4th International *SIIV* Congress

ADVANCES IN TRANSPORT INFRASTRUCTURES AND STAKEHOLDERS EXPECTATIONS

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Road Safety Evolution, Revolution, Convolution and Resolution – a North American Perspective

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Overview of lecture

- **Evolution of road infrastructure safety management**
  - **Stakeholders interest**
  - **Practical solutions**
  - **Research revolution**
- **Current resolution initiatives**
  - Highway Safety Manual
  - AASHTO strategic highway safety plan
    - **Applied safety evaluation research**
- **Future directions**

Evolution of road safety management

- **Pre-1950's:** *emphasis on providing mobility*
- **> 1950:** *increasing importance of congestion management (1st edition of the Highway Capacity Manual)*
- **1960's:** *Increasing interest of administrators: Start of revolutionary practical resolutions*
  - Guide-rail, barriers and crash-cushions
    - *Reduced severity, but increased hits*
  - Breakaway-poles – eliminate severe accidents
    - *but also reduce non-severe ones!*

Evolution of road safety management, ctd.

- **Early 1980's:** *Start of the knowledge revolution*
  - Recognition of problems with existing knowledge on safety implications of roadway improvements
    - Regression-to-mean in before after studies – safety benefits overestimated
    - Knowledge from cross-section studies -- safety benefits tend to be underestimated
    - Better methods for before-after and cross-section studies
    - ***5 papers on safety analysis submitted to TRB in 1985.***

- **Mid-1980's:** *From congestion management to safety management*
  - Managing congestion to improve safety

Is it better to be ……..

- **DEAD?**

- **OR ALIVE AND STUCK IN TRAFFIC??**

Evolution …. ctd.

- **Mid-1980's to mid-1990's:** *Dramatic increase in road safety research, researchers and practitioners*
  - Mostly ad hoc research
  - Road Safety Auditor as a profession
  - Safety considerations in design, construction and maintenance

- **1997:** *Ezra Hauer's landmark book on observational before-after studies*

- **Late 1990's:** *Formal recognition by administrators of need for science based road safety management;*
  - Increase in research directed to facilitate the management process
    - Identify locations for detailed safety investigation
    - Detailed safety investigations of sites and development of remedies
    - Prioritization and implementation of remedies
    - Evaluation of remedies

Evolution of road safety management, ctd.

- **TURN OF THE CENTURY:** *Formalizing safety considerations in the design, construction and maintenance processes*
  - Explicit consideration of safety in design guides and manuals
  - Interactive Highway Safety Design Model
  - Safety audits
    - Pre-construction
    - During construction
    - Post-construction
    - During maintenance

- **2000's:**
  - AASHTO Strategic Highway Safety Plan
  - Highway Safety Manual
  - PIARC Road Safety Manual

- **2007:** *80 papers on highway safety analysis submitted to Transportation Research Board Annual Meeting*

THE HIGHWAY SAFETY MANUAL

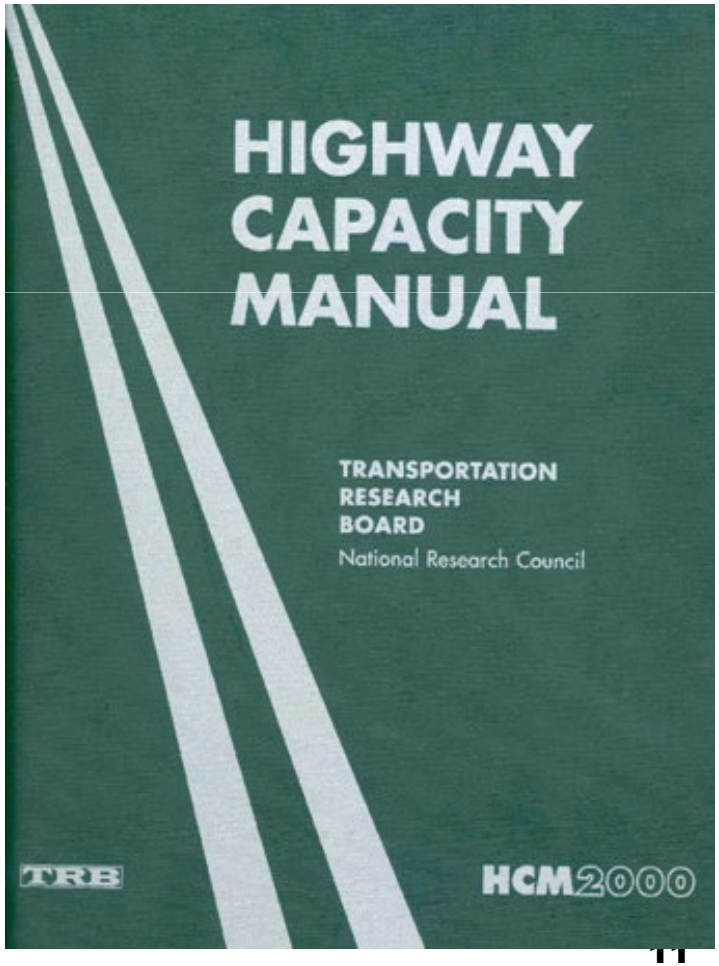
– a new era in highway safety analysis

HSM Purpose

- To provide the best factual information and tools in a useful form to facilitate roadway planning, design, operations, and maintenance decisions based on explicit consideration of their safety consequences.

The ‘vision’ of the HSM -- a document akin to the HCM

- Definitive; represents quantitative ‘state-of-the-art’ information
- Widely accepted in professional practice
- Science-based; updated regularly to reflect new research



First edition outline

Part I – Introduction and Fundamentals

Part II – Knowledge

Part III – Predictive Methods
-- Two lane roads
-- Urban/suburban arterials
-- Multilane rural roads

Part IV – Safety Management

Part V – Safety Evaluation

AASHTO STRATEGIC HIGHWAY SAFETY PLAN

- A comprehensive plan to substantially reduce vehicle-related fatalities and injuries on U.S. highways
  - *Achieve less than 0.6 fatalities per 100 million vehicle-km*
- Produce guidebooks for emphasis areas
  - *Identify proven, tried and experimental countermeasures*
- Not just a plan!
  - *Stimulate/support research to fill in gaps in countermeasure knowledge*
  - *Market research to ensure implementation of results*

Emphasis areas

- **Drivers**
  - Young
  - Unlicensed/Suspended/Revoked
  - Older
  - Aggressive
  - Impaired
  - Distracted/Fatigued
  - Seat Belt Use
  - Speed
- **Special Users**
  - Pedestrians
  - Bicyclists
- **Vehicles**
  - Motorcycles
  - Heavy Trucks
- **Highways**
  - Trees
  - Run Off the Road
  - Horizontal Curves
  - Utility Poles
  - Unsignalized Intersections
  - Head-On Collisions
  - Work Zones
- **Emergency Medical Services**
  - Rural EMS
- **Management**
  - Data
  - Integrated Safety Management Process

Guide for addressing run-off-road collisions – *Strategies to keep vehicles from encroaching on the roadside*

- shoulder rumble strips
- edgeline “profile marking,” edgeline rumble strips
- midlane rumble strips
- enhanced shoulder or in-lane delineation and marking for sharp curves
- improved highway geometry for horizontal curves
- enhanced pavement markings
- skid-resistant pavement surfaces
- shoulder treatments
- shoulder drop-offs
- wider and/or paved shoulders

Research to fill in gaps in knowledge
The Challenges

- Need for sound evaluation methodology
  - Example of rail-highway crossings
- Extensive data needs to support new methodologies
  - Before-after accident and traffic data at large enough sample of treatment and non-treatment sites
  - Accident prediction models for condition before treatment
- Need for trained analysts in new methodologies
  - E.g. Opportunity in Enna's road quality management Master's programme

INSTALLING GATES AT 934 U.S. RAIL CROSSINGS WITH FLASHERS

Accidents before = 286
Accidents after = 114

Apparent savings = 172
(60% reduction)

The Reality:
Accidents expected = 208

Actual savings
(208 – 114) = 94
(45% reduction)

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Recent safety evaluations with latest methods (for AASHTO SHSP)

- Flashing beacons
- Two way left turn lanes
- Raised pavement markers
- Centre line rumble strips
- Improve skid resistance

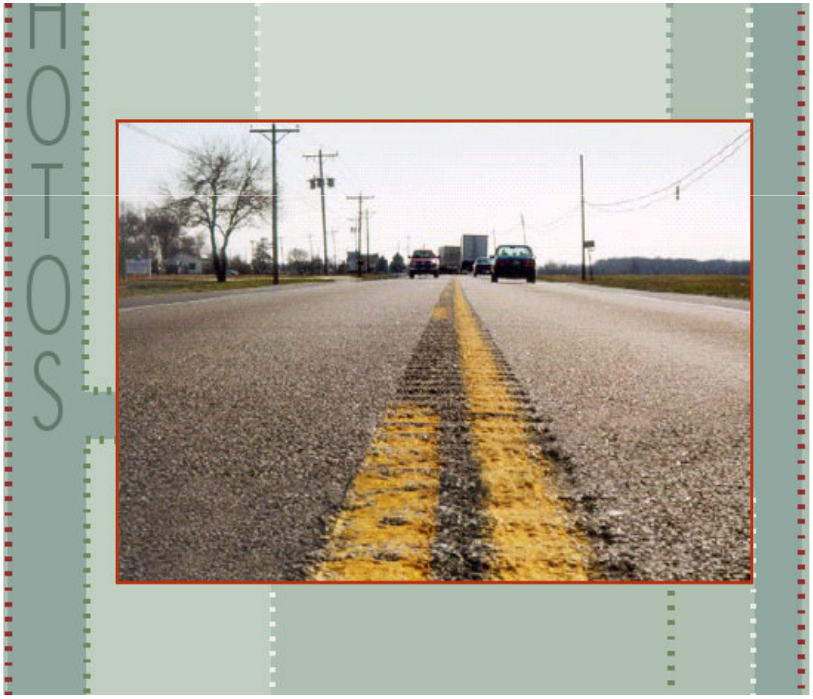
Flashing Beacons
Accident reductions at 106 sites

Angle	Injury & Fatal
13.3%	10.2%

turn lanes

Percent reduction in crashes (standard error)		
Rear-end	**Injury**	**Total**
38.7 (4.0)	**26.1 (6.8)**	**20.3 (3.0)**

SAFETY EVALUATION OF CENTRE LINE RUMBLE STRIPS
340 km at 98 U.S. sites



	% reduction
All Impact types	14-15%
Opposite direction and sideswipe	21-25%

SAFETY EVALUATION OF Pavement markers

% Reduction in crashes

	Night	Wet
New Jersey Non-Selective 174 miles	0.9	3.2
New York Selective 82 miles	12.7	20.2

Improve skid resistance at targeted locations *(High skid numbers and wet weather accident frequency)*

% reduction in crashes

Location Type	All Crashes	Wet-road	Rear-end Wet-road
Segments	**23%**	**56%**	**43%**
Intersection approaches	**20%**	**57%**	**68%**

Where do we go from here?
… Future directions

My vision for the future of infrastructure road safety

- Road safety as public health issue
  - Research funding/interest from Health Institutes
  - Publications in public health journals

- Interdisciplinary/multidisciplinary approaches
  - Accommodation in all road engineering disciplines
  - Canadian multidisciplinary examples
    - Network Centre of excellence: AUTO21
    - Fatigue related accidents .. Canadian Institutes for Health Research

- International cooperation
  - Research transferability – Is it possible?
    - E.g., transferability of accident prediction models

- High level research using microscopic data
  - SHRPII