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Aircrew Personality and the Impact of Crew Resource Management Training on Hazardous Attitudes

**A thesis presented in partial fulfilment of the requirements for the
degree of
Master of Arts in Psychology
At Massey University, Albany, New Zealand**

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2005**

Abstract

It has been established that poor non-technical skills, such as crew communication and coordination, in aircrew, are antecedents to accidents and incidents in aviation. Crew Resource Management (CRM) training has developed over the last 20 years in response to the need to educate crews in resource management, decision-making, situational awareness and other human factors related topics. This current study sought to evaluate the CRM training currently administered by the Royal New Zealand Air Force (RNZAF). Evaluation was made on three of Kirkpatrick's levels; reaction, learning and behaviour. Personality as a mediator in the relationship of CRM attitudes to behaviour was also investigated. Finally personality differences in the sample were identified. Results showed that the RNZAF CRM training was perceived by aircrew as useful and 100% of trainees felt this training should be offered to all aircrew. At the learning level of evaluation the results revealed a positive attitude change in one scale of the Cockpit Management Attitudes Questionnaire - 'Recognition of Stressors'. The personality trait Agreeableness was found to mediate the relationship between attitudes and behaviour post CRM training. Agreeableness and Conscientiousness also explained 25% of the variance in scores of CRM behaviours. Finally it was established that pilots display higher levels of Instrumentality and lower levels of Neuroticism than non-pilot aircrew. Officers display higher levels of Extroversion and lower levels of Expressivity than Non Commissioned Officers. The results are discussed in terms of their implication for future RNZAF research and training. Limitations of the current study and areas for future research are presented.

Acknowledgements

Firstly I have to give credit to all the Officers of the Royal New Zealand Air Force who took time out of their very busy schedules to support, encourage and participate in my research. I would like to mention FLTLT Delwyn Neill, FLTLT Lisa D'Oliveira, FLTLT Jen Atkinson and SQNLDR Ian Saville who indulged my need for data collection on their CRM Courses. I would also like to thank SQNLDR Emma Davis and SQNLDR Jason Milne who provided guidance through the RNZAF organisational system, and kept the ball rolling at times when I thought it was deflated.

I would like to thank my supervisor, Richard Fletcher, who calmly put out all my fires and taught me to relax in the midst of thesis dramas.

Finally the friends and family, who sustained me, must be given their due. Kate, it's been a rocky thesis journey, and I'm glad I made it with you, thanks for all the advice! Kris, thanks for providing the home life entertainment and encouraging the practice of my psychological skills! Mandy, the weekly coffee debriefs and keeping me in touch with reality – priceless.

As I read through the acknowledgment sections of other theses, I note one sure consistency. A person that seems to pop up in each person's life and provide the support encouragement and financial aid required to get through to the end. My life was no exception, once again the award for thesis helper extraordinaire goes to: the ever present, ever underrated but greatly appreciated Mum.

So many things went wrong with this thesis, but here it is in completion – it all just seemed to work out – how? By the grace of God.

'So let us come boldly to the throne of our gracious God, there we will receive his mercy, and we will find grace to help us when we need it.' Heb 4 v 16.

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Glossary

Aircrew Roles, Abbreviations and Descriptions:

AEOP	Air Electronics Operator: Operates the radio and radar stations on a P3-K Orion.
ALM	Air Load Master: Responsible for loading and unloading of cargo and passengers from the C-130 Hercules. Also responsible for all international customs and MAF type requirements.
AOM	Air Ordnanceman: Responsible for all weapons, search stores and air droppable packages on the P3-K Orion. Also carries out photography and video during flight.
HCM	Helicopter Crewman: Manages the cargo area of the helicopter, loading cargo, supervising passengers, operating rescue hoist and machine gun. Helicopter crewmen also give the pilots a verbal picture of what is going on in the back and all around the outside of the aircraft.
NAV	Navigator/ Tactical Coordinator: Responsible for mission planning, interpreting tactics and procedures and completing post flight mission reporting. Also involved in route and fuel planning.
AIRENG	Air Engineer: Responsible for the mechanical side of the aircraft while it is airborne. Manages fuel, power settings and any emergency and minor repairs while on deployment.

Aviation Abbreviations and Terms:

CAA	Civil Aviation Authority: Government organisation that regulates the aviation industry and air traffic within New Zealand.
FAA	Federal Aviation Authority: Federal Government authority that regulates aviation in the U.S.A.
LOFT	Line Oriented Flight Training: Training programme set in a high fidelity aircraft simulator that allows an entire aircraft to fly a simulated flight (Helmreich & Foushee, 1993).
Go Around	A go around is the process of converting the approach into a departure i.e. apply full or climb power, clean up the aircraft configuration (gear up, flaps -climb/up) and fly away and either join the visual circuit, or position for another approach.
NCO	Non Commissioned Officer, from rank of corporal to Master Air Crewman.
Squadron	Unit or division of an Air Force.
SOP	Standard Operating Procedures: a mandatory way of accomplishing a task.
Sortie	Operational flight made by a military aircraft.
Situational Awareness	Situational awareness is the accurate perception of the factors and conditions affecting the aircraft and the flight crew (Williams, 1998).

Chapter One: Introduction

1.1 Introduction: The Story of Bud Holland.

Lieutenant Colonel Arthur “Bud” Holland was an instructor pilot at Fairchild Air Force Base, Washington State in the United States of America. While Bud Holland was noted as a pilot with superior stick and rudder skills, who had an accomplished career of 23 years and 5,200 hours of flying with the U.S. Air Force (U.S.A.F), he was most infamous for his final flight on June 24th of 1994. It was on this flight that he caused the death of himself and three other senior U.S.A.F Officers by over-extending the physical capabilities of the B52-H he was flying. As with other aircraft accidents, the real tragedy of this event lay in the fact that it could have been prevented. Bud’s story presents an excellent introduction to the issues addressed in this thesis: hazardous attitudes, personality of aircrew, aviation culture and how this impacts on flight safety behaviours. The cause of the accident was determined to be poor judgement on the part of the flying pilot, Lt Col Holland. On approach to land, after a tactical practice for an air show, the B52 was ordered to ‘go around’ as another aircraft on the runway prevented them from landing. Bud Holland executed a 360° turn at 250 feet altitude and banked the aircraft at a 90° angle, exceeding the recommended limitations of the aircraft. The aircraft stalled and crashed into the ground.

Bud Holland was recognised as a rogue aviator. Prior to the fatal accident Bud had on several occasions pushed the limits of his aircraft. In one incident at an Air Show in 1991 his Commanding Officers and hundreds of spectators witnessed him violate not only the recommended limitations of the aircraft but also Federal Aviation Regulations such as flying over the crowd. Bud had no official reprimands on his record for his unsafe behaviours however junior crewmen began refusing to fly with him (Kern 1995). Through his behaviours it could be inferred that Bud had an attitude of invulnerability, the belief that nothing bad was going to happen to him (Murray 1999). This belief, built-up over time, also manifested itself outside the flying environment as evidenced by his

lack of respect for simple base rules such as failing to observe 'no parking' zones (Kern 1995). Bud, it seemed, could get away with anything.

Lt Col Holland's risk-taking tendencies were the final factor in a chain of events that led to the B52 crash, however a break in the chain at any point may have averted this tragedy. Whilst the 90° bank that caused the aircraft to stall was not in the initial flight plan, the actual brief for that sortie included other manoeuvres such as high pitch climbs and steep bank angles that were violations of set regulations and potential antecedents for an accident. At any point the other three crewmembers, all of substantial rank and experience could have refused the flight plan, or objected in some way. Also the leadership of Fairchild Air Force Base could have acted on the previous incidence of Bud's wilful violations of base regulations and grounded him. Further the squadron's culture could have encouraged the reporting of flight safety threats, such as Buds behaviour, as opposed to silencing the junior crewmen who were known to feign illness just to avoid flying with him (Kern 1995).

The events surrounding this B52 crash highlight several aspects of military flight operations that need attention within any national Air Force: specifically military aviator selection, pilot and officer training and standard operating procedures may not be enough to manage errors within aviation. Crew Resource Management (CRM) training was developed by civil and military aviators to help combat flight safety violations. In particular CRM training is designed to address issues such as rogue personalities, hazardous attitudes, poor crew coordination and leadership issues within crews.

1.2 Royal New Zealand Air Force (RNZAF) and CRM

Over the last 20 years the RNZAF has had six aircrew fatalities and documented 45 aircraft incidents serious enough to be considered crashes. Flight Safety in the RNZAF is of great importance to the organisation and personnel and is reflected in the safety motto 'Mission first, safety always'¹. Despite the high level of professionalism that exists within

¹ Used by 5 Squadron, taken originally from the Royal Australian Air Force.

the service and the world-class pilot training, flight safety incidents do occur and the issues surrounding them remain salient.

Subsequent to completing a CRM courses in August of 2005, a pilot from the helicopter squadron presented a Flight Safety Event Report (FSE) to the RNZAF Flight Safety Office. The pilot reported that in a standard training sortie the crew had experienced a breakdown in CRM due to fatigue. The pilot reported:

‘The sortie was successfully accomplished, but during the debrief the co-pilot admitted that he had completely missed one of the Captain’s approach briefs as he was thinking about ‘things he had to do when he got back’, and only ‘switched on’ during late finals. The Captain also admitted that during one of the co-pilots approaches, he was not entirely sure where they were approaching, as he was also preoccupied with thinking about non-related work activities. At the time he felt too tired to speak up.’ (FSE NZ295/05).

What is unique about this FSE is that within the RNZAF database this kind of report is not generally submitted. The report details the pilots experiencing a loss of situational awareness, a loss of perception of the surrounding environment by the pilots, which was caused by fatigue. Previously a FSE would only be generated if an actual accident, near accident or incident occurred. One of the principles taught on current CRM courses is the reporting of simple breakdowns in CRM to draw attention towards larger organisational issues that may be antecedents to accidents. In the case of this report a wider organisational issue maybe changing the culture to support the withdrawal of pilots from operations when over-fatigued, or encouraging the re-evaluation of shift schedules to minimise pilot fatigue. Another issue central to this RNZAF example of a breakdown in CRM is the common misperception that aircrew should be able to leave their private life behind when flying. The pilot who reported this incident has illustrated this point, and the documentation of this incident will establish a precedent and reaffirm the CRM premise that stressful life events and circumstances in the personal life of aircrew will affect their performance (Prince & Salas, 1993).

This example further highlights the importance of raising aircrew awareness of issues surrounding crew resource management, and the relevance that this American developed flight deck management theory has to the New Zealand military.

1.3 Purpose and Significance of this Research.

Analysis of aviation accidents over the last fifty years has revealed that the major cause of 60-80% of aviation accidents and incidents is human error (Freeman & Simmon, 1991). Substandard crew coordination, communication, judgement and decision-making, as with Bud Holland's case, have all been cited as causal factors in the chain of events leading to accidents and incidents (Billings & Reynard, 1984).

Despite the minimal number of serious aircraft accidents in the RNZAF, flight safety initiatives are undertaken to ensure errors are managed appropriately and do not culminate in an accident. One of these initiatives is CRM training run by the RNZAF Flight Safety Office. This is a two-day course with three CRM trained instructors, the Flight Safety Officer (a navigator who previously flew on the C130 Hercules), a pilot with over 20 years experience in the Royal Air Force and the RNZAF who currently works in the Central Flying School, and a RNZAF Registered Psychologist. The training is an interactive course that consists of lectures, group activities and demonstrations combined with group discussions and experience sharing.

In the past the CRM training within the RNZAF has been informal, with some CRM concepts being integrated into the last component of pilot training. CRM scenarios are also used in simulator training for the different squadrons, which are all carried out overseas in different countries depending on the squadron. Formal CRM training courses were introduced to the RNZAF in only in the last few years. The RNZAF Flight Safety Office is currently being proactive in propagating CRM principles throughout the Air Force by increasing the number of CRM courses running and encouraging crew to stay current.

CRM training has been shown to change the hazardous attitudes of both military and commercial aviators in the United States (Salas et al, 2001), however no such research has investigated the effectiveness of CRM training with RNZAF Aircrew. This research will be significant in evaluating the RNZAF CRM training and potentially proving its benefits via positive changes in aircrew attitudes towards Flight Safety behaviours on the flight deck. Transfer of training to the operational environment will also be investigated to discover if the training affected the in-flight behaviour of aircrew.

While it is possible to influence and change ones attitudes, changing ones personality is a different matter. Personality traits can be defined as “stable, deep-seated predispositions to respond in particular ways” (Chidester et al, 1991, p127). As personality traits are stable they are less susceptible to change and if they result in hazardous behavioural patterns, personnel who display these traits may be resistant to training (Chidester et al, 1991). Research on pilot personality has generally shown the predictive validity of personality tests in pilot selection to be of little value (Hunter & Burke, 1994). However studies in this vein have generally concentrated on pilot training success and not success within the operational environment. The important difference is that in pilot training the pilot is generally focused on learning in a solo environment, or with one other instructor. When the pilot graduates, he or she must now work in conjunction with a crew of people, where personality may play a more important role. Investigations into aviator personalities have revealed distinct personality clusters that influence CRM attitudes and behaviours (Retzlaff & Gibertini, 1987; Chidester et al, 1991; Sandal et al, 1998). This study hopes to identify specific personality traits, as opposed to clusters that may influence how well aircrew learn the concepts taught in the CRM training, and further how well this learning will be transferred to behavioural changes in the operational environment.

1.3 Structure of the Thesis.

This thesis has been organised into six chapters. The first chapter has introduced the subject of CRM, and highlights the significance and importance of research designed to

evaluate the CRM programmes currently being operated by the RNZAF. The second chapter reviews the literature on research related to the evolution and theory behind CRM training, the relation of hazardous attitudes to CRM behaviours, the relevance of aircrew personality and finally a model of training evaluation suitable for evaluating CRM training.

Chapter three outlines the methodology used in this thesis, with an introduction to the RNZAF as a military organisation and related information that will help elucidate the background situations of the participants, such as rank, role and squadron. The measures used are discussed in this chapter along with the experimental design and procedure. In Chapter four the results of the evaluative study are presented and in Chapter 5 these results are discussed and related to prior research. Chapter 5 also presents the concluding arguments and statements for this thesis.

Chapter Two: Literature Review

2.1 Crew Resource Management

2.1.1 Crew Resource Management Defined.

The focus of pilot selection has predominately been on the psychomotor and intellectual capacities of the individuals flying the aircraft, as pilot success was traditionally associated with pure 'stick and rudder' skill (Helmreich & Foushee, 1993). However investigations into the causes of aircraft accidents and incidents revealed that up to 80% of these were caused by poor crew coordination in the cockpit (Freeman & Simmons, 1991), suggesting the skill set needed for successful operations in multi-crew aircraft must be expanded to include interpersonal relations.

In 1979 a report by the U.S. National Transportation Safety Board (NTSB) highlighted a problem in one specific airline accident, when the crew became distracted by a small mechanical malfunction allowing the aircraft to run out of fuel and crash. The Board made the following statement (NTSB 1979b as cited in Foushee 1984):

The Safety Board believes that this accident exemplifies a recurring problem – a breakdown in cockpit management and teamwork during a situation involving malfunctions of aircraft systems in flight. To combat this problem, responsibilities must be divided among members of the flight crew while a malfunction is being resolved. Admittedly, the stature of a captain and his management style may exert subtle pressure on his crew to conform to his way of thinking. It may hinder interaction and adequate monitoring and force another crewmember to yield his right to express an opinion (pp.26-27).

The analysis of this aircraft accident and others led to a closer scrutiny of the training received by pilots to manage relationships with crewmembers during flights (Foushee, 1984). In the early 1980's the concept of cockpit resource management training was introduced and was amended to Crew Resource Management (CRM) in order to encompass those involved in aircraft operations outside the cockpit, such as flight

attendants and loadmasters (Helmreich & Foushee, 1993). Lauber (1984) defined CRM as 'using all available resources – information, equipment and people – to achieve safe and efficient flight operations', thus crew resource management is literally the management of resources within the aircraft through the mediums of teamwork, communication and heightened awareness of the environment.

2.1.2 CRM Theory

An effort to understand outcomes as a function of individuals working together within the context of an aviation environment has led to the development of the Input-Process-Output Model (IPO) (Helmreich & Foushee, 1993) represented in figure 1.

The IPO model proposed by Helmreich and Foushee (1993) provides a theoretical framework for understanding the principles behind CRM training. The model has its roots in social psychology specifically the research surrounding group interactions and group processes (Sherman, 2003). IPO's are defined as the three main elements of group behaviour in the aircrew environment.

Input Factors

In the IPO model input factors represent the characteristics of the individual, team, and organisation. They also represent the wider professional culture of aviation, military and the over-arching national culture. The individual crewmember brings to his or her working environment his or her own knowledge skills and abilities. They bring their attitudes, personality type, fatigue level, capacity and physical fitness. All these factors and more influence their input to the flight.

Personality in particular has received much attention from researchers as an important component of group behaviour in the cockpit. Bowles, Ursin & Picano (2000) investigated the impact of captain personality type on crew performance and stress levels and found that captains' with the 'right stuff' personality type i.e. active, warm, confident, and competitive were associated with high-performing crews with generally lower stress levels in subordinate crewmembers. Personality type has also been found to

influence training success in flight safety attitudes in aviation (Chidester, Helmreich, Gregorich & Geis, 1991; Lester & Bombaci, 1984).

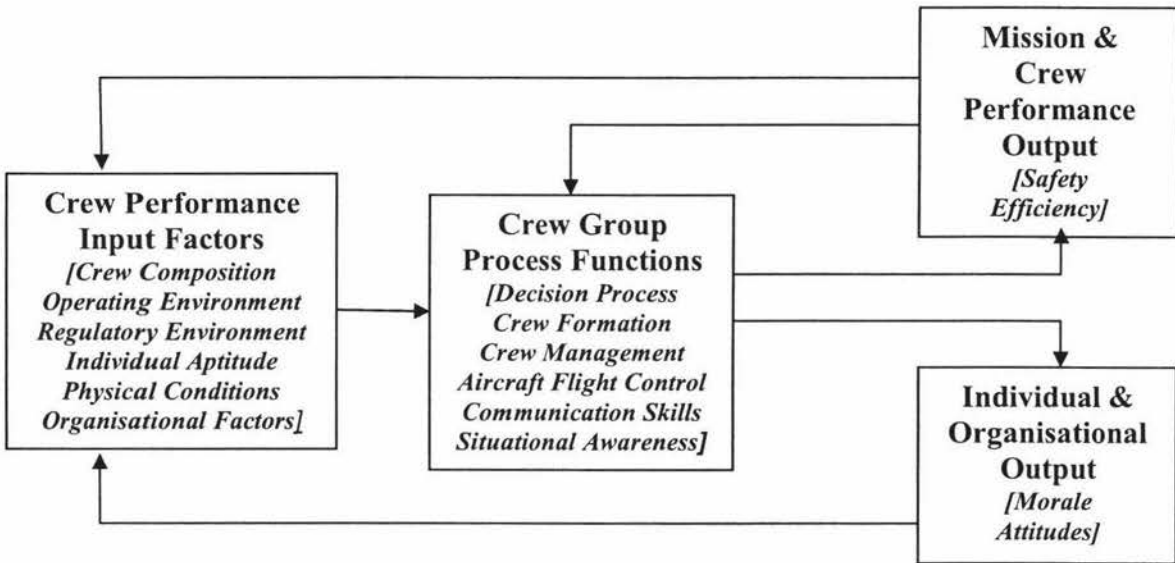


Figure 1. Input-Process-Output Model (adapted from Helmreich & Foushee, 1993).

The attitudes of flight crewmembers are another input factor that have received a lot of attention in research on human factors in aviation. Helmreich (1984) developed the Cockpit Management Attitudes Questionnaire (CMAQ), a 25-item measure that elucidates the flight safety attitudes held by pilots and crewmembers. Helmreich, Foushee, Benson & Russini (1986) found that the attitudes measured by the CMAQ significantly predicted the behaviour of airline pilots.

Group or team input factors are determined by the cohesion of the individuals that make up the cockpit crew. These input factors are a direct result of the combining of different personalities, attitudes, skills and knowledge levels into either an effective or ineffective unit (Sherman, 2003).

Cultural and organisational factors are an important influence in the process and outcomes in the aviation environment. The values and belief systems supported by the organisational culture and climate will influence the attitudes and behaviours of its employees (Glisson & James; 2002, O'Toole, 2002). In a preliminary study on safety perceptions of employees in concrete manufacturing companies, O'Toole (2002) found positive correlation between manager's active commitment to safety, and employee's perceptions of the safety management process, as well as the employees safety behaviours. Also, if the organisation has a culture whereby the regulations are not strictly enforced then important safety procedures may inevitably not be adhered to. Conway, Mode, Berman, Martin & Hill (2005) investigated the attitudes and practices of high and low risk air carriers in Alaska, a country known for its high aviation accident rate. They discovered that in high-risk air carriers the organisations input, such as poor working conditions, resulted in the outcome of pilots flying while fatigued in bad weather conditions. Aviation organisations are responsible for providing ongoing training, operational and personnel support and the maintenance of equipment and materials as per industry standards. Even something as innocuous as the provision of updated flight manuals can influence operational outcomes (Helmreich & Foushee, 1993).

Finally, regulatory and environment factors will input into the process and outcomes of operations. Regulations provided by national and international aviation authorities will set the standard of training and operations adhered to by individual organisations. The environmental factors such as weather patterns and the physical conditions of both the aircraft and equipment used by the crew are important in determining mission performance.

Process Factors

The group's process factors (represented in Figure 1 as 'Crew Group process functions') refer to the processes involved in team formation, interaction and management. These process functions are manifested in the communication between the involved parties, (flight crew, air traffic control, maintenance, support crews and organisational management) and the allocation of tasks, such as decision-making and problem solving

(Helmreich & Foushee, 1993). Poor communication and decision making have been identified as leading causes of aircraft accidents and incidents, and reflect a breakdown in team management and interaction (Helmreich, Wilhelm, Gregorich & Chidester, 1990). The most commonly cited communication breakdowns occur between the captain of the aircraft and the co-pilot or first officer. This is generally brought about by individual input factors such as low levels of assertiveness on the part of the co-pilot or authoritative manifestations in the captain's personality (Alkov, Borowsky, Williamson & Yacavone, 1992). The result of these input factors on the process is reduced communication, where the co-pilot is too intimidated to communicate important flight safety issues to the captain. This phenomenon has been labelled trans-cockpit authority gradient (Edwards, 1988). Alkov et al. (1992) found that a difference in rank in military marine pilots yielded a higher rate of flight mishaps than when there was no difference in rank between pilot and co-pilot. The larger the rank difference, or the steeper the trans-cockpit gradient, the higher the rate of flight incidents.

The communication patterns between high performing and low performing groups have also been investigated. Kanki & Palmer (1993) revealed in high performing crews the captains and co-pilots had roughly the same proportion of questions, acknowledgements and utterances. In low performing crews this did not occur. Foushee & Manos (1981) found that crews who communicated with each other more were rated as the higher performers in simulated flight exercises.

The decision making and problem solving processes of the group are a major factor in determining the operation outcomes, especially in terms of safe flight operations. Orasanu (1993) has investigated the metacognitive processes of decision-making in high performing teams, and found that this process was characterised by shared mental models that were verbalised by the crew. The problem solving techniques displayed by these crews involved communicating ideas about how the problem should be solved, and ensuring that all crew understood the situation (Orasanu, 1993).

Communication and decision making within the crew are turning cogs in the larger machinery of team formation, functioning and management. The recipe for successful team functioning has been a hot topic in management research, and social psychology for the last 20 years. Maani & Benton (1999) use Team New Zealand, an America's cup yachting syndicate from 1995, as an example of a high performing team. The principles drawn from this example are universal to successful team performance and easily transposed into the aviation environment. For example, having an explicit and overriding goal that draws on the individual visions of the team members, meaningful communication manifested through each members right to voice an opinion, commitment to team goals and purposes, acknowledgement and use of individual strengths within the group for team goals. The operational success of any aircrew will be a function of its ability to include all team members in the information gathering process, including flight attendants, maintenance, et cetera and also the efficient briefing of team goals, and each member's responsibilities. Ginnett (1993) showed that effective crews were a result of the strong leadership of the captains' who specifically balanced their imposed authority with the invitation for crew to actively participate in the decision-making process. Further, successful captains discussed explicitly the expectations of performance for the crew and set goals and boundaries for the team.

Expanded View Of Group Process

Helmreich, Wilhelm, Kello, Taggart & Butler (1990) propose the division of group processes during operations into two main categories: interpersonal and cognitive functions, and machine interface tasks. The first category, interpersonal and cognitive functions, results from individual input factors such as personality, attitudes and culture. As represented by figure 2, this category of group processes also involves team formation and management, communication, decision-making, situational awareness² and management of tasks. The significance of these functions is the involvement of human interaction and management, coupled with group cognitive processing. The second category is necessary given that human interaction and cognitive processing will be of

² For definition of Situational awareness see glossary.

little use if not integrated properly with the mechanics of the aircraft and aircraft systems (Helmreich & Foushee, 1993).

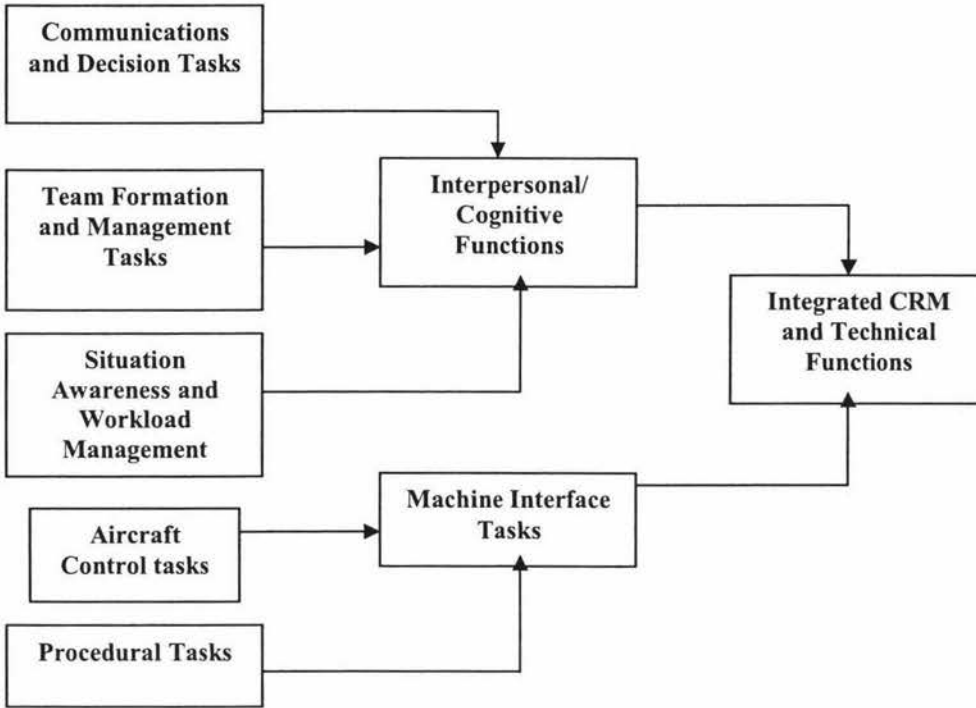


Figure 2. Flight crew performance model: Expanded group process factors (Helmreich & Foushee 1993).

The second category of machine interface tasks results from individual inputs such as knowledge, skills and abilities related to flying an aircraft. Organisational inputs will involve the technological level and maintenance of the equipment, and environmental inputs at this processing level will include the aircraft itself, and the effects of weather on the functioning of the aircraft. While accidents are predominately attributed to interpersonal breakdowns (Helmreich et al., 1990), the importance of these mechanical interface tasks cannot be underestimated. ‘Integrated CRM and Technical functions’ reflects the importance of combining the two processes as a function of effective and safe operations (Helmreich & Foushee, 1993).

Output Factors

In the IPO model, Helmreich & Foushee (1993) make a distinction between two types of outcome variables, mission and crew performance outcomes and individual and organisational outcomes. Mission performance can include the successful and safe completion of a flight or military operation, whilst crew performance may be the successful application of technique and procedure during flights. This is determined by organisational and aviation regulations. The completion of a successful mission will also have the outcome of improved attitudes and possibly an increase in morale for the organisation. A favourable outcome in particular has a recursive effect, whereby the production of positive attitudes and morale will improve the input into further missions – thus the inclusion of the feedback arrows in the model (figure 1, Helmreich & Foushee, 1993). Jex & Beliese (1999) illustrated that increased levels of self and collective efficacy can reduce work-related stress and strain. If high levels of stress do not depreciate individual inputs higher quality of group processes will result. The cycle of positive outcomes will either increase or decrease depending on the regenerating quality of inputs and processes.

2.1.3 Evolution of CRM Training

The natural conclusion of this theoretical model is that by improving the inputs and group processes of the operational aviation environment one can improve mission outcomes such as flight safety. A study by Ruffell Smith (1979) exposed the need for such improvement, when an investigation of B747 crews in a simulator with an emergency scenario produced unanticipated results. At that stage it was commonly assumed that, with standardisation of procedures and training in aviation, any crew would deal with a specific problem uniformly. However Ruffell Smith found large variation in how the same scenario was handled as well as variation in safety behaviours displayed by the participating crews. CRM training was designed, although not initially, to address the issue of poor group processes in the cockpit, and through training increase the quality of inputs such as attitudes and knowledge base, and also increase the team functioning through awareness of group norm pressures and personality variables.

The evolution of CRM training and concepts has happened over the last 25 years of aviation history, with cockpit resource management courses beginning in the early 80's, burgeoning out of similar human factors training from as early as the 1970's (Helmreich & Foushee, 1993). Most of the research and progress surrounding CRM initiatives was conducted through commercial airline companies and universities in the United States of America (U.S.A.). Early education in CRM principles began with a focus on changing individual style and behaviour. Of particular interest was the breakdown in communication between captain and co-pilot, termed trans-cockpit authority gradient (Edwards, 1988). The emphasis of these educational courses was the individual personality of the captain and co-pilots, in terms of reducing this gradient, and increasing the assertiveness of some pilots, however these initiatives were not group process focused (Sherman, 2003).

The concept of the trans-cockpit authority gradient led to an examination of captains' leadership styles in the cockpit, inciting airline companies to draw on theories from psychology and business management to provide their aircrew with the requisite skills (Helmreich, Merritt & Wilhelm, 1999). Techniques proposed by Blake & Mouton (1964) were used to enable pilots to understand their own managerial style and how this affected their crew (Helmreich & Foushee, 1993). The flaw in this methodology was its transference into the aviation environment. Whilst personnel claimed it was interesting they could not relate it to the operational cockpit setting (Chidester, 1993). Further criticisms were levelled at overly psychological focused training, which was not well received by pilots (Helmreich, Merritt & Wilhelm, 1999).

A second wave of CRM training emerged in the late 1980's, where research on reactions and application of CRM principles led to a more group process focus within the context of aviation (Sherman, 2003). Where CRM training had been primarily classroom based, airlines began integrating it with Line Oriented Flight Training (LOFT). LOFT is a training programme set in a high-fidelity aircraft simulator that allows an entire aircraft crew to fly a simulated flight. The crew must complete all the preparations and communications associated with a real flight. This method gives instructors the

opportunity to create realistic emergency scenarios that challenge the crew to implement CRM principles taught in lecture situations. Most LOFT programmes also allow the simulated exercises to be video taped in order for crews to view, debrief and be provided with feedback. This methodology had a positive effect on the “buy-in”, or acceptance of pilots and crewmembers as the principles of CRM gained credibility and applicability to the aviation environment (Helmreich & Foushee, 1993).

With the introduction of LOFT into CRM training, the emphasis shifted towards group processes and team dynamics. Ginnett (1987, as cited in Ginnett, 1993), in his study on three people, high functioning teams in the aviation environment, provided evidence of the importance of skilled leadership for effective crew performance. Ginnett’s conclusions on cockpit teamwork outlined high performance as a function of communication within teams, quality briefing and debriefing, explicit boundary setting and role definition (Ginnett, 1993). As a result social psychological principles of group dynamics were integrated into the CRM training alerting crews to the importance of group process in flight safety. A consequence of this latest focus was to change the name from Cockpit Resource Management to Crew Resource Management, which increased the crew’s ownership of the team aspects of CRM (Helmreich, Merritt & Wilhelm, 1999).

As CRM training developed the focus was sharpened to address specific behaviours and attitudes that were desirable for aircrew. CRM behavioural markers were identified and feedback for participants in training became more comprehensive with the development of CRM behavioural assessments, through observations and use of CRM competencies in check-sheets (Flin & Martin, 2001). The importance of training the observers and assessors became more apparent as research by Helmreich & Wilhelm (1987) showed the systematic training of assessors in CRM concepts significantly improved the quality of ratings produced. With improved ratings, CRM assessments are able to provide a reliable picture of the state of aircrew CRM competencies.

In the early 1990’s a third generation of CRM training began to emerge that saw the focus of CRM switch to the systems within which aircrew operate. CRM training became

more integrated with the technical training that aircrew and pilots received, as the impact of increased flight deck automation on CRM concerns was realised. Other factors, such as organisational culture, also began to emerge as areas affecting flight safety and CRM behaviours (Helmreich, Merritt & Wilhelm, 1999; Sherman, Helmreich & Merritt, 1997). CRM training was encouraged for all members of aircrew, including flight stewards and maintenance personnel, however this brought concerns as to the dilution of the human factors focus – the original intent of CRM training (Helmreich, Merritt & Wilhelm, 1999).

Throughout the 1990's CRM training within airlines became more integrated, and further CRM behaviours became part of procedure. In the U.S.A., the Federal Aviation Authority (FAA) introduced their Advanced Qualification Programme (AQP), which allowed airlines to design their own customised CRM training that met the needs of their organisation and addressed inherent issues in each organisation's culture (Helmreich, Merritt & Wilhelm, 1999).

Towards the end of the 1990's, Robert Helmreich and colleagues spearheaded a new movement in CRM theory that asserted error management as the overarching justification of CRM training (Helmreich, Merritt & Wilhelm, 1999). This new generation in CRM theory was spawned out of a search for a training system more robust to the influences of national culture (Helmreich, Wilhelm, Klinect & Merritt, 2001)³. The underlying assumptions made by these researchers are: human error is common and inevitable; and is a valuable source of information. A three-pronged approach to managing errors in aviation was proposed (as represented in figure 3). First, avoiding errors, second, trapping incipient errors before they are committed and third, mitigating the consequences of the errors that have already occurred (Helmreich, Merritt & Wilhelm, 1999). The theory behind error management has its roots in James Reason's work on managing risks in organisations (Reason 1997).

³ See section 2.1.5 Cultural Influences on CRM for more detail.



Figure 3. The Error Trioka, Helmreich, Merritt & Wilhelm (1999).

This new approach to error management as the foundation for CRM training combines the focus of human factors with group process to look specifically at how each can be responsible for errors during flight. Helmreich and colleagues encourage the acceptance of the normalization of human errors in aviation, and that organisations need to foster reporting of all incidents as a means to gain information about where holes in the system of each specific organisation may be occurring (Helmreich et al., 1999). This requires organisational commitment, not purely to the CRM training itself, but to values and practices within the organisation that will make it easier for crew to reflect on their performance without fear of repercussions (excluding blatant procedural violations).

The implications of this new paradigm of human error management would be increased reporting of incidents that would usually be left unreported, such as near-miss events, or events relating to institutionalised practice for example flying when fatigued or stressed, such behaviour that is generally overlooked and regarded as part of the culture of an organisation.

2.1.4 Regulatory Support.

In the Input-Process-Output Model discussed previously, one of the important input factors that aids in flight safety outcomes is the regulatory environment. As the U.S.A. has been the forerunner of most of the CRM concepts and implementation it is not surprising it is reflected in the government regulations. As mentioned previously the FAA introduced AQP in 1990. In 1997 another FAA initiative, the Aviation Safety Actions

Programme (ASAP) was introduced as a proactive way to encourage the reporting of incidents within commercial airlines. The FAA continues to provide regulatory support for CRM principles, as evidenced by its Federal Aviation Regulation (FAR) 121.404, which states:

After March 19, 1998, no certificate holder may use a person as a flight crewmember, and after March 19, 1999, no certificate holder may use a person as a flight attendant or aircraft dispatcher unless that person has completed approved crew resource management (CRM) or dispatcher resource management (DRM) initial training, as applicable, with that certificate holder or with another certificate holder.

In Australia and Britain there is similar support from regulatory authorities. Australia's Civil Aviation Safety Authority has instituted set rules, which detail the requirements for CRM training for pilots and cabin crew. In New Zealand, the Civil Aviation Authority (CAA) has CRM requirements listed in Part 121, which is only applicable to aircraft with 30 or more passenger seats or a payload capacity of greater than 3410kg. The rule specifically states:

121.917 Crew resource management requirements

- (a) Each holder of an air operator certificate shall ensure each indoctrination, qualification and continuing qualification curriculum includes-*
- (1) CRM training applicable to each position for which training is provided; and*
 - (2) Training in the use of each crewmembers CRM skills, and evaluation of the skills and proficiency of each person being trained; and*
 - (3) Training and evaluation of each flight crewmember's piloting or other technical skills in actual or simulated line-operating flight time.*

While it is encouraging that New Zealand has regulations supporting CRM concepts, the requirement does not extend to general aviation and smaller aircrafts, where CRM may also be important. Research has shown that hazardous attitudes addressed in CRM training occur in general aviation pilots, as well as commercial and military pilots (Lester

& Bombaci, 1984). CRM training has also been demonstrated to reduce accident rates in helicopters with as little as three crewmembers (Alkov & Gaynor, 1991). Thus the regulatory support for CRM concepts within New Zealand could and should be stronger.

2.1.5 Cultural Influences on CRM.

The exportation from the U.S.A. of research based CRM training packages considered suitable for commercial operations in other countries revealed CRM training was not transposable when these courses failed to achieve the same level of effectiveness. It was reasoned that national culture might be a mediating factor (Helmreich et al., 1999). The universal aviation language and jargon, the standardised procedures and similarities in technology, generated the assumption that the world of aviation operates in its own supranational culture that supersedes individual, national, professional and organisational cultures, however this has not proved to be the case (Johnston, 1993; Soeters & Boer, 2000; Helmreich, Wilhelm, Klinect & Merritt, 2001).

Culture can be defined as a shared set of values, beliefs and attitudes that direct the behaviour of a collective of people (Helmreich & Wilhelm, 1999). Military and commercial aviators can be classed into several different collectives: the profession of pilot, the specific organisation and their national group. These collectives all have influential cultures that direct their behaviour towards safety on the flight deck (Helmreich et al., 2001.). Researchers pose the existence of a safety culture that further influences these behaviours (Helmreich et al., 2001, Helmreich & Wilhelm, 1999). The safety culture is manifested in the employee behaviours related to the perception of how the organisation will trade off between profit and the safety of their staff (Helmreich et al., 2001). Figure 4 represents the theoretical relationships proposed between different cultures and safety behaviours.

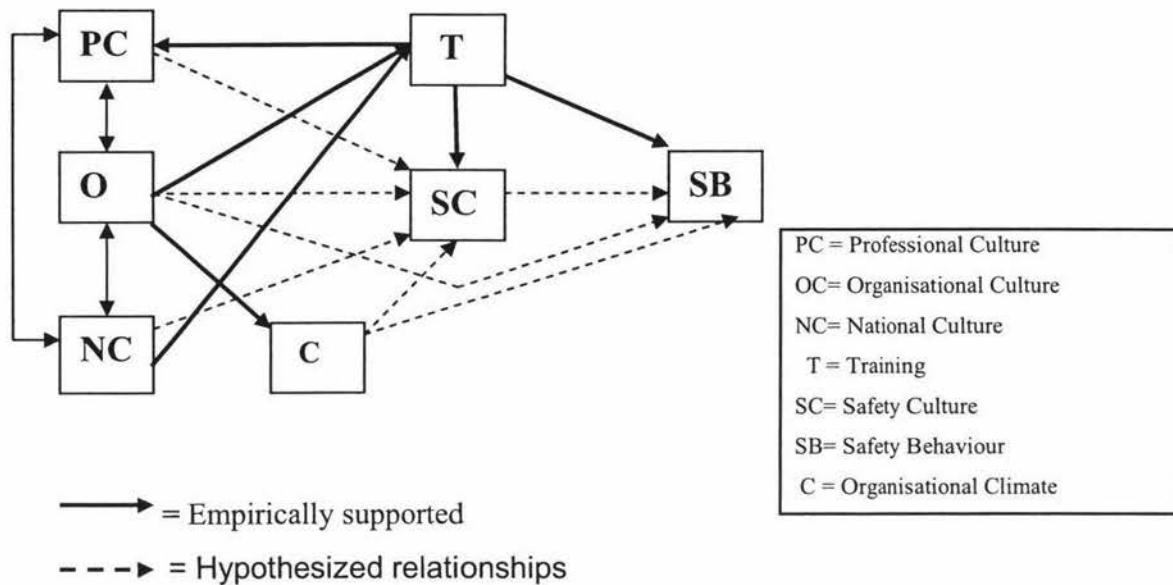


Figure 4. Model of relationships between the different cultures affecting crew behaviour (adapted from Helmreich & Wilhelm, 1999).

National Culture

The research surrounding the effect of culture on aviation has been strongly influenced by the seminal research by Hofstede on cultural dimensions (Hofstede, 1984; Soeters & Boer, 2000). Hofstede originally surveyed 60,000 employees from the international company IBM and discovered several dimensions that differed between national groups. These dimensions Hofstede identified as Individualism/Collectivism, Power Distance, Uncertainty Avoidance and Masculinity/Femininity (Hofstede, 1984). Helmreich & Merritt (1998) replicated these findings with civil aviation pilots, and found significant support for two of the four constructs, power distance and uncertainty avoidance. Soeters & Boer (2000) also found support for these constructs among NATO Air Forces. The results of both of these studies suggest that national culture has an effect on flight safety attitudes and behaviour over and above the individual organisational culture or professional culture of pilots.

The reason for the significance of the two dimensions of power distance and uncertainty avoidance is their relationship to crew resource management concepts. Power distance refers to the individuals' perception of the distribution of power between people and their acceptance of unequal power distribution (Hofstede, 1984). A country with high power distance, such as Russia, Spain or Morocco⁴, will have a large distinction between superiors and subordinates, and there will be a general unwillingness of subordinates to question those in authority. In low power distance countries, i.e. U.S.A. or New Zealand subordinates will be more likely to contradict superiors and display informal communication patterns (Soeters & Boer, 2000). As discussed one of the specific problems that CRM training attempts to address is the trans-cockpit authority gradient, where the co-pilot is encouraged to assert himself with the captain. If this CRM principle is taught in countries with a high power distance, the cultural pressures on the co-pilot need to be taken into account in training delivery, where as countries, such as New Zealand where power distance is lower should receive this information more readily (Helmreich & Merritt, 1998). Soeters & Boer (2000) supported these findings by revealing the lower rate of Air Force aircraft accidents in countries with a low power distance. Thus national cultures that embody clear distinctions in the value of contribution from persons based on rank, status, age or any such reason may in fact be causal in communication problems in the cockpit or cabin of an aircraft.

Uncertainty avoidance, as defined by Hofstede (1984) refers to an individuals perception of uncertain or unusual situations as threatening. In organisations this construct manifests itself in strict adherence to rules and regulations. In aviation, pilots from countries who have a high level of uncertainty avoidance will tend not to deviate from standard operating procedures (SOP) even if an emergency situation may require it (Helmreich & Merritt 1998). Soeters & Boer (2000) found a higher correlation between countries with high uncertainty avoidance (based on Hofstede's data) and rate of accidents in the corresponding Air Force. The conclusion drawn from this was in emergency situations pilots often need to deviate from normal rules⁵ and orders to mitigate problems, thus if

⁴ Countries ratings on cultural dimensions taken from Hofstede (1984).

⁵ Deviations within reason, not as in the case of Bud Holland discussed in Chapter One.

pilots are unable to think 'outside the square' it can result in accidents (Soeters & Boer, 2000; Helmreich & Merritt, 1998).

The dimension of Individualism/Collectivism also has significance in aircrew behaviour. A study by Merritt & Helmreich (1996) revealed the level of individualism/collectivism from Asian and American airline companies was related to the scores of pilots and flight attendants on the Cockpit Management Attitudes Questionnaire (CMAQ). Individualism relates to levels at which an individual's behaviour is driven by their own needs and desires, whereas collectivists are more drawn towards behaviour that supports and relates to the needs of those in their society (Merritt & Helmreich, 1996). Within organisations of countries high on the individualism dimension employees will be independent of the organisation, moving around organisations frequently to best suit themselves. Conversely collectivist nations employees stay loyal to the same firm, moving jobs within organisations (Soeters & Boer, 2000). In individualistic societies such as the U.S.A., Australia and Britain, people tend to manage their own careers, take care of their own families and make their own decisions. In aviation this manifests itself in the romantic notion of the pilot hero, who declares his invulnerability, and braves conditions to get his aircraft/cargo/passengers through (Retzlaff & Gibertini, 1987). This intuitively seems counterproductive to the basic concepts that CRM training espouses, however despite the 'do it on your own' mentality of individualistic pilots, there is a drive towards a high level of professionalism in individuals who manage their own careers. This drive towards gaining a greater knowledge base and high skill level manifests in highly professional behaviours (Hofstede, 1984), and *lower* aircraft accident rates than collectivist countries (Soeters & Boer, 2000).

Organisational & Professional Culture

In an investigation of the cultural influences on commercial aviation Helmreich and Merritt (1998) discovered that while the majority of pilots enjoyed their occupation there were marked differences in their perception of their organisations. In their study of 22 countries (including New Zealand) they found that no pilot 'disagreed strongly' with the statement 'I like my job'. However when asked 'I am proud to work for my organisation'

there was a large variation, with 97% of pilots from one organisation agreeing with this statement, and in another organisation less than 20% agreed (Helmreich & Merritt, 1998). This research illustrates the interaction of professional culture with organisational culture. While pilots may enjoy their line of work, organisational stressors may exert significant pressure to impact on flight safety behaviours in the cockpit (as illustrated by figure 4, Helmreich & Wilhelm, 1999). Within organisations there may also be sub-cultures from different units that interact. For example throughout the world air forces generally operate more than one aircraft type, consigning squadrons to deal with specific aircraft. Each aircraft has its idiosyncrasies, such as fighter jets have one or two crewmembers, while large transport or surveillance aircraft, such as the C130 Hercules, or the P3 Orion operate with a crew from six up to 12. The idiosyncratic differences of each squadron can reinforce different value structures and support different behavioural patterns in personnel. Anecdotal evidence suggests that pilots who fly solo in combat situations encapsulate fully the invulnerable, macho loner pilot stereotype, where as pilots who operate in a crew are more likely to have team concepts reinforced and value such ideals as camaraderie. Mjos (2004) investigated the Hofstede's cultural elements in three different airline companies within the same country and found significant cultural differences between each suggesting that organisational culture does indeed impact upon professional culture. One of the companies in the study employed ex-military pilots and despite being significantly more experienced than the pilots in the other two airlines, their reported operational mistakes were just as high. Mjos proposed that this was due to the high scores on the power distance and masculinity dimensions displayed by these pilots. While cultural variations have been found between and within countries, further research needs to investigate cultural differences in safety behaviours within diverse organisations such as a military air force with multiple operational squadrons.

2.1.6 CRM in the Military.

As discussed commercial airlines in the U.S.A. have led the world in CRM training development and it was not until the late 1980's that the American military services started developing their own CRM programmes (Prince & Salas, 1993). The reason for the delay in military CRM training (or Aircrew Coordination Training) was the apparent

lack of need. Whilst airlines are driven by public concern for aviation safety due to the large number of casualties involved in aircraft accidents, military aviation mishaps generally involved only a small number of personnel, and given the extensive military training to become officer or non-commissioned aircrew, military commanders viewed further CRM initiatives as unnecessary (Prince & Salas, 1993). Yet research as early as 1975 had revealed that over 50% of U.S.A. air force accidents and incidents were due to human error (Lewis, 1975). Specifically Lewis's study illustrated that poor crew coordination, task fixation, failure to use procedures and disrupted communications were major causal factors in 545 accidents between 1971 and 1973. A second report by Leedom (1990) on the causes of army aviation crashes also revealed crew coordination was an issue within the military. It was these findings that finally brought about commitment from Senior Officers to upgrade the aircrew coordination training to align with the current CRM programmes developed from research in commercial airlines (Prince & Salas, 1993). Research by Cavanagh & Williams (1987) gave military command further impetus to initiate CRM when they showed a relationship between crew coordination training and mission effectiveness.

Military operations embraced CRM, when training was being customised to individual organisational needs, contributing different factors that influenced the effectiveness of CRM training. Specifically military organisations differ to commercial airlines in tasks, people and organisational structure (Prince & Salas, 1993).

Tasks

Military flight operations differ in many ways from that of commercial airliners. In the Royal New Zealand Air Force (RNZAF) there are four operational squadrons with differing tasks ranging from defence force activities, transporting the Prime Minister, coastal protection, and search and rescue missions at sea. The flexibility of RNZAF aircrew has to be optimal due to the uncertain and changing nature of their work tasks. Comparing this to the tasks of commercial airline pilots who fly specified routes for transportation purposes it becomes clear that the management style and needs of military aircrew are inherently different. Military aircrew too have other non-flying tasks during

flight operations, especially in wartime – where the safety of the aircraft is not solely affected by the crew's actions, but also by evading the enemy (Prince & Salas, 1993). CRM concepts that may be easily applied in general and commercial aviation will be more difficult when the tasks are as demanding as those found in the military. For example if a pilot is fatigued or stressed, he or she may have no option but to continue flying.

People

Selection for military aircrew is very different from that of civilian airliners. The RNZAF selection boards, for example, are looking for people who not only have technical skills required for flying aircraft, but who, in addition, will also make good officers and non-commissioned officers (NCO's). Military selection systems are set up to select for highly motivated, intelligent people with leadership skills (Damitz, Manzey, Kleinmann & Severin, 2003). Military pilots' personalities have been shown to differ to civilian pilots (Ashman & Tefler, 1983) and this should be taken into account when customising CRM training. For example military officers are selected based on their assertiveness and leadership skills, they also undergo extensive officer training which focuses on improving leadership and assertion, thus this aspect of CRM may be redundant in CRM training for Military aircrew.

Organisation

Organisational culture has been cited by Helmreich & Foushee (1993) as an important input factor in determining flight outcomes such as safety. Military organisations have a very different culture to that of civilian organisations; even squadrons within military sectors may have differing cultures from each other (Helmreich & Merritt, 1999).

Unique to military organisations is a formalised rank structure. It is possible that differences in ranks between captain and co-pilot may add to coordination problems such as the trans-cockpit authority gradient (Edwards, 1988). Further, military aircrew, such as those in the RNZAF have organisation specific duties that extend beyond flying. Officers in particular are given other charges related to the management of personnel within the squadron, and roles such as duty officer, or treasurer for the Mess Committee (social

club). When aircrews are engaged in flying their other duties may be distracting their thoughts (Prince & Salas, 1993).

In order to gain acceptance from military personnel, CRM training must cater directly for the individual needs of each operational squadron. Whilst some military CRM training has been based on airline courses (Prince & Salas, 1993), there is a need to provide specific military examples and exercises that will increase the face validity of the course to personnel (Helmreich & Foushee, 1993).

2.1.7 Summary.

In sum, CRM emerged in response to flight safety events that could have been avoided. The aetiology of aircraft accidents over the last 30 years, commercial, general and military alike has revealed certain aspects of crew characteristics and performance that can be improved upon to reduce the likelihood of further accidents. The focus of CRM training is elucidating the effect of a combination of individual, group and organisational variables that lead to errors in aviation. At the individual level personality, attitudes and experience contribute substantially to how the aircrew operate and function as a team. The culture of the organisation, profession and nation are also antecedents to successful or unsuccessful group functioning. Military organisations and personnel in particular bring unique attributes to the CRM fray in terms of how their values and perceptions pertaining to flight safety and in terms of their needs in CRM training. CRM training is about giving the crewmember the bigger picture when operating of the aircraft. Cultural, team and individual influences affect crew behaviour and technically proficient personnel need to have access to non-technical skills training in order that errors can be successfully managed in the aviation industry.

2.2 Hazardous Attitudes

2.2.1 Attitude-Behaviour Link.

One of the major contributing factors to the effectiveness of Crew Resource Management (CRM) has been identified as the attitudes of individual crewmembers to appropriate behaviour on the flight deck (Helmreich, 1984). Thus the actual CRM *training* was designed specifically to inform and influence the crew to maintain attitudes congruent with the flight safety principles derived from human factors research (Helmreich & Foushee, 1993; Sherman, 2003).

The existing definitions of 'attitude' are abundant. The Collins Dictionary defines an attitude prosaically as 'a way of thinking and behaving'. Psychological definitions of the concept tend to be more comprehensive ranging from 'Some internal affective orientation that would explain the actions of a person' (Reber & Reber, 2001 p. 63) to 'an evaluative feeling that is evoked by a given object' (Fazio & Zanna, 1981 p. 162). Usage of the term attitudes in literature tends to involve many facets such as evaluation, affectation and potential for action. The term attitude in this study will refer to the definition proposed by Eagly & Chiaken (1993), 'Attitude is a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour' (p1), also, as figure 5 represents, an attitude is ordinarily expressed in cognitive, affective and behavioural responses. Taking the three components depicted in figure 5, we can apply this to a CRM example, such as the formation of a captain's attitude towards the contribution of the co-pilot. Firstly the captain may know the level of ability of his or her co-pilot (cognitive), the captain may feel that the level is not up to his or her standard (negative affectation) and this may be displayed in the captain's tendency to ignore or minimise the co-pilot's contribution to the flight (behavioural).

In this example the captain is displaying a common attitudinal problem within the genre of flight deck management that may be the result of a combination of variables such as personality traits, past experience, attitudes and also organisational culture (Lester & Bombaci, 1984; Helmreich, 1984; Merritt & Helmreich, 1998).

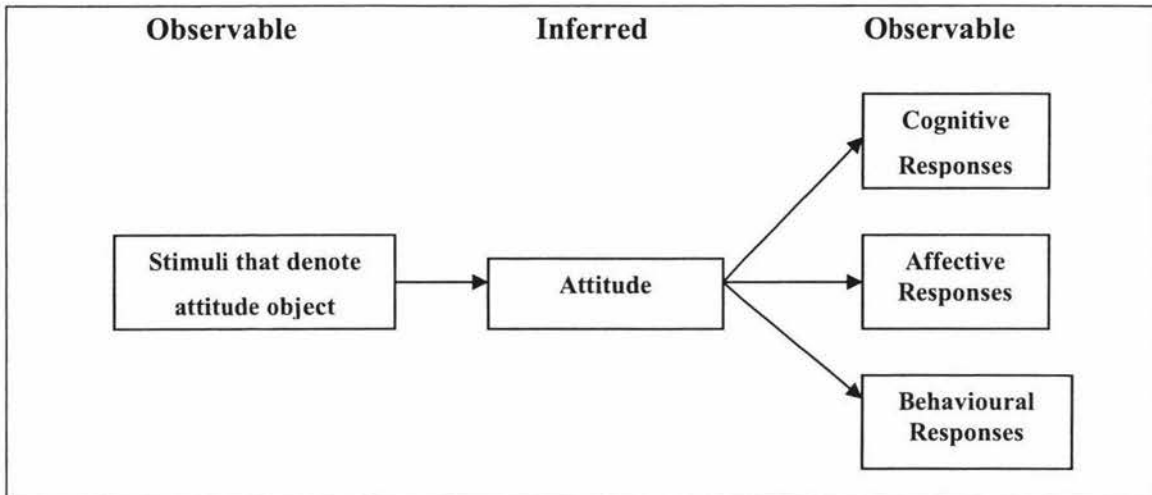


Figure 5. Attitude as an inferred state, with three categories of responses (taken from Eagly & Chiakien 1993, p10).

Personality is a factor that has received a lot of attention in the literature on CRM related issues, specifically its relation to the formation of flight safety attitudes. Due to the stable unchanging nature of personality factors and the malleable nature of attitudes, research has focused on altering attitudes (Helmreich, 1984; Gregorich, Helmreich & Wilhelm, 1990). Targeting aircrew attitudes also stemmed from the common axiom in psychology that attitudes predict future behaviour. While this notion appears intuitive, the empirical evidence proved inconsistent (Ajzen & Fishbein, 1977). Fazio & Zanna (1981) posited the question ‘Under what conditions do what kind of attitudes held by what kinds of individuals predict what kinds of behaviours?’ (p165) to reveal the complex nature of the attitude-behaviour link. Although the attitude behaviour link has been empirically supported in some situations, for example, an individuals attitude about political parties will greatly predict his or her voting behaviour (Kelley & Mire, 1974), would this link generalise to attitudes of pilots to flight safety and predict their tendency to apply them?

Previous research has highlighted attitudes tend to predict behaviour when the attitude is developed through direct experience producing a stronger predictive behaviour-attitude-behaviour formational chain as opposed to the simple attitude-behaviour link (Fazio & Zanna, 1981). Thus previous experiences in emergencies may lead pilots to hold stronger

attitudes that are more likely to predict their behaviour in subsequent situations. In any given situation, an individual attitude held by a person may not be the sole predictor of behaviour, but a combination or interaction of different attitudes may result in the behaviour (Hawkins, 1987). In the previous example the captain's latent negative attitude may be superseded by his or her attitudes to flight safety, which promotes teamwork in the cockpit despite personal differences. This attitude may then lead the captain to acknowledge the input of the co-pilot despite feelings of enmity. The implications of this are that improving and reinforcing the flight safety attitudes of crew may override or negate their current hazardous attitudes.

2.2.2 The Five Hazardous Attitudes in Aviation.

Investigations into major airliner accidents have revealed in certain cases the pilots had the technical capacity to land safely which points to other factors affecting their performance during the emergency. An example of this is the crash of a United States Air Force B52⁶ that was executing a pre landing turning manoeuvre in preparation for an air show in June of 1994. The pilot, a Lieutenant Colonel, pushed the aircraft beyond its mechanical limits and caused it to stall in mid air and crash to the ground. The pilot was perhaps reflecting an attitude of invulnerability, that is the belief that accidents and incidents happen to others and not oneself (Murray, 1999). As attitudes are not directly observable, the attitudes of pilots can only be inferred through their behavioural responses and verbalisations of thoughts (Hawkins, 1987). An investigation by the Embry- Riddle Aeronautical University (ERAU) into the behaviours and verbalisations of pilots led to the identification of five hazardous attitudes existing in the pilot population, which may affect safety behaviours (Trollip & Jensen, 1991; Berlin et al., 1982). The five attitudes were described as follows (Murray, 1999):

- **Antiauthority:** A general disrespect for those in positions of authority, and a lack of inclination to do what one is told.
- **Impulsivity:** The disposition to act immediately, often without much consideration.

⁶ See Chapter One.

- Invulnerability: The general feeling that accidents and incidents will always happen to other people and not oneself, leading to increasingly risky behaviour (Lester & Bombaci, 1984).
- Macho: The feeling or competitive need to show off and illustrate how good one is, marked by consistently trying to impress other people.
- Deference: Feeling that one has little control over the course of events, a general resignation to let things happen coupled with a tendency to let others influence ones decisions (previously referred to as 'external control' or 'resignation' (Lester & Bombaci, 1984; Tefler, 1987).

Whilst criticisms have been levelled at the five hazardous attitudes model, due to its lack of empirical support (Lester & Connolly, 1987), subsequent research has found support for three of these attitudes in particular. The impulsive, invulnerable and macho attitudes have been found to be the most prevalent in aircrew and the most predictive of poor pilot decision-making and judgement, as illustrated by the incidence with Bud Holland discussed in chapter one of this thesis (Lester & Bombaci, 1984; Lester & Connolly, 1987). The attitude, now labelled 'Deference' has been expanded from 'resignation' by Murray (1999), which may increase its validity. With an expanded definition this attitude encompasses the well-documented problem of lack of assertion of the co-pilot, and impacts on the trans-cockpit authority gradient. If the deference is the predominant hazardous attitude of a co-pilot this will mean that the co-pilot will not question any poor decision-making made by the Captain. The co-pilot who has this attitude may feel resigned to what will happen. The Macho attitude also received little support in Lester & Bombaci's study (1984), however this definition has also been expanded to include, 'when faced with threats to their competence, they are reluctant to accept or admit their shortcomings by seeking assistance, either within the cockpit from fellow crewmembers or externally from air traffic control or other aircraft' (Murray, 1996 p408). This behavioural pattern has serious implications for crew coordination and delegation of responsibilities. Further, refusal to acknowledge and subsequently manage stressors (see table 1) has been shown to exist in the pilot population (Helmreich, 1984; Gregorich et al., 1990). The five hazardous attitudes provide an insight into the thought structures of

pilots with potentially dangerous behavioural patterns; however, the applicability of this model to multi-crew situations is limited, as interactions with other crewmembers, with a different combination of attitudes, will mediate the affect on hazardous behaviour.

2.2.3 Cockpit Management Attitudes.

The Cockpit Management Attitudes Questionnaire (CMAQ) was developed in response to the need for an objective index of attitudes towards CRM principles in the cockpit (Helmreich, 1984). Research revealed that the CMAQ was discriminatory between good and poor performing pilots (Helmreich, Foushee, Benson & Russini, 1986), subsequently it became a useful instrument to determine attitude changes pre and post CRM training (Gregorich et al., 1990). Factor analysis of the CMAQ revealed three factors that represent crew coordination issues, or infer attitude clusters that may be causal factors of these issues (Gregorich et al., 1990). These factors were:

1. *Communication and Coordination* – This factor included 11 items that were orientated towards interpersonal relations between crewmembers, delegation of tasks, briefing and debriefing and monitoring of other crewmembers.
2. *Command and Responsibility* – This factor included four items from the CMAQ all relating to appropriate leadership styles and shared responsibility of tasks such as decision making.
3. *Recognition of Stressors* – This factor also included four items that related to the individuals ability to recognise the effect that stressors, such as fatigue or personal problems, may have on their performance during a flight.

The attitudinal clusters and behavioural implications of the underlying factors in crew resource management has now formed a picture of what an effective and ineffective pilot may look like as Helmreich et al. (1986) succinctly describes them:

'The effective pilot: Recognizes personal limitations, and diminished decision making in emergencies and encourages other crewmembers to question decisions and actions. This individual is sensitive to personal problems of other crewmembers that might effect operations and feels obligated to discuss personal

limitations. He or she recognises the need for the pilot flying to verbalise plans and importance of the Captain's role in training other crewmembers' (pp1199).

'The ineffective pilot: The stereotype of the "macho pilot" with the "right stuff" is clearly present. This individual does not recognise personal limitations due to stress and emergencies, does not utilize the resources of fellow crewmembers, is less sensitive to problems and reactions of others, and tends to employ a consistent authoritarian style of management' (pp1200).

The presence and absence of the previously discussed hazardous attitudes are apparent in the descriptions of the effective and ineffective pilot. It is important to recognise the underlying facets that relate the hazardous attitudes to the factors in the CMAQ, as depicted in table 1, and acknowledge the individual attitudes of crewmembers are subject to group influences.

2.2.4. Groups, Attitudes and Risk.

The seminal research by James Stoner (1961) addressed the issue of group influence on risky behaviour. In his study participants were asked to advise a fictional person on the course of action they should take in one of 12 scenarios involving risk taking. Stoner found that an individual's decision of acceptable level of risk would be increased following discussions with their peers. He also found group decision-making lead to riskier outcomes than the original mean of individual group member's decisions. The implication for this in a cockpit situation is that after consulting with his or her crew the captain may be inclined to make decisions that are a higher risk to flight safety. The potential to make risky decisions in aviation is related to the previously discussed hazardous attitude, invulnerability (Lester & Bombaci, 1984). O'Hare (1990) found that pilots who rated themselves as taking more risks, also scored highly on a measure of personal invulnerability. These individuals were also reported to have more flying hours than pilots who were rated as less likely to take risks (O'Hare, 1990; Murray, 1999), thus experience does not decrease risky behaviour patterns.

Table 1. Hazardous attitudes and their relation to CMAQ factors.

Hazardous Attitude	Descriptive Thought Patterns (Lester & Bombaci 1984, Murray 1999)	Relation to the 3 factors derived from the CMAQ (Gregorich, Helmreich & Wilhelm 1990)
Anti-Authority	This thought pattern is found in people who do not like anyone telling them what to do. They think, "Don't tell me!" In a sense, they are saying, "No one can tell me what to do." This person may either be resentful of having someone tell him or her what to do or may just regard rules, regulations and procedures as silly or unnecessary. However it is always your prerogative to question authority if you feel it is in error.	Factor 1: The coordination of tasks will be affected by crewmembers unwillingness to follow orders. Factor 2: These individuals may undermine leadership, or if it is the captain displaying this attitude, he or she may have a disregard for organisational and regulatory standard operating procedures.
Impulsivity	This is the thought pattern of people who frequently feel the need to do something, anything, immediately. They do not stop to think about what they are about to do; they do not select the best alternative – they do the first thing that comes to mind.	Factor 1: Communication will be reduced, as impulsive individuals will not stop to inform the crew of their impending actions. Also delegation will be at a minimum due to reduced time in decision- making. Factor 3: Individuals who act impulsively may not have time to consider the effects of stressors on their reaction times.
Invulnerability	Many people feel that accidents happen to others but never to them. They know accidents can happen, and they know that anyone can be affected; but they never really feel or believe that they will be the one involved. Pilots who think this way are more likely to take chances and run unwise risks, thinking all the time, "It won't happen to me!"	Factor 3: Individuals who feel invulnerable will be less likely to recognise the stressors in their environment and the affect that fatigue, personal problems or other hazardous may have on their performance.
Macho	People who are always trying to prove that they are better than anyone else think, " I can do it!" They prove themselves by taking risks and by trying to impress others. While this pattern is thought to be a male characteristic, women are equally susceptible.	Factor 1: This individual will be less likely to delegate to other crew. Factor 2: The leadership style of someone who seeks to prove themselves may result in an authoritative 'I know best' mentality, and the likelihood that other crew can participate in decision-making will be reduced.
Deference	This thought pattern is found in pilots who feel that they have little or no control over their circumstances. They are resigned to let things be as they are. They may deny that the situation is (as bad) as it appears. They are likely to fail to take charge of the situation. They may also let other people, such as those in authority or significant peers, or commitments, unduly influence their decisions.	Factor 1: Communication may be reduced, as this individual may not put forth ideas or observations that will help the situation due to lack of assertiveness. Factor 2: The leadership style of this individual will be lacking, not willing to take control and make decisions.

Despite these findings being replicated by other researchers (Wallach, Koga & Bem, 1964), evidence began to emerge demonstrating group decision-making was shifting towards the side of caution (Marquis, 1962; Nordhøy, 1962). Stoner (1968) postulated the cause for these contradicting results was that 'individuals make their own decisions in manners that are consistent with widely held values' and 'group discussion and decision-making will lead to individual and group decisions that are still more consistent with widely held values' (p445). The cultural values of the individual making the risky or cautious shift are reinforced by discussion with like-minded individuals, emphasising the importance of culture on the formation of attitudes in individuals (Nordhøy, 1962).

2.2.5 Summary.

It has been illustrated that attitudes are linked to behaviours in aircrew, to the degree that attitudinal measures are sensitive enough to discriminate between high and low performing crews (Helmreich et al., 1986). This has implications for flight safety in the respect that attitudes may not only lead to low performing crews, but actual accidents or incidents. Determining current attitudes towards flight safety issues needs to be a priority in aviation organisations in order to determine if change must take place. In crew resource management research there is a push towards the development of safety cultures within aviation organisations in order that positive attitudes, values and behaviours surrounding flight safety will be reinforced (Mearns, Flin & O'Connor, 2001, Merritt & Helmreich, 1998). CRM training itself is a tool organisations can use to encourage the adoption of flight safety attitudes, and reduce the risky shift phenomenon within aircrew.

2.3 Personality and CRM

2.3.1 Personality Theory.

There has been much debate in psychological literature over the structure and nature of personality. The exact number and description of personality factors has received the most attention. Over the last 20 years of research in this area a predominant paradigm of personality has emerged proposing that five overarching factors account for all the variance in personality (Costa & McCrae, 1992; Barrick & Mount, 1991). The five factors identified through factor analytic research are Extroversion, Emotional Stability (also labelled Neuroticism), Agreeableness, Openness to Experience (also known as Culture or Intellectance) and Conscientiousness (or Dependability)(Costa & McCrae, 1991; Digman & Inouye, 1986; Norman, 1963). Criticisms have been levelled at the five-factor taxonomy due to its apparent incomplete nature, and lack of predictive validity with occupational criterion (Hough, 1992). Several alternative taxonomies have arisen, including six, seven and nine factor models (Ashton, Lee & Goldberg, 2004; Ashton & Lee, 2001 & Hough 1992) Recent research in particular, has focused on a six-factor taxonomy of personality. This six factor model includes the previously mentioned five factors, and maintains that lexical analysis of European languages, including English has revealed a sixth factor labelled Honesty/Humility (Ashton, Lee & Goldberg, 2004).

Despite the criticisms of the Five Factor Model, the theory has gained much credence. The reasons for this have ranged from its replication across different cultures and languages (Digman, 1990), to its emergence as a useful tool in personnel selection.

Barrick & Mount (1991) in their meta-analysis of personality research studies involving job performance criterion from several different occupations, illustrated the predictive validity of the Conscientious trait for all criteria. Extraversion too, was able to predict job performance criteria in jobs involving a high amount of interpersonal interaction such as sales (Barrick & Mount, 1991). This research has been supported by further meta analysis conducted by Mount, Barrick & Stewart (1998) who replicated the findings of the predictive validity of the Conscientious scale and also found evidence that Emotional

Stability and Agreeableness were strongly related to job performance in work situations involving teamwork. While the numerical value of personality factors may remain in contention, it seems reasonable to accept the five-factor model as displaying value for use in organisations.

2.3.2 Personality Research in Aviation.

Personality research in aviation became important due to the increase in costs associated with training undergraduate pilots in the military. The selection systems used in National Air Forces, such as New Zealand and the United States already include tests of potential technical skills such as cognitive and psychomotor abilities, but it is evident with the continued failure of a portion of pilot students in military undergraduate training that other factors must also account for training success (Carretta & Ree, 1996; Carretta, 2000). Early research into personality tests as valid measures for selection yielded disappointing results. Several meta-analysis found the predictive validity of personality tests in pilot selection to be at best marginal, as compared to cognitive intelligence tests (Hunter & Burke, 1994; Dolgin & Gibb, 1989). The criticism of these results centred on the use of inappropriate measures, such as the MMPI which was originally designed to detect personality disorders and generally only taps into one of the five factors; Emotional Stability (Retzlaff & Gibertini, 1987). However other personality tests were used, such as Eysneck's Personality Inventory (EPI), which had two of the five scales, Neuroticism (Emotional stability) and Extroversion. Significant correlation was found between high Introversion scores, low Neuroticism scores and pilot training pass rates (Jessup & Jessup, 1971). Bartram and Dale (1982) showed in their research, using the EPI, that candidates applying to the military for pilot positions are generally more emotionally stable and more extroverted than the general population, further, those who pass flying training are even more stable and more extrovert – conflicting results to the study by Jessup & Jessup (1971). Bartram (1995) also found a strong effect of self-selection, where certain personality types that were highly motivated generally selected themselves for pilot roles. This penchant for certain personalities to apply for pilot positions tends to be a confounding factor in personality research related to selection, as the question may be asked whether motivation to succeed can compensate for personality

weaknesses (Bartram, 1995). 'Motivation to succeed' has been classed by some researchers, to be a component of the factor Conscientiousness (Dolgin, 1990). However no relationship between conscientiousness or a similar factor was revealed in Bartram's study (Bartram 1995).

A limitation of these criterion studies was that personality was being researched as a predictor for training success when initially students undertaking pilot training fly predominantly in single pilot aircraft and interact only with the instructor. Chidester et al. (1990) proposed that personality measures would be more predictive of pilot performance in the operational work environment where personality becomes a more important factor in the interaction with crewmembers.

2.3.3 Personality Research and CRM.

Personnel selection is not the only area for personality research application in aviation. Researchers became interested in what personality types existed in the pilot population and how this related to current performance. Retzlaff and Gibertini (1987) analysed 350 US Air Force personnel finding significant differences between males in the general population and male pilots who displayed higher levels of dominance, competitiveness and achievement orientation. Of interest are the three distinct personality clusters that arose out of this study, which the researchers labelled 'Right Stuff', 'Wrong Stuff' and 'Company Man' (see table 2 for descriptions). The results of this study dispelled the commonly held axiom that there is only one personality type among pilots. Historically, pilots were idealised as heroic, fearless individuals, highly motivated and intelligent, known for having the 'right stuff' (Helmreich & Foushee, 1993; Retzlaff & Gibertini, 1987).

In order to determine the impact of personality on CRM training, Chidester et al. (1991) investigated the personality types that exist among military pilots and how, after training, these impacted attitude changes. These researchers focused on two critical personality dimensions, which they identified as 'Instrumental' and 'Expressive Traits'. Instrumental traits are those commonly associated with masculinity, task and goal focused,

achievement orientated and competitive. Expressive traits are those that are related to interpersonal interaction and are strongly associated with femininity. These traits include sensitivity, compassion, kindness and interpersonal warmth. The previously held assumptions about masculinity and femininity suggested that these constructs were bipolar opposites, or on the same continuum, as reflected by the singular factor of rugged individualism or masculinity in popular personality taxonomies (Hough, 1992; Kamp & Gough, 1986). Spence (1980) argued that these traits are independent of one another, and can coexist within the same individual, for example a person could be high on masculine/instrumental traits as well as high on feminine/expressive traits. The significance of these traits lay in relation to cockpit management concepts, which were based on the assumption that to be effective at cockpit management pilots would have to display both achievement orientation and interpersonal orientation. Application of Cluster Analysis by Chidester et al. (1991) revealed three personality clusters: 'Positive Instrumental/Expressive', 'Negative Instrumental' and 'Low Motivations'. Although different personality measures were utilised these personality clusters bare a remarkable resemblance to those found by Retzlaff & Gibertini (1987), (see table 2). The results of Chidester and colleagues were also replicated in a sample of military cadets from Norway (Sandal et al., 1998). Chidester and colleagues found that personality type did have a significant effect on crew resource management training in that individuals who were labelled 'Positive Instrumental/Expressive had the most favourable attitudes to CRM concepts, whilst those in the Low Motivation cluster not only did not display positive attitudes towards CRM, their attitudes changed in the opposite direction to those advocated. The cause of this negative attitude change, referred to as the 'boomerang effect', may not solely be explained by the personality of the individual, further empirical evidence is needed to determine other mediating factors (Salas et al., 2001).

In addition to impacting on CRM training the personality type of pilots has an effect on the application of CRM principles in the Cockpit. Bowles, Ursin and Picano (2000) found that crews operating under a Captain classified into cluster one out-performed, with less errors in flight, and less stress, crews operating under captains' with cluster two and three personality types. Air force cadets who were high on the instrumental and expressive

traits, characterising good CRM performers, where also shown to have superior coping in stressful situations (Sandal et al., 1998).

Table 2. Descriptions of three pilot personality types taken from Retzlaff & Gibertini (1987) and Chidester et al. (1991).

	Sample	Cluster One	Cluster Two	Cluster Three
Retzlaff & Gibertini (1987)	350 US Air Force Pilot trainees	Labelled “Company-man”. Less impulsive and aggressive than cluster two, displays dominance, achievement, endurance, affiliation and order. Lower on thrill seeking and playfulness.	Labelled “Right Stuff”. Characterised by high levels of aggression, dominant, impulsive, exhibitionist. Low on autonomy and self-direction.	Labelled “Wrong Stuff”. Individuals are cautious, polite, conforming, and compulsive. Low on exhibition and understanding. Follow rather than lead.
Chidester et al. (1991),	531 US Air Force Pilots	Labelled “Positive Instrumental/Expressive”. Above average instrumentality, expressivity and mastery. Low on aggression, team players. Optimal personality for CRM.	Labelled “Negative Instrumental”. High on verbal aggressiveness, rugged individualist, not team players. High on mastery and competitiveness.	Labelled “Low Motivation”. Low expressive and instrumental traits. Some elevation on verbal aggressiveness.

It is widely recognised by psychologists that personality traits are generally stable over time (Chidester et al., 1991), consequently, while CRM training may educate aviators about the impact of their personality on performance, it is unlikely that training will alter personality. However, it is important to be aware of the relationship that personality has with the more malleable attitudes that pilots and aircrew may hold in order that these attitudes may be more effectively changed, and thus influence performance. Personality traits have been directly linked to hazardous attitudes, for example pilots who displayed a macho hazardous attitude were found to be higher on a measure of internal control than pilots who were predominantly impulsive or invulnerable in their attitudes (Lester & Bombaci, 1984).

2.3.4 Summary.

Chidester and colleagues (1991) hold that 'pilot performance can be construed as a product of skill, attitudes and personality factors' (p25) thus in order to effect flight safety by improving the performance in pilots, personality issues in crew resource management need to be addressed. Specifically aircrew should be aware of the different personality types that commonly exist within the pilot population, right stuff, wrong stuff and company man. If aircrew are made aware that a person with a difficult personality may also harbour hazardous attitudes that lead to unsafe behaviours, then action can be taken to initiate training or to curb poor behaviours.

2.4 CRM Training Evaluation

2.4.1 Maximising CRM Training Effectiveness

The evaluation of an organisation's training programme that has developed from a foundation of a needs analysis ensures credible, useful and applicable results. A thorough needs analysis will include the programmes 'fit' with the organisation and its work schedule, along with a task and person analysis covering the required knowledge, skills, abilities and attributes of the trainees (Tannenbaum & Yukl, 1992).

The purpose of a comprehensive organisation, task and person analysis is to produce a relevant set of objectives which the design and delivery of the training are based on and that incorporate the criteria for the evaluation process. The effectiveness of any training programme will be a function of a combination of several input variables including the quality of the needs analysis as illustrated in figure 6.

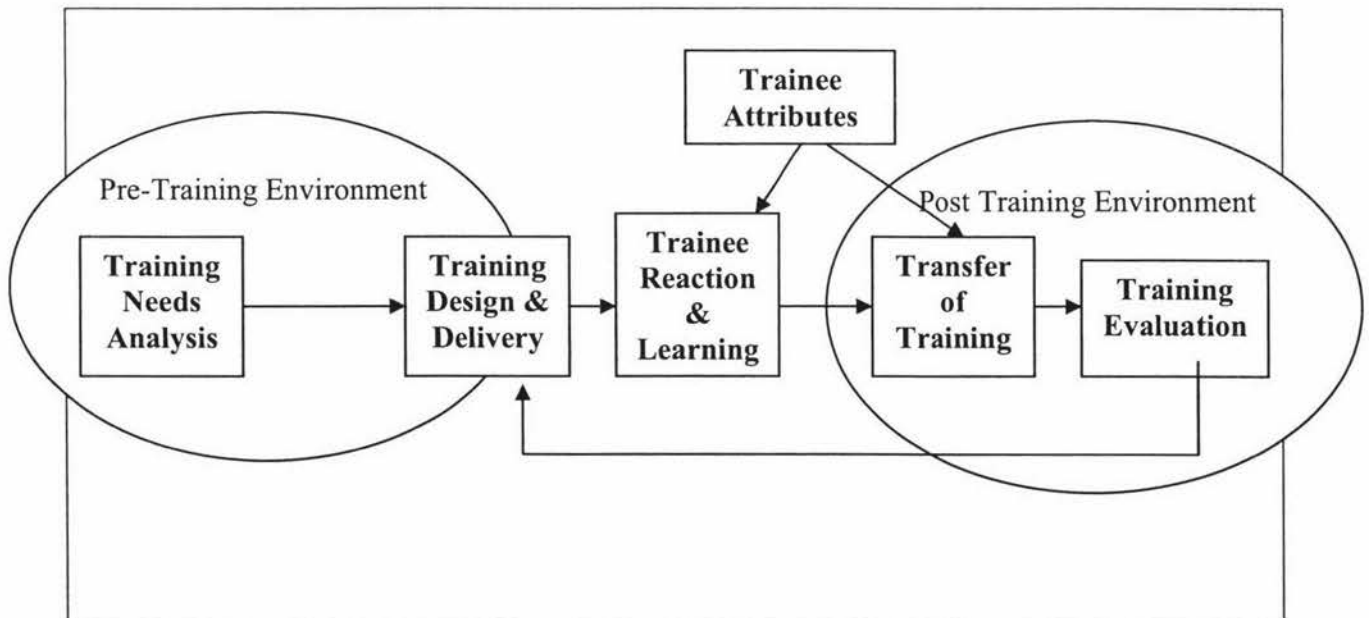


Figure 6. Conceptual model of the factors effecting training effectiveness.

In the context of flight safety Helmreich & Foushee (1993) illustrated the input and process variables that contribute to the performance of flight crews in operations (see figure 1). These input variables also influence the effectiveness of CRM training within an aviation organisation. Researchers have shown that the pre-training environment, or the culture of the organisation, will effect how training is viewed and accepted by employees (Tannenbaum & Yukl, 1992). Employees with supportive supervisors are likely to enter into training with more positive attitudes (Cohen, 1990). In addition, when the trainee returns to the operational environment the new behaviours should be reinforced to prevent the training being rendered ineffectual. A positive post-training environment should manifest itself in the form of open communication, management commitment to safety principles, and positive attitudes and behaviours being displayed by senior staff or in the case of aviation, check airmen and captains (Helmreich et al., 2001). The trainee characteristics, such as personality and attitudes have also been shown to influence CRM training effectiveness (Chidester et al., 1990). The training design and delivery should take into account its target audience. With CRM training there are several programmes available that have been designed specifically for commercial airlines, these programmes may not translate to general aviation personnel or military personnel (Sherman, 2003; Prince & Salas, 1993).

2.4.2 Training Evaluation Model

Training initiatives can be costly to an organisation, in terms of finances, time and personnel not performing their usual duties. Training evaluation is necessary and important to justify the existence of the programme by elucidating how it contributes to the organisational objectives and outputs (Kirkpatrick, 1998). Researchers in training development agree that, not only is training evaluation worthwhile in terms of justification of costs, but it is crucial for providing feedback on the effectiveness of the design and delivery of the training, and whether it is meeting the needs of the organisation (Tannenbaum & Yukl, 1992; Alliger et al., 1997). Training evaluation can answer the following questions:

- How do the trainees feel about the training, and do they find it useful?
- Are the trainees learning the material?

- Does the training transfer to the operational environment?
- Does the training fulfil its purpose (for example, increasing safety in the workplace)?

The most prevalent framework of training evaluation in both military and civilian organisations is Kirkpatrick's four level model (Kirkpatrick, 1998; Nullmeyer & Spiker, 2003; Alliger et al., 1997). Kirkpatrick's taxonomy of training criteria includes reaction; the affective reactions of participants as well as their perceptions of its utility, learning; the extent to which participants increase their knowledge base, change required attitudes or gain skills for use in the workplace, behaviour; the transfer of learning to behaviour changes at work, and results; the final outcome for the organisation. The value of information and the frequency with which organisations employ evaluations at each of these levels varies greatly and depends significantly on the ease of use and cost involved in the process itself (as depicted in figure 7).

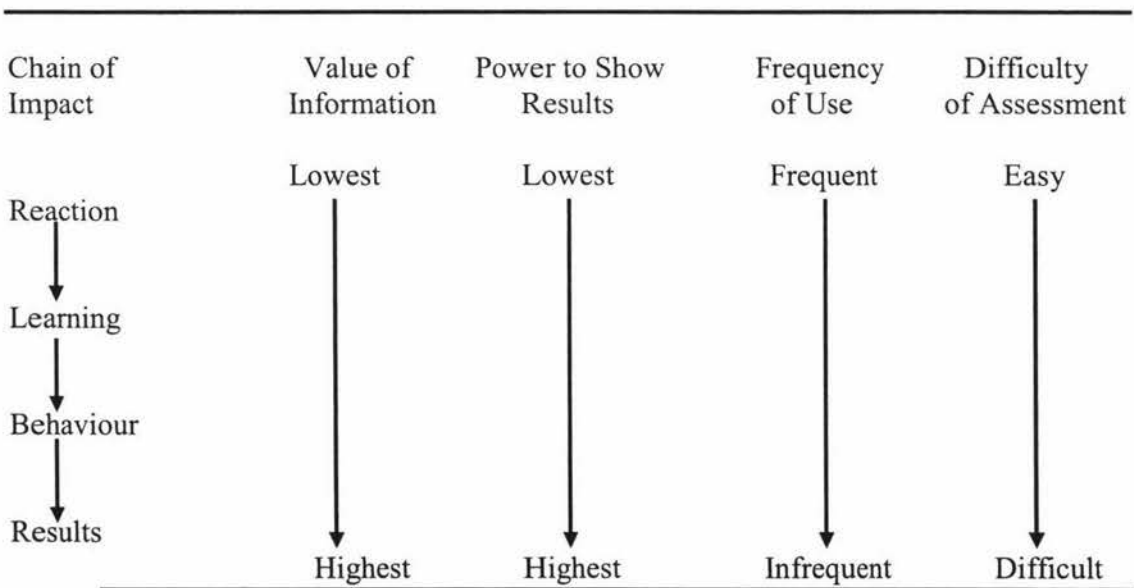


Figure 7. Characteristics of Kirkpatrick's evaluation levels (adapted from Phillips, 1996).

Reaction

In a meta-analysis of CRM training evaluation studies, Salas et al. (2001) found 44% of their sample studies employed this level of evaluation. Evaluations at this level of Kirkpatrick's model generally involve the use of surveys and questionnaires to ascertain how participants felt about the training. In general participants have been reported to have positive affective responses to CRM training (Salas et al., 2001) however a suggestion put forth by Alliger et al., (1997) is researchers should focus on the participants judgements of the utility of the training programmes. Nine out of the 58 studies assessed by Salas and colleagues investigated the perceived utility of the training, finding overall participants felt that CRM training is useful and applicable. Participants can also inform on effectiveness of the training delivery. Indeed Schiewe (1995) found CRM trainees reacted more favourably to participative teaching styles involving case studies and role-plays as opposed to lecture style formats. Despite the ease of use of evaluation techniques, at this level, the information gained is rather limited. While it is important for training to have face validity for the participants this type of evaluation does not provide information on whether training goals and organisation objectives have been met.

Learning

To illustrate that learning has occurred in normal training environments participants are generally assessed in tests of declarative knowledge (Alliger et al., 1997). However, with CRM training the most common evaluation method is the measurement of a change in attitudes to flight safety and crew management issues as measured by the CMAQ (Helmreich, 1984; Salas et al., 2001.). Several studies using attitude change as an index of learning have illustrated the positive results of CRM training (Chidester et al., 1991; Alkov & Gaynor, 1991; Brynes & Black, 1993). Attitudes measured by the CMAQ have also been found to be significant predictors of pilot behaviour (Helmreich et al., 1986). Whether participants retain the learned material over time is contentious. Brynes & Black (1993) study of delta airlines found that positive CRM changes remain stable over a five year period however; other researchers posit that the attitude changes elicited from CRM training are likely to decline over time (Helmreich et al., 1999). The level at which the positive flight safety attitudes will be retained are likely to be a function of the supportive

post-training environment into which participants return (Salas et al., 2001; Helmreich et al., 1999).

Behaviour

The third level of evaluation proposed by Kirkpatrick is behaviour. This level specifically refers to the application of the knowledge; skills and abilities gained in the training environment to the operational environment, and are often referred to as 'transfer of training' (Cheng & Ho, 2001). The methodology for measurement at this level of evaluation can involve pre- and post-training measurements of participants' workplace job performance or a comparative look at the performance of trained and untrained individuals. Meaningful evaluation of CRM competencies in the operational aviation environment has proved problematic. The problem is twofold. First, CRM skills are in the main poorly defined and thus difficult to measure. For example one of the aims of CRM training has been to improve the decision-making abilities of the crew (Orasanu, 1993), but because decisions are processed cognitively they may not manifest in behaviours until they reach an end-point, making observations and measurements difficult. Asking the trainee to verbalise their thought process helps to overcome this problem. Another example is the CRM objective to improve teamwork. Until the definition of teamwork is standardised and mitigating factors such as personality are addressed evaluation results will continue to be confounded. Second, the operational constraints in data collection can pose difficulties (Nullmeyer & Spiker, 2003) for example observing aircrew in an operational environment or in high-fidelity simulators, if available, can prove time consuming and expensive.

Researchers in CRM evaluation tend to use behavioural marker check sheets and behavioural observations forms (Flin & Martin, 2001; Nullmeyer & Spiker, 2003; Salas et al., 2001). The content of these behavioural marker systems vary between organisations and recommendations have been made to limit behaviour markers to observable phenomenon such as 'communicates that a decision has been made' as opposed to 'makes a decision' (Flin & Martin, 2001). A critical factor in the collection of data for the behavioural level is the reliability of the ratings. Flin and Martin (2001) posit

the importance of training those who will observe CRM behaviours to ensure inter-rater reliability.

Despite the obstacles involved in the methodology at this level, researchers have found positive results (Salas et al., 2001). Helmreich et al. (1986) found that training in CRM increased the likelihood that crews would be rated as above average performers. Byrnes & Black (1993) also reported improved behaviours towards flight attendants by the CRM trained cockpit crew of Delta Airlines. Salas, Prince, Bowers, Stout, Oser & Cannon-Bowers (1999) found crew performance had an average increase of 8% - 20% after CRM training was implemented.

Results

The impact of training on the organisation in terms of increased safety and profits is difficult to determine due to the host of mediating variables. In the meta-analysis of CRM training studies by Salas & Colleagues (2001) only six studies used the results of evaluation. The measurement of aviation accidents to evaluate CRM training improving flight safety is unrealistic as crashes rarely occur, also it is unviable to measure good examples of CRM effectiveness in terms of accidents that do not happen. However, studies investigating aviation incidences such as Alkov & Gaynor's (1991) study of naval aviators found a reduction in mishaps after CRM training had been initiated.

Multilevel Evaluation

Each level of evaluation provides information on the effectiveness of any training programme. Therefore, in order to acquire a comprehensive picture of areas requiring improvement, and identify benefits to the organisation, a multilevel approach to training is recommended (Salas et al., 2001). Only one study out of 58 evaluated CRM training on all four levels of Kirkpatrick's model and ten studies evaluated on three levels in the meta-analysis by Salas and Colleagues. The challenge is finding new and reliable ways of gaining data on CRM related competencies. To this end Nellmeyer & Spiker (2003) have posited the use of alternative forms of data such as instructor comments on student performance reports. It is also essential to factor in confounding variables such as

personality traits and culture when evaluating CRM training (Chidester et al., 1990; Helmreich et al., 1999). Clarifying the CRM objectives prior to training and eliminating vague behavioural descriptors can streamline the evaluation process and find significant training effects.

2.4.3 Defining the Research Problem

This literature review has illustrated the importance of crew resource management training to the aviation environment and how different input factors, such as individual skill level, attitudes and personality combined with group process factors will produce outputs such as mission performance and flight safety (Helmreich & Foushee, 1993). The culture of the organisation has also been highlighted as an important variable in not only the current flight safety practices of aircrew, but also in terms of the design of training interventions. With regard to the current study, the RNZAF is the target organisation, thus such things as the military structure of the organisation and the differing cultures within each squadron should be taken into account for the design and delivery of CRM training. This study will evaluate the current CRM training implemented by the RNZAF Flight Safety Office.

Aims of the Research:

- To determine the reaction of RNZAF Aircrew to CRM training.
- To establish whether Aircrew learn the material presented in the CRM training.
- To develop a tool for measuring CRM Behaviours in RNZAF Aircrew, and further to use this tool in determining whether Aircrew who undertake CRM training display a higher level of CRM behaviours compared to Aircrew who have not undergone training.
- To identify personality characteristics that may mediate an attitude change in CRM training.
- To identify whether these personality characteristics also mediate the relationship between CRM attitudes and behaviours.

2.4.4 Hypothesis

As previous research has shown, CRM training has generally been well received by aircrew in both military and commercial aviation (Salas et al., 2001). However following recommendations from Alliger, et al (1997) this study will focus on the perceived utility of the training to aircrew in the RNZAF:

H 1: At the reaction level of evaluation, the topics taught within the RNZAF CRM training will be found to be useful by the majority of aircrew who undertook the training in all three courses evaluated in this study.

The RNZAF CRM training is shorter in duration and limited in resources in comparison to training programmes from the U.S.A., however despite this it is likely that aircrew will still learn valuable skills from the course. As with results found by Chidester et al., (1991), Helmreich, (1984) and Helmreich et al, (1986), it is likely aircrew attitudes towards flight deck management will improve:

H 2: At the learning level of evaluation, CRM training will produce a positive attitude change towards acceptable behaviours on the flight deck, as measured by the CMAQ.

The research by Chidester and colleagues (1991), found different pilot personality profiles, determined by Cluster Analysis predicted different attitude changes post CRM training.

H 2a: The attitude change elicited from the training will be mediated by personality characteristics, specifically extroversion, agreeableness and expressiveness, traits relating to interpersonal skills.

Unfortunately, due to the nature of work within the RNZAF, the researcher was unable to collect pre CRM training behavioural data, thus the only means of behavioural level analysis comes from comparing the behavioural skills of aircrew who have completed

training to those who have not. This is not ideal, as from this it cannot be determined whether individuals have improved post training, as previous research has determined (Helmreich et al., 1986). Therefore in a between groups comparison:

H 3: At the behavioural level of evaluation, Aircrew who undertook CRM training will display high levels of CRM competencies than Aircrew who have not undertaken training.

Personality research in CRM has focused on domains that relate to sociability and interpersonal relations. The two traits that have received the most attention in the CRM literature have been Instrumental or agentic traits, stereotypically associated with men and Expressive or communal traits, stereotypically associated with women (Chidester et al., 1991, Retlaff & Gibertini, 1987, Sandal et al., 1998). Thus in concert with these findings:

H 4: Aircrew who score higher on measures of Agreeableness, Instrumentality and Expressivity will also display higher levels of CRM competencies.

H 5: Personality traits relating to interpersonal skills, such as agreeableness and expressivity will mediate the relationship between attitudes post CRM training and CRM behaviours post training.

CRM training and human factors training has been previously focused predominantly on pilots and on the relations between the Captain and the first officer or flying and non-flying pilot. This is still reflected in the examples and case studies used in many CRM training courses, including the RNZAF course, despite the move towards incorporating other aircrew trades. Therefore:

H 6: CRM training will be more effective for pilots than for non- pilot trades.

Chapter Three: Methodology

3.1 Organisational description

The RNZAF is a military arm of the New Zealand government concerned with such things as air movement of troops and personnel, search and rescue and monitoring of New Zealand and Pacific waters. The RNZAF employs 349 Aircrew, 211 of which are Officers and 138 are Non Commissioned Officers (NCO)⁷.

Squadrons

A division or unit of an air force is referred to as a squadron. Within the RNZAF there are five flying squadrons, three operational and two training. These squadrons comprise of a number of aircraft, aircrew personnel, ground crew personnel and support personnel. The RNZAF also provides an operational support squadron for the Royal New Zealand Navy aircraft, located within RNZAF base Whenuapai. In order to understand the functions of the different aircrew positions it is important to place them in the context of their squadrons, for example the role of a navigator or pilot may vary depending on their aircraft type specific to each squadron. The following is a synopsis of the roles, functions and attributes of each of the flying squadrons in the RNZAF, including Naval Support Flight:

- 40 Squadron: This squadron operates five C130 Hercules aircraft and two Boeing 757-200s. The primary functions of this squadron are strategic and tactical air transport along with support to government and Antarctic operations. This squadron is also involved in disaster relief, humanitarian operations and medical evacuations. Aircrew in this squadron operate in crews of up to six people and roles include pilots, navigators, air engineers, parachute jump instructors and air loadmasters.
- 5 Squadron: This squadron operates the P3-K Orion and is primarily responsible for maritime surveillance and reconnaissance, search and rescue and patrolling the

⁷ See Glossary for description of NCO

exclusive economic zone. Aircrew operating in this squadron includes pilots, navigators (NAV), tactical coordinators, air engineers (AIRENG), air electronics operators (AEOP) and air ordnancemen. A crew on the Orion aircraft can include up to 11 people.

- 3 Squadron: This squadron operates 14 UH-1H Iroquois Helicopters, 5 Bell-47 Sioux Helicopters. The primary functions of this squadron are search and rescue, operational support for the New Zealand army, support for the New Zealand Police and other government agencies and VIP transport. Aircrew roles within this squadron include pilots and helicopter crewman (HCM). A 3-squadron crew consists of three members, two pilots and a HCM.
- 6 Squadron /Naval Support Flight⁸ (NSF): NSF is a unit within 3 squadron that maintains the five SH-2G Sea sprite Helicopters that are operated by Royal New Zealand Navy (RNZN) personnel. The primary functions of this unit are surveillance-based missions from RNZN Ships. Aircrew roles in this squadron unit include pilot, tactician (navigator) and helicopter crewman.
- 42 Squadron: This squadron operates five-twin engine Beech King Air B200 aircraft. The primary function of this squadron is the second phase of pilot training, conversion to the multi-engine aircraft. This squadron also carries out VIP transport duties. Pilot is the only aircrew role within this squadron. A crew of two pilots, one usually under training generally operates the aircraft, however one pilot can fly the aircraft.
- Pilot training Squadron (PTS): PTS operates 13 CT-4E Airtrainers and its primary role is pilot training for RNZAF and RNZN pilot trainees. The Airtrainer has dual controls and is generally operated two pilots, an instructor and trainee, although trainees must complete a Solo-flying phase.

Personnel

Personnel within the RNZAF undergo comprehensive training for their particular trade as well as initial training on entry. Officers, which range in rank from Pilot Officer through to Air Marshal, must all undergo a five-month initial officer-training course (IOTC) at

⁸ Naval Support Flight changed it's name to 6 Squadron during the write up of this thesis.

RNZAF base Woodbourne on entry into the RNZAF. This training consists of basic military skills, military history and tradition, and leadership skills. Further training is required at certain levels of promotion, such as the Senior Staff course, which marks the transition from Flight Lieutenant to Squadron leader. Once commissioned, the Officer then must undergo specific training for the particular trade they were selected for. For example pilots undergo an intensive 18 month pilot training course at Ohakea Air Base. Table 3 represents the current number of Aircrew Officers, during this data collection phase of this study, that are employed in the RNZAF⁹.

Table 3: The number of RNZAF Aircrew Officers currently employed in each trade.

Aircrew Officers Trade	Number of Personnel
Air Electronics Officer (AEO)	18
Air Engineering Officer (AIRENGO)	7
Helicopter Crewman Officer (HCMOFF)	2
Air Load Master Officer (ALMOFF)	8
Navigator (NAV)	46
Parachute Jump Instructor (PARA)	3
Pilot	127

NCO aircrew, ranging in rank from Corporal to Master Aircrewman, undergo a three-month recruit-training course, which teaches basic military skills, and also further training relating to their trade. Table 4 shows the number of NCO Aircrew employed by the RNZAF, during the data collection phase of this study.

⁹ Some of the Aircrew Officers in this table may not be operational active, as through promotion Aircrew Officers may end up in ground duties, but still be current in their trade. The Chief of Air Force, for example is a pilot.

Table 4: The number of RNZAF NCO Aircrew currently employed in each trade.

Aircrew NCO Trade	Number of Personnel
Air Electronics Operator (AEOP)	33
Air Engineer (AIRENG)	26
Air Load Master (ALM)	18
Air Ordnanceman (AOM)	8
Flight Steward	19
Helicopter Crewman (HCM)	29
Parachute Jump Instructor (PJI)	5

3.2 Participants

All participants in this study were members of the New Zealand Defence Force, predominantly the RNZAF, however six were from the RNZN, based at Naval support flight, Whenuapai Air Force Base. These six were all aircrew with equivalent positions and ranks to RNZAF personnel.

Experimental Group.

The experimental group included 45 RNZAF and RNZN aircrew that undertook one of three CRM training courses during 2005. Personnel were self selected for these courses or were asked to attend by their Commanding Officers. The existence of this research project had no relation to who signed up for the CRM training. Only personnel who were working in operational squadrons were included, as participants whose behaviour could not be measured due to leave, or ground duties were excluded. The age range of participants in this group was from 20-53. Only one of the participants was female¹⁰. Table 5 shows the dispersion of participants in trades across squadrons. Table 6 shows the ranks of participants across squadrons.

¹⁰ There was subsequently only one female in the control group as well.

Table 5: Number of Experimental group in each trade across squadrons.

		Aircrew Position						Total
		HCM	AIRENG	ALM ¹¹	AEOP/AEO	NAV	PILOT	
S Q N	40		3	4		4	2	13
	NSF	2				3	2	6
	3	1					6	7
	42						5	
	5			1	6	1	1	9
	PTS						4	4
	Total	3	3	5	6	8	20	45

Table 6: Number of each experimental group of each rank across squadrons.

		Aircrew Rank							SQNLDR
		CPL	SGT	F/S	MACR	PLTOFF	FGOFF	FLTLT	
S Q N	40	2	2	2	1	3	1	2	
	NSF	2						3	2
	3		1				1	5	
	42					1	3	1	
	5	3	1	2				3	
	PTS							3	1
	Total	7	4	4	1	4	5	17	3

Control Group

The participants in the control group were Aircrew personnel from the RNZAF that did not partake in the CRM training offered by the RNZAF Flight Safety Office this year. The control group participants were selected by the Assistant Director of Career Management, who sent the researcher a list of personnel currently operational on each Squadron, who had not undergone CRM training in the last year and who might be able to participate in the study. They were chosen based on similarity in trades to the Experimental group. There were no Flight Stewards or Parachute Jump Instructors on this list, as these trade groups were not represented in the Experimental group.

¹¹ Due to the similarity in roles, Air Load Masters and Air Ordnanceman have been classified under the same heading of ALM.

There were originally sixty names on the list, and all sixty were sent out research packs. 38 of these people returned their questionnaires. Reasons for not returning packs included time constraints, unwillingness to participate and individuals that had received CRM training in the last two years. The age range was between 23-44. Only one participant in this group was female. Table 7 shows the distribution of Aircrew trade across squadrons and Table 8 shows the distribution of rank across squadrons.

Table 7: Number of control group aircrew in each position across squadrons.

		Aircrew Position						Total
		HCM	AIRENG	ALM ¹²	AEOP/AEO	NAV	PILOT	
S Q N	40			2		5	5	12
	NSF						1	1
	3	3					7	10
	42							
	5		2		4	5	2	13
	PTS						2	2
	Total	3	2	2	4	10	17	38

Table 8: Number of control group of each rank across squadrons.

		Aircrew Rank							SQNLDR
		CPL	SGT	F/S	MACR	PLTOFF	FGOFF	FLTLT	
S Q N	40		1		1		2	7	1
	NSF							1	
	3		2	1			2	4	1
	42								
	5		3		2		3	4	1
	PTS							2	
	Total		6	1	3		7	18	3

3.3 Materials

- **NEO-FFI:** The NEO Five Factor Inventory (NEO-FFI) is a self-report personality measure intended to capture five of the major dimensions of personality: Neuroticism (N), Extraversion (E), Openness to Experience (O), Agreeableness (A) and Conscientiousness (C). The NEO-FFI is a 60-item

¹² Due to the similarity in roles, Air Load Masters and Air Ordnanceman have been classified under the same heading of ALM.

measure, with 12 items per factor, and is a shortened version of the original 240-item measure- the Revised NEO Personality Inventory (NEO PI-R). The items for the NEO FFI were chosen based on the 12 items with the highest homogeneity and the lowest correlations with the rest of the factors (Costa & McCrae, 1992). The NEO-FFI uses a five point Likert scale from strongly disagree to strongly agree. An example of a question would be:

I am not a worrier

Strongly Disagree Disagree Neutral Agree Strongly Agree

The test-retest coefficients for the NEO FFI are acceptable at 0.79, 0.79, 0.80, 0.75, 0.83 for the N, E, O, A and C scales respectively (Costa & McCrae, 1992). Egan, Deary & Austin (2000) using British samples, found high reliabilities for the five scales: 0.87, 0.74, 0.72, 0.74, 0.74 and 0.84 for the N, E, O, A, and C scales respectively. Analysis of scale reliabilities in the current study revealed Cronbach's alphas of 0.79, 0.72, 0.63, 0.77 and 0.83 for the N, E, O, A and C scales. These values are similar to previously found alphas, with exception of the Openness scale. This may be due to the small sample size in this study and the relatively low power. The NEO-FFI has been found to be less reliable than the NEO PI-R, however the benefit of this shortened test is that it is convenient to use, only taking 10-15 minutes to complete. See Appendix 6 for descriptions of NEO FFI factors.

- **PAQ:** The Personal Attributes Questionnaire (PAQ) is a measure of gender related personality traits (Spence & Helmreich 1978). The PAQ consists of three scales with 8 items per scale. The scales were originally labelled Masculinity, Femininity and Masculinity-Femininity, but Masculinity and Femininity have since been relabelled Agentive and Communal respectively or Instrumental, Expressive respectively (Hill, Fekken & Bond 2000). In this study these two dimensions shall be referred to as Instrumental (I) and Expressive (Ex). The Masculinity-Femininity (M-F) scale is designed so that one pole of the item is a socially desirable characteristic for Males and the other pole is socially desirable

for females. Each item has a bipolar adjective, with a scale of four points which the test taker responds to, for example:

Artistic 1 2 3 4 *Not at all Artistic*

The test takes participants approximately 8-10 minutes to complete.

The reliabilities of the scales are reasonable, with Cronbach's alpha of 0.78 for the M-F scale and 0.82 for the Ex scale and 0.85 for the I scale (Lester & Bishop, 2000). A study evaluating the PAQ for English and French samples found the internal consistency to be acceptable for two of the three scales I, and Ex with coefficients alpha ranging between 0.74 and 0.83. The M-F scale however was lower, with coefficients alpha ranging from 0.41 to 0.64 (Hill, Fekken & Bond 2000). In the current study scale reliabilities for the PAQ were analysed, with Cronbach's alpha acceptable for the Ex scale at 0.73. The I scale reliability was marginal at $\alpha = 0.65$ and the M-F scale was less than acceptable with an alpha of 0.58. The M-F scale will not be referred to in the results, as it is not useful to this investigation. See Appendix 6 for more details on the I and Ex scales.

- **CMAQ:** The Cockpit Management Attitudes Questionnaire (CMAQ) is a 25-item measure with a four point Likert scale for participants to respond on. The CMAQ took approximately 10 minutes for participants to complete. This measure was designed specifically for use of Airline pilots operating in crews and measures attitudes related to CRM concepts. However in this study it was used for all aircrew in different varying aircraft. Factor analysis of the measure revealed three stable factors, labelled 'Communication and Coordination', 'Command Responsibility' and 'Recognition of Stressors' (Gregorich, Helmreich & Wilhelm, 1990). Helmreich et al. (1986) demonstrated the predictive validity of the CMAQ, when it was demonstrated that the CMAQ could differentiate between high and low performing pilots. The Cronbach alpha for each of the factor scales ranged from 0.47 to 0.67, which is acceptable for scales of such a short length (Gregorich et al., 1990). Reliability analysis in the current study revealed Cronbach's Alpha of 0.73, 0.46 and 0.58 for the three scales, similar to that found by Gregorich et al. (1990). It should be noted that the CMAQ was primarily designed for commercial

airlines in America. However due to the unavailability of a more appropriate measure, this tool was used in the present study.

- ***RNZAF CRM Training Evaluation Questionnaire:*** This questionnaire was designed by the researcher specifically to assess the perceived utility of the RNZAF CRM training, and to gain information on how to improve the course. The evaluation questionnaire contained 18 items. The first 9 items related to the nine topics presented in the course. Participants responded to a four point Likert scale in regards to the usefulness of each section:

<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>
<i>A waste of Time</i>	<i>Not very useful</i>	<i>Useful</i>	<i>Extremely Useful</i>

The remaining questions were designed to gage the participants overall impressions of the course and CRM itself, and also how they thought it could be improved. The RNZAF CRM training evaluation questionnaire is found in the Post Training Booklet in Appendix 2.

- ***Background Information Questionnaire:*** The Background Information questionnaire was used to gain bio data on all participants. This gathered information on Age, Gender, Rank, Tenure in the RNZAF, Crew Position and also the different aircraft that the crew had operated. This can be found in the Pre Training Booklet in Appendix 1.
- ***RNZAF CRM Behavioural Check-Sheet:*** This criterion measure was designed specifically for this study. The researcher obtained an RNZAF CRM Markers sheet¹³ that contained CRM competencies with Pass/Fail marking criteria. This was presented to the CRM instructor, Squadron Leader Saville, who took it to his colleagues, experienced flying instructors, at Central Flying School (CFS) and produced an evolved version of the form with a Likert scale in place of the

¹³ See Appendix 9

pass/fail criterion. The researcher then adjusted and expanded each item to give more clarity. Two experienced senior pilots, checked the measure for wording appropriate to the RNZAF and expanded on some items to produce the final measure (See Appendix 4). The form is designed so an instructor or senior crew member can rate the participants' CRM behaviours on a four point Likert scale from 'Never meets requirements', through to 'Always meets requirements'.

Factor Analysis of the RNZAF Behaviour Check-Sheet revealed four factors (See Chapter Four, section 4.2.1), these factors were labelled Compliance, Communication, Management and Interpersonal Relations. The reliability of these scales was acceptable with Cronbach's alpha of 0.86, 0.90, 0.90 and 0.82 respectively.

3.4 Procedure

The first step in this research project involved gaining the necessary access to participants. The RNZAF Flight Safety Officer was approached and agreed that the evaluation of the CRM training would be useful to the organisation. Permission was gained from Chief of Air Force and the Director of Psychology for the RNZAF to undertake psychological research with defence force personnel. Initially there was to be four CRM courses evaluated, but due to workload pressures for RNZAF personnel this number was reduced to three. Prior to each course an estimate of how many personnel were to attend had to be made, as late entries to the course came as late as the actual first day of each course. This was due to the uncertainty of work scheduling within the RNZAF, which is often subject to unforeseen circumstances, such as the breakdown of aircraft, weather, and government tasking.

The actual lecture content of the CRM course is not presented in this thesis, due to RNZAF intellectual copyright, however the training content was kept constant on all three courses with the exception of discussions that rose from individual questions and examples from participants. The structure of the CRM courses run by the RNZAF differs to some of the CRM training discussed in the literature review, as many of the courses discussed integrated Line Oriented Flight simulations into the CRM training. As no

simulators are available for RNZAF use within this country, the courses were restricted to lecture and discussion format.

During the introduction section of CRM training the researcher was introduced and handed out the Pre-Training Booklet (Appendix 1) and an information sheet explaining the research (Appendix 5). This booklet contained the PAQ, CMAQ, Background information sheet and a consent form. The participants were also handed the NEO FFI. They then filled these forms out in silence and handed them back to the instructor. This process took at least 40 minutes and it was decided that this was too long to incorporate into the course. For the next two courses a Pre-Training Booklet containing the PAQ, Background Information sheet and the NEO-FFI were sent out to participants before the course. They were instructed to complete these forms in a quiet place and then to bring them along to the CRM course. If new participants arrived on the first day with no warning, these people were given the Pre-Training booklet with everything except the CMAQ to take home and send back to the researcher when completed. As personality is generally thought of as stable over time (Chidester et al., 1991), this change should not affect the outcome of the study. The CMAQ however was consistently given to participants at the start of each course to maintain consistency.

At the completion of the training the participants of all three courses were given the Post-Training Booklet (Appendix 3), containing the CMAQ and the RNZAF CRM Training Evaluation Questionnaire. This was then handed back to the researcher before the participants left.

Four weeks after the participants had undergone training the Commanding Officers of each squadron were contacted and asked to appoint qualified instructors or senior crew-members to complete an assessment of each participants CRM behaviours using the RNZAF CRM Behavioural Check-sheet (Appendix 4). The assessors were given instructions to observe each participant on routine flights over a period of a week if necessary to observe all the behaviours on the check-sheet. These were then posted back to the researcher and kept in confidence. Ideally this study would have collected pre-

training behavioural data, however this was not viable due to the uncertain nature of participation in the course. Thus control group data was collected to ascertain between group behavioural differences between those who had or had not undertaking the training.

After the completion of the third course, the researcher contacted the Assistant Director of Career Management (Aircrew), who provided a list of 60 operational aircrew within the RNZAF who had not undergone CRM training that year. This list was a cross section of trades and ranks similar to that of the experimental group. A control group pack containing a consent form, Background Information Questionnaire, PAQ, CMAQ, NEO-FFI and an information sheet was sent out to participants. A letter inviting the recipient to take part in the research project was also included in the pack along with a return envelope. Those who chose to be involved in the research returned the completed forms and then their Commanding Officers were contacted and asked to delegate the assessment of the RNZAF CRM Behavioural Check-sheets for each participant to qualified personnel on the squadron. The data for all participants was then tabulated and analysed and is presented in Chapter Four of this thesis. A time line of data collection events is presented in Table 9.

3.5 Data Analysis.

Initial Analysis

Principal Components Analysis was completed on the RNZAF Behavioural Check-sheet to determine underlying latent factors. Cronbach's alpha for the five revealed scales was also completed. Factor Analysis was not completed on the remaining measures due to the sufficiency of previously reported research on each measure as discussed in the measures section of this chapter. However the reliabilities of each scale were reassessed and reported in chapter 4.

Hypothesis Testing

To determine the difference in attitudes pre and post CRM training a Repeated Measures ANOVA was undertaken using the experimental group data set. A mixed ANOVA was

conducted to determine whether pilots learned more from the training than Non-pilots. Behavioural level analysis consisted of a One Way ANOVA to determine the control group versus experimental group differences in behaviour. Path Analysis was conducted to determine whether personality mediated an attitude change pre to post training. Path Analysis was also used to determine whether personality variables mediated the relationship between post training attitudes in the experimental group and CRM behaviours.

Table 9: Time Line for Data Collection

Date	Activity
May 12-13th	First CRM Course, collected pre & post course data.
June 9th-24th	Collected Behavioural Check Sheet data from first course
August 15th	Send out Pre-Training Pack for second course
August 22-23rd	Second CRM course. Collected Pre-Training packs, administered CMAQ before course, and Post-Training Booklet at conclusion of course.
September 16th	Send out Pre-Training pack for third course
September 19-30th	Collect Behavioural Check Sheet data from second course.
September 22-23rd	Third CRM Course. Collected up pre-training packs, administered CMAQ before course and Post- Training Booklet at conclusion of course
September 28th	Send out control group packs
October 20-28th	Collect Behavioural Check Sheet Data for third course and Control group. Receive control group packs back.

Chapter Four: Results

4.1 Sample Description.

Of the original 53 RNZAF personnel who attended the CRM training in the year 2005, eight were excluded from the study as they were currently in ground crew roles (i.e.; maintenance). The mean, standard deviation and range of the age of the remaining 45 participants and the hours flown by participants with the RNZAF and RNZN in total are presented in Table 10. As previously mentioned, to gain a control group, 60 packs were sent out to operational personnel. There was a 63% response rate; descriptive statistics for age and flying hours of these participants are presented in Table 10.

Table 10: Descriptive statistics of aircrew age and hours flown.

	N	Range	Minimum	Maximum	Mean	SD
Training						
Age	45	33	20	53	29.40	5.64
Hours Flown	45	7588	12	7600	1512	1405
Control						
Age	38	21	23	44	30.34	5.06
Hours Flown	38	7079	325	7404	2249.69	1662.99

4.2 Initial Analysis.

4.2.1 Factor Analysis.

A principal components analysis with varimax rotation was conducted to determine underlying components for the 23 items of the RNZAF Behavioural Check-Sheet (BCS). The Kaiser-Meyer-Olkin (KMO) statistic and Bartlett's test of Sphericity were used to determine if the data was suitable for factor analysis. The KMO was 0.864, which is deemed acceptable (Hinton et al., 2004). Bartlett's test was significant, indicating that there are relationships between the variables and thus a Factor Analysis is suitable. The number of factors chosen was based on the Kaisers Stopping Rule, the method of choosing factors with eigenvalues greater than one (Bryant & Yarnold, 1995). Four factors meeting this criterion were then extracted, the first accounting for 19.89% of the

variance after rotation. The second, third and fourth factors accounted for 18.13%, 17.85% and 13.35% of the variance after rotation respectively. Table 2¹⁴ present the items, factor loadings and communalities for the rotated factors. Items with loadings less than 0.40 were omitted to improve clarity.

Table 11: Factor loadings for the rotated factors on the RNZAF BCS.

Item ¹⁵	Factor Loading				Communality
	1	2	3	4	
4.Uses checklists correctly.	.514		.451		.517
5.Applies SOP appropriately.	.783				.718
14.Makes decisions in the appropriate time.	.633	.425			.685
19. High level of self-discipline.	.705				.629
20. Is assertive when needed.	.545	.520			.633
22. Reacts calmly in emergencies.	.700				.684
1. Uses correct standard calls.	.516	.633			.733
2. Clear, concise briefing technique.		.777			.773
3.Communicates all appropriate info.		.808			.817
6.Sets priorities and order of tasks.	.425	.545			.715
11.Displays perception of environment.		.684	.431		.726
18.Appropriate self-confidence levels.		.586		.477	.680
7.Makes use of all resources, delegates.			.673		.716
8.Conducts tasks in a timely manner.	.437		.539		.510
9.Conducts appropriate risk assessments.	.495		.535		.541
10.Aware of and monitors other crew.			.760		.715
12.Gathers all info for decision-making.	.447	.431	.473		.635
13.Includes all crew in decision-making.			.671		.733
23. Delegates tasks in emergencies.	.453		.536		.641
15.Monitors and evaluates decisions.			.731		.723
16. Displays a positive attitude to tasks.				.905	.837
17. Is able to work with personalities.				.860	.819
21. Recognises errors in self and others.	.458			.665	.734

¹⁴ Loadings presented in bold are the highest loading for each factor.

¹⁵ Abbreviated items. See Appendix 4 for full item descriptions.

Factor 1

Factor 1 loads most strongly onto items 4,5,14,19,20 and 22. These items relate to following set procedures (checklists, SOP's), punctual decisions and personal control in terms of discipline, assertion and composure in emergencies. This factor loads onto items that measure a form of rule adherence and conscientious¹⁶ personality traits; therefore this factor has been labelled 'Compliance'.

Factor 2

Factor 2 loads most strongly onto items 1,2,3,6,11 and 18. The first three items comprise descriptors of communication patterns i.e.; correct calls, clear concise briefing, disseminating information. Item 11 assesses situational awareness, which will once again be manifested in an individual's ability to communicate to the crew impending dangers and information regarding state of the aircraft and environment. Item 18 relates to self-confidence, which in a crew situation will be manifested in ones ability to contribute and communicate ideas and information. Due to the features of these items being predominately associated with communication form and structure, this factor has been labelled 'Communication'.

Factor 3

Factor 3 loads most strongly onto 8 items: 7,8,9,10,12,13,15 and 23. The content of items 7-10 and 23 comprises the management of tasks and people in terms of delegation of tasks, time management, risk assessment, performance monitoring. Items 12,13 and 15 relate specifically to the decision-making process, gathering necessary information, inclusion of other crew in decision-making process and evaluating decisions made. As decision-making is another function of managing situations, this factor has been labelled 'Management'.

¹⁶ See description of Conscientious scale in Appendix 6.

Factor 4

Factor four loads most strongly onto three items, 16,17 and 21. Item 16 and 17 describe interpersonal behaviours, such as a positive attitude to people and work tasks, and the ability to work well with different personalities. Item 21 relates to the acknowledgement of ones own weaknesses and errors and the weakness in others. As these items are all related to interpersonal interaction this factor has been labelled 'Interpersonal Relations'.

4.2.2 Internal Consistency.

Internal consistency for the scales used in this study ranged from 0.475 to 0.902, evaluated using Cronbach's Alpha (see Tables 12 & 13). The command and responsibilities scale and the recognition of stressors scale are concerning at 0.475 and 0.578 respectively. The lower limit deemed acceptable for scale reliability is 0.60 (Hair, Anderson, Tatham & Black, 1998) however previous researchers who utilise the CMAQ have accepted low alpha's for these scales due to the small number of items in each (Gregorich et al. 1990). Analysis utilising these scales should be interpreted with caution.

Table 12: Scale Internal Consistency Reliabilities for the NEO-FFI and the RNZAF Behavioural Check-Sheet (BCS).

NEO-FFI		BCS	
Scale	Alpha	Scale	Alpha
N	0.789	Procedure	0.860
E	0.723	Communication	0.902
O	0.633	Leadership	0.899
C	0.825	Interpersonal	0.819
A	0.766		

Table 13. Scale Internal Consistency Reliabilities for the PAQ and the CMAQ

PAQ		CMAQ	
Scale	Alpha	Scale	Alpha
I	0.654	Com/Coor	0.732
Ex	0.733	Command	0.475
M-F	0.575	Rec. of Stressors	0.578

4.3 Reaction Level Analysis

4.3.1 Training Utility.

Training Group participants were asked to rate the usefulness of each of the nine components of the CRM course. The results for this are presented in Table 14. For each topic, with the exception of Decision-Making, over 90% of trainees found the CRM training to be either useful or extremely useful. With the decision making topic 11% of participants found this topic not very useful. Comments that were handed in at the end of the course reflected that some participants felt a more in-depth decision-making case study could have been used (see Table 14). It is encouraging to see that 50% of participants found the communication section of the training extremely useful, considering communication breakdowns in the cockpit has been previously cited in research as a leading cause of aviation accidents (Billings & Reynard, 1984).

Participants were also asked how useful recurrent training in CRM would be; 63% felt this would be useful and 32% felt that it would be extremely useful. 100% of participants in the training group felt that this training would be useful for other aircrew.

When asked whether the trainees felt that CRM training had the potential to increase safety 33.3% agreed and 67% strongly agreed. No trainee disagreed with this statement. Participants were asked whether they felt that the CRM training would elicit a behavioural change in them. 11% felt that the CRM training would elicit no behavioural

change, 87% felt that it would elicit a moderate change and 2% felt that it would elicit a large change.

Table 14: Aircrew ratings of each topic taught on the RNZAF CRM Training.

Topic	% of Participant Agreement		
	Not Very Useful	Useful	Extremely Useful
Personality		93	7
Human Performance Limitations	7	70	23
Teamwork		62	38
Error Management		84	16
Communication	5	45	50
Situational Awareness	2	68	30
Decision-Making	11	81	8
Workload/Automation	5	72.5	22.5
Briefing/Debriefing	7	80	13

4.3.2. Participants Comments.

The CRM Training Evaluation Questionnaire received by participants at the conclusion of the training, allowed for further comments on what participants felt were good points of the training course, and what they felt could be improved upon. While only a small amount of participants took the opportunity to contribute, a summary of the comments received is presented in table 15.

Table 15: Summary of participant’s comments regarding CRM Training as assessed by the CRM Training Evaluation Questionnaire.

Question	Comments
What aspects of the training were particularly good?	<ul style="list-style-type: none"> • Discussions • Swapping of instructors was good to keep interest • Highlighting other SQN's techniques or lack thereof • The link between SA & CRM that was emphasised • It was good to have reps from each SQN – this is important • Use of positive CRM examples was good
What can be done to improve the training?	<ul style="list-style-type: none"> • Less repetition of content across topics • Individual squadron training for specific aircraft type • More real life examples • Using a particular scenario for the decision-making topic would encourage more discussion • Possibly two courses, one for pilots and one for back-enders • Automation brief was good, but too long
Has the course influenced your attitudes towards the application and management of CRM safety principles?	<ul style="list-style-type: none"> • No, but it reinforced them • No, there was no new information or areas not been seen before • Yes, two days on CRM is more than I've thought about it in a few years of SQN work – SQN life is too busy with secondary duties to pay much attention to increasing CRM on each flight
Additional Comments	<ul style="list-style-type: none"> • It was good to gain other perspectives, although most of the course was pilot orientated. Maybe some examples could be focused on other aircrew • Less PowerPoint lists, better to go in-depth on lesser number of points

4.4 Learning Level Analysis.

4.4.1 Change in Attitudes.

A repeated measures ANOVA was conducted to assess whether there were differences in the mean CMAQ scores for each of the three scales at time one (Pre-training) and time two (Post-training). Results indicate that there was a significant increase in scores at time two on the 'Recognition of Stressors' scale of the CMAQ, $F(1,44) = 24.04, p < 0.001, \eta^2 = 0.35$. There were positive increases in the means on the 'Communication and Coordination' scale and the 'Command/Responsibility' scale, but these were too small to be significant, suggesting that a training effect for increasing positive attitudes in aircrew only occurred in relation to recognition of stressors on the flight deck. The non-significant results found for the remaining two scales could be due in part to the small sample size and low power of this study. The means pre and post training for the three CMAQ scales are presented in Table 16.

Table 16: Means and standard deviations of the three CMAQ Scales pre and post training.

Variable	M	SD
Communication/Coordination		
Time1	37.04	3.10
Time2	37.47	3.18
Command/Responsibility		
Time 1	11.09	1.66
Time 2	11.22	1.68
Recognition of Stress		
Time 1	10.36	1.46
Time 2	11.44	1.60

4.4.2 Repeated Measures ANOVA, Between Groups.

A mixed ANOVA was conducted to determine whether there were differences in pilot and non-pilot attitude scores pre and post training. The null hypothesis was accepted as there was no significant effect for pilot group and time interaction ($F(1,43) = 0.431$, $p=0.515$, $\eta^2=0.10$), suggesting that the training was as effective for non-pilots as it was for pilots. A mixed ANOVA was also conducted to assess if there were differences between NCOs vs. Officers, Large Crew Sizes vs. Small Crew Sizes and Rotary Wing vs. Fixed Wing crews¹⁷, no significant differences were found for any of these interactions. Once again this may be due to the low power of the study as a result of the small sample size.

4.5 Behavioural Level Analysis.

A one-way ANOVA was conducted comparing the mean scores of the training and control groups on each of the scales of the CRM Behavioural Check-Sheet. No significant difference was found with any of the four scales between each group suggesting that participants who have undergone CRM Training display the same levels of CRM behaviours in the operational environment as those who have not undergone training. Table 17 presents the summary statistics from the one-way ANOVA.

¹⁷Large crew vs. small crew 40 & 5: crews of 6 upwards were considered large, where crews of 2-3 were considered small. Rotary wing crews are those from the helicopter squadrons, 3 & NSF.

Table 17: One-Way Analysis of Variance Summary Table Comparing the Training Group to the Control Group on Scores on the Four Scales of the CRM BCS.

Scale	<i>df</i>	SS	<i>MS</i>	<i>F</i>	<i>p</i>
BCS Compliance					
Between Groups	1	3.34	3.34	0.41	0.524
Within Groups	68	555.46	8.17		
Total	69	558.80			
BCS Communication					
Between Groups	1	4.25	4.25	0.67	0.416
Within Groups	61	387.49	6.35		
Total	62	391.75			
BCS Management					
Between Groups	1	24.07	24.07	1.61	0.210
Within Groups	58	868.51	14.97		
Total	59	892.58			
BCS Interpersonal					
Between Groups	1	1.89	1.89	0.69	0.408
Within Groups	71	194.22	2.76		
Total	52	196.11			
Total Score					
Between Groups	1	195.05	195.05	1.95	0.168
Within Groups	71	5590.97	99.84		
Total	72	5786.02			

4.6 Further Analysis.

4.6.1 Regression and Path Analysis.

A simple regression was conducted initially to determine how well flight deck attitudes, as measured by the CMAQ, predict CRM behaviours. The data from the training group was analysed taking the attitude scores post training. Results were statistically significant $F(1,32) = 6.741, p < .05$. The resulting equation to understand this relationship is Total Score on CRM BCS = $-5.05 + 1.26 * (\text{Score on the CMAQ post training})$. The adjusted *R* squared value was 0.152. This means that 15% of the variance in CRM behaviour can be explained by Attitudes measured by the CMAQ.

The small amount of variance explained by the CMAQ may well be due to the limited reliability of the scales. A closer examination of the how well total CMAQ scores

predicted each factor of the BCS was made. A path analysis was conducted to look at the simultaneous regression of total CMAQ to the four factor scales. Figure 8 presents the resulting standardised beta weights¹⁸. Each regression relationship was significant ($p<0.001$).

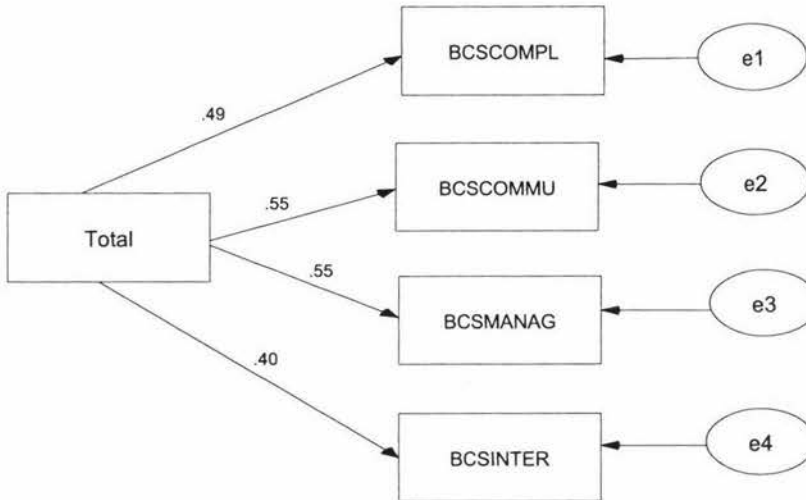


Figure 8: Path diagram depicting the relationship between total attitude scores on the CMAQ and the five factors of the RNZAF CRM BCS.¹⁹

4.5.2 Personality Analysis.

Personality factors were also investigated in order to explain the variance in behaviour. Linear regression revealed that Agreeableness and Conscientiousness significantly predicted the total score on the BCS, $F(2,30) = 6.221, p<0.005$. The adjusted R squared value was 0.25, suggesting that Agreeableness and Conscientiousness together explain 25% of the variance in BCS Total Score.

Personality Differences

A series of one-way ANOVAs were initially conducted to compare the means of personality traits between the training group and the control group, pilots and non-pilots, NCOs and Officers, large crew vs. small crew and fixed wing vs. rotary wing crews. Significant differences were found between pilots and non-pilots for the Neuroticism

¹⁸ In this diagram 'Total' represents the total score on the CMAQ. Error is represented by e1-e4.

¹⁹ Each relationship depicted in this diagram was significant ($p<0.001$)

scale, $F(1,79)=5.461$ $p<0.05$ and the Instrumental scale, $F(1,79) = 4.147$, $p<0.05$. The means and standard deviations are presented in Table 18.

Table 18: Mean and standard deviation for pilot and non-pilot scores on the Neuroticism and Instrumental scales.

Group	Neuroticism			Instrumental		
	N	Mean	SD	N	Mean	SD
Pilots	37	11.49	5.05	37	26.59	1.88
Non Pilots	44	13.95	4.98	44	25.36	2.97

Table 18 indicates that the mean score for pilots on scores of neuroticism is lower than that of non-pilot aircrew, and the mean score for Instrumentality is higher for pilots than non-pilots. There was also a significant difference between officers and NCOs in the means of Extroversion, $F(1,79) = 4.192$, $p < 0.05$, and Expressivity, $F(1,79) = 5.108$, $p < 0.05$. The means and standard deviations presented in Table 19 indicate that Officers score higher on the measures of Extroversion and lower on measures of Expressivity than NCOs.

Table 19: Mean and standard deviation for Officers vs. NCO on the Extroversion and Expressivity scales.

Group	Extroversion			Expressivity		
	N	Mean	SD	N	Mean	SD
Officers	57	33.81	4.02	57	23.37	3.05
NCOs	24	31.67	4.90	24	24.96	2.46

Personality Mediation

The hypothesis that the attitude change from pre-training to post-training was mediated by the personality scales, N, E, O, A, C, I and Ex was investigated using Path Analysis.

The results revealed no significant mediation for any of the individual personality traits in attitude change in the Recognition of Stressors scale.

The relationship between CMAQ attitudes, personality and CRM behaviours was also investigated using Path Analysis. It was hypothesized that certain personality traits would mediate the relationship between attitudes and CRM behaviours. Due to the limited power of this study only one personality scale could be investigated at a time. The personality scale for Agreeableness (A), from the NEO-FFI, was the only trait that showed significant mediation ($p < 0.05$). Figure 9 illustrates the Path Analysis diagram and the resulting standardised beta weights.

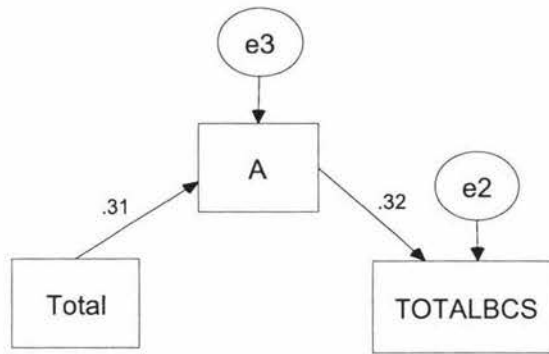


Figure 9: Path diagram depicting the Agreeableness (A) factor mediating the relationship between the total scores on the CMAQ (Total) and the total scores on the Behavioural Check-Sheet (TOTALBCS)²⁰.

²⁰ The circles e2 & e3 represent error variance. Each of the relationships depicted in this diagram were significant ($p < 0.05$)

Chapter Five: Discussion

Research of this nature regarding Crew Resource Management has not been conducted before within the RNZAF; therefore the exploratory nature of this study should be emphasised. Sample size was limited for each analysis but this was an expected consequence of researching in an organisation such as the RNZAF, which is subject to transitory operational demands.

5.1 Reaction Level Evaluation.

This study sought to evaluate the RNZAF CRM training in terms of its perceived utility to operational aircrew. In order for the training to be effective in changing attitudes and behaviour, it needs to be first well received by trainees. The results support the hypothesis that the topics within the training would be found to be useful by the majority of the aircrew who partook in each of the three courses. These results also support the previous findings of Salas and colleagues (2001) who investigated a series of studies evaluating CRM training at the reaction level. At least 89% of trainees in this study found each of the topics to have utility. Of the nine topics taught on this course personality, teamwork and error management were found to be useful by all 45 trainees. Also the communication topic was found to be extremely useful by 50% of trainees. These findings are very encouraging, suggesting that the CRM training had face validity for participants.

Some of the topics were perceived by a small number of trainees as not very useful. The decision-making topic, which outlines the cognitive functions antecedent to decision making in flight operations was perceived as not useful by 11% of trainees. Human Performance Limitations, which teaches about physiological and cognitive processes of aircrew and how such things as fatigue and overload etcetera can affect performance, was perceived as not useful by 7% of participants. It is possible that these topics were not well received due to the psychological nature of the content. For example, within the teaching session on decision-making time is spent outlining the break down of cognitive processes involved in decision-making. Early research into CRM training reported criticism from

pilots as they felt the content was overly psychological (Helmreich, Merrit & Wilhelm, 1999). Suggestions from trainees included a statement that a particular scenario could have been used for the decision-making segment.

Other comments that came through the training suggested that the trainees particularly enjoyed group discussions and wanted more real life RNZAF case studies or scenarios. In order for crew to perceive this training as useful, it needs to be applicable to their work environment. Previous use of management material in CRM training was found to be interesting, but not transferable to the aviation environment (Chidester, 1993). Research by Helmreich et al., (1999) revealed that CRM training packages were not transferable across cultures, therefore in order for it to be well received measures need to be taken to adjust the training to suit the professional, organisation and national culture of the intended recipients. While the training has been well received in this instance, it is noted from comments of trainees that more measures could be taken to make this training more squadron specific and use more real life RNZAF examples.

In order to assess whether the trainees perceived that CRM training actually impacted on flight safety, participants were asked to rate whether the CRM training conducted had the potential to increase safety. 100% of participants agreed with this statement, with 67% of those strongly agreeing. This reflects that trainees do understand the importance of CRM in the context of flight safety, and the benefits that training in this area can have to reduce accidents and incidents. This was further supported by 100% of trainees agreeing with the statement that CRM training would be useful for other aircrew within the RNZAF.

The trainees were finally asked if they believed that the CRM training would elicit a behavioural change in them. Indication of agreement in this statement may reflect the novel nature of the information taught in CRM training to those who have not been taught this or applied its principles previously. 87% of trainees felt that the training intervention would elicit a moderate behavioural change. 11% felt that it would elicit no change. Comments came through from some of the participants that the information

taught was not new to them. This could account for the percentage that did not believe that CRM would impact on their future behaviours.

5.2 Learning Level Analysis.

5.2.1 Attitude Change.

One of the prominent goals in CRM training is for aircrew trainees to converge upon an optimal attitude set, or improve their current attitudes (Gregorich et al., 1991). The extent to which the RNZAF CRM training achieved this goal may be evidenced by an attitude change. At the learning level of analysis, attitude measures were taken pre and post training, to determine if trainees had learned the material as represented by an improvement in attitudes. It was hypothesized that there would be a positive change in attitudes towards CRM principles. The measure that was used for attitudes was the CMAQ. Several problems ensued from the use of this measure. Firstly the measure was designed for airline pilots, thus the terminology was not appropriate to a military cockpit. For example, the measure refers to the relationship between the First Officer and the Captain. In an airliner the Captain is the senior pilot, and the First Officer is the second ranked pilot. In a military crew the Captain of the mission is not necessarily a pilot but may actually be a tactical coordinator (Navigator). Also the junior pilot is referred to as a co-pilot. Secondly, the measure does not incorporate crew that are not pilots, for example Air Electronics Operators. The third reason this measure was not an ideal tool was the low reliabilities reported by this study and others (Gregorich et al., 1990). This information needs to be taken into account when interpreting the results of the training effect on attitude change.

What the results did discover is a significant change in the Recognition of Stressors scale ($p < 0.001$). No significant difference was found for the Communication/Coordination scale or the Command/Responsibility scales, but there were slight increases in the mean. Had the analysis had a larger sample size with greater power, and further had the scales been more reliable an effect may have been determined for these two scales. However

these findings are positive as they suggest that CRM training improves attitudes concerning recognition of stressors, which is an important aspect of CRM.

Recognition of Stressors

The Recognition of Stressors scale contained four items. The interesting thing about each of these items is that the content is not airline specific. This supports the notion that no learning effect was found on the other two scales due to lack of military specific items.

Items in the Recognition of Stressors scale:

- 'Even when fatigued, I perform effectively during critical flight manoeuvres'
- 'My performance is not adversely affected by working with an inexperienced or less capable crewmember'
- 'A truly professional crewmember can leave personal problems behind when flying the line'
- 'My decision-making ability is as good in emergencies as in routine flying situations'

Agreement with these statements denotes a lack of understanding concerning the effects of stressors on performance. The mean scores for this scale pre-training were lower than for all the other scales, indicating that in terms of stressor effects RNZAF had poorer attitudes than those initially held towards Communication/Coordination and Command/Responsibility. In terms of the five hazardous attitudes in aviation, outlined by Lester & Bombaci (1984), the invulnerability attitude, the belief that accidents and bad things cannot happen to one-self, maps most closely onto Helmreich's (1984) Recognition of Stressors scale. Lester & Bombaci (1984) describe pilots who suffer from this attitude to be likely to take more chances and believe that negative consequences will not ensue. Invulnerability can also include a belief in the invulnerability of oneself to stressors such as fatigue. It is encouraging that RNZAF CRM training elicited a change of behaviour in this area, as further evidenced by the FSE reported in chapter one of this thesis, where a pilot who attended this course proceeded to apply CRM safety principles by terminating a flight when he established that fatigue was affecting the performance of his crew and himself. The effect size of this change was relatively small suggesting there is room for improvement in the attitude set.

The results of this analysis, that CRM training affects an attitude change in aircrew towards the recognition of stressors supports previous research (Salas et al., 2001). Alkov and Gaynor (1991) also found a strong change of attitudes in relation to stressors, however the difference being, in their study a significant effect was found also for the Command Scale and the Communication scale. While Alkov and Gaynor utilised the CMAQ, it was modified for naval use to fit their sample.

5.2.2 Training effectiveness between groups.

CRM training initially was designed specifically for pilots and engineers in the cockpit, however after the importance of incorporating all crew was recognised (Helmreich & Foushee, 1993), non-cockpit crew were included. RNZAF CRM training encompasses many case studies that outline how poor communication/ coordination and other factors lead to serious aviation crashes. The majority of these examples still centre on the actions of the pilots, and in particular airline pilots. It was thus hypothesized that pilots would benefit more from the training in terms of a greater degree of attitude change than non-pilots. Pilots would relate better to scenarios used than an Air Electronics Operator for example. However the results did not support this hypothesis and no differences were found between non-pilots and pilots in attitude change from pre to post training.

Although in comments from the course evaluation questionnaire one trainee did mention that there should be a CRM course specifically for back end crew (as in the crew at the back end of an Orion). These findings are surprising in light of the fact that the CMAQ was designed specifically for pilots. It was expected that non-pilots might not score so well on items about the actions of the Captain and First Officer, being unrelated to their actual role. This is a positive finding as it illustrates that the CRM training is as potent for non-pilots as it is for pilots, despite pilot focused content.

5.3 Behavioural Level Analysis.

Kirkpatrick's behavioural level analysis intends to measure transfer of training to the operational environment (Kirkpatrick, 1998). Due to the changing nature of work within the RNZAF, behavioural data was unable to be collected prior to the commencement of

the CRM training. Thus in order to establish a training effect on behaviour, the only means was to compare the behaviours of those who had completed training to those who had not. Helmreich et al., (1986) found that CRM training increased the likelihood that crews would be rated as above average performers, thus these findings were expected to be replicated in this study. The results did not support the hypothesis that aircrew that undertook the CRM training would be rated higher. There was no difference between the control group and the training group on any of the five behavioural scales. There are several possible reasons for the lack of transfer of training. Firstly research by Helmreich and colleagues (1986) investigated CRM training courses that utilised LOFT, simulated training exercises. Using simulations in CRM training gives crew an opportunity to practice CRM principals and get feedback on their performance. The RNZAF training is two days in length and only encompasses lectures and discussion. Thus the training may not be potent enough to effect a change in behaviour.

It is possible that this study did not have enough power for the behavioural measure to detect differences. Flin and Martin (2001) opine that the most critical factor in the collection of behavioural data is the reliability of the actual ratings. The scales reliabilities reported were acceptable, with Cronbach's alpha reported at above 0.8 for all four scales, however no inter-rater reliability was reported. It was beyond the scope of this study to investigate the reliability of the senior crew and instructors ratings for their crew. While RNZAF instructors receive training in rating their crews for performance evaluation and check flights, assessors for this particular behavioural assessment received no specific training. Different assessors were used for each squadron and each trade. Ratings received by aircrew may have been subject to bias, limiting the reliability of the results.

5.3.2 Behaviour and attitude linkage.

Analysis was conducted to determine if crew resource management attitudes predict CRM behaviours in an operational setting. Results indicate there is a significant linkage between the attitudes immediately post CRM training and behaviours four weeks post. This relationship was significant ($p < 0.001$) for all four of the CRM Behavioural Check-

Sheet scales; compliance, communication, management and interpersonal relations. This reinforces the literature surrounding attitude performance linkages in areas outside of aviation (Kelly & Mirer 1974). Within aviation, Helmreich et al., (1986), found that the CMAQ attitude scores correctly classified 95.7% of pilot behaviour in airlines. The total score on the CMAQ explained 15% of the variance in CRM behaviours, while this is significant it does not sufficiently explain the variance. Thus further analysis was conducted to determine if personality might be a mediating factor, which can account for some of the variance in behaviour, as suggested by Chidester et al., (1991).

5.3.3 Personality behaviour linkage.

Two of the personality traits measured in this research, Instrumental and Expressive have had substantial support for their relationship to CRM attitudes and behaviours in the literature (Chidester et al., 1991; Retlaff & Gibertini, 1987, Sandal et al., 1996). The results of this study found no significant causal relationship between either of these scales and CRM behaviours. Two scales, however did significantly predict CRM behaviours, conscientiousness and agreeableness. Higher levels of agreeableness and conscientiousness were related to higher scores on the Behavioural Check-Sheet. Together these personality traits, from the five-factor theory (Costa & McCrae, 1992) explained 25% of the variance in the total score of the CRM Behavioural Check-Sheet ($p < 0.005$). An explanation for this is that Agreeableness and Conscientiousness are likely to measure some of the same facets as Instrumentality and Expressivity, with the NEO-FFI providing a more reliable measure of the traits (see reliability alphas table 12).

Conscientiousness, as measured by the NEO-FFI, generally measures an individual's level of discipline, diligence and competence in relation to work place duties. Out of the five factors Conscientiousness has been found to be the most predictive of workplace performance (Barrick & Mount, 1991), therefore it is no surprise that conscientiousness predicts CRM performance. Specifically the Compliance scale of the Behavioural Check-Sheet asks assessors to rate crewmembers on the correct use of procedure, such as SOPs, call signals and checklists. The aviation industry is highly regulated for obvious

safety reasons, thus conscientiousness would be a reasonable predictor of a persons ability to adhere to prescribed rules and procedures.

A large aspect of CRM is interpersonal relationships, in terms of communication between crew of information and ideas, the leader-follower relationship, and general interaction. The Agreeableness scale measures facets of interpersonal relations. As with Expressivity, Agreeableness taps into an individual's sympathy towards the feeling of others. For example, an item on the NEO-FFI Agreeableness scale is 'I generally try to be thoughtful and considerate' compared to an item on the Expressive scale 'Very understanding of others' and 'Very aware of feelings of others'. Therefore the predictive nature of Agreeableness does lend support to the research surrounding expressivity in that these two traits map onto the same construct, or expressivity may be encompassed in agreeableness.

5.4 Personality as a mediator.

Attitudes

Chidester and colleagues (1991) investigated personality clusters in military pilots and found that these clusters mediated attitude change following the training. It was hypothesized in the current study, that certain individual traits would mediate the change in attitudes. Expressivity and Instrumentality were two of the traits used in Cluster Analysis in the Chidester study. These traits were identified as critical dimensions therefore it was logical to predict they would mediate an attitude change in this study. No mediation was found for any of the personality traits including Expressivity and Agreeableness. It is possible that a Type II error (acceptance of the null hypothesis when it is indeed false) may have occurred due to the small sample size; therefore further investigation with a larger sample size may yield a significant result. Also only individual traits were investigated due to limited sample, therefore the use of Cluster Analysis, with the interaction of different levels of each trait may also have yielded a significant result.

Behaviour

The predictive relationship between attitudes and behaviour discussed earlier was significant but not particularly explanative, therefore personality factors, such as Agreeableness and Expressivity, were investigated to determine if they might mediate this relationship. The hypothesis was that these two traits in particular, being related to interpersonal skills would mediate this relationship, nevertheless all traits were individually analysed. Significant results were found for the Agreeableness trait suggesting that mediation was occurring ($p < 0.05$).

In terms of personality and its relation to behaviour in aviation, previous research has not specifically looked at CRM behaviours in crews. Bowles et al., (2000) investigated personality clusters and the performance of captains, concluding that certain personality clusters could increase or decrease the stress levels in their crew. The personality cluster causing the least amount of stress was labelled 'Positive Instrumental/Expressive' by Chidester and Colleagues, and was labelled thus due to the high scores on both Instrumental and Expressive scales. As discussed earlier the difference in results of this study can be explained by the similarity of the Agreeableness trait to Expressivity. However it is interesting that the Expressive scale itself and the Instrumental scale yielded no significant result, thus not supporting the previous research.

5.5 Aircrew personality difference.

In line with previous research into personality differences in pilot populations, aircrew personality was investigated to determine if there were any overall differences in personality between aircrew roles²¹ and the rank levels of the individuals. Ashman and Tefler, (1983) had previously discovered differences among different pilot population on such traits as Sociability and Affiliation. While early notions of pilot personality suggested there was only one 'type' spawning the romantic notion of the pilot hero (Retzlaff & Gibertini, 1987), Cluster Analysis by several researchers yielded a three cluster typology of pilot personality across several different cultures, organisational and national (Retzlaff & Gibertini, 1987; Chidester et al., 1991; Sandal et al., 1998). This

²¹ See Glossary for definitions of Aircrew Roles.

current study investigated the differences in personality along singular personality traits, as opposed to clusters. Also the sample was increased to include the entire population of aircrew instead of specifically looking at pilots. It is important in light of the changed focus of CRM training from pilots to all aircrew that this is reflected in subsequent research.

The results yielded significant differences between the mean scores of pilots and non-pilots along two dimensions, Neuroticism and Instrumentality, suggesting that pilots are both less neurotic and more instrumental than non-pilot aircrew. The results for Extroversion, were non significant, but only just, indicating that further research with a larger sample may yield different results. The selection process for pilots within the RNZAF is slightly different to that of non-pilot aircrew, in that pilots are more cautiously selected due to the exorbitant training costs. Thus this difference in personality may be due to the initial selection process of the RNZAF. Indeed it is comforting to know that the pilot in control of the aircraft is, on the whole less neurotic.

Instrumentality, though found in both men and women, relates specifically to positive characteristics ascribed to be the masculine personality stereotype (Spence 1980). Examples include: competitiveness, decisiveness, independence, leadership and confidence. All these traits are those one would hope to find in a pilot, male or female. Decisiveness in particular is a trait that is utilised most frequently by pilots, and championed in CRM training. Although the Instrumental scale was found not to predict attitudes or behaviour in the context of this study, it has in previous research been linked to higher performance in captains, and lower stress levels in Air Force Cadets. (Bowles et al., 2000; Sandal et al., 1998).

Analysis was conducted to determine if there was a difference in the mean personality scores of Officers and NCOs. Results showed a significant difference in the means on the Extroversion scale and the Expressive scale ($p < 0.05$). Officers display higher levels of Extroversion and lower levels of Expressivity than NCOs. The selection process in the RNZAF does distinguish between what is expected of Officers and NCOs. Officers must

display strong leadership qualities and higher results in academia, however extroversion is not a trait specifically selected for. It is not surprising that Officers as a whole are more extroverted, as RNZAF selectors are looking for social people due to the strong emphasis on team sport and recreational activities in the Defences Force. Also extroverts may be more likely to put themselves forward and be noticed in the selection process.

The results concerning the higher levels of Expressivity in NCOs is surprising. The Expressivity construct encapsulates the positive aspects of the female stereotype, and similar to Instrumentality this is found in both males and females. Communal is another term for expressive, reflecting the interpersonal orientation of people who score higher on this scale. Characteristics of those high on this scale include; tactfulness, kindness, concern for others and adeptness in expressing ones emotions. High performing pilots have been identified as scoring higher on this scale (Chidester et al., 1991, Bowles et al., 2000), thus it would be expected that Officers would be higher on this scale. The role of the officer as a manager and coordinator of personnel suggests that this would be a desirable trait. However NCO aircrew also have high levels of responsibility in terms of managing subordinate personnel and leadership in their particular trade.

5.6 Implications of the Findings.

Training Evaluation

The initial aim of this research was to evaluate the RNZAF CRM training. The findings suggest that this training is well received by aircrew and found to be useful. There is a significant positive change in attitudes in those who have attended training to the CRM concepts relating to recognition of stressors in aviation, however there is no behavioural difference between aircrew who have and have not undergone training. It is thus concluded that the current RNZAF CRM training is sufficient for raising awareness in aircrew towards CRM concepts and has made headway in propagating the impact that CRM has on flight safety. More importantly, due to the attitude behaviour link, it is important that the attitudes of aircrew have been improved. However a more potent training intervention may be required to detect a direct impact upon aircrew behaviours.

This may involve the use of role-play in lieu of simulators, where aircrew actually practice CRM training principles in context of their work situation.

Personality

Interesting data has come to light about the effect of personality on behaviours and the relationship personality has in mediating attitudes and behaviours. Agreeableness and Conscientiousness predict CRM behaviours in aircrew, suggesting that these two traits may indeed be more closely scrutinised in the selection process. This information also has implications for the CRM training itself. Aircrew are already subject to a personality tutorial within the CRM training. Evaluating their own levels of these two traits and explicating how these traits may impact on the CRM performance in operations may be a useful tool to add to the personality section of training. Personality as a mediator of attitudes and behaviour emphasises the axiom that performance of pilots is a function of their technical skill, attitude and personality (Chidester et al., 1991).

General understanding of the personality differences within New Zealand aircrew will also provide more relevant information to RNZAF aircrew, as opposed to providing them with American findings. Understanding that different crewmembers have different strengths and weakness may lead to utilising crew strengths in a more productive manner. While Pilots²² within the crew may be more instrumental, and thus stronger decisive leaders, NCO crew display higher levels of expressivity suggesting they may have better interpersonal relations and be more adept at solving personnel problems.

5.6 Limitations of the Study.

Research Design

As previously mentioned, this research project was an exploratory look at the current RNZAF CRM training and the relationships between personality, attitudes and behaviour in the context of CRM. The realities of military tasking impacted on the design of the study. It would have been more appropriate to collect pre-training behavioural data on the CRM trainees, in order to establish if there was an improvement in the behaviour of each

²² Pilots are always officers.

participant. As the personnel who were to attend the course were sometimes not known till the day before, this was impossible.

A Power Analysis was conducted prior to commencing research to determine how many participants were needed. It was decided that at least 80 participants were needed for the training group. I intended to have a matched number in the control group. In order to achieve the recommended power of 0.80 for the study, the minimum number of participants needed in each group is 68, to detect an effect size of 0.40 (Cohen 1988). Initially the RNZAF was to run four CRM courses with 15-20 aircrew on each course. However due to organisational pressures throughout the year of 2005 the number of courses was reduced to three, and thus the number of participants was likewise reduced. The limitation of lack of power due to small sample size was an expected factor in research of this nature, within a military organisation subject to changes.

Measures

The measures used in this research have also limited the findings. As articulated in section 5.2 of this chapter, the CMAQ was not designed specifically for this target population. An American military version of the CMAQ is in existence, but was not able to be acquired for the commencement of data collection. The participants of this study could still interpret the information contained in the CMAQ, however comments were made on returned tests that indicated some participants were unimpressed with the terminology used. The reliabilities of the scale were also a concern.

The RNZAF CRM Behavioural Check-Sheet was designed specifically for this study and showed reasonable reliabilities, however the range of data retrieved from this measure was limited. Further development of this tool could include increasing its sensitivity by reducing the scale options. Once again the exploratory nature of this research should be emphasised and the development of the Behavioural Check-Sheet seen as an area for further research.

5.7 Directions for future research.

Development of Measures

The issues discussed with the CMAQ has highlighted an area that can be further researched. A specific attitude measure for New Zealand Military Aircrew could be developed, using correct terminology and trade relevant questions, including items that involve non-cockpit crew, such as the Air Loadmasters, Air Electronics Operators and helicopter crewman. A measure such as this would have more face validity to RNZAF personnel and could be incorporated into CRM training to determine problem areas to be focused on within the training. This present study highlighted that pre-training RNZAF Aircrew had particularly poor attitudes to 'Recognition of Stressors'; a more sensitive, relevant measure would discover other areas for future improvement.

The RNZAF Behavioural Check-Sheet also needs to be further developed. In order to improve the reliability of ratings (which was addressed in the current study), a word picture of each level of the scale could be developed. For example for the item 'Displays a positive attitude towards tasks and crewmembers' a word picture describing someone who is 'poor in this area', 'average in this area' and 'excellent in this area' could be utilised by assessors for crewmember comparisons. The scale needs to be developed further to gage differentiation between poor and excellent performers. Alternatively new methods of collecting behavioural data could be researched, such as the use of simulator scenarios and observation ratings.

Research Design Improvements

CRM training could be given to different squadrons, as opposed to general RNZAF aircrew population, and then prior to training the squadron could focus on obtaining measures of attitudes and behaviours. The difficulty in running training incorporating personnel from different squadrons is fitting into the different timetables. Addressing one squadron at a time might give an opportunity to gather relevant data pre-training, and then specifically address each squadron's problem areas. Sample sizes however would still be limited through this method.

Personality and Culture Research

Prior CRM research that incorporated personality utilised Cluster Analysis in order to ascertain personality differences in pilot populations (Chidester et al., 1991). This was beyond the scope of this research, however future research might determine if these personality clusters in American pilots could be generalised to a New Zealand sample, and further generalised to wider aircrew. Further research may also determine personality differences within the cultures of the different squadrons, and this might also be compared to different national Air Forces, such as Australia and Britain.

Once again the sample size limited the use of squadron as a variable, in terms of ascertaining if there were differences in CRM attitudes and behaviours between squadrons. Differing cultures within squadrons may support or hinder the adoption of CRM attitudes, thus this is an important area, which needs to be addressed in research.

5.8 Conclusion.

This research has presented results that suggest CRM training is effective in changing the attitudes of aircrew to specific CRM related concepts. The training was well received by RNZAF Aircrew and it was successful in propagating important flight safety principles. Trainees felt that CRM training would impact upon their safety behaviours, and they also supported the notion that it should be extended to all other aircrew. The behavioural impact of this training has not been ascertained by this study, but a clear link was found between attitudes post training and behaviour post training. Further, distinct personality differences have been found in the RNZAF aircrew populations, suggesting that Officers are more extroverted and less expressive than NCOs. Also pilots are less neurotic and more instrumental than non-pilots.

The relationship between personality and attitudes and behaviour has been elucidated in that certain personality traits such as Agreeableness and Conscientiousness do impact upon CRM behaviours in operations. Agreeableness has been identified as mediating the relationship between post training CRM attitudes and post training CRM behaviours. The exploratory nature of this research has highlighted several areas for further investigations.

Further research into the development of measures specifically relevant to military aircrew within New Zealand and examination of intra-organisational culture as a variable within CRM training effectiveness may yield interesting results.

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Appendices

- Please note that participants in the experimental group were given the CMAQ prior to training and post training. In order to conserve space and avoid replication the CMAQ is found here only in Appendix 2., the Post-Training Booklet.
- The control group also received the CMAQ, PAQ, Background Information Sheet and consent form. These are identical to those received by the experimental group, thus only the cover letter has been reproduced here in Appendix 3 to avoid replication.

A.1 Pre Training Booklet



Air Crew Personality and Hazardous Attitudes: Impact on Crew Resource Management Training.

Researcher: Carolyn Freeman

Pre-Training Booklet

Thank you for taking part in this study. Please fill out the questionnaires provided in this booklet prior to completing the RNZAF CRM training course. Answer as honestly as you can. Don't think too long on each question, generally the first answer that comes to your mind best reflects your attitudes.

This booklet contains:

- **A participant consent form**
- **A general Background information sheet**
- **The Personal Attributes Questionnaire**

After you have finished this booklet, please complete the NEO five-factor personality inventory that has been provided.

1.1 Consent Form

PARTICIPANT CONSENT FORM

This consent form will be held for a period of five (5) years

I have read the Information Sheet and have had the details of the study explained to me. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I wish/do not wish to have data placed in an official archive.

I agree to participate in this study under the conditions set out in the Information Sheet.

Signature: _____ **Date:** _____

Full Name - printed _____

1.2 Background Information

Name: _____

Gender: _____

Date of Birth: ____ / ____ / _____

Rank: _____

Squadron: _____

Crew Position: _____

Tenure in Crew Position: _____
(Years and months)

Tenure in RNZAF: _____
(Years and months)

Flying Hours:

Aircraft type:	Hours Flown:
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Have you completed any CRM training previously? Yes / No
(Please Circle)

1.3 PAQ

Personal Attributes Questionnaire

The following questionnaire contains a list of descriptions of personal attributes. Please circle the number which best represents where you feel you fit on the scale.

1. Not at all aggressive	1	2	3	4	Very aggressive
2. Not at all independent	1	2	3	4	Very independent
3. Not at all emotional	1	2	3	4	Very emotional
4. Very submissive	1	2	3	4	Very dominant
5. Not at all excitable in a major crises	1	2	3	4	Very excitable in a major crisis
6. Very passive	1	2	3	4	Very active
7. Not at all able to devote self completely to others	1	2	3	4	Able to devote self completely to others
8. Very rough	1	2	3	4	Very gentle
9. Not at all helpful to others	1	2	3	4	Very helpful to others
10. Not at all competitive	1	2	3	4	Very competitive
11. Very home orientated	1	2	3	4	Very worldly
12. Not at all kind	1	2	3	4	Very kind
13. Indifferent to others' approval	1	2	3	4	Highly needful of others approval
14. Feelings not hurt easily	1	2	3	4	Feelings hurt easily
15. Not at all aware of feelings of others	1	2	3	4	Very aware of feelings of others
16. Can make decisions easily	1	2	3	4	Has difficulty making decisions
17. Gives up very easily	1	2	3	4	Never gives up easily
18. Never cries	1	2	3	4	Cries very easily
19. Not at all self confident	1	2	3	4	Very self-confident
20. Feels very inferior	1	2	3	4	Feels very superior
21. Not at all understanding of others	1	2	3	4	Very understanding of others
22. Very cold in relation with others	1	2	3	4	Very warm in relations with others
23. Very little need for security	1	2	3	4	Very strong need for security
24. Goes to pieces under pressure	1	2	3	4	Stands up well under pressure

Once you have completed this form please send it directly to Director of Psychology, Air Staff, Freyberg Building, Wellington. Thank you for your cooperation. The information you have given will be used for the purposes of this research only and will be held securely by the researcher. Any questions, please contact Carolyn Freeman; carolynfreeman@paradise.net.nz.

A.2 Post-Training Booklet



Air Crew Personality and Hazardous Attitudes: Impact on Crew Resource Management Training.

Researcher: Carolyn Freeman

Post – Training Booklet

Thank you for taking part in this study. Please fill out the questionnaires provided in this booklet after you have completed the RNZAF CRM training course. Answer as honestly as you can. Don't think too long on each question, generally the first answer that comes to your mind best reflects your attitudes.

This booklet contains:

- CRM Course Evaluation Questionnaire
- The Cockpit Management Attitudes Questionnaire

Name: _____

2.1 Evaluation Questionnaire

RNZAF Crew Resource Management Training

Date: _____

Questionnaire Aim:

The aim of this evaluation questionnaire is to answer the following two questions:

1. Were you satisfied with the course? and
2. Do you feel the course was useful?

Your responses to these questions will assist in the future development of Crew Resource Management (CRM) training and will aid in the current research project evaluating the effectiveness of the training. **Please do not write your name on this sheet as it will be removed from the booklet and remain anonymous.**

Training and Experience:

For each of the topic areas or training techniques listed below, please rate the value of this aspect of the training to you. Rate each item by choosing the letter on the scale below which best describes your personal opinion and then write the letter beside the item. If the topic was not included in your training please put "NA" in the blank space.

A	B	C	D
A Waste Of Time	Not Very Useful	Useful	Extremely Useful
___ 1. Human Behaviour			___ 2. Human Performance Limitations
___ 3. Communication			___ 4. Teamwork
___ 5. Situational Awareness			___ 6. Decision Making
___ 7. Task & Mission Planning			___ 8. Workload Management & Automation
___ 9. Briefing & Debriefing			
___ 10. Overall, how useful did you find the training?			___ 11. How useful is recurrent training in aircrew coordination?
___ 12. How useful will such training be for other crewmembers?			

13. Crew resource management training has the potential to increase safety and crew effectiveness. (Circle one)

Disagree Strongly **Disagree** **Agree** **Agree Strongly**

14. How much will the training change your behaviour on the flight deck?
(Circle one)

No Change **A moderate Change** **A large Change**

15. What aspects of the training were particularly good?

16. What do you think could be done to improve the training?

17. Has the course influenced or altered your attitude towards the application and management of CRM safety principles? YES / NO please comment:

18. Additional comments on any element of the course:

That completes the questionnaire, thank you for your help!

2.2 CMAQ

Cockpit Management Attitudes Survey

As part of a Massey University research project, we are collecting data on attitudes about flight deck management in RNZAF operations. You will greatly assist our research if you complete this form. All information will remain confidential.

Please answer by writing beside each item the letter that best reflects your personal attitude. Choose the letter from the scale below.

A	B	C	D
Disagree Strongly	Disagree	Agree	Agree Strongly

1. Crewmembers should avoid disagreeing with others because conflicts create tension and reduce crew effectiveness. **A B C D**
2. Crewmembers should feel obligated to mention their own psychological stress or physical problems to other flight crew personnel before or during a flight. **A B C D**
3. It is important to avoid negative comments about the procedures and techniques of other crewmembers. **A B C D**
4. Captains should not dictate technique to their first officers. **A B C D**
5. Casual, social conversation in the cockpit during periods of low workload can improve crew coordination. **A B C D**
6. Each crewmember should monitor other crewmembers for signs of stress or fatigue and should discuss the situation with the crewmember. **A B C D**
7. Good communications and crew coordination are as important as technical proficiency for the safety of the flight. **A B C D**
8. Pilots should be aware of and sensitive to the personal problems of other crewmembers. **A B C D**
9. The captain should take physical control and fly the aircraft in emergency and non-standard situations. **A B C D**
10. The pilot flying the aircraft should verbalise plans for procedures or manoeuvres and should be sure that the information is understood and acknowledged by the other crewmembers. **A B C D**

- | | | | |
|----------------------|----------|----------|-------------------|
| A | B | C | D |
| Disagree
Strongly | Disagree | Agree | Agree
Strongly |
11. Crewmembers should not question the decisions or actions of the captain except when they threaten the safety of the flight.

A B C D
 12. Crewmembers should alert others to their actual or potential work overloads.

A B C D
 13. Even when fatigued, I perform effectively during critical flight manoeuvres.

A B C D
 14. Captains should encourage crewmembers questions during normal flight operations and in emergencies.

A B C D
 15. There are no circumstances (except total incapacitation) where the first officer should assume command of the aircraft.

A B C D
 16. A debriefing and critique of procedures and decisions after each flight is an important part of developing and maintaining effective crew coordination.

A B C D
 17. My performance is not adversely affected by working with an inexperienced or less capable crewmember.

A B C D
 18. Overall, successful flight deck management is primarily a function of the captain's flying proficiency.

A B C D
 19. Training is one of the captain's most important responsibilities.

A B C D
 20. Because individuals function less effectively under high stress, good crew coordination is more important in emergency or abnormal situations.

A B C D
 21. The pre-flight crew briefing is important for safety and for effective crew management.

A B C D
 22. Effective crew coordination requires crewmembers to take into account the personalities of the other crewmembers.

A B C D
 23. The captain's responsibilities include coordination between flight and cabin crews.

A B C D
 24. A truly professional crewmember can leave personal problems behind when flying the line

A B C D
 25. My decision-making ability is as good in emergencies as in routine flying situations.

A B C D

A.3 Control Group Cover Letter



Dear _____,

You have been selected to take part in an independent research project investigating the effectiveness of Crew Resource Management (CRM) training in the RNZAF. As you have not undergone any CRM training this year, you are able to participate in the control group. A control group refers to a group of individuals who have not taken part in the training intervention, in this case CRM training, and thus are compared to those who have undergone training. All this requires of you is to fill out the booklets in this pack, which include two personality tests, an attitude measure and some background details. After these have been filled in return them to the Director of Psychology in the envelope provided, through the internal mail system.

Once your information has been received a peer or supervisor in your squadron will fill out a behaviour check-sheet on your CRM abilities. **This information will remain confidential and be used only for the purpose of this research.**

If you wish to learn more about what is being investigated, an information sheet is enclosed in this pack for your benefit. If you wish to ask any questions or if you would like feedback on your personality profile, please feel free to email me at carolynfreeman@paradise.net.nz.

The speedy return of this questionnaire will greatly aid this research, as due to the supervision of Massey University there are substantial time pressures for completion. This research will be of great help to the RNZAF Flight Safety Office and your participation in this study is very much appreciated. Thank you for your time.

Yours faithfully

C.M. Freeman
Officer Cadet
RNZAF Undergraduate Scheme.

A.4 RNZAF CRM Behavioural Markers Check-sheet

Name of Participant _____

Date: ___/___/___

Rank/Name of Assessor _____

Please rate the participant on the following Crew Resource Management competencies. Tick the box that you feel best represents the behaviour displayed by the participant that you have observed. If the competency is not relevant to the crew position of the participant, then leave the spaces blank. Please note, this information will be used for research purposes only. If you have any queries or comments please email OCDTU Carolyn Freeman at carolynfreeman@paradise.net.nz. Thank you for your help.

- RATING SCALE:**
- 1 Never meets requirements
 - 2 Sometimes meets requirements
 - 3 Generally meets requirements
 - 4 Always meets requirements

COMMUNICATION

1 2 3 4

Uses correct standard calls, in accordance with applicable aeronautical publications, military RT procedures, orders or SOPs.				
Clear, concise briefing technique with appropriate content, timing and tone. Realistic intentions i.e.; not briefing one thing then doing another.				
Communicates overall in a fashion that facilitates the dissemination of appropriate information to all crewmembers.				

PROCEDURES

1 2 3 4

Uses checklists as published, using correct technique i.e.; correct response and correct order.				
Applies SOP appropriately and has rational reasons for deviations when necessary				

MANAGEMENT

1 2 3 4

Sets priorities and order of tasks as appropriate. Balances mission requirements with safety.				
Makes use of all resources, including other crew members, delegates when necessary and obtains all relevant information for the situation at hand.				
Conducts tasks in a timely manner				
Conducts appropriate risk assessments and takes action to minimise unnecessary risks where possible.				
Is aware of capabilities of crewmembers and monitors other crewmembers performance and well being (i.e.; physical and mental state).				

- RATING SCALE:**
- 1 Never meets requirements
 - 2 Sometimes meets requirements
 - 3 Generally meets requirements
 - 4 Always meets requirements

SITUATIONAL AWARENESS

1 2 3 4

Displays an accurate perception of the factors and conditions affecting the aircraft and the flight crew.				
---	--	--	--	--

DECISION MAKING

1 2 3 4

Gathers all necessary information and will analyse given information sufficiently to make the best possible decision in any given situation.				
Includes all members of the crew in the decision making process when the situation allows.				
Makes decisions within the appropriate amount of time.				
Monitors and evaluates decisions made by providing feedback.				

PERSONALITY

1 2 3 4

Displays a positive attitude towards tasks and crewmembers.				
Is able to work well with different personalities.				
Displays an appropriate level of self confidence for given situations.				
Displays a high level of self-discipline				
Is assertive when the situation requires it.				
Is able to recognise and acknowledge errors in own and others performance.				

EMERGENCY HANDLING

1 2 3 4

Reacts calmly and decisively in emergency situations.				
Is able to delegate tasks in emergency situations.				

A.5 Information Sheet

Aircrew Personality and Hazardous Attitudes: Impact on Crew Resource Management Training

Researcher Introduction

My name is OCDTU Carolyn Freeman and I am currently undertaking my Masters in Psychology through Massey University. I am also on the RNZAF University Scheme and once I complete my thesis I will begin my Officer training in January 2006. If you have any queries about the following research project or just wish to know more please feel free to contact me at the below postal or email address, or phone me on my mobile.

Contact details

Postal Address: 35b Ironside Rd
Johnsonville
Wellington

Email: carolynfreeman@paradise.net.nz
Cell: 027 464 8228

Supervisors

I will be supervised through Massey University by Dr Richard Fletcher a lecturer in Psychology. If you wish to contact him please email: R.B.Fletcher@massey.ac.nz or phone 09 414 0800 Ext 9077

I will also be supervised through the RNZAF by the Director of Psychology, SQNLDR Emma Davis. If you wish to contact her please email: emma.davis@nzdf.mil.nz

Research Aim

The aim of this research is to evaluate the effectiveness of the Crew Resource Management (CRM) courses run by the RNZAF. The evaluation will take place on three levels. Firstly the face validity of the training will be investigated. What this means is that aircrews' reaction to the course will be recorded to see whether RNZAF staff find the training useful and applicable to their work environment.

The second level of evaluation will determine whether participants of the course have learned the material. This will be evaluated by monitoring an attitude change towards CRM principles. Finally the course will be evaluated at the behavioural level, where participants of this study will undertake an evaluation of their CRM behavioural skills after completion of the course. Participants will be rated by a qualified superior on CRM behaviours on a routine flight. This data will remain confidential and only be used for this research and not for performance evaluation purposes.

This study will also involve a control group who will not undergo the course. The purpose of this is to determine what behaviours and attitudes towards CRM skills and principles RNZAF aircrew display with no CRM training at all.

This study will also investigate what role aircrew personality plays in an individual's ability to learn new attitudes and behaviours related to safety in the aircraft. Ratings from personality measures will be correlated with scores on attitude and behavioural measures to determine if

there is a connection. Further, rank, position and squadron will be recorded to determine if these factors affect the outcome of learning in the CRM Training environment.

Participant Recruitment

All RNZAF aircrew working in an operational squadron are eligible to participate in this research, as it is important that all personnel are involved in safety management.

Experimental group:

These are participants who wish to undergo the two-day CRM course administered by the RNZAF Flight Safety Office and the department of Psychology. It is anticipated that there shall be 20 personnel per course and four courses run throughout the year. Participants in this group will be required to fill in a personality questionnaire and an evaluation of the CRM course. Participants will also fill out an attitude questionnaire pre and post training. Also 4-6 weeks after the completion of this course participants will be rated on the CRM skills by a qualified member of the RNZAF.

Control group:

These are participants who will not undergo the CRM course, but still wish to be involved in the study. Participants in this group will be required to fill in a personality questionnaire and an attitudes questionnaire. Participants will also be rated on the CRM skills by a qualified member of the RNZAF. The anticipated number of participants for this group is 80 personnel.

Confidentiality

All data obtained from this study will remain confidential, and only the researcher and supervisors will have access to the data. Data will be coded in order to preserve the confidentiality of participants. The data will only be used only **IN THE CONTEXT OF THIS RESEARCH**. It will not be available to other RNZAF personnel for use in individual performance evaluation. All data will be stored with the researcher in a secure environment.

Research Results

Participants will have access to the final results of the study and can acquire a copy of research findings by contacting the researcher at the details stated above.

Participant's Rights

You are under no obligation to accept this invitation. If you decide to participate, you have the right to:

- Decline to answer any particular question;
- Withdraw from the study (specify timeframe);
- Ask any questions about the study at any time during participation;
- Provide information on the understanding that your name will not be used unless you give permission to the researcher;
- Be given access to a summary of the project findings when it is concluded.
- Completion and return of the questionnaire implies consent. You have the right to decline to answer any particular question.

Committee Approval Statement

This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher and supervisors are responsible for the ethical conduct of this research. If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher, please contact Professor Sylvia Rumball, Assistant to the Vice Chancellor (Ethics & Equity), telephone 06 350 529, email humanethicspn@massey.ac.nz.

A.6 Descriptions of Personality Factors

NEO-FFI

Factor Analysis of the original NEO Personality Inventory-Revised (NEO PI-R) revealed a five-factor structure (Costa & McCrae, 1992). These factors were labelled: Neuroticism, Extroversion, Openness, Agreeableness and Conscientiousness. Items for the shortened NEO Five Factor Inventory (NEO-FFI) were chosen based on the 12 items with the highest homogeneity and lowest correlations to the other factors (Costa & McCrae, 1992). Descriptors of the latent factors of the NEO-FFI and NEO PI-R are presented here:

Neuroticism (N): The N scale is a measure of ones emotional stability. High N scores denote anxiety, fear, guilt, shame, anger and embarrassment – emotions traditionally thought of as negative affects. In contrast those who have low N scores are more emotionally stable, even-tempered calm and relaxed individuals (Costa & McCrae, 1992).

Extroversion (E): The E scale measures an individuals' proclivity for social situations, as well as levels of assertion, vigour and activity. Individuals with high E scores tend to thrive on and enjoy peoples' company. They are excitable people with high energy levels, optimistic and cheerful. Introverts, or those who have low E scores are not opposite in behaviour to extroverts, merely extrovert behaviours are absent (Costa & McCrae, 1992). Therefore introverts are not anxious in the company of others, they just prefer their own space and tend to be more individualistic. Low E scores relate to more even paced people reserved people.

Openness (O): The openness scale covers a broad spectrum of elements, such as an individuals openness to experiencing new and different phenomena, the imagination, intellectual curiosity, sensitivity to emotions in oneself and others and so forth. High scores on O denote individuals with broad minds who are willing to entertain unconventional ideas and innovative theories. These people are more sensitive to emotional experiences and tend to be imaginative and creative. Low scores on O reflect more conservative conventional people who are more at ease with familiar experiences and ideas (Costa & McCrae, 1992).

Agreeableness (A): The A scale, similar to extroversion, measures a facet of interpersonal relations. Altruism, benevolence, sympathy and trust in others are associated with high scores on A. High Scorers also tend to differ more to others, to comply in a meek and mild manner. They are modest and self-effacing. Low scores on A indicate people who are antagonistic, more inclined to be sceptical about the motives of others, egocentric and competitive. A low scorer will be more aggressive and willing to put forth his or her opinion where necessary (Costa & McCrae, 1992).

Conscientiousness (C): This dimension of personality has received increased attention in the industrial and organisational literature due to its predictive validity for job performance criterion (Barrick & Mount, 1991). High C scores indicate individuals who are diligent in their duties, competent, achievement focused, driven and disciplined. High C scores can also relate to tidiness, organisation and cautiousness. Those who score low on C tend to be less organised and have a more lackadaisical approach to the task at hand. Low scorers tend to procrastinate more and be less focused on achievement (Costa & McCrae, 1992).

PAQ

The Personal Attributes Questionnaire (PAQ) has three scales, labelled by the authors, Masculinity, Femininity and Masculinity-Femininity (Helmreich & Spence, 1978). Each scale was initially constructed to represent a cluster of personality characteristics that were social desirable for males and for females (Hill, Fekken, & Bond, 2000). The final scale, Masculinity-Femininity, has traits desirable for males or females, but not both. It is bipolar in its orientation with one extreme relating to female characteristics and the other relating to masculine characteristics (Hill, Fekken, & Bond, 2000). While these traits have been classed as stereotypic for each gender, positive aspects from both scales can be found in each gender. For example a female can display high levels of positive masculine traits. In other words women are not generally non-instrumental, they are just less instrumental on average than men (Spence, 1980). For this study only the Masculinity and Femininity scales were utilised, so only these shall be described in more detail here:

Masculinity/ Instrumental (I): The masculinity scale has also been referred to by researchers as Instrumental and agentic (Spence, 1980). This scale measures traits stereotypically associated with characteristics of males, but also measures traits desirable to both sexes, such as Independence, competitiveness, decisiveness, leadership, activeness and confidence.

Femininity/ Expressiveness (Ex): This scale has also been referred to as expressive or communal due to the nature of the traits described (Hill, Fekken & Bond, 2000). The femininity scale measures traits that are more characteristic of women than men, but are also desirable in both women and men (Spence, 1980). Such characteristics include tactfulness, kindness, expressing emotions, concern for others and sensitive to the feelings of others.

A.7 Ethics Application

Human Ethics Committee

Application for approval of proposed research involving human participants

SECTION A

1. **Project Title:** Aircrew Personality and Hazardous Attitudes: Impact on Crew Resource Management Training.

2. **Applicant Details**

Full Name: Carolyn Marie Freeman
Employer: New Zealand Defence Force (Air Force)
Telephone: 027 464 8228
Email: carolynfreeman@paradise.net.nz
Postal Address: 35B Ironside Rd
Wellington

Supervisor Details

Full Name: Richard Fletcher
School/Dept: Psychology Department, Massey University
Region: Albany, North Shore. Auckland.
Telephone: (06) 356 9099 ext. 2071
Email: R.B.Fletcher@massey.ac.nz

3. **Type of Project:** Master's Research

4. **Summary of Project:**

The primary purpose of this research project is to evaluate the psychological aspects of Crew Resource Management (CRM) training programme initiated by the Royal New Zealand Air Force (RNZAF) Flight Safety office. The research will determine whether the CRM training programme elicits a change in attitudes held by aircrew regarding appropriate aircrew behaviour relating to safety in an operational environment. Further

the effect of individual personality traits will be explored to determine whether this facilitates or hinders a change of attitude during the course. Other factors that may affect aircrew attitudes will also be examined, such as squadron, rank and aircrew position. In order to gain a comprehensive view of the effects of the CRM course, the training will be evaluated on three of Kirkpatrick's (1976) levels of evaluation; reaction, learning and behaviour. The reaction of the participants will be measured by a self report questionnaire, the learning of participants will be measured via a change in attitudes towards flight crew behaviour and finally aircrew undertaking the course will be rated on CRM behavioural markers post training in an operational environment.

5.	List of Appendices:	Page
	(a) Research proposal	15
	(b) Information Sheet for Participants	23
	(c) Consent Form for Participants	25
	(d) Questionnaire Booklet – pre-training	26
	(e) Questionnaire Booklet – post training	32
	(f) CRM Behavioural Marker Cheek sheet	38

SECTION B: Project Information

6. General
- Do you wish the protocol to be heard in a closed meeting?**
No
- Does this project have links to other approved Massey University Human Ethics Committee applications?**
No
- Is approval from other Ethics Committees being sought for the project?**
No
7. **Project Details**
- Aims of the project:**
The aim of this research is to evaluate the psychological aspects of the CRM training within the RNZAF and to determine whether the personality traits, squadron, rank and locus of control of the participant's effects their attitudes towards flight crew behaviour, and their ability to learn from CRM training.
- Background to the project and significance:**

It is now widely accepted by researchers in the aviation industry that human factors play a major role in aviation safety (Helmreich, Wilhelm, Gregorich & Chidester 1990). In fact the actions of aircrew have been attributed as the causal factor in over 70% of commercial aviation accidents over the last 40 years (Freeman & Simmon 1991). It has been identified by several researchers that these failings in aircrew behaviour are due to a lack of non-technical skills such as teamwork, communication, decision-making and the general management of human resources in the cockpit (Helmreich et al 1990). Crew Resource management training has been advocated by the American National Aeronautics and Space Administration (NASA) and Federal Aviation Authority (FAA) and training programmes have been in place since the late 1970's (Salas et al 2001). The courses have been proven in changing aircrew attitudes towards safety and in some companies have notably reduced aviation accidents and incidents. However the RNZAF has no formal system of CRM training in place and has only run small courses for interested aircrew infrequently over the past five years. An initiative by the Flight Safety office has brought to light the importance of CRM training, and in conjunction with the RNZAF psychology team, will be running four CRM training courses for aircrew in 2005. This research will be significant in evaluating CRM training and potentially proving its benefits via positive changes in aircrew attitudes towards safe behaviour in the cockpit, increased awareness of interpersonal variables and teamwork principles and actual changes in safety behaviours. This may further lead the Flight Safety office to follow the lead of their American and European aviation counterparts, making CRM training compulsory to all RNZAF aircrew.

Outline the research procedures to be used (including approach/procedure for collecting data):

Participants will be made aware of the availability of the CRM course and will volunteer to attend. Once interest in the course has been noted participants will be invited to take part in the study. Data will be collected pre and post training and participants will be informed that all information given will remain confidential. Also Aircrew who do not wish to attend the CRM training will be approached and asked to participate in the study as a control group. All aircrew will be notified via postings in their work place and emails asking for volunteers to participate.

Ser	Activity	Description
1	Disseminate participants consent forms	Consent forms posted to candidates requesting permission to collect performance data from immediate superiors, peers and from self report questionnaires
2	Disseminate CMAQ, PAQ, NEO-FFI questionnaires to participants undertaking the CRM course	Information sent out to participants will be disseminated to participants via post to their squadrons and come with envelopes to return questionnaires via post to the researcher. The researcher will administer all questionnaires.
3	Disseminate CMAQ, PAQ, NEO-FFI to participants not undertaking the course (control group)	Information sent out to participants will be disseminated to participants via post to their squadrons and come with envelopes to return questionnaires via post to the researcher.
4	Administration of CRM training.	Participants in experimental group will voluntarily attend a two day CRM course
5	Collection post training data	CMAQ, PAQ, NEO-FFI, CRM evaluation will be re-administered to the experimental group post training. Also both experimental and control groups will be rated on CRM behavioural markers by their peers and/or superiors.
6	Analyse Data	Information is collated, coded and statistically analysed
7	Draw conclusions	
8	Disseminate results	Project results are disseminated to participants via thesis and internal report to the RNZAF.

Where will the project be conducted?

Research will be conducted within New Zealand. The participants will all be employees of the Royal New Zealand Air Force, stationed at Ohakea and Whenuapai. Participants from all four operational squadrons 3, 5, 40 and 42 will be invited to participate in this study.

What experience does the researcher have in this type of project activity?

I have been a territorial in the RNZAF since 2003 and I am familiar with the organisation. In 2004 I assisted in the administration of a pilot CRM course with the RNZAF psychologists and Flight Safety office. I have no previous experience in undertaking research.

Participants

Describe the intended participants:

There will be two subsets of participants involved in this research.

Group 1: Experimental

The participants of this group will all be RNZAF aircrew that have volunteered to undertake a two day CRM training course. This course will be a part of their normal working week and all participants will maintain their normal pay for the

two days in question. The aircrew will not be limited to pilots but will include all personal who are involved in cockpit environment. The participants will potentially be both male and female, range in rank from corporal to squadron leader and range in age from 19-60 yrs. There will potentially be four sets of twenty participants in this group if all who attend the course agree to undertake the study.

Group 2:

Control

The participants of this group will all be RNZAF aircrew that have volunteered to participate in the study, but will not undergo the CRM training course. The demographics of this group will be approximately the same as the experimental group. There will be eighty participants in this group.

What is the reason for selecting this number?

The flight safety office in the RNZAF has only the means to run four CRM courses in 2005 with a maximum volume of 20 trainees. I intend to have a matched number in the control group. In order to achieve the recommended power of 0.80 for the study, the minimum number of participants needed in each group is 68, to detect an effect size of 0.40 (Cohen 1988).

How will potential participants be identified and recruited?

Participants for the experimental group will be recruited by advertising the CRM courses at morning briefs at each squadron and via the internal email system of the RNZAF. All those interested in participating in the course will be invited to contact the flight safety office. The aircrew that have self selected themselves for this course will then be informed of the study and invited to participate. The control group will be recruited through word of mouth, email and information disseminated at morning briefs. These participants will be invited to contact the flight safety office if they wish to be involved in the research.

Does the project involve recruitment through advertising?

No

Does the project require permission of an organisation to access participants or information?

Yes. Approval to conduct research within the NZDF has to be given by the NZDF. This approval has been granted and is enclosed as Attachment I.

Who will make the initial approach to potential participants?

The researcher.

How much time will participants have to give to the project?

Those in the experimental group will be involved in the two-day CRM course. Also they will be required to fill in questionnaires prior to training and post training. It is estimated that the total time of filling in questionnaires will take 1hr 30mins.

9. **Data Collection**

Does the project include the use of a participant questionnaire? Yes

Will the participants be anonymous? No

Describe how the questionnaire will be distributed and collected:

The questionnaire will be posted using the RNZAF internal mailing system. Questionnaires will be accompanied with an addressed return envelope to allow participants to return information to the researcher.

Does the project involve observation of participants? No

Does the project involve the use of focus groups? No

Does the project include the use of participant interviews? No

Does the project involve the use of audiotaping? No

Does the project involve videotaping? No

Does the project require permission to access databases? No

Who will carry out the data collection?

Carolyn Freeman (the applicant/researcher)

SECTION C: Benefits/Risk of Harm

10. **What are the possible benefits of the project to individual participants, groups, communities and institutions?**

The project has the potential to identify training requirements for all aircrew. Those in the experimental group will benefit from the two day course teaching them skills in teamwork, communication, decision-making and situational awareness – all skills valuable to the aviation environment. For those in the control group training needs may be identified that can be addressed by the RNZAF in future courses.

What discomfort, incapacity or other risk of harm are individual participants likely to experience as a result of participation?

Nil

What is the risk of harm of the project to the researcher? Nil

What discomfort, incapacity or other risk of harm are groups, communities and institutions likely to experience as a result of this research?

Nil

Is ethnicity data being collected as part of the project?

No

SECTION D: Informed and Voluntary Consent

11. **By whom and how, will information about the research be given to potential participants?**

Information about the research will be provided to participants through the Information Sheet (Attachments A) delivered with the questionnaires and Consent Forms. Participants will also be given contact details of the researcher in case further questions arise.

Will consent to participate be given in writing?

Yes

Consent Forms are included as Attachment B

Will participants include persons under the age of 16?

No

Will participants include persons who are vulnerable or whose capacity to give informed consent may be compromised?

No

Will the participants be proficient in English?

Yes

SECTION E: Privacy/Confidentiality Issues

12. **Will any information about participants be obtained from third parties?** Yes

Information will be obtained from the immediate superior officer of each candidate to provide performance ratings. This information will only be collected once consent to do so has been given by the candidate. Immediate superiors will be provided with a CRM behavioural markers questionnaire and the name of the candidate they are to rate.

Will the participants be anonymous?

No

Confidentiality of participant identity will be maintained by coding participant data.

Will an institution to which the participants belong be named or able to be identified? Yes

Outline how and where the data and consent forms will be stored:

Electronic data will be stored on a password-protected computer. All consent forms, and electronic media (CD's, computer disks, memory sticks) will be collated and stored in a locked cabinet.

Once all consent forms have been collected they will be stored within secure storage at the RNZAF Psychology Services Department in Wellington.

Who will have access to the data/consent forms?

During the project the researcher and the Senior Psychologist (RNZAF), and Richard Fletcher, the Massey Supervisor will have access to the data/consent forms. After completion of the research, only the coded data will be available to the RNZAF Psychology Service at the discretion of the Senior Psychologist (RNZAF) for future validation purposes. Any participant, who indicated (via their consent form) that they did not wish their coded data to remain available to the RNZAF Psychologist Services, will have their data removed.

How will data/consent forms be protected from unauthorised access?

Data and consent forms will be protected through the use of passwords and secure storage facilities.

Who will be responsible for disposal of the consent forms when the five-year storage period is up?

The researcher and the Senior Psychologist (RNZAF).

SECTION F: Deception

13. Is deception involved at any stage of the project? No

SECTION G: Conflict of Interest

14. Is the project to be funded in any way from sources external to Massey University? No
Does the researcher have a financial interest in the outcome of the project? No
Is there any professional or other relationship between the researcher and the participants?

No

SECTION H: Compensation to Participants

15. Will any payments or other compensation be given to the participants? No

SECTION I: Treaty of Waitangi

16. Does the proposed research impact on Maori persons as Maori? No

Are Maori the primary focus of the project? No

If Maori are not the focus of the project, outline what Maori involvement there may be and how this will be managed:

It is anticipated that some of the participants may recognise themselves as Maori ethnicity. However as this data will only be obtained in order to control for ethnicity in the project, it is not anticipated to be a concern. The researcher has approached the RNZAF Maori coordinating officer, Warrant Officer Patrick Smith, who has determined that the research in no way negatively impacts on Maori within the RNZAF. Warrant Officer smith can be contacted by email at patrick.smith@nzdf.mil.nz.

SECTION J: Other Cultural Issues

17. **Are there any aspects of the project that might raise specific cultural issues, other than those covered in Section I?**

No

What ethnic or social groups other than Maori does the project involve?

The project predominately involves officers and non-commissioned officers within the RNZAF, and their immediate superior officers. RNZAF personnel may come from a variety of ethnic backgrounds, however the sample will predominantly be New Zealand European.

Does the researcher speak the language of the target population? Yes

Describe the cultural competence of the researcher for carrying out the project:

I have been involved in the RNZAF as a territorial officer cadet since 2003 and have been engaged in work experience and socialising with this population through sporting events. I understand the culture and climate of the military environment and will be able to relate to participants as being part of the organisation myself. In terms of dealing with Maori, I have taken undergraduate papers in Maori Language and tradition at Massey University as well as a paper on Whanau and psychology. Further, I have as an adviser, Warrant Officer Patrick Smith, the RNZAF Maori Coordinating Officer.

Identify the groups with whom consultation has taken place or is planned:

Consultation has taken place with the RNZAF Maori Coordinating Officer as previously discussed. The other major ethnic group that will partake in the study is New Zealand Europeans who have no cultural representative to contact.

SECTION K: Sharing Research Findings

18. **Describe how information resulting from the project will be shared with participants:**

Participants will have access to a summary of findings at their request, which will be posted to their work address at the completion of project. No Participant will be identified.

SECTION L: Invasive Procedures/Physiological Tests

19. **Does the project involve the collection of tissues, blood, other bodily fluids or physiological tests?**

No

SECTION M: Declaration

20. **Declaration for Student Applicant**

I have read the Code of Ethical Conduct for Research, Teaching and Evaluations involving Human Participants and discussed the ethical analysis with my supervisor. I understand my obligations and the rights of the participants. I agree to undertake the research as set out in the Code of Ethical Conduct for Research, Teaching and Evaluations involving Human Participants. The information contained in this application is to the very best of my knowledge accurate and not misleading.

Student Applicant's Signature:

Date:

Declaration for Supervisor

I have assisted the student in the ethical analysis of this project. As supervisor of this research I will ensure that the research is carried out according to the Code of Ethical Conduct for Research, Teaching and Evaluations involving Human Participants.

Supervisor's Signature:

Print Name:

Date: