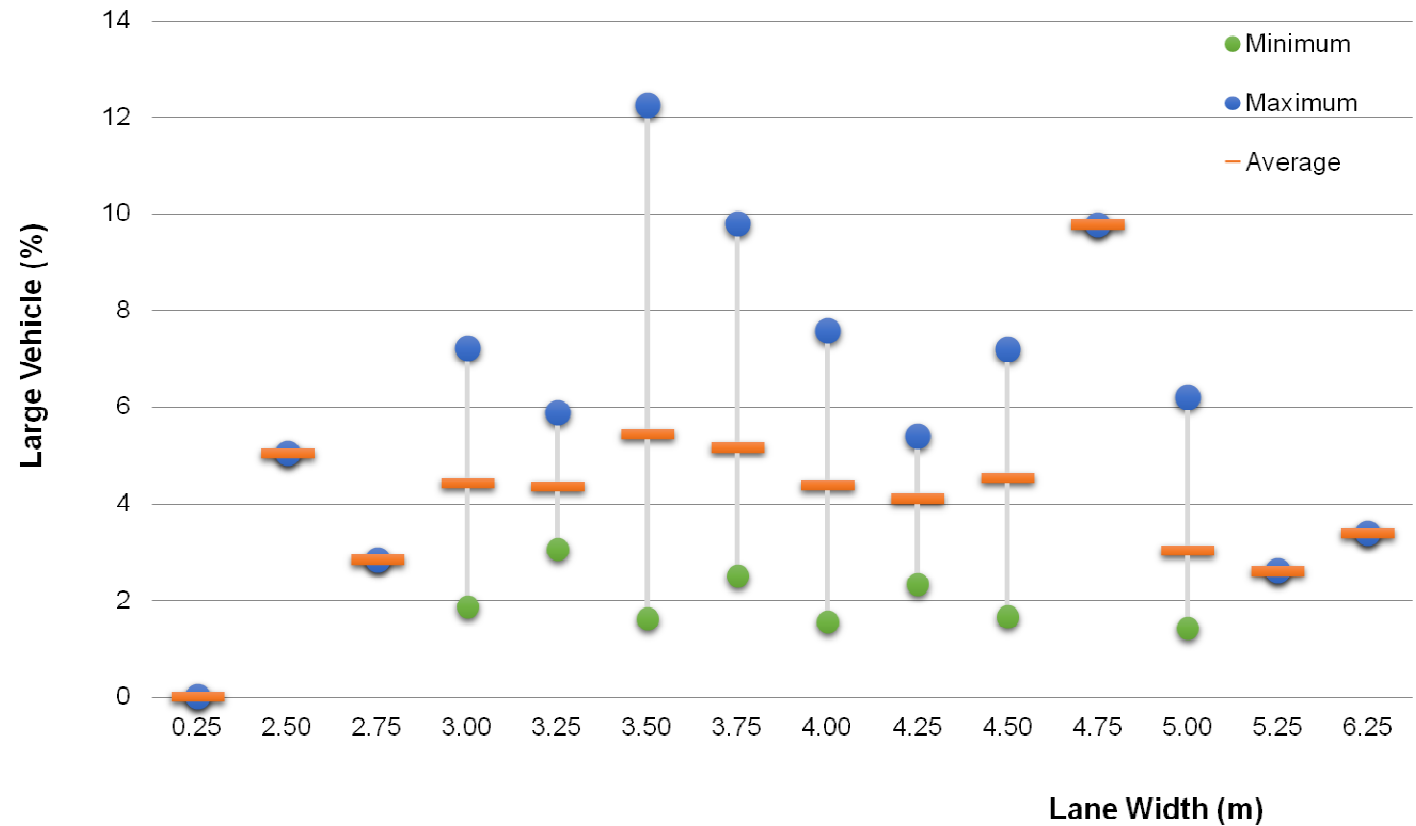
### Approach Traffic Volumes for Different Lane Width



**Findings:** Safest Range of Lane Width Carries Highest Volume of Traffic

## Key Findings: Large Vehicles Impact

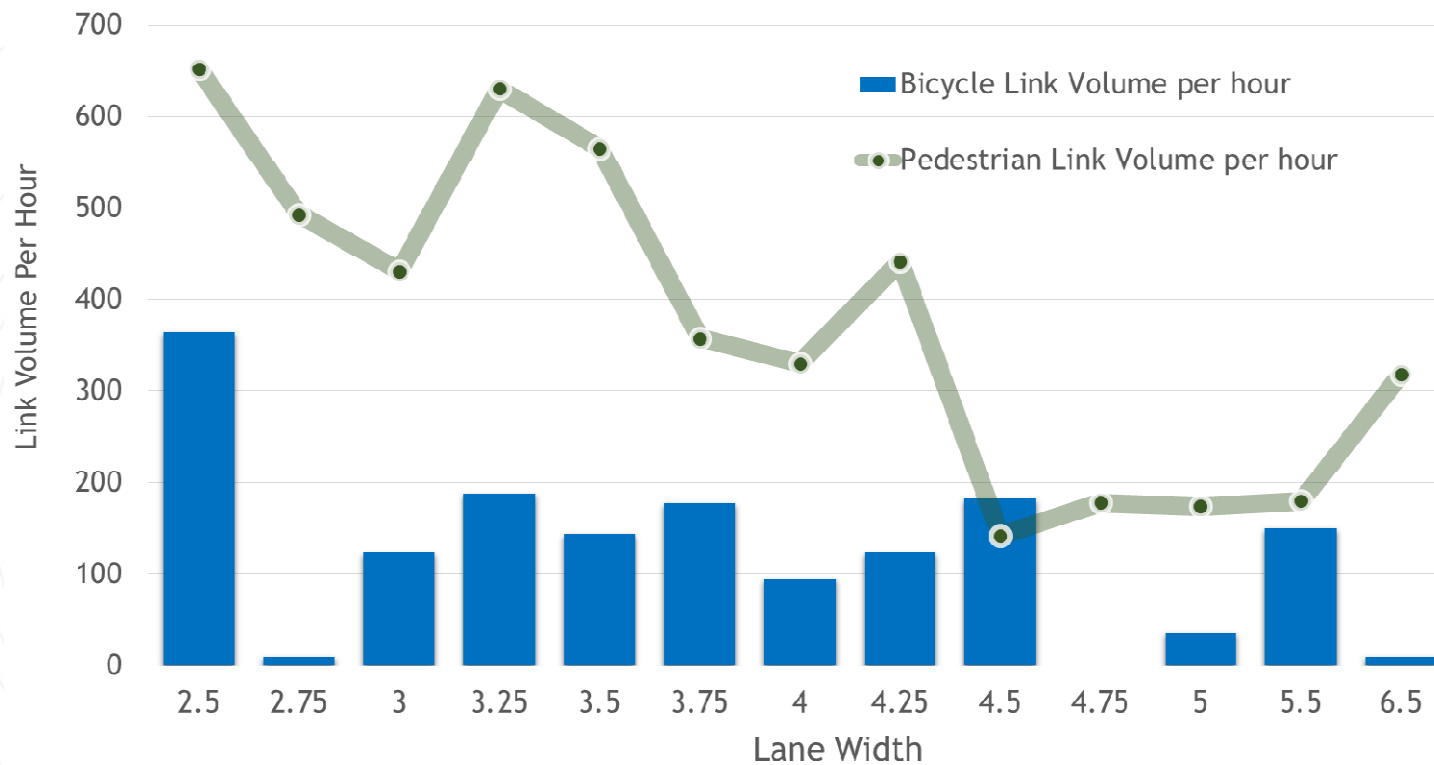
### Distribution of Large Vehicles Lane Width



**Findings:** Safer range of lane width carries similar large vehicle volumes

## Key Findings: Narrower Lanes and Bicycles/Pedestrians

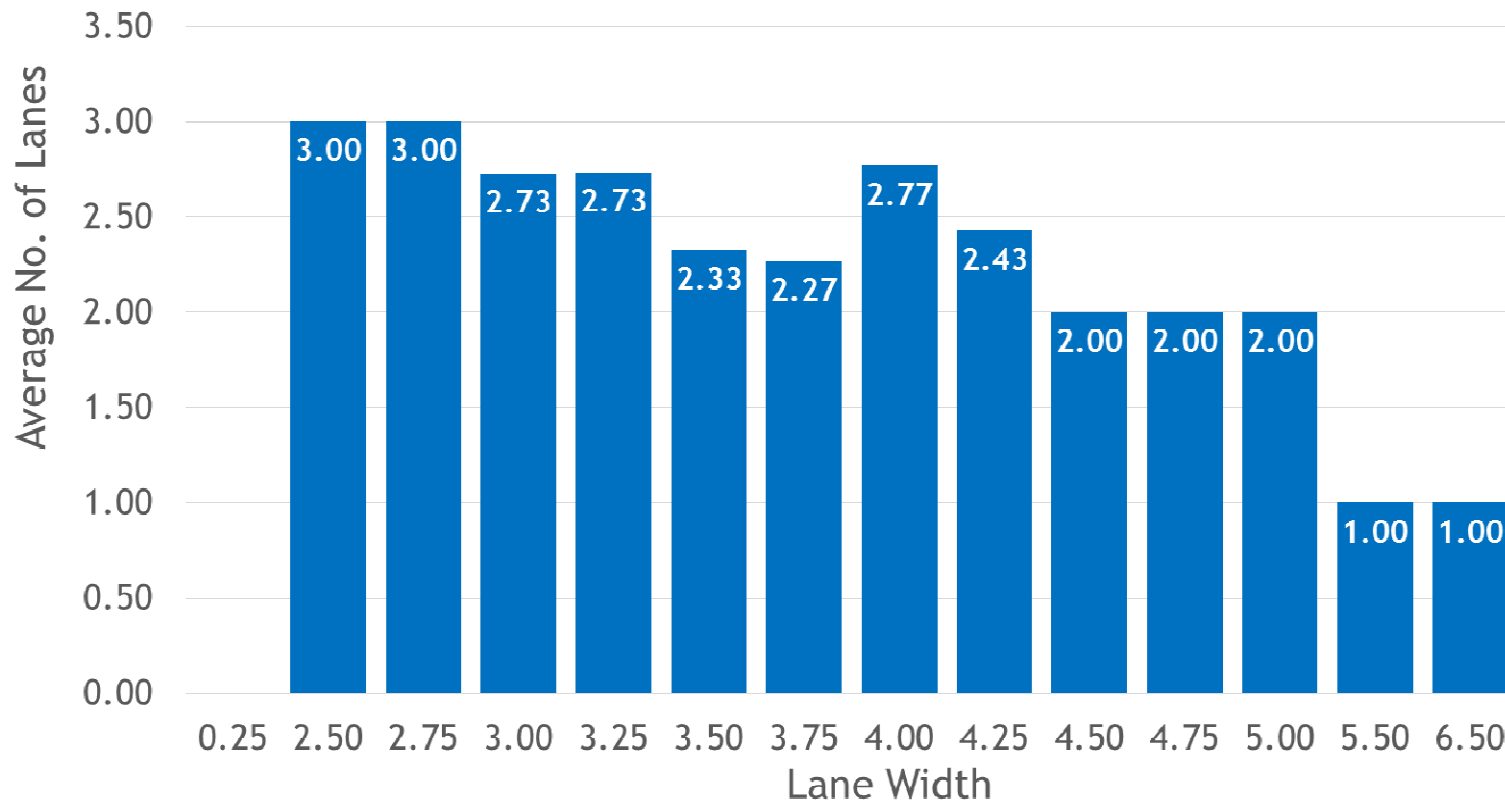
### Distribution of Bicycle and Pedestrian for Different Lane



**Findings:** Narrower lanes helps to accommodate bicycle/pedestrian demand without additional



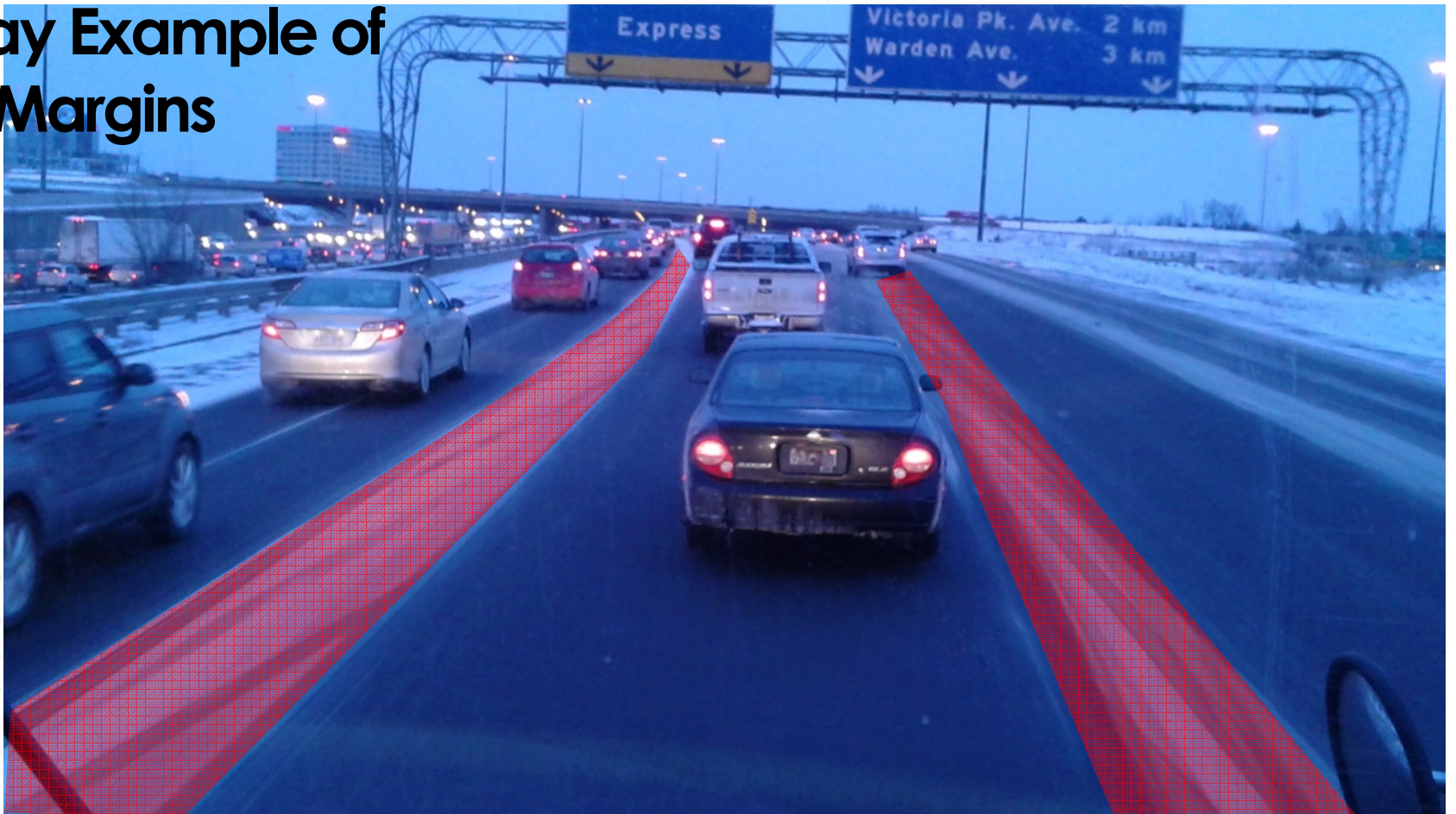
## Key Findings: Narrower Lanes and No. of Lanes



**Findings:** Narrower lanes helps to squeeze more lanes without additional ROW

## Example from Real World: Safety Margins

### Highway Example of Safety Margins



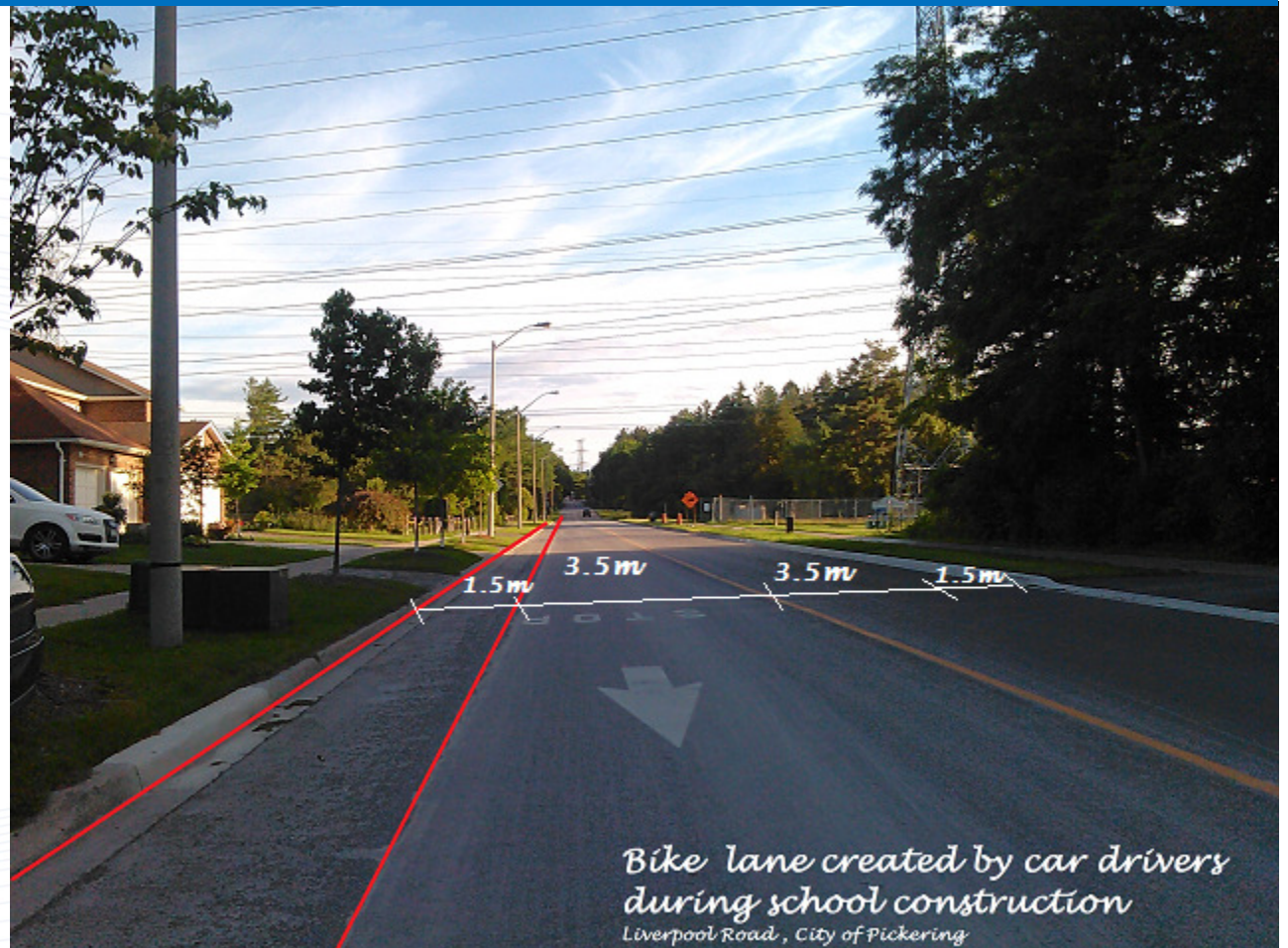
## Example from Real World: Comfortable Safer Zone

**Safer Lane Width is Visible During the Snowstorm**

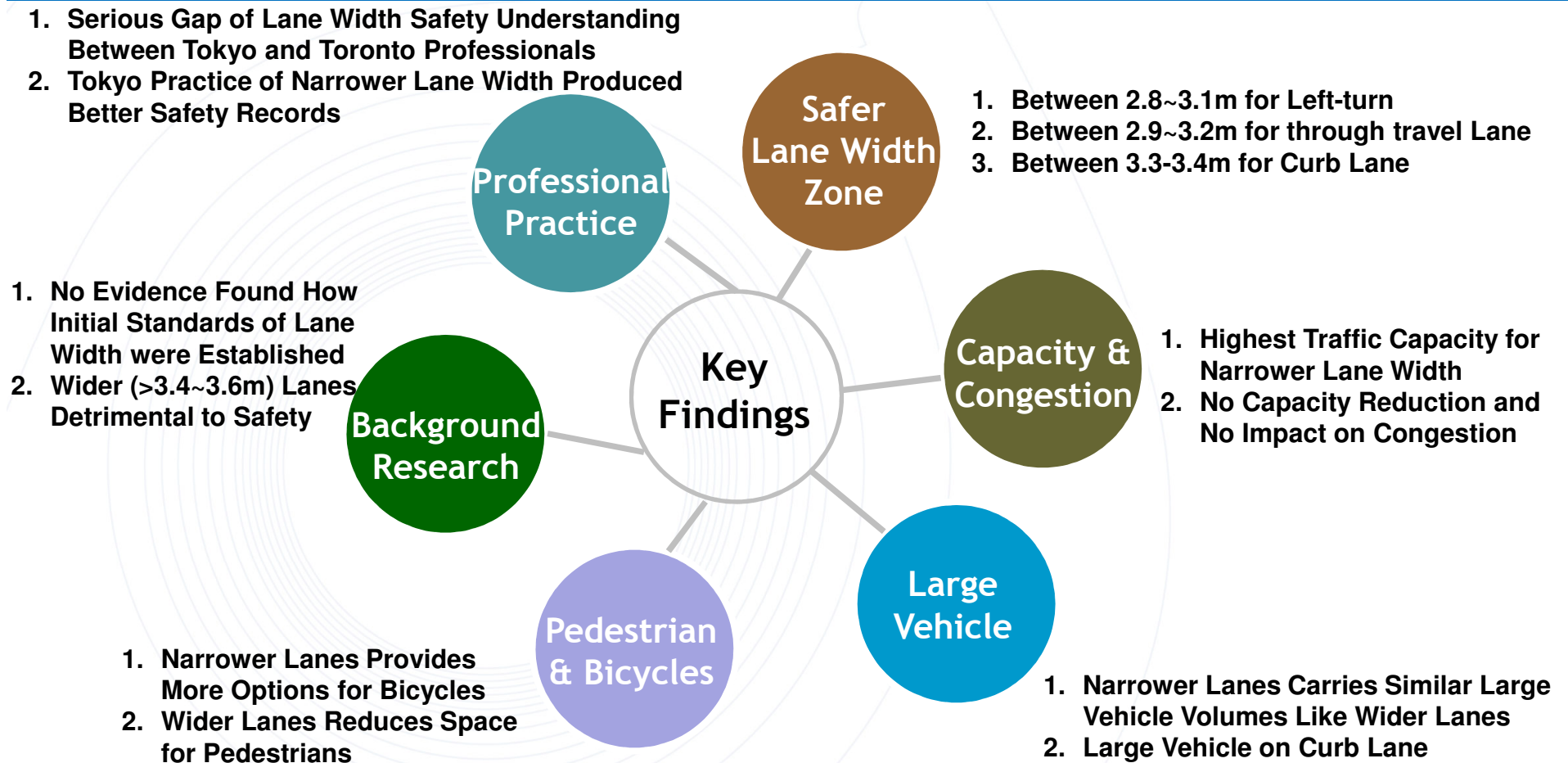


## Example from Real World: Comfortable Safer Zone

**Safer Lane Width is Visible During Summer Time Construction**

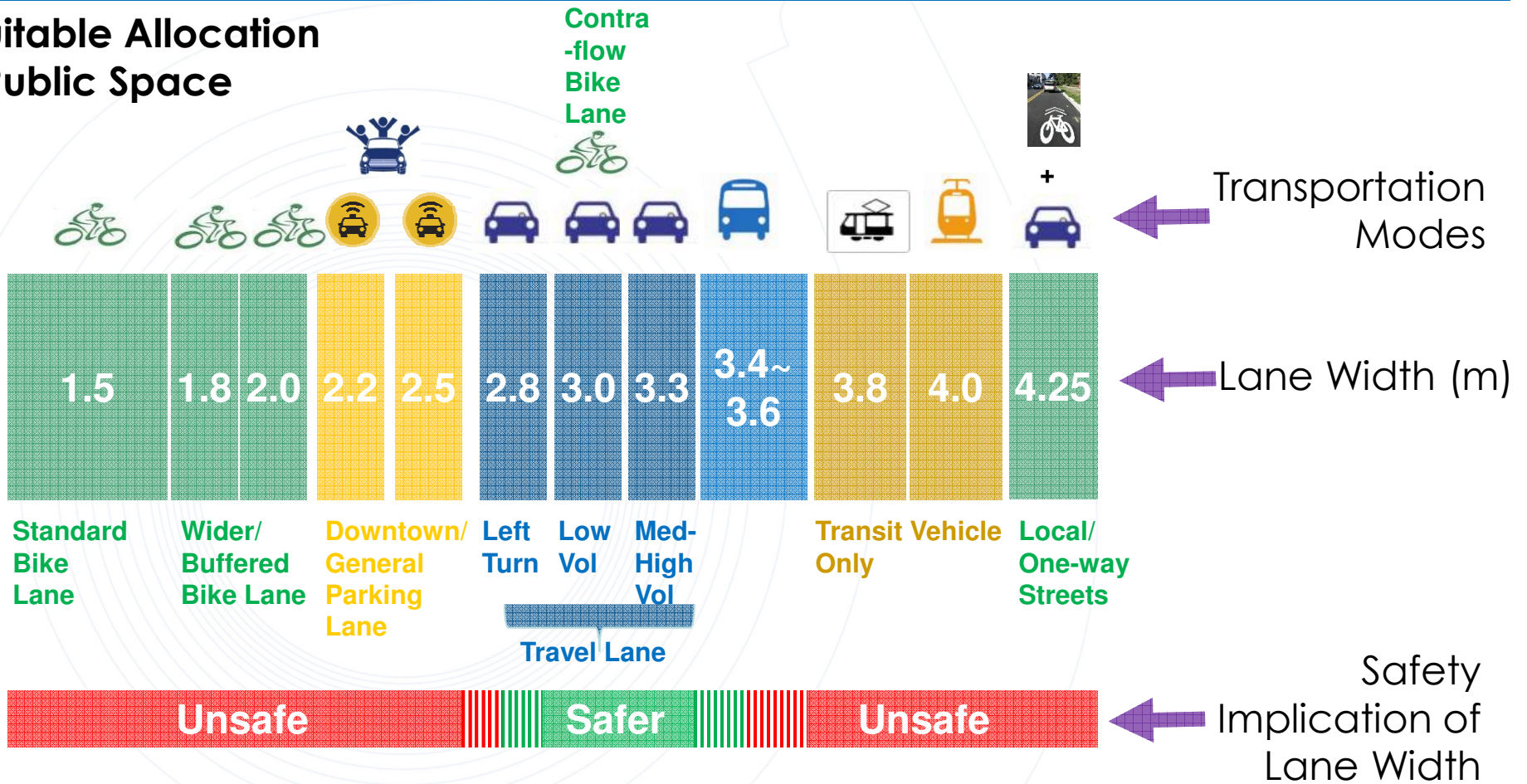


# Research Conclusions



# Research Outcome: Context-Based Lane Width

Equitable Allocation of Public Space



# Accepting Evidence in Practice

Stages of  
Establishing  
Truth

1. It is Ridiculed

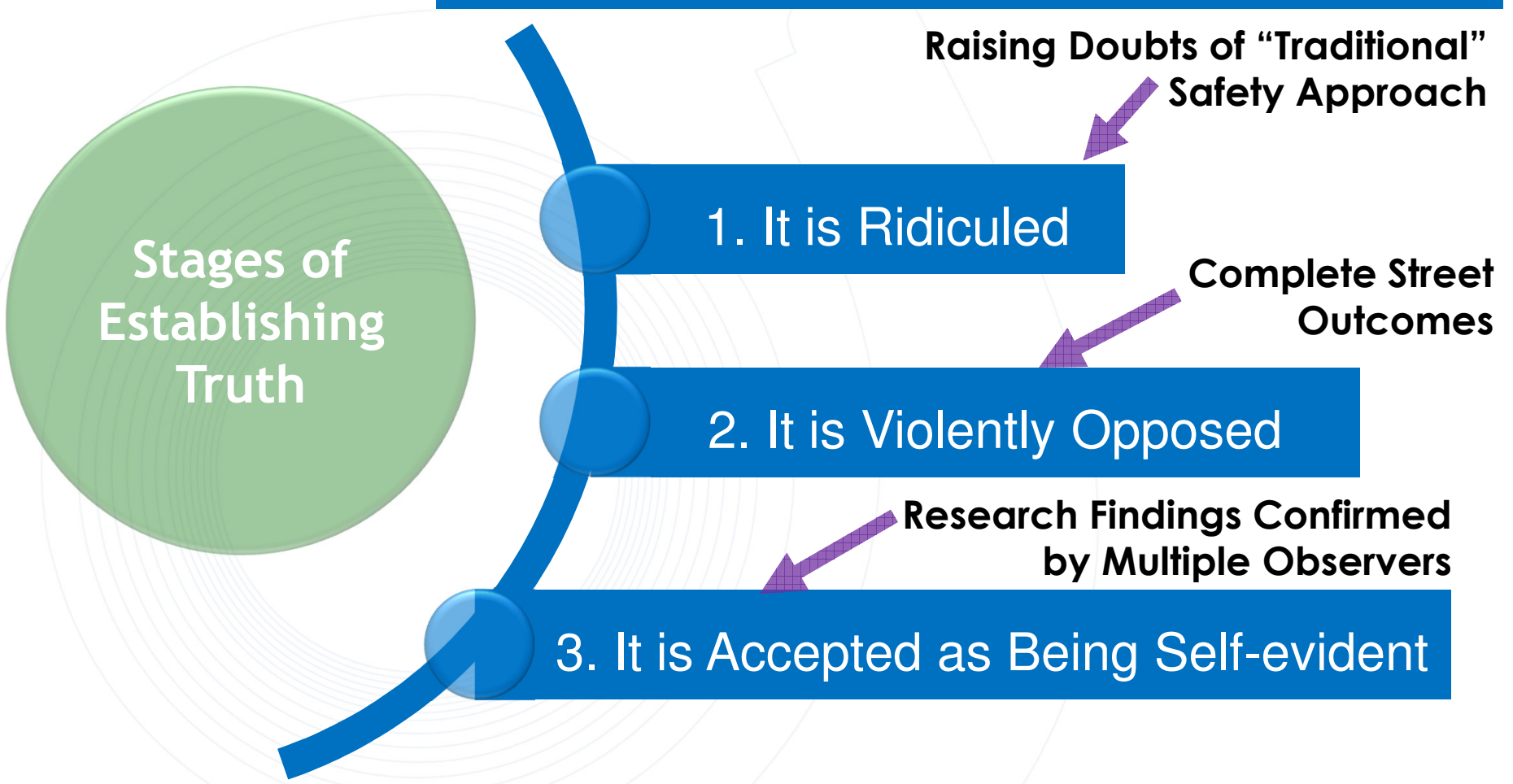
Raising Doubts of “Traditional”  
Safety Approach

2. It is Violently Opposed

Complete Street  
Outcomes

3. It is Accepted as Being Self-evident

Research Findings Confirmed  
by Multiple Observers



# Practicing Engineering with Evidence



**“The Most urgently needed change of road-safety culture is to make intuition-based road-safety delivery **socially unacceptable**”**

**Dr. Ezra Hauer,  
Leading Contributor of  
Highway Safety Manual**

Source: Hauer E., (2007). "A Case for Evidence-Based Road-Safety Delivery". AAA Foundation for Traffic Safety, Retrieved on May 2011 at <http://www.aaafoundation.org/pdf/Hauer.pdf>.



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**Thank You  
for Your Time**