No-blame Safety Investigation: some lessons and methodology
*SIA Visions Conference 2008*

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Multi-modal ATSB
ATSB context

- Multi-modal body to investigate, analyse and report independently on aviation, interstate rail & major marine safety occurrences
- Transport safety investigations are not intended to be the means to apportion blame or liability, in accordance with the *Transport Safety Investigation Act 2003* (TSI Act) & Annex 13 to the Chicago Convention
- Powers to investigate, including to search and compel evidence even if incriminatory
- But reports/evidence can’t be used in courts with the exception of Coronial inquests.
The ATSB seeks to contribute to maintaining and improving transport safety and public confidence through excellence in:

- independent investigation of transport accidents and other safety occurrences;
- safety data recording, analysis and research; and
- fostering safety awareness, knowledge and action.

We investigate/report without fear or favour.
The ATSB is part of the Commonwealth Department of Infrastructure, Transport, Regional Development & Local Government for administrative and resourcing purposes.

Separate from State bodies like Police, rail regulators, OHS and coroners, and federal bodies like the Civil Aviation Safety Authority (CASA), AMSA, the ARTC and Airservices.

Importantly, separate investigations by Police, regulators and OHS bodies occur consistent with a ‘just culture’ (perhaps 10% of accidents via a form of culpable actions).
• The ATSB’s no-blame safety investigation is only one part of the system
• To reinforce independence, under the TSI Act S15, neither the Minister nor Secretary are to influence ATSB investigations
• ATSB mandatory occurrence reporting, voluntary confidential reporting and data analysis and research supplement both investigation & industry schemes, eg SMS
• Approx 95 ATSB staff, most in Canberra & ¾ aviation-related including notifications - Brisbane, Adelaide & Perth field offices - annual budget $15.4m (+corp=$23m)
Safety Action

• The ATSB seeks to encourage safety action ahead of publishing its final report and to release any recommendations necessary in a non-directive ‘safety issue’ format.

• In 2007-08, the ATSB reported 131 separately identified aviation safety actions associated with 43 investigations, 23 extra recommendations and 2 advisory notices.

• 101 marine safety actions and safety recommendations.

• 84 rail safety actions/recommendations.
Overview

- My focus will be on what can be learned from no-blame transport safety investigation - I hope this will resonate with your expertise
- I will look at a couple of examples in each of marine, rail and aviation modes and, as requested, also outline the ATSB no-blame systemic investigation methodology
- Given the increasing importance of safety management systems (SMS), I will sketch some key aspects and what can be learned from poor SMS when things go badly wrong
Lessons in marine safety

• The International Maritime Organization (IMO) requires (via International Safety Management Code) company safety management objectives - that provide for safe practices in ship operation and a safe working environment - establish safeguards for all identified risks - continuously improve safety management skills of personnel ashore and aboard ships, including preparing for emergencies related both to safety and environmental protection.

• Two examples – Nego Kim and Malu Sara
Nego Kim 18 November 2001, 8 dead
Nego Kim: Safety Failures

The ATSB investigation also found that the ship management company contributed to the explosion and eight deaths by:

• Failing to recognise the risks associated with the operation and thus provide appropriate instructions and safeguards,
• Failing to provide appropriate equipment,
• Failing to ensure that basic safety information in relation to the use of the paint was available to the crew.
Malu Sara 15 October 2005, 5 dead
12:22 Vessel phones with Departure Message

14:08 Vessel reports it is on “front side” of Turnagain Island.

15:57 Vessel reports it is a “bit lost in fog”

18:22 Vessel reports it has sighted an island

21:30 Vessel reports it is at anchor with EPIRB transmitting

02:47 Last time a number dialled on vessel’s phone

02:15 Vessel reports it is sinking

01:33 Vessel at anchor. Taking some water

23:40 Vessel asked to steer due East to lee of island
121.5 MHz EPIRB
ATSB Investigation

- Initially on Thursday Island
- Interviews with DIMIA staff, police, …
- Gathering of documentary evidence
- Sister vessel sea trials, inspection and preliminary testing
- Interview with boat builder in Cairns
- Telephone records
- Post mortem results
- Interim recommendation issued
- Further interviews and swamp testing
USL Code Requirements

Depth Sounder

VHF radio

Sea anchor
Not required but sensible and standard fit

GPS/Chart plotter

406 MHz EPIRB
ATSB conclusions

Seaworthiness is an all encompassing concept which relates to a vessel and its crew’s preparedness to safely undertake a given sea voyage in specified conditions.

Malu Sara was unseaworthy in relation to its design, construction, the equipment it carried and the training and preparedness of its crew to undertake the voyage which started from Saibai Island on 14 October 2005.
Regulatory oversight

- Commercial vessel survey conducted by State marine safety authorities requires design approval, construction, equipment and periodic surveys to meet USL Code Changed AMSA policy 2003 - start MO 62
- Performance based regulatory approach - premise that Cwlth authorities have rigorous procurement systems and OHS obligations
- MO 62 requires expert interpretation and relies on sufficient maritime knowledge to ensure compliance with relevant vessel safety standards
Organisational oversight/lessons

- No organisational assessment of the risks of small boat operations in Torres Strait
- Deficient IRV operating procedures
- Insufficient knowledge and management oversight of the procurement process and Thursday Island operation generally
- Insufficient training of IRV crews
- DIMIA’s response, AMSA’s response to the safety issues, community awareness of maritime safety all important safety action
- Note Coronial inquest report still pending
Lessons

6 basic questions need to be answered to assess operational risk properly addressed:

• Were risk factors identified/identifiable?
• Equipment in use fit for purpose?
• Systems and procedures on board effective to maintain safe operation?
• Individuals fit, competent, effective?
• Emergency procedures/defenses?
• Performance monitoring system?

For *Malu Sara* in each case, tragically, the answer was ‘no’.
Marine safety - overview

• ATSB contributions include:
  - ship/fishing boat collisions
  - structural stability of bulk carriers
  - evacuation of cruise ships
  - lifeboat accident fatalities
  - engine fires
  - bridge resource management
  - fatigue etc

• ATSB lead in rewriting the international investigation Code at the IMO.
Rail safety

Ban Ban Springs accident – 13/12/06
Rail example: Two Wells, 6 Aug 2007

• In rail, there is ‘co-regulation’ and both ‘safety cases’ and SMS are utilised by state regulators

• Level crossing collision between The Ghan passenger train and a loaded sewage truck

• Truck drove into the path of The Ghan and truck driver seriously injured, truck destroyed

• Train driver not injured, lead locomotive severely damaged; minor injuries suffered by two passengers, minor track damage
Farm Road Crossing, Two Wells
• ATSB found insufficient sighting distance for truck driver to see *The Ghan* approaching from north

• Vegetation growing adjacent to track which impeded sighting

• Maintenance practices for vegetation clearing at the level crossing were inadequate

• Programmed works to clear vegetation within 28 days not carried out in accordance with maintenance specification

• Maintenance priority revised from 28 days to 180 days without re-assessment of sighting hazard
View from the Stop sign position to the north (where *The Ghan* was coming from)

View to the south
ATSB Investigation Safety Recommendations:
• Action required on maintenance practices for control of vegetation in rail corridor
• Placement and proximity of crossing signage
• Interface agreement required between track manager & local council defining each organisation’s responsibilities regarding maintenance of level crossings and land adjoining rail corridor (ie system perspective)
• No issues for rail operator in this accident
• Truck driver used a ‘rolling stop’ procedure.
Derailment of Cairns Tilt Train VCQ5

North of Berajondo, Queensland
15 November 2004
• Before leaving Bundaberg the driver placed his bag under the co-driver’s seat.
• After leaving Berajondo at about 23.54 after passing through a series of eight curve speed restrictions, the co-driver left his seat and entered the adjacent vestibule area to tidy-up and make a ‘brew’ for the driver.
• The co-driver was not in a position to observe the train’s speed as it approached the critical curve at 419.410km and intervene as may have become possible.
• The primary defence of having two drivers in the cab was not available.
• Shortly after co-driver left cab, hypothesised that the driver reached under his seat for his bag but realising it was under the co-driver’s seat, left his seat to get it

• While out of his seat, an alarm activated but he incorrectly interpreted it as the station protection magnet in advance of Baffle that leads into a 90/110 km/h speed restriction

• The train continued at a speed of about 110 km/h until the driver recognised where he was – but by this time it was too late and the derailment was inevitable.
• Main ‘cause’ of derailment was excessive speed. Train not reduced to a safe speed before entering the curve at 419.411km
• Safe operation depended on two-driver presence, route knowledge & competency
• Driver probably became disorientated and/or distracted from his principal driving task
• External darkness may have contributed to a loss of route awareness by the driver
• No technical system was on the tilt train that detected very short periods of driver inactivity or distraction
• No Automatic Train Protection system was operating to reduce risk of human error
Rail safety - overview

- ATSB investigations since 1999 and including the tilt train have led to action on:
  - signalling problems
  - communications deficiencies
  - health standards and checks
  - fatigue
  - risk reduction and management
  - track stability and maintenance
  - train brakes and rolling stock
  - dynamic track/rolling stock effects
  - level crossing safety
  - moving away from a ‘blame’ emphasis

- A July ATSB publication summarises these.
Safety Management Systems

• Before looking at methodology and aviation examples, I want to reinforce that robust safety management systems (SMS) can make a major difference to safety
• The ATSB often finds poor SMS and weak safety culture contributes to accidents
• SMS compulsory among aviation operators from 2009 (aerodromes already)
• An International Civil Aviation Organization (ICAO) Manual published in 2006 is a key document and is to be updated with cases
ICAO 2006 Manual

• “Safety is the state in which the risk of harm to persons or of property damage is reduced to, and maintained at or below, an acceptable level through a continuing process of hazard identification and risk management.”

• “A safety management system is an organized approach to managing safety, including the necessary organizational structures, accountabilities, policies and procedures.... As a minimum, such SMS shall: identify safety hazards; ensure that remedial actions necessary to mitigate the risks/hazards are implemented; and provide for continuous and regular assessment of the safety level achieved.”
ICAO 2006 Manual

• ICAO Annexes “require establishment of a safety programme to achieve an acceptable level of safety in aviation operations. The acceptable level of safety shall be established by the State(s) concerned. … [and] may include provisions for such diverse activities as incident reporting, safety investigations, safety audits and safety promotion. To implement such safety activities in an integrated manner requires a coherent SMS.”

• An organization’s SMS accepted by the State shall also clearly define lines of safety accountability, including … senior management.”
ICAO stresses ‘acceptable level of safety’ is the overarching concept and regulatory compliance has to be complemented by a performance-based approach [ie ‘both/and’]

- Further, an ‘acceptable level of safety’ can vary across industry sectors and should be set with regard to implied risk, cost-benefit of improvements, operational context and complexity, and public safety expectations
- This is not an easy or uncontroversial task!
ICAO 2006 Manual

• ICAO says an ‘acceptable level of safety’ is expressed via safety performance targets and safety performance indicators, and implemented through safety requirements

• Many bodies share responsibility for safety and effective safety management - ICAO sees ‘considerable merit’ in a regulatory system with ‘a well-balanced allocation of responsibility’ between the regulator and the operator or service provider that is justifiable given the economic resources of the State - & risk-based regulatory resource allocation
Specialist independent accident & incident investigation authorities are important to avoid potential conflicts of interest [cf ATSB]

A positive safety culture is crucial, including:
- a senior management safety emphasis;
- realistic view of ST and LT hazards;
- fostering feedback & deal with safety deficiencies;
- non-punitive ‘just culture’ (but punish if culpability);
- communicating safety at all levels;
- good training & learning;
- safety ethic so little risk-taking behaviour;
- human factors understood and defences in place;
- pro-active data gathering, analysis & response.
Anca (2007)

- Swinburne’s Dr Joey Anca in *Multimodal Safety Management and Human Factors*, uses a squirrel as an iconic representation of SMS because a squirrel is in constant motion, anxiously scanning the environment for threats and opportunities: “the essence to the mad anxiety is an incessant monitoring of what goes as expected (normal operations) and what doesn’t (deviations)”
Hopkins (2005)

• ANU’s Professor Andrew Hopkins in Safety, Culture and Risk emphasises organisational safety culture, collective mindfulness, and risk-awareness.

• “Major accidents are frequently traced to failures in safety management systems and investigations sometimes reveal SMS are little more than sets of manuals occupying metres of shelf space …”

• Hopkins argues that the Royal Commission on the Esso Melbourne gas plant explosion in 1998 came close to describing the SMS at the site as ‘virtual’
Perhaps a dead wombat cf a squirrel is an appropriate icon for a poor or virtual SMS?
ATSB perspective on SMS

• As a no-blame safety investigator, in the context of an accident or a more serious incident, the ATSB may need to look at what type of Safety Management System was in place and how it was operating.

• Often the greatest learning can be from what went wrong and poor SMS if we are prepared to be honest and put ourselves imaginatively in the context and situation.
Aviation Investigation

• In aviation we received 15,400 event reports last FY of which 8,299 were classified as incidents or accidents
• Resourced for 80 investigations (25 larger)
• Required under Chicago Convention to investigate international carrier accidents
• Annex 13 standard re all accidents and recommended practice re serious incidents
• Do non-sport fatals to assist Coroners but often most safety value in selected RPT incidents so very tough judgements/choices
Collision with Terrain
11 km NW Lockhart River Aerodrome
7 May 2005, RPT 2 crew/13 pax fatalities
VH-TFU, SA227-DC (Metro)
Lockhart River Investigation

Large team of investigators:

• Examined aircraft components - on-site and in laboratory
• Examined cockpit voice recorder and flight data recorder and radio recordings
• Hindered by lack of usable cockpit voice recorder information, level of damage to aircraft, and no survivors or witnesses
• Assisted by flight data recorder, 25,000 pages of evidence, over 100 interviews
Lockhart River investigation

- Considered all aspects of the aviation system which included organisational & regulatory issues as well as aircraft/crew
- Conducted a research study into instrument approaches
- 10 recommendations before final report
- 500 page final report released 4 April ‘07
- Used ATSB Safety Investigation Information Management System (SIIMS) developed via $6.1m over 4 years.
Lockhart River approach profile
Basic Reason ‘swiss cheese’ model of accident causation

Some holes due to active failures

Other holes due to latent conditions

Accident

Hazards
ATSB investigation analysis model
ATSB investigation analysis model

- **Organisational Influences**
  (What could have been in place to minimise problems with the risk controls?)

- **Risk Controls**
  (What could have been in place to reduce the likelihood or severity of problems at the operational level?)

- **Local Conditions**
  (What aspects of the local environment may have influenced the individual actions / technical problems?)

- **Individual Actions**
  (What individual actions increased safety risk?)

- **Occurrence Events**
  (including technical problems)
  (What events best describe the occurrence?)
Contributing safety factors

• Defined as a safety factor that, if it hadn’t occurred/existed … the accident would probably not have occurred … or another contributing safety factor would probably not have occurred or existed

• Evidence not sufficient for some (eg CRM) with ‘probably’ defined as >66% (c. 2 in 3)

• ‘Acci-map’ diagram shows 19 contributing safety factors (black border) and 13 other safety factors (purple outline).
The Acci-map diagram is built from bottom up
Lockhart River and SMS

• Among the many contributing safety factors the ATSB Lockhart River investigation found Transair’s SMS to be poor

• Poor company organisation structure, weak Chief Pilot commitment to safety, and inadequate risk management processes

• Other factors included Ops Manual, variable training including HF/CRM, poor supervision of flight ops, TAWS not fitted
Transair’s SMS

- Chief Pilot was also MD & head of Check & Training and regularly in PNG – overloaded & poor organisational structure back-ups
- He did not demonstrate a high level of commitment to safety, e.g., Cairns base largely unsupervised and checked itself, reported pilot hazards not addressed, etc
- SMS largely in manuals not reality - virtual
Transair’s SMS

- Transair did not have a structured process for proactively managing safety-related risks associated with its flight operations.
- This included the move from charter into RPT with passengers in QLD, & expansion of operations in QLD and NSW to 25 pilots with new ports such as Lockhart River.
- Training was variable and sometimes entailed little more than an open book exam.
Transair’s SMS

• Transair’s Operations Manual involved a mass of Word documents slapped onto a CD with no indexing or version control

• Manual requirements for human factors training, like crew resource management for multi-crew operations, did not happen

• Transair appeared to have a SMS and a commitment to best practice but actual practice reflected a poor safety culture driven from the top (cf ICAO 2006 Manual)
Garuda 737-400, Yogyakarta
International example: AdamAir

- The ATSB has a longstanding relationship with Indonesian counterparts (NTSC)
- Assisted with Garuda 7 March 2007 Jogjakarta 737 landing overshoot accident
- Also assisted with AdamAir 737-400 high speed ocean crash of 1 January 2007
- The final report into this accident was released by NTSC on 25 March this year
- All on board died instantly: 2 pilots, 4 cabin crew, 96 passengers (11 children)
Final Adam Air Investigation Report released 25 March 2008
AdamAir SMS

• Based on flight recorder data, at FL350 the crew were trouble-shooting Inertial Reference System (IRS) anomalies
• Didn’t notice auto-pilot disengage and aircraft begin to bank and when the crew took action on aural alerts, they did not roll wings level before pitch recovery
• Aircraft reached 3.5g and negative 2.8g and Mach 0.926 – well beyond design limits—before ‘thumps’ and CVR ended
AdamAir SMS

• In addition to pilot inattention, AdamAir provided no training in upset recovery
• Indonesian regulations didn’t require it
• In 3 months prior to accident, 154 recurring defects in IRS logged but little or no action by company or regulator
• A good SMS requires timely action on accident precursors – this was opposite
• Late 2007 still IRS issues before action taken. AdamAir was wound up in 2008.
Some Lessons from Poor Transport SMS

- ICAO: a positive safety culture is crucial
  - senior management safety emphasis;
  - realistic view of ST and LT hazards;
  - fostering feedback & deal with safety deficiencies;
  - non-punitive ‘just culture’ (but punish if culpability);
  - communicating safety at all levels;
  - good training & learning;
Some Lessons from Poor Transport SMS

- safety ethic so little risk-taking behaviour;
- human factors understood and defences in place;
- pro-active data gathering, analysis & response.

• Take a systemic perspective, avoid complacency (mindfulness), learn from past accidents and incidents

• If you want to know more about the ATSB’s methodology and analysis, a 26 June 2008 research publication is on our website.
Be a scanning SMS squirrel not a dead SMS wombat!
ATSB reports see: www.atsb.gov.au

ATSB website:
• 1m annual new users and 40m ‘hits’
• All ATSB investigation reports and an increasing number of older BASI reports
• Quarterly aviation data and weekly summaries of occurrences processed
• ATSB research reports for aviation
• Rail and marine reports & safety material including 6-monthly rail safety data
• ATSB Annual Reviews…
Questions?