Canadian Multi-Disciplinary Collision Investigations

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WP1 Sept 2022
Overview

- Canadian Context
- Overview of Canada’s MDCI Team
- Investigation Process
- Crash Investigation Examples
- MDCI Summary Approach & Objectives
- Path Forward
Canadian Road Safety Jurisdictions
A shared responsibility

**FEDERAL AREAS OF RESPONSIBILITY**

Transport Canada:
- Setting and enforcing compliance with safety standards for manufactured and imported vehicles (including the import of trial vehicles) as well as motor vehicle equipment (tires and child car seats);
- Investigating and managing the recall and remedy of non-compliances and safety-related motor vehicle defects;
- Motor vehicle safety research; and
- Public education on motor vehicle safety issues.

Innovation, Science and Economic Development Canada:
- Setting and enforcing compliance with technical standards and licensing requirements related to wireless technologies integrated in vehicles and roadside infrastructure (for trials involving the testing of connected vehicle technology).

**PROVINCIAL/ TERRITORIAL AREAS OF RESPONSIBILITY**

- Driver Licensing;
- Vehicle Registration;
- Enacting and enforcing traffic laws and regulations (including trials);
- Conducting safety inspections;
- Regulating motor vehicle insurance and liability;
- Public education on motor vehicle safety issues;
- Adapting infrastructure to support AV deployment.

**MUNICIPAL AREAS OF RESPONSIBILITY**

- Enacting and enforcing by-laws;
- Enforcing traffic laws and regulations;
- Advocating for and accommodating testing;
- Adapting infrastructure to support AV deployment;
- Managing passenger transportation (including public transit and taxi cabs);
- Parking;
- Traffic control; and
- Public education on motor vehicle safety issues.
Canadian Road Safety Authorities

**Police**
- Canadian police forces are responsible for investigating all road traffic collisions
- Each province or territory set their own reporting and investigation legislation

**Transportation Safety Board (TSB)**
- Mandate includes air, marine, rail and pipeline incidents
- Investigates incidents involving the road/rail interface
- Can make recommendations in relation to road vehicles as well as rail

**Transport Canada (TC)**
- Establishes federal vehicle standards and regulations as well as certain operational requirements for federally regulated motor carrier and drivers
- Investigates road incidents / potential vehicle safety equipment issues
Transport Canada operates with mandates from:

The Canadian Motor Vehicle Safety Act (MVSA) and Motor Vehicle Transport Act (MVTA)

- Allows TC to propose, apply and enforce national safety standards
- MVSA Section 15 provides the collision investigator access to the vehicle
- MVSA Section 8 provides the means to retrieve/analyze information recorded by the vehicle
- Pursuant to MVSA
  - Canada Motor Vehicle Safety Standards (CMVSS)
  - Motor Vehicle Safety Regulations (MVSRS)

Certification Regime

The National Safety Mark (NSM) is used to indicate the vehicle compliance with the MVSA

- Certification is the responsibility of the manufacturer of the vehicle (Self-Certification)
- The compliance label is affixed to vehicles to indicate compliance
- Transport Canada conducts oversight and compliance activities
MDCI Mandate

Conduct Real-World Crash Investigations to:

- Examine the effectiveness of Canadian Motor Vehicle Safety Standards
- Identify the need for further regulatory action under the MVS Act
- Advance the development of road safety policy and regulations
- Collect real-time information on high profile crashes
- Obtain real-world crash data to validate laboratory results
- Support development of future regulatory initiatives
MDCI Team Evolution

Road Safety involves many disciplines:
- Road design - civil engineering
- Vehicle design - mech/elec engineering
- Behavioural factors - psychology
- Occupant injury/kinematics - medicine

Transport Canada MDCI Team History:

1969: Road and Motor Vehicle Traffic Safety Branch
- Develop and enforce safety standards
- Identification of safety defects

1970: Motor Vehicle Safety Act (MVSA) enabled = Authority to Enforce Standards
- Team system vision was to have 1-Team per Province

1974: 10 Teams in Operation
- All 10-Teams gathered in Ottawa for the first Canadian Road Safety meeting

1990s: 9 Teams in Operation
- NS, NB, QC, 2-ON, SK, AB, BC and TC-HQ

2000s: 7 Teams in Operation
Today’s MDCI Team
Road Safety Partners

Provincial and Municipal Police Services and Royal Canadian Mounted Police (RCMP)
- First responders to vehicle collisions such as municipal or provincial police or the RCMP, collect vital information about the scene, victims and vehicles involved.
- Transport Canada assists the police with:
  i) new technologies such as obtaining telemetry data and camera images
  ii) component failure identification such as airbag non deployments and seatbelt failures

Health Authorities, Medical Facilities and Regional Coroners
- The collection of medical data and record of injuries sustained in collision analysis allows investigators to gain an understanding of the performance of safety devices, such as seat belts and airbags, during a collision.
- Information regarding the severity, location and type of injury assists in evaluating the effectiveness of these features in vehicles.

Provincial/Territorial/Municipal Ministries of Transport
- Transport Canada also works with provincial/territorial/municipal transport ministries as needed to collect statistical data on motor vehicle collisions
- Specific information on commercial vehicle collisions and incidents that may inform safety standards and/or regulations.
Investigative Process

Notification of Collision Event
- Via
  - Police
  - Research Agreements
  - Media

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Go Event
- High Profile
- Occupant Fatal
- Go-Team Active

No Go Event
- Assist Police
- Collect Data
- Retrospective Investigation

Field Investigation
- scene inspection and measurement
- inspection vehicle / restraints
- download EDR data (silent witness)
- photograph exterior / interior
- measure vehicle crush damage

Analysis
- evaluate restraint systems
- evaluate crashworthiness
- data entry to searchable database

Human Factors
- conduct occupant interviews
- obtain medical injury data
- code injuries (AIS Tool)

Reconstruction
- obtain police data
- obtain OEM telemetry + camera data
- quantify vehicle dynamics
- combine EDR, telemetry + camera data, scene evidence, crush, PDOF and $\Delta V$

Technical Report
- root cause analysis
- identify safety concerns
- reports do not allocate blame

TC Defects
- component failure
- collision assistance

TC Stand / Regs
- crashworthiness issue
- regulatory initiatives

Manufacturers
- component failure
- crashworthiness issue

Coroner
- VRU, E-bikes, Bus crashes
- mitigate incidents + injury

Investigative Process

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- Pre-Crash Data -
  - 5-second window
  - Vehicle speed (km/h)
  - Engine RPM
  - Throttle position (0-100%)
  - Brake switch (on/off)
  - Steering input
  - ABS - Traction Control
  - Cruise control
  - Drive Gear select
  - Long/Lat accelerations (g)
  - Yaw rate (deg/sec)

- Crash Data -
  - Longitudinal velocity ($\Delta v$ km/h)
  - Lateral velocity ($\Delta v$ km/h)
  - Longitudinal acceleration (g)
  - Lateral acceleration (g)
  - Window usually around 300 ms
  - Airbag firing times (ms)
  - Diagnostic trouble codes
  - Rollover angular rate (deg/sec)
  - Rollover data longer window
Data Retrieval

New Vehicle Technologies

- New vehicles equipped with Cameras, Radars, and Sensors = DATA
- Data is recorded at Pre-Programmed Triggers
- Telemetry (cloud) Data is Proprietary to the Manufacturer
- Canadian MVSA allows access to OEM Proprietary Data
- Canadian Experience = Manufacturers are Co-operative
- Advanced investigator Training Required (SAE / Manufacturers)
Canadian Crash Example # 1
Rear Occupant Crash Investigation

Context
- Rural head-on crash, Maritime Province of Nova Scotia
- RCMP and TC Halifax Field Team on-scene
- Crash involved 2 vehicles:
  1. SUV MY2011
     - $\Delta v$ 75 km/h
     - 4 passengers:
       - major injuries for driver,
       - moderate injuries for passenger
       - fatal for 2 rear passengers
  2. Pickup MY2011
     - $\Delta v$ 60 km/h
     - 2 passengers: minor injuries
Canadian Crash Example # 1
Field Investigation

Inspection of the Case Vehicle SUV

• Right-rear seatbelt webbing had failed
• Investigator identified the location of the seatbelt webbing separation was in proximity to the metal seat cushion frame edge
Canadian Crash Example # 1
Reconstruction Crash Test

Crash Test Summary

• Both rear seatbelts separated at the lap portion near the exposed metal edge of the seat structure

• The location and appearance of the separated seatbelts in the crash test were similar in appearance to the seatbelt damaged in the case vehicle

Motor Vehicle Test Centre

• The largest and most advanced automotive test and research center in Canada located in Blainville, QC

• Collision Laboratory, Environmental Chambers and Test Tracks
Canadian Crash Example # 1
Defect Investigation

Transport Canada Defect Investigation
• Right-rear seatbelt webbing had failed
• It was determined the seat frame edge cut the webbing while the seatbelt was in tension
• The exposed seat structure may pose an important safety risk to rear occupants in severe frontal crashes
• Manufacturer was made aware and provided with the reconstruction data

Manufacturer's Response
• Conducted testing and confirmed Transport Canada results
• The rear outboard seatbelts in the test vehicle separated as a result of contact with a portion of the metal seat cushion frame flange edge
• Announced a **Worldwide Safety Recall** of 2.87 million vehicles
Canadian Crash Example # 2
Humboldt Coach Bus Crash Investigation

Context
- Rural intersection crash, Prairie Province of Saskatchewan
- Coach Bus (hockey team) vs. Transport Truck (hauling peat moss bales)
- Truck (90 km/h) failed to stop at intersection and T-boned Coach Bus
- Coach Bus passengers: 16-fatal and 13-injured
- RCMP and TC Calgary Field Team on-scene

Outcomes
- Investigation led to substantive regulatory changes:
  - standards for entry training of truck drivers
  - seatbelts required on all new buses
  - mandated electronic logging devices (ELD)
MDCI Summary Approach and Objectives

- Multi-Disciplinary Team Approach
- Investigate Collisions with several Fatalities
- Conduct In-Depth Investigations of Fatal Collisions
- Attend ‘Live’ Collision Scenes
- Field investigation → Reconstruction → Analysis → Report
- Accessibility to Medical Data via formal agreements
- Close Links with Police via formal agreements
- Accessibility to OEM Proprietary Data via legislation
- Reports do not Allocate Blame or Liability
- Learn from Incidents / Root Cause Analysis
The Path Forward

**Connected and Automated Vehicles**

- Electric and hybrid technology is becoming more prevalent
- Vehicles will communicate between themselves and infrastructure
- Automated vehicles will access and generate large amounts of data from the nearby roadway environment (V2X) and other roadway users (V2V)
- Data will be used to execute decisions. When a collision occurs, the key source of information for identifying the cause will be the vehicle itself
- Physical and electronic evidence from V2X and V2V must be collected and analyzed in order to identify the cause of the crash
- A documented process for the collection of AV collision data elements is necessary
- The data should also contain information related to the status of the AV system and if the AV system or the human driver was in control of the vehicle at the time of the crash
- These areas are being deliberated via the UNECE WP.29 EDR/DSSAD IWG
International Alignment
Meeting Proposal

Proposed MDCI International Meeting
• Shared international experience
• What approaches have been successful
• Data retrieval topics
• New technologies
• Share lessons learned
• Sharpen our strategies
• Make our roads safer for everyone
Questions / Comments?

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