Transport Safety and Technology

Where Do You Want To Go Today? How Do You Want To Get There?

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Invited Lecture, School of Public Health
Unit 382 Health and Safety Technology
April 2010

Overview

- Transport System and Safety Summary
- Transport Safety Regulation
- Waterfall Rail Crash Case Study
- Transport Safety Technology
- Further Transport and Safety Information
Learning Outcomes

Successful students will:

- Understand the basic transport system
- Understand the regulatory frameworks for transport safety regulation
- Appreciate the complexity of safety issues based on a case study
- Know how to find the information they need in future

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The Transport System

- People
- Vehicles
- Infrastructure
- Land use
- Systems
- Information
- Regulation
- Industry practice
- Funding
- Enforcement
- Education
- Technology
- Environment
- Government policy
- Community response
- Research & Innovation
- Leadership
- Community response
- Research & Innovation
- Leadership

How Important is Transport?

- Transport is 9% of the national economy (GDP)
- Transport & logistics (T&L) is 14.5% of national GDP
- Transport & logistics (T&L) is 24.1% of WA's economy
- Transport & logistics (T&L) is largest of any sector in the Australian economy
- Transport is essential for communities and the Australian economy

Source: Australian Logistics Council Reports 2007
Transport Benefits

- Efficient and effective passenger and freight transport provides a numerous benefits to the Australian community, business and the environment including:
  - supporting regional communities
  - reducing community health effects
  - minimising environmental consequences
  - reducing the road toll by reducing crashes
  - limiting local government road maintenance
  - limiting investment demands on Treasuries
  - improving international competitiveness for agriculture
  - reducing infrastructure costs for state government authorities
  - maintaining robust transport systems to suit a variety of futures, including reduced oil availability.

- An efficient, effective, safe transport system is required to meet Australia's short and long term needs

Sources:

Perth's Transport Future?

- By 2020 for Perth it is estimated\(^1\) that
  - population will increase by **13%**;
  - road freight transport will increase by **34%**;
  - traffic delays will increase by **28%**;
  - congestion costs will rise by **69%** to **$1.2 billion** per annum.

- More people die from transport emissions in Australian cities than from road crashes\(^2\)
Transport Health & Safety

- Australian transport fuel use, emissions and transport infrastructure are amongst the highest per capita in the world
- Nearly 1500 people die on our roads and another 30,000 are injured and road crashes cost over $29.6 billion annually
- Transport emissions are responsible annually for:
  - the deaths of over 1500 people
  - over 4,500 cases of asthma and other sickness (but could be 40% higher)
  - cost of death and sickness by transport emissions exceeds $2.3 billion annually
- Fuel efficiency of passenger cars has not improved

Transport Safety by Mode

<table>
<thead>
<tr>
<th>Indicator (2007)</th>
<th>Mode</th>
<th>Road</th>
<th>Rail</th>
<th>Marine</th>
<th>Air</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatalities</td>
<td></td>
<td>1616</td>
<td>37</td>
<td>52</td>
<td>22</td>
</tr>
<tr>
<td>Number of deaths</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fatality Rate</td>
<td></td>
<td>7.69</td>
<td>0.18</td>
<td>0.25</td>
<td>0.10</td>
</tr>
<tr>
<td>Deaths per 100,000 population</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Injury Rate</td>
<td></td>
<td>150.7 (2006)</td>
<td>0.84</td>
<td>0.57</td>
<td>0.21</td>
</tr>
<tr>
<td>Serious injuries per 100,000 population</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fatality Rate</td>
<td></td>
<td>5.36 (2006)</td>
<td>2.8</td>
<td></td>
<td>0.42</td>
</tr>
<tr>
<td>Deaths per billion passenger km</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: BITRE
Australian Transport Statistics Yearbook 2009
Overview

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WA Transport (Safety) Regulation

- Air Navigation Act 1937
- Damage by Aircraft Act 1964
- Harbours and Jetties Act 1928
- Jetties Act 1926
- Lights (Navigation Protection) Act 1938
- Marine and Harbours Act 1981
- Marine Navigational Aids Act 1973
- Planning and Development Act 2005
- Pollution of Waters By Oil and Noxious Substances Act 1987
- Port Authorities Act 1999
- Rail Safety Act 1998
- Railway and Port (The Pilbara Infrastructure Pty Ltd) Agreement Act 2004
- Railway Discontinuance Acts 2006
- Road Closure Act 1969
- Road Traffic Act 1974
- Road Traffic Amendment (Vehicle Licensing) (Taxing) Act 2001
- Sea Carriage of Goods Act 1909
- Shipping and Pilotage Act 1967
- Transport Co-ordination Act 1996
- Western Australian Marine Act 1982
- Western Australian Marine (Sea Dumping) Act 1981
- The Motor Vehicle Drivers Instructors’ Act 1963
# Road Safety Regulation

<table>
<thead>
<tr>
<th>Ownership</th>
<th>Vehicles</th>
<th>Private ownership</th>
</tr>
</thead>
</table>
| Infrastructure | Generally public ownership: | • State, local government  
• Also private roads, forest and park roads  
Funding by Commonwealth, State and local government.  
Occasional private contributions |

| Safety Regulation | General | State based  
‘National consistency’ through Australian Transport Council and National Transport Commission |
|-------------------|---------|---------------------------------------------------------------|
| Drivers | Dept. of Transport WA driver licensing  
Police enforcement  
Fatigue by WorkCover in WA, by Transport or Roads Depts in other States |
| Goods | Weight enforcement through MRWA  
Fair rates by Dept. of Transport WA  
Chain of responsibility by WorkCover |
| Vehicles | National ‘standards’: Australian Design Rules  
Police and Dept. of Transport WA enforcement  
National Heavy Vehicle Regulator (coming soon) |
| Reporting | Police, Main Roads, Dept. of Transport WA, WorkCover  
Regular national summaries  
Selected crashes only  
Different types - whole of State, specific users, types of events, etc |
| Incident Investigation | Crashes only  
Police - Major Crash Unit for prosecution  
MRWA for some major crashes  
Coroner |

# Rail Safety Regulation

| Ownership | Rolling Stock | Passenger: Generally public ownership, may be leased or franchised  
Freight: Public and private ownership |
|-----------|---------------|---------------------------------------------------------------------|
| Infrastructure | Passenger: Generally public ownership, may be leased or franchised  
Freight: Public (Commonwealth and State) and private ownership |
| Safety Regulation | General  
Regime | Railways must be accredited for construction, operation and maintenance (‘rail work’).  
State based, Dept. of Transport: independent Rail Safety Regulator.  
Considerable national consistency and process integration.  
Complete national consistency and integration proposed but not achieved.  
National Rail Safety Regulator approved, now being implemented.  
Accreditation requires proof of:  
• capacity (financial, staff numbers, etc),  
• competency (range of skills),  
• systems (Safety Management System - under AS4292).  
Rail Safety Regulator monitors and requires improvement where under performance is identified. |
| Infrastructure | Self regulated  
Australian Standards, local guidelines (modifiable, not mandatory) |
| Workers | Self regulated  
Rail Safety Worker accreditation (includes but not specific to drivers) |
| Goods | Self regulated |
| Vehicles | Self regulated |
| Reporting | Through Rail Safety Regulator  
Limited national summary  
All crashes and many other incidents  
Different types - whole of State, specific users, types of events, etc  
Policy, planning, design, remediation investigations |
| Incident Investigation | Office of Rail Safety  
Australian Transport Safety Bureau  
Coroner  
Commission of Inquiry |
### Aviation Safety Regulation

<table>
<thead>
<tr>
<th>Ownership</th>
<th>Aircraft</th>
<th>Privately owned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infrastructure</td>
<td>Mostly Australian Government owned</td>
<td>Many public airports are privately operated (e.g. all capital cities)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Safety Regulation</th>
<th>General Regime</th>
<th>National legislation. Integrated with international conventions, standards and obligations through the International Civil Aviation Organization.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infrastructure</td>
<td>Civil Aviation Safety Authority (CASA)</td>
<td></td>
</tr>
<tr>
<td>Workers</td>
<td>Pilots licensed by Civil Aviation Safety Authority (CASA)</td>
<td></td>
</tr>
<tr>
<td>Aircraft</td>
<td>Civil Aviation Safety Authority (CASA)</td>
<td></td>
</tr>
<tr>
<td>Airspace</td>
<td>Civil Aviation Safety Authority (CASA)</td>
<td>Operated by Air Services Australia</td>
</tr>
<tr>
<td>Reporting</td>
<td>Civil Aviation Safety Authority (CASA)</td>
<td>Australian Transport Safety Bureau (ATSB) Dept. of Infrastructure Transport Regional Development and Local Government</td>
</tr>
</tbody>
</table>

| Incident Investigation | Australian Transport Safety Bureau (ATSB) |

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### Maritime Safety Regulation

<table>
<thead>
<tr>
<th>Ownership</th>
<th>Vessels</th>
<th>Mostly privately owned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infrastructure</td>
<td>Mostly State Government owned</td>
<td>Some privately operated</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Infrastructure</td>
<td>Within 3 nautical miles: Dept. of Transport WA (navigation aids, ports, etc) Outside 3 nautical miles: Australian Maritime Safety Authority (AMSA)</td>
<td></td>
</tr>
<tr>
<td>Workers</td>
<td>Generally only pilots, captains qualified. Australian Maritime Safety Authority (AMSA): large craft Dept. of Transport WA: small craft; commercial and recreational</td>
<td>Industrial legislation</td>
</tr>
<tr>
<td>Reporting</td>
<td>Australian Maritime Safety Authority (AMSA): large craft Dept. of Transport WA: small craft and infrastructure</td>
<td></td>
</tr>
</tbody>
</table>

| Incident Investigation | Australian Maritime Safety Authority (AMSA): large craft Dept. of Transport WA and/or WA Police: small craft |

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Transport Safety Regulation

- Transport as a specific element of OSH

Transport Safety
- Transport outside the workplace

Transport in the workplace

Occupational Safety
- Safety in the transport industry

Whose Responsibility?
Transport - Occupational Safety Issues - Transport Industry

Safety in the transport industry is important. In 07/08, the Transport & Storage industry recorded:

- 68 fatalities, the highest number in any sector, 52 were in road freight transport
- the highest number (9945) and percentage (7.6%) of total Serious Claims for any occupation subcategory
- the highest fatality incidence rate, 15.1 compensated fatalities per 100,000 employees

Transport - Occupational Safety Issues - Any Industry

- Transport safety in any industry is important (not everyone involved in transport works in the Transport and Storage Sector)
  - vehicle crashes are the 2nd highest cost per insurance claim
  - transport work is 2nd highest frequency of serious claims
  - level crossing crash reported to cost $20m.

Is a crash between a minerals train and a grain truck a transport, resources or agricultural industry incident?

Curtin – Monash Accident Research Centre www.c-marc.curtin.edu.au
Transport - Occupational Safety
Issues - Outside the Workplace

- Transport safety outside the workplace is important
  - About 1500 people die on Australian roads each year and more than 30,000 are injured
  - The cost of road crashes in Australia is approx. $30 bn pa
  - Approx 30% of lost time at work is due to road crashes (not necessarily occurring in the workplace)

Overview

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Case Study: Waterfall Passenger Rail Crash, NSW 2003

- Crash Summary
- Response Process
- Inquiry Conclusions
- Technology Issues

Crash Summary

- 7.00 am, 31 January 2003
- State Rail Authority (SRA) passenger train, travelling from Sydney to Port Kembla carrying 47 passengers and 2 crew
- Approximately 2km south of Waterfall NSW, 50km SW of Sydney
- Overturned at high speed and collided with stanchions and a rock cutting
- The driver and 6 passengers were killed

Source: ITSRR, NSW

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Crash Response Process

- Emergency response
  - emergency services, health and rail
- Carriage and infrastructure repair
- State Rail Authority (SRA) internal investigations
- Special Commission of Inquiry (SCOI)
  - 127 recommendations
  - January 2005
- Government and SRA response
- Monitoring and reporting
  - Independent Transport Safety and Reliability Regulator (ITSRR)
  - Office of Transport Safety Investigations (OTSI)

Primary Contributory Factors

- The driver was probably incapacitated as a result of a pre-existing medical condition.
  - The driver was working his second day of early morning shift after returning from extended period of leave and was likely to have been affected by fatigue resulting from circadian disruption.
- The train accelerated, out of control, with maximum power applied.
- The designated risk controls against driver incapacitation (the deadman system and the guard) failed to intervene.
  - The deadman pedal system was ineffective as a defence against driver incapacitation.
- The immediate cause of the accident was the train exceeding the overturning speed for a curve while travelling at approximately 117 km/h.
- The driver and six passengers were ejected from the train as a result of the accident.
Secondary Contributory Factors

- Simultaneous systemic failures of risk controls: medical standards, deadman system and training.
- Two data loggers were fitted but not commissioned.
- An underdeveloped safety culture had resulted in:
  - failures in the application of the published Safety Management System
  - insufficient safety and risk management expertise
  - risks were not systematically identified or effectively controlled
- The Rail Safety Regulator had been inadequately resourced, so had not identified the risk management deficiencies that existed at SRA.

SCOI Conclusions

Improvements
- driver safety systems and medical examinations
- risk management
- safety culture and integrated safety management systems
- rail safety regulation

127 recommendations
- Emergency Response
- Design and Procurement of Rolling Stock
- Driver Safety Systems
- Risk Assessment and Risk Control Procedures
- Data Loggers
- Communications
- Train Maintenance
- Alcohol and Drug Testing
- Periodic Medical Examination
- Safety Document Control
- Train Driver and Guard Training
- Rail Accident Investigation
- Safety Culture
- Occupational Health and Safety
- Passenger Safety
- Corporate Governance
- Safety Reform
- Safety Regulation
- Integrated Safety Management
- Implementation of Recommendations
Waterfall SCOI Technology
Recommendations

- Provide and maintain adequate communications and train staff.
- Fit trains with minimum of two independent engineering defences in the event of train driver incapacitation.
- **Implement level 2 automatic train protection (ATP) signalling systems**
- Implement a standard in relation to the collection and use of data from data loggers.
- **Ensure compatibility of communications systems throughout the rail network**
  - All rail workers must be able to communicate using the same technology.
- Standardise communications procedures throughout the rail network and improve communications protocols.
- **Ensure interoperability of communications equipment between all trains operating on the New South Wales rail network**
- Establish an electronic document control system to enable effective and reliable information to be gathered for monitoring the safety of the NSW rail system.
- RailCorp should use its simulators in an interactive manner during training.
- Establish a data and information management system, containing all data and information that it requires, to continually monitor the safety of the NSW rail system.
- Train doors should have an override facility (with an alarm and monitoring of use).
- New rail cars must have appropriate signage and lighting identifying escape routes in the case of emergency.

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www.c-marc.curtin.edu.au
What is Technology?

- Intelligent Transport Systems (ITS)
  - The application of electronics, telecommunications, information and computing to improve transport systems and their outcomes

Technology Management

- Strategic Planning
  - Identify outcomes, develop outputs, inputs & processes
- Project Planning
  - Identify inputs & processes develop outputs
- Identify and Manage all Stages
  - Life cycle Processes
  - Policy, planning, design, construction, installation, maintenance, review, documentation, training, costing,
- Identify and Manage all Outputs
  - Everyone and everything affected
  - Cost, time, risk/safety/health/environment, benefits
ITS - Generic Arrangement

- Sensors
- Communications
- Data and Processing
- Outputs

Central Information System

Mobile, Fixed, or Distributed

Bus 1 0715
Bus 2 0745
Bus 3 0800

Fixed

Distributed

Other Systems

ITS - Context

External Environment

Organisation or Company

Legal
Staff
Processes
Sales

ITS Application

Sensor
Communications
Output

Information Technology

Finance
Risk
Skills
Quality

Resources
Marketing

Other Internal Information Systems

Other External Information Systems
ITS Management

- Systems Engineering Guidebook for Intelligent Transport Systems
  - 3. ITS Life cycle Processes
  - 4. Systems Engineering Environment
  - 5. CASE Studies Key Lessons
  - 6. Roles and Responsibilities in Systems Development
  - 7. Systems Engineering Capabilities and Process Improvement

Source: www.fhwa.dot.gov/cadiv/segb

Curtin – Monash Accident Research Centre www.c-marc.curtin.edu.au
Train Protection & Control (TPC) System Benefits

- TPC Systems offer opportunities to:
  - improve train safety;
  - improve train movement efficiency and increase capacity for both freight and passenger railways independently and when they operate together;
  - improve train operations lowering fuel use, emissions and other inputs and outputs;
  - reduce train and infrastructure costs by more 'friendly' train movement and monitoring train operations and rolling stock; and
  - delay major infrastructure investment by increasing train movement efficiency on current physical infrastructure.

TPC Levels of Sophistication

- External 'passive' monitoring
- Active intervention
  - ERTMS level 1: based on existing signalling
  - ERTMS level 2: with in-cab signalling
  - ERTMS level 3: higher capacity
- Automated trains
  - more than 100 automated train systems worldwide
- Driverless trains
  - Pilbara Rail (RioTinto) with Perth control centre soon
TPC Issues

- Different technologies
  - ERTMS/ETCS (European, proprietary, probably NSW)
  - ATMS (US based, national (ARTC) being developed)
  - Other proprietary systems (Pilbara, most urban rail)

- Performance requirements
  - Levels of safety, railway capacity, cost, technology risk, interoperability

- Context
  - Urban/regional/remote, freight/passenger, train length, train density

TPC System Interoperability

- Strategic Framework agreed
  - Objective, Requirements, Framework Implementation

- Strategic Framework includes:
  - Background, Terminology, Issues
  - Expected Outcomes
  - Functionality, Key Principles
  - Implementation, Next Steps

- Interoperability?
  - All systems, sub-systems, components, rules, procedures, processes or practices which interface with others will be able to work together seamlessly with those others.
  - This interoperability will apply regardless of which infrastructure, rollingstock or operation they are a part of.
  - This interoperability will contribute to safe, efficient, cost effective and practical outcomes for the operation of railways.
Interoperable Railway Communications Systems

- 22 radio systems around Australia
- Different requirements depending on need and situation
  - ARTC - Telstra 'Next G' mobile phone based system with satellite backup
  - NSW, Vic GSM-R mobile phone based system
- Interoperability agreement
  - single handset, single screen
  - in cab integrator
- Being implemented

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Transport Technology Information

- ERTMS/ETCS
  - ERTMS collaboration website [www.ertms.com/](http://www.ertms.com/)

- ATMS

- Communications and TPC Interoperability

- ITS Organisations
  - ITS America [www.itsa.org](http://www.itsa.org)
  - Ertico (ITS Europe) [www.ertico.com/](http://www.ertico.com/)

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Department of Transport (for all modes) www.transport.wa.gov.au
Main Roads WA www.mainroads.wa.gov.au
Office of Road Safety www.ors.gov.au
Workcover www.workcover.wa.gov.au
Fremantle Ports www.fremantleports.com.au

Western Australian Port Authorities Association
WA Local Government Association (WALGA) www.walga.asn.au
other individual Local Governments

WA Transport Forum www.transportforumwa.com.au

Australian Transport Council (ATC) www.atcouncil.gov.au
Department of Infrastructure Transport Regional Development and Local Government www.infrastructure.gov.au
Bureau of Transport Infrastructure and Regional Economics (BITRE) www.bitre.gov.au

Australian Transport Safety Bureau (ATSB) www.atsb.gov.au
National Transport Commission (NTC) www.ntc.gov.au
National Rail Safety Regulators Panel www.rsrp.asn.au
Civil Aviation Safety Authority (CASA) www.casa.gov.au
Australian Maritime Safety Authority (AMSA) www.amsa.gov.au
National Marine Safety Committee (NMSC) www.nmsc.gov.au
National Offshore Petroleum Safety Authority (NOPS) www.nopsa.gov.au
Austroads www.austroads.com.au
ARRB Transport Research www.arrb.com.au
Other Transport and Safety

National
- Monash University Accident Research Centre (MUARC): C-MARC partner www.monash.edu.au/muarc
- Australian Trucking Association www.atatruck.net.au
- Many other truck operators groups, see: www.atatruck.net.au/member_org.html
- Australasian Railway Association www.ara.net.au
- Australian Shipowners Association www.asa.asn.au
- Australian Logistics Council www.austlogistics.com.au
- Ports Australia www.portsaustralia.com.au
- Australian Automobile Association www.aaa.asn.au
- Transport Unions

International
- International Civil Aviation Organization (ICAO) www.icao.int
- International Maritime Organization (IMO) www.imo.org
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