



Using Incident Investigation Tools Proactively for Incident Prevention.

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Introduction

- Reducing Error
- Investigative Tools / Frameworks
- Incident Cause Analysis Method (ICAM)
- Proactive Application
- Aviation Case Study - NTSB
 - Learjet Accident in 1999.
- Conclusion





Reducing Error

- Can simply correcting the deficiencies found through incident investigations reduce error?
 - Modern safety theory suggests that relying on correcting deficiencies found through incident investigation as a means to reduce error is restrictive.
- Many incidents occur, not because they cannot be prevented, but because of:
 - Gaps in their safety systems,
 - Failing to learn or retain the lessons from past incidents.
- Future direction for incident prevention:
 - using investigation methodologies as a tool that integrate with and compliment pre-existing processes.



Investigation Tools/Frameworks

- Principle objective:
 - Prevent recurrence, reduce risk and advance health and safety performance.
- Provide guidance for the Investigation Team.
- Effectiveness in reducing error needs improvement.
 - Not focused on, therefore not truly effective at making organisations “safer”.
- Good investigative tools / frameworks are able to be used not only *reactively*, but also *proactively*.
- ICAM
 - Holistic tool.
 - Improve safety at an organisational level.

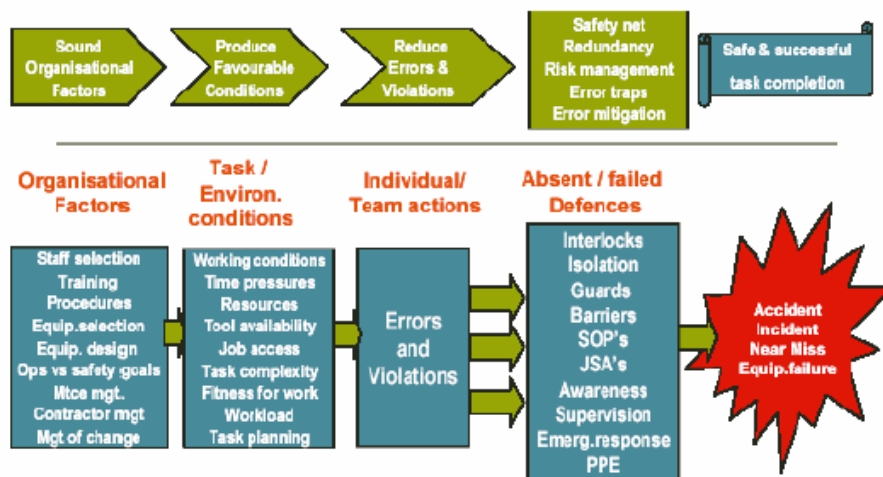


Incident Cause Analysis Method - ICAM

- ICAM stems from the work of Professor Reason and his modelling of organisational accidents.
- Systems approach - not only looks at *what* happened, but *why* it happened.
- Designed to ensure that the investigation is not restricted to the errors and violations of operational personnel.
- ICAM is an analysis tool that sorts the findings of an investigation into a structured framework consisting of four elements.



ICAM Model of Accident Causation





Objectives of ICAM

- The objectives of incident investigations using ICAM:
 - Establish the facts
 - Identify contributing factors and latent hazards
 - Review the adequacy of existing controls and procedures
 - Report the findings
 - Recommend corrective actions which can reduce risk and prevent recurrence
 - Detect organisational factors that can be analysed to identify specific or recurring problems
 - Identify key learnings for distribution
- It is **not** the purpose of an ICAM Investigation to apportion blame or liability.



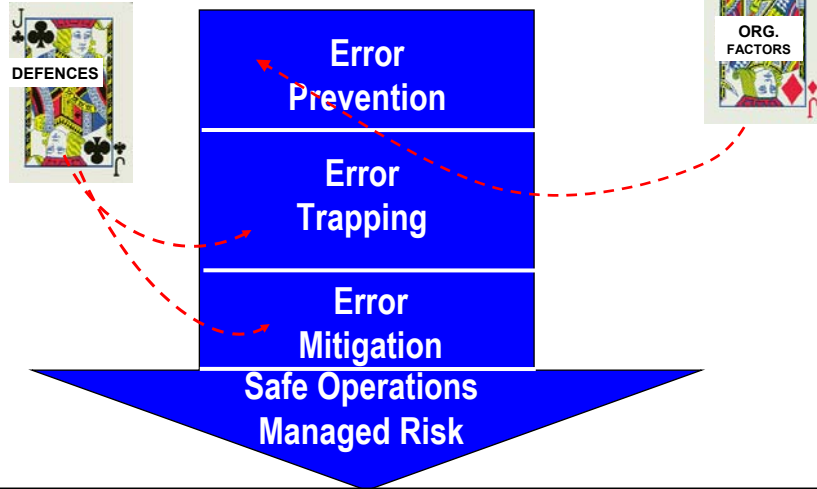
Applying ICAM Proactively

- Extremely effective reactive tool
 - Development of safety performance improvement strategies.
- Future direction – proactive use of the model.
- For incident reduction to occur, precursors to error must be identified and rectified.
- Error management systems needed to:
 - Reduce error,
 - Mitigate the consequences of error; and
 - Proactively prevent incidents.

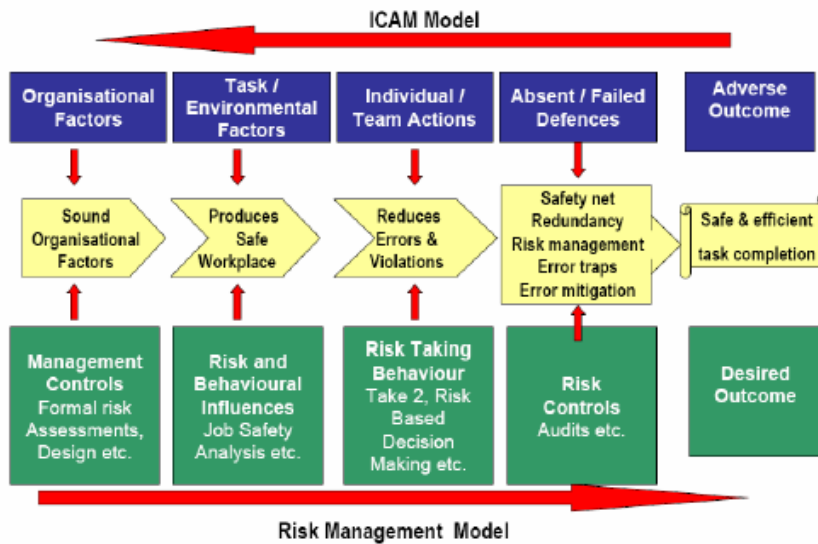


ICAM Error Management Strategy

- 3-way strategy to manage workplace errors.



Applying ICAM Proactively





Case Study

- ICAM is used widely for the investigation of incidents throughout the aviation, rail, mining, marine, medical and petroleum industries.
- Aviation Case Study - demonstration of how the proactive use of ICAM may have identified precursors to error, effectively breaking the links that led to the accident.
- Learjet Accident
 - 25th October 1999
 - Near Aberdeen, South Dakota USA
 - Pax included Professional Golfer, Payne Stewart.



Accident Summary

- Learjet Model 35 (N47BA) flown from Sanford on the morning of the accident to Orlando Florida, where passengers boarded.
- Flight departed Orlando for 'Love Field' in Dallas, Texas with two pilots and four passengers at approx. 0919 hours.
 - Planned flight time: 2 hours
 - Fuel - Aircraft had approx. 4 hours & 45 minutes flying time.
- Air Traffic Control cleared the aircraft to FL 390 at 0944 hours
 - aircraft was NW of Gainesville, Florida, climbing through 37,000 ft.





Accident Summary

- ATC lost radio contact with the flight at this point.
- The aircraft proceeded on a northwest heading at approximately 45,000 ft.
- Alarm raised – aircraft intercepted by military aircraft.
 - Pilots reported the forward windshields seemed to be frosted over or covered with condensation.
 - No structural anomalies or other unusual conditions noted.
- At 1326 hours, the Learjet departed controlled flight and spiralled to the ground
 - All occupants sustained fatal injuries
 - Aircraft destroyed



Accident Summary

- Diagram shows planned route and deviation.





Accident Summary

- Aerial photograph to the right displays emergency vehicles parked near the site - Learjet wreckage circled in red.



- Investigators at the accident site.



Accident Summary

- Rescue workers at the accident site



- FAA Investigator at the accident site.



Investigation Challenges

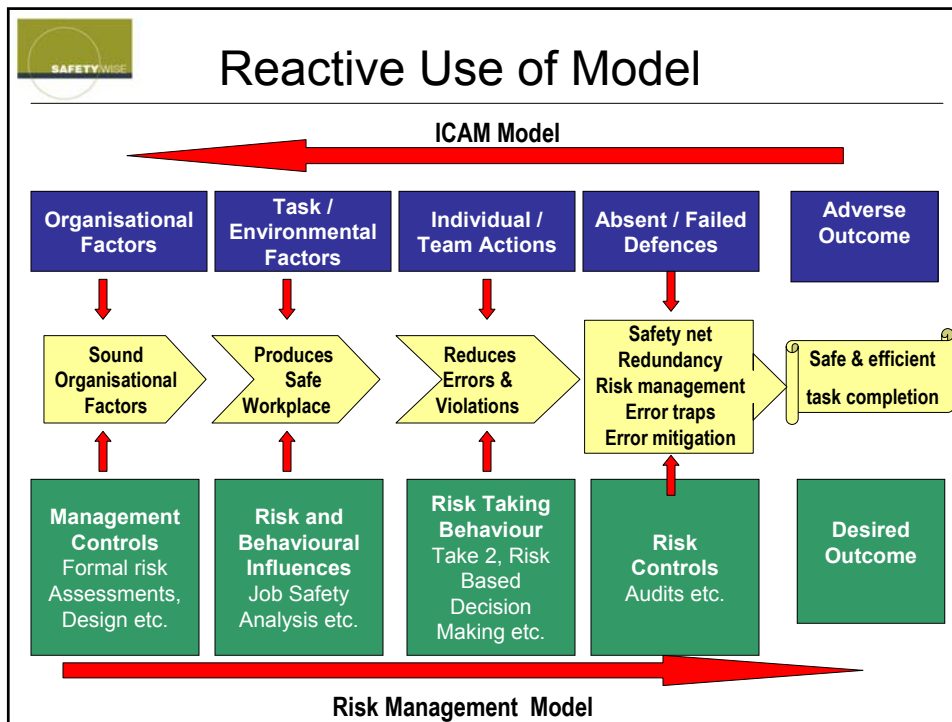
- NTSB
 - Difficult investigation – much of the physical evidence destroyed.
 - As the aircraft impacted at nearly supersonic speed and at an extremely steep angle, none of its components remained intact.
 - The airplane was not equipped with a flight data recorder and it had only a 30-minute cockpit voice recorder, which was of limited use during the investigation.
 - All of the investigators involved in the investigation were also investigating other accidents. The Investigator-in-Charge was working on four other investigations in addition to this one.



Probable Cause of Accident

- NTSB Findings:
 - Incapacitation of the flight crew members as a result of their failure to receive supplemental oxygen following a loss of cabin pressurisation, for undetermined reasons.
 - The Safety Board was unable to determine why the flight crew could not, or did not, receive supplemental oxygen in sufficient time and/or adequate concentration to avoid hypoxia and incapacitation.
- ICAM applied to the accident based on the contributing factors identified in the NTSB Report.





- ## Application of ICAM
- Absent / Failed Defences
 - Unable to maintain cabin pressurisation
 - Lack of bleed air supply to the cabin
 - Closed flow control valve (supplying warm air to windshield)
 - Timeliness/warning for donning oxygen masks
 - Oxygen quality/quantity
 - Incomplete standardised manual and procedures
 - Previous inconsistencies in application of SOP's
 - Crew pairing of inexperienced captain and first officer
 - Limited flying time on type by Captain
 - Maintenance procedures not adhered to, some verbal, incomplete written, some not signed off.



Application of ICAM

- Individual / Team Actions
 - Crew did not don oxygen masks in a timely manner
 - Crew did not detect the onset of hypoxia



Application of ICAM

- Task / Environmental Conditions
 - Loss of cabin pressurisation
 - Flow control valve closed
 - Limited time of type
 - Altitude
 - Low pressure evident in cabin (via alarm)
 - Ambiguity surrounding effectiveness of alarm system
 - Lack of supplemental oxygen
 - Hypoxia / Incapacitation



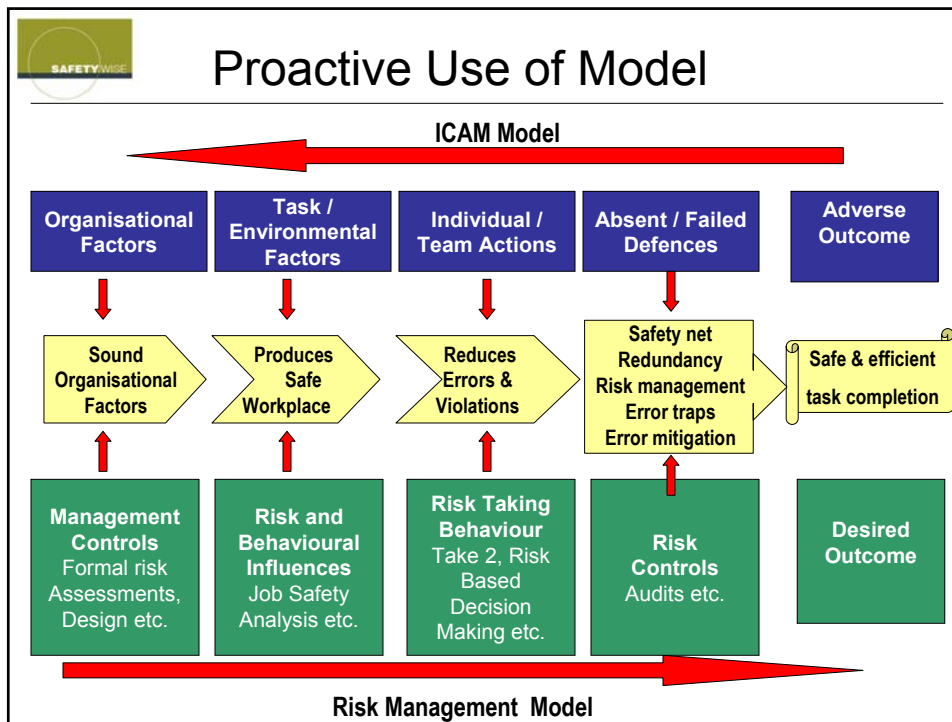
Application of ICAM

- Organisational Factors
 - Deficient monitoring/ auditing of maintenance item completion
 - Equipment not fit for purpose- suspected valve problems with closure of flow control valve.
 - Process of managing the introduction of new aircraft.
 - Incident reporting system deficiencies.
 - Inadequate procedures for checking quality and quantity of on board emergency oxygen bottle.
 - Deficiencies in maintenance control – use of MEL etc.
 - No evidence of risk appreciation process used.



Application of ICAM

- Organisational Factors cont...
 - Ambiguous monitoring by management of resources, climate and processes of a safe working environment.
 - Incomplete corporate commitment to safety.
 - Failure to revise maintenance strategy.
 - Failure to appreciate the risk exposure or vulnerability within the organisation.
 - No follow-up from previously failed defenses – identification, tracking and resolving maintenance items and adverse trends.



- ### Identifying the Precursors
- Application of a proactive tool may have been able to identify the precursors and break the error chain.
 - Given the contributing factors found and the types of issues that are typically found during the proactive application of ICAM:
 - Poor follow through on work procedures.
 - Incomplete standardised manual and procedures.
 - Monitoring / audit processes.
 - Change management issues (new aircraft).
 - Crew pairing
 - Risk Management
 - Procedures for checking quality/quantity of oxy bottle.



Benefit of Proactive Approaches

- Proactive error management strategy that leads to overall incident reduction is beneficial and can be measured in both tangible and intangible means.
- The proactive use of tools such as ICAM can provide safety learnings without the costs associated with an incident.
- By designing error tolerant workplaces that will reduce error, organisations have the potential to mitigate error consequences and therefore, proactively prevent incidents.
- Shift in focus from investigation findings to preventative safety.



- *“Our investigation and corrective actions tend to be based on the amount of damage and injury – which is random. We don’t really have prevention programs; we have accident correction programs.”*

– Richard Wood (1997). Aviation Safety Programs – A Management Handbook.



Conclusion

- Correcting the deficiencies found using standard reactive incident investigation methods should reduce and manage the errors that led to a particular incident.
- However, to reduce the precursors to error and fundamentally improve the safety of an organisation, a more proactive approach is required.
- The proactive use of investigation methodologies may enable the precursors to error to be identified and remedied prior to actual occurrences..... saving time, money and perhaps lives.

Further Details



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