



From Scepticism to Strength?

(A perspective on the Integration & Maturing of System Safety)



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From Scepticism.....?

- A Long Time Ago (say the 80's/90's).... not so far away (Australia)...the way it used to be:
- System Safety Programs were emerging but not :
 - well integrated,
 - well budgeted,
 - well contracted, or
 - well understood.
- Significant safety escapes /incidents
- But there were the enlightened few !
 - Individuals and..
 - Organisations
 - e.g. SVRC,ACCS,UQ,aSCSa

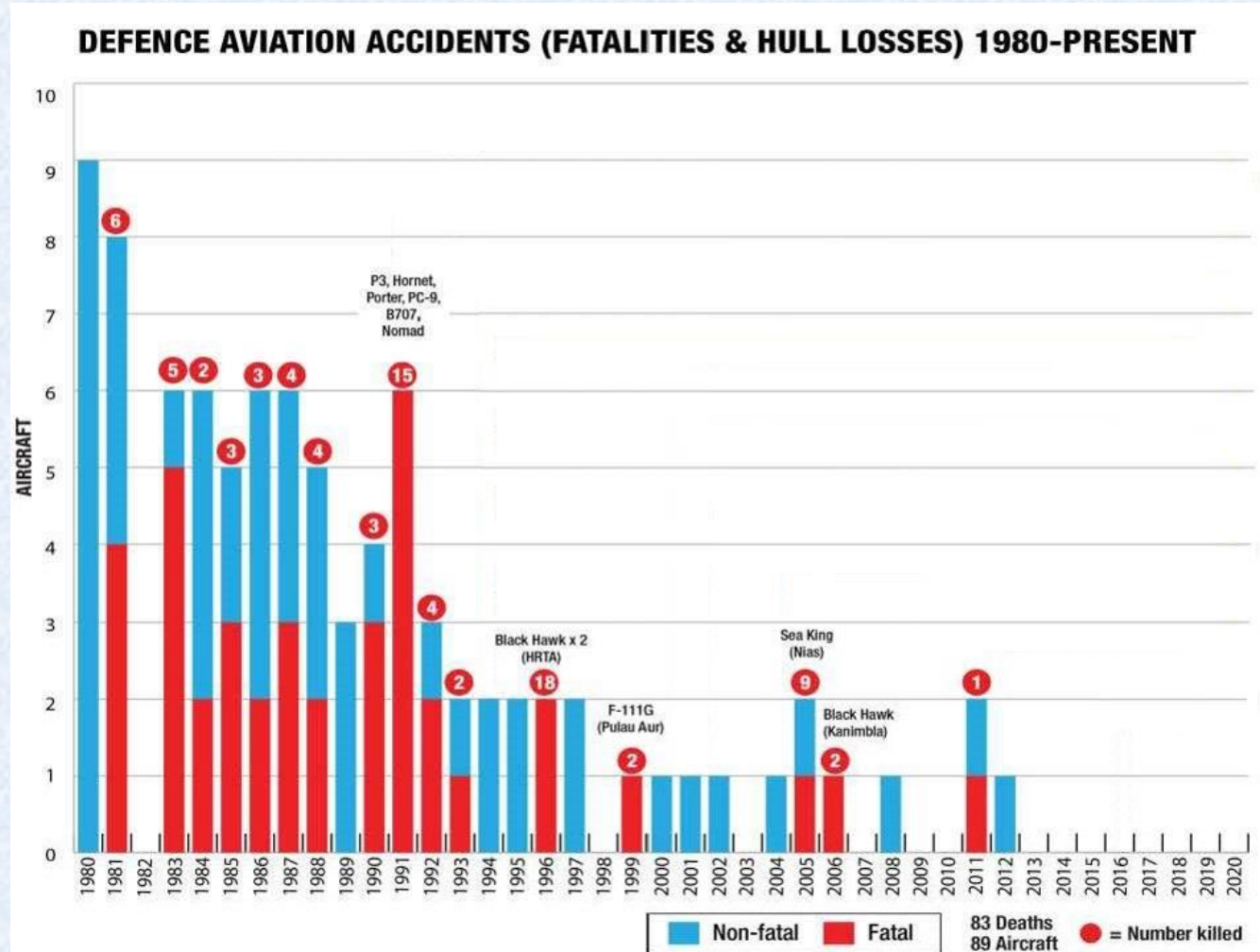
To Strength ?I definitely think so.



Lets look at some Statistics !

- Specifically some historical safety data from Civil/Military Aviation & Rail

Military Aviation Safety – Aircraft Accident History



* Acknowledgement – This slide data an extract from Defence Aviation Safety Authority (DASA) Training Material

Military Aviation Safety – Aircraft Accident History (contd)

“In 2017, the Defence Aviation Safety Program encompassed 26 Defence-registered aircraft types totalling over 480 airframes. During the 12 month 16/17 reporting period Defence-registered aircraft flew over 125 000 hours without fatality, serious injury or hull loss.

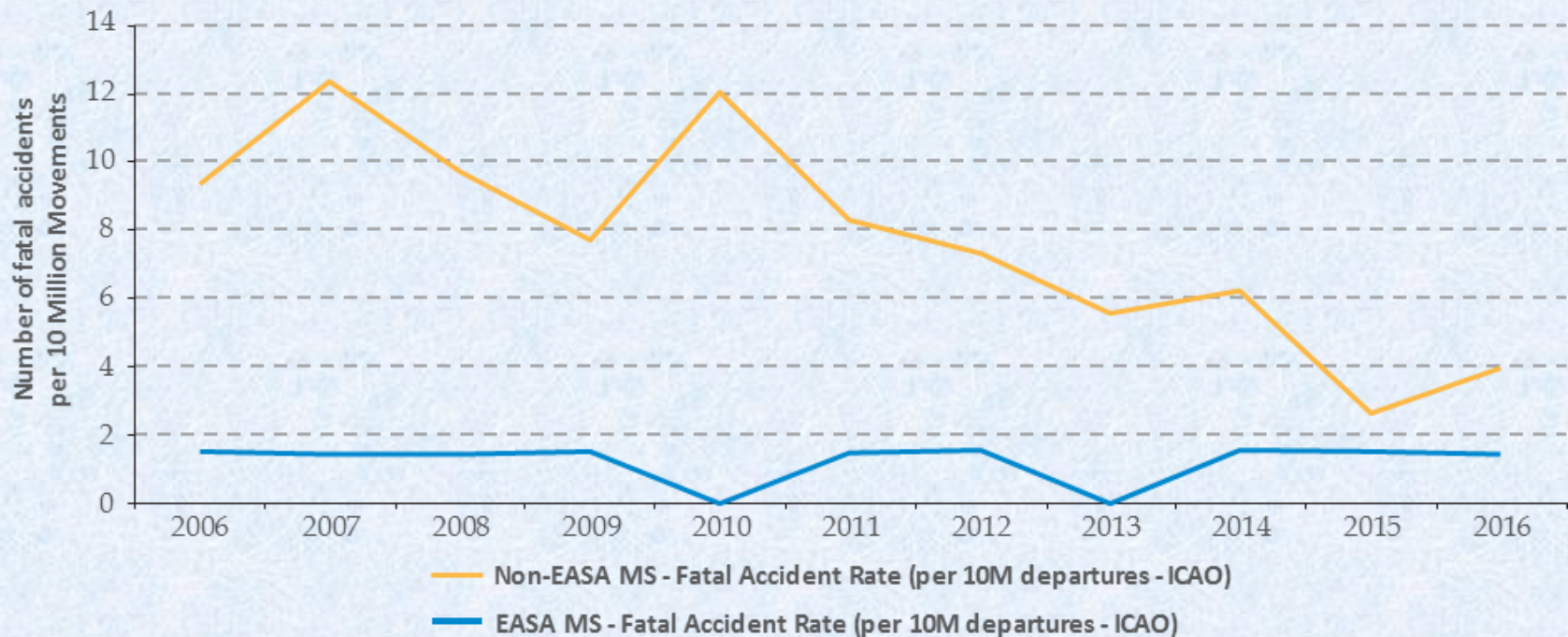
Importantly, a positive outcome that has prevailed for the last five years. ”

Note: *perhaps changed this year with recent F/A-18 Growler incident*

* Acknowledgement – This data an extract from Defence Aviation Safety Authority (DASA) 2016/2017 Data

Commercial Aviation Safety – Aircraft Fatality History

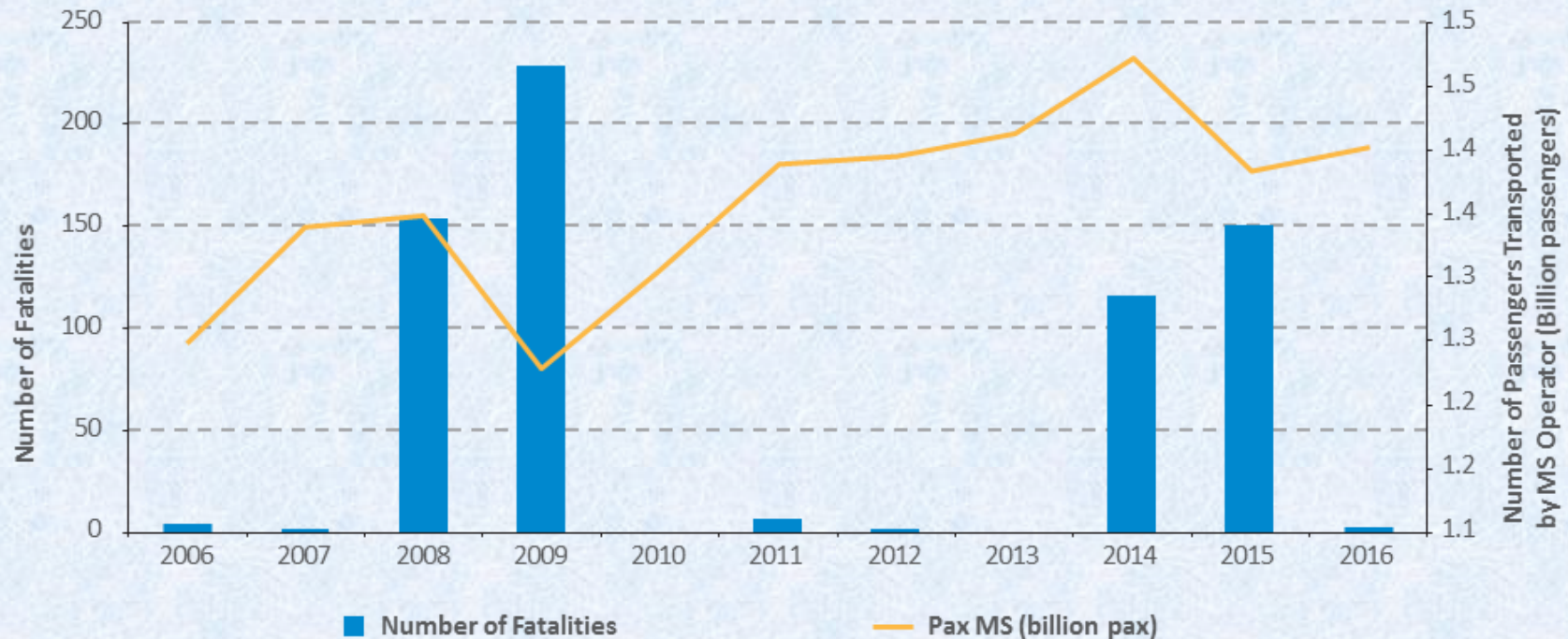
Airline fatal accident rate for EASA MS AOC and non-EASA MS for period 2006-2016



* Acknowledgement – This slide data an extract from EASA Annual Safety Review 2017

Commercial Aviation Safety – Aircraft Fatality History

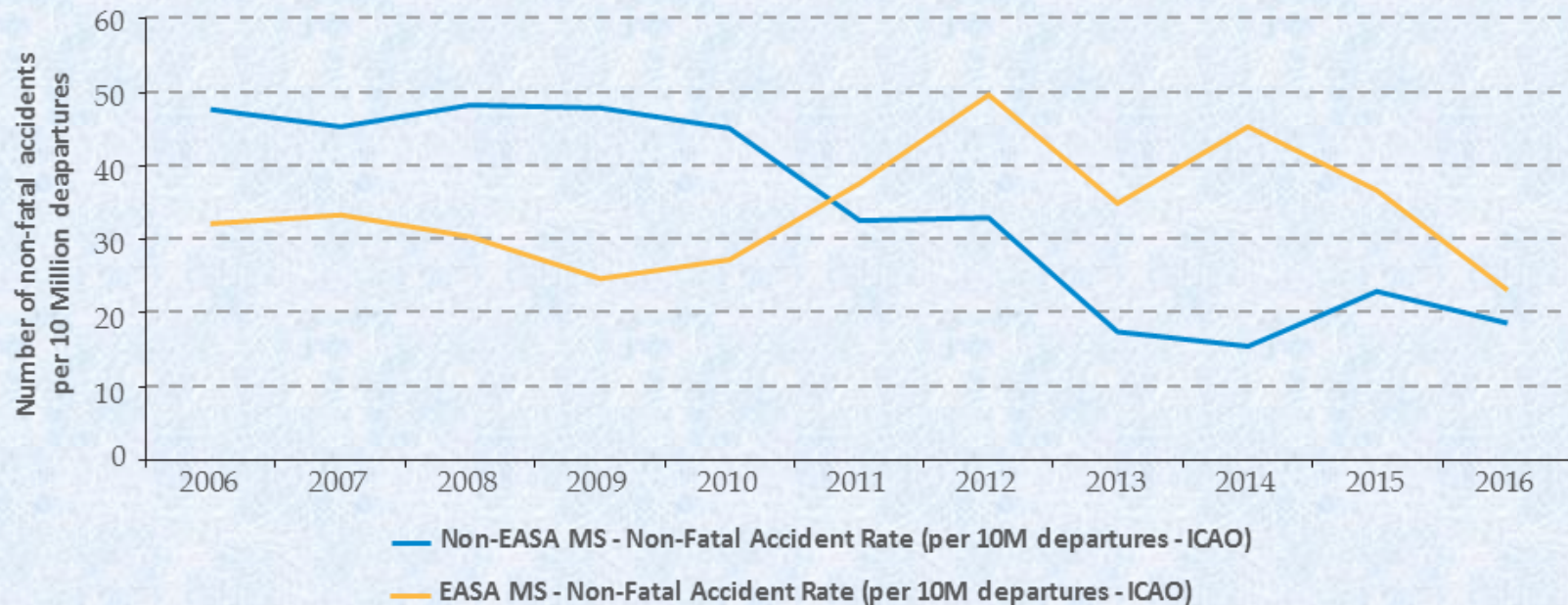
EASA Commercial Airlines, fatalities for period 2006-2016



* Acknowledgement – This slide data an extract from EASA Annual Safety Review 2017

Commercial Aviation Safety – Aircraft Non-Fatality History

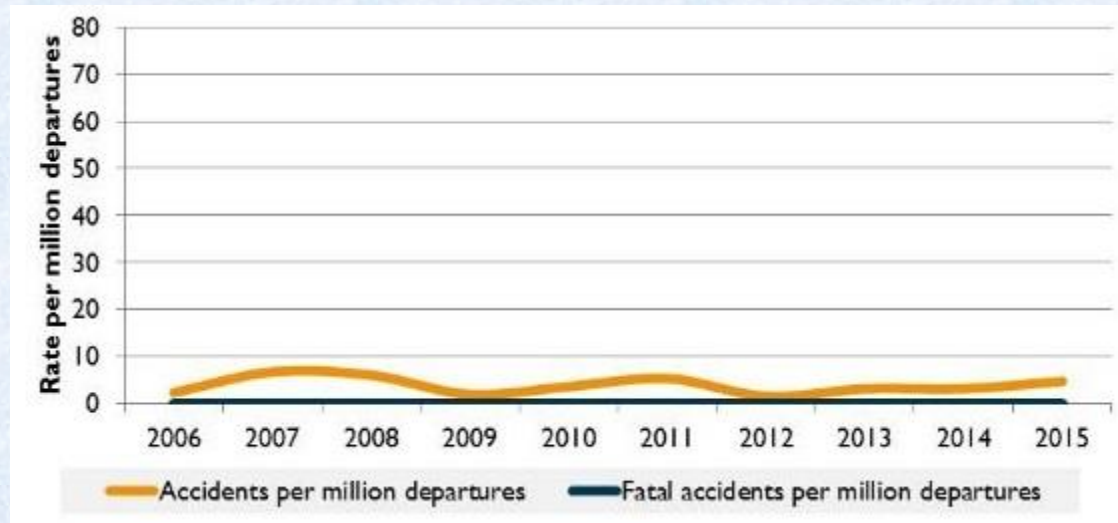
Airline non-fatal accident rate for EASA MS AOC and non-EASA MS



* Acknowledgement – This slide data an extract from EASA Annual Safety Review 2017

Aviation Safety – Australia High Capacity Commercial Aircraft

Accident rate for high capacity RPT aircraft, 2006 to 2015



- Further....No fatalities involving VH- registered high capacity RPT (Regular Public Transport) aircraft have occurred since 1975.

* Acknowledgement – This slide data an extract from ATSB Aviation Statistics 2017 Report (ATSB report)

Rail Safety – Railway Fatalities AU/GB/US

Railway fatalities – ONRSR, Great Britain and United States

SA, NSW, NT, Tas., Vic., and ACT data for full period, WA data from 2 November 2015 onwards.
Fatalities involving passengers, workforce, public and trespass (excluding suspected suicide).

		2014-15	2015-16	2016-17	3 YEAR
ONRSR (SA, NSW, NT, Tas., Vic., ACT, WA)	Fatalities	9	12	16	37
	Train Km (million)	115.7	153.4	177.3	446.4
	Rate	0.078	0.078	0.090	0.083
Great Britain (GB)	Fatalities	39	45	39	123
	Train Km (million) ²	558.5	556.7	572.2	1687.4
	Rate	0.070	0.081	0.068	0.073
United States (US)	Fatalities ³	765	779	846	2390
	Train Km (million) ³	1068.6	985.4	977.9	3031.9
	Rate	0.716	0.791	0.865	0.788

¹ Source: Rail Safety and Standards Board, Annual Safety Performance Report 2016/17, RSSB, UK, 2017.

² Source: Rail Safety and Standards Board, Rail KM on request (provided 7 October 2017), RSSB, UK, 2017.

³ Source: Source: Federal Railroad Administration Office of Safety Analysis: online database query (accessed 27 September 2017)
<http://safetydata.fra.dot.gov>.

* Acknowledgement – This slide data an extract from ONRSR 2016- 17 Safety Report

Rail Safety – Railway Fatalities AU 2012/2017

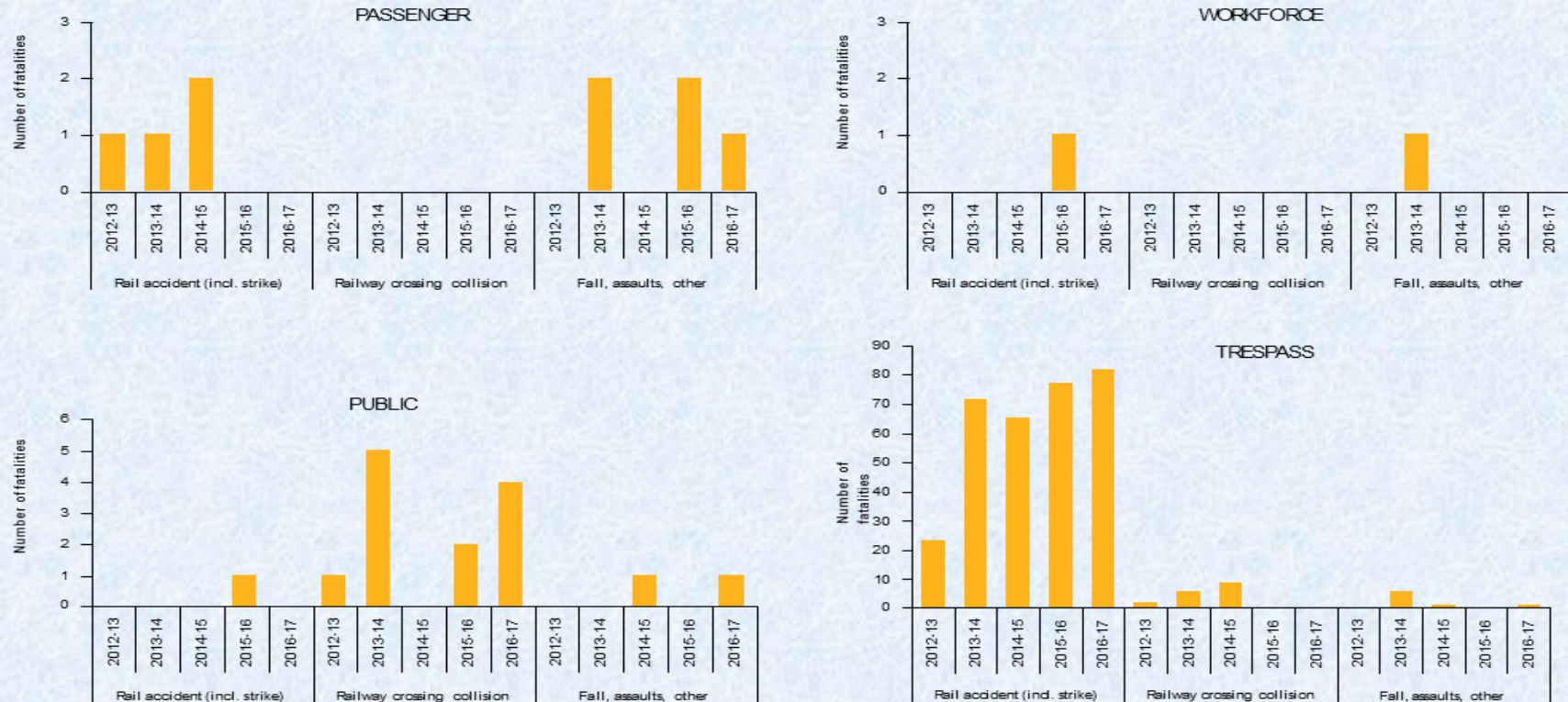


FIGURE 2

Railway related fatalities, July 2012 to June 2017

SA, NSW, NT and Tas. data is for full period, Vic. data is from 2013–2014 onwards, ACT data is from July 2014 onwards, WA data is from 2 November 2015 onwards. Non-passenger fatalities at railway crossings are classified as Public if neither trespass nor suicide is suspected. Railway crossing collision excludes suspected suicide at railway crossings, which are classified as Rail accident (incl. strike) involving Trespass.

* Acknowledgement – This slide data an extract from ONRSR 2016- 17 Safety Report

Rail 16/17 Fatalities – Summary

There were 89 fatalities in the 2016–2017 financial year on railways regulated under the RSNL(Rail Safety National Law) . These consisted of:

- 73 incidents involving suspected suicide
- nine incidents involving trespassers struck by rolling stock
- four fatalities to members of the public involved in railway crossing collisions between a train and a road vehicle
- one incident involving the assault of a member of the public at a train station
- one incident involving a trespasser impaling themselves on a boundary fence
- one incident involving a passenger who fell down the stairs of a train.

* Acknowledgement – This slide data an extract from ONRSR 2016- 17 Safety Report



My Perspective on This Data?

- The accident rates have become consistently low/lower on larger regulated Aviation and Rail operational segments over many years.
- Safety Performance Reporting has improved (still improving) and more open.
- There is convergence on types of metric/KPI's used, common approaches in reported data and data analytics.
- Good Data has enabled targeted improvement.
- Stakeholder Engagement seen as an essential element.
- Accidents causing serious injury or worse from core Technical System Design/maintenance errors are a small proportion of reported occurrences

So this suggests.....

- The broader Safety Community (System, WHS, Operational Safety) is doing something right across industries...and
- Where it is applied, System Safety Analysis is very successfully mitigating risks in design and maintenance programs.

Why Have We Improved in Safety (including System Safety) Performance?



My Top 5 Reasons



Number 5 – Tendering and Contracting

- Initial System Acquisition cost not all important any more...well increasingly the case.
- Accurate Through Life Costings have become important
 - Has put more focus on through life modelling based on reliability data etc., relying on RAM and risk analysis skills
 - These skills now much more prevalent and in demand
- Performance based Sustainment or Own/Operate Contracts
 - Painshare/gainshare based on KPI's and SHI's (System Health Indicators) including Safety, Availability, Mission Success Rates, On time Performance
- The benefits of investing in Hazard/Risk/Safety improvement were always there....but now more financially tangible
- But....Fixed Price Contracting on development contracts remains imperfect and the “enemy” of systems engineering practice
- and there is the opportunity forget history is always present on new initiatives....e.g. naval shipbuilding strategy is topical





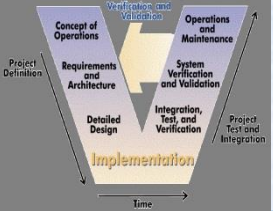
Number 4 – Legal Environment & Accountability

- Much more direct accountability for Safety
 - Company Directors and Leadership
 - Not just an “Engineering” thing
- Spread of the Litigation Virus
- Driven the Risk Based Approach to Program Management, Business Management, Regulation & Improvement
- Growing consistency in laws for safety incident reporting
- Advent of “Just Culture” has encouraged increased reporting.
 - Just Culture \neq No Accountability
- SFAIRP – Risk/Cost based analysis



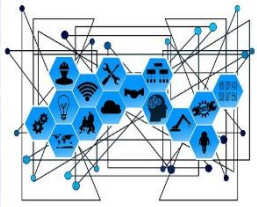
Number 3 – Improved Regulation

- Risk Based Approach to Regulation & Improvement
- Growing focus on Organisational Approvals/Certifications not just Individuals
- Move from “How” to “What” Regulation
- Convergence and move to Common Regulation making things simpler
 - DASA/CASA/EASA Airworthiness Regulations Convergence
 - ONRSR – Integrating previous State Based Regulation
 - Consistent Occurrence Reporting
- Stakeholder Engagement seen as essential
 - Industry Consultation
 - Separation of Regulation Development from Compliance
- SFAIRP Risk/Cost Based Principles



Number 2 – Adoption of Systems Engineering and Improved Process/Tools

- System Safety much more an integrated part of the process...not a bolt on.... or worse, reversed engineered to meet a contract deliverable requirement (surely not ...)
- Convergence of Standards/Processes
 - CENELEC
 - DoD
 - EASA
- Major bids and tenders require genuine System Safety related deliverables.
- Much more focus on the right side of the “V” , informal integration and formal V&V.
- Integrated/automated development and testing tools
 - Much Improved software quality and safety.



Number 1 – Technology Advancement/Cost



- Technology Reliability
 - Safety more integrated in Product Development
- Technology Availability/ Affordability
 - Safety and associated systems have become affordable
 - Car Airbags (current recall notwithstanding)
 - Moving Map GPSprofound affect on recreational aircraft accidents
 - Driver/Operator Alert Systems
 - Driver Assist Technology (Automatic Braking, Drowsiness detection)
 - System Health Monitoring
 - Injury Minimisation Design
 - Advanced Communications (voice/data)
 - Health Monitoring/Diagnostics
 - e.g aircraft engines
 - Semi/Fully Automated operator support
 - Improved maintenance management tools/systems
- Improved Manufacturing Accuracy/Repeatability
- Driving Consumer expectations
 - Can now have affordability, personal style and relative safety

Common Industry Priorities/ Themes:

Stakeholder Engagement

ONRSR - “ONRSR acknowledges that changes to reporting requirements and methods of operator-regulator interaction will impact industry stakeholders. ONRSR will consult with industry over such changes to validate that they are practical and to fully examine the benefits that can be provided back to operators. For specific projects such as the portal, ONRSR will seek to partner with industry to ensure end user requirements are captured and met.”

DASA

- Defence Aviation Regulation - Industry Consultative Committee (DARICC)
 - Representation from DASA, Industry, CASG & CASA
- Airworthiness Conferences/forums, training.
- 2017 Identified Focus - “Enhanced regulated community engagement to assist with DASA transition, including targeted training and widespread interactive educational forums”

CASA

- “As part of a fresh approach to stakeholder consultation and engagement, CASA established the new Industry Relations Branch and Aviation Safety Advisory Panel.”

Common Industry Priorities/Themes:

Risk Management

AUSTRALIAN RAIL RISK MODEL (ONRSR)

In November 2017 the first version of the Australian Rail Risk Model was launched by the Rail Industry Safety Standards Board (RISSB). The model uses occurrence data and network information to model and quantify safety risk on railways across Australia.

"ONRSR has long championed the need for a rail industry risk model and is pleased to see the collaborative work in this space come to fruition. Attention now shifts to encouraging operators to utilise the model as an additional and vital source of risk information to inform safety investment decisions. The model also presents a new and important source of risk information for ONRSR which will be considered alongside its internal analysis to inform regulatory decision-making"

As the scope and uptake of the model grows over time it is expected to foster a shared understanding of safety priorities between ONRSR and industry and reinforce co-regulation"

- ONRSR

"Effective safety reporting, just like command commitment **and risk management**, is a cornerstone of safety management and is an element of the Defence Aviation Safety Management System."

- DASA

Common Industry Priorities/Themes:

Regulation Convergence

Military/Civil Aviation

- Continued expansion of airworthiness recognition with other national and international authorities improving the effectiveness and efficiency of airworthiness governance and logistic overheads.
- DASA engagement with Australian Government agencies and the development of Australia's State Safety Program.
- Externally, the agreement between CASA and Defence on the promotion and recognition of aviation safety between the two agencies, to:
 - harmonise civil and Defence regulation where suitable to do so
 - collaboratively develop future regulation
 - enable a single Australian aviation sector by recognising the adequacy of civil and Defence regulation organisational approvals, engineering licensing and oversight to allow aviation organisations and people to operate across regulatory boundaries
 - pursue efficiencies in the collection and sharing of aviation safety data and intelligence.

Rail

- At the start of the 2016–2017 financial year ONRSR had responsibility for rail safety regulation in South Australia, New South Wales, Tasmania, Northern Territory, Victoria, Australian Capital Territory and Western Australia. ONRSR's coverage increased on 1 July 2017 when the RSNL was enacted in Queensland.

A Key Enabler

- Separation of Regulation Development from Regulation Compliance

Common Industry Priorities/Themes:

Transparent Occurrence Reporting

- “In June 2017, ONRSR released the Reporting Requirements for Notifiable Occurrences to replace the occurrence classification guideline (OC-G1) and the occurrence notification standard (ON-S1). The new document was introduced to provide greater clarity on what is and isn’t reportable for each occurrence category. It did not alter the main categories of occurrence that must be notified to ONRSR, but did include some refinement of subcategories and definitions. The new document assists operators to report more accurately, thus improving the quality and relevance of rail safety data collected by ONRSR” - ONRSR
- “Effective safety reporting, just like command commitment and risk management, is a cornerstone of safety management and is an element of the Defence Aviation Safety Management System” - DASA

Common Emerging Risks



Cyber Security

- The introduction of automated, safety-critical systems across many industries has no doubt helped provide significant increases in safety. However in the current era , it also brings an increased exposure to cyber security threats.
- In recent years, both the German Deutsche Bahn and the San Francisco Municipal Railway became the targets of cyber-attacks. Although there were no injuries as a result of these attacks they serve as a reminder of the serious threat that cyber security poses. ONRSR is represented on the RISSB Advisory Group and Development Group on rail cyber security and will continue to be active in this space in 2018.(ONRSR)
- In June 2015, an attack grounded around 1,400 passengers when the flight planning system of 10 aircraft went down for around five hours at Warsaw's Chopin airport.

Unmanned Systems

Requires focus on the safety of unmanned systems themselves (e.g unmanned vehicles), and also their impact on other systems (e.g aircraft)

- Growth and rapid advancements in unmanned systems technologies
 - Regulation catching up
- Employment Growing Rapidly
 - > 50000 used in Australia....expected to quadruple by 2020
 - > 1000 CASA remotely piloted aircraft operator certificate holders (2017) & 6,049 individuals and organisations notifying their intention to conduct low-risk commercial drone operations



- Physical and privacy/security conflict
- Near miss reports growing
- Although the data is limited, there is an expectation that the number of events or incidents reported in will increase over time, and warrants as an area of heightened vigilance and interest for Defence aviation. (DASA)
- 2018 Federal Budget Allocation to CASA - The Government will provide A\$2.9 million in 2018-19 to further support CASA to manage safety standards and associated compliance for recreational and commercial drone technologies in Australia.



Unmanned Systems

- Requires focus on the safety of unmanned systems themselves (e.g unmanned vehicles),
and also their impact on other systems (e.g aircraft, people)

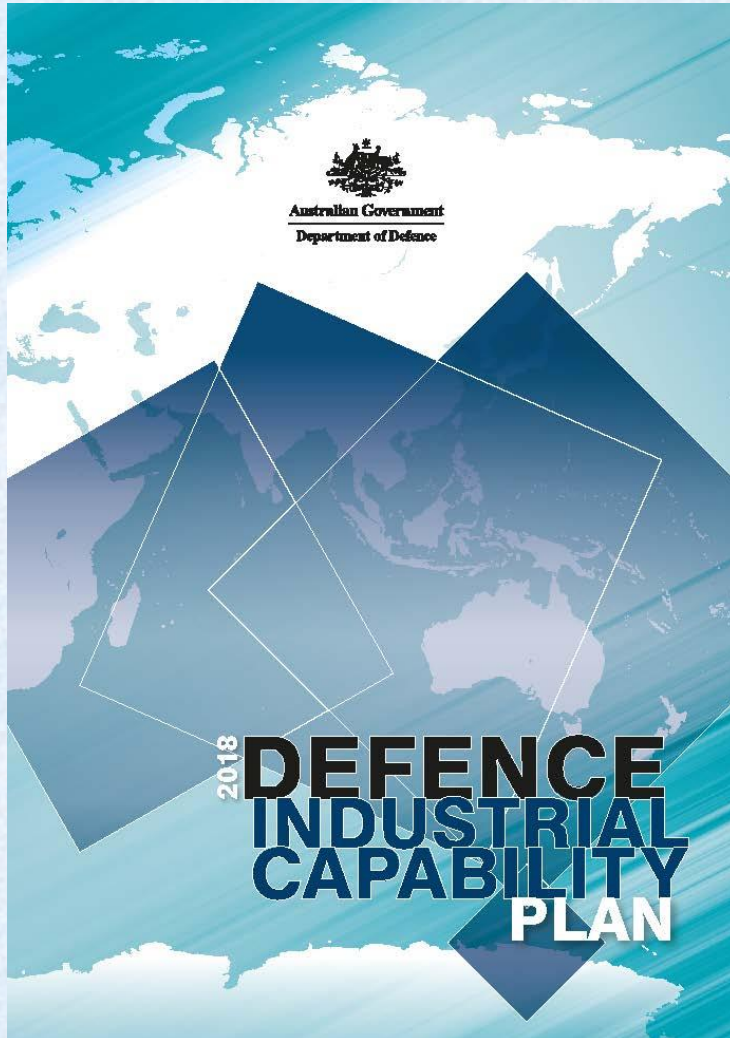
“The changing aviation environment due to the proliferation and advancements in unmanned aerial systems technologies” – Identified DASA Focus Area

“An Uber self-driving car has hit and killed a woman crossing the street in Arizona, marking the first time a self-driving car has killed a pedestrian and dealing a potential blow
to technology which is expected to transform transportation.” - News Mar 2018



- Rail is well advanced in unmanned systems
 - ETCS systems and levels of automation (perhaps with the advantage of less degrees of freedom on rails)

In Conclusion : Systems Assurance – A Recognised National Defence Priority



In Conclusion : Systems Assurance – A Recognised National Defence Priority (contd)

“The initial Sovereign Industrial Capability Priorities are (in no particular order):

- Collins Class submarine maintenance and technology upgrade.
- Continuous shipbuilding program (including rolling submarine acquisition).
- Land combat vehicle and technology upgrade.
- Enhanced active and passive phased array radar capability.
- Combat clothing survivability and signature reduction technologies.
- Advanced signal processing capability in electronic warfare, cyber and information security, and signature management technologies and operations.
- Surveillance and intelligence data collection, analysis, dissemination and complex systems integration.
- **Test, evaluation, certification and systems assurance.**
- Munitions and small arms research, design, development and manufacture.
- Aerospace platform deep maintenance.”

In Conclusion : Systems Assurance – A Recognised National Defence Priority (contd)

“Test, evaluation, certification and systems assurance – providing the initial and in-service test, evaluation, certification and systems assurance of Defence platforms and systems is a shared Defence and industry role. This ensures that our equipment is fit and safe for purpose for the Australian operating environment, operationally ready and secure, and able to be sustained for maximum benefit over its service life. Australian industry must have a suitably skilled workforce and the equipment needed to ensure the safety, accessibility and usability of Defence platforms and systems, both for peacetime and operations. These capabilities must support Australia’s unique requirements, and allow indigenous design, development and implementation of modifications and upgrades.”

Final Thought – What should practitioners do to continue to further the “Strength” of System Safety ?

- Help avoid the Complacency Risk (and return to Scepticism!)
 - Remind people about the lessons of history
 - Take Responsibility for understanding and advertising the “why” for System Safety and the benefit to the wider business of the underlying skills

THANKS!