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*Examining the Relationship between Shift
Pattern, Risk Perception, Fatigue,
Subjective Well-Being and Stress
among Mongolian Air Traffic Controllers*

A thesis presented in partial fulfilment of the requirements
for the degree of
Master of Aviation
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ABSTRACT

The relationship between shift pattern, fatigue, unrealistic optimism, stress and subjective well-being, may affect the safety of air traffic controllers and their likelihood of continuing in the occupation.

The aim of this thesis was therefore to investigate the effect of shift pattern (fixed or rotating) on fatigue, unrealistic optimism, stress and subjective well-being among Mongolian air traffic controllers.

A battery of four separate questionnaires (and nine demographic items) was completed by 124 Mongolian air traffic controllers (response rate 71%), of whom there were 31 females and 93 males. Length of employment ranged from two months to 28 years.

The main findings were that air traffic controllers who work rotating shifts reported higher subjective fatigue, lower subjective well-being and higher stress compared to their colleagues working in fixed shifts. In addition, there was strong evidence of unrealistic optimism towards both general life and air traffic control specific events. Subsequent investigation revealed that unrealistic optimism towards an air traffic control specific events, was approximately two times less than that towards general life events. There was no evidence that shift pattern, fatigue, unrealistic optimism, stress and subjective well-being were related to the length of employment of participants or the likelihood of continuing in their chosen profession.

As unrealistic optimism may affect judgment and decision-making (and it can lead to unnecessary risk-taking in aviation), this lower level of unrealistic optimism towards air traffic specific negative events is considered to be a positive finding. However, it was noted that the overall mean of the perceived stress score of Mongolian air traffic controllers was higher than that of New Zealand air traffic controllers, although lower than New Zealand college students and a smoking-cessation sample.

Mongolian air traffic controllers are prey to both unrealistic optimism and the effect of shift pattern on their fatigue, stress and well-being. This thesis highlights the need to be aware that this might lead to compromised decision-making and subsequently, unnecessary risk taking.

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GLOSSARY OF ACRONYMS AND ABBREVIATIONS

AAIIB	Aircraft Accident and Incident Investigation Bureau of Mongolia
AC	Advisory Circulars
AIP	Aeronautical Information Publications
AIS	Aeronautical Information Service
AMO	Approved Maintenance Organization
ANS	Air Navigation Services
ANSD	Air Navigation Services Division
ASD	Airport Services Department
ASRD	Aviation Safety and Regulations Department
ATC	Air Traffic Control
ATO	Aviation Training Organization
ATS	Air Traffic Service
CAA	Civil Aviation Authority
CAR	Civil Aviation Regulations
DME	Distance Measuring Equipment
GPS	Global Positioning System
GOM	Government of Mongolia
ICAO	International Civil Aviation Organization
MCAA	Mongolian Civil Aviation Authority
MCAR	Mongolian Civil Aviation Regulations
MIAT	MIAT Mongolian Airlines
NASA	National Aeronautics and Space Administration of the USA
NATS	National Air Traffic Services

NCMH	National Centre of Mental Health of Mongolia
NTSB	National Transportation Safety Board of USA
SHELL	Software, Hardware, Environment, Liveware and Liveware
SOE	State Owned Enterprise
SSR	Secondary Surveillance Radar
SWLS	Satisfaction With Life Scale
PSS	Perceived Stress Scale
USA	United States of America
VOR	VHF Omnidirectional Radio Range
WHO	World Health Organisation

1. INTRODUCTION

1.1. Introduction to Mongolian Civil Aviation Authority

1.1.1. General

Mongolia is a large, sparsely populated and landlocked country. It ranks among Asia's richest countries, in terms of mineral resources, but it has yet to establish the viability of developing its vast natural wealth (CIA, 2011). Specifically, the mining boom that the country has seen over the last few years and the under-developed infrastructure, such as the lack of paved roads or railways, has increased demands on the aviation industry and the need for safe, secure and efficient aviation practices (MCAA, 2011). However, the Mongolian aviation industry is relatively small, compared to other developing nations (ICAO, 2005).

1.1.2. Brief History of Mongolian Civil Aviation Authority

The history of the Mongolian civil aviation industry is inseparably linked with the history of the Mongolian Air Force. May 25, 1925, was the day of the first landing of a Y-13 (Yonkers) freight aircraft invented by German designer Gugo and presented to Mongolia by the former Soviet Union. This day is considered to be the foundation day of the Mongolian Air Force (MIAT, 2011).

The year 1956 was the start of a new period in the development of civil air transportation in Mongolia. At the beginning of 1956, five small passenger Antonov An-2 aircraft were delivered from the Soviet Union and transition training for pilots was successfully completed, thus enabling them to serve Mongolians with scheduled flights (MIAT, 2011).

The Agency of Air Affairs, established in 1957, was the first organisation responsible for managing the civil aviation activity of Mongolia and, until 1980, it was under the jurisdiction of the Ministry of Defence of Mongolia. In 1980, it was reorganised into the Civil Air Transport Administration under the Council of Ministers of the People's Republic of Mongolia, and it remained so until 1989. From 1989 to 1992, it was operated as the MIAT Mongolian Civil Air Transport Corporation, under the Ministry of Road and Transportation (MCAA, 2012).

Until 1992, all civil aviation functions in Mongolia were carried out by a single entity: the MIAT Mongolian Civil Air Transport Corporation. The structure of this company closely resembled that of Aeroflot, as it existed in the time of the former USSR. What was significant about this structure was that it came directly under the national government and it was solely based on a service provision, with no clearly identifiable regulatory components.

Mongolia became an International Civil Aviation Organization (ICAO) contracting state in 1989. This fact, together with the development of civil aviation industry, the growth of Mongolia's relationship with other countries, and the requirements to operate flights that met international standards raised the question of a re-organisation within the Mongolian civil aviation sector (MCAA, 2012).

On August 10, 1993, the Minister of Road, Transport and Communication of Mongolia passed Order No.180, to re-structure the MIAT Mongolian Civil Air Transport Corporation. By that order, the air carrier component was established as a state owned enterprise: MIAT Mongolian Airlines. Furthermore, by that order, the Civil Air Transport Administration of Mongolia was established, the main goal of which was government surveillance to ensure civil aviation safety and aviation

security, in addition to providing air traffic services and the operation of airports (MCAA, 2012).

In 1999, the Parliament of Mongolia passed the Civil Aviation Law of Mongolia and as a result, renamed the Civil Air Transport Administration of Mongolia the Implementing Agency of Government of Mongolia, Mongolian Civil Aviation Authority (MCAA).

1.1.3. Objectives, roles and functions of the MCAA

The MCAA is a government agency charged with professional oversight and regulation of civil aviation activities in Mongolia. The MCAA is obliged, under the Civil Aviation Law of Mongolia, to direct its activities towards ensuring civil aviation safety and security (MCAA, 2012).

Under the Civil Aviation Law of Mongolia, the MCAA exercises the following powers:

- Setting up aviation safety regulations/standards compliance, in accordance with the Annexes of Chicago Convention and presenting them for approval or registration to relevant authorities and control implementation, thereof;
- Resolving matters relating to air navigation service charges;
- Collecting, publishing, exchanging and distributing aviation related information and collaborating with others in these matters;
- Taking preventive actions, as submitted by the accident/incident investigation and
- Issuing reports and safety recommendations.

1.1.4. Organisational Structure, Units and Services of the MCAA

The MCAA has two main functions: its regulatory function and its service provision. Specifically, the MCAA is responsible for:

- (1) providing air traffic services, for the operation of airports; and
- (2) setting safety standards (and the oversight thereof) and overseeing other regulatory aspects of the civil aviation system.

As of January 1, 2012, the MCAA employed a total staff of 2026 people (MCAA, 2012). The revenues for 2010 were USD 71.8 million, from which a total of USD 25.0 million was included in the government's budget of Mongolia, and the total expenditure for its own operations was USD 34.7 million. Charges for providing Air Navigation Services (ANS) accounted for 95% of these revenues (MCAA, 2011).

1.1.4.1. Regulatory Functions of the MCAA

According to the Civil Aviation Law of Mongolia, regulatory functions such as surveillance and oversight for the operation of civil aviation activities are implemented by the Aviation Safety and Regulations Department (ASRD) of the MCAA. This department is headed by the First Deputy Director General of MCAA and the General State Inspector for Aviation Safety. This work is carried out by 47 staff members within the ASRD, most of whom are professionally qualified as pilots, aircraft maintenance engineers, air traffic controllers and lawyers. The ASRD consists of five divisions and one section:

- Flight Standards and Operations Surveillance Division;
- Airworthiness Division;
- Personnel Licensing Division;

- Aerodrome and Air Navigation Division;
- Rule Making and Rule Registration Division;
- Administration and Internal Quality Section;

Between 2001 and 2008, the MCAA developed a complete set of Mongolian Civil Aviation Regulations, which were based on the New Zealand Civil Aviation Regulation System. The MCAA has been successfully audited on their regulatory system by ICAO in 1997, 1999, 2001 and 2010 (ICAO, 2012).

As of January 1, 2012, the MCAA has 10 certified air operators, three of which serve both the domestic and international routes to and from Mongolia. There are also four foreign air operators certified by MCAA. The MCAA has 41 aircraft listed on the Mongolian Registry, 25 of which have a valid Certificate of Airworthiness and there are seven domestic and 15 foreign Approved Maintenance Organisations. Furthermore, the Personnel Licensing Division of MCAA has issued a total of 616 licences to airmen. Table 1 represents the Licence Holders Issued by MCAA (MCAA, 2012).

Table 1

Licences Issued by MCAA

Licence Type	
Aircraft Maintenance Engineer Licence	202
Air Traffic Controller Licence	189
Airline Transport Pilot Licence	58
Aircraft Repairman Licence	47
Flight Service Operator Licence	44
Commercial Pilot Licence	41
Flight Dispatcher Licence	13
Airline Transport Pilot Licence (Helicopter)	9
Private Pilot Licence	7
Flight Engineer Licence	6
Total	616

1.1.4.2. Service Provider Functions of MCAA

The MCAA is also responsible for providing air traffic services and for the operation of airports. For these purposes, the MCAA has two departments within its organisational structure: the Air Navigation Services Department (ANSD) and the Airport Services Department (ASD). There are 1,911 MCAA staff members working in these two departments.

Airport Services Department

The ASD of MCAA, headed by the Deputy Director General of MCAA, is responsible for the operation of domestic and international airports in Mongolia. The

MCAA operates the ‘Chinggis Khaan’ International Airport near the capital city Ulaanbaatar, in addition to 21 domestic airports (MCAA, 2011).

Air Navigation Services Department

The ANSD of MCAA, headed by the Deputy Director General of MCAA, is responsible for air traffic management and services over the territory of Mongolia. All Mongolian airspace is covered by the Ulaanbaatar Flight Information Region (ULN FIR), and the current method of air traffic management is based on Procedural air traffic control. The contiguous Flight Information Regions are Chita, Irkutsk and Kizil administered by the Russian Federation; and Beijing, Lanzhou and Urumqi administered by the People’s Republic of China (MCAA, 2012).

Both international and domestic air routes over the territory of Mongolia (Figure 1) are subject to ICAO airspace classification rules (MCAA, 2011). There are eight international air routes that generally serve over-flying traffic between Europe, China and Korea, and 30 domestic GPS air routes that are normally operated up to 6150 m in metric standards (ICAO, 2005).

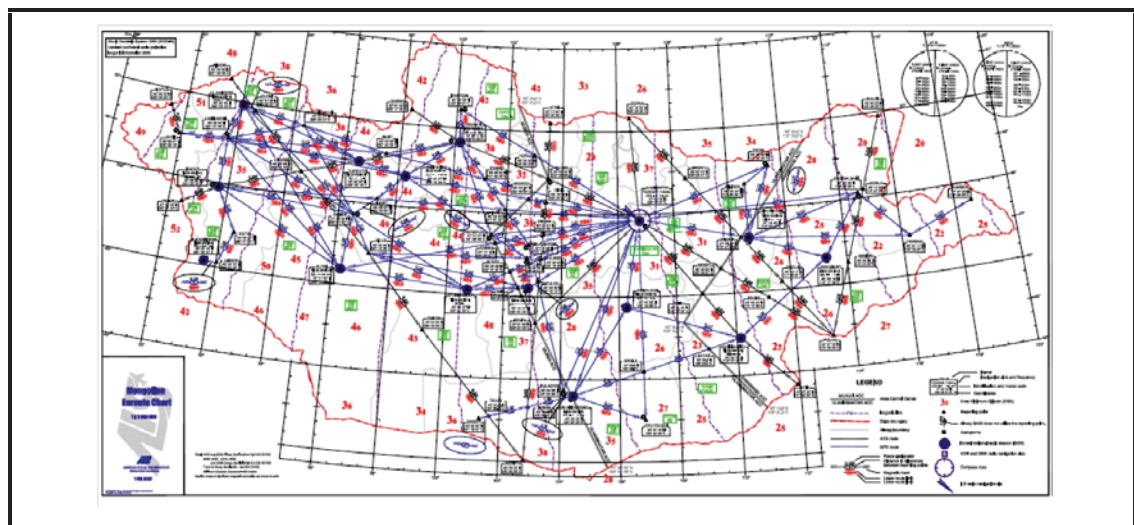


Figure 1. Mongolian Air Routes (MCAA, 2011).

Table 2
Flights Over Territory of Mongolia from 2004 to 2009 (MCAA, 2011)

Year	2004	2005	2006	2007	2008	2009
Month						
January	2,660	3,437	4,009	4,367	5,125	4,682
February	2,772	3,111	3,600	3,880	4,578	4,247
March	3,198	3,679	4,382	4,781	5,353	4,983
April	3,384	3,727	4,403	5,020	5,539	5,060
May	3,539	3,840	4,557	5,145	5,809	4,957
June	3,451	3,900	4,636	5,212	5,590	5,035
July	3,655	4,267	4,990	5,496	5,803	5,346
August	3,754	4,272	4,970	5,636	6,089	5,413
September	3,725	4,194	4,905	5,528	5,608	5,229
October	3,940	4,495	5,016	5,593	5,753	5,461
November	3,718	4,197	4,708	5,404	5,424	5,273
December	3,461	4,007	4,400	5,183	4,872	5,092
Total	41,257	47,126	54,576	61,245	65,543	60,778

The volume of over-flying traffic over the period from 2004 to 2008 increased at a rate of between 11% to 15% annually (see Table 2). According to MCAA (2011), this trend is expected to continue into the foreseeable future, with about 59% of this traffic operating to and from locations in China.

In 2007, 61,245 flights crossed over Mongolia and in 2008, this number increased by 7% to 65543 flights. However, in 2009, the number of flights decreased to 60,778. This decrease of 7% may be explained by the global economic crisis that occurred in 2009 (MCAA, 2011).

At the time of this study, there was no Secondary Surveillance Radars (SSR) in Mongolia. SSR is a system widely used in air traffic control in many countries (Trim, 1990). As SSR is not installed in Mongolia, the ANSD of MCAA uses 'procedural control' or 'non-radar' procedure, when providing air traffic services for flights. In procedural control, every aircraft is allowed to fly in a pre-determined airway and other aircraft in the same, converging, or crossing courses, are longitudinally separated by 10 minutes (approximately 150 km) and vertically separated by; i) 500 m above 8100 m (metric standards); ii) 300 m below 8100 m (metric standards); or iii) 1000 m above 12,100 m (metric standards) (ICAO, 2005).

According to the study conducted by Shouksmith and Burrough (1988), New Zealand air traffic controllers named equipment limitation (such as unavailability of SSR) as the most stressful factor affecting their daily duties, as at the time of that study, there was no SSR installed in New Zealand. Indeed, Shouksmith and Burrough (1988) reported that air traffic controllers' job is of a highly stressful.

In procedural control, the air traffic controller must rely on a flight progress strip and maintain a mental picture of the location of aircraft, which is based on each aircraft's flight progress strip. According to Older and Cameron (1972), the procedural control position requires the air traffic controller to:

- operate radio equipment;
- review the accuracy of flight progress strips and weather information;
- receive and post flight progress reports;
- analyse the traffic picture for potential conflicts;

- initiate, issue, revise, and forward clearances, advisories and other control information to departing, en route, and arriving aircraft, as well as relaying appropriate information to the adjacent sector/facility; and
- prepare required reports and maintain sector logs.

Ultimately, the use of procedural control within air traffic services significantly increases the workload of air traffic controllers, as they need to keep the location of every aircraft in their mind: and they can only rely on the flight progress strip (Wickens, Mavor, & McGee, 1997).

As there has been an increase in air traffic flow over the territory of Mongolia during the last few years, the Government of Mongolia (GOM) have decided to install some additional navigation aids to be used from 2013, including three SSRs and five VOR/DME stations (MCAA, 2012). At the time of this study, the ANSD of MCAA was in a transition period from procedural control to radar control.

1.2. Statement of the Problem

Stress, fatigue, incorrect evaluations of risk and subjective well-being are all factors that could affect the safe and efficient transportation of passengers and goods. One such area is Air Traffic Control (ATC), where safety related decisions are crucial to aviation safety. This area is the focus of this study.

In the growth of air traffic over the territory of Mongolia, in addition to the growth of air traffic within domestic routes, has resulted in increased workloads of ANSD's air traffic controllers, while the number of staffing levels remained unchanged (MCAA, 2011). Aviation safety could be compromised if the level of fatigue and stress of air traffic controllers becomes too high, which is potentially an important issue. When

people are over-tired or experiencing high levels of stress, their judgment (and subsequently their decision-making) can be impaired (Dias-Ferreira et al., 2009; A. L. George, 1986; Kowalski-Trakofler, Vaught, & Scharf, 2003). As a result, the safety and efficiency of an air traffic control service can be put at risk, which would be inconsistent with safety, performance, occupational health and well-being. Air traffic controllers must not become over-tired or stressed, due to excessive working hours or workloads. As such, the prevention of fatigue and stress among air traffic controllers should exert an important influence on management decisions.

The International Civil Aviation Organization (ICAO) seeks to address human factors issues such as the prevention of fatigue and stress by publishing guidelines, standards and recommended practices in the application of human factor principles within the aviation industry (Gilbey, Fifield, & Rogers, 2006; ICAO, 1989, 1993). As a result, many ICAO Contracting States have established regulatory requirements in order to provide basic human factor training, as part of their initial training for air traffic controllers (ICAO, 1993). The Air traffic control service providers employ a pro-active approach to human factor principles in its operations, according to their established Safety Management System. Additional stress management and human factor training courses are made available to all licensed staff (Gilbey, et al., 2006).

The main aim of this study was to extend the work of Gilbey et al. (2006) by investigating the effect of shift pattern (fixed or rotating) on fatigue, unrealistic optimism, stress and subjective well-being among Mongolian air traffic controllers. This was an important limitation of Gilbey et al.'s (2006) study, insofar as the effect of shift pattern was not investigated.

1.3. Significance of Thesis

This thesis contributes to the body of knowledge related to unrealistic optimism, fatigue, subjective well-being and stress among aviation professionals. In addition, this thesis is of value to the ANSD of MCAA, as it is the first to have investigated unrealistic optimism, fatigue, well-being and stress among Mongolian air traffic controllers, and their relationship to shift pattern.

1.4. Structure of Thesis

This thesis is presented in six chapters. Chapter 1 provides introductory information about the MCAA and ANSD, and introduces the problem statement of under investigation.

Chapter 2 provides the theoretical background and literature review of this thesis. This includes general information about the theoretical background and also a review of relevant literature about human factors in aviation, stress, fatigue, unrealistic optimism and subjective well-being from various perspectives. This chapter also includes a formal statement of the hypotheses investigated in this study.

The method and procedures used to conduct this study are reported in Chapter 3, and results are presented in Chapter 4. These results are discussed in Chapter 5, where ideas for further research are suggested.

Chapter 6 concludes the thesis and presents recommendations and implications derived from the discussion.

2. LITERATURE REVIEW

2.1. Human Factors in Aviation

On December 17, 1903, the powered and piloted heavier-than-air airplane, built by the Wright Brothers, made its first successful flight. Ten years later, Silas Christofferson would transport passengers between San Francisco and Oakland harbours by hydroplane (Bilstein, 2001).

In the early days of aviation, risk was essentially due to issues of design, as well as aerodynamics and mechanical failures (ICAO, 1989). Since then, aviation has evolved into a technological, intensive system and modern aircraft are much safer and more reliable than decades ago (Shappell, 2006). Nowadays, anyone who works in the aviation industry, either as a pilot or an air traffic controller or a maintenance person, needs to interact with highly sophisticated technology in order to provide for the safe and efficient transportation of passengers and goods (ICAO, 1989). According to (Koonce, 1999), the main cause of air accidents is not the aircraft but the human in the cockpit. Interestingly, Hobbs (2004) examined 100 aircraft accidents that occurred between 1921 and 1932 in Australia and reported that pilot error contributed significantly more to accidents than mechanical failure. However, despite the presence of human error, the latter was not identified as a significant scientific discipline in the early days of aviation (Koonce, 1999).

A systematic approach to the understanding of human factors was taken, when the SHELL concept was introduced by Edwards in 1972 (ICAO, 1989). The SHELL concept was later adapted into a 'building block' structure by Hawkins (1987). The SHELL concept was named after the first letters of its modules: Software, Hardware,

Environment, and Liveware. Hawkins (1987) suggested the following interpretations:

- Software - the rules, procedures, written documents etc., which are part of the standard operating procedures,
- Hardware - machine,
- Environment - the situation in which the L-H-S system must function, the social and economic climate as well as the natural environment, and Liveware – human.

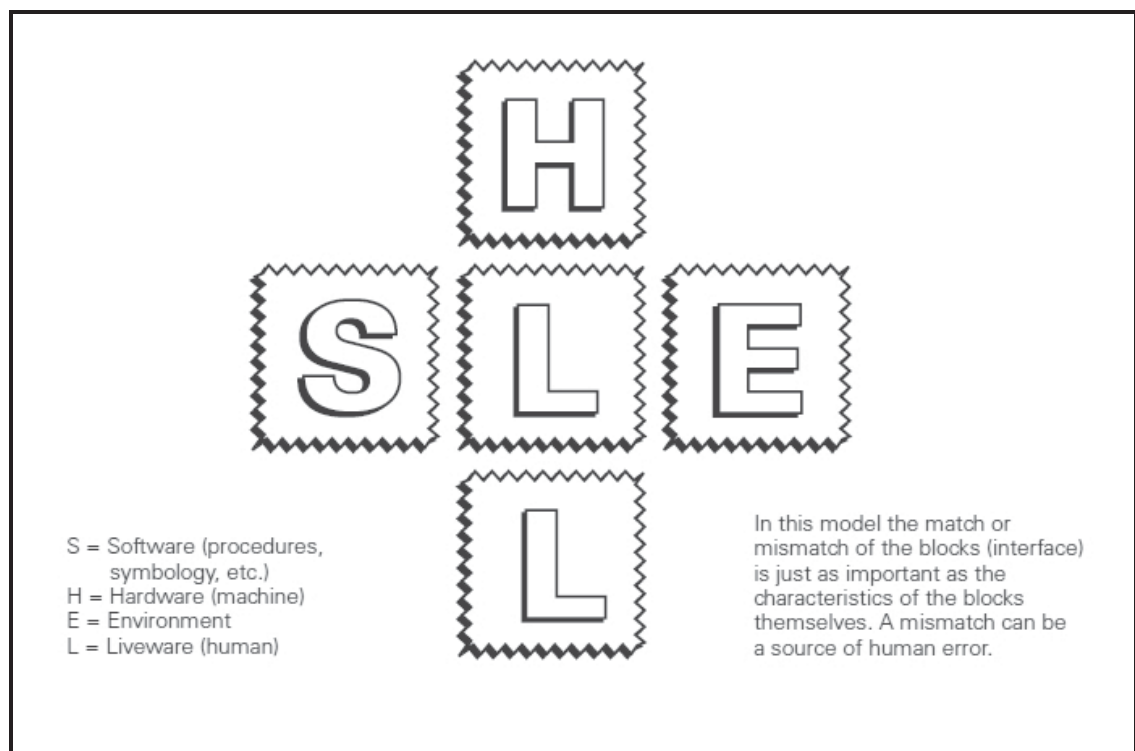


Figure 2. The SHELL Model as Adapted by Hawkins (ICAO, 1989)

As seen from Figure 2, the Liveware (human) has four main types of interaction:

- Liveware-Hardware: Interaction between human and machines, including equipment. For example, in air traffic management perspective, highly sophisticated automated equipment in air traffic management could, for

example, change the air traffic controller's role from an 'active planner' to that of a person that reacts passively to alternative commands of action that is proposed by the machine. This could lead to boredom, confidence and lowered readiness (Koenig, 1995).

- **Liveware-Software:** Interaction between human and written procedures, such the rules, procedures, written documents etc. For example, in air traffic management perspective, problems in these interactions can include misinterpretation and/or non-compliance with procedures.
- **Liveware-Environment:** Interaction between human and environment, the situation in which the L-H-S system must function. The environment is not limited to the work place, it also includes the social and economic climate as well as the natural environment (ICAO, 1989). In air traffic management perspective, problems in this area might involve high work levels, shift work, sleep deprivation and economical restraints. These factors are outside the personal control boundaries of air traffic controllers, but might be avoided if addressed correctly by the management team of air traffic service organisations.
- **Liveware-Liveware:** Interaction between human and other individuals, including family and colleagues. In air traffic management perspective, problems in this area might involve poor team work. These problems might be avoided if addressed correctly by the management team of air traffic service organisations; for example by introducing and implementing team work principles and safety management system (ICAO, 1993).

One aim of the SHELL model is to optimise these relationships. Figure 2 does not cover the interfaces, such as software-hardware, hardware-environment and hardware-hardware, which fall outside the area of human factors. The SHELL model should be used only as a fundamental aid to understanding human factors (ICAO, 1989), and can be used as a framework to identify problem areas, to trace the origins of specific problems, and to define appropriate data collection tasks. The SHELL model includes the main interactions between individuals and other aspects of the system, but there can also be second and third order interactions. For example, in the context of the SHELL model, what an air traffic controller (liveware) actually sees on a display can depend on which information is displayed (hardware); how appropriate it is for the task (software); whether it is obscured by glare (environment); and what the controller is expecting to see after conversing with the pilot (liveware) (ICAO, 1993).

The SHELL model can be used to investigate the relationship between airplane crashes and communication patterns with air traffic controllers. A report published by the National Aeronautics and Space Administration (NASA) of the United States of America (USA) showed that more than 70% of 28 000 incident reports were due to a problem in the transfer of information, especially between the pilot and the air traffic controller (ICAO, 1993). It has been found that the most common cause for this lack of communication was that the person that had the critical information, did not believe that it was important enough to communicate, or that the information was communicated, but incorrectly. The lack of communication was attributed to high workloads which is believed to contribute to air traffic controllers' high stress levels, and could then lead to incidents or accidents (Van der Doef & Maes, 1999).

According to Wiegmann and Shappell (2003), the SHELL concept adopts a systems perspective that proposes the ‘human’ is very rarely the one and only cause of an accident. This systems perspective considers a range of ‘contextual and task-related factors’ that interact with the human operator within the aviation system, and which have an effect on operator performance (Wiegmann & Shappell, 2003). Therefore, the SHELL concept considers both latent and active failures within the aviation system.

Recent studies have shown that, although percentages vary, the weakest chain in these interactions is often the human (Liveware). According to these studies, human error was a major cause or a contributing factor in 60%-80% in aviation accidents and incidents which have occurred over the past two decades (Billings & Reynard, 1984; Endsley, 1999; Gaur, 2005; Li, Baker, Grabowski, & Rebok, 2001; Ruishan, Lei, & Ling, 2007; Shappell, 2006; Wiegmann & Shappell, 2003). Although it has been demonstrated that human error has been a major cause or contributing factor to air accidents, until recently very scarce information has been available about the nature of human errors and the factors that contribute to them. Early efforts in human factor identification were aimed at the flight crew, in relation to the effects of cold, heat, vibration, noise and acceleration forces on humans (ICAO, 1989).

The acknowledgment that basic human factor education is needed was tragically emphasised in 1977 (ICAO, 1989). Shortly after a terrorist attack, the Gran Canaria International Airport, Las Palmas, was closed and aviation authorities diverted all incoming flights to Los Rodeos airport (Musson, 2008). At least five large aircraft were diverted to Los Rodeos airport, which had only one runway and one taxiway. The aircraft were parked on the taxiway, thus ensuring that the taxiway was not usable to taxi. The departing aircraft had to use a procedure known as a ‘runway

back taxi', where pilots are required to taxi onto a runway to position the aircraft for take-off. In such situation, a Pan Am Boeing 747 passenger aircraft taxiing on the runway was hit by the landing gear of a KLM Boeing 747 passenger aircraft that was taking-off in heavy fog, killing 583 people on-board both aircraft (Gero, 2000). As well as factors as poor communication and increased traffic volume at Los Rodeos airport (Rao, 2007) that led to this accident, it was stated that "Stress and its effect on human and organizational behaviour are major factors in the Tenerife collision" (McCreary, Pollard, Stevenson, & Wilson, 1998, p. 24).

From a human factor perspective, and taking into consideration the SHELL model, it can (with some certainty) be said that an air traffic controllers' environment influences their stress levels. As discussed previously, this stress can then affect their decision-making. Therefore, it is essential to discuss the concept of stress, in order to further understand how stress is manifested within the role of an air traffic controller. This is specifically important in the case of Mongolian air traffic controllers who use procedural control during high flows of air traffic; that is, keeping in their mind the position of all aircraft within their sector of responsibility and with only a flight strip aid.

2.2. Stress and Decision Making

2.2.1. General

Stress is a non-specific reaction of a human organism to extreme factors that are difficult to solve, or the result of a menacing situation. Stress is a normal part of human life and it is necessary in certain quantities. If there were no stressful situations, risk or desire to work on the edge of possibilities, then our lives would be very boring. Sometimes, stress plays a role as a type of calling or motivation, which

is necessary, in order to feel a completeness of emotions, even if it is a question of survival. However, if these calls and/or challenges become too large, then the ability of the person to cope with these problems is gradually lost (NCMH, 2011).

In each person's life, there are moments when s/he experiences stress or a disturbing condition. Generally, an 'alarm' condition helps the person cope with external dangers, by forcing the brain to work intensively and thus, leading to an organism being in a ready state for action. When alarms and fears begin to suppress the person and influence their everyday life, disturbing frustration can be the result and the person can experience different condition such as panic conditions, fear of losing a job, specific fears, post-traumatic stresses or generally anxiety. These situations can appear between the ages of 15-20 years (NCMH, 2011) and include:

- *External sources of stress and anxiety*, such as moving to a new residence, work change, death of a loved one, divorce, in addition to everyday troubles connected with monetary problems, performance of obligations to certain terms, disputes, family relationships and/or sleep loss.
- *Internal sources of stress and anxiety*, can include vital values, beliefs and fidelity to the given word, or self-estimation.

In the aviation industry (in addition to other industries such as the medical industry), where the stress of Liveware can lead to loss of life, it is important to examine the relationship between stress and the stressor. Like most other individuals, aviation professionals might experience married life, divorce or might get involved in management disputes, or face a myriad of petty frustrations and worries in their daily life. Even positive life events, such as the birth of a child, can induce stress (ICAO, 1989).

2.2.2. *History of the term 'Stress'*

The term 'stress' was first used by Walter Cannon which involved both aspects of physiology and psychology. Cannon established the universal reaction which he named 'fight or flight response' (Goldstein & Kopin, 2007). Later Selye published the first work on the 'general adaptation syndrome', but avoided using term 'stress' for a period of time as he believed that the term stress was used in many respects for a designation of 'psychological pressure' (a syndrome 'fight or flight response')(Goldstein & Kopin, 2007). Initially Selye described stress as the 'general adaptation syndrome', and only in 1946 did he begin to use regularly the term 'stress' for the general adaptation syndrome which he described 3 stages (Selye, 1956):

- Alarm reaction (A.R.) - a stage analogous to Cannon's 'fight or flight' response, mobilisation of adaptable possibilities - these possibilities are limited;
- Stage of Resistance (S.R.) - a stage of adaptation, associated with resistance to the stressor; and
- Stage of Exhaustion (S.E.) - a stage, where adaptation eventually wears out and further resistance becomes impossible.

Initially, Selye (1956) considered stress exclusively as the destructive, negative phenomenon, but he later stated "The stress is the non-specific response of the body to any demand placed upon it" (Selye, 1956, p. 30). The author introduced additional concepts of positive stress and negative stress which he named as 'Eustress' and 'Distress' respectively (Goldstein & Kopin, 2007):

Eustress. The concept has two values: a) the stress caused by positive emotions, and b) not strong stress, mobilising an organism.

Distress. Negative type of stress with which organism not in forces to consult. It negatively affects the health of the person and can lead to a serious illness.

2.2.3. *Work stress*

It has been shown that stress, as a classical non-specific reaction in Selye's description, is only one of the reactions that comprise the general system of non-specific adaptable reactions of an organism. The organism's sub-systems react differently to different stressors' force and quality, thus causing fluctuations of a homeostasis within a normal range. The organism is a more sensitive system than its sub-systems and hence stress is a reaction to strong stressors (Goldstein & Kopin, 2007).

In the context of the SHELL model, the stress refers to the failure of Liveware (human) to react adequately, due to a physical, emotional or mental state, whether that state is actual or imagined. Lazarus and Folkman (1984, p. 19) defined stress as, “a particular relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and endangering his or her well-being”. In line with this definition and the SHELL model by Hawkins (1987), it can be said, with some certainty, that the environment (the situation in which the L-H-S system must function, including the social, economic climate and the natural environment) — that is, where the air traffic controller works and lives — can play the role of the stressor.

Ornelas and Kleiner (2003) claimed that work is the main factor of stress in western countries. Stress related to a job can be found in various professions, and the aviation industry is especially rich in potential stressors. In the early days of aviation, stressors were created from the natural environment: temperature; noise; humidity; vibration; heat and acceleration forces, and those stressors were mostly physiological in nature. Nowadays, there are new sources of stress, such as non-regular resting and working arrangements, and disturbed circadian rhythms related to non-regular and night-time shifts or long-range flights (ICAO, 1989).

Work stress can be defined as the harmful, physical and emotional responses that occur when the requirements of a job do not match the capabilities, resources, or needs of the worker (NIOSH, 1999). Some authors claim that work stress can lead to poor health and even injury (Colligan & Higgins, 2006; Levi, Sauter, & Shimomitsu, 1999), and is believed to be the painful psycho-emotional condition formed in the course of work (NIOSH, 1999; Ornelas & Kleiner, 2003). This concept covers the large set of frustration, including psychological disorders, such as depression, anxiety, post-traumatic stress disorder (Lovibond, 1998; Yehuda, 2002), and other types of emotional strain, such as dissatisfaction, fatigue (Conway, Campanini, Sartori, Dotti, & Costa, 2008; Maghout-Juratli, Janisse, Schwartz, & Arnetz, 2010). It also covers inadequate behaviours such as aggression (Taft et al., 2009), substance abuse (Andersen & Teicher, 2009), and cognitive impairment such as concentration and memory problems (Dias-Ferreira, et al., 2009; Garrett, Grady, & Hasher, 2010). These problems can lead to unsatisfactory implementation by the employee in relation to his/her duties, and are believed to be harmful to health (Colligan & Higgins, 2006).

Work stress is an important problem within modern workplaces. For example, according to (NIOSH, 1999), at least 25% of employees in the United States consider that their work is a stressful factor and their psychological reactions to working under stress can cause long-term negative consequences for their health (Conway, et al., 2008). Colligan and Higgins (2006) claimed that the reason for the existence of working stress is working conditions.

George (1986, p. 536) outlined some specific effects of stress on the performance of complex tasks, such as “impaired attention and perception, increased cognitive rigidity, shortened and narrowed perspective”. According to McCreary et al. (1998), most of the above effects existed in the Tenerife accident. The pilot in command of KLM’s Boeing 747 passenger jet made the decision to take-off under stress, resulting in the world's worst civil aviation disaster (Cawthorne, 2006).

Judgment, in relation to risky situations and decisions made in aviation, is crucial to the prevention of accidents or incidents. According to Hammond (2000, p. 6), “judgment and decision making under stress is an aspect of human behaviour that is poorly understood”. Kowalski-Trakofler et al. (2003, p. 281) pointed out the importance of including “the concept of perception when discussing stress in relation to performance, including performance in judgment and decision making”. In this context, Salas (1996, p. 6), defined stress as a “process by which certain work demands evoke an appraisal process in which perceived demands exceed resources and result in undesirable physiological, emotional, cognitive and social changes”. In this explanation of stress by Salas (1996), the vital expression 'perceived demands' was used. According to Kowalski-Trakofler et al. (2003), 'the ability to cope with stress' is reliant on the individual’s interpretation or perception of the event. Gillis (1993, p. 1361) stated that “certain stressful circumstances may impair judgments but

only if these circumstances lead to an individual experiencing distress at the time the subject is required to make such judgments”.

Although the 'perceived experience of stress' has been shown to impact on people's overall well-being, individual differences exist in people's responses to stress (Baldwin, Chambliss, & Towler, 2003). The problems that people face during their day-to-day living are usually very common in their scope. However, there are also some cases where people have had no prior experience with the given stressor, or the stressful event unfolds over a relatively long period of time (Scheier & Carver, 1987). In these cases, have suggested that generalised expectancies or 'unrealistic optimism' may play an important role in coping with stress (Brydon, Walker, Wawrzyniak, Chart, & Steptoe, 2009; Curbow, Somerfield, Baker, Wingard, & Legro, 1993; Salovey, Rothman, Detweiler, & Steward, 2000; Scheier & Carver, 1987; Taylor & Brown, 1988). Scheier and Carver (1987) have also suggested that there is a causal link between physical well-being and optimism, because optimists use more effective approaches to coping with stress. Therefore, it is essential to discuss the concept of unrealistic optimism in order to further understand its effects on the person's ability to cope with stress within the role of an air traffic controller.

2.3. Unrealistic Optimism

In many situations, people demonstrate unrealistic optimism where they believe that, compared to other people, they are more likely to experience positive events and less likely to experience negative events, (Weinstein, 1980, 1987). Other terms are also used to describe this phenomenon such as positive illusions (Taylor & Brown, 1988, 1994; Taylor, Kemeny, Reed, Bower, & Gruenewald, 2000); unrealistic optimism (Weinstein, 1980); illusion of unique invulnerability (Burger & Burns, 1988);

perceived invulnerability (Breheny & Stephens, 2004) and comparative optimism (Gilbey, et al., 2006; Radcliffe & Klein, 2002). In this thesis the term 'unrealistic optimism' will be used.

Weinstein (1980) reported that most students tend to believe that they have a better chance than their classmates of owning their own home, having a high starting salary and liking their future job. At the same time, they rate negative items, such as getting lung cancer, having an alcohol related problem, being divorced within a few years after marriage, contracting venereal disease and being sterile, as being more likely to occur to others. Internet users reported that positive internet-related events, such as finding items that they are searching for and being contacted by an old friend, is more likely to happen to them, whilst negative internet-related events, such as personal information or a credit card being stolen, being harassed online or being infected by a virus, is less likely to happen to them, when compared to their peers (Campbell, Greenauer, Macaluso, & End, 2007). Similarly, smokers believed that they had a low risk of having lung cancer than the average smoker (Weinstein, Marcus, & Moser, 2005); gay men believed that they were less at risk of being infected by HIV than most other gay men when engaging in high-risk sex (Gold & Aucote, 2003); motorcyclists believed themselves to be less at risk of being involved in an accident needing hospital treatment than others (Rutter, Quine, & Albery, 1998); consumers with a higher degree of unrealistic optimism tended to choose credit cards with features that were not in their best interest (Yang, Markoczy, & Qi, 2007); and subjects rated themselves as safer, more skilful, and less likely to have a traffic accident than the average motorist (DeJoy, 1989). In other words, the subjects with unrealistic optimism tended to take risks, by relying on their beliefs about negative events.

In contrast to the negative aspects of unrealistic optimism, other researchers suggested that there may also be positive points. For example, Regan, Gosselink, Hubsch and Ulsh (1975) claimed that because of a need for high self-esteem and the need for psychological well-being, people might inflate self-assessments of their own ability. As a consequence, a positively biased view of one's future accompanied a variety of psychological benefits such as self-reports of happiness and contentment, increased motivation and persistence, and ultimately better performance and greater success (Taylor & Brown, 1988). In addition, the study on the implication of dispositional optimism for physical well-being suggested that "compared to pessimists, optimists seemed to show fewer signs of intra-operative complications and to evidence a faster rate of recovery" (Scheier & Carver, 1987, p. 179).

In aviation, a number of studies have reported unrealistic optimism in pilots. Wichman and Ball (1983) found that pilots believe they are safe pilots with better flight skills and their chances of being involved in an accident were low. Lester and Bombaci (1984) suggested that 'invulnerability thoughts' may be a major mediator of pilots' irrational judgment. O'Hare (1990) suggested that higher personal invulnerability scores affect pilots' judgment and decision-making, and this may be a factor leading pilots to fly into worsening weather conditions. In Goh and Wiegmann's study, where computer simulated flights were used to identify whether pilots would make a decision to divert, or continue into worsening weather conditions, an overconfidence in personal ability was found (2002). That means if people wrongly perceived risky situations to be lower than those situations actually were, there was a tendency to demonstrate risky behaviour based on their wrong perception (e.g. Burger & Burns, 1988). In general, it is evident that optimistic

assessments of potentially risky situations are common and persistent in aviation, and this factor might affect safety related decisions (Gilbey, et al., 2006).

2.4. Fatigue and Shift Work

Fatigue is a further human factor issue that can contribute to an aviation accident or incident. Indeed, fatigue has been recognised as a causal factor of accidents, injuries and death in many areas. These areas can include the transport industry, such as road (Horne & Reyner, 1995; Lyznicki, Doege, Davis, & Williams, 1998; Philip, Vervialle, Breton, Taillard, & Horne, 2001), air (Caldwell, 2005; Goode, 2003; NTSB, 1994), rail (Baysari, McIntosh, & Wilson, 2008; Sussman & Coplen, 2000) and marine (Hetherington, Flin, & Mearns, 2006; McCallum, Raby, & Rothblum, 1996), as well as other occupational areas such as hospitals (Conway, et al., 2008; Gander, Merry, Millar, & Weller, 2000) and emergency operations (Lawrence, 2011). According to (Caldwell, 2005), the problem of fatigue is more pronounced in occupations where working hours are irregular, implying that tired people could have a lessened likelihood and probability to give sound performance of a safe action. Moreover, fatigue is thought to cause further negative behaviours such as slow responses, failure to pay attention or inappropriate action which can be the primary causes leading to a large number of accidents (Mitler et al., 1988).

In many countries, fatigue is believed to be one of the major factor contributing to accidents in the transport industry (Caldwell, 2005; Horne & Reyner, 1995; Lyznicki, et al., 1998; Petrilli, Roach, Dawson, & Lamond, 2006; Philip, et al., 2001). The estimated rate of fatigue in accidents can vary, due to different circumstances and the severity of these accidents, ranging between 1-3% (Lyznicki, et al., 1998) to 20% of accidents on the highways (Horne & Reyner, 1995). However,

it is generally understood that using percentages to estimate the role of contributing factors to accidents does not depict the real magnitude of the dilemma; hence the involvement of fatigue cannot be questioned because it excludes other factors that may contribute to the accident.

Fatigue can be attributed to a number of factors which and hence, one can come up with a number of safety related outcomes. With regard to the modern transportation system, it is more evident that mental fatigue and sleepiness are the basic and important forms of fatigue. The prolonged period without sleep may result in incidents and accidents. The accident that occurred on August, 18, 1993 involving a Douglas DC-8-61 aircraft operated by Connie Kalitta Services, was the first accident in aviation where fatigue was named as the primary factor (Printup, 2000). The National Transportation Safety Board (NTSB) of USA determined that the probable causes of this accident were "... the impaired judgment, decision making, and flying abilities of the captain and flight crew due to the effects of fatigue" (NTSB, 1994, p. 78). The accident investigation revealed that the flight crew had been on duty for about 18 hours and had been flying for about 9 hours at the time of the accident. The Safety Board cited the inadequacy of the flight and duty time regulations as an additional factor contributing to the cause of the accident (NTSB, 2001). Fatigue has also contributed to the accident of Korean Air Flight 801, in which 228 people were killed when their Boeing 747 collided with a hillside in 1997 at Guam (NTSB, 2001), and to the crash of American Airlines Flight 1420 in 1999 at Little Rock, Arkansas (FAA, 2005).

Currently, there is no consensus on a definition of fatigue. For example, Brown (1994, p. 298) posited that "Psychological fatigue is defined as a subjectively experienced disinclination to continue performing the task at hand". However,

Soames, Job and Dalziel (2001) argued that Brown's definition fails to identify the cause of the feeling and suggested the following definition:

Fatigue refers to the state of an organism's muscles, viscera, or central nervous system, in which prior physical activity and/or mental processing, in the absence of sufficient rest, results in insufficient cellular capacity or system wide energy to maintain the original level of activity and/or processing by using normal resources (Soames Job & Dalziel, 2001, p. 469).

As this thesis explores the effect of fatigue in aviation, the International Civil Aviation Organisation's (2011) definition of fatigue is used:

A physiological state of reduced mental or physical performance capability resulting from sleep loss or extended wakefulness, circadian phase, or workload (mental and/or physical activity) that can impair a crew member's alertness and ability to safely operate an aircraft or perform safety related duties.

Fatigue may be conceptualised as both a psychological and physiological experience (Brown, 1994; NASA, 1996). Cercarelli and Ryan (1996, p. 36) stated that "fatigue involves a diminished capacity for work and possibly decrements in attention, perception, decision making, and skill performance". Therefore, in aviation, where 'attention, perception, decision making, and skill performance' is crucial in the promotion of aviation safety, it is important to explore the impact of fatigue on the Liveware (human).

According to Dalziel and Job (1997), fatigue may result from 'circadian rhythm' disruption and sleep loss, and can result in reduced reaction time and lack of

concentration, in addition to a worsened mood and poorer decision-making. Changes from day to night shifts, or changes in time zones may affect the human body's 'internal clock' resulting in circadian rhythm disruption. The effect remains until the human body's internal clock re-adapts to the change. In the case of sleep loss, if individuals are not getting sufficient sleep, then their performance and alertness are reduced. In particular, when sleep loss happens during several nights in a row, it accumulates into a 'sleep debt'. As a consequence, this sleep debt can result in effects which are similar to the case of 'circadian rhythm' disruption. Dalziel and Job (1997, p. 489) noted, "when circadian disruption and sleep loss occur together, they can interact to compound their adverse effects". Overall, fatigue can be considered as the state of a human's body which reflects insufficient rest, and the collection of symptoms related to disturbed or displaced biological rhythms.

According to the National Aeronautics and Space Administration of the USA, there are two types of fatigue: acute and chronic (NASA, 1996). Acute fatigue may occur intensely within a relatively short period of time, following some substantial mental or physical activity such as extended duty periods. Chronic fatigue occurs when symptoms of fatigue accumulate over a longer period of time. This situation occurs when an individual does not get sufficient sleep over a prolonged period of time (e.g. as sleep loss), or when an individual is involved in continuing mental or physical activity with insufficient rest (e.g. shift work). Even with normal physical rest, the emotional stress may result in mental fatigue that may lead to potentially risky situations and a worsening in a person's well-being (Baba, Jamal, & Tourigny, 1998; Gander, et al., 2000; Sonnentag & Zijlstra, 2006; Van Damme, Crombez, Van Houdenhove, Mariman, & Michielsen, 2006).

Fatigue can be caused by many sources and one of these is the irregular shift work environment. According to Blau and Lunx (1999), Dunham (1977) and Shouksmith and Taylor (1997), shift work has been the most frequently used method of managing responsibilities and delegating authority/responsibility in the communication, healthcare, transportation and manufacturing sectors. The average shift of employees working in aviation ranges between 8 to 15 hours, but the normal time of shifts may be extended if any flight is delayed or workloads are altered, and this occurs on a continuous basis (Tourigny, Baba, & Wang, 2010). As a result, aviation safety is vulnerable to decision-making processes affected by shift work. Hence, it is essential to investigate the influence of shift work environment on employees' fatigue level, in order to reduce the adverse effects of a shift work environment on employees who work in aviation. According to Luna, French, and Mitcha (1997) and Cruz, Della Rocco, and Hackworth (2000), air traffic controllers working in rotating shifts reported higher levels of fatigue.

Studies by Baba et al. (1998), Gander, et al. (2000), Sonnentag and Zijlstra (2006) and Van Damme et al. (2006) have shown that fatigue affects the well-being of people. Therefore, it is essential to discuss the subjective well-being among air traffic controllers, in order to further understand how this fatigue affects their subjective well-being. It is specifically important in the case of Mongolian air traffic controllers who use procedural control in a high flow of air traffic. Mongolia is located between Russia and China, and approximately 59% of its air traffic is flights operating between locations in China. The main workload for Mongolian air traffic controllers occur during the early morning shift (MCAA, 2011).

2.5. Subjective well-being

Psychological and physical health may be severely affected by the rotating shifts of employees within the aviation industry (Jamal & Baba, 1992; Totterdell, 2005). This IS likely to be due to inconsistent guidance and supervision of employees during rotating shifts (Tourigny, et al., 2010). According to Baba et al. (1998), employees working in rotating shifts experience negative effects in their well-being.

Van der Doef and Maes (1999) suggested that an air traffic controller's job can be considered a 'high-strain job' (high demands-low control), as depicted by Karasek's job strain model, although observations by Crump (1979), Costa (1993) and Gilbey et al. (2006) show that air traffic controllers are no more stressed than any other groups of the population; for example, smoking cessation sample of tertiary students (Cohen, Kamarck, & Mermelstein, 1983). According to Van der Doef and Maes (1999, p. 88), "[j]ob control, which is sometimes called decision latitude, refers to the person's ability to control his or her work activities. Decision latitude includes two components: skill discretion and decision authority". According to Karasek's job strain model (Figure 3), the psychological tension upon a human being usually occurs as a result of the 'intense workload' a human has to deal with, and the amount of time that a human has to spend on this workload. From an air traffic management perspective, this intense workload involves the processing of information, such as the location of aircraft and their position relating to other aircraft and/or ground objects. Furthermore, Karasek (1979) explains that the major reason for psychological tension is if a job requires more energy and concentration than is readily available.

Clearly, it becomes very difficult for employees to manage their resources correctly, if the amount of work outweighs the resources available to them. This type of work

condition has a negative impact on the ‘psychological well-being’ of the employee (Karasek, 1979).

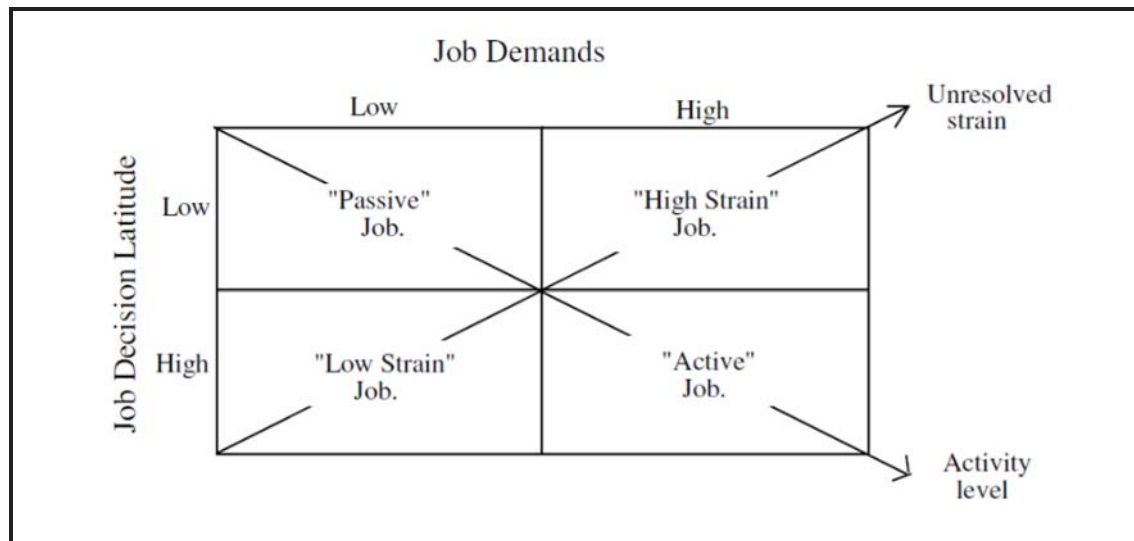


Figure 3. Karasek's Job-Strain Model

Theorell et al.s' longitudinal study confirmed that 'feelings of exhaustion' were much more common among air traffic controllers, who claim that they are subjected to relatively high demands, but they have relatively poor authority over decisions (1988). Furthermore, the authors confirmed that the air traffic controller job is a 'high-strain job' (high demands-low control), according to Karasek's job strain model.

In addition, according to Van der Doef and Maes (1999), employees working in a high-strain job (high demands-low control), such as air traffic controllers, experience the lowest well-being that could be a result of high levels of stress, due to the selection of ineffective coping strategies. However, a study by Gilbey et al. (2006) shows that unrealistic optimism may mitigate stress and that air traffic controllers are no more stressed than other groups within a population, such as smoking cessation sample of tertiary students (Cohen et al., 1983).

2.6. The Aim of Thesis

Nowadays, anyone who works in the aviation industry, either an airline pilot (Sexton, Thomas, & Helmreich, 2000; Tourigny, et al., 2010), an air traffic controller (Shouksmith & Burrough, 1988; Zeier, 1994), or maintenance person (Hobbs, 2008), faces stress and fatigue in their daily life. Whilst numerous studies (Brydon, et al., 2009; Curbow, et al., 1993; Salovey, et al., 2000; Scheier & Carver, 1987) have suggested that 'unrealistic optimism' might be helpful in coping with stress, it is evident that unrealistic optimism may affect judgment and decision-making and it can lead to unnecessary risk-taking in aviation (Binnema, 2005; Goh & Wiegmann, 2002; O'Hare, 1990; Wichman & Ball, 1983; Wilson & Fallshore, 2001).

The relationship between shift pattern, fatigue, unrealistic optimism, stress and subjective well-being, may affect the safety of air traffic controllers and their likelihood of continuing in the occupation. The aim of this thesis is to investigate the effect of shift pattern (fixed or rotating) on fatigue, unrealistic optimism, stress and subjective well-being among Mongolian air traffic controllers.

2.7. Hypotheses

The following hypotheses are tested in this thesis:

2.7.1. Unrealistic Optimism

Given that the Mongolian Civil Aviation Regulation System is based on the New Zealand Civil Aviation Regulation System, and that working conditions for Mongolian air traffic controllers, such as shift management, are similar to New Zealand's air traffic controllers (if seen from the SHELL model perspective the

Software is similar), this thesis proposes the following hypotheses on unrealistic optimism among Mongolian air traffic controllers:

- H₁: Mongolian air traffic controllers will demonstrate unrealistic optimism in overall.
- H₂: Mongolian air traffic controllers will report significantly lower levels of unrealistic optimism towards air traffic specific events, compared to general life events.

2.7.2. *Fatigue and Shift Work*

The following hypotheses regarding subjective fatigue among Mongolian air traffic controllers are proposed:

- H₃: Mongolian air traffic controllers working in rotating shifts will report higher levels of subjective fatigue compared to their colleagues working in fixed shifts (This is consistent with the findings of Cruz, et al. (2000) and Luna et al. (1997)).
- H₄: Air traffic controllers' subjective fatigue will be negatively correlated with their subjective well-being (This is consistent with the findings of Van der Doef and Maes (1999)).
- H₅: Air traffic controllers' subjective fatigue will be positively correlated with perceived stress.

2.7.3. *Subjective Well-Being*

Based on the literature review outlined in Chapter 2.6 (and if hypotheses H₃ and H₄ outlined in the previous sub-chapter are supported), then the following hypotheses on subjective well-being among Mongolian air traffic controllers are proposed:

H₆: Mongolian air traffic controllers working in rotating shifts will report lower levels of subjective well-being, compared to their colleagues working in fixed shifts.

H₇: Air traffic controllers' subjective well-being will be negatively correlated with perceived stress.

2.7.4. Stress

Based on the literature review outlined in Chapter 2.3, and assuming that software, rules, procedures, written documents (which are part of standard operating procedures for the work of New Zealand and Mongolian air traffic controllers) are similar (if seen from the SHELL model perspective), the following hypotheses on stress among Mongolian air traffic controllers are proposed:

H₈: There will be a negative correlation between stress and the degree of unrealistic optimism towards air traffic specific negative and general life negative events (This is consistent with the findings of Gilbey et al. (2006)).

If hypotheses H₅ and H₇ outlined in the previous sub-chapters are supported, then it is proposed that:

H₉: Mongolian air traffic controllers working in rotating shifts will report higher stress levels, compared to their colleagues working in fixed shifts.

The following chapter provides an overview of the methodology used in this thesis.

3. METHOD

3.1. Research Design

3.1.1. General

In order to test the experimental hypotheses, a dilemma choosing an appropriate research design was encountered. Therefore the chapter begins with the choice of an appropriate 'research paradigm'. The following three sub-chapters offer a brief overview of the two main research approaches, which justify the choice of research approach when investigating the hypotheses of interest outlined in Chapter 2.7.

3.1.2. Research Approach: Qualitative versus Quantitative?

According to Gravetter and Wallnau (2004, p. 237) “hypothesis testing is an 'inferential process', which means that it uses limited information as the basis for reaching a general conclusion”.

The research paradigm is a “framework that guides how research should be conducted, based on people's philosophies and their assumptions about the world and nature of knowledge” (Collis & Hussey, 2009, p. 55). Thus choosing the appropriate research paradigm is a philosophical question dealing with the underlying paradigm of the research. There are two main paradigms: 'positivism' and 'interpretivism'. According to Collis and Hussey (2009, p. 57),

Positivism: A paradigm that originated in the natural sciences. It rests on the assumption that social reality is singular and objective, and is not affected by the act of investigating it. The research involves a deductive process with a view to providing explanatory theories to understand social phenomena;

Interpretivism: A paradigm that emerged in response to criticisms of positivism. It rests on the assumption that social reality is in our minds, and is subjective and multiple. Therefore, social reality is affected by the act of investigating it. The research involves an inductive process with a view to providing interpretive understanding of social phenomena within a particular context.

3.1.3. *Qualitative Approach*

According to Saunders, Lewis and Thornhill (2007, p. 106), “interpretivism is an epistemology that advocates that it is necessary for the researcher to understand differences between humans in our role as social actors”. The hypotheses of interest outlined in Chapter 2.7 could be investigated, through the use of an interpretivist paradigm and a participative enquiry methodology. The use of a participative enquiry methodology could be appropriate, as this type of methodology is “about research with people rather than on people” (Reason, 1994, p. 326). Therefore, as the main method of data collection in participative enquiry methodology “involves participants as fully as possible in the study” (Collis & Hussey, 2009, p. 80), it might have been possible to choose a group of Mongolian air traffic controllers and attempt to observe their unrealistic optimism, fatigue, stress levels and subjective well-being over a long period time, in real settings; that is, in their workplace.

However, the use of an interpretivist paradigm and participative enquiry methodology in this study would have increased the workload of the participating air traffic controllers. Moreover, attempting to involve participants as fully as possible in the study would take the attention of participating air traffic controllers away from their job responsibility of directing aircraft, which is unacceptable in terms of

aviation safety. According Saunders, et al. (2007), as qualitative research studies mainly deal with the comprehension and understanding of what takes place in a particular setting, the research is always limited by the nature of sampling processes adopted, therefore, using a qualitative approach to test the hypotheses of interest outlined in Chapter 2.7 was deemed to be not appropriate, in terms of aviation safety.

In view of the potential risks to the Mongolian air traffic controllers and their role in maintaining aviation safety, a different approach was needed in order to test the hypotheses of interest.

3.1.4. Quantitative Approach

The measurement of stress and unrealistic optimism poses a major challenge to researchers, because these are covert mental activities that occur within a person. In the measurement of covert mental activity occurring within a person, an alternative approach can be self-reporting and self-observation of participating air traffic controllers. According to Wiggins and Stevens (1999), more common use of self-reported and self-observation can be found in survey research. Therefore, using a positivist paradigm and a survey methodology in this thesis was deemed to be the most appropriate way to test the hypotheses of interest outlined in Chapter 2.7.

Surveys have the additional advantage of including the provision of quick, inexpensive, efficient and accurate quantitative data (Kumar, 2002; Neuman & Kreuger, 2003; Zikmund, 2007). For this reason, a positivist paradigm and survey methodology would also be appropriate as they can be used to measure human thought and behaviour (Cozby, 2009).

The format of questions used in a survey can vary considerably, depending upon the nature of the data and the level of knowledge required concerning the domain (Wiggins & Stevens, 1999). Furthermore, Wiggins and Stevens (1999) claimed that, where a great deal of information is known about a particular domain, it may be possible to categorise responses in such way that there are a number of fixed alternatives that allow for the acquisition of quantitative data in the form of ordinal, interval or ratio scales (Wiggins & Stevens, 1999). The psychological difference between each of the numeric values is assumed to be equal, thereby satisfying the requirement for interval data. This is an important assumption that has provided the basis for the development of questionnaires summarising the perceptions or attitudes of a number of participants into a single, numeric value (Wiggins & Stevens, 1999).

3.2. Research Strategy

In this thesis, the positivist paradigm and survey methodology have been chosen as being the most appropriate, because a survey is the most widely used data collection method in social science research (Neuman & Kreuger, 2003). In this study, the use of a survey was deemed to be appropriate due to its ability to collect quantitative data for further statistical analysis (Zikmund, 2007).

3.3. Participants

3.3.1. Sample Size

Most research involves sampling participants from the population of interest (Cozby, 2009), not least because of the difficulty in collecting population. In this study, the population of interest is air traffic controllers employed by ANSD of MCAA. As of January 1, 2012, the Personnel Licensing Division of MCAA has issued a total of 189 licenses to air traffic controllers in accordance with Mongolian Civil Aviation

Regulations Part 65 'Air Traffic Service Personnel Licences and Ratings' (MCAA, 2012). Therefore deciding on required sample size and sampling technique in order to represent the population of interest is important.

In this study, the use of non-probability sampling methods are deemed appropriate, hence most of the studies within the context of social research use non-probability sampling (Saunders, et al., 2007). Non-probability sampling technique provides a range of alternative techniques to select samples based on our subjective judgment such as 'convenience' or 'haphazard' sampling technique. the advantages of this sampling technique are that it is inexpensive, efficient and convenient. its disadvantages include the possibility to introduce bias into sample and results may not generalise to intended population Cozby (2009).

When conducting inferential statistical tests, the main problem that faces the researcher is to avoid *Type I* and *Type II* errors. According to Lipsey and Hurley (2008), finding statistical significance where actually there is no effect is known as *Type I* error, symbolised by the Greek letter α . Contrarily, Lipsey and Hurley (2008) stated that failure to find statistical significance when actually there is an effect is known as *Type II* error, symbolised by the Greek letter β . Statistical power is thus the probability $(1 - \beta)$ that statistical significance will be attained, given that there really is an intervention effect. This is the probability that must be maximised for a research design to be sensitive to actual intervention effects (Lipsey & Hurley, 2008).

To a certain extent, hypothesis testing can be structured to control and minimise the risk of committing *Type I* and *Type II* errors, where the probability of committing *Type I* error (α) and the probability of committing *Type II* error (β) and 'effect size' can be predetermined. According to Lipsey and Hurley (2008), if there is a real

difference between treatment and control conditions, the size of that difference will influence the likelihood of attaining statistical significance. The larger the effect, the more probable is statistical significance and the greater the statistical power. For a given dependent measure, effect size can be thought of simply as the difference between means of the treatment versus control populations' measurement. Cohen (1988) suggested that the effect size (ES) can be represented as follows:

$$ES = \frac{\mu_t - \mu_c}{\sigma}$$

where μ_t and μ_c are the respective means for the treatment and control populations and σ is their common standard deviation.

By convention, researchers generally set $\alpha = .05$ as the maximum acceptable probability of a *Type I* error (Gravetter & Wallnau, (2004). According to Lipsey and Hurley (2008), there is no analogous convention for probability of a *Type II* error. Cohen (1988) suggested $\beta = .20$ as a reasonable value for general use and accordingly power = $1 - \beta$, would be at least .80. This suggestion represents a judgment that *Type I* error is four times as serious as *Type II* error (Lipsey & Hurley, 2008).

In this study, in order to estimate the required sample size, *a priori* power analysis was conducted to ensure statistical power of at least $(1 - \beta) = .80$, at $\alpha = .05$. This means accepting a 5% risk of *Type I* error and 20% risk of *Type II* error when using one sample t-test (two tailed) to detect optimistic bias. Wilson and Fallshore (2001) reported comparative optimism effect size (Cohen's *D*) in excess of .70 in pilots, while (Gilbey, et al., 2006) reported comparative optimism effect size (Cohen's *D*) towards air traffic specific negative events approximately .44, towards air traffic

specific positive events approximately .62, towards general life negative events approximately 1.24, and towards general life positive events approximately 0.84 in air traffic controllers. In this thesis medium effect size = .50 was chosen in order to determine required sample size. Therefore in this study, where hypotheses of interest will be tested using one sample *t*-test (two-tailed): when $\alpha = .05$, effect size = .50 and power = $(1 - \beta) = .80$, the minimum required sample size was calculated to $n = 54$.

However, considering that in reality there might be non-responses to the survey, it is necessary to estimate the response rate and increase the sample size accordingly. For this reason, the formula outlined in Saunders et al. (2007, p. 214) is used:

$$n^a = \frac{n \times 100}{re\%}$$

where n^a the actual sample size required is, n is the minimum sample size and $re\%$ is the estimated response rate expressed as percentage.

According to Saunders et al. (2007), estimating the response rate from a sample to whom the questionnaire is sent is difficult. One way of obtaining this estimate is to consider the response rates achieved for similar surveys and base the estimate on these. The response rate in previous research on comparative optimism and stress was 60% (Gilbey, et al., 2006), and 31% (Segerstrom, Taylor, Kemeny, & Fahey, 1998). Therefore in this study, the rate of response was estimated at 45,5 percent, based on the mean of Segerstrom, et al. (1998) and Gilbey, et al. (2006) studies. Accordingly, the actual sample size required for this study is,

$$n^a = \frac{54 \times 100}{31} = \frac{5400}{31} \approx 118$$

3.3.2. Participants

Participants for this study were licensed air traffic controllers working at the Air Navigation Service Division (ANSD) of Mongolian Civil Aviation Authority (MCAA) through which they were recruited.

3.4. Materials

Questionnaire methodology was used to collect the empirical data. Based on a review of the literature (and specifically the literature on unrealistic optimism, stress, fatigue and subjective well-being), a 51-item questionnaire battery was used in this study. The content validity of the questionnaire was tested through an examination of the literature (i.e., the items in the questionnaire were based on previous studies). The original version of the questionnaire can be found in Appendix A.

Although Mongolian air traffic controllers are required to speak in English, according to the ICAO and Mongolian Civil Aviation Regulations requirements, the actual questionnaire was conducted in the Mongolian language, to improve response rates and also to allow Mongolian air traffic controllers to better express their answers and thus improve validity. Therefore the questionnaire was professionally translated into the Mongolian Language and it was reviewed by a number of aviation safety inspectors working for the Aviation Safety Regulation Department, and by a small number of air traffic controllers working for the ANSD of MCAA, who were acknowledged in the beginning of this thesis. The Mongolian version of the questionnaire can be found in Appendix B. During the review of the translated version, the above mentioned reviewers offered some suggestions on the questionnaire's layout and wording. Finally, the Mongolian language version of the questionnaire was professionally translated back into the English language (and

compared against the original English version in Appendix A by a person familiar with this study). This version can be found in Appendix C. The questionnaire battery comprises five sections (each of which is explained in detail):

(1) Demographic Data of the Participants [5 items]

(2) Unrealistic Optimism (‘Air traffic control comparative optimism scale’ (Gilbey et al., 2006) [24 items] including:

- air traffic control specific negative events [8 items];
- general life negative events [8 items];
- air traffic control specific positive events [4 items];
- general life positive events [4 items];

(3) Fatigue (‘Samn-Perelli Fatigue Scale’ (Samn & Perelli, 1982) [3 items]

(4) Subjective Well-Being (‘Satisfaction with Life Scale’ (Diener, Emmons, Larsen, & Griffin, 1985) [5 items]

(5) Stress (‘Perceived Stress Scale’ (Cohen et al., 1983) [14 items].

3.4.1. Section I. Demographic Data of the Participants

Participants were asked to state their gender, how long they had been working as an air traffic controller and their age group (below 25, 26 to 35 years, 36 to 45 years, 46 to 55 years, and above 56). Age bands, rather than exact age, were used to protect participants’ confidentiality. Participants were also asked to state the type of the longest shift they had worked over the last month (fixed or rotating), and whether they had attended a ‘Human Factors’ course.

3.4.2. Section II. Unrealistic Optimism

In order to measure unrealistic optimism, the questionnaire and methodology used by Gilbey et al. (2006) was adapted for the current study. Specifically, the original wording used in the study by Gilbey et al. (2006) was slightly changed, in order to be understood by the Mongolian air traffic controllers.

In particular, the participants were asked the likelihood of general negative and positive events within their lives, in addition to stating specific air traffic control events, negative and/or positive, which they had experienced, compared to other air traffic controllers of a similar age. Using the format of Gilbey et al. (2006) who had based their study on that of Weinstein (1980), 24 questions were worded as follows: *'Compared to other air traffic controllers my age, my chances of (problem) in the future are: much below average; below average; a little below average; average; a little above average; above average; much above average'*. If the participant experienced the ailment/problem/advantage at the time of completing the questionnaire, they were asked to write N/A by the side of the table, as the probability of the event occurring in the future would either be known for certain or at least, may no longer be independent. For the purpose of statistical analysis, the following numerical values were assigned: *'much below average'* = 1; *'below average'* = 2; *'a little below average'* = 3; *'average'* = 4; *'a little above average'* = 5; *'above average'* = 6 and *'much above average'* = 7. This means that, if the participant exhibits no unrealistic optimism, the mean numerical score would be four. Any variation from the numerical score 'four' would indicate the presence of unrealistic optimism. As a way of example, for negative events, a numerical score higher than four would indicate the presence of unrealistic optimism. Accordingly for positive events, a numerical score of less than four would indicate the presence of

unrealistic optimism. Logically, the greater the deviation from the mean numerical score is, the higher the level of unrealistic optimism.

i) Air traffic control specific negative events (eight items).

Eight items, which include failing an annual licence renewal assessment; suffering work related stress; having an aviation incident as a result of fatigue; losing medical status (either temporarily or permanently); having an air traffic incident; having a serious air traffic incident; contributing to an incident; and having an incident as a result of distraction, were based on the study by Gilbey et al. (2006) study. The majority of these items can be effortlessly understood by non-air traffic control people. However, items 1, 5 and 6 of the air traffic control specific negative scale of Table 3 may require explanation.

Item 1 of the air traffic control specific negative scale, 'Failing an annual licence renewal assessment':

According to the Mongolian Civil Aviation Regulations, Part 65 'Air Traffic Service Personnel Licences and Ratings', Mongolian air traffic personnel are required to renew their licence by undertaking a written and an oral examination annually at Personnel Licensing Division of the MCAA. These written and oral examinations are conducted to ensure that the air traffic controller maintains the required performance standard.

Item 5 of the air traffic control specific negative scale, 'Air traffic incident':

According to Appendix A of Mongolian Civil Aviation Regulations Part 12 "Accident and Incident Reporting", an Air traffic incident is:

- runway incursion or runway excursion;
- vertical and horizontal separation minimum between aircraft was breached;
- failure to receive and transmit important air traffic information;
- deviation from, or inadequacy of, air traffic rules and procedures.

Item 6 of the air traffic control specific negative scale. ‘Serious air traffic incident’:

According to Appendix B of Mongolian Civil Aviation Regulations Part 12 “Accident and Incident Reporting”, a serious air traffic incident is:

- near collision, or where aircraft performed necessary manoeuvre to avoid collision with other aircraft using advisory from Airborne Collision and Avoidance System (ACAS);
- near collision, or where aircraft avoided collision with terrain, using advisory from Terrain Awareness and Warning System (TAWS).

Serious air traffic incidents and accidents happen very rarely, and if these happen, they trigger detailed investigations of the events by ASRD of MCAA and/or Aircraft Accident and Incident Investigation Bureau (AAIIB) of Ministry of Road Transport and Urban Development of Mongolia (AAIIB, 2011).

ii) General life negative events (eight items).

Eight items, which include lung problems associated with air pollution; developing cancer; having alcohol problems; having a nervous breakdown; being involved in a

traffic accident; developing diabetes; having a heart attack; and being fired from a job, were all based on Gilbey et al. (2006), and also Weinstein (1980).

iii) *Air traffic control specific positive events (four items).*

This sub-scale included four items: successfully dealing with a work-related emergency, should one occur; enjoying or continuing to enjoy a chosen career; being recognised with a state award; and being recognised as a top air traffic controller, all of which were identical to those used by Gilbey et al. (2006).

iv) *General life positive events (four items).*

This sub-scale included four items, as appeared in Gilbey et al. (2006). However, the item about 'living past 70 years of age' was altered as, according to the World Health Organisation (WHO), the life expectancy at birth for a Mongolian male is 65 years and for females is 75 years, with an average of 69 years (WHO, 2009).

The four questionnaire scales used to measure unrealistic optimism may be inspected in Table 3.

Table 3

Unrealistic Optimism Items by Subscale

I.	Air traffic control specific, negative
<i>Compared to other air traffic controllers my age, my chances of..... in the future are</i>	
	1. Failing an annual licence renewal assessment
	2. Suffering work related stress
	3. Having an aviation incident as a result of fatigue
	4. Losing my medical status (either temporarily or permanently)
	5. Having an Air traffic incident
	6. Having an Serious air traffic Incident
	7. Contributing to an incident
	8. Having an incident as a result of distraction
II.	General life, negative
<i>Compared to other air traffic controllers my age, my chances of..... in the future are</i>	
	1. Lung problems associated with air pollution
	2. Developing a cancer
	3. Having alcohol problems
	4. Having a nervous breakdown
	5. Being involved in traffic accident
	6. Developing diabetes
	7. Having a heart attack
	8. Being fired from a job
III.	Air traffic control specific, positive
<i>Compared to other air traffic controllers my age, my chances of..... in the future are</i>	
	1. Successfully dealing with a work related emergency should one occur
	2. Enjoying or continuing to enjoy chosen career
	3. Being recognised with State award
	4. Being recognised as a top air traffic controller
IV.	General life, positive
<i>Compared to other air traffic controllers my age, my chances of..... in the future are</i>	
	1. Being promoted
	2. Living past 70 years of age
	3. Achieving my personal goals
	4. General happiness

3.4.3. Section III. Subjective Fatigue

The subjective fatigue level of participants was measured using the ‘Samn-Perelli Fatigue Scale’ (Samn & Perelli, 1982), as this scale has been widely used within aviation (Powell, Spencer, Holland, Broadbent, & Petrie, 2007; Spencer, Rogers, Birch, & Belyavin, 2000).

The Samn-Perelli Fatigue Scale is a one-item self-reporting instrument scored on a 7-point scale (*1 = fully alert, wide awake; 2 = very lively, responsive, but not at peak; 3 = Okay, somewhat fresh; 4 = a little tired, less than fresh; 5 = moderately tired, let down; 6 = extremely tired, very difficult to concentrate; 7 = completely exhausted, unable to function effectively*).

The participants were asked to think of an average working day and then indicate how they feel at the beginning, middle and end of their shift, using the 7-point scale. The range of possible scores is therefore 3 – 21, with higher scores indicating higher fatigue.

3.4.4. Section IV. Subjective Well-Being

The subjective well-being of participants was measured by the ‘Satisfaction with Life Scale’ (Diener, et al., 1985). This scale is a five-item self-reporting instrument, which measures subjective well-being, by using five items including: *In most ways my life is close to my ideal; The conditions of my life are excellent; I am satisfied with my life; So far, I have got the important things I want in life; If I could live my life over, I would change almost nothing*.

The participants were asked to report the extent to which they agree with the statement, by using a 7-point Likert-type scale: (*1 = Strongly Disagree; 2 =*

Disagree; 3 = *Slightly Disagree*; 4 = *Neither Agree nor Disagree*; 5 = *Slightly Agree*; 6 = *Agree*; 7 = *Strongly Agree*). The range of possible scores is therefore 5 – 35. Higher scores indicate higher subjective well-being. Diener et al. (1985) reported an internal consistency of .85. In aviation, this Satisfaction with Life Scale was used in a study by Ayres and Malouff (2007) on flight attendants, where $M = 24.46$, $SD = 6.04$ for the control group and $M = 23.78$, $SD = 5.47$, $F = 0.41$, $p = .52$ for the experimental group of flight attendants has been found.

3.4.5. Section V. Perceived Stress

The stress level of participants was measured by the ‘Perceived Stress Scale’ (Cohen et al., 1983). This scale is a 14-item self-reporting instrument, which quantifies stress by measuring the degree to which situations in a participant’s life are appraised as stressful. Seven of the items relate to positive items, and seven to negative items. These situations are outlined in Table 4.

The participants were asked to indicate how often they have felt (or thought) the way that each situation is described, during the last month, by using a five-point scale: (0 = *never*; 1 = *almost never*; 2 = *sometimes*; 3 = *fairly often*; 4 = *very often*). The Perceived Stress Scale total score was calculated by reversing the scores on the seven positive items and summing all 14 items. The range of possible scores is therefore 0 – 56. Higher scores indicate higher stress. Cohen, et al. (1983) reported an internal consistency of .84 for the college student sample and .86 for the Smoking-Cessation Sample. In aviation, Cohen et al’s Perceived Stress Scale was used in a study by Gilbey, et al. (2006) on New Zealand air traffic controllers, where $M = 19.09$ ($SD = 6.0$) has been found; although females’ scores ($M = 21.45$, $SD = 7.16$) suggested significantly higher stress levels than males’ scores ($M = 18.47$, $SD = 5.52$), $t(148) = 2.51$, $p < 0.05$.

Table 4

*Perceived Stress Situations***Negative Situations**

In the last month, how often have you been upset because of something that happened unexpectedly?

In the last month, how often have you felt that you were unable to control the important things in your life?

In the last month, how often have you felt nervous or stressed?

In the last month, how often have you found that you could not cope with all the things you had to do?

In the last month, how often have you been angered because of things that happened been outside your control?

In the last month, how often have you found yourself thinking about things that you have to accomplish?

In the last month, how often have you felt difficulties were piling up so high you could not overcome them?

Positive Situations

In the last month, how often have you dealt with irritating life hassles?

In the last month, how often have you felt that you were effectively coping with important changes that were occurring in your life?

In the last month, how often have you felt confident about your ability to handle your personal problems?

In the last month, how often have you felt that things were going your way?

In the last month, how often have you been able to control irritations in your life?

In the last month, how often have you felt that you were on top of things?

In the last month, how often have you been able to control the way you spend your time?

3.5. Procedure

3.5.1. Data Collection

Participants were recruited through the ANSD of MCAA. Prior approval to conduct the present study was obtained from the First Deputy Director General of the MCAA and the Head of the ASRD. (The letter of approval to conduct the present study can be found in Appendix D.)

After obtaining approval, the invitation letter to participate in the study, together with an information sheet and questionnaire, were distributed among the Mongolian air traffic controllers. This letter and information sheet contained an introduction about the researcher; a brief count of the aim of the study; a brief description of procedures; the participants' rights and Massey University's Human Ethics Committees approval statement.

A total of 174 questionnaires, together with the invitation letter to participate in the study and an information sheet, were distributed among Mongolian air traffic controllers by chief controllers and team leaders. A return-addressed envelope was included with all questionnaires so that responses could easily be returned to the organisation's training department for analysis. Alternatively, participants were offered the option of returning the questionnaire to an independent researcher, though none selected this option. The participant information sheet made it clear that confidentiality was assured and that participation was entirely voluntary. No financial incentive to participate was offered. A total of 124 questionnaires were completed and returned (response rate 71%), all of which were usable. There were no spoilt questionnaires.

The study was evaluated using Massey University's Human Ethics Committee guidelines, and was considered to be low risk. Full approval from Massey University Human Ethics Committee was therefore not required, and a low risk notification was completed instead. This would be recorded on the Massey University low risk database. The letter of acknowledgement from Massey University's Human Ethics Committee can be inspected in Appendix E.

3.5.2. Data Analyses

All analyses were conducted using the software Statistical Package for Social Sciences (SPSS v.17).

3.6. Ethical Considerations

A discussion was held between the researcher and his supervisor. During this discussion, the supervisor raised a series of potential ethical dilemmas that could possibly arise during the conducting of this study (e.g., what if during your data collection you identify a particular air traffic controller who admits to an illegal behaviour?). These dilemmas were jointly discussed, together with ways of how to resolve such issues using the Massey University Human Ethics Committee guidelines as a general guiding framework. As all data collected would be anonymous and participation in the survey would be strictly voluntary, no serious ethical issues were envisaged to arise.

All air traffic controllers working for the ANSD of MCAA were invited to participate in this questionnaire. It was essential that the participants understood the information provided and that their participation in the questionnaire was strictly voluntary. Through the information sheet of questionnaire it was explained to

participants that they have no obligation to accept invitation to participate in this study. It was also explained that if they decide to participate, they have the right to:

- decline to answer any particular question;
- ask any questions about the study at any time before, during or after participation (please use the contact details above);
- withdraw from the study at any time.

The researcher respected the participants' privacy and confidentiality, through the use of the Massey University Human Ethics Committee guidelines, as a general guiding framework for the research.

This study was evaluated by peer review and judged to be low risk. Consequently, it was recorded on the low-risk database of Massey University's Human Ethics Committee (see Appendix E).

4. RESULTS

4.1. Demographic Information of Participants

Demographic information regarding the participants' gender, age group, shift type (fixed or rotating) and attendance to Human Factors course may be inspected in Table 5.

Thirty-one participants were female and 93 were male. The length of time they had been employed as air traffic controllers ranged from two months to 28 years.

Table 5

Demographic Data of Air Traffic Controllers

	Male	Female
Total	93	31
Human Factors course attendance		
Yes	54	21
No	39	10
Shift Type		
Fixed	25	11
Rotating	68	20
Age		
< 25	16	10
26 to 35 years	37	15
36 to 45 years	26	4
46 to 55 years	14	2
Mean number of years employed as an air traffic controller	11.01 (<i>SD</i> = 7.73)	7.49 (<i>SD</i> = 5.46)

4.2. Unrealistic Optimism

For the general life and air traffic control specific negative events, numerical scores higher than four would indicate the presence of unrealistic optimism, whereas for the general life and air traffic control specific positive events, numerical scores of less than four would indicate the presence of unrealistic optimism. To test for optimistic biases, the responses for each of the four unrealistic optimism scales were examined using one-sample *t*-test (two tailed, test value = 4).

- One-sample *t*-test significant evidence of unrealistic optimism towards general life negative events (i.e., a score significantly higher than four) ($M = 4.93$, $SD = 0.75$), $t(123) = 13.71$, $p < .001$, $d = 1.23$;
- One-sample *t*-test indicated significant evidence of unrealistic optimism towards air traffic control specific negative events (i.e., a score significantly higher than four) ($M = 4.39$, $SD = 0.69$), $t(123) = 6.34$, $p < .001$, $d = 0.57$;
- One-sample *t*-test indicated significant evidence of unrealistic optimism towards general life positive events (i.e., a score significantly lower than four) ($M = 3.51$, $SD = 0.61$), $t(123) = -9.04$, $p < .001$, $d = -0.81$; and
- One-sample *t*-test indicated significant evidence of unrealistic optimism towards air traffic control specific positive events (i.e., a score significantly lower than four) ($M = 3.56$, $SD = 0.75$), $t(123) = -6.44$, $p < .001$, $d = -0.58$.

Cronbach's (1951) alphas for the 8 air traffic control specific negative events, 4 air traffic control specific positive events, 8 general life negative events and 4 general life positive events were .80, .61, .73 and .69 respectively, none of which could be substantially improved by the deletion of any single item. According to George and Mallery (2003), these ranged from 'acceptable' (.61) to good (.80).

Table 6

Mean Difference from 'Average', t-Statistics, Degrees of Freedom and Significance for Individual Unrealistic Optimism Items and Scale Totals

Questions	Mean difference from average	Effect Size (Cohen's D)	SD	t- value	df	p
<i>Air traffic control specific, negative:</i>						
18. Having an Serious air traffic Incident	0.82	0.55	1.50	6.09	123	<.001
15. Having an air traffic incident	0.69	0.48	1.45	5.31	123	<.001
5. Suffering work related stress	0.49	0.33	1.50	3.65	123	<.001
21. Contributing to an incident	0.34	0.23	1.47	2.57	123	=.011
24. Having an incident as a result of distraction	0.27	0.17	1.60	1.85	123	=.066
3. Failing an annual licence renewal assessment	0.22	0.13	1.69	1.44	123	=.154
9. Having an aviation incident as a result of fatigue	0.19	0.13	1.39	1.49	123	=.139
12. Losing my medical status (either temporarily or permanently)	0.15	0.10	1.61	1.06	123	=.291
<i>Scale mean</i>	<i>0.39</i>	<i>0.57</i>	<i>0.70</i>	<i>6.34</i>	<i>123</i>	<i><.001</i>
<i>General life, negative:</i>						
10. Having a nervous breakdown	1.81	1.48	1.22	16.48	123	<.001
16. Developing diabetes	1.32	0.92	1.43	10.27	123	<.001
6. Having alcohol problems	1.20	0.76	1.57	8.51	123	<.001
22. Being fired from a job	.58	0.70	1.54	8.22	123	<.001
19. Having a heart attack	1.08	0.61	1.22	7.82	123	<.001
13. Being involved in traffic accident	.85	0.74	1.43	6.81	123	<.001
4. Developing a cancer	.31	0.17	0.79	1.91	123	=.059
1. Lung problems associated with air pollution	.26	0.14	0.75	1.61	123	=.111
<i>Scale mean</i>	<i>0.93</i>	<i>1.23</i>	<i>0.75</i>	<i>13.71</i>	<i>123</i>	<i><.001</i>

Continued on the next page

Cont.

Questions	Mean difference from average	Effect Size (Cohen's D)	SD	t-value	df	p
Air traffic control specific, positive:						
11. Enjoying or continuing to enjoy chosen career	-0.66	-0.53	1.26	-5.87	123	<.001
17. Being recognised with State award	-0.54	-0.35	1.56	-3.85	123	<.001
7. Successfully dealing with a work related emergency should one occur	-0.33	-0.23	1.41	-2.61	123	=.010
4. Being recognised as a top air traffic controller	-0.21	-0.14	1.54	-1.52	123	=.131
<i>Scale mean</i>	<i>-0.44</i>	<i>-0.58</i>	<i>0.75</i>	<i>-6.44</i>	<i>123</i>	<i><.001</i>
General life, positive:						
8. Living past 70 years of age	-0.78	-0.47	1.66	-5.26	123	<.001
20. General happiness	-0.59	-0.43	1.37	-4.77	123	<.001
14. Achieving my personal goals	-0.59	-0.38	1.55	-4.23	123	<.001
2. Being promoted	-0.02	-0.01	1.40	-0.13	123	=.898
<i>Scale mean</i>	<i>-0.49</i>	<i>-0.81</i>	<i>0.61</i>	<i>-9.04</i>	<i>123</i>	<i><.001</i>

The individual items within each unrealistic optimism subscale were also explored. Table 6 shows the mean difference from average score, t-statistics, degrees of freedom and significance for individual unrealistic optimism items for each event and scale totals. The events are grouped by scale and by descending size of effect size (*Cohen's D*) within each scale.

Air traffic control specific negative events (such as having an serious air traffic incident; having an air traffic incident; suffering work-related stress); general life

negative events (such as having a nervous breakdown; developing diabetes; having alcohol problems; being fired from a job; having a heart attack; being involved in traffic accident); air traffic control specific positive events (such as enjoying or continuing to enjoy a chosen career and being recognised with a state award); and general life positive events (such as living past 70 years of age, general happiness and achieving personal goals), indicate highly significant unrealistic optimism.

The mean difference from average was not statistically significant (no evidence of unrealistic optimism) for air traffic control specific negative events, such as contributing to an incident; having an incident as a result of distraction; failing an annual licence renewal assessment; having an aviation incident as a result of fatigue; losing medical status (either temporarily or permanently); and air traffic control specific positive events, such as successfully dealing with a work related emergency should one occur and being recognised as a top air traffic controller.

There was no evidence of unrealistic optimism (mean difference from the average score of 4 was not statistically significant) for general life negative events, such as developing cancer; having lung problems associated with air pollution and general life positive events, such as being promoted.

The largest effect size (Cohen's D) and mean difference from average was for the event referring to personal chances of having a nervous breakdown. The subsequent four largest effect sizes (Cohen's D) and mean differences from average were also for general life negative events, such as developing diabetes; having alcohol problems; being fired from a job; and having a heart attack, the Mongolian air traffic controllers have strong unrealistic optimism towards their personal chances of developing diabetes; having alcohol problems; being fired from a job; and having a heart attack.

In order to explore whether participants demonstrated a different level of unrealistic optimism towards general life events, compared to air traffic control specific events, two paired-sample *t*-tests were conducted. For negative events, the degree of unrealistic optimism for general life events ($M = 4.93$) was significantly greater than that for air traffic control specific events ($M = 4.39$), $t(122) = 5.50$, $p < 0.001$. For positive events, the degree of unrealistic optimism for general life events ($M = -3.51$) was not significant, compared to air traffic control specific events ($M = -3.56$), $t(122) = -0.689$, $p = 0.492$.

In addition to the planned comparisons, an *a posteriori* analysis was conducted to test whether there was any difference in the level of unrealistic optimism associated with the length of time employed as an air traffic controller. To test whether there was a significant difference in the level of unrealistic optimism due to the length of time employed as an air traffic controller, a between-subject one-way analysis of variance (ANOVA) was performed using the mean score of unrealistic optimism as the dependent variable and the length of time employed as the independent variable. As participants' length of time they had been employed as air traffic controllers ranged from two months to 28 years, to maximise experimental power, participants were divided into three groups, split at the 33.33% and 66.66% percentiles as follows:

- less than 60 months ($n = 42$),
- between 61 months to 149 months ($n = 40$), and
- from 150 months to 336 months based on length of time employed ($n = 42$).

One-way analysis of variance showed that there was a highly significant effect of the length of time employed on general life negative events at the $p < .05$ level for the

three groups ($F(2, 121) = 7.74, p = 0.001$)]. Post hoc comparisons using the Tukey HSD test indicated that the mean score for air traffic controllers employed below 60 months ($M = 5.28, SD = 0.70$) was significantly higher than the mean score for air traffic controllers employed between 61 months to 149 months ($M = 4.78, SD = 0.79$) and for air traffic controllers employed from 150 months to 336 months ($M = 4.72, SD = 0.66$). However, the mean score for air traffic controllers employed between 61 months to 149 months ($M = 4.78, SD = 0.79$) did not significantly differ from the mean score for traffic controllers employed from 150 months to 336 months ($M = 4.72, SD = 0.66$). Taken together, these results suggest that air traffic controllers employed below 60 months have a higher level of unrealistic optimism towards general life negative events.

One-way analysis of variance showed:

- no evidence of an effect of length of time employed as an air traffic controller on level of unrealistic optimism towards general life positive events at the $p < .05$ level for the three groups, $F(2, 121) = 2.01, p > .05$;
- no evidence of an effect of length of time employed as an air traffic controller on level of unrealistic optimism towards air traffic control specific negative events at the $p < .05$ level for the three groups, $F(2, 121) = .21, p > .05$;
- no evidence of an effect of length of time employed as an air traffic controller on level of unrealistic optimism towards air traffic control specific positive events at the $p < .05$ level for the three groups, $F(2, 121) = 1.36, p > .05$.

4.3. Subjective Fatigue

The overall mean score on the Samn-Perelli fatigue scale was 2.95 ($SD = 1.07$), meaning that Mongolian air traffic controllers' mean response was close to that of "Okay, somewhat fresh". In order to explore whether the levels of fatigue of air traffic controllers differed according to whether they were on fixed or rotating shifts, an independent samples t -test was conducted. The air traffic controllers working in rotating shifts ($M = 3.49$, $SD = 0.72$) reported significantly higher levels of fatigue, compared to their colleagues working in fixed shifts ($M = 1.61$, $SD = 0.43$), $t(122) = 14.49$, $p < 0.01$. However, there was no evidence that fatigue scores were related to human factors' training or air traffic controllers' age group and gender. Cronbach's (1951) alpha for the 3 items of Samn-Perelli fatigue scale was .83.

In addition to the planned comparison, an *a posteriori* analysis was conducted to test whether there was any difference in the level of subjective fatigue associated with the length of time employed as an air traffic controller. One-way analysis of variance found no evidence of an effect of length of time employed as an air traffic controller on the level of subjective fatigue for the three groups (less than 60 months, between 61 months to 149 months, from 150 months to 336 months), $F(2, 121) = 1.47$, $p > .05$.

4.4. Subjective Well-Being

The overall mean score on the satisfaction with life scale was 4.14 ($SD = 1.58$). Mongolian air traffic controllers working in rotating shifts ($M = 3.92$, $SD = 1.37$) report significantly lower subjective well-being, compared to their colleagues working in fixed shifts ($M = 4.68$, $SD = 1.37$), $t(122) = 2.49$, $p < 0.05$.

Satisfaction with life scale scores are not related to human factors' training or air traffic controllers' age group and gender. Cronbach's (1951) alpha for 5 items of satisfaction with life scale was .91.

In addition to the planned comparison, an *a posteriori* analysis was conducted to test whether there was any difference in the level of satisfaction with life associated with the length of time employed as an air traffic controller. One-way analysis of variance found no evidence of an effect of length of time employed as an air traffic controller on the level of satisfaction with life for the three groups, $F(2, 121) = 1.10, p > .05$.

4.5. Perceived Stress

The overall mean score on the perceived stress scale was 21.21 ($SD = 4.82$). However, Mongolian air traffic controllers working in rotating shifts ($M = 22.20, SD = 4.52$) reported significantly higher stress levels, compared to their colleagues working in fixed shifts ($M = 18.78, SD = 4.71$), $t(122) = -3.11, p < 0.001$.

Perceived stress scale scores were not related to gender or human factors' training and there was no evidence of a correlation between the perceived stress scale score and the participants' age group. Cronbach's (1951) alpha for the 14 items of perceived stress scale was .72.

In addition to the planned comparison, an *a posteriori* analysis was conducted to test whether there was any difference in the level of perceived stress associated with the length of time employed as an air traffic controller. One-way analysis of variance found no evidence of an effect of length of time employed as an air traffic controller on the level of perceived stress for the three groups (less than 60 months, between 61 months to 149 months, from 150 months to 336 months), $F(2, 121) = 1.19, p > .05$.

4.6. Inter scale correlations

The relationship between each pair of scales was examined using Pearson's product moment correlation. The following associations were found (the Pearson's Product Moment Correlations between each of the scales are summarised in Table 7):

- Highly significant positive correlation between Samn-Perelli fatigue scale scores and the perceived stress scale scores, $r = .27$, $n = 124$, $p < 0.01$, two-tails. Mongolian air traffic controllers with higher fatigue level have higher stress levels.
- Highly significant negative correlation between Samn-Perelli fatigue scale scores and the satisfaction with life scale scores, $r = -.25$, $n = 124$, $p < 0.01$, two-tails. Mongolian air traffic controllers with higher fatigue levels have a lower subjective well-being.
- Significant negative correlation between Samn-Perelli fatigue scale scores and the general life negative events scale scores, $r = -.19$, $n = 124$, $p < 0.05$, two-tails. Mongolian air traffic controllers with higher fatigue levels have a lower degree of unrealistic optimism towards general life negative events in their lives.
- Significant positive correlation between Samn-Perelli fatigue scale scores and the general life positive scale scores, $r = .22$, $n = 124$, $p < 0.05$, two-tails. Mongolian air traffic controllers with higher fatigue levels have a higher degree of unrealistic optimism towards general life positive events in their life.
- Highly significant negative correlation between the satisfaction with life scale scores and the perceived stress scale scores, $r = -.49$, $n = 124$, $p < 0.01$, two-

tails. Mongolian air traffic controllers with higher stress levels have lower subjective well-being.

- Significant negative correlation between the perceived stress scale score and the degree of unrealistic optimism on the two negative event scale scores: air traffic control specific negative scale ($r = -.22$, $n = 124$, $p < 0.05$, two-tails) and the general life negative scale ($r = -.21$, $n = 124$, $p < 0.05$, two-tails).
- Significant positive correlation between the satisfaction with life scale scores and the degree of unrealistic optimism on the two negative event scale scores: air traffic control specific negative scale ($r = .23$, $n = 124$, $p < 0.05$, two-tails) and the general life negative scale ($r = .24$, $n = 124$, $p < 0.01$, two-tails) [highly significant].

There was no evidence of a relationship:

- between the Samn-Perelli fatigue scale scores and the air traffic controllers specific negative scale scores ($r = .01$, $n = 124$, $p = 0.96$, two-tails);
- between the Samn-Perelli fatigue scale scores and the air traffic controllers specific positive scale scores ($r = -.02$, $n = 124$, $p = 0.87$, two-tails);
- between satisfaction with life scale scores and the air traffic controllers' specific positive scale ($r = -.13$, $n = 124$, $p = 0.15$, two-tails);
- between the satisfaction with life scale scores and the general life positive scale ($r = -.09$, $n = 124$, $p = 0.29$, two-tails);
- between the perceived stress scale score and the air traffic controllers' specific positive scale ($r = .04$, $n = 124$, $p = 0.69$, two-tails);
- between perceived stress scale score and the general life positive scale ($r = .10$, $n = 124$, $p = 0.28$, two-tails).

Table 7
Pearson's Product Moment Correlations

	Perceived Stress Scale Score	Samn-Perelli Fatigue Scale Score	Satisfaction With Life Scale Score	Air traffic control Specific Negative Scale Score	General Life Negative Scale Score	Air traffic control Specific Positive Scale Score	General Life Positive Scale Score
Perceived Stress Scale Score	1	.27**	-.49**	-.21*	-.22*	.04	.10
Samn-Perelli Fatigue Scale Score	.27**	1	-.25**	.01	-.19*	-.02	.22*
Satisfaction With Life Scale Score	-.49**	-.25**	1	.23*	.24**	-.13	-.10
Air traffic control Specific Negative Scale Score	-.21*	.01	.23*	1	-.09	-.03	-.01
General Life Negative Scale Score	-.22*	-.19*	.24**	-.09	1	.04	-.11
Air traffic control Specific Positive Scale Score	.04	-.02	-.13	-.03	.04	1	.05
General Life Positive Scale Score	.10	.22*	-.10	.01	-.11	.05	1

Note. * = $p < .05$, ** = $p < .01$. $N = 124$ for all analyses.

5. DISCUSSION

5.1. Unrealistic Optimism

The findings presented in this thesis suggest that there is evidence of unrealistic optimism among Mongolian air traffic controllers. This result supports hypothesis H₁: Mongolian air traffic controllers will demonstrate strong levels of unrealistic optimism.

This finding is consistent with the findings of Weinstein (1980) and Gilbey et al. (2006), where unrealistic optimism was reported as widespread, both in general and air traffic controller populations. The Mongolian air traffic controllers are optimistic about their personal chances of not experiencing negative and experiencing positive events, either in general life and/or in air traffic specific events relating to their work. The pattern of findings was broadly similar to that found for New Zealand's air traffic controllers (Gilbey, et al., 2006) and American college students (Weinstein, 1980).

The individual items within each unrealistic optimism scale (air traffic specific and general life) showed a wide variation from the no unrealistic optimism score of four (although the internal consistency, as measured using Cronbach's alpha reliability coefficient, was of an acceptably high level). The largest mean difference score, in the general life negative scale, was for personal chances of having a nervous breakdown. The largest mean difference score, in the air traffic control specific negative scale, was for personal chances of having a serious air traffic incident, and the next largest was having a personal chance of an air traffic incident. This finding was particularly interesting in the context of procedural air traffic control, where an air traffic controller must keep the position of all aircraft within his/her control sector

in their mind by just relying on flight strips. Mongolian air traffic controllers are optimistic about their personal chances of not having a serious and/or air traffic incident, despite working in a non-radar environment.

The largest mean difference score, in the air traffic control specific positive scale, was for personal chances of enjoying or continuing to enjoy a chosen career, while the smallest mean difference score (no unrealistic optimism) in the air traffic control specific positive scale, was for personal chances of being recognised as a top air traffic controller. This means that, while Mongolian air traffic controllers enjoy their chosen career, they are not optimistic about being recognised. The reason for enjoying their chosen career could be that air traffic controllers' job is well paid within the Mongolian aviation community (MCAA, 2011).

The largest mean difference score in the general life positive scale was for personal chances of living past 70 years of age. This finding is particularly interesting because, according to the Country Health Profile published by the World Health Organisation, the life expectancy at birth for a Mongolian male is 65 years and for females is 75 years with an average of 69 years (WHO, 2009). This means that while statistics state that the average age is 69 years for Mongolians, the Mongolian air traffic controllers believe that they will live past 70 years of age as they believe that they may be better educated than the mean of the population. According to Cutler and Lleras-Muney (2006), there is a positive correlation between longevity and level of education.

There was no evidence of unrealistic optimism for two general life negative events: developing cancer or having lung problems associated with air pollution. This is consistent with Mongolia's Country Health Profile, which named Mongolia's capital,

Ulaanbaatar, as being the most air polluted city in the world, and stated that the main cause of death among Mongolians is cancer (WHO, 2009).

Overall, the Mongolian air traffic controllers are optimistic about their personal chances, consistent with findings of Weinstein (1980) and Gilbey et al. (2006) where it was shown that unrealistic optimism phenomena is widespread and persistent, both in general and air traffic controller populations. This is concerning particularly with regard to aviation safety, as unrealistic optimism towards negative events may increase the likelihood of being engaged in such events that could result in accidents or incidents.

Closer inspection of the results of this study showed that unrealistic optimism of Mongolian air traffic controllers towards air traffic specific negative events was approximately two times lower than for general life negative events, thus supporting hypothesis H₂. This result is broadly consistent with the findings of Gilbey et al. (2006), where New Zealand air traffic controllers reported approximately three times lower comparative optimism for air traffic specific negative events, compared to general life negative events. According to Hoorens (1996) and Gilbey et al. (2006), the comparative optimism for negative events arguably more serious than unrealistic optimism towards positive events.

In aviation, the phenomenon of unrealistic optimism has been studied with the view to minimise risk-taking attitude in pilot judgements. For instance, Berlin et al, (1982) introduced invulnerability as one of five hazardous thought patterns (also including anti-authority, impulsivity, macho and resignation). Since then, these five hazardous thought patterns have been adopted into virtually every pilot decision making training syllabus to teach the pilots how to recognise and take a countermeasure

whenever any of these hazardous thought patterns were encountered in order to minimise the number of irrational pilot judgements.

Although efforts have been made to minimise the tendency of these hazardous attitudes, evidence suggests that unrealistic optimism in particular, remains widespread and persistent in aviation. For instance, Lester and Bombaci (1984) argued that unrealistic optimism may be the most common hazardous attitude. The authors' study showed that 43% of the subjects displayed invulnerability, 20% displayed impulsivity, and 14% displayed macho attitudes. Subsequent research by Lester and Collony (1987) found a similar pattern of results: Invulnerability (39%), Impulsivity (24%) and Macho (19%). According to Wetmore and Lu (2006), unrealistic optimism was the most common hazardous attitude displayed by the accident pilots resulting in substantially higher risk factors per accident flight. Therefore lower level of unrealistic optimism of Mongolian air traffic controllers towards air traffic specific negative events than for general life negative events could be positive finding.

5.2. Subjective Fatigue

The findings suggest that Mongolian air traffic controllers working in rotating shifts report higher subjective fatigue, compared to their colleagues working in fixed shifts, thus supporting hypothesis H₃: Mongolian air traffic controllers working in the rotating shifts will report higher subjective fatigue, compared to their colleagues working in fixed shifts.

A further finding of concern is that Mongolian air traffic controllers with higher fatigue levels self-report lower subjective well-being and, at the same time, higher stress levels, thus confirming hypotheses H₄: Air traffic controllers' subjective

fatigue will be negatively correlated with their subjective well-being) and H₅: Air traffic controllers' subjective fatigue will be positively correlated with perceived stress.

Overall, Mongolian air traffic controllers working in rotating shifts reported higher fatigue, worsened subjective well-being and higher stress level than their colleagues working in fixed shifts. This finding is consistent with Cruz, et al. (2000) and Luna et al. (1997), which found that workers in rotating shifts tend to report higher fatigue levels; specifically, participants working early morning shifts report higher fatigue levels. In the Mongolian air traffic controllers case, this might be related to the fact that the main volume of over-flights in Mongolian air space occur during the early morning, due to the location of Mongolia and because Mongolian international air routes generally serve over-flying traffic between Europe, China and Korea (MCAA, 2011). As a result, aviation safety is vulnerable to decision-making processes affected by shift work. Hence, it is essential to take preventive measures against the fatigue, in order to reduce the adverse effects of a shift work environment on aviation employees.

5.3. Subjective Well-Being

The findings suggest that Mongolian air traffic controllers working in rotating shifts report lower levels of subjective well-being, compared to their colleagues working in fixed shifts, thus supporting hypothesis H₆: Mongolian air traffic controllers working in rotating shifts will report lower levels of subjective well-being, compared to their colleagues working in fixed shifts, and H₇: Air traffic controllers' subjective well-being will be negatively correlated with perceived stress.

In particular, subjective well-being among Mongolian air traffic controllers is negatively correlated with perceived stress ($r = -.49, p > 0.01$), which is consistent with the findings of Mosadeghrad, Ferlie and Rosenberg (2011), where a significant negative correlation is also reported ($r = -.59, p > 0.01$) between stress and satisfaction with life.

Theorell et al.s' (1988) longitudinal study confirmed that 'feelings of exhaustion' were much more common among air traffic controllers, who claim that they have are subjected to relatively high demands, but they have relatively poor authority over decisions. According to Van der Doef and Maes (1999), employees working in a high-strain job (high demands-low control), such as air traffic controllers, experience the lowest well-being, which could be a result of high levels of stress. The results of this study showed that the Mongolian air traffic controllers' subjective well-being was negatively correlated with perceived stress, thus confirming the findings of Van der Doef and Maes (1999).

5.4. Perceived Stress

The findings indicate a significant negative correlation between stress and the degree of unrealistic optimism towards air traffic specific negative and general life negative events. As unrealistic optimism increases the perceived stress score reduces among Mongolian air traffic controllers, thus supporting hypothesis H₈: There will be a negative correlation between stress and the degree of unrealistic optimism towards air traffic specific negative and general life negative events.

This is consistent with the findings of Perloff (1983) and Gilbey, et al. (2006), where a significant negative correlation between stress and the degree of unrealistic optimism is also reported.

The findings suggest that Mongolian air traffic controllers working in rotating shifts report higher stress levels, compared to their colleagues working in fixed shifts, thus supporting hypothesis H₉: Mongolian air traffic controllers working in rotating shifts will report higher stress levels, compared to their colleagues working in fixed shifts. This is consistent with the findings of Jamal and Baba (1992) and Tourigny et al. (2010), which showed that participants in rotating shifts tend to report higher stress levels. Specifically, participants working night or early morning shifts report higher stress levels. This is unacceptable in terms of safety, performance, occupational health and well-being, as higher levels of stress may negatively affect performance (A. L. George, 1986; Hancock & Szalma, 2008; Sexton, et al., 2000).

The overall mean perceived stress score for Mongolian air traffic controllers ($M = 21.21$, $SD = 4.82$) was higher than that found by Gilbey, et al. (2006) among New Zealand air traffic controllers ($M = 19.09$, $SD = 6.0$), but lower than that found by Cohen, et al. (1983) for college students ($M = 23.18$, $SD = 7.31$) and for smoking-cessation sample ($M = 25.00$, $SD = 8.00$). This is consistent with Crump (1979), Costa (1993) and Gilbey, et al.'s (2006) observations that air traffic controllers are no more stressed than other groups of population. Although the 'perceived experience of stress' has been shown to affect people's overall well-being, individual differences exist in people's responses to stress (Baldwin, et al., 2003).

The problems that people face during their day-to-day living are usually very common in their scope. However, there are also some cases where people have had no prior experience with the given stressor, or the stressful event unfolds over a relatively long period of time (Scheier & Carver, 1987). Scheier and Carver (1987) suggested that there is a causal link between physical well-being and optimism, because optimists use more effective approaches to coping with stress. In this

context, the lower stress level among Mongolian air traffic controllers might be because they have demonstrated strong unrealistic optimism towards both general life and air traffic control specific events.

5.5. Ideas for Future Research

The results of this study show that Mongolian air traffic controllers have a lower level of unrealistic optimism towards air traffic specific negative events, compared to general life negative events, which is similar to results found by Gilbey, et al. (2006) among New Zealand air traffic controllers. It is possible that air traffic controllers' training generally affects their unrealistic optimism and this is a particular phenomena found among air traffic controllers. Therefore, the following ideas are suggested for future research.

First, longitudinal research could be conducted with a focus group of air traffic controllers, from their initial selection and training through to gaining their air traffic controllers' licence. The proposed longitudinal research should explore whether ab-initio controllers are low in comparative optimism towards aviation events when they are recruited into the air traffic control provider used in this study, or whether it happens somewhere in their training.

Second, this study could be replicated in other areas of aviation, such as maintenance, to see if the differential effect size between aviation and general life events is specific to air traffic controllers

Finally, this study could be repeated among Mongolian air traffic controllers, following the MCAA's introduction of SSRs for air traffic control, in order to explore whether unrealistic optimism, fatigue, subjective well-being and stress levels

change, following introduction of Secondary Surveillance Radars. For example, the natural experiment could be conducted to investigate differences before and after the implementation of an SSR.

5.6. Limitations of Study

As noted earlier, this study contributes significantly to the body of knowledge relating to unrealistic optimism, fatigue, subjective well-being and stress among aviation professionals. However, as with all research, it is important to acknowledge (and learn from) the limitations of a study.

Firstly, any research applying a survey-based method, including the one adopted in this current study, is prone to the inherent limitation of measurement errors. For example, the responses of those who chose not to participate are unknown, it is possible that the degree of unrealistic optimism in non-respondents may be more or less than that found in the sample (although given the size of the effect and the return rate it is somewhat unlikely that the effect would be lost amongst the entire population), potentially reducing or increasing the size of the effect that was found. Nevertheless, the measurement errors were minimised and ensured, as indicated by the reports on the study's good validity and the reliability of the results. It was noted that the response rate of questionnaires was 71%, which for this type of study, was relatively high. The high participation rate interpreted as indicative of an effective safety culture at the air traffic control provider (as one of the aims specified on the invitation to participate was to further improve safety).

A second limitation is the use of self-reported behavioural measures, which could produce less validity than actual behavioural measures. In this case, self-reported behavioural measures were used due to time and cost restrictions. Notwithstanding

this limitation, the study reports good internal consistency, thus indicating that the use of a self-reported measure of unrealistic optimism, fatigue, subjective well-being and stress, was not problematic.

The hypotheses of interest were not disclosed to participants at the time of participation in order to minimise any biases such as demand characteristics (e.g., Orne, 1962 cited in Cozby, 2009). However, because the overall purpose of this research was described to participants in order to obtain their consent to participate, it is possible that the participants may have predicted the hypotheses of interest.

The limitations discussed here are identified for the purpose of acknowledging their existence and to pinpoint future research opportunities, rather than to reduce the significance of the study's findings, or the validity and reliability of the methods used.

6. CONCLUSION

The aim of this study was to explore the relationship between shift pattern, risk perception, fatigue, subjective well being and stress among Mongolian air traffic controllers.

Mongolian air traffic controllers working in rotating shifts report higher subjective fatigue, lower subjective well-being and higher stress levels, compared to their colleagues working in fixed shifts. Therefore, it is important to introduce a fatigue management programme among Mongolian air traffic controllers. As pointed out by Gander (2001, p. 49) “...fatigue management approach requires adaptation of traditional roles and attitudes for controllers' unions, companies and regulators. Fatigue management regimes are still in their infancy and ongoing evaluation will be necessary to improve practice in different industries”.

In this context, ‘Notice of Proposed Rule Making’ suggested by the New Zealand Civil Aviation Authority, considered to be particularly useful. (This notice is included in Appendix F.) Therefore, it is recommended that the MCAA add the above rule “172.55 Management of fatigue” to the Mongolian Civil Aviation Regulations Part 172 ‘Air Traffic Service Organisations – Certification’.

The lower level of unrealistic optimism towards air traffic specific negative events, compared to general life negative events among Mongolian air traffic controllers is a positive finding, given that optimism may affect their judgment and decision-making and can lead to unnecessary risk-taking in aviation (Binnema, 2005; Gilbey, et al., 2006; Goh & Wiegmann, 2002; O'Hare, 1990; Wichman & Ball, 1983; Wilson & Fallshore, 2001).

The Mongolian air traffic controllers believe that they are more vulnerable to the occurrence of negative events in their daily work duty, compared to general life events. As a result, as highlighted by Hoorens (1996) and Gilbey, et al. (2006), Mongolian air traffic controllers may take fewer risks in air traffic control, relative to the risks they tend to take towards general life events. Risk-taking in any aviation profession could affect the safe and efficient transportation of passengers and goods. Therefore, this result is considered a positive finding, as the primary reason for this study is aviation safety.

The results of this study indicate that Mongolian air traffic controllers appear to be less vulnerable to unrealistic optimism phenomena towards air traffic specific events, which is consistent with the findings of Gilbey et al. (2006) among New Zealand air traffic controllers. Thus, initial and/or recurrent training syllabi for air traffic controllers (which is similar between New Zealand and Mongolian air traffic controllers) may be applied to other areas of the aviation industry, as recommended by Gilbey et al. (2006).

It is concluded that a unrealistic optimism phenomena is persistent and widespread in many areas, and the aviation industry is no exception. Thus, it is might not be possible to stop the development of this unrealistic optimism phenomena since it is just human nature to believe in a bright future. Therefore, it is important to be aware of symptoms that might lead to unrealistic optimism phenomena and to take preventive measures, in order to prevent unrealistic optimism affecting decision-making and subsequently, unnecessary risk taking. These preventive measures can include, but are not limited to the following:

- The introduction of personnel training on stress management and human factors;
- Changes in air traffic service providers, in order to lower the influence of organisational sources of stress etc.

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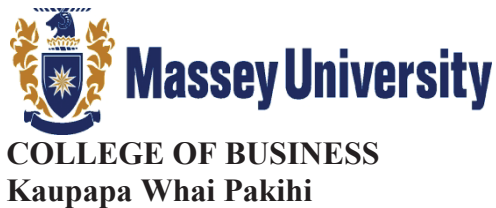
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APPENDIXES

Appendix A. Questionnaire English Version (Original)



SCHOOL OF AVIATION
Private Bag 11 222
Palmerston North
New Zealand

Project title: Examining the Relationship Between Shift Pattern, Risk Perception, Fatigue, Subjective Well Being and Stress among Mongolian Air Traffic Controllers

Dear Air Traffic Controller,

I would like to invite you to participate in an exploratory study regarding your perception of risk in relation to stress and fatigue. This study is being carried out by Lkhagvasuren Togtokhbayar (Student, Massey University).

It should take you around ten minutes to complete all five sections of this questionnaire. Your name is not required.

If you choose to participate, please return your completed questionnaire through the internal mail system in the addressed envelope provided. Completion and return of the questionnaire implies consent to participate.

A full project information sheet on the following page is followed by the questionnaire.

Thank you for your time.

Lkhagvasuren Togtokhbayar

Information sheet

Project title: *Examining the Relationship Between Shift Pattern, Risk Perception, Fatigue, Subjective Well Being and Stress among Mongolian Air Traffic Controllers*

Researcher:

<p>Lkhagvasuren Togtokhbayar Student School of Aviation Massey University Turitea Campus, Palmerston North Phone: +64 21 207 9806 Email: T.Lkhagvasuren@gmail.com</p>

Participant recruitment:

All air traffic controllers working for Air Traffic Service Division of MCAA are invited to participate in this survey.

Project procedures:

The data you supply will be anonymous and all statistical analyses will be on group data. Data will be stored securely at Massey University for 5 years, after which it will be destroyed. A summary of the project findings will be circulated to all air traffic controllers at the end of the project.

Participant involvement

Approximately 10 minutes of your time will be required to complete the questionnaire..

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;
- ask any questions about the study at any time before, during or after participation (please use the contact details above);

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(s) named above 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(s), please contact Professor John O'Neill, Director (Research Ethics), telephone: +64 6 350 5249, e-mail: humanethics@massey.ac.nz

The questionnaire:

Section 1.

How long have you been an air traffic controller? Yrs..... Mths.....

Please state your gender Male/female (delete one)

Do you currently work in tower or radar control? tower/radar (delete one)

How long have you been in this ATC position? Less than 1 yr, 1 yr, 2 yrs, 3 yrs, 5 yrs, 10 yrs (circle one)

Are you a current on job training instructor (OJTI)? yes/no (delete one)

Have you completed a human factors course? yes/no (delete one)

If yes, approximately which year was it completed?

Have you completed a stress management course? yes/no (delete one)

If yes, approximately which year was it completed?

Are you operational? yes/no (delete one)

Please indicate your age group Less than 30, 30-40, 41-50, 51-60, more than 60 (circle one)

Section 2

In the next section, for each of the following statements, please report what you believe is your level of risk. For each statement, place a tick in the box that best describes your assessment of your risk.

***It is important that you take into account all of the things that only you know about yourself and which make you unique and may set you apart from other air traffic controllers (e.g., your attitude to health, your ATC skills, your determination, your general behaviour, etc).**

Please **do not** answer the question if you currently actually experience the ailment/problem/advantage; instead write n/a by the side of the table.

Compared to other air traffic controllers my age, my chances of catching influenza in the future are:

Much above average	<input type="checkbox"/>
Above average	<input type="checkbox"/>
A little above average	<input type="checkbox"/>
Average for air traffic controllers	<input type="checkbox"/>
A little below average	<input type="checkbox"/>
Below average	<input type="checkbox"/>
Much below average	<input type="checkbox"/>

Compared to other air traffic controllers my age, the chances of my home increasing substantially in value in the future are:

- Much above average
- Above average
- A little above average
- Average for air traffic controllers
- A little below average
- Below average
- Much below average

Compared to other air traffic controllers my age, my chances of failing an annual performance assessment (APA) in the future are:

- Much above average
- Above average
- A little above average
- Average for air traffic controllers
- A little below average
- Below average
- Much below average

Compared to other air traffic controllers my age, my chances of lung cancer in the future are:

- Much above average
- Above average
- A little above average
- Average for air traffic controllers
- A little below average
- Below average
- Much below average

Compared to other air traffic controllers my age, my chances of successfully dealing with a work related emergency, should one occur in the future are:

- Much above average
- Above average
- A little above average
- Average for air traffic controllers
- A little below average
- Below average
- Much below average

Compared to other air traffic controllers my age, my chances of suffering work related stress in the future are:

- Much above average
- Above average
- A little above average
- Average for air traffic controllers
- A little below average
- Below average
- Much below average

Compared to other air traffic controllers my age, my chances of alcohol problems in the future are:

Much above average	<input type="checkbox"/>
Above average	<input type="checkbox"/>
A little above average	<input type="checkbox"/>
Average for air traffic controllers	<input type="checkbox"/>
A little below average	<input type="checkbox"/>
Below average	<input type="checkbox"/>
Much below average	<input type="checkbox"/>

Compared to other air traffic controllers my age, my chances of living past 80yrs of age are:

Much above average	<input type="checkbox"/>
Above average	<input type="checkbox"/>
A little above average	<input type="checkbox"/>
Average for air traffic controllers	<input type="checkbox"/>
A little below average	<input type="checkbox"/>
Below average	<input type="checkbox"/>
Much below average	<input type="checkbox"/>

Compared to other air traffic controllers my age, my chances of having an incident as a result of fatigue in the future are:

Much above average	<input type="checkbox"/>
Above average	<input type="checkbox"/>
A little above average	<input type="checkbox"/>
Average for air traffic controllers	<input type="checkbox"/>
A little below average	<input type="checkbox"/>
Below average	<input type="checkbox"/>
Much below average	<input type="checkbox"/>

Compared to other air traffic controllers my age, my chances of nervous breakdown in the future are:

Much above average	<input type="checkbox"/>
Above average	<input type="checkbox"/>
A little above average	<input type="checkbox"/>
Average for air traffic controllers	<input type="checkbox"/>
A little below average	<input type="checkbox"/>
Below average	<input type="checkbox"/>
Much below average	<input type="checkbox"/>

Compared to other air traffic controllers my age, my chances of enjoying or continuing to enjoy my chosen career in the future are:

Much above average	<input type="checkbox"/>
Above average	<input type="checkbox"/>
A little above average	<input type="checkbox"/>
Average for air traffic controllers	<input type="checkbox"/>
A little below average	<input type="checkbox"/>
Below average	<input type="checkbox"/>
Much below average	<input type="checkbox"/>

Compared to other air traffic controllers my age, my chances of losing my medical status (either temporarily or permanently) in the future are:

Much above average	<input type="checkbox"/>
Above average	<input type="checkbox"/>
A little above average	<input type="checkbox"/>
Average for air traffic controllers	<input type="checkbox"/>
A little below average	<input type="checkbox"/>
Below average	<input type="checkbox"/>
Much below average	<input type="checkbox"/>

Compared to other air traffic controllers my age, my chances of being a victim of crime in the future are:

Much above average	<input type="checkbox"/>
Above average	<input type="checkbox"/>
A little above average	<input type="checkbox"/>
Average for air traffic controllers	<input type="checkbox"/>
A little below average	<input type="checkbox"/>
Below average	<input type="checkbox"/>
Much below average	<input type="checkbox"/>

Compared to other air traffic controllers my age, my chances of achieving my personal goals in the future are:

Much above average	<input type="checkbox"/>
Above average	<input type="checkbox"/>
A little above average	<input type="checkbox"/>
Average for air traffic controllers	<input type="checkbox"/>
A little below average	<input type="checkbox"/>
Below average	<input type="checkbox"/>
Much below average	<input type="checkbox"/>

Compared to other air traffic controllers my age, my chances of having an A3 incident in the future are:

Much above average	<input type="checkbox"/>
Above average	<input type="checkbox"/>
A little above average	<input type="checkbox"/>
Average for air traffic controllers	<input type="checkbox"/>
A little below average	<input type="checkbox"/>
Below average	<input type="checkbox"/>
Much below average	<input type="checkbox"/>

Compared to other air traffic controllers my age, my chances of developing diabetes in the future are:

Much above average	<input type="checkbox"/>
Above average	<input type="checkbox"/>
A little above average	<input type="checkbox"/>
Average for air traffic controllers	<input type="checkbox"/>
A little below average	<input type="checkbox"/>
Below average	<input type="checkbox"/>
Much below average	<input type="checkbox"/>

Compared to other air traffic controllers my age, my chances of promotion in the future are:

Much above average	<input type="checkbox"/>
Above average	<input type="checkbox"/>
A little above average	<input type="checkbox"/>
Average for air traffic controllers	<input type="checkbox"/>
A little below average	<input type="checkbox"/>
Below average	<input type="checkbox"/>
Much below average	<input type="checkbox"/>

Compared to other air traffic controllers my age, my chances of having an A1 or A2 incident in the future are:

Much above average	<input type="checkbox"/>
Above average	<input type="checkbox"/>
A little above average	<input type="checkbox"/>
Average for air traffic controllers	<input type="checkbox"/>
A little below average	<input type="checkbox"/>
Below average	<input type="checkbox"/>
Much below average	<input type="checkbox"/>

Compared to other air traffic controllers my age, my chances of developing asthma in the future are:

Much above average	<input type="checkbox"/>
Above average	<input type="checkbox"/>
A little above average	<input type="checkbox"/>
Average for air traffic controllers	<input type="checkbox"/>
A little below average	<input type="checkbox"/>
Below average	<input type="checkbox"/>
Much below average	<input type="checkbox"/>

Compared to other air traffic controllers my age, my chances of general happiness in the future are:

Much above average	<input type="checkbox"/>
Above average	<input type="checkbox"/>
A little above average	<input type="checkbox"/>
Average for air traffic controllers	<input type="checkbox"/>
A little below average	<input type="checkbox"/>
Below average	<input type="checkbox"/>
Much below average	<input type="checkbox"/>

Compared to other air traffic controllers my age, my chances of contributing to an incident in the future are:

Much above average	<input type="checkbox"/>
Above average	<input type="checkbox"/>
A little above average	<input type="checkbox"/>
Average for air traffic controllers	<input type="checkbox"/>
A little below average	<input type="checkbox"/>
Below average	<input type="checkbox"/>
Much below average	<input type="checkbox"/>

Compared to other air traffic controllers my age, my chances of attempting suicide in the future are:

Much above average	<input type="checkbox"/>
Above average	<input type="checkbox"/>
A little above average	<input type="checkbox"/>
Average for air traffic controllers	<input type="checkbox"/>
A little below average	<input type="checkbox"/>
Below average	<input type="checkbox"/>
Much below average	<input type="checkbox"/>

Compared to other air traffic controllers my age, my chances of being recognised by others as a top ATC performer in the future are:

Much above average	<input type="checkbox"/>
Above average	<input type="checkbox"/>
A little above average	<input type="checkbox"/>
Average for air traffic controllers	<input type="checkbox"/>
A little below average	<input type="checkbox"/>
Below average	<input type="checkbox"/>
Much below average	<input type="checkbox"/>

Compared to other air traffic controllers my age, my chances of having an incident as a result of distraction in the future are:

Much above average	<input type="checkbox"/>
Above average	<input type="checkbox"/>
A little above average	<input type="checkbox"/>
Average for air traffic controllers	<input type="checkbox"/>
A little below average	<input type="checkbox"/>
Below average	<input type="checkbox"/>
Much below average	<input type="checkbox"/>

Section 3.

Try to think of average working day and then indicate how you feel at the beginning of shift.

Fully alert, wide awake	<input type="checkbox"/>
Very lively, responsive, but not at peak	<input type="checkbox"/>
Okay, somewhat fresh	<input type="checkbox"/>
A little tired, less than fresh	<input type="checkbox"/>
Moderately tired, let down	<input type="checkbox"/>
Extremely tired, very difficult to concentrate	<input type="checkbox"/>
Completely exhausted, unable to function effectively	<input type="checkbox"/>

Try to think of average working day and then indicate how you feel at the middle of shift.

Fully alert, wide awake	<input type="checkbox"/>
Very lively, responsive, but not at peak	<input type="checkbox"/>
Okay, somewhat fresh	<input type="checkbox"/>
A little tired, less than fresh	<input type="checkbox"/>
Moderately tired, let down	<input type="checkbox"/>
Extremely tired, very difficult to concentrate	<input type="checkbox"/>
Completely exhausted, unable to function effectively	<input type="checkbox"/>

Try to think to think of average working day and then indicate how you feel at the end of shift.

Fully alert, wide awake	<input type="text"/>
Very lively, responsive, but not at peak	<input type="text"/>
Okay, somewhat fresh	<input type="text"/>
A little tired, less than fresh	<input type="text"/>
Moderately tired, let down	<input type="text"/>
Extremely tired, very difficult to concentrate	<input type="text"/>
Completely exhausted, unable to function effectively	<input type="text"/>

Section 4.

Below are five statements with which you may agree or disagree. Using the 1-7 scale below, indicate how much you agree with each item. Please be open and honest in your responding

In most ways my life is close to my ideal.

Strongly Disagree	<input type="text"/>
Disagree	<input type="text"/>
Slightly Disagree	<input type="text"/>
Neither Agree nor Disagree	<input type="text"/>
Slightly Agree	<input type="text"/>
Agree	<input type="text"/>
Strongly Agree	<input type="text"/>

The conditions of my life are excellent.

Strongly Disagree	<input type="text"/>
Disagree	<input type="text"/>
Slightly Disagree	<input type="text"/>
Neither Agree nor Disagree	<input type="text"/>
Slightly Agree	<input type="text"/>
Agree	<input type="text"/>
Strongly Agree	<input type="text"/>

I am satisfied with my life.

Strongly Disagree	<input type="text"/>
Disagree	<input type="text"/>
Slightly Disagree	<input type="text"/>
Neither Agree nor Disagree	<input type="text"/>
Slightly Agree	<input type="text"/>
Agree	<input type="text"/>
Strongly Agree	<input type="text"/>

So far I have got the important things I want in life.

Strongly Disagree	<input type="text"/>
Disagree	<input type="text"/>
Slightly Disagree	<input type="text"/>
Neither Agree nor Disagree	<input type="text"/>
Slightly Agree	<input type="text"/>
Agree	<input type="text"/>
Strongly Agree	<input type="text"/>

If I could live my life over, I would change almost nothing.

Strongly Disagree
 Disagree
 Slightly Disagree
 Neither Agree nor Disagree
 Slightly Agree
 Agree
 Strongly Agree

Section 5.

The following questions are about your feelings and thoughts during the last month. For each question, please indicate how often you have felt or thought the way that is described. Although some questions appear may appear similar, there are differences between them and each should be treated as a separate question. The best approach is to answer each question fairly quickly. That is, don't try to count up actual instances, but rather indicate the answer which seems like a reasonable estimate. Please mark the appropriate response.

The following questions are about your feelings and thoughts during the last month. For each question, please indicate how often you have felt or thought the way that is described. Although some questions appear may appear similar, there are differences between them and each should be treated as a separate question. The best approach is to answer each question fairly quickly. That is, don't try to count up actual instances, but rather indicate the answer which seems like a reasonable estimate. Please circle the appropriate response underneath each question

1. In the last month, how often have you been upset because of something that happened unexpectedly?

Never Almost never Sometimes Fairly often Very often

2. In the last month, how often have you felt that you were unable to control the important things in your life?

Never Almost never Sometimes Fairly often Very often

3. In the last month, how often have you felt nervous or stressed?

Never Almost never Sometimes Fairly often Very often

4. In the last month, how often have you dealt with irritating life hassles?

Never Almost never Sometimes Fairly often Very often

5. In the last month, how often have you felt that you were effectively coping with important changes that were occurring in your life?

Never Almost never Sometimes Fairly often Very often

6. In the last month, how often have you felt confident about your ability to handle your personal problems?

Never Almost never Sometimes Fairly often Very often

7. In the last month, how often have you felt that things were going your way?

Never Almost never Sometimes Fairly often Very often

8. In the last month, how often have you found that you could not cope with all the things you had to do?

Never Almost never Sometimes Fairly often Very often

9. In the last month, how often have you been able to control irritations in your life?

Never Almost never Sometimes Fairly often Very often

10. In the last month, how often have you felt that you were on top of things?

Never Almost never Sometimes Fairly often Very often

11. In the last month, how often have you been angered because of things that happened that been outside your control?

Never Almost never Sometimes Fairly often Very often

12. In the last month, how often have you found yourself thinking about things that you have to accomplish?

Never Almost never Sometimes Fairly often Very often

13. In the last month, how often have you been able to control the way you spend your time?

Never Almost never Sometimes Fairly often Very often

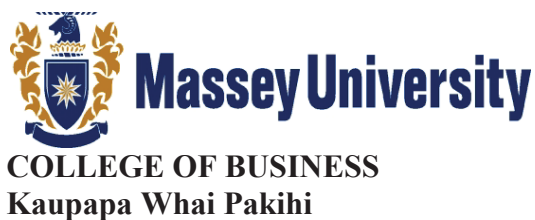
14. In the last month, how often have you felt difficulties were piling up so high you could not overcome them?

Never Almost never Sometimes Fairly often Very often

Thank you for participating in this survey.

Once again, I would like to emphasize that your responses are anonymous, and will not be made available to anyone other than the researcher(s) for the purposes of statistical analysis.

Appendix B. Questionnaire Mongolian Version



SCHOOL OF AVIATION
Private Bag 11 222
Palmerston North
New Zealand

Төслийн нэр: Нислэгийн удирдагчдын Эрсдлийн үнэлгээ, Ядаргаа болон Стресс

Хүндэт Нислэгийн удирдагч танаа,

Би таныг стресс болон ядаргаатай холбоотойгоор таны эрсдлийн үнэлгээг судлах судалгааны ажилд оролцохыг урьж байна. Энэхүү судалгааны ажлыг Шинэ Зеланд улсын Массей Их сургуулийн оюутан Тогтохбаярын Лхагвасүрэн явуулж байгаа болно.

Энэхүү асуулгын нийт 5 хэсгийг бөглөхөд 15 орчим минут зарцуулах бөгөөд та өөрийн нэрээ дурьдах шаардлагагүй.

Хэрэв та энэхүү судалгаанд хамрагдах хүсэлтэй байгаа бол, асуулгыг бөглөж өөрийн менежерт өгнө үү. Та бөглөсөн асуулгыг өгсөнөөр судалгаанд хамрагдахын зөвшөөрч байгаа гэсэн үг болно.

Асуулгын эхний хуудсан дээр төслийн талаархи дэлгэрэнгүй мэдээлэл байгаа болно.

Цаг гаргасанд баярлалаа.

Тогтохбаярын Лхагвасүрэн

Мэдээллийн хуудас**Төслийн нэр: Нислэгийн удирдагчдын Эрсдлийн үнэлгээ, Ядаргаа болон Стресс****Судлаач:**

Тогтохбаярын Лхагвасүрэн
 Нисэхийн Сургууль
 Массей Их Сургууль
 Палмерстон норд
 Шинэ зеланд
 Phone: +64 21 207 9806
 Email: T.Lkhagvasuren@gmail.com

Оролцогчдын мэдээлэл

Монгол Улсын Иргэний Нисэхийн Ерөнхий Газрын Нислэгийн Хөдөлгөөний Үйлчилгээний Албаны нийт нислэгийн удирдагчдыг энэхүү судалгаанд оролцохыг урьж байна.

Төслийн явц

Таны бөглөн илгээсэн асуулганд хувь хүний талаар тодорхой мэдээлэли йг дурьдахгүй бөгөөд асуулгатай холбоотой мэдээллийг багцлан статистик дүн шинжилгээ хийх болно. Таны бөглөсөн асуулгыг Массей Их Сургуульд нууцлалтайгаар 5 жилийн хугацаанд хадгалж, үүний дараа устгалд оруулах болно. Энэхүү төслийн дүгнэлтийг төслийн төгс гөлд нийт нислэгийн удирдагч нарт хүргэх болно.

Оролцогчдоос шаардагдах зүйл

Энэхүү асуулгыг бөглөхөд танд ойролцоогоор 15 минут шаардагдах болно.

Оролцогчдын эрх

Та энэхүү судалгаанд заавал оролцох шаардлагагүй болно. Хэрэв та оролцохоор шийдвэл та дараах эрхтэй. Үүнд:

- Тодорхой асуултанд хариулахаас татгалзах;
- Судалгааны өмнө, судалгааны үеэр, мөн түүнчлэн судалгааны дараа энэхүү судалгааны талаар аливаа асуулт асуух. (Энэ тохиолдолд дээр байгаа хаягаар хандана уу)
- Судалгааны дундуур судалгаанд оролцохоос татгалзах.

Ёс зүйн хорооны баталгаа

Энэ төслийг бусад судлаачид үнэлж үзээд ёс зүйн хувьд эрсдэл багатай гэж дүгнэсэн бөгөөд Массейн Их Сургуулийн Хүний Ёс Зүйн Хороогоор хянагдаагүй болно. Дээр нэр нь дурьдагдсан судлаач энэ судалгааны ёс зүйн талаар хариуцах болно.

Судалгааны явцад аливаа асуулт гарвал судлаачаас гадна дараах хаягаар хандан зөвлөмж авч болно.

Хэрэв танд энэхүү судалгааны талаар аливаа асуулт байгаа бөгөөд судлаачаас өөр хүнтэй тэр талаар ярилцахыг хүсвэл:

Professor John O'Neill, Director (Research Ethics),
 telephone: +64 6 350 5249,
 e-mail: humanethics@massey.ac.nz

хаягаар хандана уу.

Асуулга:**Хэсэг I.**

1. Та нислэгийн удирдагчаар хэр удаан ажиллаж байна вэ? Жил..... Сар.....
2. Өөрийн хүйсийг дурьдана уу <input type="checkbox"/> Эрэгтэй <input type="checkbox"/> Эмэгтэй
3. Та аль насны ангилалд багтах вэ? <input type="checkbox"/> 25-аас доош <input type="checkbox"/> 26-35 <input type="checkbox"/> 36-45 <input type="checkbox"/> 46-55 <input type="checkbox"/> 56 –аас дээш
4. Та ямар сүүлийн нэг сарын туршид ямар ээлжээр ажилласан бэ? <input type="checkbox"/> Байнгын (Fixed) <input type="checkbox"/> Ээлжилсэн (Rotating)
5. Та Хүний Хүчин Зүйлсийн сургалтанд хамрагдсан уу? <input type="checkbox"/> Тийм <input type="checkbox"/> Үгүй

Хэсэг II.

Энэхүү хэсэгт, дараах хүснэгт тус бүрт өөрийн тань хувьд эрсдлийн түвшин ямар байгаагаа тэмдэглэнэ үү. Хүснэгт бүрт та өөрийн эрдслийг үнэлэн тэмдэглэгээ хийнэ үү.

***Асуулганд хариулахдаа та зөвхөн өөрийн тухай мэддэг зүйлсээ тооцох нь чухал юм. Өөрөөр хэлвэл бусад нислэгийн удирдагчдаас та юугаараа ялгарч байгааг тэмдэглэх нь чухал. Жишээ нь та өөрийн эрүүл мэнддээ хэрхэн ханддаг, таны нислэгийн удирдлагын ур чадвар, таны ерөнхий байгаа байдал гэх мэт..**

Хэрэв та одоогоор өвчин хууч, асуудал, давуу тал байгаа бол, асуултанд хариулахгүй байж болох бөгөөд хүснэгтийн зайднд N/A гэсэн тэмдэглэгээ хийнэ үү.

II. Надтай нас ойролцоо бусад нислэгийн удирдагчидтай харьцуулахад ирээдүйд миний боломж.....							
	1 Дундаж аас маш доогуур	2 Дундажаа с доогуур	3 Дундажаа с арай доогуур	4 Дундаж	5 Дундажаа с арай дээгүүр	6 Дундажаа с дээгүүр	7 Дундажаа с маш дээгүүр
1. Агаарын бохирдлоос шалтгаалан асуудал үүсэх:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Албан тушаал дэвших:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Мэргэжлийн хүчинтэй хугацаа сунгуулах шалгалтанд тэнцэхгүй байх:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Хавдартай болох:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Ажилтай холбоотой стрессд орох:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Архинд орох:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Ажил дээр ноцтой байдал үүсэх тохиолдолд түүнийг амжилттай шийдвэрлэх:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. 70-аас дээш наслас:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Ядаргаанаас шалтгаалан эерчил гаргах:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Мэдрэлийн ядаргаанд орох:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Сонгосон мэргэжлээрээ бахархах:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Эрүүл мэндийн статусаа алдах (түр хугацаагаар эсвэл бүр мөсөн):	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Зам тээврийн осолд орох:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. Өөрийн хувийн зорилгоо биелүүлэх:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Үргэлжлэл дараагийн хуудсанд...

Үргэлжлэл.

II. Надтай нас ойролцоо бусад нислэгийн удирдагчидтай харьцуулахад ирээдүйд миний боломж....							
	1 Дундаж аас маш доогуур	2 Дунда жаас доогуу ур	3 Дундажаас арай доогуур	4 Дундаж	5 Дундаж аас арай дээгүүр	6 Дундаж аас дээгүүр	7 Дундаж аас маш дээгүүр
15. Нислэгийн хөдөлгөөний удирдлага үйлчилгээтэй холбоотой зөрчил гаргах:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16. Чихрийн шижинтэй болох:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
17. Төрийн гавьяа шагналаар шагнуулах:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18. Нислэгийн хөдөлгөөний удирдлага үйлчилгээтэй холбоотой ноцтой зөрчил гаргах:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19. Зүрхний шигдээс болох:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20. Аз жаргалтай байх:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
21. Нислэгийн осол зөрчил гарахад нөлөөлөх:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
22. Ажлаасаа халагдах:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23. Шилдэг Нислэгийн удирдагч болох:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
24. Анхаарал сарниснаас болж нислэгийн осол зөрчил гаргах:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Хэсэг III.

III. Өөрийн ердийн ажлын өдрийн талаар бодож байгаад ээлжийн тухайн үед та ямар нөхцөлд байдаг талаар тэмдэглэнэ үү.

	1 Бүрэн бэлэн байдалд, маш сонор сэрэмжтэй	2 Маш сэргэлэн, хариуцлагатай, гэхдээ дээд зэргээр биш	3 Зүгээр, сэргэгдүү	4 Бага зэрэг ядарсан, бага зэрэг сэргэг	5 Нилээн ядарсан, сулдсан	6 Маш ядарсан, төвлөрөхөд хүндрэлтэй байх	7 Бүрэн эцсэн, үр ашигтайгаар үүрэг гүйцэтгэх боломжгүй
1. Ээлжийн эхэнд	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Ээлжийн дунд үед	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Ээлжийн төгсгөлд	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Хэсэг IV.

Доор байгаа 5 хариултаас та хүснэгтэнд байгаа 1-7 хүртэл тэмдэглэгээг ашиглан тухайн хариулттай хэр зэрэг санал нийлж байгаа, эсвэл нийлэхгүй байгаагаа тэмдэглэнэ үү. Та хариултаа тэмдэглэхдээ нээлттэй ба үнэн зөв хариулахыг хичээгээрэй.

	1 Бүрэн санал нийлэхгүй	2 Санал нийлэхгүй	3 Бага зэрэг санал нийлэхгүй	4 Санал нийлэхгүй ч биш Санал нийлэх ч биш	5 Бага зэрэг санал нийлнэ	6 Санал нийлнэ	7 Бүрэн санал нийлнэ
1. Ихэнхи тохиолдолд миний амьдрал миний санаанд бүрэн нийцдэг.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Миний амьдарлын нөхцөл маш сайн.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Би өөрийн амьдралдаа сэтгэл хангалуун байдаг.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Одоогийн байдлаар би амьдралдаа хүсэж мөрөөдөж байгаа бүх зүйлсээ биелүүлсэн.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Хэрэв би дахиж шинээр амьдрах боломж гарвал өөрийн одоогийн амьдралаас бараг юу ч өөрчлөхгүй.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Хэсэг V.

Дараах асуултууд өнгөрсөн сарын туршид таны санаа сэтгэл болон мэдрэмжийн талаар байгаа болно. Таны санаа сэтгэл болон мэдрэмж ихэвчлэн ямар байдаг талаар асуулт тус бүрт тохирох тэмдэглэгээг хийнэ үү. Хэдийгээр зарим асуултууд адилхан мэт харагдаж буй боловч тэдгээрийн хооронд тодорхой ялгаанууд бий бөгөөд тусдаа асуулт гэж ойлгон тохирох хариултыг бөглөнө үү. Тухайн асуултанд хурдан хариулах нь чухал юм.

	1 Үгүй	2 Бараг үгүй	3 Заримдаа	4 Үе Үе	5 Үргэлж
1. Өнгөрсөн сард, та санамсаргүй тохиолдсон ямарваа зүйлээс болж хэр их сэтгэл зовсон бэ?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Өнгөрсөн сард, танд амьдралынхаа чухал зүйлсийг удирдах боломжгүй болсон мэт мэдрэмж хэр их төрсөн бэ?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Өнгөрсөн сард, та хэр их бухимдах эсхүл стресссэн бэ?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Өнгөрсөн сард, та амьдралын төвөгтэй асуудалд бухимдсан бэ?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Өнгөрсөн сард, та амьдралд тань болж буй чухал зүйлсийг үр ашигтайгаар зохицуулсан мэт мэдрэмж хэр их төрсөн бэ?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Өнгөрсөн сард, та хувийн асуудлаа зохицуулах өөрийн чадварт итгэлтэй байгаа мэдрэмж хэр их төрсөн бэ?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Өнгөрсөн сард, бүх зүйл таны төлөвлөснөөр болж байгаа мэт мэдрэмж хэр их төрсөн бэ?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Өнгөрсөн сард, та хийх ёстой байсан бүх зүйлээ зохицуулж чадаагүй тохиолдол хэр их байсан бэ?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Өнгөрсөн сард, амьдралынхаа бухимдлыг хянах боломж хэр их байсан бэ?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Өнгөрсөн сард, та бүгдээс дээгүүр байгаа мэт мэдрэмж хэр их төрсөн бэ?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Өнгөрсөн сард, таны хяналтаас гадуур тохиолдсон зүйлээс болж хэр их уур уцаартай байсан бэ?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Өнгөрсөн сард, та өөрийн амжилттай хийж дуусгах ёстой зүйлсийн талаар хэр их бодсон бэ?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Өнгөрсөн сард, та цагаа хэрхэн өнгөрөөж буйгаа хянах боломж хэр их байсан бэ?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. Өнгөрсөн сард, хүндрэл бэрхшээлүүд таны дийлэхээргүй их бөөгнөрсөн байгаа мэт мэдрэмж хэр их төрсөн бэ?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Судалгаанд оролцсонд баярлалаа.

Дахин хэлэхэд, таны бөглөсөн мэдээлэлд таны нэр дурьдагдахгүй бөгөөд зөвхөн статистикийн дүн шинжилгээний зорилгоор ашиглах, судлаачидаас бусад этгээдэд ил гарахгүй байх болно гэдгийг онцлон тэмдэглэж байна.

Appendix C. Questionnaire English Version (Back translated version)



**COLLEGE OF BUSINESS
Kaupapa Whai Pakihi**

**SCHOOL OF AVIATION
Private Bag 11 222
Palmerston North
New Zealand**

Project title: Examining the Relationship Between Shift Pattern, Risk Perception, Fatigue, Subjective Well Being and Stress among Mongolian Air Traffic Controllers

Dear Air Traffic Controller,

I would like to invite you to participate in an exploratory study regarding your perception of risk in relation to stress and fatigue. This study is being carried out by Lkhagvasuren Togtokhbayar (Student, Massey University).

It should take you around 15 minutes to complete all five sections of this questionnaire. Your name is not required.

If you choose to participate, please return your completed questionnaire through the internal mail system to your manager. Completion and return of the questionnaire implies consent to participate.

A full project information sheet on the following page is followed by the questionnaire.

Thank you for your time.

Lkhagvasuren Togtokhbayar

Information sheet

Project title: *Examining the Relationship Between Shift Pattern, Risk Perception, Fatigue, Subjective Well Being and Stress among Mongolian Air Traffic Controllers*

Researcher:

<p>Lkhagvasuren Togtokhbayar Student School of Aviation Massey University Turitea Campus, Palmerston North Phone: +64 21 207 9806 Email: T.Lkhagvasuren@gmail.com</p>

Participant recruitment:

All air traffic controllers working for Air Traffic Service Division of MCAA are invited to participate in this survey.

Project procedures:

The data you supply will be anonymous and all statistical analyses will be on group data. Data will be stored securely at Massey University for 5 years, after which it will be destroyed. A summary of the project findings will be circulated to all air traffic controllers at the end of the project.

Participant involvement

Approximately 15 minutes of your time will be required to complete the questionnaire.

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;
- ask any questions about the study at any time before, during or after participation (please use the contact details above);
- withdraw from the study any time.

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(s) named above 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(s), please contact Professor John O'Neill, Director (Research Ethics), telephone: +64 6 350 5249, e-mail: humanethics@massey.ac.nz

The questionnaire:**Section I.**

1. How long have you been an air traffic controller?	Years.....	Months.....
2. Please state your gender	<input type="checkbox"/> Male	<input type="checkbox"/> Female
3. In which of the following age groups do you belong?	<input type="checkbox"/> Below 25 <input type="checkbox"/> 26 to 35 years <input type="checkbox"/> 36 to 45 years <input type="checkbox"/> 46 to 55 years <input type="checkbox"/> Above 56	
4. Over the last month in which shift have you worked more?	<input type="checkbox"/> Fixed	<input type="checkbox"/> Rotating
5. Have you completed Human Factors course?	<input type="checkbox"/> Yes	<input type="checkbox"/> No

Section II.

In this section, for each of the following statements, please report what you believe is your level of risk. For each statement, place a tick in the box that best describes your assessment of your risk.

***It is important that you take into account all of the things that only you know about yourself and which make you unique and may set you apart from other air traffic controllers (e.g., your attitude to health, your ATC skills, your determination, your general behaviour, etc.).**

Please **do not** answer the question if you currently actually experience the ailment/problem/advantage; instead write n/a by the side of the table.

<i>II. Compared to other air traffic controllers my age, my chances of..... in the future are</i>							
	1 Much below average	2 Below Average	3 A little below average	4 Average	5 A little above average	6 Above average	7 Much above average
1. Lung problems associated with air pollution:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Being promoted:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Failing an annual performance assessment (APA):	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Developing a cancer:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Suffering work related stress:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Having alcohol problems:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Successfully dealing with a work related emergency should one occur:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Living past 70 years of age:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Having an incident as a result of fatigue:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Having a nervous breakdown:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Enjoying or continuing to enjoy chosen career:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Losing my medical status (either temporarily or permanently):	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Being involved in traffic accident:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. Achieving my personal goals:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Continued on next page...

Cont.

<i>II. Compared to other air traffic controllers my age, my chances of..... in the future are</i>							
	1 Much below average	2 Below Average	3 A little below average	4 Average	5 A little above average	6 Above average	7 Much above average
15. Having an air traffic Incident:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16. Developing diabetes:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
17. Being recognised with State award:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18. Having an Serious air traffic Incident:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19. Having a heart attack:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20. General happiness:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
21. Contributing to an Incident:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
22. Being fired from a job:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23. Being recognised as a top ATC performer:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
24. Having an incident as a result of distraction:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Section III.*III. Try to think of average working day and then indicate how you feel.*

	1 Fully alert, wide awake	2 Very lively, responsive, but not at peak	3 Okay, somewhat fresh	4 A little tired, less than fresh	5 Moderately tired, let down	6 Extremely tired, very difficult to concentrate	7 Completely exhausted, unable to function effectively
1. At the beginning of shift	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. At the middle of shift	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. At the end of shift	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Section IV.

Below are five statements with which you may agree or disagree. Using the 1-7 scale below, indicate how much you agree with each item. Please be open and honest in your responding.

	1 Strongly Disagree	2 Disagree	3 Slightly Disagree	4 Neither Agree nor Disagree	5 Slightly Agree	6 Agree	7 Strongly Agree
1. In most ways my life is close to my ideal.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. The conditions of my life are excellent.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. I am satisfied with my life.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. So far I have got the important things I want in life.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. If I could live my life over, I would change almost nothing.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Section V.

The following questions are about your feelings and thoughts during the last month. For each question, please indicate how often you have felt or thought the way that is described. Although some questions appear may appear similar, there are differences between them and each should be treated as a separate question. The best approach is to answer each question fairly quickly. That is, don't try to count up actual instances, but rather indicate the answer which seems like a reasonable estimate. Please mark the appropriate response.

	1 Never	2 Almost never	3 Some- times	4 Fairly often	5 Very often
1. In the last month, how often have you been upset because of something that happened unexpectedly?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. In the last month, how often have you felt that you were unable to control the important things in your life?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. In the last month, how often have you felt nervous or stressed?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. In the last month, how often have you dealt with irritating life hassles?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. In the last month, how often have you felt that you were effectively coping with important changes that were occurring in your life?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. In the last month, how often have you felt confident about your ability to handle your personal problems?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. In the last month, how often have you felt that things were going your way?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. In the last month, how often have you found that you could not cope with all the things you had to do?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. In the last month, how often have you been able to control irritations in your life?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. In the last month, how often have you felt that you were on top of things?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. In the last month, how often have you been angered because of things that happened that been outside your control?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. In the last month, how often have you found yourself thinking about things that you have to accomplish?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. In the last month, how often have you been able to control the way you spend your time?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. In the last month, how often have you felt difficulties were piling up so high you could not overcome them?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Thank you for participating in this survey.

Once again, I would like to emphasize that your responses are anonymous, and will not be made available to anyone other than the researcher(s) for the purposes of statistical analysis.

Appendix D. Letter to Air Navigation Division of MCAA



ИРГЭНИЙ НИСЭХИЙН ЕРӨНХИЙ ГАЗАР
НИСЭХИЙН АЮУЛГҮЙ
АЖИЛЛАГААНЫ ХЯНАЛТ
ЗОХИЦУУЛАЛТЫН АЛБА

17120 Улаанбаатар хот, Хан-Уул дүүрэг
Буянт-Ухаа, Утас 28-50-13, 28-50-09, Факс: 32-65-62

2012.01.05 № 02/11
танай _____-ны № _____-т

НИСЛЭГИЙН ХӨДӨЛГӨӨНИЙ ҮЙЛЧИЛГЭЭНИЙ
АЛБАНЫ ДАРГА Н.НАРАНБОЛД ТАНАА

Танай албаны нийт нислэгийн удирдагч нарын дунд “Нислэгийн удирдагчдын Эрсдлийн үнэлгээ, Ядаргаа болон Стресс” сэдэвт судалгааг Шинэ Зеланд улсын Массей их сургуулиас явуулах гэж байгаа тул нийт албаны бие бүрэлдэхүүнийг идэвхитэй оролцуулах тал дээр анхаарал хандуулж хамтран ажиллана уу.

Хавсралт 2 хуудас

ДАРГА



П.МӨНХЖАРГАЛ

Appendix E. Low risk notification



MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA

23 November 2011
Lkhagvasuren Togtokhbayar
2/20 Victoria A venue
PALMERSTON NORTH 4410

Dear Lkhagvasuren

Re: Risk Perception, Fatigue and Stress among Mongolian Air Traffic Controllers

Thank you for your Low Risk Notification which was received on 11 November 2011.

Your project has been recorded on the Low Risk Database which is reported in the Annual Report of the Massey University Human Ethics Committees.

The low risk notification for this project is valid for a maximum of three years.

Please notify me if situations subsequently occur which cause you to reconsider your initial ethical analysis that it is safe to proceed without approval by one of the University's Human Ethics Committees.

Please note that travel undertaken by students must be approved by the supervisor and the relevant Pro Vice-Chancellor and be in accordance with the Policy and Procedures for Course-Related Student Travel Overseas. In addition, the supervisor must advise the University's Insurance Officer.

A reminder to include the following statement on all public documents:

"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(s) named above 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(s), please contact Professor John O'Neill, Director (Research Ethics), telephone 06 350 5249, e-mail humanethics@massey.ac.nz."

Please note that if a sponsoring organisation, funding authority or a journal in which you wish to publish requires evidence of committee approval (with an approval number), you will have to provide a full application to one of the University's Human Ethics Committees. You should also note that such an approval can only be provided prior to the commencement of the research.

Yours sincerely

John G O'Neill (Professor)
**Chair, Human Ethics Chairs' Committee and
Director (Research Ethics)**

cc Dr Andrew Gilbey
School of Aviation
PN833

Capt Ashok Poduval, CEO
School of Aviation
PN833

Massey University Human Ethics Committee
Accredited by the Health Research Council

Research Ethics Office, Massey University, Private Bag 11222, Palmerston North 4442, New Zealand
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E humanethics@massey.ac.nz animaethics@massey.ac.nz gte@massey.ac.nz
www.massey.ac.nz

Appendix F. NZ CAR Part 172.55 Management of fatigue

The Notice of Proposed Rule Making suggested by New Zealand Civil Aviation Authority proposes following change in New Zealand Civil Aviation Rule Part 172 “Air Traffic Service Organisations – Certification”:

172.55 Management of fatigue

(b) Each applicant for the grant of an air traffic service certificate shall establish a scheme, acceptable to the Director, for the management of fatigue in those persons directly responsible for the provision of an air traffic service.

(c) The scheme established under paragraph (b) shall take account of:

- (1) the rest period available prior to commencing duty:*
- (2) typical traffic for the shifts to be worked:*
- (3) the availability of rest, refreshment, and meal breaks:*
- (4) the availability of relief staff:*
- (5) circadian rhythms:*
- (6) short-term and accumulated sleep deficit:*
- (7) the shift rotation system in use.*

(d) The scheme established under paragraph (b) shall include measures to avoid fatigue through:

- (1) monitoring of workload on ATS staff while on duty:*
- (2) consideration of fatigue as a causative or contributory factor in incidents and accidents:*
- (3) education of operational staff on the avoidance of fatigue:*
- (4) management responsibility for the proactive avoidance of fatigue:*
- (5) specification of the following duty limitations :*
 - (i) the maximum time or times for continuous operational duty:*

- (ii) *the minimum time or times for breaks from operational duty:*
 - (iii) *the maximum time or times for a single period of duty:*
 - (iv) *the minimum off-duty time or times between consecutive periods of duty:*
 - (v) *the minimum off-duty time following a night shift:*
 - (vi) *the maximum number of consecutive periods of duty*
 - (vii) *the maximum number of consecutive night shifts:*
 - (viii) *the maximum average period of duty within any shift cycle:*
 - (ix) *where the shift cycle is based on the calendar week, the minimum number of actual days off duty in any period of 4 calendar weeks:*
- (e) *The scheme shall detail the extent, if any, by which the standard provisions of the scheme may be varied for circumstances involving—*
- (1) *a national or local emergency; or*
 - (2) *the safety of life or property; or*
 - (3) *unforeseen operational circumstances.*
- (f) *Each applicant shall establish a procedure to ensure that no air traffic controller or flight service operator shall be required or permitted to work periods of duty or shift cycles that do not conform to the scheme required by paragraph (b).*

Each applicant shall establish a procedure to ensure that no air traffic controller or flight service operator provides an air traffic service if the applicant knows or has reason to believe that the person is suffering from, or, having regard to the circumstances of the operational duty, is likely to suffer from, such fatigue as may endanger the safety of any aircraft.