

Review of the Implementation of the Court of Inquiry's Recommendations following the 2010 ANZAC Day Iroquois Crash

Report prepared for:

State Services Commission

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Disclaimer

In preparing this report, we have relied upon, and assumed the accuracy and completeness of, all the information made available to us from New Zealand Defence Force (NZDF). We have been assured by the New Zealand Defence Force that all information relevant to the completion of the review has been provided. We have evaluated that information through our analysis, judgment and review but have not sought to verify the accuracy or completeness of any such information. It should not be construed that we have conducted an audit of the information.

The statements and opinions expressed in this report are based on information available as at the date of the report. We reserve the right, but will be under no obligation, to review or amend our draft interim report, if any additional information, which was in existence on the cutoff date of the report, was not brought to our attention, or subsequently becomes known.

The statements and opinions expressed in this report have been made in good faith and on the basis that all relevant information for the purposes of preparing this report has been provided to us and that all such information is true and accurate in all material aspects and not misleading by reason of omission or otherwise.

The State Services Commission and New Zealand Defence Force acknowledge that it will use its own judgement in using the advice provided.

This report and the subsequent final report have been prepared solely for use by the State Services Commission and New Zealand Defence Force for the purpose of assisting these organisations complete an independent quality assurance of the implementation plan and actions taken by New Zealand Defence Force in response to the recommendations in relations to the crash of the Air Force Iroquois helicopter on ANZAC Day 2010.

Summary

Introduction

The Court of Inquiry completed its report into the fatal crash of Iroquois NZ3806 in December 2011. The Court of Inquiry undertook a comprehensive assessment of the causes of the accident. The Court of Inquiry report contained 169 findings and made 78 recommendations.

The Minister of Defence has sought assurance, through the State Services Commissioner, that New Zealand Defence Force has a robust plan to implement the recommendations of the Court of Inquiry, and good project management and reporting processes in order to deliver on the plan.

Conclusions

The key conclusions from the detailed review of the implementation plan and actions taken in response to the Court of Inquiry recommendations are that:

- The majority of recommendations (including all substantive recommendations) made by the Court of Inquiry are now completed.
- All outstanding recommendations are expected to be concluded by June 2013.
- Adequate management arrangements were put in place and they did support the implementation of the recommendations.
- A wide range of action has been undertaken to enable the Court of Inquiry recommendations around organisational culture to be implemented including the introduction of an independent Operating Airworthiness Regulator, the formation of 488 Wing and the changes in command at No 3 Squadron.
- That appropriate progress reporting arrangements in relation to the implementation of the Court of Inquiry recommendations are currently in place.

Strengthening governance

The Court of Inquiry identified the particular chain of events that resulted in the crash of Iroquois NZ3806 rather than a system wide analysis of all Royal New Zealand Air Force activities. The successful implementation of the Court of Inquiry recommendations therefore by themselves however, will not be enough to ensure that another major accident will not occur.

Operational safety is inherently complex. It requires a combination of on-going rules-based risk-management system as well as proactive leadership. In addition to the operational safety work undertaken by the Airworthiness Board there is a need for the Air Force Leadership Board (AFLB) to strengthen its governance role by explicitly:

- Implementing an appropriate safety/operational integrity index that would provide an objective assessment of trends in operational safety and a means for the AFLB to be better placed to take proactive steps to mitigate risks.
- Conducting regular on-going discussion about the impacts their “strategic choices” such as resource allocation may be having on operational safety.

Strengthening the governance role of the Air Force Leadership Board is critical to enabling the Chief of Air Force to demonstrate that he is meeting his on-going obligation to ensure the protection of personnel.

Recommendations It is recommended that State Services Commission:

1. **Note** that the majority of major recommendations made by the Court of Inquiry are now completed
2. **Note** that it is expected that all recommendations will be concluded by June 2013.
3. **Note that** adequate management arrangements were put in place and they did support the implementation of the recommendations.
4. **Note** that a wide range of action has been undertaken to enable the Court of Inquiry recommendations around organisational culture to be implemented including the introduction of an independent Operating Airworthiness Regulator, the formation of 488 Wing and the changes in command at No 3 Squadron.
5. **Note** that appropriate progress reporting arrangements in relation to the implementation of the Court of Inquiry recommendations are currently in place.

It is recommended that New Zealand Defence Force:

6. **Agree** to strengthen the governance role of the Air Force Leadership Board by explicitly:
 - a) Reviewing an appropriate safety/operational integrity index that would provide an overall objective assessment of trends in operational safety and a means for the Air Force Leadership Board, to take proactive steps to mitigate risks.
 - b) Conducting regular on-going discussion about the impact of “strategic choices”, such as resource allocation may be having on operational safety.
 7. **Note** that strengthening the governance role of the Air Force Leadership Board is critical to enabling the Chief of Air Force to demonstrate that he is meeting his on-going obligation to ensure the protection of personnel.
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1. Introduction

Request for an independent quality assurance

On the morning of 25 April 2010 a formation of three Iroquois helicopters departed RNZAF Base Ohakea to conduct a series of ANZAC Day flyovers in Wellington. At about 0549 NZST Iroquois Black 2 impacted the terrain east of Pukerua Bay, fatally injuring 3 people on board. A fourth crew member survived but was seriously injured. The aircraft was destroyed.

In accordance with the Armed Forces Discipline Act 1971 (AFDA), on 26 April 2010, the Air Component Commander (ACC) convened a Court of Inquiry.

The Court of Inquiry December 2011 Report made extensive recommendations regarding:

- Operating policy and procedures.
- Training.
- Capability i.e. capital expenditure / equipment.
- Culture.
- Areas for further investigation.

The Minister of Defence sought assurance through the State Services Commissioner that the New Zealand Defence Force (NZDF) has a robust plan to implement the recommendations of the Court of Inquiry, and good project management and reporting processes in order to deliver on the plan.

Terms of reference

The terms of reference for this review are set out in Appendix A.

I have been asked “to provide advice to the Minister of Defence through the State Services Commissioner about:

- The NZDF plan to implement the various recommendations.
- NZDF’s progress to date against these recommendations.
- The appropriate reporting framework and timing of reports of progress against the recommendations.”

In providing advice I have been directed to consider the following questions:

- What programme management arrangements are in place and do they best support the implementation of the recommendations?
- What progress has been made to implement the various recommendations?
- What recommendations can be implemented easily and quickly and which will be more difficult or take longer to fully implement and why? What are the realistic timeframes for implementation?
- What specific initiatives have been taken to address the recommendations around organisational culture and how will the effectiveness of implementation be measured over time?
- What are the appropriate progress reporting arrangements?

In the next section, we discuss the approach taken to complete the review.

2. Approach

Introduction In this section we outline the approach used to undertake the review.

Approach The approach taken was based on:

1. Information gathering and interviews (23 October -16 November 2012):

- Interviews with senior personnel (refer Appendix C) including:
 - Chief of Air Force, Deputy Chief of Air Force, Officer Commanding 485 Wing and Officer Commanding 488 Wing.
 - Personnel from No 3 Squadron.
 - Directorate of Air Force Safety and Health (DASH).
 - Operational Airworthiness Regulator.
- Interviews with Air New Zealand’s Airline Operations & Safety unit.
- Observing an Iroquois night flying training exercise that required the use of Night Vision Goggles (NVG).
- Examining various documentation and reports (refer Appendix E) including:
 - The redacted Report of the Court of Inquiry investigating the accident involving Iroquois NZ3806 near Pukerua Bay on 25 April 2010.
 - Status reports on the implementation of the Court of Inquiry recommendation (prepared by the Directorate of Air Force Safety and Health).
 - Internal RNZAF documents, correspondence and reports.

2. Analysis and Interpretation (16 November- 23 November 2012):

- Undertake an analysis and interpretation of the information gathering.
- Follow up discussions to confirm accuracy of initial findings.
- Considered best practice and practicality of action taken.

3. Report preparation and review

- Preparation of an interim report. (24 November -4 December 2012):
- Verify the factual accuracy of the events and actions outlined in the report.
- Provide a response to observations made in the report.
- Peer review.

4. Final Report (5 December – 7 December 2012):

In the next section we provide an outline of the Court of Inquiry key findings.

3. Court of Inquiry Findings and Recommendations

Introduction In this section a summary of the approach taken by the Court of Inquiry as well as its findings and recommendations is outlined. The purpose of the summary is to provide the basis for making an assessment on:

- The NZDF plan to implement the various recommendations.
- NZDF’s progress to date against these recommendations.
- The appropriate reporting framework and timing of reports of progress against the recommendations.

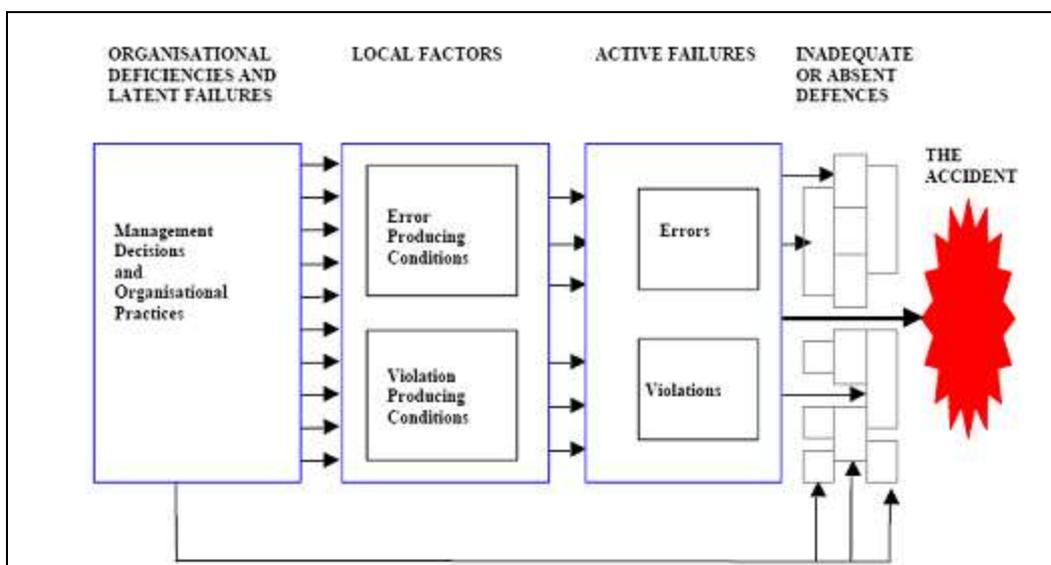
The analysis used by the Court of Inquiry The analysis used by the Court of Inquiry into the circumstances relating to the accident was framed on the Reason model of accident causation, which analyses human, environmental and organisational causes of accident. The Court of Inquiry identified flaws corresponding to all levels of the model.

As a system-based approach the Reason model recognises that a safety system needs to be more than just establishing rules that are to be followed and recognises the need to also understand the positive and negative influences that the surrounding environment (including human interactions) has on safety performance.

Figure 1

The Reason Model of Accident Causation

The Reason model is a system based approach that seeks to identify the sequence of multiple interacting, interrelated or interdependent elements that create a flow of events that result in a major or catastrophic accident.



Source: Annex B to the Report of the Court of Inquiry Iroquois NZ3806

Court of Inquiry recommendations The Court of Inquiry undertook a comprehensive assessment of the causes of the accident and the report needs to be read in its entirety before an informed judgment can be made on the causes of the accident. The system-based approach undertaken resulted in the Court of Inquiry making 169 findings and a total of 78 recommendations that comprised:

- 10 recommendations to address the causes of the accident.
- 10 recommendations to address findings not directly relevant to the causes of the accident.

- 7 non-causal recommendations deemed in need of urgent attention.

The full wording of these 27 recommendations is set out in Appendix B.

In the next section we discuss the assessment the Royal New Zealand Air Force's (RNZAF 's) plan to implement the various recommendations, its progress to date and reporting framework.

4. Action taken pending Court of Inquiry report

Introduction	<p>In this section the action taken prior to the Court of Inquiry completing its report is discussed. The Court of Inquiry was convened by the Air Component Commander (ACC) on 26 April 2010 and it did not submit its final report until 2 December 2011.</p> <p>During the 19 months in which the Court of Inquiry operated:</p> <ul style="list-style-type: none">• The President of the Court of Inquiry maintained regular contact with the ACC to provide advice on major issues that were emerging from the investigation.• Two other Court of Inquiries into the accidents involving Airtrainer NZ1990 and the mid-air collision between Airtrainers NZ1986 and NZ1991 were concluded. <p>As a consequence the Air Force leadership was able to implement a range of measures prior to the completion of the Court of Inquiry.¹</p>
Temporary Orders Issued	<p>A number of temporary orders relating to Iroquois were issued including:</p> <ul style="list-style-type: none">• Temporary Orders by 488 Wing including orders to address flight manual amendments, 3 Squadron standing orders and Iroquois Flying currencies.• A Temporary Order by 485 Wing to clarify the application of Defence Force Flying Orders (DFFOs) related to Helicopter Low Flying.• Temporary Orders by ACC to address flying displays and support to Operation Linda (joint operation with the New Zealand Police involving the use of Iroquois).
Command and Control Review	<p>In July 2010, the influence of the Defence Transformation Programme contributed to a major review of Command and Control (C2) to enable RNZAF to operate in a matrix management environment while ensuring that it:</p> <ul style="list-style-type: none">• Continues to safely and effectively conduct its core business (military air operations).• Has a robust process in place for command and control, and supervision of flying operations.• Effectively coordinates within the NZDF network to support the generation and conduct of air operations.² <p>The purpose of the C2 Project was to ensure that Chief of Air Force (CAF) was adequately supported to meet his responsibilities for commanding, raising, training, and maintaining the RNZAF and that the wider RNZAF is able to effectively implement CAF's command direction.³</p> <p>The C2 project was able to draw on preliminary feedback from the Court of Inquiry that indicated that an earlier organisational change in 2001 known as Project REFOCUS⁴ had a major unintended consequence of creating an unclear allocation of command responsibility. The unclear allocation of responsibility had an adverse impact on the Command effectiveness of No3 Squadron. One of the key outcomes of the C2 Project was the establishment of No 488 Wing to reinstate direct command</p>

¹ Refer to Appendix F for a timeline of action taken.

² CAFGRAM AIR 1000/7 03/10 RNZAF C2 Change.

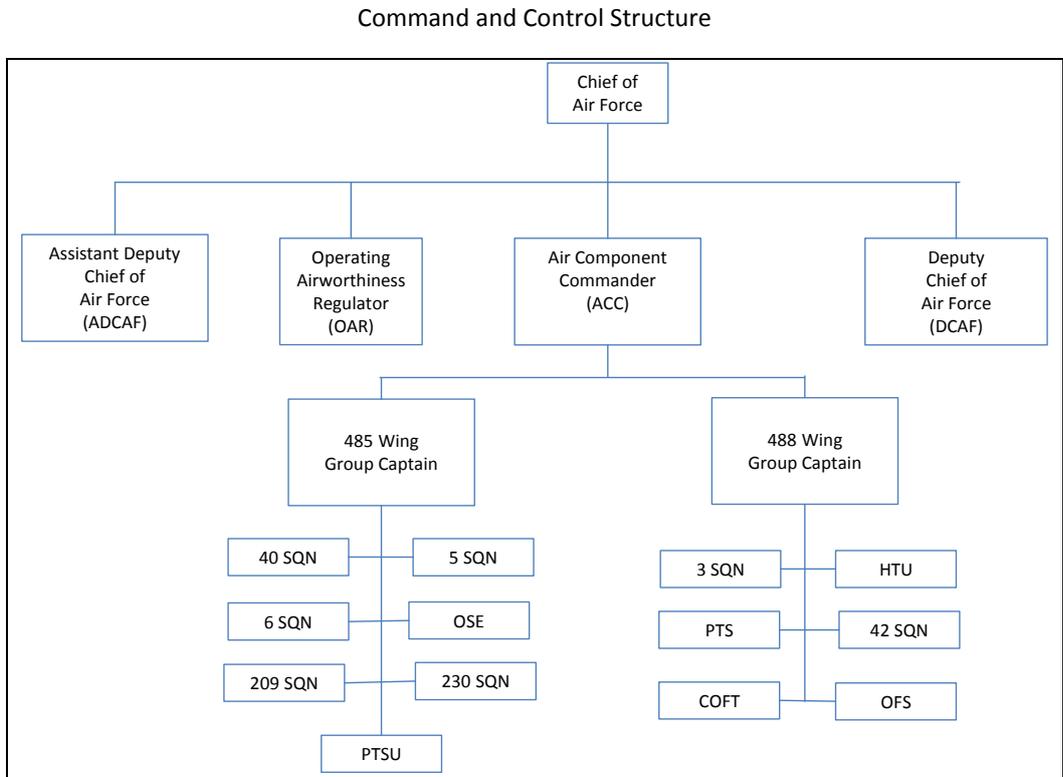
³ Office of the Chief of Air Force Minute 21/2011 AIR 1910/26 11 April 2011

⁴ In 2001 two layers of "middle management" were eliminated with the functional command system replacing geographically co-located Base Commanders

and control of those units located at Ohakea, including No 3 Squadron with appropriate staff support to provide expertise in the supervision of flying activities.

Figure 2

This diagram provides a simplified description of the Command and Control structure following the C2 project. This included the establishment of 488 Wing to provide “direct command and control of those units located at Ohakea as well as the establishment of an independent Operating Airworthiness Regulator (OAR) reporting directly to Chief of Air Force.



Strengthening of Airworthiness standards

In the light of the Haddon Cave report⁵ the CAF requested that the Ministry of Defence Evaluation Unit undertake an independent review of the RNZAF’s airworthiness framework⁶.

The Ministry of Defence report concluded that there was a lack of transparency and independence of the airworthiness framework. In response to the Ministry of Defence’s finding the Operating Airworthiness Regulator (OAR) role was established in December 2010. (The new system was based on the Royal Australian Air Force system). The OAR provides separation and independence of the regulation and review functions of operating airworthiness from the operation (tasking and flying activities) function of the NZDF⁷. The OAR is an Active Reserve position and is able to operate independently to consider the best of civilian and military practice and provide direct advice to the CAF.⁸

⁵ Independent report to the House of Commons by Haddon-Cave QC into the loss of the RAF Nimrod MR2 aircraft XV230 in Afghanistan 28 October 2009.

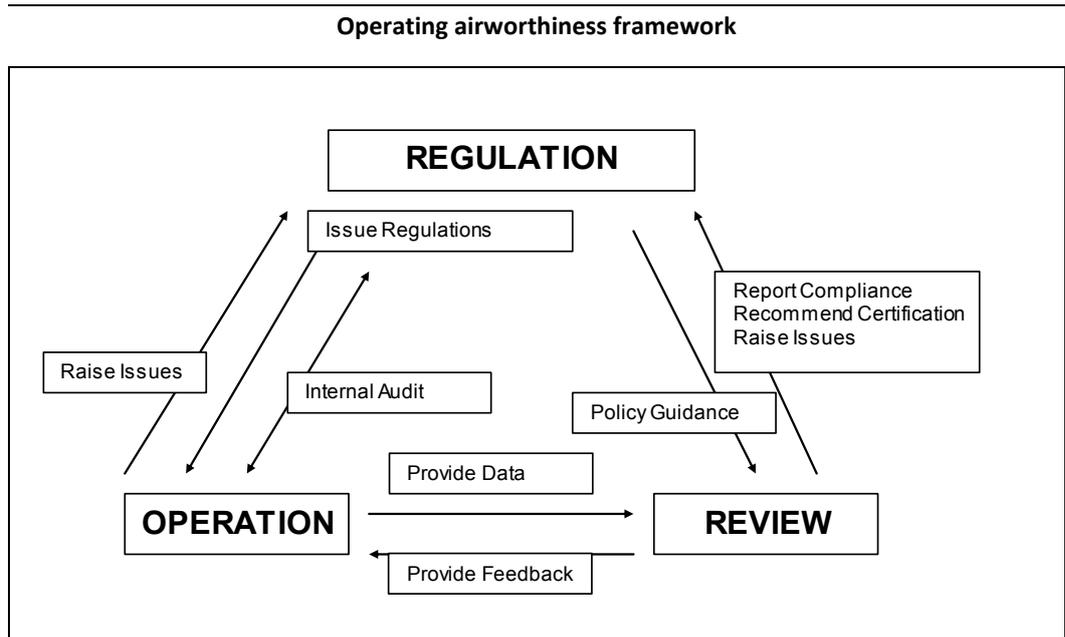
⁶ *The Airworthiness Framework*, Ministry of Defence Report No 12/2010 26 August 2010

⁷ Operating airworthiness is defined as: Aviation systems are operated by proficient crew, in approved roles, according to approved regulations under a system of supervision and monitoring.

⁸ CAFGRAM 06/10AIR.

Figure 3

The RNZAF's airworthiness management is based on a system of regulation, operation and review. The OAR is the regulator and sets the minimum requirements as part of the regulation function, and monitors compliance as part of the review function of the operating airworthiness framework.



Source: Office of Strategic Management Air 1910/26

Creation of Aviation Orders

In December 2010, CAF directed a review of flying Orders Instructions and Procedures (OIP) relating to display flying and training as a result of the deficiencies identified by the Court of Inquiries into the accidents involving Airtrainer NZ1990 and the mid-air collision between Airtrainers NZ1986 and NZ1991.

In early 2011, 488 Wing initiated the OIP project to implement changes to the Defence Force Flying Orders (DFFOs) and issue new Wing Temporary Orders to address urgent deficiencies.

As the OIP review progressed, it became evident that there was a much wider problem with both DFFOs and other OIPs. Additionally, the issue of the Defence Force Standards for Operating Airworthiness (DFO 9) in late 2011 required that the re-write of DFFOs take into account compliance requirements of the new standards for operating airworthiness.

As a consequence, in March 2012, CAF directed that the major revision and rewriting of the DFFOs being undertaken would result in their replacement with Military Aviation Orders (AVOs). The goal was “to re-write DFFOs and subordinate flying OIP into unambiguous, clear and relevant Military Aviation Orders (AVOs) that meet the requirements of DFO9 and address the identified deficiencies in COI reports”⁹.

The OIP project was closed and the new AVOs formally issued on 1 October 2012.

Improvements in operating environment and risk awareness

The consistent message from the interviews as part of this review is the strong belief by senior officers that the operating environment and risk awareness within the RNZAF has markedly improved since April 2010.

In addition to the action outlined above examples of the changes that have resulted in improvement in the operating environment and risk awareness include:

- The new appointments to No 3 Squadron including a new Commanding Officer and Utility Flight Commander (who was a member of the Court of Inquiry). The

⁹ Air Force Order (Temporary) AFO(T) 08/2012 Orders, Instructions and Procedures Project.

Commanding Officer of No 3 Squadron has reported that the changes made to the Squadron are already having an effect: the simulator is being used more than previously, instrument flight currency is being maintained and flight authorisation processes have been tightened.

- The decision to reduce the deployable output from the Rotary Wing Transport Force (RWTF) to mitigate the risk identified by the OAR that without a reprioritisation of activity there was a likelihood of RNZAF personnel being overstretched during the transition to 109 and NH90 helicopters.¹⁰
- The engagement of the OAR by Officer Commanding 488 to independently investigate various operational safety matters.

Conclusion

Pending the conclusion of the Court of Inquiry the CAF initiated a range of actions and projects. These included temporary orders to immediately address identified deficiencies in OIPs, wider structural reform to strengthen command effectiveness and the creation of an independent airworthiness regulator.

In the next section, the progress to date in implementing the Court of Inquiry recommendations is reviewed.

¹⁰ Office of the Chief of Air Force Minute AIR 3176/1 11 April 2011.

5. Implementation of the Court of Inquiry recommendations

Introduction In this section, we discuss the action taken by the Air Component Commander (ACC) as Assembling Authority and subsequently by Chief of Air Force (CAF). We also outline the action taken by the Directorate of Air Force Safety and Health (DASH) who have responsibility for tracking all Court of Inquiry recommendations on completion of a flight safety related Court of Inquiry.

Action by ACC following the Court of Inquiry On 13 April 2011, following interim advice from the Court of Inquiry report the ACC issued a Minute “wholly accepting eight of the 10 recommendations made to address the causes of the accident”¹¹.

Two were partially accepted on the basis of his reservation being around the use of the words “establish and implement” for a flying supervision system (Para 370b)¹² and “appropriate management systems to support RNZAF flying supervision” (Para 370c). ACC stated that the RNZAF already have these systems and they do need to be reviewed and if necessary modified to ensure their effectiveness.

The ACC endorsed alternative recommendations reading:

- (For Para 370b) The RNZAF review and, if necessary, modify current flying supervision systems to ensure that they support flying operations.
- (For Para 370c) The RNZAF review and, if necessary, modify current management systems to ensure that they support NZDF flying supervision.

The ACC also accepted the Court’s endorsement, and non-endorsement, of those other recommendations not related directly to the event. The ACC stated that these recommendations would be forwarded to the appropriate authority for action.

The ACC also noted his intention to release the Emergency Response Report to NZDF emergency response authorities.

Action by CAF following the Court of Inquiry On 2 February 2012 CAF issued Minute 07/2012 endorsing the Assembling Authority’s finding in terms of the recommendations and observations and directed they be taken for appropriate action where this has been initiated.

Of the 20 recommendations contained paragraphs 370 and 371 of the Court of Inquiry report the CAF assessed they belong to ACC for action except for following that belong to the Deputy Chief of Air Force:

- (370 i) The NZDF fit effective ground proximity warning equipment to all aircraft that do not already have such equipment fitted and which operate in close proximity to terrain.
- (371 b) The RNZAF establish and implement an appropriate flying supervision system to ensure RNZAF aircrew are qualified and competent to undertake assigned tasks.

¹¹ Assembling Authority Comments Post Reassembly_Redacted.pdf

¹² The numbering used relates to the paragraph numbers in the Redacted Court of Inquiry Report dated 2 December 2011

- (371c) The RNZAF establish and implement appropriate management systems to support RNZAF flying supervision. FEMS has not proved effective for 3 Squadron in this regard.
- (371 h) Fit crash-worthy Cockpit Voice Recorders and/or Flight Data Recorders to all NZDF aircraft.
- (371 i) That protection of evidence from judicial proceedings is provided for all safety reports and investigations, in order to foster open and honest reporting.
- (371 j) The RNZAF investigate possible parallels between this accident and the reports of other Courts of Inquiry, flight safety issues and broader organisational issues that could be relevant to preventing future accidents.

CAF noted that in the case of capability requirements (e.g. Cockpit Voice Recorders) that these need to be “staffed through normal RNZAF/NZDF channels as appropriate”. CAF directed that action items deadlines for completion are to be established where practicable and all relevant items were to be included in the new Court of Inquiry management process that was being developed with DASH to play a lead role in monitoring and reporting progress¹³.

Progress to date

DASH has tracked on a monthly basis the implementation of the Court of Inquiry recommendations. DASH also conducts a formal six monthly update of all recommendations to CAF.

On 2 February 2012 CAF endorsed the Assembling Authorities (ACC) findings in terms of findings and observations and directed all appropriate action be taken¹⁴.

As at 14 May 2012, only 15% of the main recommendations were closed. There were:

- Two of the ten causal recommendations were closed
- One not directly related recommendation was closed
- One non causal recommendation was closed.
- None of the specialist report recommendations were closed.

As at 20 November 2012, 85% of the main recommendations have been closed and it is anticipated that by June 2013 that all recommendations will be implemented and formally closed as projects.

The current status of the main recommendations contained in paragraphs 270-372 of the Court of Inquiry Report is as follows:

- Eight out of the ten causal recommendations have been closed (370a, 370b, 370e, 370f, 370g, 370h, 370i, 370j)
- Eight out of the ten not directly related recommendations have been closed (371b, 371c, 371d, 371e, 371f, 371g, 371h, 371i)
- All seven non causal recommendations have been closed.

¹³ CAF Minute 07/2012 AIR 1010/2/Report/NZ3806 2 February 2012

¹⁴ CAF Minute 07/2012 AIR 1010/2/Report/NZ3806 2 February 2012

Specialist reports

To assist the Court of Inquiry process specialist reports were commissioned from RNZAF Aircraft Accident, Psychology (Human Factors report), Aviation Medicine and Incident Response experts. These reports contained various recommendations and the Court of Inquiry endorsed 51 recommendations to the Assembling Authority for consideration. There were:

- All 23 recommendations of the Engineering Investigators report endorsed.
- 13 of the 14 recommendations of the Human Factors Report endorsed to the Assembling Authority for consideration.
- All 10 recommendations of the Emergency Response Investigator's Report endorsed to the Assembling Authority for consideration. The Court of Inquiry also requested that the Assembling Authority consider forwarding this report to NZDF emergency response authorities for consideration and action.
- All 5 recommendations of the Medical Officer's Report endorsed to the Assembling Authority for consideration.

As at 20 November 2012, 50 of the 51 specialist report recommendations were closed. It is expected that the one outstanding Human Factors recommendation relating to a review of how safety audits are conducted will be closed by January 2013.

Actions still required

The actions required to fully implement the Court of Inquiry recommendations are as follows:

- In relation to the two outstanding causal recommendations:
 - 370c, that *appropriate management systems be established and implemented to support RNZAF flying supervision* is expected to be closed in February 2013 when policy statements are updated by 485 Wing and 488 Wing.
 - 370d, that *an appropriate and effective Operational Risk Management (ORM) system for flying operations be published* is expected to be closed in January 2013 when an updated manual containing the new policy is issued.
- In relation to the two outstanding non causal recommendations:
 - 371a, that *crash response procedures (including post-crash aircrew checklists and family reconciliation) should be updated and aligned* remains open. Initial response procedures and post-crash aircrew checklists have been updated and this section of the recommendation is complete. The revision to family reconciliation procedures is on-going. This recommendation is expected to be completed by March 2013 when a family reconciliation checklist is finalised.
 - 371j, that *possible parallels between this accident and the reports of other Courts of Inquiry be investigated* is expected to be completed in March 2013. The Accident Analysis report identified the immediate issues associated with this accident and it analysed RNZAF accidents to identify common causal factors. These findings were incorporated into subsequent pan-RNZAF actions (such as rewriting DFFOs into AVO's). DASH has been tasked with developing an on-going safety "feedback loop" process to educate personnel within the RNZAF and it is expected this process will be established by June 2013.

- Four of the closed non causal recommendations relate to the fitting of additional equipment. An assessment by the Airworthiness Board¹⁵ on the 24 October 2012. It concluded that it is not feasible to fit all RNZAF aircraft with new and additional equipment in a short space of time. It recommended that Capability projects be established to identify which aircraft require and are to be subsequently fitted with the following equipment:
 - Effective Ground Proximity Warning Equipment (370i).
 - Crash worthy, automatically activated 406.025Mhz emergency location transmitters with integral GPS 406.025 beacons (371b).
 - Personal Locator Beacons 406.025MHz with integral GPS (371c).
 - Crashworthy Cockpit Voice Recorders/Flight Data Recorders (371h).CAF has endorsed the Airworthiness Board’s recommendation and review projects have been initiated by New Zealand Defence Force Capability Branch.

Conclusion

The majority of major recommendations made by the Court of Inquiry are now completed and progress is being made on completing the outstanding recommendations. It is anticipated that all recommendations will be concluded by June 2013.

In the next section, we outline a number of observations made during the course of the review

¹⁵ Membership of the Airworthiness Board includes Chief of Air Force, the Operating Airworthiness Authority, the Technical Airworthiness Authority and the Operating Airworthiness Regulator.

6. Complexity of Safety Management

Introduction

In this section, we outline our observations on a range of issues that were identified during the course of our review that impact on the ability to operating effective safety management.

These issues will have a material impact on the RNZAF's on-going ability to operate an effective and proactive safety management system. An understanding of these issues is therefore essential to any consideration of the following terms of reference questions:

- What recommendations can be implemented easily and quickly and which will be more difficult or take longer to fully implement and why? What are the realistic timeframes for implementation?
- What specific initiatives have been taken to address the recommendations around organisational culture and how will the effectiveness of implementation be measured over time?

It is impossible to completely eliminate human failure

Operational safety management is inherently complex. Over the last 30 years both academic studies and the investigation of major accidents has reinforced that major or catastrophic accidents arise because there is a sequence of multiple interacting, interrelated or interdependent elements that create a hazardous flow of events. (A fuller discussion of Accident Theory is outlined in Appendix D).

The Court of Inquiry identified the particular chain of events that resulted in the crash of Iroquois NZ3806 rather than a system wide analysis of all RNZAF activities. The successful implementation of the Court of Inquiry recommendations by themselves however, will not be enough to ensure that another major accident will not occur.

The consistent message from both academic studies and the investigation in to major accidents has reinforced the point that human error should not be viewed as occurring within a vacuum but rather within the wider context in which the organisation operates¹⁶. Two types of "human failure" conditions have been identified as needing to combine to create major accidents or catastrophic organisational failures. They are:

- Latent conditions that describe a cumulative build-up of background circumstances and/or an undetected degradation of standards that eventually lead to an unsafe act e.g. DFFOs becoming out of date, pilots not being current.
- Active failures that are unsafe acts committed by people who are in direct contact with the system and consist of slips, lapses, mistakes, procedural violations, e.g. the decision to fly below the "NVG cloud base minima of 600ft".

Latent conditions can lie dormant in the system for many years before they combine with active failures to create an accident opportunity.

¹⁶ There are a number of leading academics who have developed the field of Accident Theory including James Reason (whose model was used by the Court of Inquiry) as well as Diane Vaughan, Scott Sagan and Charles Perrow).

Operational safety is complex

The Haddon Cave report identified twelve “uncanny, and worrying”, parallels between the organisational causes of the loss of Nimrod XV230 and the organisational causes of the loss of the NASA Space Shuttle ‘Columbia’. Upon review of the Haddon Cave report the OAR in turn noted parallels with the current state of RNZAF airworthiness.

These 12 parallels identified within the Haddon Cave report are known within the RNZAF as the “dirty dozen”:

- “Can do” attitude and “perfect place” culture.
- Torrent of change and organisational turmoil.
- Imposition of business principles.
- Cuts in resources and manpower.
- Dangers of outsourcings to contractors.
- Dilution of risk management processes.
- Dysfunctional databases.
- PowerPoint engineering.
- Uncertainties as to out of service date.
- Normalisation of deviance.
- Success engendered optimism.
- The tired and few.

The parallels identified by Haddon Cave and then in turn by the OAR indicate that ongoing operational safety and airworthiness is a complex issue and goes beyond the strengthening of the Airworthiness framework, the updating of Aviation Orders etc.¹⁷. This is discussed in more detail in Appendix D.

Organisational Theory provides a framework...

It is impossible for the RNZAF to eliminate human error from its operations so it needs to ensure that it has effective, dynamic and integrated mechanisms to mitigate its occurrence.

The analytical framework of Organisational Theory developed by James Reason is informative. As outlined in the Haddon Cave report¹⁸:

“...The ‘organisational theory’ analytical framework... works in two ways. First, it works in the traditional way of allowing causal failures to be identified by accident investigators and tracked back to their organisational roots in order to prevent recurrence. Second, since the same precise mixture of causes is unlikely to recur the ‘causal pathways’ model enables ‘pathogen’ auditing of both ‘active’ and ‘latent’ failures within an organisation since this is considered to be the most effective way of managing safety... therefore, by specifying the organisational and situational factors involved in the causal pathways, it is possible to identify potentially dangerous latent failures before they combine to cause an accident. These conceptual tools can be applied to any event, no matter how trivial...”

¹⁷ Pages 449 - 452

¹⁸ Pages 468- 470

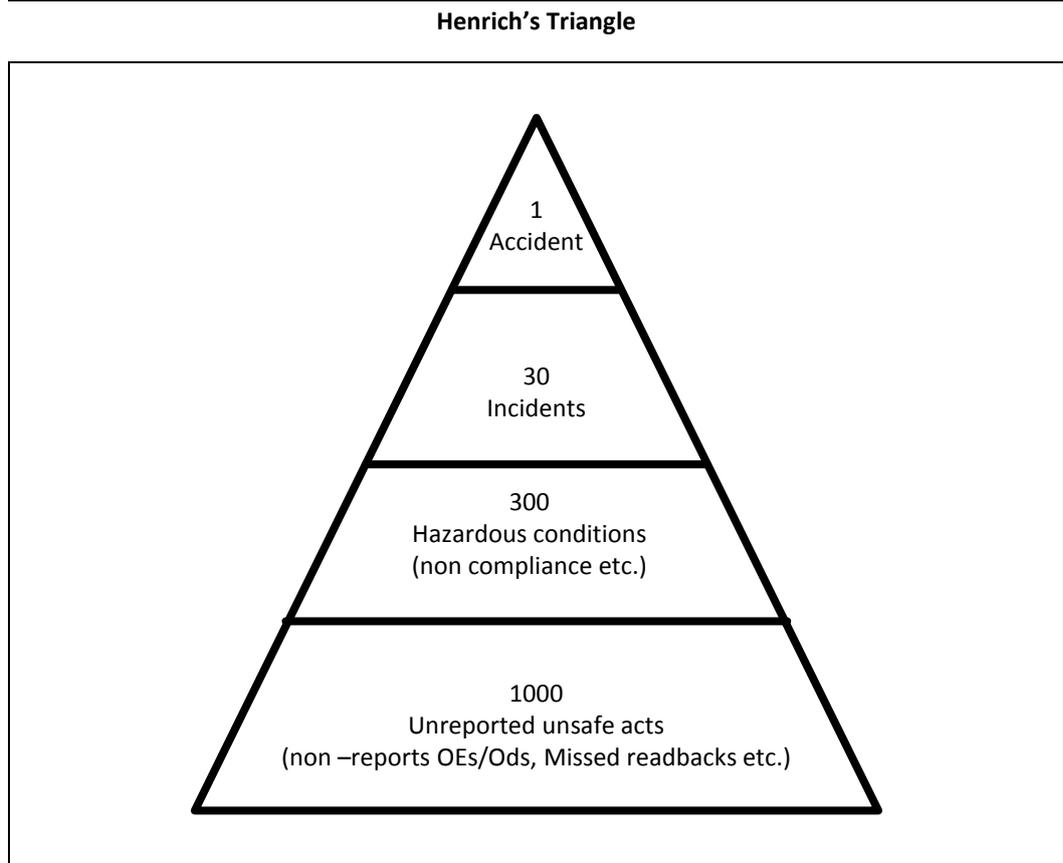
... that indicates the need to further strengthen the monitoring regime

It is one thing to recognise the existence of active failure and latent conditions within an organisation it is another matter to develop and implement an effective means of mitigating them. Active errors by operators are often felt more immediately while the impact of latent conditions may lie dormant within the system for a long time. In discussing options for proactive management of safety risks the Haddon Cave report noted the following:

“As Professor John McDermid has pointed out,¹⁹ there are many ‘low-level’ errors which are precursors of, and hence warnings of, impending accidents. He emphasises, “Good safety management identifies these low-level issues and feeds them back to reduce risk”. Analysis of 1920s industrial accidents led to the development of “Heinrich’s Triangle” showing the relationship between low-level deviations and accidents... Whatever the precise ratio in any given field, the key point is to capture and understand these low level errors and deviations before they conspire to cause an incident or accident. This is why systems that focus’ on ‘below the water line’ near-misses and trends which help provide forewarning before an incident or accident occurs. This changes fundamentally the approach of hazard management from reactive to pro-active.”²⁰

Figure 4

This example was used in the Haddon Cave report. It illustrates data reported from air traffic management about the number of low level Operational Errors (OE) and Operational Deviations (OD). The purpose of the triangle is to highlight that monitoring low level errors and deviations provide a mechanism to predict the likelihood of a more serious accident and engage management to take proactive steps to avoid or eliminate the risk.



Source: Haddon Cave report page 470.

¹⁹ JA McDermid, PHD, FREng, University of York, Through Life Safety Management: Some Concepts and Issues, 2007

²⁰ Haddon Cave report page 469 -470.

Pike River has set a new benchmark that will be challenging to meet

The recently released report issued by the Royal Commission on the Pike River Coal Mine Tragedy is relevant to this review. The report (like many other investigations into major accidents or disasters) highlighted a significant number of failures across many different areas.

The Commission has clarified the standard of accountability for safety management by determining that the Pike River Board of Directors shoulders some of the responsibility for what happened.

For the purposes of this review we consider that the responsibilities of the Air Force Leadership Board (AFLB) are similar to those of a commercial Board of Directors, although it is noted that many aspects of the AFLB are closer to that of an operational management group. Furthermore, it is notable that the NZDF is its own airworthiness authority, performing a role analogous to the Civil Aviation Authority (CAA) that adds a degree of complexity to the governance structure.

The Commission concluded that the Pike River Board's focus on meeting production targets set the tone for executive managers and their subordinates and that the Board did not satisfy themselves that executive managers were ensuring that the workers were being protected. The report states:

"The board needed to satisfy itself that executive managers were ensuring that its workers were being protected...The board needed to have a company-wide risk framework and keep its eye firmly on health and safety risks. It should have ensured that good risk assessment processes were operating throughout the company. An alert board would have ensured that these things had been done and done properly...It would have held management strictly and continuously to account...Because it did not follow good management principles and industry best practice, Pike's workers were exposed to health and safety risks."²¹

An Air New Zealand model offers a possible way forward

To have an effective on-going organisation risk management regime the CAF needs to establish a mechanism that goes beyond "that things were under control, unless told otherwise " and forms the basis on which Air force Leadership Board can "satisfy itself that [senior officers] were ensuring that its [personnel] were being protected."

Such a mechanism would complement rather than replace the activity of the Airworthiness Board, command and flight supervision and the risk management processes.

The purpose of such a predictive mechanism is to ensure there is an objective and internal consistent means of identifying predictive trends and to stimulate discussion.

In the late 1990s Air New Zealand developed an operational integrity or safety index that uses a mix of leading and lagging indicators to develop an overall assessment of safety and provide a means for the board of directors to assess trends.

²¹ Royal Commission on the Pike River Coal Mine Tragedy Report, Vol 1 page 56, 30 October 2012.

Figure 5

The diagram outlines the leading and lagging indicators use by air New Zealand to provide an overall assessment of safety and a provide a means for the Board of Directors to assess trends.



Source: Air New Zealand.

While the Air New Zealand Safety index provides a useful model it is not a simple or straight forward matter for the RNZAF to develop its own index. It needs to be recognised that there are some fundamental difference in how Air New Zealand and the RNZAF operate. Namely:

- Air New Zealand has pre-defined routes that are flown on a regular basis whereas the RNZAF has much fewer flights across a wide range of ad hoc routes.
- As its own airworthiness authority (regulator), the RNZAF must manage a degree of separation between the 'operator' and 'regulator' functions of the Air Force. Whereas for Air New Zealand, the separation from Civil Aviation Authority is clearly defined²².

There would be value in the RNZAF considering Operational Safety indices and governance methodologies utilised by similar militaries such as the Australian and UK forces, alongside commercial models such as that used by Air New Zealand.

In order to make progress it is more likely that the RNZAF would need to use a combination of whatever relevant reporting that is currently available with qualitative assessments by senior officers. On this basis it would be expected that any index developed by the RNZAF would need to progressively evolve through modifications that are based on actual experience and as new information or indicators become available.

²² Given the nature of military air operations, it is considered impracticable to have an independent regulatory authority as per the civilian model. The new internal separation of the conduct of air operations and the regulatory environment is considered by the RNZAF to be appropriate to meet the special nature of military operations

Maintaining effective Command and Control is essential...

One of the major the outcomes of the Command and Control (C2) Project was to strengthen the operational safety environment through the formation of 488 Wing (refer page 9). The establishment of No 488 Wing reinstated direct geographically co-located command and control of those units located at Ohakea (complementing command and control at Whenuapai by 485 Wing).

Geographically co-located Command and Control has the potential to provide a major “defence” in terms of operational safety. However, two key issues that will require vigilant on-going judgments to be made by the CAF to ensure this “defence” remains effective are:

- *Matrix management.* Currently the New Zealand Defence Force operates under a matrix management structure that creates a point of “constructive tension” between the roles of Air Component Commander and the Officers Commanding 488 Wing and 485 Wing. There is a continual series of short term trade-offs (without compromising safety or currency) that need to be made (e.g., between say directing resources towards completing an immediate operational task versus directing personnel to undertake on-going training). It is important that the CAF is able to maintain visibility of the short term trade-offs being made by senior officers so he can assure himself that an appropriate balance is being reached.
- *Staffing of 488 Wing.* A major benefit of the establishment of 488 Wing to provide geographically co-located command was to provide a major “defence” in terms of operational safety. Currently a number of positions in 488 Wing (as well as 485 Wing) are not filled. Many of the personnel that would ordinarily staff these positions have been reassigned to work on other NZDF projects.

... as will strengthening the operational safety governance role of the Air Force Leadership Board

A recent study in the academic study presented in the June 2012 edition of the Harvard Business Review (HBR) magazine presented a new framework for managing organisation risk that has some relevance to the RNZAF²³ (This is discussed in more detail in Appendix D).

The key message from the study is that a rules-based risk-management system (e.g. the Airworthiness regime, Operating Instructions and Procedures etc.):

- Works well to align values and control employee behaviour; but
- is unsuitable for managing risks inherent in the RNZAF’s “strategic choices” (i.e. conducting the delivery of military air operations) or the risks posed by major disruptions or changes in the external environment (e.g. New Zealand Defence Force Transformation Programme).

Those types of risks require systems aimed at generating discussion and debate among senior officers.

This HBR analysis supports the view that in addition to the work undertaken by the Airworthiness Board (including Regulation, Review, Certification and Assurance) there is a need for the Air Force Leadership Board (AFLB) to strengthen its governance role by explicitly:

- Reviewing the results of an appropriate safety/operational integrity index.
- Conducting regular discussions about the impact of its “strategic choices” such as resource allocation and external disruptions may be having on operational safety.

²³ A New Framework For Managing Organisation Risk Robert Kaplan and Anette Mikes, Harvard Business Review June 2012

Strengthening the governance role of the AFLB so its members are able to make informed independent judgments about the impact of strategic and resourcing issues on operational safety and integrity would greatly assist the CAF meet his on-going obligation to satisfy himself “that [senior officers] were ensuring that [personnel are] being protected.”

Conclusion

It is impossible for the RNZAF to eliminate human error from its operations so it needs to ensure that it has an effective, dynamic and integrated system of operational safety management to mitigate its occurrence.

Operational safety management however, is inherently complex and it requires a combination of a rules-based, risk-management system as well as proactive leadership. In order to meet its obligation to ensure personnel are being protected the governance role of the Air Force Leadership Board needs to be further strengthened:

- By developing a mechanism that allows it to proactively and objectively measure trends in operational safety and integrity.
- Conducting regular on-going discussion about the impact their “strategic choices” such as resource allocation may be having on operational safety.

Strengthening the governance role of the Air Force Leadership Board in these areas is critical to enabling the Chief of Air Force to demonstrate that he is meeting his on-going obligation to ensure the protection of personnel.

Appendix A Terms of Reference

Terms of Reference for a Review of the Implementation of the Court of Inquiry's Recommendations following the 2010 ANZAC Day Iroquois crash.

Objective of the review

The objective of this review is to provide independent quality assurance of the implementation plan and actions taken by NZDF in response to the recommendations in relations to the crash of the Air Force Iroquois helicopter on ANZAC Day 2010.

Background

On the morning of 25 April 2010 a formation of three Iroquois helicopters departed RNZAF Base Ohakea to conduct a series of ANZAC Day flyovers in Wellington. At about 0549 NZST Iroquois Black 2 impacted the terrain east of Pukerua Bay, fatally injuring 3 people on board. A fourth crew member survived but was seriously injured. The aircraft was destroyed.

The NZDF Court of Inquiry reported in December 2011 and made extensive recommendations regarding:

- Operating policy and procedures
- Training
- Capability i.e. capex / equipment
- Culture
- Areas for further investigation

The Minister of Defence is seeking assurance through the State Services Commissioner that NZDF has a robust plan to implement the recommendations of the Court of Inquiry, and good project management and reporting processes in order to deliver on the plan.

Scope of review

The scope of this review is to provide advice to the Minister through the State Services Commissioner about:

- The NZDF plan to implement the various recommendations.
- NZDF's progress to date against these recommendations.
- The appropriate reporting framework and timing of reports of progress against the recommendations.

In providing advice the following questions should be considered:

- What programme management arrangements are in place and do they best support the implementation of the recommendations?
- What progress has been made to implement the various recommendations?
- What recommendations can be implemented easily and quickly and which will be more difficult or take longer to fully implement and why? What are the realistic timeframes for implementation?
- What specific initiatives have been taken to address the recommendations around organisational culture and how will the effectiveness of implementation be measured over time?
- What are the appropriate progress reporting arrangements?

Issues not covered by the scope of this review

It is not intended that this review considers the roles and responsibilities of the Civil Aviation Authority (CAA) and the Ministry of Business, Innovation, and Employment (MBIE) or other agencies in relation to accidents involving military aircraft.

Timeframe

The review is expected to take approximately 120 hours over a 6 week period with a draft of the report required to be available in the fourth week from the commencement date of the review.

Appendix B Court of Inquiry Recommendations

Introduction	This appendix contains the recommendations set out in paragraphs 370, 371 and 372 of the Court of Inquiry report respectively.
Causes of the accident	<p>The Court of Inquiry made the following 10 recommendations to address the causes of this accident:</p> <ol style="list-style-type: none">The RNZAF revise and reissue orders and instructions, including DFFO, Base, Wing, and Unit Orders to establish a logical and consistent set of regulations for RNZAF flying operations. In particular, revise and reissue orders and instructions relating to aircrew currency and qualification, low level and NVG operations.The RNZAF establish and implement an appropriate flying supervision system to ensure RNZAF aircrew are qualified and competent to undertake assigned tasks.The RNZAF establish and implement appropriate management systems to support RNZAF flying supervision. FEMS has not proved effective for 3 Squadron in this regard.The RNZAF establish and publish an appropriate and effective Operational Risk Management (ORM) System for flying operations, at both the Operational and Tactical levels.The RNZAF take action to address the negative aspects of the ‘can do’ culture of 3 Squadron.²⁴The RNZAF establish procedures and training to ensure crews are adequately prepared to take effective action after inadvertently entering IMC, either as single aircraft or in formation.No. 3 Squadron revise and implement Iroquois crew duties for IF in order to better share the workload of IF amongst the crew.No. 3 Squadron develop and publish effective procedures to make best use of the functions and warnings available using currently fitted RADALT equipment.The NZDF fit effective ground proximity warning equipment to all aircraft that do not already have such equipment fitted and which operate in close proximity to terrain.RNZAF CRM training should be reviewed and updated to current industry best practice.
Not directly related causes	<p>The following 10 recommendations were made to address findings, not directly relevant to the causes of the accident:</p> <ol style="list-style-type: none">NZDF crash response procedures, including HQ JFNZ Watch Keeper SOP, casualty status reports, post-crash aircrew checklists and family reconciliation should be updated and aligned.

²⁴ This factor was determined to be of sufficient importance that it was notified to the Assembling Authority for urgent attention corrective action in the letter dated 26 May 10 HQ485WG 3176/7/3164.

- b) Fit all NZDF aircraft with a crash-worthy, automatically activated, 406.025 MHz emergency location transmitter with integral GPS.
- c) The current 406.025 MHz Personal Locator Beacon be upgraded to include an integral GPS.
- d) An investigation be undertaken to determine the reason for low transmitter power on 406.025 MHz for Personal Locator Beacon serial number 242.
- e) Ensure that the best method of Personal Locator Beacon activation and operating procedures are identified and incorporated.
- f) Ensure that the Ohakea based Iroquois simulator is better utilised for CRM and basic IF training.
- g) Develop a safer method of securing miscellaneous cabin items in the RNZAF Iroquois.
- h) Fit crash-worthy Cockpit Voice Recorders and/or Flight Data Recorders to all NZDF aircraft.
- i) That protection of evidence from judicial proceedings is provided for all safety reports and investigations, in order to foster open and honest reporting.
- j) The RNZAF investigate possible parallels between this accident and the reports of other Courts of Inquiry, flight safety issues and broader organisational issues that could be relevant to preventing future accidents.

Non-causal recommendations

The following non-causal recommendations were passed to the RNZAF prior to the conclusion of the Court of Inquiry because they were deemed in need of urgent attention:

- a) The siphon breaker vent valve lock wiring should be checked on the whole Iroquois fleet.
- b) The Iroquois Pilot seating weight limits should be investigated, noting that both pilots had stowed equipment on their respective seats.
- c) SAP missing parts alerts be reviewed.
- d) Iroquois tail rotor blade grip bolt torque loading and length be checked across the fleet.
- e) Engine monitoring policy anomalies should be standardised.
- f) Initiate modification action to the ALP to ensure the spiral steel release cable will operate under, or after, high loads.
- g) All seat belts and restraints in service in RNZAF aircraft are inspected to ensure they are serviceable and in an appropriate condition, and are replaced if necessary.

Key causes of the accident

Following receipt of the Court of Inquiry report the Air Component Commander (ACC) as the Assembling Authority concluded that the accident was caused by:

- a) The failure to comply with NZDF orders, instructions, and flying supervision procedures, and the deficiencies of those orders, instructions, and flying procedures, led to failure to ensure the crews of IROQUOIS BLACK were fully qualified, competent and current to undertake the task;
- b) Operational Risk Management (ORM) processes were not effective in identifying and mitigating the risks associated with the task;

- c) The operating culture on No 3 Squadron was such that the crews considered they were permitted to continue the task below ordered minima provided they themselves were 'comfortable' to do so;
 - d) Flying management, supervision and practices did not adequately prepare the crews for an inadvertent IMC situation;
 - e) The crew of IROQUOIS BLACK 2 (the accident aircraft) losing situational awareness after entering IMC from which they did not recover in time to take effective escape action; and
 - f) RADALT procedures and training did not optimise the equipment to give effective awareness of proximity to terrain²⁵.
-

²⁵ Assembling Authority Comments Post Reassembly Redacted

Appendix C Who was interviewed

As part of the review interviews we conducted with the following:

- Air Vice Marshal Peter Stockwell
 - Air Commodore Kevin Short
 - Air Commodore Steve Moore
 - Brigadier Kevin Riordan
 - Group Captain Andy Woods
 - Group Captain Darryn Webb
 - Group Captain Kevin McEvoy
 - Wing Commander John McWilliam
 - Wing Commander Shaun Clark
 - No 3 Squadron personnel
 - Richard Westlake (independent member of the Air Force Leadership Board)
 - William Peet Chief Operating Officer New Zealand Defence Force
 - Logan Cudby (former Wing Commander and President of the Court of Inquiry investigating the accident involving Iroquois NZ3806 near Pukerua Bay on 25 April 2010)
 - Squadron Leader Lisa D'Oliveiria
 - Squadron Leader Russell Kennedy
 - Errol Burtenshaw Manager Operational Safety and Integrity Air New Zealand
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Appendix D Safety Management Frameworks

Introduction

In this section, we discussed two safety management theories High Reliability Theory and Accident Theory. We also discuss a new organisational risk framework that has recently emerged.

High Reliability theorists believe that properly designed and well-managed organisations can safely operate the most hazardous technologies²⁶. Normal Accident theorists, however, consider much of the above to be an illusion. They regard serious accidents in organisations managing hazardous technologies as inevitable over time²⁷. There is value to be gained from each of these safety management theories and the various organisational risk frameworks however, there are differences in the underlying assumptions and areas of focus with each of them.

The purpose of the discussion in this section is to gain some appreciation of the challenge facing the RNZAF leadership, as it attempts to keep pace with the development of thinking as it emerges as well as understanding the subtle differences in order to maintain a framework that is appropriate for the RNZAF.

Accident Theory

Over the last 30 years both academic studies and the investigation into major accidents has reinforced the point that human error should not be viewed as occurring within a vacuum but rather within the wider context in which the organisation operates²⁸. Two types of conditions have been identified as needing to combine to create major accidents and catastrophic organisational failures. They are:

- *Latent conditions* that describe a cumulative build-up of background circumstances and/or an undetected degradation of standards that eventually lead to an unsafe act e.g. DFFOs becoming out-of-date, pilots not being current.
- *Active failures* that are unsafe acts committed by people who are in direct contact with the system and consist of slips, lapses, mistakes, procedural violations e.g. the decision to fly below the NVG cloud base minima of 600ft.

Latent conditions can lie dormant in the system for many years before they combine with active failures to create an accident opportunity.

Study of major accidents

The academic study of the organisational causes of accidents (including Accident Theory) has and will continue to be informed by major accidents or catastrophic organisational failures including:

- The United Kingdom:
 - Kings Cross Underground Fire (1987) 31 people killed
 - Capsize of the Herald of Free Enterprise Ferry (1987) 189 people killed
 - Clapham Junction rail crash (1988) 35 people killed and 500 injured
 - Piper Alpha Oil Rig Explosion (1988) 167 people killed

²⁶ Scott D Sagan, The Limits of Safety, 1993

²⁷ Ibid, page 28

²⁸ There are a number of leading academics who have developed the field of Accident Theory including James Reason (whose model was used by the Court of Inquiry) as well as Diane Vaughan, Scott Sagan and Charles Perrow.

–	Crash of RAF Nimrod XV230 in Afghanistan (2006)	14 people killed
•	Canada	
–	Crash of Air Ontario Flight 1363 (1989)	25 people killed
•	USA	
–	Crash of NASA Space Shuttle “Challenger” (1986)	7 people killed
–	Crash of NASA Space Shuttle “Columbia” (2003)	7 people killed
–	BP Texas City oil refinery explosion (2005)	25 people killed and 167 injured
•	New Zealand	
–	Crash Air New Zealand Flight 901 on Mt Erebus (1989)	257 people killed
–	Pike River mine explosion (2010)	29 people killed
–	Crash of Iroquois NZ3806 (2010)	3 people killed

High reliability organisations

In addition to Accident Theory the academic study by Karl Weick and Kathleen Sutcliffe into high reliability organisations (HRO)²⁹ is also relevant to the RNZAF as it seeks to continue to strengthen its organisational risk management.

HROs either operate in high risk environments and/or are required to accept higher risks in order to achieve their organisational objectives (e.g. naval aircraft carriers, fire fighting units, and emergency medical units). A consistent theme arising from the interview with senior officers as part of this review was the need to recognise by its very nature military aviation carries with it a much higher level of operating risk.

HROs are successful in avoiding catastrophes through the use of complex processes to manage complex technologies and complex work. These complex processes include actions to limit the incidence of dangerous errors as well as creating systems that are better able to tolerate the occurrence of errors and contain their damaging effects.

HROs, according to Weick and Sutcliffe, effectively manage small crises on a regular basis because they are guided by five enduring principles. They are:

1. *Preoccupation with failure.* Leaders ensure personnel are very clear about what types of failures the organisation regards as detrimental in terms of safety or the organisation’s performance. It could include expecting, supporting, and rewarding employee behaviour such as reporting errors and mistakes, as these “weak signals,” or subtle cues, could be signs of impending disaster.
2. *Reluctance to simplify.* A strong value of the organisation’s culture involves leaders pushing for more information about causes of small failures, as these small failures could signal bigger organisational problems.
3. *Sensitivity to operations.* Leaders actively listen to workers/operators closest to hazards, as those workers/operators are most likely the first ones to notice if aspects of their work are amiss.
4. *Commitment to resilience.* Leaders build into their organisational culture ways of continuing operations under extreme circumstances.
5. *Deference to expertise.* The organisation’s culture is based on the premise that during crises, leadership is most effective when shared, such that those with the most amount of expert knowledge have the authority and resources to act.

²⁹ Weick, K. E., & Sutcliffe, K. M. (2007). *Managing the Unexpected: Resilient Performance in an Age of Uncertainty*

Weick and Sutcliffe believe that these principles can influence the design of processes and move the system toward a state of 'mindfulness':

"[M]indfulness is different from situational awareness in the sense that it involves the combination of on-going scrutiny of existing expectations, continuous refinement, and differentiation of expectations based on newer experiences, willingness and capability to invent new expectations that make sense of unprecedented events, a more nuanced appreciation of context and ways to deal with it, and identification of new dimensions of context that improve foresight and current functioning."³⁰

Insights from accidents identified by Haddon Cave report

The seminal Haddon Cave inquiry into the crash of the RAF Nimrod XV230 in Afghanistan the report identified seven key insights that can be drawn from the safety management theories and some of the investigations into major accidents and catastrophic organisational failures listed above³¹. The insights identified by Haddon Cave are relevant to the RNZAF's response to the crash of Iroquois NZ3806 and an extract from pages 460 -461 of the report is set out below. The Haddon Cave report noted that the following points are to be considered:

1. *There are limits to safety.* Life is, by its very nature, unsafe. The activities that bind the human condition and go to make up 'living' carry with them residual or irreducible risks. Some activities, however, are more unsafe than others, for instance, defying the laws of gravity by flying in heavier-than-air machines.
2. *Simply knowing how accidents have happened in the past does not, of itself, prevent future ones.* Nevertheless, as James Reason has pointed out, by a careful study of earlier cases and accident theory we can begin to assemble a body of principles which, when applied to the design, maintenance and operation of high-risk technological systems, can reasonably be expected to help reduce either the occurrence of errors or their damaging consequences³².
3. *It is important to guard against 'hindsight bias'.* There is a danger in exaggerating what we think people should have been able to anticipate in foresight, or allowing knowledge which we have gained as to the outcome of a particular event to influence perceptions as they would have appeared at the time. Unless the potency of these retroactive distortions are appreciated, we will never truly understand the realities of the past, nor learn the appropriate remedial lessons.³³
4. *To err is human.* Error is a normal characteristic of human behaviour.³⁴ So long as human fallibility remains a fact of life, it will be important to investigate serious accidents in detail in order to seek to learn the relevant preventative lessons.³⁵ Further, whilst it may not possible to change human nature very much, it is possible to change the conditions under which people work and think in order to make errors less likely and more easily recoverable³⁶.

³⁰ Karl Weick and Kathleen Sutcliffe, *Managing the Unexpected*, 2007.

³¹ Independent report to the House of Commons by Haddon-Cave QC into the loss of the RAF Nimrod MR2 aircraft XV230 in Afghanistan 28 October 2009

³² James Reason, *Human Error*, 1990, page 17. (Cambridge publishing).

³³ *Ibid*, pages 214-216

³⁴ Reason, 1990; Senders and Moray, 1991

³⁵ See Daniel E Maurino, James Reason, Neil Johnston and Rob B Lee, *Beyond Aviation Human Factors*, 1995, page 34. (Ashgate publishing).

³⁶ James Reason, *The Human Contribution*, 2008, page 34

5. *Chance or 'bad luck' often plays a significant role in accidents.* In all cases, an adverse event requires some assistance from chance in order to create a path of accident opportunity through the various barriers, safeguards and controls.³⁷ Moreover, "Chance does not make moral judgements. Bad luck can afflict those who deserve better."³⁸ It is said that accidents happen because 'latent' factors, i.e. that collectively produce defensive weaknesses, are created (called "conditions") which then permit the chance conjunctions of local triggers and active failures to breach all the barriers and safeguards (called "causes").³⁹
6. *Lessons are not always learned the first time.* Lessons and worthy sentiments are easy to espouse but not always easy to put into practice. This is particularly true when fundamental organisational and cultural changes are called for. NASA found this to be the case following the Challenger disaster. As Diane Vaughan said when giving evidence to the CAIB: "What we find out from [a] comparison between Columbia and Challenger is that NASA as an organisation did not properly address all of the factors that the Presidential Commission [in ... on the Challenger disaster] identified."
7. *Do not simply blame individuals whilst ignoring more fundamental organisational causes.* Human error does not take place in a vacuum. Investigators of accidents often fall prey to the temptation to focus simply on performance of individuals whilst ignoring the organisational deficiencies which may have caused or contributed to the individuals' ignorance or sub-optimal performance. Such flawed attribution sometimes arises because of the relative ease with which it is possible to point to individual human failures and the relative difficulty in identifying and analysing the more complex 'task', 'situational', 'institutional' and/or 'organisational' factors that shape human performance. Most people involved in serious accidents are neither stupid nor reckless, although they may have been blind to the consequences of their actions.⁴⁰ Key to any accident investigation is understanding why they acted as they did and the organisational factors that shaped their approach and behaviour.

A new categorisation of risk

In addition to the various safety management theories there is also a large body of academic study into organisation risk management. In June 2012 edition of the Harvard Business Review magazine a new framework for managing organisation risk was outlined by Robert Kaplan and Anette Mikes.

The approach taken in the article was to present a new way of categorising risk so executives (or senior officers) could tell which risk they could manage through a rules based approach and which ones required a new approach.

Kaplan and Mikes outlined three categories of risk:

1. **Preventable risks.** These are internal risks arising from within the organisation that are controllable and ought to be eliminated. The risk mitigation objectives with these risks are to avoid or eliminate them from occurring. These risks as managed by standard operating procedures, control (and command) systems and require independent oversight. From the RNZAF's perspective the revision and

³⁷ Ibid, page 73.

³⁸ Daniel E Maurino, James Reason, Neil Johnston and Rob B Lee, Beyond Aviation Human Factors, 1995, page 86.

³⁹ See James Reason, The Human Contribution, 2008, page 138

⁴⁰ See James Reason, Human Error, 1990, page 216

rewriting of Aviation Orders and the appointment of the OAR as an independent regulator has greatly strengthened its ability to manage this type of risk.

2. **Strategic risks.** These are risks that an organisation accepts in order to achieve specific strategic goals (e.g. the RNZAF undertaking high risk military tasks). The risk mitigation objectives for strategic risks are to reduce the likelihood of them happening. Strategic risks are different from preventable risks because they are not inherently undesirable. Strategy risks cannot be managed through a rules-based control model. Instead, you need a risk management system designed to reduce the probability that the assumed risks actually materialize and to improve the company's ability to manage or contain the risk events should they occur. These types of risks require interactive discussions, risk scorecards and risk review meetings. The strengthening of the RNZAF's airworthiness regime has improved its ability to manage this type of risk. The development of regular and relevant information (to assist with the early identification of latent conditions) will be critical to the RNZAF's ability to effectively manage this type of risk.
3. **External risks.** These are risks beyond the control or influence of the organisation such as natural disasters or major macroeconomic shifts. For the RNZAF these include the risks associated with resources being stretched in response to say the Defence Force Transformation Programme or the budget constraints imposed by the Value for Money Continuous Improvement Levy. The risk mitigation objectives with these risks are to reduce the impact should the risk eventuate. The decision to reduce the deployable output from the Rotary Wing Transport Force (RWTF) discussed above is an example of how such risks can be mitigated. This type of risk requires the senior leadership and decision makers to be able to have the time and information to conduct on-going stress testing and scenario planning. Given the existing heavy workload of the senior officers effective and proactive management of these types of risk will require a new approach to workload management by senior officers.

**Haddon Cave
insights within
the new risk
framework**

One of the challenges of the "dirty dozen" list is that it can either be perceived as being overwhelming and beyond the control of senior officers or as being someone else's responsibility. The new framework presented by Kaplan and Mikes may offer a useful insight to the RNZAF as a means to make the issues more manageable and establish clearer accountabilities for managing the risks.

A preliminary attempt to categorise the "dirty dozen" using the Kaplan and Mikes framework is as follows:

- Preventable Risks:
 - "Can do" attitude and "perfect place" culture.
 - Normalisation of deviance.
 - Uncertainties as to out of service date.
 - Dilution of risk management processes.
- Strategic risks:
 - Success engendered optimism.
 - Dangers of outsourcing to contractors.
 - Dysfunctional databases.
 - PowerPoint engineering

- Imposition of business principles.
- External risk:
 - Torrent of change and organisational turmoil.
 - Cuts in resources and manpower.
 - The tired and few.

Using the preliminary categorisation outlined above, preventable risks would be managed through the Airworthiness regime, the strategic risks by the Air Force Leadership Board and the External risk via normal consultation with Ministers and/or the Defence White Paper.

Conclusion

The challenge for the RNZAF leadership is to keep pace with the development of thinking as it emerges as well as understanding the subtle differences in insight the various academic studies offer in order to develop a framework that is appropriate for the RNZAF.

Appendix E Documents examined as part of the review

As wide range of documents were reviewed and examined. They were:

- Court of Inquiry:
 - Redacted Report Of The Court Of Inquiry Investigating The Accident Involving Iroquois Nz3806 Near Pukerua Bay on 25 April 2010.
 - Redacted Human Factors Report into Iroquois NZ3806 Crash Court of Inquiry 20 July 2010.
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 - Examples of Operational risk Management Risk Profile Diagrams.
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Appendix F Timeline of action

Figure 6

This timeline outlines the action taken to implement a range of measures both prior to and after the completion of the Court of Inquiry.



Sources: NZDF

Appendix G Glossary

ACC	Air Component Commander
AFDA	Armed Forces Discipline Act 1971
AFLB	Air Force Leadership Board
AVOs	Aviation Orders
C2	Command and Control
CAF	Chief of Air Force
CVR	Cockpit Voice Recorders
DASH	Directorate of Air Force Safety and Health
DFFOs	Defence Force Flying Orders
EGPW	Enhanced Ground Proximity Warning System
FDR	Flight Data Recorders
FEMS	Force Element Management System
NVG	Night Vision Goggles
NZDF	New Zealand Defence Force.
OAA	Operating Airworthiness Authority
OAR	Operating Airworthiness Regulator
OIP	Orders Instructions and Procedures
ORM	Operational Risk Management
PLB	Personal Locator Beacons
RNZAF	Royal New Zealand Air Force
RWTP	Rotary Wing Transport Force
TACA	Technical Airworthiness Authority