Culture and its Impact on Flight Deck Management

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Culture and its Impact on Flight Deck Management

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Statement of Originality

I declare that the work presented in this thesis is, to the best of my knowledge and belief, original and my own work, except as acknowledged in the text. The material in this thesis has not been submitted, either in whole or in part, for a degree or any other award at this or any other university.

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Abstract

The mixing of culture in any work place brings a series of challenges; the aviation industry is no different. The major down side to these challenges is the risk to safety in an industry that prides itself on being considered one of the safest industries in the world.

The issue of culture on the flight deck is of particular interest because for some time there have been negative outcomes when crews of mixed cultural backgrounds have been forced to deal with adverse situations. These situations may have many root causes but have often been far less relevant to the outcome than the cockpit dynamics at play (Kanki & Palmer, 1993). Kanki & Palmer (1993) suggest that culture plays a significant role in flight deck management. The procedures developed by aircraft manufacturers (who are predominately Anglo-European) may not be appropriate for airlines whose pilots are predominately from non-Anglo-European backgrounds. There is however little quantifiable evidence to support this line of argument.

This study was performed to investigate the role that culture plays on the flight deck, in particular flight crew performance (flight deck management) as it impacts on both safety and efficiency. Previous studies have discussed flight crew performance, demonstrating the interrelated nature of technical and non-technical skills and the relationship between the flight crew skill set and operational outcomes. This study seeks to expand knowledge in the area of flight crew performance by exploring the impact of culture on procedures, training and crew interrelationships.

This study was conducted in two parts. A preliminary study used direct observations made in accordance with the subjective sociology philosophy and conducted using a

data collection instrument based on the Line Observation Safety Audit (LOSA) process as developed at the University of Texas. This initial study was used to better understand the research question and as a basis for the question data bank used for the main study which consisted of research conducted under the Empirical Phenomenological Method. Six participant airline captains were interviewed to quantify their experiences obtained during flight operations, in particular the different operational practices they had experienced when operating with Anglo-European airlines and Chinese airlines.

The research was ultimately able to build on previous research by adding four additional elements to the six non-technical skills that had been identified in previous research. This led to the development of a model (The Flight Deck Management Pyramid) which reflects both non-technical skills and cultural elements pertaining to flight deck management.

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List of Abbreviations

ATC Air Traffic Control

CAA Civil Aviation Authority (United Kingdom)

CAAC Civil Aviation Administration of China

CASA Civil Aviation Safety Authority (Australia)

CCAR Chinese Civil Aviation Regulations

CRM Cockpit (Crew) Resource Management

EASA European Aviation Safety Agency

ECAM Electronic Centralised Aircraft Monitoring

FAA Federal Aviation Administration (United States of America)

FAR Federal Aviation Regulations (United States of America)

FMA Flight Mode Annunciator

FMGC Flight Management Guidance Envelope Computer

IATA International Air Transport Association

ICAO International Civil Aviation Organisation

JAR Joint Aviation Région (Europe)

LOFT Line-oriented Flight Training

MEL Minimum Equipment List

MMEL Master Minimum Equipment List

SOP Standard Operation Procedure

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Chapter 1

Culture, Aviation Safety and Efficiency in Context

1.1 Introduction

The importance of the airline industry to modern life can scarcely be disputed. The industry has seen continuous growth for the last century and that growth is expected to continue for many years to come (Airbus, 2013; Boeing, 2013; International Air Transport Association (IATA), 2013; International Civil Aviation Organisation (ICAO), 2013). In 2012 the aviation industry was reported to account for 3.5% of global Gross Domestic Product (GDP) (Joyce, 2013). The aviation industry in 2012 was responsible for transporting some three billion passengers and 47 million metric tons of freight, employing 57 million people and generating $2.2 trillion US in revenue (Joyce, 2013). The International Air Transport Association's (IATA) forecasts indicated that the airline industry would continue to expand at a global rate of 5.4% p.a. through to 2017 (IATA, 2013). This forecast expansion is not projected to be uniform across the globe. Domestic passenger growth in the US from 2013 to 2017 is predicted to occur at an annual rate of 2.2% compared to China's projected growth rate of 10.2% (IATA, 2013). The major aircraft manufacturers take a slightly longer view with regards to growth forecasting. Both Airbus and Boeing publish 20-year forecasts (Airbus, 2013; Boeing, 2013). The latest forecast from Boeing (2013) estimates the world's airlines will grow at an annualised rate of 5% from 2013 to 2032 with the majority of that growth stemming from emerging economies (Boeing, 2013). Projected growth rates by Boeing (2013) suggest that international airline traffic growth in the developed economies will be in the region of 2.1% as compared with the Middle East at 3.8%, Latin America 4.0% and Asia Pacific at 4.5% (Boeing, 2013). The disparity in growth rates is even more apparent when domestic growth is considered (Airbus, 2013; Boeing, 2013; IATA, 2013). Boeing expects North America to retain its place as the world's largest domestic market with a projected growth rate of 2.3% annually for the next 20 years while Airbus expects China to overtake North America as the world's largest domestic market by 2032 with a growth rate of 7.0% (Airbus, 2013; Boeing, 2013).

Forecasts indicate a shift in aviation's epicentre. North America was universally reported to have a lower growth rate when compared to other regions (Airbus, 2013; Boeing, 2013; IATA, 2013; ICAO, 2013). The two regions with the lowest domestic growth rates were North America and Europe with 2.3% and 3.6% domestic growth respectively (Boeing, 2013). The emerging economies of Latin America, China and Russia and Independent States (CIS) are expected to show domestic passenger growth rates of 6.9%, 6.8% and 4.8% respectively (Boeing, 2013). To give these figures some perspective the world's airline fleet is anticipated to double over the next 20 years, from approximately 20,300 aircraft today to 41,200 by 2032 (Boeing, 2013). Of the 20,300 aircraft in service today 6,590 are in service in North America and 4,390 are in service in Europe leaving 9,320 aircraft, approximately 46% of the world's airline fleet operating in the remainder of the world (Boeing, 2013). Over the next 20 years, a substantial shift in fleet distribution is likely to occur (Airbus, 2013; Boeing, 2013; IATA, 2013; ICAO, 2013). Boeing (2013) expects the world airliner fleet to reach 41,200 aircraft by 2032 with 8,810 aircraft deployed in North America and 8010 in Europe. But the majority of aircraft, 24,380 or 59% of the fleet will be operated by airlines outside of North America and Europe (Boeing, 2013). This projected shift seems likely to present the industry with challenges as the industries growth takes it away from the regions where its traditional cultural roots lie.

1.2 Culture in Context

Culture has been shown to have an impact on every area of human activity, because culture determines the way in which people solve problems. Trompenaars (1993, p.8) stated that 'every culture distinguishes itself from others by the specific solutions it chooses to solve certain problems.' If this is so then it stands to reason that generic procedures relying on the behavioural assumptions of one culture may be incompatible when people of another culture use the same procedures.

Early researchers identified five culturally defining problems and further indicated that most societies were aware of all the possible solutions for these problems but culturally proffered different solutions depending on their norms and values (Kluckhohn & Strodtbeck, 1961). Later research by other researchers supported this early research (Bond & Hofstede, 1988; Kagitcibasi & Berry, 1989; Barnlund & Yoshioka, 1990; Trompenaars, 1993; Oetzel *et al*, 2001; Oetzel & Ting-Toomey, 2003; Ryan *et al* 2008; Heine & Buchtel, 2009; Scherer & Brosch, 2009; Mulaudzi, 2014; Puntscher *et al*, 2014;). Trompenaars (1993) presented these five basic problems as follows:

1. What is the relationship of the individual to others? (Relationship Orientation)
2. What is the temporal focus of human life?
3. What is the modality of human activity?
4. What is the human being's relation to nature?
5. What is the character of innate human nature? (p. 27)

Trompenaars (1993) also considered that the solutions to these questions varied depending on seven key dimensions of culture. These are as follows:

1. Universalism verses particularism influencing orientation to rules and relationships.
2. Individualism verses collectivism affecting the focus of activity, either group or individual.
3. Affective verses neutral cultural traits of emotionality determining feelings and relationships.
4. Specific verses diverse cultural bias underlying interaction and involvement of the individual.
5. How groups accord status.
6. How groups manage time.
7. How groups relate to the natural environment.

In this context culture is recognised on three levels; national, corporate and professional (Trompenaars, 1993). Further, the cultural differences which occur on these levels have been shown to have an impact on motivation, conflict, change, learning, efficiency, coordination, strategies, negotiation, and employee interrelations (Bond & Hofstede, 1988; Kagitcibasi & Berry, 1989; Barnlund & Yoshioka, 1990; Trompenaars, 1993; Oetzel *et al*, 2001; Oetzel & Ting-Toomey, 2003; Ryan *et al*, 2008; Heine & Buchtel, 2009; Scherer & Brosch, 2009; Falk *et al*, 2014; Trafmon & An, 2014; Wan & Lu; 2014). When measured in this context it seems possible that culture will have an impact on flight deck management and flight crew interrelationships just as it does in all other areas of human endeavour.

1.3 Aviation Safety

Much of the future growth in the aviation industry is anticipated to occur in the Asia Pacific, Latin America, China and Indian regions (IATA, 2009). Until the recent economic crisis, the aviation sector in China was projected to have double digit growth through to 2012 (Wang, 2007). While the 2008 economic downturn saw worldwide growth stall, especially in Europe and North America, the markets in Asia and the Middle East continued to expand, although at a reduced pace (IATA, 2009). As has been the case following previous industry downturns, the Chinese aviation market returned to high rates of growth fairly quickly and reported strong growth again by 2011 (Airbus, 2013; Boeing, 2013; IATA, 2013). The return to high growth rates is expected to see China's aviation industry approach or pass that of the United States by 2032 (Airbus, 2013; Boeing, 2013).

For the aviation industry to deliver its projected growth, profits and other goals it must safely and efficiently transport goods and people. How safe is the aviation industry and is the standard of safety uniform in all parts of the globe? In a broad sense the IATA accident statistics are divided into eight regions (IATA, 2009). These regions are: Africa and Indian Ocean Region (AFI); Caribbean and South American Region (LATAM); European Region (EUR); Middle Eastern and North African Region (MENA); North Atlantic and North American Region (NAM); Asia and Pacific Region including Japan and Korea (ASPAC); Russia and Independent States (CIS); China, Hong Kong, Macau and Taiwan (NASIA).

Most reports quote global statistics when the various interested parties—politicians, press or regulators—raise safety concerns. Statistics commonly quoted in the media such as 0.41 Western-built jet hull loss accidents per million hours or 0.81 Western-built jet hull loss accidents per million sectors, are no doubt useful especially in a public forum where detailed in-depth analysis may be considered as either not necessary or perhaps not desirable (IATA, 2009). A more detailed region-by-region comparison reveals that accident rates for CIS, LATAM, and MENA are substantially higher than the world average (IATA, 2009). Even this data does not tell the complete story. For example, Australia and Indonesia are in the same IATA region but have very different safety records. For example for the five year period from 2008 to 2012 inclusive Indonesia recorded eight hull loss accidents while none were recorded for Australia (Bureau of Aircraft Accidents & Archives, 2014).

A further issue with safety statistics is that the hull–loss accident rate is merely the tip of the iceberg. Only the most extreme safety lapses lead to a hull loss accident, and therefore do not necessarily reflect the underlying safety issues. The rate of safety related incidents (for example near accidents and equipment failures) also forms part of the safety equation however due to varying reporting standards from country to country, and even company to company, reliable statistics are not readily available. Yet there are many more incidents than accidents and it is in this area that cultural influence is likely to underlie issues such as miscommunication, mixed mode mishaps and misinterpretation of charts or instructions.

During the decade ending 2005, China experienced 32 fatal aircraft accidents with flight crew performance being cited as a significant factor in well over half of these cases (Wang, 2007). The Chinese hull loss rate for the decade 1996 to 2005 equates to an average of 0.649 hull losses per million flight hours (Wang, 2007). This rate compared quite favourably with the world average of 0.999 hull losses per million flight hours (Wang, 2007) but is considerably higher than the rate for the USA for the corresponding period at 0.156 hull losses per million hours (NTSB, 2005; FAA, 2005). More recent statistics indicate an improvement in Chinese safety standards with no jet hull–loss accidents in China for the years 2011 and 2012 (IATA, 2013; ICAO, 2013). Data trends associated with very low rate incidents are often seen to be 'associated with some gradual or sudden change in quality, age or maintenance practice' (Viertävä & Vaurio, 2009, p. 1129). Additional statistical testing would be required to determine whether the apparent trend is statistically significant or due to random variation (Viertävä & Vaurio, 2009). Even if a statistically significant trend is confirmed, there remains the open question as to whether the trend is due to improvements in operational practices or due to advances in technology.

Despite China's improving safety standards there are significant challenges ahead for the country's aviation industry, especially as the Chinese aviation market is one of the fastest growing aviation markets in the world (Wang, 2007). Mr Wang, the Vice-Minister of CAAC, highlighted the following deficiencies within the Chinese aviation industry: '(1) a shortage of qualified operating personnel; (2) a lack of infrastructure; (3) legal and regulatory shortcomings; and (4) the need for enhanced safety management' (Wang, 2007, p. 7). Encouragingly there is a will to improve. The vice-minister set an ambitious goal by stating that the 'CAAC is intent on reducing the accident rate to less than 0.300 hull losses per one million hours by 2010' (Wang, 2007, p. 9). This goal seems to have been achieved with China recording no western jet- hull- loss accidents for either 2011 or 2012 (IATA, 2013). To maintain the low accident rate achieved, a continuing commitment to providing additional resources will be required. In particular, both funding and the technology will be required to address continuing safety issues. A lack of adequate funding and technology may result in the perpetuation of a safety system and culture that is predominately managed through administrative orders and slogans (Wang, 2007; CAAC, 2007, 2008; China Eastern Airlines, 2007, 2008).

It seems that the CAAC is aware of this issue and are moving to address the safety issues by changing the present safety culture to include:

- Further development of safety data reporting and analysis.
- Implementation of proactive safety measures instead of relying on reactive post-accident measures.
- Real compliance with international standards and procedures.
- Acceptance of open monitoring by external expert bodies.
- Adoption of a non-punitive reporting system.
- Recognition of regionally specific aspects of culture as they impact on safety.

(Wang, 2007)

1.4 Why Research Culture and its Impact on Flight Deck Management?

The resolving of cultural issues—should they exist is—of importance to all industries, not just the aviation industry. At present, there is an unprecedented transfer of both technology and infrastructure from the Western economies to the Asian region. Both China and India—the Asian economic powerhouses—depend heavily on the adoption of foreign technology in the four areas crucial to the modern economy: (1) process and design technology in manufacturing; (2) war technology; (3) software and; (4) biotechnology (Majumdar, 2009; Cox, 2013). The implication then is that much of the technology being used in Asia is conceived, developed and intended to be operated from a Western perspective. If through cultural variance this is not the case, then there are likely to be negative outcomes in the areas of safety and efficiency. Negative outcomes in these areas are likely to result in additional costs and increased hazards for all stakeholders.

It is anticipated that this study will deliver information that can be used in four ways:

1. Improve aviation safety.
2. Improve efficiency within the aviation industry.
3. Provide findings that can form the basis of further research in the aviation field.
4. Provide findings that can form the basis for research in other areas. In previous studies, this has already been shown to be the case with cultural influence having a similar impact in more than one industry (Helmreich & Merritt, 1998).

1.5 Summary

Cultural differences influence workplace interactions and outcomes because every culture distinguishes itself from other cultures by the specific solutions its members choose to solve certain problems (Trompenaars, 1993). The ability to solve problems with specific predetermined solutions forms the basis for operating procedures as determined by aircraft manufacturers, airlines and regulators. These procedures underpin the high safety standards achieved by the aviation industry.

The face of aviation is changing with much of the forecast growth set to occur in China and India (IATA, 2009; Airbus, 2013; Boeing, 2013). In China, the CAAC has acknowledged that there could be issues for the Chinese aviation industry with the majority of their civil aircraft having been designed and built by western manufacturers (Wang, 2007). These aircraft are designed, built and operated from a Western cultural perspective and philosophy. While it is convenient for Chinese airlines to adopt a turnkey approach to airline operations, it is also important to recognise and account for the differences that characterise people from different cultural backgrounds. Culture can be defined as a multilayered concept of human interrelations. Culture underpins all thought, communication and social interaction. Thus culture is a significant and important component of personal interaction and has been shown to impact on situational management. As yet, however, there has been little evidence presented to show how significant this issue may be with regards to flight deck management.

1.6 Overview of Thesis

This thesis consists of nine chapters in all. Chapter 1 provides context and significance for a study of this nature and why the researcher considers it to be of significance to the aviation community.

Chapter 2 presents a summary of the literature reviewed to develop an understanding of culture from a historical perspective, an interactive perspective and a social perspective. The review of culture is intended to provide some understanding of the importance of culture in the work environment. This chapter also introduces to the concept of flight crew performance and presents the case that performance on the flight deck is determined by a combination of both technical and non-technical skills which together may be considered flight deck management.

Chapter 3 discusses the approach to the Preliminary Study which was used to develop an in-depth understanding of the subject and to provide direction, information and to assist with the development of a question data base for the Main Study. This study focused on the effects of culture on flight deck management by comparing the results of targeted observations of flight crew behaviours in two airlines, one a Chinese airline and the other an Anglo-European airline.

Chapter 4 presents the data collected from the Preliminary Study. The data collected from observations of a Chinese airline was compared with LOSA data from an Anglo-European airline. This data set was used as a basis to develop an interview schedule and question data base for the Main Study.

Chapter 5 presents the case for social constructionist methodologies as being suitable for research into areas of human performance, especially in the aviation field. The chapter discusses the difficulty faced by researchers when studying areas related to human performance, especially as many research topics in this arena are externally set by regulators, manufacturers and equipment operators. Chapter 5 also introduces the idea of using a research decision model as a basis for determining an appropriate methodology. By working through the decision model it was determined that Culture and its Impact on Flight Deck Management, the Descriptive Phenomenological Psychological Method would be appropriate as a research methodology for this thesis.

Chapter 6 describes in detail the Empirical Phenomenological Method as a research methodology. The description illustrates how the method has developed both structure and rigour. The description also shows that in its present form the Empirical Phenomenological Method has been shown to be both valid and reliable.

Chapter 7 describes how the research methodology was specifically applied to this research project and the three additional items relevant to the research methodology including: participant selection, ethical approval and question development. The chapter contains a description as to how the researcher met the various criteria as stipulated in the methodology and has demonstrated that both requirements of validity and reliability were obtained.

Chapter 8 presents the findings of the Main Study. It starts with a synopsis of each participant airline captain's interview after which the structure of combined interviews is presented. In accordance with the methodology the constituent elements and their relationships are also revealed and discussed.

Chapter 9 seeks to build on previous research by discussing performance on the flight deck. Flight deck management was seen to be made up of both technical and non-technical skills. Previous studies have identified that non-technical skills are comprised of six elements. This study found that there were four additional elements when cultural aspects were considered. Chapter 9 also seeks to contribute to the aviation industry by examining the role that these four elements play in flight deck management, and makes recommendations for changes in procedures and training for the Chinese aviation industry. Finally there are recommendations for future research on this subject.

Chapter 2

An Overview of Culture and Flight Crew Performance

2.1 Introduction

In Chapter 1 culture, aviation safety was discussed. This subject was considered in context with two conclusions being made. Firstly that cultural differences impact on interactions and outcomes in the work place on the basis that every culture distinguishes itself from other cultures through the solutions its members use in the problem solving equation. Secondly that the present unprecedented transfer of technology from the Anglo-European region to the rest of the world is not without its challenges, as outcomes in safety and operational efficiency may be adversely affected by design, man/machine interface and operating procedures having been conceived and developed from a western cultural perspective.

This chapter consists of a literature review intended to establish the background and context for the research components of this thesis. To this end, the literature reviewed provides an overview of culture, the theories of cultural development and its relevance in industrial settings, especially in relation to the aviation industry. This chapter also discusses flight crew performance. The key elements of this discipline are described with the nature of their interconnected relationship being described.

2.2 The Development of Culture

That there are different cultures evident in the world today implies that there are causal factors, either historical events and/or biological reasons that have led to this reality. On face value, it would seem that this simple observation would have led to a definitive or unified theory of cultural development. However, this does not appear to be the case. At present there are numerous competing theories relating to cultural development.

From a historical perspective it has been hypothesised that cultural differences—as seen at a national or regional level—are modern manifestations of the various ancient civilisations (Toynbee, 1946: Diamond, 1997). The rise of the first civilisations reportedly took place some 13,000 years ago with the modern industrialised world often considered the sum product of the expansion of those early civilisations at the expense of small groups of hunter-gatherer tribes (Toynbee, 1946; Diamond, 1997). It was implied that the larger civilisations are populated by people who are in some way biologically more advanced than the vanquished ((Taylor, 1871, 1881; Spencer, 1876, 1880; Morgan, 1877; Metchinkoff, 1889; Toynbee, 1946; Diamond, 1997; Scharff, 2000). The theory that there is a biological basis for technical and therefore cultural supremacy has been used for many years. In the 19th Century, numerous researchers considered culture in terms of advanced culture (Anglo-European Culture) and primitive culture (Tribal/Hunter Gatherer Culture) and sought to classify cultures by their rank in a table of culturally primitive to culturally advanced states with the process of natural selection as the driving force leading to a culturally advanced state (Taylor, 1871, 1881; Spencer, 1876, 1880; Morgan, 1877; Metchinkoff, 1889). The theory of Sociology proposed by Comte (1798 to 1857) considered that there were three stages of human development: a theological state, natural phenomena being caused by the supernatural; a metaphysical stage, natural phenomena as a result of unknown forces; and a final positive stage where natural phenomena were explained through knowledge and science (Scharff, 2000). Thus for these researchers the most developed form of human culture was the Anglo-European culture with its scientific base and logic-driven values.

The theory was based on cross-cultural data evaluated on the basis of three assumptions. First, contemporary societies could be classified and ranked from primitive to civilised.

Secondly, that there were a determinate number of stages in the classification process from primitive to civilised (e.g. band, tribe, chiefdom, and state). Finally, all societies progress through these stages in the same sequence, though at different rates (Scharff, 2000). This form of cultural evolution as an explanation for the different levels of technology, literacy and political organization of various groups of people persisted until the late 1950s (White, 1949, 1959; Trigger & Masson, 2001). By the 1940s other theories describing cultural evolution as change rather than advancement were being developed (Engels, 1942; Child, 1951; Barnett, 1953; Trigger, 1998; Trigger & Masson, 2001). Some of the theories developed to describe cultural evolution include Functionalism (Rosenkranz, 2011; Rastau & Bican, 2012; Islam, 2013), Systems Theory (Bergthaller & Schinko Eds, 2011; Philippi, 2011; Flynn, 2014); Conflict Theory (Ember & Ember, 1992, 1994; Ross, 1993, 1994, 2007, 2011; Udogu, 2013); Unfolding Models (Meier, Otten & Abdel-Hameed, 2011; Reinert, 2011; Harper, 2013; Morin, 2013); Rational-choice Theory (McGovern, 2003; De Jonge, 2012); Symbolic Interactionism (Latour, 2005; Fuhse, 2012; Denzin & Faust, 2013); and Actor-network Theory of Change (Farias & Thomas, 2010; Jensen, 2013). This proliferation of theories suggests that there has been and continues to be considerable interest in attempting draw a link between culture, biology and intelligence.

The underlying premise to the development of these theories seems to fall in to three main categories: (1) socio-biological change, (2) social selection, and (3) socio ecological factors. The theory of a socio-biological basis for culture proposed by Wilson (1975)' considered that population genetics is affected by phenotypes. Thus, a population's culture was derived from unique and observable characteristics through additive genetic variance caused by environmental factors (Wilson, 1975). Smith (1982, p.2) disagreed with this argument stating that excluding cases of physical and mental defect ‘there is no single case in which it is known that a difference in a human gene causes a difference in behaviour’. A competing theory of cultural development proposed that cultural change was a process of natural selection through social relationships. Consequently a group’s culture was determined by its selection of desirable behavioural and organisational practices and relationships (Cavalli-Sforoza & Fieldman, 1981). Another theory—Social Ecology—hypothesised that advanced societies and their attendant cultures developed in response to the availability of suitable plants and animals for domestication (Wrangham, 1980; Diamond, 1997; Bailey, 1998; Best, 1998). The mapping of plant and animal domestication and hybridisation has attracted a considerable body of research due to its multi faceted implications. Recent genetic research has been able to not only refine time lines for the expansion and transfer of crops and animals but also identify their regional specialisations (Clutton-Prock, 1994; Schwabe, 1994; Heun *et al*, 1997; Murphy, 2007; Peters *et* al, 2008; Smith, 2013). The general consensus indicates that there were a variety of plant and animal species on the Eurasian continent suitable for domestication as presented in Table 2.1 below (Diamond, 1997).

Table 2.1: Examples of Species Domesticated in Each Area

Area	Domesticated Plants	Domesticated Animals	Date of Domestication
Southwest Asia	wheat, pea, olive	sheep, goat	8500 BC
China	rice, millet	pig, silk worm	by 7500 BC
Mesoamerica	corn, beans, squash	turkey	by 3500 BC
Andes & Amazonia	potato, manioc	llama, guinea pig	by 3500 BC
Eastern United States	sunflower, goosefoot	none	2500 BC
? Sahara	sorghum, African rice	none	by 5000 BC
? Tropical West Africa	African yams, oil palm	none	by 3000 BC
? Ethiopia	coffee, teff	none	?
? New Guinea	sugar cane, banana	none	7000 BC?
Local Domestication Following Arrival of Founder Crops from Elsewhere			
Western Europe	poppy, oat	none	6000-3500 BC
Indus Valley	sesame, eggplant	humped cattle	7000 BC
Egypt	sycamore fig, chufa	donkey, cat	6000 BC

Note. ? in the table above indicates that data is inconclusive.

Source: (Diamond, 1997, p.100)

Both plants and animals were domesticated in all the areas where independent civilisations developed. It is also evident that the domestication of both plants and animals in each region pre-dates the rise of civilisation in that region and further that the earliest civilisations in the Fertile Crescent, Indus Valley and the Yellow/Yangtze River arose in those areas where the earliest domestication of plants and animals enabled farming to occur (Diamond, 1997, p.100).

From the current research it seems possible that advanced societies with their attendant cultures developed in response to the availability of suitable plants and animals however this is far from certain at present as new technologies are continually refining and expanding understanding in this area (Wrangham, 1980; Clutton-Prock, 1994; Schwabe, 1994; Diamond, 1997; Heun *et al*, 1997; Bailey, 1998; Best, 1998; Murphy, 2007; Peters *et* al, 2008; Smith, 2013).

There is to date no universally accepted theory regarding the origin and development of culture. This situation has been considered by other researchers who have considered that it is probable that no single theory explains the mechanisms leading to the evolution of different cultures. These researchers have concluded that an interrelated spectrum of theories from ecological change to cultural determinism better explains cultural diversity (Trigger, 1998; Hemelrijk, 2002; Newman & Newman, 2007; Crozier, 2008).

For the purposes of this study into culture and its impact on flight deck management a resolution to this issue was not considered possible. The broad term ‘culture’ may be viewed as a social construct consisting of two parts, a cultural (social) and a racial (physical) identity (Loury, 2001). Under this description race refers to physical appearance while culture refers to social identification. Therefore, culture is seen as a series of behaviours and other factors that are learned from and shared amongst people from a common cultural group (Sutton & Anderson, 2010). Every person in a cultural group shares common patterns of behaviour, values and language (Schein, 1985; Trompenaars, 1993; Sutton & Anderson, 2010). Language is considered a central element in the cultural equation as cultural identity is largely thought to be transmitted through language (Sutton & Anderson, 2010; Everett, 2013; Morin, 2013).

While the members of a culture tend to hold their identity separate from other cultures, cultural states are not fixed. Cultural groups interact with and learn from each other in a constant state of change and at a personal level, individuals often cross from one culture to another in response to life choices (Sutton & Anderson, 2010). Despite their constant interaction, cultures are considered to be ethnocentric in their relationships with other cultures (Sternberg, 2004; Sutton & Anderson, 2010). The ethnocentric nature of intercultural relationships has led to discussion on the subject of a cultural basis for intelligence, in other words the members of one cultural group being intrinsically more intelligent than members of another cultural group (Sternberg, 2004). However, there is no substantiated evidence to suggest that culture determines an individual's intellectual abilities, although it is recognised that intelligence means different things to different cultures (Berry, 1984; Sternberg & Kaufman, 1998; Serpell, 2000, 2002). Yet culture, as will be discussed in following chapters, may have an impact on how an individual learns, expresses and values acquired knowledge (Hofstede, 1986; Bond & Hofstede, 1988; Kagitcibasi & Berry, 1989; Barnlund & Yoshioka, 1990; Ishii, 1993; Kasuya, n.d.; Kawai, 1993; Trompenaars, 1993; Lockhart, 1994; Richards & Lockhart, 1994; Oetzel *et al*, 2001; Husijer, Stück & Tanaka, 2002; Oetzel & Ting-Toomey, 2003; Lee, *et al*, 2005; Huijser, 2006; Ryan *et al*, 2008; Heine & Buchtel, 2009; Scherer & Brosch, 2009; Everett, 2013; Morin, 2013).

2.3 An Overview of Culture

As discussed above, culture has been considered in the context of social orientation, shared patterns of behaviour, values, language and other factors forming the basis for a homogenous, ethnocentric group. The following section describes culture from this perspective in more detail. It has already been stated that 'culture is the way in which a group of people solves problems' (Schein, 1985, p.6). Nevertheless culture is of course much more. Culture may be described as a multi-layered concept of human interrelations and as such is the underlying all inclusive life experience which guides social interaction, meaningful communication and prescribes common values and thought processes (Drake, 1991; Trompenaars, 1993; Lynn & Gleb, 1996; Lenartowicz & Roth, 1999, 2001; Soares, 2005; Soares *et al*, 2007).

2.3.1 The Layers of Culture

Culture has been described as being a multi layered concept. In these terms it is usually accepted that culture can be most easily described as having three concentric layers. Figure 2.1 below depicts this concept starting with an outer layer, an explicit area where the easily observed accompaniments of a culture may be observed. The next layer contains the less obvious cultural behaviours, a culture's norms and values. Finally in the inner layer lie the basic assumptions that underpin organisation and interaction.

A MODEL OF CULTURE

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Figure 2.1: A Model of Culture

Source: Trompenaars. (1993, p.23)

2.3.1.1 The Explicit Area

The most obvious manifestation of culture lies in an area of culture often referred to as the explicit area. Cultural identity in this area is demonstrated by such things as artefacts and products as produced by the members of a cultural group. These are the first things encountered when entering a country and form the observable reality of that culture. Language, food, architecture, fashion and art all form part of this observable suite of symbols that overlay the less fathomable aspects of culture (Hofstede, 1986, 2001; Trompenaars, 1993; Everett, 2013).

2.3.1.2 The Norms and Values

The middle layer sitting beneath the explicit immediately observable manifestations of culture are the norms and values attributable to a group or society. Norms are described as the sense of what is right and wrong. This sense of right and wrong is often tabulated in the form of written laws (Trompenaars, 1993; Helmreich & Merritt, 1998). Values are described as the sense of good and bad and therefore underpin the ideals of a society. In essence norms formulate normal behaviour whereas values underwrite desired behaviour and as such provide a guide for acceptable alternative behaviour (Hofstede, 1984, 1991, 2001; Trompenaars, 1993; Helmreich & Merritt, 1998; Lenartowicz & Roth, 2001; Liu *et al*., 2001). Norms and values are considered to have a pivotal role in underpinning the bonds of common identity that unify the members of a common cultural group (Goode, 1957; Trompenaars, 1993; Helmreich & Merritt, 1998).

2.3.1.3 The Basic Life Assumptions

At the core of a culture we find the implicit underlying basic assumptions about existence. These underlying assumptions are born in most instances from a community's need to find effective ways to deal with their respective environments, for example Eskimo's dealing with the Arctic cold (Drake, 1991; Trompenaars, 1993; Lenartowicz & Roth, 2001; Stewart, 2006). Once a solution to an all-pervading environmental or social problem is used successfully on a continual basis by successive generations, the solution becomes automatic and as such disappears from conscious thought, becoming a subconscious and intuitive function within a culture's context (Trompenaars, 1993; Diamond, 2005). Hofstede (1980) distilled these elements into his four dimensions of culture, Power Distance, Individualism-Collectivism, Uncertainty Avoidance and Masculinity-Femininity. Cultural imperatives as displayed at this level have a large impact on organization, interaction and logic when applied to the problem-solving equation. Changes in these core cultural assumptions usually only occur when it becomes obvious that a society's or community's environmental solutions are no longer working and that change is required for the survival of the community (Trompenaars, 1993; Diamond, 2005).

2.4 The Relevance of Culture to Flight Deck Management

Culture has relevance to the management of any situation because culture underpins the nonverbal basis for action in any given circumstance. Geertz (1974, p.24) states, culture is how people 'communicate, perpetrate and develop their knowledge about attitudes towards life. Culture is the fabric of meaning in terms of which human beings interpret their experience and guide their action.' Trompenaars (1993) interpolates and expands on this idea by saying:

> Over time, the habitual interactions within communities take on familiar forms and structures. These structures are imposed upon the situations which people confront and are not determined by the situation itself. For example, the wink of an eye. Is it a physical reflex from dust in the eye? Or an invitation to a date? Or could it be someone making fun of you to others? Perhaps a nervous tick? The wink is real, but the meaning is attributed to it by observers. The attributed meaning may or may not coincide with the intended meaning of the wink. Effective social interaction, though, depends on the attributed meaning and the intended meaning coinciding. (p.25)

Cross-cultural differences are typified by the different meanings attributed to physical observations (Trompenaars, 1993; Helmreich & Merritt, 1998; Gladwell, 2008). Difficulties arise when the reactions to an observed phenomenon differ between people of different cultural backgrounds causing a breakdown in shared meanings or expectations (Trompenaars, 1993; Gladwell, 2008).

The idea that all individuals within a cultural group share an identical blueprint of norms, values and assumptions is simplistic and does not represent reality (Hofstede, 1984, 1991, 2001; Lynn & Gelb, 1996; Lenartowicz & Roth, 1999, 2001; Soares, 2005; Soares *et al*., 2007). Trompenaars (1993) described this spread of cultural imperatives with the use of a standard deviation graph with cultural traits being spread either side of a cultural norm. When comparing the standard deviations of two cultures it is the extremes of cultural behaviour that can be used to describe the behavioural characteristics of each. Stereotypes of each culture develop by registering and describing these extremes (Trompenaars, 1993; Gouttefarde, 1996). In order to display cultural similarities and differences as they occur between different cultures, Trompenaars (1993) used standard deviation graphs Figure 2.2 & 2.3 in the manner as depicted below.

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Figure 2.2: Shared Norms and Values.

Source: Trompenaars. (1993, p.26)

In principle, each culture shows the total variation of its human components. So while America and France have great variations, there are also many similarities. The "average" or "most predictable" behaviour, as depicted by Figure 2.2 will be different for these two countries. In Figure 2.3 below it can be seen how the shift in the average behaviour also provides the basis for the cultural outliers (extreme behaviour). This extreme behaviour forms the basis for stereotypical comparison.

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Figure 2.3: Extreme Norms

Source: Trompenaars. (1993, p.26)

Extreme norms occur outside the area of shared norms and values and lead to stereotyping. 'In the case of the clash of cultures between the United States of America and French culture the observed stereotypes would be thus: Americans see the French as being; arrogant, flamboyant, hierarchal and emotional whereas, the French see Americans as being; naive, aggressive, unprincipled and workaholic' (Trompenaars, 1993, p.26). By extrapolating from this example it may be considered that while members of any cultural group (national, corporate or professional) share many common traits, there are also differences between individuals. When comparing different cultural groups it can be seen that while the groups share most traits they are separated by minor outliers which ultimately form the basis for each group's distinguishing features. When professional culture is considered, a subgroup's overriding national culture may provide the basis for stereotypical outliers that differentiate a subgroup within the broader professional group. This has been seen to occur despite the acknowledged professional bonds and sense of community (Helmreich & Merritt, 1998). As previously discussed, culture has been shown to have an impact on human endeavours and indeed previous studies have discussed culture and aviation, however a link between cultural preference and flight deck management practices has yet to be drawn. For a connection to be made in this area, culture cannot be considered in isolation, but must be considered in context with flight deck management and flight crew performance.

2.5 Pilot Performance

The efficiency of any flight is determined by flight crew performance (Harris, 2011). The crew's performance is to a large extent determined by both technical and non-technical skills, the combination of which may be considered 'Flight Deck Management' (Ferroff *et al*, 2010; Harris, 2011). The technical skills required to operate an aircraft are laid down by the various aviation regulatory bodies such as ICAO, EASA, the FAA, CASA and CAAC. These skills are based around technical and theoretical knowledge, and the demonstration of manipulative proficiency (Harris, 2011; Mavin & Roth, 2014). The theoretical and technical requirements cover various theory subjects essential to aviation such as meteorology, engineering, aerodynamics, navigation, flight planning, aviation regulation and aviation law (CASA, 2009). The manipulative requirements relate to the skills required to operate the aircraft safely in all conditions including emergencies (CASA, 2008).

Non-technical skills are those skills which have been identified as being essential building blocks for improving operational standards and safety, and have been identified as 'the Cognitive and Social skills that complement a worker's technical skills' (Flin *et al*, 2008, p.1). The non-technical or complementary skills referred to can be placed under four broad categories: (1) Situational Awareness; (2) Communication Skills; (3) Management; (4) Decision Making (Harris, 2011).

2.6 Situational awareness.

Situational Awareness (SA) may be defined as 'the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning and the projection of their status in the near future' (Endsley, 1994, p.36). Many researchers (Endsley, 1988, 1994, 1998, 1999, 2010; Hartel, Snith & Prince, 1991; Helmreich & Merritt, 1996, 1998; Kern, 1997; Durso & Gronlund, 1999; Endsley & Robertson, 2000; Helmreich, 2000, 2002; Klampfer *et al*, 2001; Thomas, 2004; Lacagnina, 2007; de Montalk, 2008; Flin *et al*, 2008; Henderson, 2009; Harris, 2011) have identified SA as being an important if not fundamental performance dimension for flights to be conducted in a safe and efficient manner. Mavin & Roth (2014) further developed the thesis that not only was SA an important skill for pilots, it was an essential constituent in flight crew performance. For effective SA there must be a realisation that the environment is dynamic with solutions requiring anticipation and constant re-assessment and correction (Shrestha *et al*, 1995; Reason, 1997; Kern, 1998; Endsley & Robertson, 2000; Banbury & Tremblay, 2004; Thomas; 2004; Tenney & Pugh, 2006; Mavin & Roth, 2014).

From the definition above it may be extrapolated that SA has five main elements. The first element covers geographical considerations such as terrain, navigation facilities, control area boundaries, clearance limits and proximate traffic (Endsley, 1999; Harris, 2011). An awareness of spatial elements related to flight path maintenance, altitude, air speed, attitude and configuration is also a requirement (Endsley, 1999; Harris, 2011). SA is further enhanced by the crew developing systems awareness consisting of an awareness of automation level, fuel status, communication status and issues related to serviceability and safety (Endsley, 1999). Environmental conditions also form part of the SA package. These elements include an appreciation of weather, such as cloud, precipitation, visibility, turbulence or windshear and icing (Endsley, 1999). Environmental factors may also include more obscure items such as braking action on landing. Finally, SA includes Commercial or Tactical items - for example operating costs, noise abatement requirements or on-time-performance considerations (Mavin, 2013).

Perception of these elements is only the first stage in developing SA. The definition indicates that two more stages are required as part of the SA package. The perceived situation needs to be analysed and comprehended with a future projection being made as to the likely outcome of the situation. That is to say, an understanding of the situation needs to be developed with each element’s importance being assessed in terms of flight safety and efficiency. Accurate predictions then need to be formulated for the most likely scenarios so that informed operational decisions can be made to mitigate potential operational threats (Amalberty & Deblon, 1992; Endsley, 1999, 2010; Mavin & Roth, 2014). The above process has been depicted by Endsley (1994) in Figure 2.4 below.

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Figure 2.4: Model of Situational Awareness

Source: Endsley. (1994, p 31)

Note: In this model the elements of perception, comprehension and prediction are labelled as levels 1, 2 and 3.

It is possible to perceive from the model above that flight crews with greater SA are likely to seek and obtain more information and as a result detect and respond more accurately and quickly to the dynamic environment in which they operate (Endsley & Robertson, 2000; Mavin & Roth, 2014). This perception is reflected in the research conducted to date, for instance in Endsley's (1999) study:

> 71% of aircraft accidents could be attributed to human error, with SA accounting for 88% of this total. Of the SA-related accidents, deficits in perceiving the

situation (level 1) accounted for 82% of the total 88%, failure to comprehend the situation (level 2) contributed 16.9% and failure to project SA (level 3) was a mere 2.9%. (p 20)

2.7 Communication.

Earlier in this chapter communication was discussed as being one of the key enabling skills supporting both SA and the essential tasks of decision making and safe aircraft operations. Good communication skills have been acknowledged as being a requirement not just in an aviation setting but as an essential component in all high risk team environments (Nieva *et al*, 1978; Thomas, 2004; Gladwell, 2008). Poor communication has been seen to be a major causal factor producing unintended outcomes in many industries not just aviation (Foushee & Helmreich, 1988; Kanki & Palmer, 1993; Kern, 1998; Thomas, 2004; Edkins, 2005; Gladwell, 2008; Flin *et al*, 2008; Mavin & Roth, 2014). In an effort to minimise these unintended outcomes and improve team performance, considerable research has been conducted on the subject. Good communication skills have been shown to be instrumental in providing information, maintaining task focus, and in establishing and maintaining both relationships and predictable behavioural patterns (Kanki & Palmer, 1993; Kern, 1998; Thomas, 2004; Flin *et al*, 2008) described communication as having four elements:

- What – the information to be communicated
- How – the means to communicate the information
- Why – the reason for the communication
- Who – the person(s) to whom the information is being communicated. (p.69)

By combining these four elements with other components of communication it was possible to develop Table 2.2 below. The table shows the relationship between the elements of communication, their attendant requirements and the method of interaction in an aviation setting (Helmreich & Merritt, 1998; Kern, 1998; Thomas, 2004; Gladwell, 2008; Flin *et al*, 2008).

Table 2.2: Elements of Communication

Element	Requirement	Interaction
Who	Sender	Pilot to pilot
	Receiver	Pilot to/from ATC Pilot to/from cabin crew Pilot to/from company Pilot to/from engineer
How	Verbal	Language Structure Tone One way/ interactive
	Written	Language Format Method One way/Interactive
	Alternative	Visual/audio Code One way/Interactive
Why	Social	Unstructured Low priority Interactive High volume low content
	Operational	Semi-structured Structured Interactive/Instructional In context and informative Low volume high content
	Emergency	Structured Interactive/instructional Time constrained Very low volume very high content
What	Message content or idea	Clear and concise Context Transmission, reception and confirmation Identify & address misunderstanding Identify & address barriers to communication

Note: Adapted from Flin *et al*. (2008, pp. 69, 88)

When considering the interaction that takes place during communication, it can be seen that at times communication may be seen as instructional. Communications of this type involve a largely one-way process, whereas interactive communication is a two-way process. These two communication styles each have their own benefits and on the flight deck each may be useful under the appropriate circumstances (Gladwell, 2008; Flin *et al*, 2008). The component elements and advantages of both styles as discussed by Flin *et al* (2008) are depicted in Figure 2.5 and Table 2.3 below.

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Figure 2.5: One-Way and Two-Way Communication Models

Source: Flin *et al*. (2008 p.72)

Table 2.3: Advantages and Disadvantages of One-Way and Two-Way Communication

One-Way Communication		Two-Way Communication	
Advantages	**Disadvantages**	**Advantages**	**Disadvantages**
Rapid	Requires planning	More accurate	Takes longer
Looks and sounds neat	Responsibility for clear message is with the sender	Permits checking of details	Receiver has to communicate in return
Sender feels in control	No feedback to sender	Less planning required	
		Receivers are able to make more accurate judgements	
		Both sender and receiver are responsible	
		Sender and receiver work together to develop understanding	

Source: Flin *et al*. (2008, p.72)

Communication as a skill may be improved in technical environments through training in three primary areas: training, structure, and discipline. Communication training may cover many aspects of the communication process including phraseology, tone of delivery, language, and how to deliver information or instructions in a concise manner (Kern, 1998). However instruction on how to prevent barriers to good communication impacting on the communication process is equally important (Helmreich & Merritt, 1998; Gladwell, 2008; Flin *et al*, 2008). Flin *et al* (2008) identified that there are both internal and external barriers to effective communication which should be considered.

The external barriers are those that may be attributed to the environment while internal barriers are those that can be attributed to the individual. These barriers are summarised in Table 2.4 below.

Table 2.4: Internal and External Barriers to Communication

Internal	External
Language difference	Noise
Culture	Interference or distraction
Motivation	Separation in location, time
Expectations	Lack of visual cues, e.g. body language, gestures, facial expressions
Past Experience	
Prejudice	
Status	
Emotions/moods	
Deafness	
Voice level	

Source: Flin *et al*. (2008, p.78)

Improving the structure of communication relates to removing ambiguity from messages so that the information and instructions contained in each message can be easily understood (Kern, 1998; Gladwell, 2008). In general this process is achieved through the use of standard operating procedures to control the flow of messages, thereby improving message timing to help prevent overloading (Kern, 1998). The use of standard phraseology to control the content and format of messages improves clarity and helps to prevent misunderstandings (Kern, 1998; Gladwell, 2008).

Kern (1998) was of the opinion that communication is enhanced by the use of a disciplined approach which he termed 'communication discipline' (p. 201). Communication discipline was considered to be a process that went beyond formulating messages to comply with content and format as dictated by standard operating procedures. Communication discipline related to the precise application and control of the communications process to prevent communications breakdowns (Kern, 1998). In an aviation context, communication discipline largely revolves around the principle of 'read back; hear back' or as previously described in two way communications, as the feedback process (Kern, 1998, p. 205). In the aviation setting there is a requirement for pilots to 'read back' clearances and many other instructions such as speed, altitudes, headings and takeoff and landing instructions (Kern, 1998, p. 205). Air traffic controllers are required to listen to the pilot's response to confirm the instruction has been understood thus creating a closed loop 'hear back' to prevent accidents and incidents (Kern, 1998, p. 205).

2.8 Management.

Management on the flight deck is a complicated and multifaceted endeavour that requires both cognitive and social skills (Wickens, 1999; Flin & Martin, 2001; Thomas, 2004; Harris, 2011; Mavin & Roth, 2014). In general terms management has been defined as 'coordinating and overseeing the work activities of others so that activities are completed efficiently and effectively' (Robbins, *et al*, 2009, p.10). On the flight deck, coordination and oversight form part of the management process as do other important skills leadership, followership and other team building elements (Hollander, 1993; Wiener *et al*, 1993; Conger *et al*, 2000; CAA, 2006). There are also other areas on the flight deck requiring management.

Abbott (1993) determined that there were four additional processes requiring management on the flight deck. These additional processes were categorised as flight management, communication management, systems management and task management (Abbott, 1993). Abbott (1993) referred to these four categories as level 1functions. Each of these categories was further divided into elements referred to as level 2 and level 3 functions. In broad terms it can be seen that each level 1 function is supported by attendant elements covering specific areas related to aircraft operation as follows;

1. Flight Management has two levels and two elements.

   i. The first element, flight guidance, is an element that covers the development of a desired plan, the identification of required resources, situational assessment and the development of a plan of action.

   ii. The second element, flight control, was seen to relate to flight path management, that is the management of speed, direction and altitude.

2. Communication Management was seen to have three elements being:

   i. Receiving information.

   ii. Processing information.

   iii. Sending information.

3. Systems Management was seen as the process of managing the aircraft from a mechanical perspective. This incorporated the management of items such as engine control, pressurisation, fuel, flaps and landing gear. The three elements related to these tasks were:

i. Configuration planning.

ii. Monitoring.

iii. Assessing.

4. The fourth level 1 function, Task Management, was seen to cover resource allocation. As such this task had the function of prioritising and coordinating the other level 1 activities (Abbott, 1993; Mavin, 2013).

Other researchers have considered these activities from the view point of threat and error management (Helmreich, Klinect & Wilhelm, 1999; Helmreich, 2002; Thomas, 2004). These studies concluded that technical skills and non-technical skills are interconnected and play a pivotal role in threat and error detection and response. In this regard technical knowledge was considered to include not only knowledge related to the aircraft, its systems and trajectory but also knowledge relating to threat and error occurrence allowing generic threat and error management strategies to be employed (Thomas, 2004).

The research conducted by Mavin (2013) however has shown that many of the functions described above may be better categorised as being functions of SA. By making this change, management on the flight deck could be seen to be more closely aligned to that in other settings (Mavin & Dall'Alba, 2011). Crew management would then be seen to be a preeminent function in support of safe and efficient aircraft operations. The crew management tasks then revolve around concepts related to team building, team working, crew resource management (CRM) and threat and error management.

Cooper *et al* (1979) identified that failures in leadership and team coordination were major causal factors in air crashes. The teamwork leadership and followership skills required on the flight deck should not be underestimated as the flight crew are expected to consistently form a team from a group of strangers and instantly perform highly technical work in a demanding safety-orientated environment (National Research Council, 1993).

Flight crews are considered to be a team, in that they are a group of individuals who come together to achieve a goal (Salas *et al*, 1992). Most teams come together for a period of months to years allowing that team to become a stable and experienced group who identify themselves with the whole team and are able to support each other, ask for help and even compensate for the short comings of others (Klein, 1998). Tuckman (1965 and later in collaboration with Jensen 1977) identified that effective teams exhibited five stages in their life cycle as shown in the table below.

Table 2.5: Stages of Team Development

Stage	Definition
Forming	Typically characterised by ambiguity and confusion. Team members may be at odds with one and other. Communication may be limited, guarded and impersonal.
Storming	A stage where conflict is possible as light is brought to bear on team hierarchy and task assignments.
Norming	Open communication is established and the team procedures, communication protocol is established. The task is able to be fully addressed.
Performing	The team reaches its full potential and becomes a highly effective group fully focused on the task or goal.
Adjourning	The team is dissolved and the group's interdependency is at an end with roles terminated and tasks completed.

Note: Adapted from Tuckman. (1965) & Tuckman & Jensen. (1977, p. 421 & 425) in Flin *et al*. (2008, p. 103)

Flin *et al* (2008) considered that teams such as flight crew, control room teams and medical teams might not undergo the forming and norming stages of team development due to the organisational aspects of those situations. While this may be the case it is more likely that those processes are still occurring but at a highly accelerated pace (Paris *et al*, 2000). Team work may be considered as the cooperative activities of a group of individuals that culminate in the successful completion of a set of tasks or goals. Salas *et al* (2002) determined that for teams to be truly effective the generic idea of team work should be further split in to two categories that of team work and task work. Team work skills consist of those interactions that allow the team to function as a group to allow tasks to be accomplished efficiently and so ensure that the defined goals can met. The behaviours that are included in the area of team work are performance monitoring, feedback, closed loop communication and back up of other team members.

Task work behaviours are those behaviours linked to the operational activities being performed. This includes an understanding of the technology in use, the standard operating procedures and ultimate outcome of the tasks at hand. High standards of task work are achieved when a team's members display high levels of team self-awareness and develop an understanding of team interdependence (McIntyre & Salas, 1995; Salas *et al*, 2000; Salas *et al*, 2002; Flin *et al*, 2008). Team work in aviation settings has also been described as being 'task-contingent', that is task-specific rather than team member specific (Paris *et al*, 2000; Flin *et al*, 2008). It is this aspect of the team work scenario that allows flight crew teams to form quickly and perform in a complex setting with a very high degree of certainty as to a positive outcome (Flin et al, 2008).

2.9 Decision making.

Decision making is an important process in all human endeavours. The decision making process relies on four elements: (1) situation analysis; (2) development of response options; (3) selection of a response; and (4) review of outcomes (Flin *et al*, 2008). There have been extensive studies related to decision making in all sorts of environments however those that have focused on decision making in high risk, highly dynamic operational settings are more limited in number. The decision making process most commonly utilised in this environment has been called 'Naturalistic' decision making and this style of decision making has been considered the most relevant style for use in the aviation industry (Klein *et al*, 1993; Flin *et al*, 1997; Zsambok and Klein, 1997; Connolly *et al*, 2000; Flin *et al*, 2008). The theory of Naturalistic decision making was conceived when researchers realised that the classical decision making processes were of limited value in time pressured environments where a satisfactory solution was of more importance than an ideal solution (Klein *et al*, 1993; Flin *et al*, 1997; Zsambok & Klein, 1997; Flin *et al*, 2008).

In order for decision making to take place SA is required, with a problem first being perceived and then assessed. Under a naturalistic decision making process two influences are of prime importance to the decision making process: risk and time. The level of risk and the available resolution time were seen to have an immediate impact on how decisions evolved with the available options falling in to four categories, recognition-primed, rule-based, choice-based, and creative (Hammond, 1988; Sarna, 2002; Gaba, 2004). The recognition-primed decision process which has at times been called an intuitive decision process and is especially useful for determining an appropriate course of action in time constrained high risk situations. The course of action is chosen by the process of recognition of the situation and applying choices as dictated by previous experience. In this situation the search for an optimum solution would be considered too time consuming thus the focus on applying a suitable course of action rather than the application of an optimum solution (Abernathy & Hamm, 1993; Klein, 1993, 2003; Claxton, 1997; Gigerenzer, 2007; Flin *et al*, 2008). Three of the key features of recognition-primed decisions are firstly that the situation requires a recognition-driven solution rather than option driven solution. Secondly the response to the situation is driven by recall and based on experience and training, and finally the course of action while not necessarily optimum should result in a successful outcome (Abernathy & Hamm, 1993; Klein 1993, 2003; Claxton, 1997; Gigerenzer, 2007; Flin *et al*, 2008). In an aviation setting, the recall actions as stipulated in the emergency procedures section of the aircraft operations manual form the basis of recognition-primed decisions used in emergency situations, while experience drives recognition-primed decisions used in normal operations.

Rule-based decision-making or procedure based decision-making is the process of applying a course of action centred on the application of a rule or procedure either from memory or from an operations manual. This process requires more effort and is generally slower than the recognition-primed decision process due to the time taken to recall the matching rule and/or search for the appropriate procedure in a manual. In an aviation setting rule-based decisions are particularly useful for the many procedurally-based activities required in both normal and emergency operations (Skriver & Flin, 1996; Skriver, 1998; Larkin, 2002: Flin *et al*, 2008). When these two decision-making processes are employed the action is largely solution-centred. That is to say that once the situation has been recognised a learned or procedural response is applied without an in depth comparison of alternative solutions. In the case of choice decisions the decision-making process changes focus from being response-centred to being problem-centred.

Choice decisions focus initially on the situation. Once the situation has been accurately analysed a number of possible solutions are generally available. The optimum solution may then be chosen once all variables have been considered. This process could be a long and drawn out process if in depth analysis and modelling is applied, and indeed this may be the case in a static environment. In dynamic environments decision making is assisted by the use of pre-task analysis often in the form of decision trees or ‘what if’ scenarios (Gigerenzer & Goldstein, 1996; Larkin, 2002; Flin *et al*, 2008).

Creative decision making is a process for devising a course of action required to solve an unseen or unforseen problem. These black swan events require novel and untried courses of action (Montgomery *et al* Eds, 2005). Again the process can be seen to be driven by situation analysis with a solution being determined after consideration of a number of possible solutions. This process is often very time consuming and the solutions untested and therefore difficult to justify. Creative decision making is not used in highly dynamic environments on a regular basis largely due to both time constraints and the procedurally based systems in place (Haynes, 1992; Orasanu & Fischer, 1997).

2.10 Combining the Elements of Flight Deck Management

Flight deck management was seen to consist of both essential and enabling elements. Mavin & Roth (in press) considered SA was the highest order essential skill required on the flight deck. This skill was seen as being the trigger mechanism for the decision-making process supported by the enabling elements of aviation knowledge, crew management and communication skills. This combination of skills enables decisions to be made considerate of risk and for the aircraft to be operated within tolerance.

While this model provides a clear demonstration of the symbiotic relationship of the six elements that underpin flight crew performance, these elements have been considered in isolation, that is, without accounting for cultural context. Yet, as has previously been discussed, culture influences all thought, communication and social interaction ultimately influencing situational management. Other researchers (Helmreich & Merritt, 1998; Gladwell, 2008)—discussed in Chapter 3—have considered the role of culture and social climate in relation to operational outcomes. Their research however, has limitations in that while the connection has been made between the cultural orientation of flight crew members and some elements that underpin flight crew performance' the findings seem inconclusive and of limited practical application in an industry setting.

2.11 Summary of Culture and Flight Crew Performance

From a historical perspective it can be seen that different cultures have developed at different times, however to date, no universally accepted theory regarding the origin and development of culture has been adopted. This being the situation at present, there is a preference amongst researchers to accept that there is no single mechanism for the evolution of culture but rather a spectrum of theories from ecological change to cultural determinism (Trigger, 1998; Hemelrijk, 2002; Therry, 2007, 2008). The broad term 'culture' was considered to be a social construct consisting of two parts, a cultural and a racial identity (Loury, 2001). Under this description, race related to physical appearance, while culture referred to social identification. Therefore, culture was seen to consist of behaviour that was learned from and shared amongst people from a common cultural group (Sutton & Anderson, 2010).

Culture was described as being a tri-layered concept of human interaction. On the macro level the external layer, the explicit area, related to the obvious manifestations of culture such as language, art and food. The middle layer related to the norms and values of a society while at the core of a culture lie the implicit underlying basic assumptions about existence (Geertz, 1973; Schein, 1985; Trompenaars, 1993). Culture has also been identified as occurring on three levels: national, professional and corporate. Culture on these levels and the interaction between their constituents both within and external to the individual has been seen to have great influence in the work environment (Geertz, 1973; Helmreich, 1984; Schein, 1985; Ting-Toomey, 1988, 1994, 1999, 2010; Trompenaars, 1993; Helmreich & Merritt, 1998).

Cross-cultural differences are typified by the different meanings attributed to physical observations. Cross-cultural difficulties arise when the reactions to an observed phenomenon differ between people of different cultural backgrounds causing a breakdown in shared meanings or expectations (Trompenaars, 1993; Lynn & Greb, 1996; Lenartowicz & Roth, 1999, 2001; Soares, 2005; Soares *et al*, 2007). With the above in mind it seems likely that culture plays a significant role in flight crew performance.

High standards of flight crew performance deliver safe and efficient air travel. In an effort to improve both safety and efficiency in the aviation industry much research has been performed and many books and papers have been published on the subject. Ultimately performance on the flight deck is largely determined by the combination of both technical and non-technical skills which together may be considered flight deck management (Ferroff *et al*, 2010; Harris, 2011). Flight deck management was seen to consist of both essential and enabling elements. Mavin (2013) considered SA the highest order essential skill required on the flight deck. This skill was seen as being the trigger mechanism in the decision making process supported by the enabling elements of aviation knowledge, crew management and communication skills which together enabled decisions to be made considerate of risk and ultimately the aircraft to be operated within tolerance. Mavin (2013) developed a model which provides a clear demonstration of the symbiotic relationship of the six elements that underpin flight crew performance however these elements have been considered in isolation, that is, without accounting for cultural context. Other researchers considered the role of culture and social climate in relation to operational outcomes however their research has limitations in that no clear connection was made between the cultural orientation of flight crew members and the impact of cultural difference on the elements that underpin flight crew performance. As previously identified one of the goals of this study is to connect culture and flight crew performance in a unified model.

Chapter 3

Methodology for the Preliminary Study

Elements of this chapter were presented and published in the proceedings of the 9th Australian Aviation Psychology Association Conference 2010 as:

Ferroff, C. V., Bates, P. R., Murray, P. S., (2010).

Culture and its impact on flight deck management – a comparative study of two airlines.

Proceedings of the 9th International Symposium of the Australian Aviation Psychology Association 2010.

3.1 Introduction

Culture has been shown in Chapters 1 and 2 to have an impact on every area of human activity because it determines the ways in which people solve problems (Trompenaars, 1993). Earlier research by Kluckhohn and Strotbeck (1961) indicated that most societies are aware of all the possible solutions for life's problems but culturally prefer different solutions depending on their norms and values. If this is so, perhaps generic airline operating procedures formulated on the behavioural assumptions of one culture may be inappropriate when used by members of another culture. Clearly this has implications for both safety and efficiency of flight operations.

This chapter considers the relevance of cultural imperatives on operational aspects of the aviation industry and introduces efficiency as an essential element to aircraft operations. This chapter also discusses the methodology used for a preliminary study and deals with issues related to the chosen research methodology, such as the use of direct observation as a research tool, the data collection instrument, validity and the process of data comparison.

3.2 Relevance

It is generally accepted within the aviation industry that over the last 30 years approximately 70% of accidents can be attributed to flight crew error (Reason, 1997; Endsley, 1999; CAA [UK], 2014; Flin *et al*, 2008). In an effort to reduce the number of accidents attributable to human factors i.e. pilot or crew error, Crew Resource Management (CRM) programs have been developed as one of the major interventions in the present suite of aviation safety training measures. Since the inception of CRM there have been conflicting views on the impact of culture on CRM with Yamamori and

Mito (in Wiener *et al*, 1993) being of the opinion that no culture specifically fits the cockpit environment and thus CRM (and by inference aircraft operation in general) is culture free. This opinion is substantially at odds with the findings of Helmreich and Merritt who state that the study of cultural differences had clearly shown that the cockpit is not a culture free environment (1998). This latter view has a substantial body of supporting evidence from a variety of sources with cultural imperatives having been shown to have an impact on motivation, (Bond & Hofstede, 1988; Trompenaars, 1993; Heine & Buchtel, 2009) conflict, negotiation, (Barnlund & Yoshioka, 1990; Trompenaars, 1993; Oetzel *et al*., 2001; Oetzel & Ting-Toomey, 2003) change, learning, (Trompenaars, 1993; Joy & Kolb, 2009; Heine & Buchtel, 2009; Scherer & Brosch, 2009), efficiency, coordination, strategies and employee interrelations (Kagitcibasi & Berry, 1989; Trompenaars, 1993; McGovern, 2003).

Other research has led to a model showing the possible connections between personal background, culture, social climate, communication and operational errors (Redding & Ogilvie, 1984; Mjos, 2004). The model in the figure below indicates that personal variables and culture underpin social climate which is a major factor in determining communication methods and styles. The effectiveness of communication was considered to affect both the nature and standard of operational outcomes.

Image has been removed

Figure 3.1: Model Containing the Main Variables Relating to Operational Outcomes.

Adapted from Mjos (2004), based originally on Redding & Ogilvie (1984)

3.3 Aviation Safety and Efficiency

As previously discussed aviation safety tends to be reported using metrics associated with accidents, for example 0.41 western jet hull loss accidents per million hours or 0.81 western jet hull loss accidents per million sectors (IATA, 2009). Accident rates however are not uniform across the globe. The IATA accident statistics are divided into eight regions and a comparison reveals that accident rates for Commonwealth of Independent States (CIS), Latin America and the Caribbean (LATAM), Middle East & North Africa (MENA) and Africa (AFI) are substantially higher than the world average (IATA, 2009). Further analysis shows that even within regions the accident rate is not consistent, for example Australia and Indonesia are in the same IATA region but have very different safety records. For the five year period from 2008 to 2012 inclusive Indonesia recorded eight hull loss accidents while none were recorded for Australia (Bureau of Aircraft Accidents & Archives, 2014). Statistics recording hull loss, hull damage and loss of life do not reflect the complete picture of underlying safety. The rate of safety-related incidents (near accidents, equipment failures etc.) also form part of the safety equation. Reliable statistics are not readily available in this area however several issues associated with incidents of this type such as miss-communication, mixed mode mishaps, miss-interpretation of charts or instructions are areas that can be captured by direct observation methodologies.

From an Anglo-European perspective an efficient operation is one that optimises the use of all resources: time, fuel, staff, equipment, and in air operations. This process, an effort to maximise profit through increased revenue and reduced costs, includes a focus on improved technology in several areas. Technological advances in both airframe and engine design have already brought benefits to the industry's efficiency, while air traffic systems improvements are projected to bring improvements in the future.

IATA reports have highlighted a number of areas where efficiencies can be obtained. In 2009 IATA set in place a 'four pillar strategy' to reduce costs, the industry's carbon footprint and improve overall operational (Bisignani, 2009, p. 8 & 9). IATA has reported that since 2009 its members have reduced their carbon emissions by an average of 1.7% per year beating their stated target of 1.5% PA (IATA, 2013). The majority of savings have come through increased load factors (increased pay load per flight), improved aircraft performance and better 'in air' operations (IATA, 2013). IATA (2013) also indicated that efficiencies are being obtained with improved technology such as Performance Based Navigation (PBN) systems leading to operational improvements by reducing separation requirements, fuel burn and noise footprints through optimising trajectories, and allowing for continuous descent approaches to be flown, all while enhancing safety. Infrastructure upgrades to reduce Air Traffic Control (ATC) delays and optimise route structures are also proving beneficial while new ATC systems such as Next GEN in the US, the Seamless Asian Sky initiative (SAS) and the Single European Sky (SES) are expected to lead to a 10% reduction in the industry's environmental footprint by expediting air traffic flow and allowing for the flexible use of air space (IATA, 2013). These new ATC systems also propose a traffic flow priority change from the present system of first come first served to a system based on the concept of most capable best served (ICAO, 2013). It is likely that culture will have some impact in this area as operational, infrastructure and economic preferences have been shown to be to some extent culturally determined (Trompenaars, 1993; Scherer & Brosch, 2009; Falk *et al*, 2014; Mulaudzi, 2014; Puntscher *et al, 2014*). Clearly, for the goals discussed above to be achieved the aviation industry needs to develop an in-depth understanding of cultural influence. This understanding is required for the design of procedures or training programs to enable standardisation of operational outcomes and so maximise the safety and efficiency enhancements available through the adoption of new technology.

3.4 The Limitations of Research to Date

As previously discussed numerous researchers have conducted research on this topic. While they have made valuable contributions to the subject, previous research did not adequately connect culture with flight crew performance in a practical manner. For example in the model containing the main variables relating to operational outcomes (See Figure 3.1), the connection between culture and communication has been drawn, however other aspects of flight deck management have not been included. Other research by Helmreich & Foushee (1993) considered flight crew performance from the perspective of inputs affecting processes and ultimately determining outputs. In their study, National, Professional and Organisational culture were considered as being input factors affecting the processes (performance functions) of crew formation and management, flight control, communications, decision making; Situational Awareness and procedures. These functions then decide a flight’s outcome in terms of safety and efficiency. This research advanced understanding of the cultural aspect of flight deck management by building on the previous research by Redding & Ogilvie (1984) expanding the number of flight crew performance functions that occur within a cultural context. However the model lacked explanative texture in the area of cultural elements. Later work by Helmreich & Merritt (1998) incorporated the elements of Power Distance (PD), Individualism-Collectivism, Uncertainty Avoidance, and Masculinity-Femininity from research by Hofstede (1980; 1991) to further expand the concept of culture as a force impacting on flight crew performance. Research by Helmreich & Merritt (1998) provided insight in to several areas of the cultural equation. They identified that organisational culture could be either ‘Discordant,’ elements of an organisation being divided and uncoordinated resulting in poor outcomes (Helmreich & Merritt, 1998 p. 122). Or organisations could have an ‘Integrated’ organisational culture leading to enhanced outcomes (Helmreich & Merritt, 1998 p. 123). This research also identified that all national cultures had elements of positive and negative behaviours that impacted on both safety and efficiency. Gladwell (2008) further expanded the aspect of PD as a causal factor in aircraft accidents in his work on the ethnic basis to aircraft accidents. This research identified that cultural issues were not contained within the flight deck but included external resources.

A considerable body of research has already been conducted on culture as it impacts on the aviation industry this work, however is incomplete. The research to date has expanded from early research simply considering culture to be focused on communication. However culture in aviation is all pervasive as it is in other settings. The research reviewed has focused on either accident or incident investigation, or on work attitudes. While this focus has identified that culture has an impact on flight crew performance it has not provided a useful link between cultural imperatives and specific behaviours on the flight deck. Additional research is needed to provide that link and practical tools for flight crew and other aviation stake holders to improve safety and efficiency by addressing the effect of culture on flight deck management.

3.5 Research Method

The preliminary study consisted of three parts. The first two components were a study on a mono-cultural Chinese airline (Airline B) using general observation (see 3.5.1 below) and data collected with the use of a data collection instrument. The third section of the study compared data collected on the Chinese airline with the results of a Line Operations Safety Audit (LOSA) conducted by a mono-cultural Anglo-European airline (Airline A). The research tool consisted of data collection sheets and was based on the LOSA methodology. LOSA methodology utilises observations made during line flight operations, in this instance observation of a mono-cultural Chinese airline. A direct observation method such as LOSA is considered to be a reliable method of studying behaviour and has been used as a method for studying performance in the airline, shipping, space and medical industries (Helmreich and Merritt, 1998). By using a data collection instrument auditors and researchers can observe and record performance in targeted behavioural skills. In an aviation setting manipulative skills, communication, leadership, management skills and general knowledge as well as safety practices interface with automation, learning styles and human relationships are all behaviours that can be observed and 'targeted' with a 'data collection instrument'. The instrument used in this study was based on the behavioural markers developed by the University of Texas for use with LOSA audits and endorsed by ICAO (ICAO Doc 9803, 2002). Using a modified Leichardt scale, these markers formed the basis for the behavioural and operational observations in this section of the study. This aspect of the research is further expanded in section 3.5.2 below. The data collected during these observations was then compared, where possible, with LOSA data collected on a mono-cultural Anglo-European airline as discussed in sections 3.6 and 3.7.2 below.

3.5.1. General Observation

The data collected for the purposes of the first component of the preliminary study is largely based on the direct observation of and interaction with, line crews operating on the flight deck. Direct observation is generally considered to be one of the most reliable methods of studying behaviour. As previously discussed this is the traditional method used in studying crew performance in the Airline, Shipping, Space and Medical industries to name but a few (Helmreich & Merritt, 1998).

Many sociologists believe that the best method by which to avoid the conflict between what are considered cultural traits and those considered individual traits is to observe participants during group interaction. It is further recommended that this interaction be observed in real life scenarios as opposed to simulation. This ensures that the group's reactions are instinctive with minimal impact made by the presence of the observer (Douglas, 1978; Lemke, 1995; Eysenck, 2004). This kind of participant observation is known as 'subjective sociology' because the researcher seeks to understand the social environment from the subject's perspective (Hammersley & Gomm, 1997; Smith, 2010; Volecstein, 2012). When using subjective sociology as a research method the researcher must enter the world of the subjects they are observing either openly or secretly. This is a very useful method for studying people and developing an understanding of the motives and meanings of people's behaviour through actually experiencing events in the way in which they themselves experience them. The value of this type of research is further supported by McBride and Schostak (1995) in their dissertation on qualitative verses quantitative research as can be seen by the following quote: 'We have found that initial hypotheses tend to be poorly informed and that after a period of immersion in a situation the researcher is better able to draw hypotheses [mature hypotheses] which emerge from experience in a setting' (p.2).

Line operations observation and participation took place over a two year period after obtaining a contract with an aircraft manufacturer to provide flight operations support to a Chinese airline under a line assistance project. The observations were made while flying as a captain operating in line operations on both domestic and international flights with both Chinese captains and first officers.

3.5.2. Data Collection Considerations

The line assistance project pilots were asked to act as observers and complete a number of data collection forms over a period of several months. This raw data was then discussed at data verification meetings to ensure that the scores recorded were of a consistent enough standard to present an accurate representation of the situation. These results were later compared where possible with parallel data from other sources.

When developing the data collection sheet there were a number of competing considerations:

1. To protect the individuals being studied.
2. Obtain valid data.
3. Ensure that this study was not seen to be a defacto LOSA audit.
4. Accomplish the above with very limited resources.

3.5.3 Ethical Approval

An ethical scope check was conducted using the Griffith University ethical scope check on line program. The result of this check was that ethics approval was not required. Appendix A contains a copy of this ethics scope check. Appendices B, C & D contain copies of other relevant letters of approval and Appendix E contains a copy of the data collection sheet developed for the study.

3.6 Methodology Comparison

Line Operations Safety Audits (LOSA) are an industry-accepted scientifically-based proactive safety measure used to capture data concerning CRM and Threat and Error Management (TEM) effectiveness (Klinect, 2005). The data for this study was collected on a similar basis to that used by LOSA and a comparison of the two methods appears below. LOSA data is collected and collated under the following precepts:

1. Using jump seat observations of line flights.
2. With voluntary flight crew participation.
3. Anonymous, confidential and non-punitive collection and use of data.
4. Joint management and union endorsement.
5. Secure data storage.
6. Use of trusted and trained observers.
7. Use of a systematic observation instrument.
8. Data verification discussions.

9. Data-derived targets for enhancement.

10. Feedback of results to line pilots. (Klinect, 2005)

The data for this study has been largely collected under the same precepts with a few variations due to available resources, operational constraints and with the understanding that this was not intended to be a LOSA audit therefore there was no requirement for the feedback of the findings to the line pilots. In general:

1. The flights observed were all line flights however due to operational constraints, while every effort was made to use jump-seat observations, observations from both jump-seats and control seats are included in the data. However the two sets of results could have been separated if any inconsistencies were found.

2. Flight crew participation was on a voluntary basis only.

3. The names of crew members being observed were not recorded. Flight numbers and dates were recorded but are not available to any individual outside the three observers. The captain's names that were recorded related to the observer's name not the crew being observed and again this information is not available to third parties.

4. The data was collected with the consent of airline management. There are no unions in China thus union consent was not possible.

5. All raw data collected is securely stored on hard copy only.

6. The observers were three of the project pilots each with approximately 20,000 hours flight time, training experience and acknowledged by the Chinese authorities as foreign experts.

7. The data collection sheet is, by its nature, a systematic observation instrument.

8. Throughout the data collection process there were observer meetings to verify the collected data and ensure its consistency.

9. Data-derived targets for enhancement and the feedback of results to line pilots. Items 9 and 10 of the previous list (Klinect, 2005) were not considered to be of relevance to this data collection exercise. The purpose of the data collection exercise for this study was to collect some empirical evidence to support or repudiate the hypothesis that culture has an impact on flight deck management and if supported, to identify and develop a question data base for the main study for this thesis. The purpose was not to audit in the traditional sense though it is impossible not to include assessments on aspects of safety, TEM and CRM as these concepts underpin all flight operations.

Due to the desire to show that the data collection was not a defacto LOSA audit the data collection forms used in this study differed slightly from the standard LOSA forms. The significant differences are that the Threats and Errors are presented in a different format to that typically used by LOSA. Performance is recorded as a score out of five, as used by Merritt (Helmreich & Merritt, 1998) and as set out in the Australian Civil Aviation Advisory Publication Draft CAAP SMS-3(0) November 2008 table 3.4, instead of the four used by the LOSA collaboration.

Figure 3.2 below sets out the behavioural markers as developed by the University of Texas at Austin and endorsed by the International Civil Aviation Organisation for use in LOSA audits.

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Figure 3.2: UTS Behavioural Markers

Source: Klampfer *et al*. (2001, p.23); Flin *et al.* (2008, p.271)

Note: Key to Phases. P=Pre-departure/Taxi; T=Takeoff/Climb; D=Descent/Approach/Land; G=Global.

The markers listed above are used in Line Operations Safety Audits and non-jeopardy observations of crews conducting normal line flights. Each of these markers has been validated as relating to either threat and error avoidance or management. With the exception of two global ratings, specific markers are rated (if observed) during particular phases of flight according to the scale shown in Figure 3.3 (9th Generation data collection instrument in Klampfer *et al*, 2001, p.23).

Figure 3.3 below sets out the behavioural markers rating scale as developed by the University of Texas at Austin and endorsed by the International Civil Aviation Organisation for use in LOSA audits.

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Figure 3.3: UTS Behavioural Markers Scale Ratings

Source: Klampfer *et al*. (2001, p.23)

Figure 3.4 below shows Non-Technical behavioural marker categories, elements and example behaviours, followed (in Figure 3.5) by the rating scale in Klampfer *et al*. (2001) and used in CAAP SMS-3(0) (2008, p.34).

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Figure 3.4: Non-Technical Skills Behavioural Markers

Source: Klampfer *et al*. (2001, p.26)

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Figure 3.5: Rating Scale

Source: Klampfer *et al*. (2001, p.26)

Although the data collection sheet used in this study is not identical to the LOSA forms it covers areas related to similar behavioural markers. As these markers are operationally specific it is believed that cultural bias has been minimised and that it is possible to compare and bench mark some data collected on the data collection sheets with some data presented a third party LOSA report.

3.7 Data collection instrument and rating scale

The data collection instrument used in this study as previously discussed was not identical to the UTS, LOSA - non-technical skills markers form; however it does record and rate the same behavioural markers in a similar manner. The data collection instrument also used a modified five point Leichardt scale for rating performance as described in CAAP SMS – 3 – (0) (2008). The markers on the data collection instrument were designed to be operationally specific, this being the case any cultural bias should have been of minimal impact allowing for the comparison and benchmarking of the data collected in this study with data collected by third party LOSA reports.

3.7.1 Description of the Data Collection Instrument

The data collection instrument contains six sections. Firstly, there is a section allowing for the recording of background information relating to the observer, date, flight number and observer's name. This information was later separated from the flight observation data at the data verification meetings. Sections two to six recorded information pertinent to the flight observation. Section two recorded information relating to the crew, their flight and duty hours, and their fatigue level. Section three rated the crew's proficiency in the area of Minimum Equipment List use and Performance calculation. Section four recorded the crew's performance in regards to aspects of Crew Resource Management. Section five dealt with areas of Flight Deck Management and section six recorded ratings covering the crew's performance and adherence to Stand Operating Procedures.

The observers were presented with clear rating guide lines that covered each targeted behaviour. For example, the section covering Flight Deck Management behaviour in response to an unexpected event would record a rating recorded from one to five depending on an observation meeting the following guide lines: a rating of one is recorded if the crew had not reacted or remained completely frozen in the case of an unanticipated failure or other event; a two is recorded if the crew had rushed procedures in the event of a technical fault, for example an ECAM procedure being commenced prior to 400ft Above Ground Level after takeoff; three is applicable in the event that the crew acted without a full evaluation of the aircraft's flight path and other environmental considerations; a rating of four is recorded if the flight path and threat had been correctly managed however some minor lapse in communication, monitoring or other management function had been observed; finally the maximum rating of five is recorded if the initial threat situation had been stabilised, flight path analysed with additional threats considered and accounted for in consultation with other crew members and then remedial actions taken. A copy of the data collection instrument and the rating guidelines applicable for each section are contained in Appendix E.

3.7.2 Data Comparison

Data collected from this study was compared with data collected by a third party LOSA audit in order to assist in highlighting the areas where cultural issues may exist and to provide an informative basis for the questions used in the subsequent phenomenological study that forms the second part of the research conducted for this thesis.

After reviewing a wide-body fleet LOSA report from an Anglo-European Airline, it was determined that although significant differences between the data collected by the LOSA audit and the first study were identified, there were still areas where meaningful comparisons could be made. It is acknowledged that while the data for both reports was collected under a similar precept—direct observation on the flight deck—there are differences in both methodology and presentation. The data collected in the LOSA report is based on a threat and error response model with Undesired Aircraft States

(UAS) also being recorded while the data collected for this study was based on a crew performance model. The data can however be compared in similar areas by looking at the ratios of threat, error or UAS events recorded as compared to those recorded as mismanaged. A mismanaged event would be considered as having been dealt with in an unacceptable manner. In the crew performance model used in the data collection exercise a score of 2 or below would be considered to be below an acceptable standard. To better understand the methodology behind the LOSA report used for comparison with the study for this thesis, a copy of definitions and terms used in Airline A's LOSA report appears below:

Threat

A threat is defined as an event or error that occurs outside the influence of the flight crew—that is not caused by the flight crew—increases the operational complexity and requires Flight Crew attention and management if safety margins are to be maintained.

Error

An error is defined as an action or inaction that leads to a deviation from crew member or organisational intentions or expectations. Errors in the operational context tend to reduce the margin of safety and increase the probability of operational consequences.

Managed/Mismanaged

The classification of managed or mismanaged, as applied to threats and errors, refers to outcome. Where a threat or error is classified as mismanaged, it means that the outcome has not met Company expectations in relation to the maintenance of safety margins.

This does not necessarily mean that the crew was at fault, as they may not have had the opportunity to manage the threat or error in such a way as to meet these expectations.

Threats and errors that have been classified as mismanaged may be further classified as inconsequential or consequential. To be classified as consequential, a threat or error must have led to either another error or a UAS (Airline A, 2006, p.7).

A further difficulty faced when attempting to compare the two data sets was that the LOSA report rated crew performance as Well Above Company Standard, Company Standard, Below Company Standard and finally Well Below Company Standard. As may be recalled the data collected for this study was scored from one to five with five being the highest score and one the lowest. With this in mind a score of three was considered to be the minimum internationally expected standard for each marker while a score of four represented a solid but not remarkable standard. For the purposes of data collected during this study, scores of three and four were deemed to be equivalent to the LOSA report score of Company Standard. A score of five is considered to be equivalent to Well Above Company Standard, a score of two to be Below Company Standard and a score of one to be Well Below Company Standard.

3.8 Other Considerations for Observationally Based Data Collection

When undertaking any field research in a cultural context the very nature of the study can give rise to various forms of bias, whether due to human error, misinterpretation or because of a bias arising from the methodology of the study itself. These various forms of bias can lead to the contamination of the data collected. This chapter is included so as to show the processes by which bias has been minimised in order to avoid data contamination in general and cultural bias in particular.

3.8.1 Bias in Social Research

Bias in social research can have many meanings. Hammersley and Gomm (1997) suggest that the term bias in this context is used in three main ways. Firstly they consider that bias is used when a one sided accentuation of data is used to present an idea of reality that is not consistent with reality as it truly is. Data presented in this fashion is often used to justify prejudicial views either on the part of the researcher or on the part of a sponsor. This form of bias results in very negative outcomes. Secondly bias can sometimes be seen to be a positive feature in the sense that bias can be used to highlight observations which might otherwise be overlooked. The third sense of the term bias, the term most commonly used, refers to any systematic variation from validity or deviation from research standard practice that unintentionally produces erroneous results.

All three of these bias types have been taken into consideration when preparing the methodology of this research and endeavours have been taken to reduce their impact upon the data collected. However it must be acknowledged that as the data collection sheet was developed by the researcher of Anglo-European heritage and the observers were also of Anglo-European background, the study may have a Western bias. However the researcher is of the opinion that even if this is the case, the data would not be invalidated because it is the differences that are observed during this study that are important in this thesis, not the judgemental aspects that could be attributed to the data in other contexts.

3.8.2 Observer and Rater Bias

In an effort to minimise the effect of observer and rater bias we have used qualitative data validated in a quantitative fashion. This type of data collection has a long history of use within the aviation industry since both types of data are considered important and complementary in presenting an appreciation of operational safety. Quantitative data presents behaviour in a statistical fashion and qualitative data is required to attempt an understanding of those statistics (McBride & Schostak, 1995). LOSA, as conducted by many airline safety departments and developed by the University of Texas at Austin, uses such a method, including the use of the behavioural markers that are contained within Figure 3.2.

3.8.3 Reliability and Validity of Participant Observation

There can be issues with the reliability of research data collected by the method used in this research. Because of the nature of these studies it is impossible to repeat the exact scenario that has been observed therefore it is impossible to identically repeat the data collection (Ritter, 2013). Each observation eminates from a single observer and as such may be interpreted differently by a different researcher. Other issues to be considered include consistency, precision, reliability, and validity (Ritter, 2013). There is a further problem known as 'observer effect' encountered when people who know that they are being studied change the way that they would normally behave (Mitchell & Jolley, 2012). While the use of multiple data sources and raters should have minimised the effects of these issues, the competency of the observers themselves to make valid observations needs to be considered under the category of observer or rater control.

3.8.4 Rater Control

The data collection sheets were completed by three line assistance project pilots, myself included. All three were of an Anglo-European background, two employed by an Anglo airline and one previously employed by a European airline. All three pilots were experienced wide body captains with flight hours ranging from 18,500 to 23,200 hours total flight time each providing a mean flight time of 20,666 hours with a standard deviation of 2,371 hours. In addition to this general flying experience all had previous experience as flight instructors.

In the course of the line operations assistance project all the project pilots participated in cultural awareness and cultural interaction seminars conducted by Airbus. In addition to these seminars they spent many hours as a group discussing daily operational experiences. During the data collection exercise the three observers compared and discussed the data collected to ensure that the rating guidelines were valid and adhered to with a high degree of consistency and accuracy. The observers were highly experienced, well-qualified captains considered by the Chinese authorities to be foreign experts able to give expert comments and opinions on operational matters.

3.9 Summary

This chapter discussed the initial approach made to study the effects of culture on flight crew performance. The chapter considered the relevance of the subject matter to the aviation industry as cultural imperatives may impact on both safety and operational efficiency as observed in other settings (Trompenaars, 1993; Scherer & Brosch, 2009). The study used a methodology centred on the use of direct observation of targeted flight crew behavioural markers to record and compare flight crew behaviours in two airlines, one a Chinese airline and the other Anglo-European. The data collection instrument itself and its validity were discussed. To this end a comparison between the process used in this study and another industry-accepted observational audit process was made. Consideration was given to avoiding cultural bias and data contamination and aspects relating to data comparison between this study and a third party LOSA were also discussed.

Chapter 4

Findings from the Preliminary Study

4.1 Introduction

Chapters 1 and 2 established the background and context for the studies that form the research components of this thesis. From these chapters two concepts were discussed as being central to this thesis. In a broad sense ‘culture’ could be considered from two perspectives, (physical appearance) a racial identity and (social identification) a cultural identity. For this thesis culture has been considered as being a social identification consisting of behaviour that is learned from and shared amongst people from a common cultural group. The second concept central to this thesis was that previous research had shown that SA was an essential element in the flight deck management process being integral in the decision making process. In this role SA was enabled and supported by other elements aviation knowledge, crew management and communication skills.

Chapter 3 discussed the preliminary study for this thesis from a number of perspectives. Firstly the discussion developed the argument that the subject matter was relevant to the aviation industry in that cultural imperatives may have an impact on both safety and operational efficiency. Secondly the study methodology was considered. Further discussion centred on the data collection instrument itself and its validity.

Chapter 4 presents the findings from the preliminary study. These findings include the comparison of the results of the study of Airline B with results from the LOSA report of Airline A. There is also a description of how this comparison highlighted the operational areas open to investigation and assisted with question development for the Phenomenological study that forms the main study for this thesis.

4.2 Results

The data collection process for the preliminary study took place over 48 line flights with a Chinese airline. As can be seen in Table 4.1 below some behavioural markers were not rated on all sectors. This was due to the high workload and dynamic nature of the operations preventing the observers from being able to observe and record every aspect of the operation on all flights. The raw data was recorded on the data collection sheets (Appendix E) and subsequently discussed at data verification meetings to ensure that the observers were rating observed behaviours in a consistent manner.

These results are presented in Table 4.1 below. The first column of the table contains the behavioural marker. The next five columns contain the frequency with which each rating was recorded and in the final column the total number of observations for each marker is noted. In this column it can be seen that while 48 observation flights were conducted, some behaviours were unable to have a rating recorded on all flights. In these cases a number less than 48 occurs representing the total number of observations where that behavioural marker was recorded.

Table 4.1: Data Collection **Results** (Chinese Airline)

Marker	Rating and Frequency					
	1	2	3	4	5	Total
MEL & Performance						
MEL Used	Yes = 5; No = 43					48
Procedure Followed	3	6	5	4	2	20
Performance Knowledge	8	16	6	13	2	45
Language Differences						
MEL	2 instances of minor translation differences observed					
VOL 2	No translation differences observed					
CRM						
Knowledge	2	24	12	9	1	48
Takes responsibility		7	24	15	2	48
Appropriate level of support	6	9	15	12	6	48
Resistance to time pressure	17	15	7	5	4	48
Flight Deck Management						
Unexpected Events	6	13	15	14		48
Error Management	6	13	15	13	1	48
Cabin Awareness	13	10	17	7		47
Fuel Conservation	16	12	13	7		48
Commercial Awareness	11	13	18	5	1	48
Noise Sensitivity	12	17	10	8	1	48
Refers to Flight Documentation	4	15	17	10	2	48
SOPs						
Taxi Speed	7	12	3	21	5	48
FMA	4	11	15	15	3	48
FMGEC	2	7	16	18	5	48
Standard Call Outs	4	18	16	8	2	48
Check List Use	5	18	9	12	4	48
Task Sharing	10	10	13	12	2	47
Dual Inputs	Yes = 10; No = 38					48
Task Sequencing	10	9	13	15	1	48
Paper Work	3	2	22	18	3	48

4.2.1 Data analysis

As discussed in Chapter 3 a score of three was considered the minimum internationally accepted standard for flight crew performance for each behavioural marker. Table 4.1 shows that there were six behavioural markers—Performance Knowledge, CRM Knowledge, Resistance to Time Pressure, Fuel Conservation, Commercial Awareness, and Noise Sensitivity—where 50% or more of the crews observed did not meet the internationally expected standard as rated by the observers. There were an additional nine areas—Performance Knowledge, Management of Unexpected Events, Error Management, Cabin Awareness, Taxi Speed, Standard Call Outs, Check List Use, Task Sharing, and Task Sequencing—where the crews were observed to perform poorly. Without a fully complementary study being completed on an Anglo-European airline this data, while indicative, is not conclusive. There may be many contributing factors leading to the poor performances observed including language skills, low experience levels and abnormal subject behaviour due to the presence of the observer. However with such high rates of poor performance being recorded in the targeted behaviours, the researcher concluded that the data collected could at least be used to refine the research direction and inform the basis for the question data bank for the phenomenological study conducted as main study for this thesis.

4.3 Description of Compatible Data.

In order to further refine the research to be conducted in the main study a comparison of the results of the preliminary study and the results of the LOSA report of an Anglo-European airline (Airline A) was made. The mechanics of this comparison were presented in Chapter 3 and while it was acknowledged that there were significant differences between the two processes and the presentation of data, a meaningful comparison was still possible. The data collected in the LOSA report is based on a threat and error response model with Undesired Aircraft States (UAS) also being recorded, while the research data collected on the Chinese airline (Airline B) was based on a crew performance model. The data can be compared in similar areas by looking at the ratios of threat, error or UAS events recorded. Those events were recorded as a mismanaged event in the LOSA data. A mismanaged event is considered as having been dealt with in manner that is below the acceptable standard. In the crew performance model used in the data collection exercise for the preliminary study, a score of two or below is considered to be below an acceptable standard.

4.4 Data Comparisons

Threats and Responses

It was possible to compare data in two threat and response areas covering four specific markers. The results of the data comparison for the first threat and response area—the pre-departure phase of the flight—had two complementary markers which were able to be compared: (a) a maintenance or similar aircraft-related procedural event and (b) pre-departure paper work. The second threat and response area related to operational threats where two comparable behavioural markers allowed for comparison of flight crew responses to threats created by: (a) time pressure and (b) ATC instructions. In all cases the events observed could have a crew management response that was considered to be either a) appropriate for the situation (indicating that the event had been managed, giving a score of three or above) or b) inappropriate for the situation (indicating that it had been mismanaged, giving a score of two or below).

1. **Crew Support Threats.**

    a. In Table 4.2 below a comparison between the recorded data of Airline A and B in the area of crew support threats created by maintenance or similar aircraft related procedural events is presented. These crew support threats occurred during the pre-flight phase and were related to threats created by a maintenance issue leading to a potential delay, or the application of a procedure due to an MEL item, or a similar event that could lead to an increase in work load for the operating crew. In this situation the event could either be dealt with by the crew in an appropriate manner, indicating that it had been 'managed' (a score of three or above), or alternatively if the event was poorly handled it was considered to have been 'mismanaged' (a score of two or below).

Table 4.2: Maintenance or Similar Aircraft Related Procedural Event

EVENT	TOTAL	MISMANAGED	
Maintenance event – MEL, CDL etc.	20	2	Anglo-European Airline
MEL and Performance/ Procedure Followed	20	9	Chinese Airline

    b. In Table 4.3 below threats presented by incomplete or inaccurate paper work related to flight operations have been considered. The comparison considers paper work over the complete flight duty including the pre-flight, flight and the post-flight phases. Items observed included Notices to Airmen

(NOTAMS), flight plans, load sheets, passenger, cargo and dangerous goods manifests as well as chart use. Mismanaged events in this area could occur as a result of incorrect or incomplete paperwork being presented to the crew and the crew failing to have a correction applied or in-flight or post-flight documentation being incorrect or incomplete.

Table 4.3: Paper Work

EVENT	TOTAL	MISMANAGED	
Dispatch/paperwork error or event	22	2	Anglo-European Airline
Paper Work	48	5	Chinese Airline

2. Operational Threats.

a. Table 4.4 below presents the comparison of data recorded for airlines A and B with regards to crew response to the threats created due to time pressure. Time pressure issues are created due to pre-flight and in-flight delays affecting metrics such as on-time performance or limitations such as the crew's maximum flight or duty time limitations. Time pressure may also be created by curfew restrictions imposed at either departure or destination airports. Time pressure is considered to be mismanaged when crews are observed to rush procedures to the point where required actions are either missed or deliberately omitted.

Table 4.4: Time Pressure

EVENT	TOTAL	MISMANAGED	
Operational Time Pressure	14	0	Anglo-European Airline
Resistance to Time Pressure	48	32	Chinese Airline

b. Table 4.5 below presents a comparison of mismanaged crew responses relating to threats created by ATC instructions, for example late changes to clearances, speed control, altitude constraints or heading requests.

Table 4.5: Threats Created by ATC Instructions

EVENT	TOTAL	MISMANAGED	
ATC Command	15	3	Anglo-European Airline
Unexpected Event	48	19	Chinese Airline

Errors and Responses.

It was also possible to compare data from Airline A and B in two error and response areas: (a) check list use; and (b) pushback or taxi error. As discussed above the crew management response was considered by the observers to be either appropriate for the situation indicating that the event had been managed (a score of three or above) or inappropriate for the situation indicating that the event was considered to have been mismanaged (a score of 2 or below).

a. Table 4.6 below presents a data comparison for error and response related to check list use. Data collected for this metric relate to appropriate use of all checklists used in the course of a flight under observation either normal or non-normal as dictated by circumstance. Checklists were considered to be mismanaged when a) the wrong check list was used or the items were incorrectly actioned or b) the challenge item was incorrectly called or the response was incorrect.

Table 4.6: Check list Use

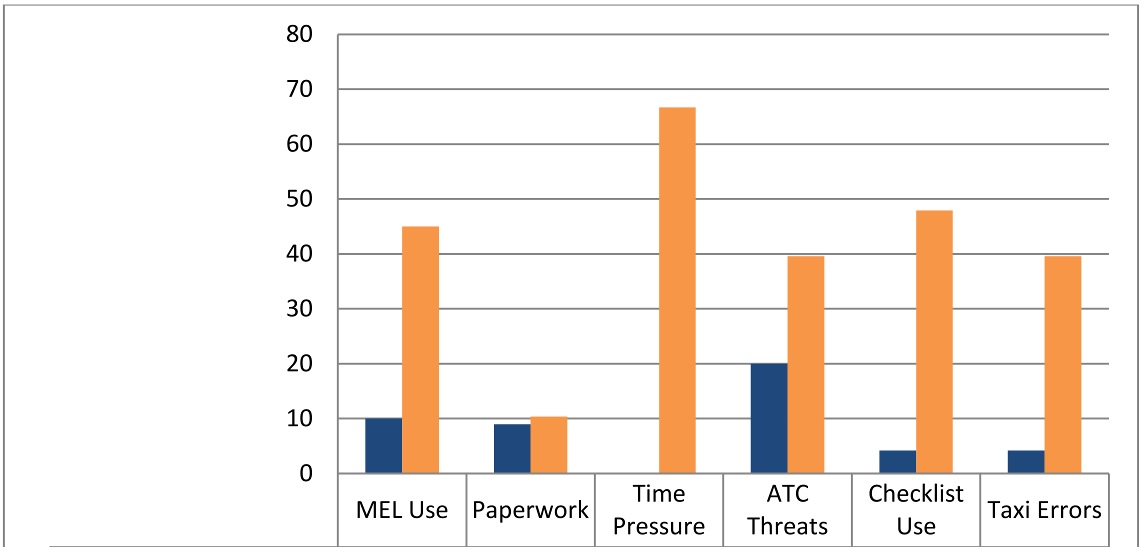
EVENT	TOTAL	MISMANAGED	
Checklist Error	48	2	Anglo-European Airline
Checklist Use	48	23	Chinese Airline

b. Table 4.7 below shows a comparison between Airline A and B in relation to errors observed during pushback and taxi procedures. The most prevalent error observed during ground operations of aircraft related to excessive aircraft taxi speeds. This excessive speed could have been related to either the maximum speed allowed under the company operations manual or a lower speed as dictated by operational conditions.

Table 4.7: Pushback, Taxi Error

EVENT	TOTAL	MISMANAGED	
Pushback, Taxi-in Taxi-out error	48	2	Anglo-European Airline
Taxi Speed	48	19	Chinese Airline

The tabulated data recorded above has been combined and is presented in Figure 4.1 below in a graph format. The data is presented as a comparison between the number of mismanaged events occurring during flight in each airline as a percentage of total flights.



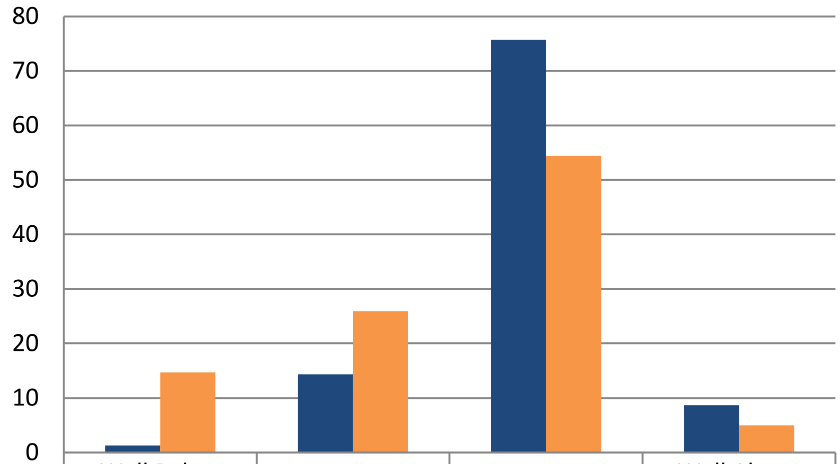
	MEL Use	Paperwork	Time Pressure	ATC Threats	Checklist Use	Taxi Errors
Anglo-European Airline	10	9	0	20	4.2	4.2
Chinese Airline	45	10.4	66.7	39.6	47.9	39.6

Figure 4.1: Percentage of Mismanaged Threats and Errors

4.5 Crew Performance Rating.

Airline A's LOSA report contains data concerning a rating to cover each observed flight crew member's performance with regard to their contribution to the overall crew performance. On a macro level the data presented in this area covers observed behaviours of crew performance and can therefore be compared to the overall totals as scored in the data collected with Airline B. The basis for this comparison was previously discussed in Chapter 3.

In Figure 4.2 below the overall crew performance ratings of Airline A and B are compared. This data has been presented in bar graph format as a percentage.



	Well Below Company Standard	Below Company Standard	Company Standard	Well Above Company Standard
Anglo-European Airline	1.3	14.3	75.7	8.7
Chinese Airline	14.7	25.9	54.4	5

Figure 4.2: Crew Performance Ratings as a Percentage

4.6 Discussion

As discussed previously, both data sets were collected under different methodologies however a comparison of the data was possible under the process previously discussed in both this chapter and Chapter Three. The significant variation in flight crew performance presented in the data collected in this preliminary study while having limitations did never the less present a compelling case for further research, hence the phenomenological study that forms the second study for this thesis.

The flight deck observations made in China when compared with the results of a LOSA audit conducted on an Anglo-European airline revealed the following: (1) MEL / Performance calculations were mismanaged seven times more frequently by the Chinese crews; (2) Operational threats and time pressure threats were mismanaged 10 times more frequently by Chinese crews; (3) ATC threats were mismanaged three times more frequently by Chinese crews; (4) Checklist errors occurred at 19 times the rate for Chinese crews as occurred for Anglo-European crews; and finally (5) Excessive taxi speed was recorded 7 times as frequently with Chinese crews as was the case for Anglo European crews. The data - though inconclusive - did suggest that there were differences in operational practices and standards between the Anglo-European crews and the Chinese crews. To what extent these differences were related to experience, training, communication and culture remained an unanswered question.

In considering how best to address this question, the research by Redding and Ogilvie (1984) and Mjos (2004) (Chapter 3) was revisited and a new model based on their work was developed to better depict the influence of culture and training on the flight deck management process. In this model (Figure 4.3 below) it can be seen that operational outcomes are dependent on the crew's abilities and orientation in many areas. The first element depicted relates to their implicit knowledge and behavioural framework. This element was seen to be dependent on a crew member's national or regional culture acting together with their social status and general education. In the second element, the operational environment, a crew's abilities were considered to depend on professional and corporate culture together with professional training and development. The next element, operational performance, was considered to have a foundation in both the crew's implicit knowledge and their behavioural and operational environments, and was further developed with operationally specific training and affected by personal variables and communication skills. The final operational outcome is then dependent on the interaction of all three elements – the implicit knowledge and behavioural framework, the operational environment, and operational performance.

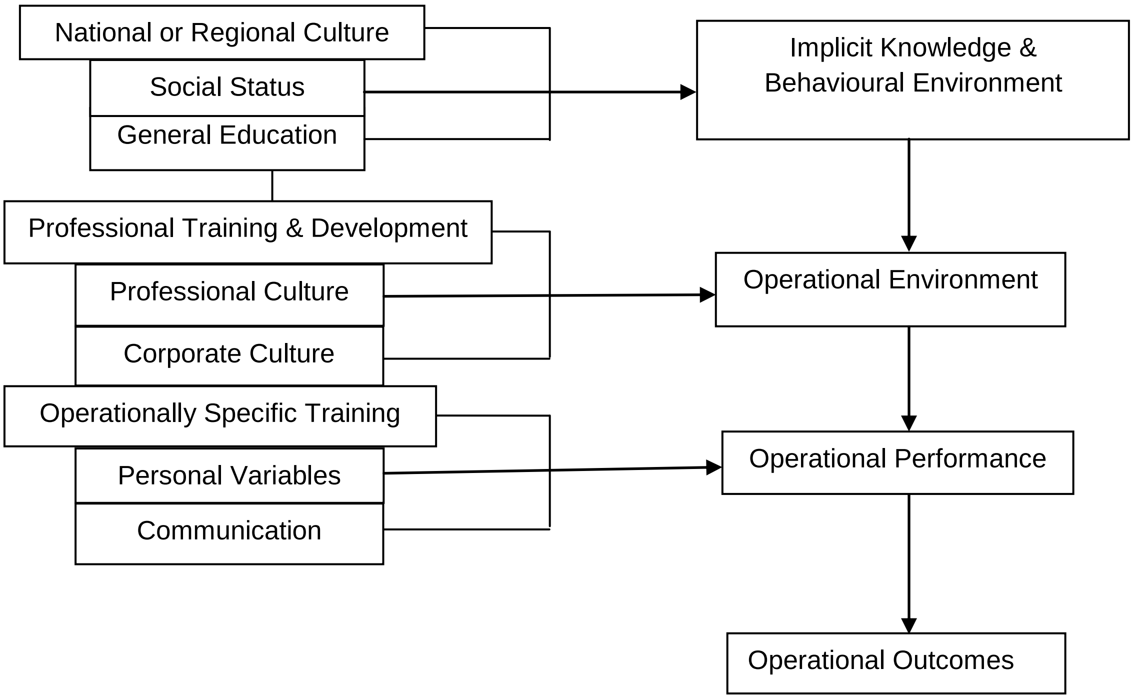


Figure 4.3: Factors Leading to Operational Outcomes

When this model was combined with research findings from Mavin & Roth (in press) the research in the main study for this thesis was able to be further refined with questions being confined to just five key areas. From the research conducted by Mavin (2013) it was determined that safe and efficient flights were achieved when flight crew recognised that the essential outcomes of the aircraft being flown within tolerance with decisions having been made commensurate of risk was made possible by having a high standard of SA, and that SA was supported and enabled through having a high degree of aviation knowledge, and good skills in both crew management and communication (Mavin, 2013).

This first study supported Mavin’s views as both direct observation and the data collection sheets revealed that the areas of inquiry for the phenomenological study should concentrate on the key performance areas of;

1. Situational Awareness
2. Flight control competence (Stick and rudder skills)
3. Communication skills
4. Aviation knowledge
5. Flight crew management including, team building and workload management

4.7 Summary

This chapter discussed the results of the preliminary study performed in the course of this study in to the effects of culture on flight deck management. This initial comparative study provided the researcher with valuable observations and comparisons between the Chinese airline and the Anglo-European airline. This study also provided insight allowing the research question for the main study of this thesis to be refined. Due to differences in data collection methodologies and result presentation there are acknowledged validity issues with the study however the results from the preliminary study presented compelling evidence that there were cultural elements evident in the flight deck management process that were worthy of further examination. These observations and comparisons also led to the development of a model describing the factors leading to operational outcomes (Figure 4.3). Following a review of the results of this study and that of Mavin (2013) a refined research criteria was developed for the phenomenological study that forms the main study of this thesis.

Chapter 5

A case for Social Constructionism in Aviation Safety and Human Performance Research.

Most of the contents of this chapter have been previously published as:

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A case for social constructionism in aviation safety and human performance research.

Aeronautica Vol 2, Issue 1, 20:06:2012, p.1-12.

5.1 Introduction and abstract

In chapters 3 and 4 the preliminary study conducted for this thesis was discussed. Chapter 3 described how the subject matter was relevant to the aviation industry with reference to both aviation safety and operational efficiency. The methodology as used in the preliminary study was also considered. In chapter 4 the data results and comparisons were discussed. This process led to a more refined and focused criteria for a further study to determine the impact of culture and its influence on the flight deck management processes. Having established the criteria for further study consideration as to an appropriate methodology for this research was needed.

This chapter outlines the use of both quantitative and qualitative research methodologies in organisational research as applied in the aviation environment. Aviation safety and human performance research, with its largely observation-based methodology and life-critical outcomes, is a research area where research quality could be considered to be more important than the academic argument over purity of the research methodology applied (Panda & Gupta, 2013). Though the desire for high quality research should always be the underlying principle in methodology selection, it appears that one research approach is more prevalent.

Quantitative research methodology has been, and continues to be, the preferred research methodology under which aviation research is conducted. With its grounding in the natural sciences, this methodology is a logical choice for research in an industry based in a highly evolved technical environment. From a historical perspective, early aviation research topics revolved around subjects with a basis in physics, chemistry, engineering and biology. These subjects naturally lend themselves to the analytical and empirical nature of quantitative research methodology, underpinned by a positivistic epistemology, with positive substantiation of all enquiries essential for authentic research. While research in aviation continues unabated under the positivistic approach, the maturation of the aviation industry has resulted in an expansion of research topics to include areas related to human performance. It is in this field that numerous researchers have concluded that the use of quantitative processes alone may exhibit flaws due to the attempted removal of the human element in the research process.

The aviation environment is complex with a myriad cultural, organisational and technical interrelationships considered by many to be a human construct. As a human construct, it is logical that some research needs a qualitative element to add context and depth to research results. Logic dictates that there may be a legitimate role for research in this field to contain elements of both qualitative and quantitative methodologies. With this in mind it is time to consider qualitative research as founded in social constructionist theory.

5.2 Background to safety system and human performance research

Research centred on safety systems and human performance is a complicated and multi-faceted area of research, especially in the aviation arena. Research in this area must contend with environmental and organisational factors as well as interpersonal relationships and the human-machine interface, all of which impact on both safety and efficiency. The vast majority of aviation research is concentrated on the improvement of safety, thus there is a preference for research conducted from a positivistic perspective. This preference is largely driven by two factors, firstly, by regulatory and prudential desire for numerically driven metrics, and secondly by a perceived need for results that are seen to be free of subjectivity. The results of research conducted under the positivist approach are intended to be free of subjective interpretation and human interference. For these reasons positivism has been a prominent, even preferred, research methodology in many fields, especially when results are intended to support organisational policy or capital expenditure.

Alongside the desire for numerically based metrics and preference for research that is free of subjectivity, there is a recognised need for enhanced data, especially in the areas of interpersonal relationships, human-machine interface and risk assessment and mitigation (McCoy, 1988; Luxhøj, 2001). The recognition of this need underpins the growing requirement for the inclusion of some qualitative methodologies for research in the aviation field. Further support for qualitative research methods comes from Pope & Mays (1995, p. 43) who were of the opinion that ‘qualitative research can explore complex phenomena not amenable to quantitative research’ in that it ‘can reach aspects of complex behaviours, attitudes and interactions’.

For research to be relevant in a safety driven, complex and highly dynamic environment where human factors are acknowledged as a major structural element, it must be credible, transferable, dependable and confirmable. In order for research to meet these ideals, an appropriate methodology must be selected. The question is as always, how to determine the most suitable methodology. For research in aviation and related fields, it is postulated that the research question itself is the determinant factor in the selection of a research methodology and that the appropriate methodology is subservient to, and dependent on, the answers sought. The statistician Tukey (1962, p. 426) said that ‘an approximate answer to the right question’ is of more relevance than the ‘exact answer to the wrong question'. By looking at the question first, philosophical perspectives need to be considered prior to the selection of a methodology.

It has been suggested that researchers should look beyond a conventional and convenient mindset that recommends that if something can be counted or measured, then, in the interest of scientific credibility, a quantitative methodology should be used as this presents the path of least resistance. However research rigour may be better served by the use of alternative methodologies.

If aviation researchers were to consider alternative methodologies, it is logical that some decision guidance would be of assistance and to this end a model contained in Figure 5.1 has been included. This model considers the Epistemological Theories of Knowledge in a linear relationship with positivistic methodologies at one extreme and subjectivistic theory at the other end of the scale.

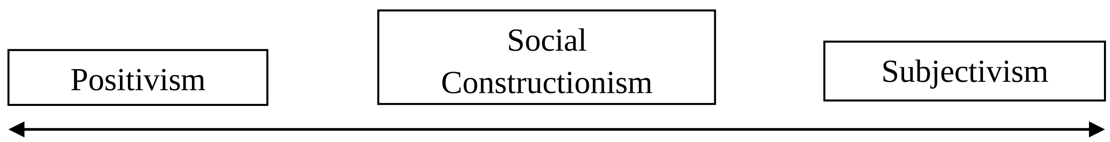

Figure 5.1: Epistemological Theories of Knowledge

Note: Adapted from Crotty (1998, p. 5; In Mavin, 2013, p. 51)

5.3 Competing Methodologies

A research methodology is in essence, the frame-work under which research is conducted. Crotty (1998) argues that methodology, as a means of gathering knowledge, is itself based on a branch of philosophy known as epistemology. Epistemology is defined as 'the theory of knowledge, especially with regard to its methods and validation' (Moore, 2004, p. 422). This branch of philosophy provides a linear scale with positivism as one extreme and subjectivism being the other. In this model positivism seeks knowledge through observation and experimentation with the complete removal of the human element (subjective interpretation). At the other end of the scale, subjectivism contends that there can be no objective results, as humanity imposes all meaning through societal and personal experience.

The middle ground in the model belongs to the area of social constructionism. Constructionist theories contend that in many research areas, observed phenomena are both objective and subjective, thus a relationship exists where meaning is dependent on experience.

5.4 Positivism

Positivism and its updated versions objectivism and critical rationalism are philosophies ideally suited to experimental research in the fields of natural science. It may be that the philosophical groundings for positivism gained significance with a group of scientific philosophers referred to as the 'Vienna Circle' (Uebel, 2011). The Vienna Circle proposed a theory of logical positivism founded on the basis that research results could be verified through determining the underlying meaning of a proposition (Uebel, 2011). For these reasons, positivism has been the predominant research methodology for some time within areas such as physics and mathematics with its influence extending to both medicine and psychology, where the research approach aims to provide an ‘assurance of unambiguous and accurate knowledge of the world’ (Crotty, 1998, p. 18). Positivistic philosophy contends that a stable, objective reality can be observed free of human interference and personal perception:

- Phenomena must be observable either directly or indirectly.
- Knowledge is developed through the accumulation of verifiable facts with findings presented as ‘laws’ with empirical tables.
- Hypotheses are developed from deductive scientific theories which are empirically tested, verifiable and repeatable.

Results are intended to be free of subjective interpretation (Devers, 1999). Critical rationalism adds the following dimensions:

- That which has been overlooked is not observable.
- The laws of Induction always apply, no number of favourable observations can prove a universal statement true but a single unfavourable observation is sufficient to repudiate it.
- A theory is accepted because it tells us something new but is made acceptable through the testing of its predictions (McFarlane, 1990).

5.5 Subjectivism

At the other end of the epistemological scale is subjectivism. Subjectivist theories maintain that knowledge can only come through human experience. This philosophical standpoint leads to the conclusion that there can be no such thing as objective truth (Crotty, 1998). While research conducted on purely subjective lines may have limited application in aviation, Drapeau (2002) suggests that subjectivity can assist with understanding of an object under investigation. This is due to the requirement of subjective methodologies to account for social and societal influences on data analysis, such as bias created by personal relationships, for example the relationship between mentor and student. From this, subjectivist research methodologies tend to rely on qualitative approaches, rejecting the view that research results can be obtained without human interference and interpretation.

5.6 Social Constructionism

As outlined, between the two extremes of positivism and subjectivism sits a branch of epistemology known as social constructionism. Social constructionist theories are seen as useful methodologies for social, organisational, and human performance research. Under constructionist theories, objects and subjects are not considered as separate entities. Social constructionism does not suggest that humans are responsible for all outcomes as in subjectivism, nor does it suggest that all research can be made completely free of human interpretation. Social constructionism does suggest that, in research where human activities are being studied, there is a relationship between the subjects and the objects under scrutiny, with individuals constructing meaning from their experiences and interactions (Crotty, 1998; Silverman, 2001). This in turn indicates that valid meanings can vary from person to person and even change within one person according to circumstance (Silverman, 2001).

It can already be envisaged that with the social constructionist realm lying as it does between two extremes, it is not in effect a single theory but a series of related yet quite different theories, giving rise to a variety of research methodologies reliant on qualitative processes. If constructionist theory is relevant for an area of inquiry, then the selection of a suitable research methodology is compounded by and dependent on, the question, data collection method, research goals and philosophical grounding of the project. Moustakas (1994) contends that there are five main human science research methodologies in the area of social constructionism: ethnography, grounded theory, hermeneutics, empirical phenomenological research and heuristic research, each sharing common qualities in that they:

- Recognise the value of qualitative designs and methodology.
- Have a holistic approach to research.
- Concentrate on the meaning and essence of the data collected rather than focusing on measurement and explanation.
- Obtain data from first-person accounts using both formal and informal methods.
- Consider behavioural research as underpinned by data that describes experience.
- Derive understanding and context from descriptive narrative.
- Reflect topics bound in the interests of the researcher.

- Consider that there is an integrated, interdependent relationships between experience, behaviour, subject and object. (Moustakas, 1994)

A brief description of the five main constructionist methodologies; ethnography, grounded theory, hermeneutics, empirical phenomenological, and heuristic, described by Moustakas (1994) follows below:

Ethnography is the direct observation of communication, interaction and activities within a closed group of individuals. Research under this model is presented as a cultural description. This methodology could be particularly useful in the aviation industry where airline crews, air traffic controllers and engineers form group associations unique to their profession and yet must collaborate with each other in a symbiotic relationship as dictated by operational requirements.

Grounded theory relies on an approach where initial data collection occurs prior to hypotheses and concept development. Research conducted under this method often benefits from the informed basis used to develop the final research hypotheses. It is possible that grounded theory could be useful in the aviation field where a statistical anomaly is identified but no firm theory or obvious issue can be sighted giving rise to a lack of research direction.

Hermeneutics is a methodology that seeks to develop meaning by distilling context from narrative by using known elements of the cultural and social environment surrounding the event or experience to which the narrative relates. There is a retrospective element to this methodology leading to its use as a means of gaining historical insights. This methodology could be useful in distilling insights from accident reports and other operational documentation particularly with emphasis on social and cultural impacts on flight operations in a historical context.

Phenomenological studies obtain empirical data through analysis of descriptions obtained through subject interviews or case studies (Barnacle, 2001; Giorgi & Giorgi, 2008). The semi-structured verbal nature of this method of enquiry makes this process useful in aviation settings because it is hard to come by personal data through the use of other methods of enquiry due to the linguistic constraints and trust issues created by its multicultural nature and high jeopardy environment.

Heuristic research is centred on the individual. Under this methodology topics of social significance are studied at the personal level using self-inquiry to develop a complete picture of personal experience covering both the researcher and participants, resulting in a composite depiction from which a synthesised meaning is developed. Heuristic research could be useful in separating individual flight operational attributes such as ‘stick and rudder skills’ and ‘good airmanship’ from corporate and regulatory constraints to address deficiencies and individuality and so develop a more complete operational overview to enhance operational safety and efficiency.

While in a philosophical sense epistemology is considered as the starting point for research methodology and method, in a practical sense research usually starts from a subject and question both of which are dependent on the area of expertise of the researcher. The goal or objective of the research is often contingent on external sources such as funding entities. As these areas seem to be somewhat externally dependent and settled prior to the commencement of research, it seems logical that a search for appropriate methodology should begin with the subject matter and research goal before progressing to epistemology, methodology and method.

To this end the following Table 5.1 was formulated to assist researchers to choose the appropriate methodology. The figure is based on Crotty's 1998 research framework based on epistemology and Higgs's 2001 Research Paradigms with some key differences. The model in table 5.1 commences with Subject matter, an element not apparent in either Crotty's or Higgs's work, and is listed first as most researchers approach research from an already established field of expertise. Research goals are from Higgs but listed next after Subject Matter, a recognition that in many instances aviation research is targeted with research goals set by external entities and not the researchers themselves. Crotty's terms Epistemology and Theoretical Perspective are used and are equivalent to Higgs's Research Paradigm and Philosophical Stance. Crotty's term Methodology is used and is equivalent to Higgs's Research Approaches.

Table 5.1: Research Method Decision Model

SUBJECT MATTER			
	Research Goals:	**Epistemology:**	**Theoretical Perspective:**
Purely Physical in Nature **Physics** **Chemistry** **Natural Sciences**	Measure Test Hypothesise	Empirico-analytical Positivistic	Positivism Objectivism Critical Rationalism (Knowledge and meaning exist objectively in the world independent of humanity)
	Methodology: Quantitative Scientific Approach Operationalism Observation	**Method:** Experiment Survey Sample Randomised Controlled Trial	
	Research Goals:	**Epistemology:**	**Theoretical Perspective:**
Both Natural and Social in Nature	Understand Interpret Identify Seek Meaning	Social Constructionist Interpretative	Idealism (Knowledge and meaning are constructed by people)
	Methodology: Ethnography Grounded Theory Hermeneutics Phenomenology Heuristic research	**Method:** Interview Participant and Non-participant Observation Case Study Textural Review	
	Research Goals:	**Epistemology:**	**Theoretical Perspective:**
Purely Social in Nature	Improve Empower Raise Consciousness	Subjectivist Critical	Historical Realism (Social practice and culture form the basis of reality)
	Methodology: Action Research Collective Research Critical Hermeneutics	**Method:** Interview Focus Groups	

Note: Adapted from Crotty (1998) and Higgs (2001)

A research topic ‘Culture and its impact on flight deck management’ could have its research method determined using the following steps.

- Subject matter – broadly considered both natural and social in nature.
- Research goals – to understand, interpret and identify issues as discovered.
- Epistemology – Social Constructionist Theories could be used.
- Theoretical Perspective – Idealism, knowledge and meaning are constructed by people.
- Methodology – Phenomenological study to obtain empirical data through analysis of descriptive narrative obtained through subject interviews or case studies.
- Research Method – Subject interviews, observation, narrative reduction, description of phenomenon.

5.7 Is Constructionist Theory a Logical Choice for Aviation Research

From a historical perspective, most organisational research, and aviation research in particular, is considered to be quantifiable in nature, that is to say, conducted under a positivistic methodology. This preference is in no small part due to the crisis orientation or focus of the vast majority of research in this field. Organisational research tends to be human performance orientated, driven by metrics that are neither contrived nor abstract, but event-driven by rates of fatality, hull loss, accident and incident. These quantifiable data sets form the basis for research topics that are event-focused. This focus however often misses the contextual interrelationship between the participants and their environment.

At the heart of all large complex systems, whether transport, nuclear power, chemical, construction or medical, there is a coupling of technical and human subsystems. This coupling results in highly specific operational and safety cultures. There also tends to be an interdisciplinary background to researchers in these fields, with studies into organisational and safety cultures utilising a variety of methodologies that tend to vary according to the academic discipline of the researcher (Deal & Kennedy, 1982; Peters & Waterman, 1982; Helmreich & Merritt, 1998). Organisational culture is considered to be an 'evolved construct', in that organisations are a phenomenon created and developed by society, and rely heavily on social and cultural practice for their existence and continued survival (Mearns & Flin, 1999, in Wiegmann *et al*, 2002. p. 4). It therefore seems logical to suggest that research methodologies that recognise that there is a relationship between subjects and objects, with individuals constructing meaning from experiences and interactions, have a place in these research fields (Crotty, 1998; Glasser & Strauss, 1967; Suchman, 1987; Creswell, 1998; Silverman, 2001). Not only can the aviation world be considered to be an 'evolved construct', but the data collection tools themselves, performance narratives, air safety reports, accident reports and so forth, are largely unrestricted in format and therefore qualitative in nature, at least at the data capture phase, leading to an additional issue of mixed methods.

Mixed methods have been recognised as a factor in the research underpinning risk assessment tools, mandated for use in numerous industries (Panda & Gupta, 2013). In aviation, risk assessment is performed under the Aviation System Risk Model, the founding precepts of which are the Human Factors Analysis and Classification System

(HFACS), Bayesian Belief Networks (BBN) and case studies (Luxhøj, 2001). Luxhøj said that both the HFACS framework and BBNs contain qualitative and quantitative elements. This mixed method approach is often described as a post-positivist paradigm (Panda & Gupta, 2013). Under this paradigm, research criteria, though intentionally positivist, may draw on elements of both qualitative and quantitative methodologies to find research methods that are best suited to their research needs, regardless of their traditional methodological affiliations (Reichardt & Cook, 1979; Richardt & Rallis, 1994; Panda & Gupta, 2013).

When considering methodology, Crotty (1998) said that research methods should be chosen based on epistemology, and that by choosing a method based on a philosophical position, a more cohesive research plan could be developed. He believed that by starting with epistemology, then considering the theoretical perspective, then the methodology, and finally the actual data collection tools, a research project would be provided with intellectual rigour that helped prevent the need for mixed methods. If Crotty's process were to be applied in aviation settings, it is probable that the outcome would be an increase in research conducted under social constructionist theory. Indeed social constructionist methodologies have been used in research in other fields especially medicine, where the outcomes of medical procedures are seen to have social implications (Poses & Isen, 1998).

Having previously looked at some theoretical perspectives based in the social constructionist area of epistemology, it seems that for research in aviation, phenomenological processes would be well suited as observation, case study, interview and narrative review are universally accepted data collection techniques, regardless of research method quoted. Husserl founded phenomenology on the basis that it was 'the study of the ways in which things appear to consciousness' (Brearley, 2001, p. 77). That is to say, it attempts to describe objects, actions, events and relationships as they are perceived by individuals.

5.8 Phenomenology as a Research Methodology in Aviation Research

Phenomenology appears a good fit for aviation research as phenomenology 'aims to clarify situations lived through by persons in everyday life' while attempting 'to remain as faithful as possible to the phenomenon and to the context in which it appears in the world' (Giorgi & Giorgi, 2008, pp 27-28). Further, phenomenology attempts to capture information and obtain insight only available through the 'first-hand experience' and insight gained by experts. Further support for Phenomenology, as a research methodology, can be found in that it has been shown to be a suitable method of investigating performance in workplace settings in general (Sandberg, 2000, 2005; Webster-Wright, 2006) and aviation settings in particular (Mavin, 2013).

One concern for phenomenological studies is that no one methodology is prescribed. As such, the researcher must choose from a variety of approaches underpinned by phenomenological theory. One such methodology is the 'descriptive phenomenological psychological method' as described by Giorgi and Giorgi (2003, p. 243). This approach contains seven steps:

- Collecting verbal data via semi-structured interview
- Transcribing verbal data
- Reduction
- Reading interview transcripts

- Dividing data into parts
- Ordering data into disciplinary language
- Expressing the structure of the phenomenon

The process set out above describes seven seemingly fixed steps with research progressing in a linear fashion from data collection to phenomenon description. In practice however, the process is more dynamic with steps being revisited to determine and test the essential constituents of the concepts and structures revealed during the research process. This dynamic process is important to the research process as it helps to establish both validity and reliability (Abawi, 2012; Abbaszadeh, 2012).

Phenomenological research has been shown to be valid under three theories of validity; communicative, pragmatic and transgressive validity (Sandberg, 2005). Communicative validity is obtained when the following conditions are met:

- The researcher and research participant share an understanding as to the research purpose.
- Coherence is preserved during data analysis.
- A feedback loop exists between the researcher and the research participants.
- The researcher maintains accountability for research findings. (Kvale, 1995; Sandberg, 2005; Giorgi & Giorgi, 2008; Abbaszadeh, 2012)

Pragmatic validity is provided when it can be confirmed that people actually do what they say they do. Pragmatic validity can be obtained by:

- Asking follow up questions.
- Obtaining descriptions of actual examples.
- Using deliberate misinterpretation to check validity.
- Test interpretations and findings in practice. (Sandberg, 2005; Abbaszadeh, 2012)

Transgressive validity can be achieved testing interpretation with counter argument, that is to say by searching for an alternative explanation for events and observations by exploiting any tension, disagreement or uncertainty within the descriptions. Original interpretations can be deliberately opposed to test for support of an opposing view point, and if support for this new perspective is found then the original interpretation may be rejected. There is a limitation to this test of validity in that phenomenological research is undertaken to try to describe experiences of objects and events not to find the absolute objective truth (Smith & Osborn, 2008; Abbaszadeh, 2012).

It has been shown that empirical phenomenology largely derives its validity through its robust methodology. Empirical phenomenology is also highly dependent on its methodology to demonstrate reliability. Very high levels of reliability are required in research conducted in the field of natural science where quantitative processes allow for duplication of an experiment or study (Babbie, 1994; Sandberg, 1997; Silverman, 2001; Abbaszadeh, 2012). This type of reliability is considered an incompatible metric for use in social research, not least because many studies cannot be repeated due to the reliance on descriptions of the individual's conception of reality. As a result, reliability relies heavily on descriptions by the researcher as to how the data was collected, analysed and the results achieved (Miles, 1979; Kvale, 1999; Sandberg, 2005; Yardley, 2008; Abbaszadeh, 2012).

5.9 Conclusion

It can be seen that research into areas of human performance, especially in the aviation field, often relies on hybrid methodologies where the research question has a basis in quantifiable data –statistically derived rates of events or similar. Research is conducted on the premise of being founded on quantifiable processes and indeed, the results are presented in a quantifiable manner. However on close examination of the data collection techniques it can be seen that the results are often a numeric representation of qualitative processes, that is, the results are a reduction of narrative to a numeric value. This process often results in a loss of detail, hence the growing support for a broadening base to the methodologies used to include qualitative processes. This presents researchers with a dilemma especially as many research topics in the aviation arena are externally set by regulators, manufacturers and airline operators. It is hoped that by using a decision model such as that depicted in Table 5.1 social constructionist methodologies such as phenomenology will be accepted as both suitable and valuable research methodologies for use in aviation research.

Chapter 6

Phenomenology as the Chosen Approach Methodology

6.1 Introduction

In Chapter Five a case was made for the use of social constructionist theories as an epistemological basis for research in aviation safety and human performance. Chapter Five also introduced the idea of using a research decision model (See Table 5.1) as a basis for determining an appropriate research methodology. By working through the decision model it was determined that for this research topic - 'Culture and its Impact on Flight Deck Management' - the '*Descriptive Phenomenological Psychological Method'* would be appropriate as a research methodology.

The methodology as described by Giorgi and Giorgi (2003) was seen to contain seven procedural steps:

- Collecting verbal data via semi-structured interview
- Transcribing verbal data
- Reduction
- Reading interview transcripts
- Dividing data into parts
- Ordering data into disciplinary language
- Expressing the structure of the phenomenon (p. 243)

Chapter Six describes these steps in greater detail and also considers the issues of validity and reliability.

6.2 The use of semi-structured interviews to collect verbal data

As the name of the methodology implies, the descriptive phenomenological psychological method relies on the description of a physical event made by a subject or 'participant' who actually experienced the event. This description is obtained by the researcher through an interview process. The descriptions of the event or phenomenon obtained through the interview process are referred to as 'second order descriptions' (Giorgi & Giorgi, 2003, p.251). The descriptions obtained through the interview process then become the research instrument (Gallagher & Zahavi, 2008). This instrument is considered by numerous researchers to be a valuable tool for obtaining data especially in areas where there is a coupling of technical and human subsystems (McCoy, 1988; Luxhøj, 2001; Gallagher & Zahavi, 2008: Gallagher, 2011).

Kvale (2006, p. 483) considered an interview, in essence a series of unstructured open-ended questions, to be a 'joint endeavour where egalitarian partners, through conversation, search for true understanding and knowledge.' With this concept in mind, a good interview from a phenomenological study standpoint is an interview in which the line of questioning progresses smoothly, from general to specific questions relating to the topics under investigation, resulting in clear descriptions of events (Smith & Osborn, 2008).

Sandberg (2001) related that language itself imposed limitations as to how events are described by subjects, and for this reason an interview may not present a totally accurate representation of an event. When using an interview process as a data collection instrument, the questions being asked should act as a topic guide and prompt the participants to describe their relevant experiences (Mavin & Roth, 2014). Smith &

Osborn (2008) considered that open-ended questions represented a suitable question style for obtaining good descriptive narrative. Other researchers have also acknowledged that while open-ended questions are indeed a useful means of obtaining narrative, their use does not guarantee high quality, meaningful, unbiased responses (Silverman, 2001; Freebody, 2003; Gallagher & Zahavi, 2008).

As an alternative to an unstructured open-ended question method a semi-structured interview process could be adopted. In a semi-structured interview, the interview is based around a series of pre-arranged but open-ended questions allowing the researcher greater control over the interview (Gallagher & Zahavi, 2008). The semi-structured interview method allows researchers to obtain more information from follow up questions and to pursue additional relevant information (Smith & Osborn, 2008; Shosha, 2012).

Once the type of interview process has been settled the line of questioning must be considered. If a semi-structured interview process is to be used, relevant questions must be developed and the sequence in which those questions will be asked must also be determined. Mavin (2013) indicated that there were several advantages in having a predetermined interview schedule. First, it forces the researcher to focus on the intended goal of the interview. Second, the interview focus is able to be maintained in the event that the interview moves off topic. Finally the researcher is better placed to ask follow up questions for clarification of experiences and events. By developing an interview schedule not only can the interview process itself be better managed allowing enhancements to data quality, but the questions themselves may be more insightful and better informed by having a basis in prior data derived from either a pilot study or from previous related research (Gallagher & Zahavi, 2008; Smith & Osborn, 2008).

All research methodologies create dilemmas for researchers in that each methodology has inherent strengths and weaknesses. All researchers attempt to account for the weaknesses of their chosen research methodology by developing strategies specific to their research discipline in order to ensure the collection of valid data. Phenomenological research is of course no different from other research methodologies in that there are both foreseen and unforeseen problems that may arise during the research process (Shosha, 2012). In the data collection or interview phase of phenomenological research there are three foreseeable challenges to the validity of the data being collected which need consideration:

1. Subjects or participants may erroneously recall the details of a phenomenon.
2. Participants may omit or even deliberately distort details of their experiences.
3. A participant may be deceitful in regards to their responses. (Giorgi & Giorgi, 2008; Shosha, 2012)

These issues may be largely countered through the use of follow-up questions and by rigorous scrutiny of the transcripts and response structure (Shosha, 2012). However it has also been recognised that there is no guaranteed method of countering deceit in either this or any other research methodology (Giorgi & Giorgi, 2008).

Another issue relevant to qualitative research methods relates to the researcher – subject relationship. The degree of familiarity that exists between the researcher and the subjects may have a substantial impact on the research, particularly on the insightfulness of the research data collected and the analysis of that data. This relationship referred to as insider or outsider status enables a researcher who is an insider, to have intimate knowledge of a group being studied. This intimate knowledge would simply not be available to an outsider (Mercer, 2007). Mercer (2007) postulated that only an outsider could obtain 'objective' results from qualitative research as their status allows for an external perspective. Flick (2006) argued that a certain level of activity always remains hidden from outsiders and that insider status is often beneficial in obtaining more complete data.

Numerous researchers have argued the issue of insider/outsider status and the benefits or otherwise that a researcher's status has on the information gained through their research (Merton, 1972; Burns & Walker, 2005; Mercer, 2007; Shosha, 2012). Burns & Walker (2005) proposed that 'knowledge produced from an acknowledged standpoint is less distorted and hence revisable than knowledge which erases its partiality' (p. 67).

6.3 Transcription of verbal data

As the title implies transcription of verbal data involves the verbatim transcription of recorded interviews to allow the researcher to read and further process the collected data. Once all verbal data has been transcribed the data collection process is complete (Giorgi & Giorgi, 2003; Shosha, 2012).

6.4 Reduction

When the transcription process has been completed, the process of phenomenological reduction may be commenced. The purpose of phenomenological reduction is to account for, remove from and critically evaluate the data to reduce the impact of assumptions and bias (Hein & Austin, 2001; Giorgi & Giorgi, 2003; Shosha, 2012). The recommended reduction process is for the researcher to bracket as many assumptions and elements of bias as possible during the initial data analysis to allow for later critical evaluation (Hein & Austin, 2001; Giorgi & Giorgi, 2003; Shosha, 2012).

Another element in the reduction process is the critical analysis of the descriptions to test for alternative interpretations to seemingly obvious descriptions and so test for alternative meanings of those descriptions (Giorgi & Giorgi, 2003; Gallagher & Zahavi 2008; Shosha, 2012). This process is intended to improve research rigour by minimising assumed meanings being imparted to the research data as a result of the researchers own experiences (McKenna, 1982; Shosha, 2012).

6.5 Reading interview transcripts

Reading of the interview transcripts in a thorough and purposeful manner is required for the researcher to become immersed in the phenomenon as experienced by the subjects and seen through their descriptions, and so gain an overall view of the data (Giorgi & Giorgi, 2008).

6.6 Dividing the data into parts

At this step the researcher analyses the transcribed narrative to divide the text into meaningful parts or ‘meaning units’. A meaning unit is derived from the narrative and may consist of a word, a sentence or a paragraph which contains a subject’s responses to a question where the meaning remains constant. When a change of meaning takes place a new meaning unit commences (Giorgi, 1997; Giorgi & Giorgi, 2008). The line of demarcation from one meaning unit to the next is termed the ‘transition’ and is marked on the transcription with a stroke (Giorgi, 1997; Giorgi & Giorgi, 2008).

6.7 Transforming narrative with the use of disciplinary language

Disciplinary language in this instance relates to the technical language demanded by the researcher's own discipline. The raw narrative as transcribed in its original state is unlikely to meet the language requirements under the concept of a disciplinary language (Giorgi, 1997; Giorgi & Giorgi, 2008). To facilitate the requirements of disciplinary language, the meaning units and their attendant raw narrative descriptions undergo a process of reduction as described in 6.4 above. These units are further reduced in plain language according to their meaning, and then in the final stage of the analysis written into disciplinary language through a process of transformation (Giorgi & Giorgi, 2003; 2008). Giorgi & Giorgi (2003; 2008) indicated that often multiple transformations were required, with similar meaning units being combined, summarised and recombined to form succinct descriptions of narrative centred on common themes. The final transformation ultimately provides a meaningful format to allow further analysis (Giorgi, 1997; Giorgi & Giorgi, 2003; 2008).

6.8 Describing the structure of the phenomenon

In order to fully evaluate the phenomenon being studied a researcher must reduce the descriptions to their essential constituent components thereby revealing the structure of the phenomenon. To describe the structure of the phenomenon the researcher uses disciplinary language to enhance and develop a deeper understanding of the data. This process allows the researcher to combine common experiences to form the structure of the phenomenon (Shosha, 2012; Mavin & Roth, 2014).

The structure will vary depending on the participants themselves, the complexity of the research topic and the number of participant subjects (Giorgi & Giorgi, 2008). In considering the number of participant numbers, Giorgi & Giorgi considered that increased subject numbers tended to provide more narrative and therefore more detail. Consequently more structure to the phenomenon could be revealed (Giorgi & Giorgi, 2008). Smith & Osborn (2008) agreed that this was also their experience, however they contended that the growth in participant subject numbers and the growth in structure revealed did not occur in a uniform manner. Their experience was that once a subject threshold was reached a diminishing return was experienced. For example two subjects may reveal three structures, 20 subjects may reveal five structures and 200 subjects may reveal six structures (Smith & Osborn, 2008).

In developing structures simplicity is the name of the game. Giorgi (1997) recommended using single structures where possible and the testing of relationships between constituents to ensure that only the essential structure survived. Giorgi & Giorgi (2003) determined that the essential structure was identified by removing constituent elements of a description until the concept created by the structure failed. At the step prior to structural failure the structure is at its most simplified state where all the constituents may be considered as essential elements rather than accidental components (Giorgi & Giorgi, 2003; Giorgi & Giorgi, 2008).

6.9 Validity

Phenomenological research has been shown to be valid under the three theories of communicative, pragmatic and transgressive validity (Sandberg, 2005; Abbaszadeh, 2012; Shosha, 2012). Validity shown under these three theories was derived from a long process of legitimisation. Early qualitative research approaches were criticised over data analysis techniques. Early research suffered due to poorly defined data analysis techniques leading to invalid or unreliable results (Miles, 1979). In the early stages of adoption of qualitative research methodologies, researchers attempted to demonstrate validity under the same precepts that applied to research conducted under quantitative methodologies. These approaches to validity lead to a 'mixed discourse' in the research process (Giorgi, 1994, p.191). To counter this criticism strategies had to be developed to ensure that high standards of validity could be demonstrated (Giorgi, 1994; Kvale, 1995; Sandberg, 2005; Giorgi & Giorgi, 2008; Gallagher & Zahavi, 2008; Abbaszadeh, 2012; Sosha, 2012). Three theories—expanded below—were developed as a means of demonstrating validity in social constructionist research.

6.9.1 Communicative Validity

Communicative validity may be demonstrated when there is a clear correlation between a subject's descriptions in a researcher's narrative relating to the subject's experience, and the researcher's interpretation of those descriptions. Smith & Osborn (2008, p. 53) referred to this process as 'double interpretation. A process where the participants apply their own interpretation and sense of reality to their experiences while the researcher observes and interprets participant's interpretation of reality.

In order to demonstrate communicative validity the following conditions should be demonstrated:

- The researcher and the research participant share an understanding as to the purpose of the research.
- Coherence in the form of a consistent, logical and recurring argument or theme existing in the original narrative is preserved throughout the data analysis.

- A feedback loop or process should exist between the researcher and the subjects participating in the dialogue. This is to ensure that interpretation of the narrative is accurate and that results can be challenged and refined.

- The researcher maintains accountability for the research findings. (Kvale, 1995; Sandberg, 2005; Giorgi & Giorgi, 2008; Gallagher & Zahavi, 2008; Shosha, 2012)

6.9.2 Pragmatic Validity

Pragmatic validity is demonstrated when it can be confirmed that people actually do what they say they do and is intended to complement communicative validity by bolstering any weakness in that process (Kvale, 1995, 1999; Shosha, 2012). As previously discussed when dealing with different cultural groups, different meanings may be attributed to an action depending on the temporal focus of the individual subject (Trompenaars, 1993). In studies where differing cultures play a role, matching action, meaning and outcome become an obvious focus and point of tension within the study, increasing the importance of pragmatic validity. Pragmatic validity may be obtained by:

- Asking follow up questions.

- Obtaining descriptions of actual examples.

- Using deliberate misinterpretation to check validity.

- Testing interpretations and findings in practice. (Sandberg, 2005; Shosha, 2012)

6.9.3 Transgressive Validity

Transgressive validity is used to test and confirm themes, perceptions, interpretations and findings obtained by the research and previously validated under the precepts of the theory of communicative validity. Transgressive validity is obtained by testing interpretations with counter argument. That is to say, transgressive validity may be tested by searching for an alternative explanative for events and observations by exploiting any tension, disagreement or uncertainty within a subject's narrative (Smith & Osborn, 2008; Shosha, 2012). Original interpretations could be deliberately opposed to test support of an opposing point of view. If support for this new perspective was found the original interpretation may need to be rejected unless further support for the original interpretation could be obtained (Lather, 1993; Sandberg, 2005). There is a caveat on this test of validity in that phenomenological research, being subjective in nature, is undertaken to try to describe experiences of objects and events not to find the absolute objective truth (Gallagher & Zahavi, 2008; Smith & Osborn, 2008; Shosha, 2012).

The three theories of validity have been shown to work together to support qualitative research methodologies. Sandberg (2005) determined that communicative validity underpinned the interview process by ensuring that accurate descriptions of the phenomena were obtained. Pragmatic validity was used to confirm that that the description obtained during the interview process was a truthful representation of the phenomenon from the subject's perspective. Transgressive validity was used to search for inconsistencies in the descriptive narrative and alternative explanations for the phenomenon (Sandberg, 2005, Abbaszadeh, 2012).

6.10 Reliability

It has been shown that empirical phenomenology largely derives its validity through its robust methodology. Empirical phenomenology is also highly dependent on its methodology to demonstrate reliability. Very high levels of reliability are required and demonstrated for research conducted in the field of natural science where quantitative processes allow for the duplication of experiments and studies (Babbie, 1994; Sandberg, 1997; Silverman, 2001; Abbaszadeh, 2012; Shosha, 2012). This type of reliability test is considered an incompatible metric for use in social research settings where qualitative process are used, not least because many studies simply cannot be replicated in an exact manner due to the reliance on descriptions of an individual subject's conception of reality. As a result phenomenological research largely derives its reliability from its methodology. In following the methodology a researcher is required to describe in detail how the subjects were selected, how the data was collected, analysed and the results achieved (Miles, 1979; Kvale, 1999; Sandberg, 2005; Gallagher & Zahavi, 2008; Yardley, 2008; Abbaszadeh, 2012; Shosha, 2012).

6.11 Summary

This chapter described in detail the '*Descriptive Phenomenological Psychological Method'* as described by Giorgi and Giorgi (2003) as a research methodology. The seven step process of data collection and analysis, (1) collecting verbal data via semi-structured interview, (2) transcribing verbal data, (3) Reduction, (4) reading transcripts, (5) dividing data in to parts, (6) ordering data into disciplinary language, (6) expressing the structure of the phenomenon as required under the methodology were explained in detail (Giorgi & Giorgi, 2003, p. 243). The chapter also discussed how over time the method developed both structure and rigour and in its present form has been shown to be both valid and reliable.

Chapter 7

Method as Applied to the Main Study

7.1 Introduction

The epistemological basis and methodology used for this study was discussed in the two previous chapters. In Chapter 5 the case for the use of qualitative methodologies in safety and human performance research was made. By following the decision model introduced in Chapter 5 (Table 5.1) it was determined that the empirical phenomenological method represented a suitable methodology for use in this study. This methodology as a research approach was described in greater detail in Chapter 6. Chapter 6 lays out the empirical phenomenological method as developed and described by Giorgi and Giorgi (2003, p. 243) as the 'descriptive phenomenological psychological method' as it was specifically applied to this study. The validity and reliability of the method were also considered in Chapter 6.

There are three additional items which will be dealt with in this chapter. These items are participant selection, ethical approval and question development. Appendices F, G & H contain details of ethical approvals, participant information and participant agreement forms.

7.2 Participant selection

Smith and Osborn (2008) made the observation that when research was conducted into highly specialised fields of human endeavour the subject pool tended to be small. In consideration of this reality the participant subjects tend not to be chosen at random, but are instead chosen from a pool of subjects with common attributes considered desirable from the perspective of the study. Smith and Osborn (2008) also noted that research conducted with even a single participant subject could and indeed had been seen to provide researchers with useful findings. Giorgi and Giorgi (2008) acknowledged that while it was possible to obtain useful data from studies with a single participant subject, they observed that with increased participant numbers both the data collected and the findings made tended to become more descriptive and insightful.

The data collection process for studies conducted under the descriptive phenomenological psychological method has been seen to be extremely time consuming when large sample groups of participant subjects have been used (Gay & Airasian, 2000; Smith & Osborn, 2008; Shosha, 2012). In order to keep research under this methodology to a reasonable timeframe, other researchers have recommended reducing the number of participants to a manageable number and concentrating on producing a more detailed analysis of the data presented in the narrative (Smith & Osborn, 2008). Indeed it may be seen that recent research conducted using phenomenological methodologies have tended to use small numbers of participant subjects. These studies have used participant numbers averaging between five and nine (Camp, 2007; Black, 2009; Mavin & Roth, 2014). This trend can also be seen in aviation research where qualitative methodologies have been used. Henderson's (2009) research in to SA amongst flight crew used five participant flight crews with observations made over ten flights. Lempereur and Lauri's (2006) research in to the psychological effects of constant evaluation used seven participant subjects, and Mavin's (2013) research assessing pilots' performance for promotion to airline captain used a participant group of five check captains. From these studies it can be seen that previous researchers have found that a participant subject base of five to six participants has been found to be both adequate and manageable for this type of research (Smith and Osborn, 2008; Mavin & Roth, 2014).

For this study into Culture and its Impact on Flight Deck Management which specifically looks at variations between how Anglo-European pilots and Chinese pilots manage flight operations, the pool of candidate participant subjects is very limited. The primary prerequisite to be considered suitable was that a candidate required substantial airline experience in major airlines from both an Anglo-European country and China. This prerequisite alone reduced the sample size to something in the order of two hundred individuals worldwide.

With such a small group of potential participant subjects, it became clear that participants would need to be selected under a process referred to as 'purposive sampling', that is the requirement of a researcher to limit the search for participants to a select group who are appropriate for the research (Cohen, Manion, & Morrison, 2000; Gay & Airasian, 2000; Mavin & Roth, 2014). It has been suggested that there are two main types of purposive sampling techniques available – homogenous and criterion sampling (Gay & Airasian, 2000; Mavin & Roth, 2014). Participants who are selected on the basis of common outlooks, experiences and perspectives may be considered as a homogenous sample, while participants who are selected based on an established set of parameters such as rank, or years of service may be considered as a criterion-based sample (Gay & Airasian, 2000; Mavin & Roth, 2014). Participant subjects for this study were chosen on the basis of a purposive, criterion selection.

This study used six participant subjects selected on the basis described above. The criterion used to select captains for the research specified that the captains have experience flying for a major Anglo-European airline, national carrier or equivalent, and experience flying for a major Chinese airline, national carrier or equivalent. As previously discussed this requirement reduced the sample pool to about two hundred individuals worldwide. The pool of available participants was again reduced when a suitable criterion with regards to experience and expertise was set. An experiential criterion was required to ensure participants had suitable experience to determine appropriate practice and discuss performance in the execution of essential skills related to the profession (Stevenson, 2003). In order to obtain useful data it was considered that an appropriate level of experience in the rank of airline captain was also a required criterion for the participant subjects. Captains with more time at that rank would be expected to have developed a better understanding of the essential and desired knowledge, skills, practices and behaviours that underpin a safe and efficient flight operation. The consensus amongst previous researchers seems to be that ten years experience in a particular field may be required to develop the skill set to be considered an expert (Lave, 1988; Hayes, 1989; Mavin, 2013). Accordingly, in consideration of this previous research and the level of expertise required for meaningful operational comparisons to be made the minimum in rank experience for a captain to participate in this research was set at ten years.

The captains who participated in this study had 23, 23, 25, 15, 10 and 18 years in command—a mean of 17.8 *(SD=5.5)* years' experience—had flown both Airbus and Boeing aircraft types and were flying wide body aircraft on long haul international operations at the time of the interview. These captains were considered by their employers in China to be foreign experts. The six participants are referred to in the research data as I1 through I6 and in Chapters Eight and Nine as Captains 1 through 6 for ease of reading. These six participant captains were located through industry associates.

7.3 Ethical approval

Ethical approval for this research was requested and granted under the Griffith University Ethical Approval process (Appendix F). Conditions for the approval being granted were identity protection and participant consent.

The identity of the participants was not to be revealed either during or after the research. The rights of participants were ensured through a process of 'informed consent'. Cohen and Manion (1994) suggested that informed consent consisted of four elements – a comprehensive information package, comprehension as to its contents, competence and a desire for voluntarism in participation. These four elements work together to provide the basis for informed consent when a competent individual agrees to participate in research on the basis of clear, precise and relevant information regarding the nature of the research as provided by the researcher. A spirit of voluntarism is a prerequisite to ensure full and free participation by a subject. If these conditions have been met then it may be considered that the rights of the participants have been given suitable consideration (Cohen & Manion, 1994).

These conditions were considered as part of the ethical approval process. University approved participant information sheets and consent forms were prepared to meet these requirements (Appendices G & H). Participant subjects were required to complete and return the consent form prior to the scheduling of interviews. Additionally, at the beginning of each recording, the researcher confirmed with the participant that the captain understood the purpose of the research, that the consent form had been signed and that the participant retained the right to withdraw from the research at any time. Participants were also reminded that there was a university contact available to address any concerns with any aspect of the research or researcher. No captain approached for this research project refused to be involved or subsequently decided to withdraw from the study or registered any other concern.

The ethical approval process also dealt with privacy and security of the raw data collected. The participants in this study shared their experiences freely with the researcher and the information given included some insider information that was at times either commercially or operationally sensitive, including company names and the names of individuals. With this in mind the original transcripts, recordings and notes have been retained by the researcher in a secure repository. The transcripts used for data analysis have been de-identified to ensure that sensitive and/or personal information is not publicly available.

7.4 Question development

The questions for the interviews were developed from the analysis of data collected from the preliminary study as described previously in Chapters 3 and 4. Therefore the questions developed for use in this study represent an informed line of inquiry based on the literature review and the data derived from previous observations.

The literature review in Chapter 2 revealed that there were four broad categories of non-technical skills plus workload management and two categories of technical skills giving a matrix of seven competencies required for appropriate operational standards to be achieved on the flight deck. The required skill sets are as follows:

1. Communication
2. Management skills

3. Team building

4. Workload management

5. Situational Awareness

6. Technical competence, on the flight deck, flight control competence (Stick and rudder skills)

7. Applicable knowledge (General and specific aviation knowledge)

Flight deck observations made in China as part of the preliminary study data analysis indicated that the Chinese flight crews performed below expectation in the following areas: knowledge of the procedures and processes to correctly calculate the required performance data for takeoff; knowledge of the principles of CRM (at least the Anglo-European concept of CRM); numerous aspects of overall flight deck management; SOPs relating to taxi speed and standard call outs were poorly handled as were check lists; and poor adherence to SOPs was also seen to lead to inappropriate task sharing and sequencing.

Where meaningful comparisons could be made with the results of a LOSA audit conducted on an Anglo-European airline the following observations were made: MEL/ performance calculations were mismanaged seven times more frequently by the Chinese crews; operational and time pressure threats were mismanaged ten times more frequently by Chinese crews; ATC threats were mismanaged three times more frequently by Chinese crews; checklist errors occurred at 19 times the rate for Chinese crews as occurred for Anglo-European crews; excessive taxi speed was recorded seven times as frequently by Chinese crews.

The questions below were developed with consideration to these observations. Question development took place in a two-step process. Firstly a series of proposed questions were developed. Then following a consultative process with both supervisors a final more mature set of questions was presented with the request for ethical approval, thereby giving Griffith University's Human Research Ethics Committee the opportunity to consider the suitability of the proposed questions.

There were nine questions developed for the study, presented below:

1. From your experience working with both Chinese and Western flight crew could you describe the process used to work through MEL items and performance calculations?

2. Can you describe any differences in the way in which this area is handled by Chinese crew as opposed to how it is handled by Western crew particularly in relation to: communication style; decision making process; SA; workload management and aviation knowledge?

3. Have you observed any difference in the way in which Chinese crew and Western crew react to operational threats and time pressure constraints? If so can you describe your observations as they relate to: communication style; decision making process; Situational Awareness; workload management and aviation knowledge?

4. Have you observed any differences between checklist and ECAM management between Chinese crew and Western crew? If so can you describe your observations as they relate to: communication style; decision making process; Situational Awareness; workload management and aviation knowledge?

5. In your experience have you observed differences in SOP adherence between Chinese crew and Western crew? If so in which areas of the SOPs have you observed compliance issues: standard call outs; FMA call outs; company speed limitations; STAR and altitude limitations; chart and flight plan use and in-flight reference and have you observed deliberate SOP non-compliance?

6. In your experience have you observed a different level of commercial awareness between Chinese crew and Western crew? If so in which areas have you observed these differences,

a) Fuel conservation through flight level selection, use of cost index, alternate selection, track shortening.

b) General commercial knowledge, delay costs, missed connection costs, general operating costs, fuel tankering (additional fuel carried to reduce the fuel uplift for the next flight) cost/benefit, engineering issues, noise abatement and other environmental issues.

c) Customer service announcements, use of seatbelt policy, turbulence penetration and weather avoidance, schedule adherence.

7. In your experience have you observed a different interpretation of CRM between Chinese and Western crew? If so what are your observations in relation to: communication style; decision making process; Situational Awareness; workload management and aviation knowledge?

And have you observed differences in the following areas: cockpit gradient, the inclusion of non-cockpit resources in problem-solving or the use of GRADE or similar problem-solving methodology?

8. In your experience have you observed a difference in training delivery in Chinese and Western airlines? If so what are your observations in the following areas: instruction technique; learning method; training outcomes and competence in terms of, general aviation knowledge, aircraft specific knowledge and manipulative skill?

7.5 Trial interviews

It has been suggested that trial interviews either in full or in part be conducted to confirm that the interview process including recordings, questions, interview technique and any other pertinent aspects of the data collection process meet the researcher's expectations (Gay & Airasian, 2000; Gallagher & Zahavi, 2008: Shosha, 2012). By conducting these trial interviews improved results may be obtained in two ways, firstly the researcher's interview technique may improve from third party feedback and secondly the questions themselves may be improved through re-examination of the questions and responses (Foddy, 1995; Gay & Airasian, 2000).

For this study one trial interview consisting of part of the complete question bank was conducted. This trial interview prompted the change in terminology for further questions where the term Anglo-European was changed to Western, as in Western crew, in the interviews for example.

C: *Have you observed any difference in the way in which the Chinese crew and the Western crews react to operational threats and time pressure constraints?*--- (Researcher in I1, Question 2)

Following the review of Interview 1 other changes to the question data bank were deemed unnecessary. The trial interview also gave the researcher an opportunity to review and improve the interview technique, a process which continued following review of each successive interview.

7.6 Data collection and analysis

As previously discussed this study was conducted following the ‘descriptive phenomenological psychological method’ as described by Giorgi and Giorgi (2003, p. 243) which sets out seven steps to be followed during the research process. How this study was able to meet the requirements imposed by the methodology is expanded below.

7.6.1 Use of semi structured interviews for verbal data collection

There were six captains interviewed for this research. The interviews lasted for between 25 and 72 minutes. I1 was interviewed in a coffee shop, I2 was interviewed in his home and I3 – 6 were interviewed via Skype because it wasn’t possible to arrange face-to-face interviews. All interviews were digitally recorded to allow transcripts to be prepared. Five of the six participant subjects were known to the interviewer through professional contact.

As can be seen above the questions developed for the interviews provided the interview schedule with both direction and format. The interviews themselves followed a semi-structured schedule with questions asked in an open ended format. The subjects seemed open, willing and keen to participate in the research, with their answers also seeming to be forthright and insightful. A few participants tended to deviate from the subject matter at hand. In these instances the questions in the interview schedule were used to help direct the interview back on course. The questions were also able to prompt both the researcher and participant to gather as much information as possible about each subject being explored.

7.6.2 Transcribing verbal data

As noted previously all interviews were digitally recorded. These digital sound files were then transcribed verbatim into a word document which forms the raw narrative for each interview. The raw narratives were then checked by the researcher for accuracy. The transcripts were also checked to remove any identifying information such as names of people or airlines and where necessary replaced with generic statements. Mavin's (2013) process for de-identification was followed and where this occurred in the narrative 'text removed' is annotated in square brackets [text removed]. On rare occasions text was added to the narrative to improve clarity and where this occurred the additional text is contained within square brackets [text added] (Mavin, 2013). The terms commonly altered appear in Table 7.1 below.

Table 7.1: Table of Modified Terms as They Appear in Transcripts

Statement in interview	**Statement in transcription**
Twin isle aircraft such as Boeing 747, 767, 787 or Airbus A300, 310, 330, 340, 380 or MD 11.	[Wide Body]
Single isle aircraft such as Boeing 727, 737 or Airbus A319, A320 or MD 80.	[Narrow Body]
Turbo propeller driven aircraft F27, F50	[Turboprop]
Names of Airlines	[Airline X]
Names	[Name removed]

7.6.3 Reduction

As previously discussed, statements in the narrative that could influence the research through bias, assumptions or preconceptions based on the researcher's previous experience or knowledge of the subject matter should be identified and bracketed to allow careful analysis to decrease the likelihood of this material having a detrimental impact on the data analysis (Hein & Austin, 2001; Giorgi & Giorgi, 2003; Abawi, 2012; Shosha, 2012). The researcher has been involved in the aviation industry for 35 years and has flown in numerous airlines in various countries including China. This experience has given the researcher unique insider knowledge of the operational practices and experiences being investigated in this study. When reading the narrative transcripts the researcher found that many of the experiences discussed by the participants paralleled his own experiences. As a result the researcher was able to readily identify areas of bias or obvious tension requiring extra consideration. Having found a large number of areas where both the researcher and participants had had similar experiences the researcher was especially vigilant in ensuring that the data analysis remained free from preconceptions, bias and assumptions as a result of the researcher's prior experiences.

7.6.4 Reading interview transcripts

The narrative generated by the transcription of the interviews was read in a purposive manner prior to the commencement of the data analysis. The purposive reading of the narratives was required for the researcher to develop an understanding of the experiences described by the various participants and to ensure that those experiences would be analysed in a stand-alone manner without bias from either the researcher's own experiences or from the experiences as described by other participants. This process was carried out in the first instance in conjunction with checking the transcripts against the recorded narrative. Each transcript was then reread several times before moving on to the next stage, that of dividing the narrative into meaning units (Abawi, 2012; Abbaszadeh, 2012; Shosha, 2012).

7.6.5 Dividing data into parts

In the previous two chapters it was determined that a meaning unit was a section in the narrative with a homogenous meaning. That is that the topic being discussed consisted of a single theme. A meaning unit could consist of a single word, sentence or paragraph (Abawi, 2012; Shosha, 2012; Mavin, 2013). When there was a change in theme a new meaning unit is considered to have begun. This point of demarcation is marked in the narrative with a stroke. For example:

I1: *As I related before, I've seen lack of checklist use that led to a problem and I saw that on a number of occasions. / The other one I saw was ah taxing to fast around corners, (as you know the [wide body] has a 10 knot limit on a 90 degree corner), I think the record I saw was 22 knots on right angle corner and a nose wheel scrubbing and ah at the time it's a very uncomfortable feeling.* --- (I1: 15)

Each of these meaning units was assigned a number and entered in the meaning unit column on a spread sheet. For example:

No.	Meaning Unit
15	I1: As I related before, I've seen lack of checklist use and ah that led to a problem and ah I saw that on a number of occasions.
16	I1: The other one I saw was ah taxing to fast around corners, (as you know the ah [wide body] has a 10knot limit on a 90 degree corner), I think the record I saw was 22knots on a right-angle corner and a nose wheel scrubbing and ah at the time it's a very uncomfortable feeling. Not too good for the passengers and it certainly is not very good for the equipment. So yes, I did observe non-compliance and ah generally by the ah Captains, not so much by the FOs, but ah, when you brought it to their attention, ah if it was an FO they'd take notice straight away, but if it was a Captain they may ignore you because ah they were regardless the P1 not the P2, so ah, there was quite a bit of non-compliance with SOPs unfortunately.

Figure 7.1: Example of Meaning Unit and Assigned Number

Note: A more complete example of this process may be seen by referring to Appendix J.

7.6.6 Transforming narrative into disciplinary language

By referring to previous chapters it may be recalled that the research method required the unstructured narrative generated by the interview process to be transformed into disciplinary language a process referred to as transformation. Each meaning unit derived from the interview narrative was transformed into disciplinary language by following the process of transformation described by Mavin (2013).

Mavin's (2013, p. 82 - 83) process for transformation to disciplinary language stated that for each interview narrative 'three transformations were carried out. Transformation 1 (TR1) was a summary of each meaning unit within the interview transcript. Once TR1 had been completed and numbered, similarities between units within TR1 were identified. They were combined and further summarised as TR2. This process of grouping similar units was continued, creating TR3. In TR3 however, rather than numbering, each component was summarised under a key heading such as Situational Awareness.' Figure 7.2 below illustrates in a broad sense how this process was completed, with a more detailed example contained in Appendix J.

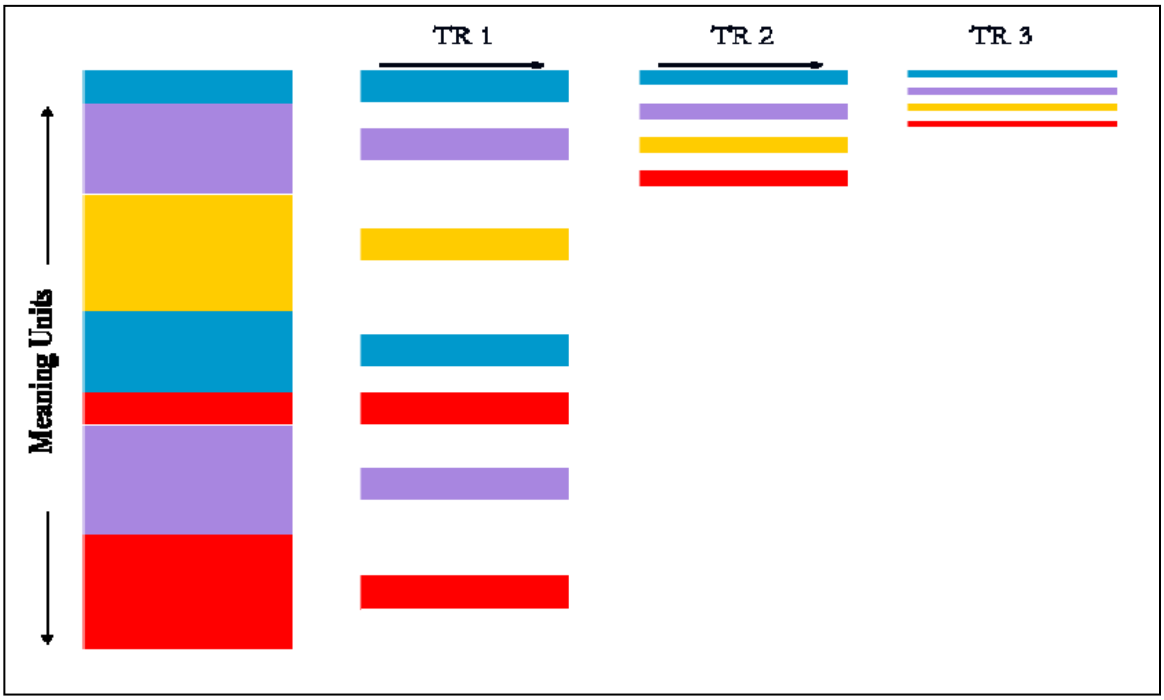

Figure 7.2: Illustration of Analysis of one Interview Transcript

Source: Mavin (2013, p. 83)

7.6.7 Describing the structure of the phenomenon

The purpose of the transformation process is to produce a single paragraph which combines and describes the phenomena as described by all the participant subjects. In accordance with the study's topic of investigation the 'impact of culture on flight deck management' the interview questions focused on obtaining descriptions of the differences observed in the management of the flight deck between Chinese and Anglo-European crews. Some of the observed differences may be categorised as cultural, but other differences in operational practices may have been due to training, experience or language difficulties. The TR3s from all the participants contain observations which included all differences regardless of root cause. This being the case the paragraph expressing the structure of the phenomenon is not the end of the research process. The structure developed from the data is merely a method of expressing the key constituent elements, in this instance the different operational practices of Chinese and Anglo-European crews. The process used in this study was based on the process used by Mavin & Roth (in press, p. 84). An overview of the process may be seen in Figure 7.3 below, with a more comprehensive example contained in Appendix K.

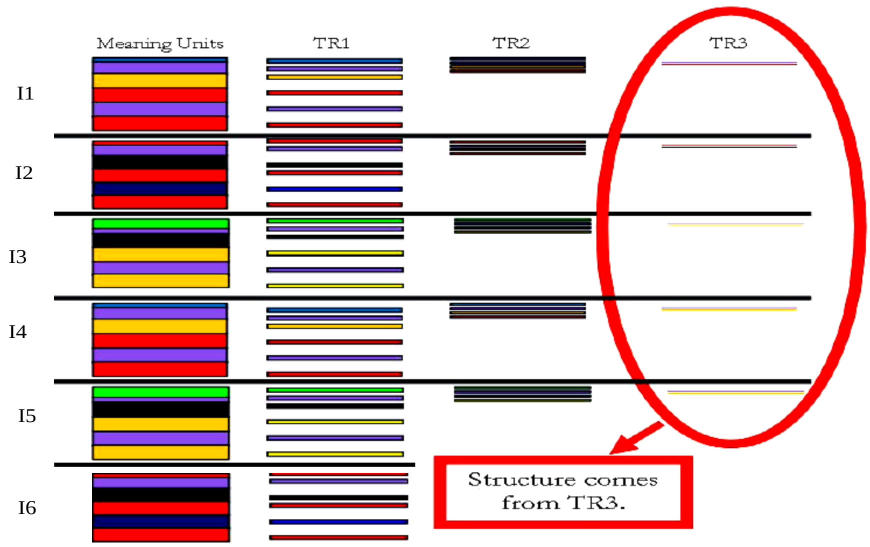

Figure 7.3: Combining TR3s of all Interviews to Develop the Final Structure

Taken From (Mavin, 2013, p. 84)

7.7 Validity

In previous chapters when discussing phenomenological methodologies it was determined that studies could demonstrate their validity under three theories of validity. The following three sub-sections (7.7.1, 7.7.2 and 7.7.3) outline how this study meets the requirements under these theories.

7.7.1 Communicative validity

Communicative validity is said to be achieved when three steps have been met. The first step may be met when it can be shown that both the researcher and the participant subject share a common understanding as to the purpose of the research (Kvale, 1995, 1999; Sandberg, 2005; Abbaszadeh, 2012). For this research project this first step was accomplished in several ways. When initial contact was made with the prospective participant subjects whether by phone, Skype or email, the research objective was clearly explained. If a prospective participant showed interest in participating in the research, then an email with an information package including an agreement to participate and an information form was sent (Appendix B). At the beginning of each interview the purpose of the interview was again confirmed for example.

Researcher C: *I just want to confirm that you received and signed the agreement to participate form and you've got all the relevant information that was sent with that form.*

Captain 6: *Yes I've signed that form sort of no clause arrangements and gone through all the practice questions and tried to give it a bit of thought to try and give you as honest and open and relevant information as I can for your thesis.* (I6: 1)

The questions were intended to highlight the differences in flight deck management practices between Chinese and Anglo-European pilots. The researcher was therefore asking for descriptions and specifics of the participant's experience, for example.

Researcher C: *Ok, so I just wanted to start off with some questions, and we would like you to answer from your personal experience, with some indications of how you, of what you have observed when working with your Chinese crews. The first ah question we have relates to how you find the Chinese crews work through the process of determining MEL issues and performance calculations?* (C, I3: 1)

The second step in complying with the requirement of communicative validity required that a consistent, cohesive and logical theme was maintained throughout (Kvale, 1995;

Sandberg, 2005). Consistency, cohesiveness and logic were demonstrated initially by tracing each participant's responses to common themes in the TR3. Then finally all TR3s were used to develop a common cohesive interpretation of the overall experience of the phenomenon.

The third element in this process involves discussion of the research findings creating a feedback loop between the researcher and the research participants (Kvale, 1995; Giorgi & Giorgi, 2008; Abbaszadeh, 2012). Discussion with third parties to obtain further feedback has also been recommended (Sandberg, 2005). To this end discussion via email, Skype and face-to-face has taken place with the research supervisors, participants and other interested pilots. For example below is a short extract from an email from one participant.

I've had numerous conversations with Captain Costa Ferroff about his PhD work. I've read the conclusions of his study and can confirm that the result of the interviews and Captain Ferroff's assessment are in line with my own experience. (Herbert, 2013)

The last element requires that the researcher maintain accountability for the research findings (Kvale, 1995; Sandberg, 2005; Giorgi & Giorgi, 2008; Abbaszadeh, 2012). To achieve this requirement for accountability the researcher has retained all interview recordings, notes, transcripts and transformations that form the basis for the research.

7.7.2 Pragmatic validity

Previously it was stated that pragmatic validity could be shown by confirming that people actually do what they say they do (Sandberg, 2005; Abbaszadeh, 2012), and that there are four methods for confirming validity. The first method was to ask follow up questions in the following example:

Captain 5 has previously introduced speed control on arrival as a subject. The researcher follows up with additional questions to elicit more information using two follow up questions.

Researcher C: *What about things we sort of touched a little bit previously on the speed limitations and STAR and altitude limitations? Do you have any more experience that you could pass on about compliance rates with those sorts of things?* (C, I5: 18)

Researcher C: *Right, what about the published limitations on STARs and SIDs?* (C, I5: 19)

The second recommended method is for the researcher to obtain descriptions of actual examples whenever possible. An example of a question seeking information on the handling of MEL items and performance calculations appears below:

Researcher C: --- *would you be able to describe and preferably have some instances where you may have used had to work through any MEL items and performance calculations and could you describe the difference between working with the Chinese and Western crews in that regard?* (C, I4: 1)

Participants also used examples to highlight their experiences for example:

Captain 3: *Most of the time tailwind is not taken in to account even in very limiting airports. There is one example where my current company that is in [name of airport] ---* -- (I3, 13)

The third technique for obtaining pragmatic validity is to use misinterpretation to elicit a correction or reiteration from the participant. In consideration of the technical nature of much of the subject matter and the open and forthright nature of the responses given by all the participants, the researcher did not see any value in pursuing this technique in confirming validity. This was also the case with other researchers using deliberate misinterpretation who found it difficult considering the subject matter. The researcher also found that even attempting to use this method interfered with the flow of the interview.

The final method for obtaining pragmatic validity is to test interpretations and findings in practice. To date it has not been possible to test the interpretations and findings in the wider aviation community, however within the small circle of supervisors, participants and other interested pilots there has been considerable discussion on the subject. One participant had the following to say:

His analysis reflects faithfully the numerous differences between the western and eastern type of airline operations and the sometimes diverging ways adopted to reach a common target, air safety (Herbert, 2013).

7.7.3 Transgressive validity

As described in Chapter 6, transgressive validity is used to test and confirm themes, perceptions, interpretations and findings obtained by the research and previously validated under the precepts of the theory of communicative validity. Transgressive validity is obtained by testing interpretations with counter argument. That is to say, transgressive validity may be tested by searching for an alternative explanative for events and observations by exploiting any tension, disagreement or uncertainty within a subject's narrative (Smith & Osborn, 2008; Abbaszadeh, 2012). Original interpretations could be deliberately opposed to test support for an opposing point of view. If support for this new perspective was found, the original interpretation may need to be rejected unless further support for it could be obtained (Lather, 1993; Sandberg, 2005). To meet the requirements of transgressive validity the researcher searched for alternative explanations for the observations made by the six participant captains, however possibly due to the highly structured and technical work environment being discussed, the researcher was unable to find alternative explanations for the observations described.

Transgressive validity may also be shown if it can be confirmed that the descriptions contained in the narrative are a reflection of what occurs in practice (Kvale, 2001; Sandberg, 2005; Abbaszadeh, 2012). Validity in this area has been shown in three ways. The researcher spent several years with a Chinese airline and as such was able to use personal experience and observations as a comparison to the participants' experiences. Secondly the researcher was able to use the findings of another study on the same topic conducted under a different methodology as an informative basis for question development and for comparison in practice. Thirdly the researcher found that even though the participants' overall experience with Chinese airlines varied considerably from the very positive to quite negative, the actual data obtained through the transformation process was well aligned in all cases. This was an item that was discussed at some length between the researcher and the participants.

7.8 Reliability

As discussed in chapter six, empirical phenomenology largely derives its validity through its robust methodology and is highly dependent on its methodology to demonstrate reliability. Very high levels of reliability are required and demonstrated for research conducted in the field of natural science where quantitative processes allow for the duplication of experiments and studies (Babbie, 1994; Sandberg, 1997; Silverman, 2001; Abbaszadeh, 2012). This type of reliability test is considered an incompatible metric for use in social research settings where qualitative process are used, not least because many studies simply cannot be replicated in an exact manner due to the reliance on descriptions of an individual subject's conception of reality. As a result phenomenological research largely derives its reliability from its methodology. In essence there are six main requirements that need to be met to ensure that the research may be considered to be reliable under the chosen methodology. 'These requirements are:

1. How the interview questions are devised;
2. Outline of how and why participants were selected;
3. A detail of procedures and processes used for data collection;
4. How data is analysed;
5. Provide sufficient detail and examples of how results were obtained; and
6. Provide a 'paper trail' for other researchers wishing to confirm or audit research.' (Mavin, 2013, p.91)

This chapter has set out the detail as required under Requirements 1 – 4. The descriptions required to meet Requirement 1 above are presented in Chapter 8 with the evidence or 'paper trail' presented in various appendices. The evidence presented in the body of the thesis has been limited to representative samples sufficient demonstrate process and to substantiate the findings. There was a large amount data produced for this research project including sound files, narrative transcripts, notes and transformations. While not all this information is included in the thesis the researcher has retained all the data as required and thus considers that the requirements under section six have been met.

7.9 Summary

This chapter described how the research methodology was specifically applied to this project. The process of participant selection was discussed. Previous studies of this type have used participant numbers of five to nine subjects thus the use of six subjects in this study seems reasonable. The use of criterion sampling as a method for selecting suitable participants was also discussed. Previous studies have confirmed that this is a reasonable method for selecting suitable subjects. The process of question development was also considered and the question databank was also presented. Chapter 7 also discussed how the seven steps of the 'Descriptive Phenomenological Psychological Method' were applied in this study. Finally there was a description of the process used by the researcher to meet the various criteria as stipulated in the methodology and demonstrated that the requirements of both validity and reliability were satisfied.

Chapter 8

Findings

8.1 Introduction

Previously in this thesis the broad term 'Culture' was discussed as having two facets and that this thesis would consider culture in a social context. In this context the case has been made that culture has an impact on every area of human activity, because culture determines the way in which people solve problems. Trompenaars (1993, p. 8) said 'every culture distinguishes itself from others by the specific solutions it chooses to solve certain problems.' If this is so then it stands to reason that generic procedures that rely on the behavioural assumptions of one culture may be inappropriate for use by people of another culture.

A review of current statistics indicated that pilot error is considered to be the major contributing factor in approximately 60% of all accidents (Boeing, 2005; ASN Aviation Data Base, 2008). In an effort to reduce the number of accidents attributable to human factors, that is to pilot or crew error. Cockpit (Crew) Resource Management (CRM) programs have been developed and now form a major linchpin in the present arsenal of aviation safety measures. The importance of national culture in CRM training has been raised by Helmreich and Merritt (1998).

The six captains who participated in this study all reported variations in flight deck management practices and standards displayed by Chinese crews as compared to those used by crew members whose formative years were spent in an Anglo-European environment. Therefore the proximate question becomes: having identified a variation in operational management practices what lies at the root of this variation? During the analysis of the data it was revealed that some of the phenomena observed had a cultural basis while others had an underlying basis in language or training.

This chapter starts with a synopsis of each captain's interview after which a paragraph containing the structure developed from the combined experiences of all the captains is presented. As discussed earlier, it may be seen that the structure is formed from a number of constituent elements and a description of these constituent elements is also contained in this chapter. The concluding section of the chapter contains the rationale behind each constituent.

8.2 Summary of Interviews

During each interview the researcher used the interview schedule to encourage participants to provide examples that highlighted the different operational practices experienced in both Chinese and Anglo-European airlines. The eight questions that formed the basis for the interview schedule were designed to reveal the key constituents of flight deck management that may have a cultural element. In developing the summaries the researcher has used the 'model for assessing pilots' performance' developed by Mavin (2013) as a guide for dividing the descriptions contained in TR3 into essential and enabling behaviours, and to provide a consistent format in the summaries.

8.2.1 Summary, Captain 1 (I1)

Captain 1 observed several areas where Chinese crew members performed to a lower standard than was expected. Chinese crew members who had poor English comprehension skills were seen to display a similarly poor performance in the areas of aviation knowledge, management of crew, and communication. Captain 1 identified that the aircraft specific knowledge of both the Chinese and Anglo-European crews was of a similar standard, however the knowledge assimilated by the Chinese crew members was almost exclusively exam-focused rather than operationally-focused. This focus led to a lower standard of general knowledge in aviation-related subjects and a lack of appreciation for the peripheral aircraft limitations. CRM was a big issue for Captain 1. CRM training was reported to have little impact on crew interaction amongst the Chinese crews. Captain 1 observed that the power distance relationship between the Chinese crew members remained very steep with the Chinese first officers having little input into the operation. Captain 1 also related that compliance in all operational areas was achieved largely through punitive measures. This was seen to impact on flight path management. Captain 1 reported that these issues along with a poor use of flight documentation and reference material and an over reliance on automation, led to SA issues for some of the Chinese flight crew.

8.2.2 Summary, Captain 2 (I2)

Captain 2 described numerous areas where some Chinese crew members displayed a poor skill set. Captain 2 observed that English language comprehension skills were seen to be a significant factor in enabling a high operational standard. Crew members who displayed poor skills in this area also displayed below-standard performance in other operational areas. Poor English comprehension was seen to have a negative impact on the knowledge base, management skills and general communication skills of Chinese crew members. Captain 2 related that as there were many different Chinese dialects, communication amongst Chinese crew members remained problematic even when using a Chinese language. Captain 2 observed that the Chinese crew members had a good knowledge base in regards to theoretical knowledge' however he reported that there was often a knowledge gap when it came to the practical application of that knowledge. Captain 2 also reported reluctance on the part of the Chinese pilots to seek assistance so as to improve their understanding of the practical operational aspects of the aircraft systems. CRM was also considered as a problematic operational area for the Chinese crews. Captain 2 observed three deficiencies in the CRM training delivered by Chinese airlines: CRM training by Chinese airlines did not seem to place any emphasis on the use of a problem-solving methodology to allow decisions to be made commensurate with risk; communication skills were not seen by the Chinese crews to be an important enabling tool; and a high power distance relationship on the flight deck continued to be in place contrary to the principles of CRM as used on the flight decks of Anglo-European Airlines. Captain 2 related that compliance in Chinese airlines was achieved through a punitive system, and so weather avoidance manoeuvres and other operational decisions were made on a pre-primed rote basis rather than through the development of a solution specifically formulated for each individual situation. Captain 2 observed that SA depended on communication skills, knowledge, observation skills, crew management skills and problem-solving skills, and that a poor performance in any area resulted in reduced overall Situational Awareness.

8.2.3 Summary, Captain 3 (I3)

Captain 3 considered low levels of English language comprehension to be a significant hindrance to the ability of the Chinese flight crews to obtain a high standard of operational competence, having an impact on both knowledge and procedures. Captain 3 observed that a good standard of knowledge was displayed by the Chinese crew members in areas that were supported by rote learning skills. The in-depth practical application of that knowledge was seen to be problematic however, with the Chinese crew members having a lower level of understanding in this area than the Anglo-European crew members. Captain 3 observed that the Chinese concept of CRM differed considerably from the Anglo-European model. A high power distance relationship was maintained with various methods employed to uphold the status quo. Decision-making by the Chinese captains was generally seen to be made in a top-down non-inclusive fashion which meant that at times decisions were made without reference to all the available information. Captain 3 also related that he had seen no evidence to suggest that a problem-solving methodology was used to assist the Chinese crew members in the decision-making process. Operational compliance was seen to be obtained through punitive measures. Captain 3 reported that this action could be detrimental to safety as aircraft damage went unreported due to the natural desire of the flight crew to avoid being penalised. Captain 3 observed that a lack of applied knowledge and decision-making processes, coupled with the existence of a high power distance relationship, a punitive compliance system, and the poor use of flight documentation and reference material, led to a lower level of SA being displayed by some Chinese crew members than by Anglo-European crew members he had flown with. Additionally, Captain 3 related that this lower level of Situational Awareness resulted in poor threat recognition and management.

8.2.4 Summary, Captain 4 (I4)

English language comprehension was also an issue addressed by Captain 4 who observed that poor English comprehension resulted in the use of an inappropriate checklist methodology, significant knowledge gaps and poor communication skills, leading to miscommunication with ATC. Captain 4 observed that Chinese crew members had a knowledge base derived from rote learning. Interestingly this knowledge was at times supplanted by information delivered through oral tradition. This oral information sometimes related to previous aircraft types or outdated procedures and as such, contradicted the source information in various operations manuals. Captain 4 also related that instructional emphasis was placed on what to do, with little emphasis being placed on why. This was seen to lead to a lack of in-depth systems knowledge. Captain 4 stated that CRM was an essential element in enabling high quality decision making and observed that the CRM, as practiced by the Chinese crew members, differed from the CRM as practiced in Anglo-European airlines in several areas. CRM training was not used to break down the high power distance relationship frequently observed on the flight decks of Chinese airliners. This was seen to lead to a poor level of interaction between the Chinese flight crew and the cabin crew. Nor was CRM routinely used as a management tool by the Chinese crew members. Captain 4 saw no evidence that a problem-solving methodology was employed as part of the decision-making process. Additionally, Captain 4 observed that external sources were not utilised as an information-gathering tool. This was most obvious when Chinese crew members focused on reported data that was not representative of the real world as observable from the flight deck. Captain 4 stated that failures in each of the areas above were responsible for the reduced Situational Awareness displayed by the Chinese crew members he flew with. The reduced Situational Awareness combined with the punitive compliance regime employed by the Chinese airlines was considered to lead to inappropriate decisions being made with poor operational outcomes being achieved.

8.2.5 Summary, Captain 5 (I5)

English comprehension skills were also seen by Captain 5 to be an important predictor to high quality operational outcomes. Captain 5 observed that the Chinese flight crew members who had a high standard of English language skills also displayed superior levels of competency in other operational areas. Captain 5 reported that from the perspective of purely theoretical knowledge the Chinese pilots had an adequate understanding of the required material. There was however a failure in many cases to apply this knowledge in a practical manner relevant to the operational environment. Captain 5 observed that there was a poor understanding of the concept of CRM or at least CRM as it was practiced in Anglo-European airlines. There was a low emphasis placed on CRM within the training process, and indeed CRM was considered to apply only to the flight crew, its purpose being to ensure that subordinate crew members supported the captain's decisions. Captain 5 reported that using CRM in this manner reinforced a high power distance relationship on the flight deck and gave the first officers little chance to manage upwards or even openly question a superior. Captain 5 also found that operational decision-making amongst the Chinese crew members was problematic for several reasons: there was a lack of formal decision-making processes, poor use of external resources and a knowledge gap in the concept of threat and error management as utilised in the Anglo-European airline industry. Captain 5 reported that compliance was obtained through a process of monitoring and enforcement through punitive measures. This practice resulted in a system where items that were monitored were complied with religiously while items not monitored were ignored. Captain 5 also observed that the punitive system often led to excessively conservative and inconsistent operational practices which resulted in risk avoidance rather than risk mitigation. The combination of poor communication and CRM skills combined with the punitive compliance regime was seen to impact on overall Situational Awareness which in turn resulted in operational decision-making that was at times less than optimal.

8.2.6 Summary, Captain 6 (I6)

Captain 6 reported that English comprehension could be an issue on the flight deck and that Chinese pilots with poor English language skills had difficulty dealing with flight documentation, ATC communication and operational threats. Captain 6 described some intervention measures that the company he had worked for had developed to mitigate the risk associated with this aspect of the operation. Despite the language problems Captain 6 stated that he found the Chinese crew members that he flew with had a good aviation knowledge base. However CRM was an area that Captain 6 found to be problematic, with the Anglo-European crew members being excluded from any process being used. Captain 6 observed that the CRM processes used by the Chinese crew members were of a poor standard with no formal decision-making process being evident. Captain 6 also reported that compliance was largely obtained through punitive measures, but he was uncertain as to the impact this practice had on flight deck management. Captain 6 found that the Chinese crew members had a high level of Situational Awareness when operating in China, however, that level of Situational Awareness was seen to degrade when operating in a foreign environment or when faced with an operational threat. Captain 6 observed that, when the operation of the Chinese pilots was viewed from a holistic perspective, deficiencies in traffic awareness, coordination issues with cabin crew and ATC and poor task sequencing and prioritisation were symptomatic of poor Situational Awareness.

8.3 Structure of all Interviews

A combined overall structure developed from the six interviews describing operational differences observed is presented in the following paragraph.

Flight deck management is a holistic process where a flight crew, under the leadership and direction of the captain, collaborate to fly an aircraft by making operational decisions that are ideally made considerate of risk, policy and economy. The captain must obtain and prioritise information from sources both internal and external to the flight deck to maintain Situational Awareness. Situational Awareness amongst Chinese flight crew members was seen to be dependent on several enabling factors. Chinese crew members who had a high standard of English language comprehension were seen to have a better understanding of flight documentation and reference material. The overall communication skill of the Chinese flight crew was also seen to be enhanced when the Chinese flight crew had a higher standard of English language skills. The knowledge base of the Chinese flight crew members was found to be high in the area of theoretical knowledge, an area well suited to the rote learning techniques preferred by the Chinese pilots. Applied knowledge however was frequently observed to be below the desired standard. The Anglo-European model of CRM was not seen to be used within the Chinese system. CRM training was used to support a high power distance relationship on the flight deck and this was seen to result in poor information gathering techniques and communication skills. The CRM training did not place any emphasis on a formalised decision-making process nor was risk or threat and error management considered as a priority. The preference of Chinese airlines to ensure operational compliance through punitive measures affected the decision-making process by creating an environment where decisions were seen to be based on threat avoidance rather than mitigation. The threat of punitive measures also influenced situational management in that there was an overreliance on pre-primed decisions rather than creating optimum solutions for specific situations. In consideration of these points, flight deck management as practiced by Chinese crew members suffered from poor Situational Awareness affected by three constituent elements: language, knowledge and crew management principles.

8.3.1 The Flight Deck Management Pyramid

From the structure above it was considered that there were 10 constituents to flight deck management: flying skills, decision-making, compliance regime, Situational Awareness, knowledge, crew management, communication, power distance relationships, English language comprehension, and culture. Of these 10 constituents six were previously identified by Mavin (2013) & Mavin & Roth (2014) and were supported by the descriptions obtained from the participants in this study. The remaining four constituents are elements that were identified from analysis of the descriptions of differences observed by the participants between the operational practices of Chinese crew members as compared to Anglo-European crew members. This information is presented below in Figure 8.1, ‘The Flight Deck Management Pyramid’. This pyramid shows the relationship of the 10 constituents by demonstrating that the final outcome is derived from a series of both essential and enabling constituents. The evidence presented below in support of the structure shows that the process is hierarchical in nature and that a change in any constituent would change the outcome while removal of a constituent would result in the structure collapsing.

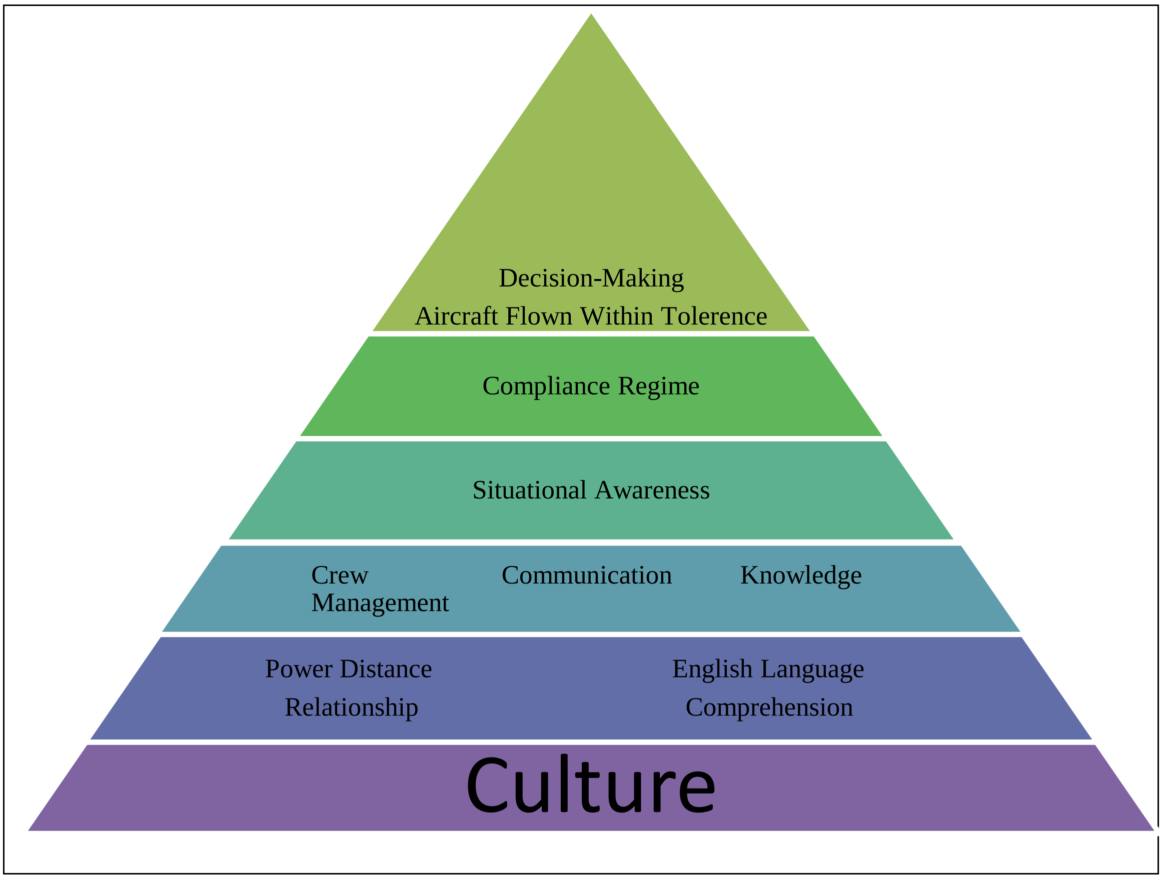

Figure 8.1: The Flight Deck Management Pyramid

In the Flight Deck Management Pyramid, culture (national, professional & corporate) is considered as an intrinsic foundational element of the management process. Cultural dimensions relating to power distance relationships and the acceptance of and proficiency in English language support the enabling elements of crew management, communication and knowledge. These enabling elements in turn underpin the essential element of Situational Awareness. Initial decisions made up to this juncture are filtered by the constraints of the compliance regime prior to completion of the decision-making process. The final outcome then is that the aircraft is flown within tolerance with decisions having been made commensurate of both risk and compliance.

8.4 Evidence Supporting the Structure

Under the phenomenological research methodology researchers need to demonstrate how the constituents were developed and how those constituents form the structure of the phenomenon (Giorgi & Giorgi, 2008; Abawi, 2012; Abbaszadeh, 2012; Shosha, 2012; Mavin, 2013). The following section seeks to describe how each constituent was distilled from the interview narratives and examine how each constituent supports the others in a hierarchical manner as described in the Flight Deck Management Pyramid above.

Culture forms the base of the pyramid. Culture has previously been seen to impact on all areas of human endeavour. Individuals absorb culture from birth and as such culture is an innate element. Most researchers have recognised that there are numerous cultural dimensions at work within each culture. In the pilot group evidence of a variation in pilot operational preferences has been indicated in previous research in to cultural values. Helmreich & Merritt's (1998) study identified that pilots from some cultural groups had a preference for a highly regulated work environment, a high reliance on automation and preferred a hierarchical command structure while other groups rejected these values. Research has also indicated that the cultural orientation of an individual may change over time as a function of education, additional language training and exposure to other cultures. On the next level of the pyramid are power distance relationship and English language comprehension. These were seen to be dependent on the cultural orientation of the individuals in question. The power distance relationship orientation of the captain was seen to have an impact on crew management, communication and knowledge which form the next tier of the pyramid. A low power distance relationship was observed to enable enhanced outcomes in these items.

Similarly a superior level of English comprehension was linked to improvements in crew management, communication and knowledge. Elevated skill levels in crew management, communication and knowledge were seen to assist with developing and maintaining Situational Awareness. Situational Awareness was seen to lack context without a compliance regime as a frame of reference, which forms the next two levels of the pyramid. The compliance regime was seen to act as a filter that enabled decisions to be made commensurate of risk and allow the aircraft to be flown within tolerance, the final outcome of the pyramid.

8.4.1 Culture

In previous research discussed in this thesis, culture has been seen to be the foundation of all human endeavours and the case has been made that the aviation industry is no different to any other endeavour in this respect. Culture however is a difficult concept from a specific perspective, as previously discussed, as culture can mean different things to different people. From a behavioural perspective underlying national culture is usually considered to be multi dimensional in nature and a large portion of the research on this subject has largely concentrated on attempting to define these cultural dimensions. These dimensions have typically been viewed from the perspective of value based assessments. The methodology used in this research has actively avoided value based questioning as a method of minimising bias.

The use of value based dimensions as a framework for cultural differences is common amongst the key researchers in this field with Kluckhohn and Strodtbekc (1961), Hofstede (1980, 1982, 1984, 1986, 1991, 2001, 2008), Hall (1987), Schwartz (1994), Trompenaars (1997), House *et al* (2004) all referring to cultural dimensions in their research.

A review of literature based around cultural research for high technology industries reveals a preference for the cultural dimensions described by Hofstede (Helmreich & Merritt, 1998; Li & Stump, 2007; Lippert & Volkmar, 2007; Gaspay *et al*, *2008*). Helmerich and Merritt's (1998) study using the Flight Management Attitudes Questionnaire (FMAQ) used Hofstede's (1980) dimensions of culture as a reference point for comparisons of national culture and value differences for the pilots of 22 nationalities (Helmerich *et al*, 1993). The results of Helmreich and Merritt's (1998) research indicated that there were strong intercorrelations between their results and Hofstede's (1980) cultural dimensions and showed some clear evidence dividing the operational preferences of pilots from different cultural backgrounds (Helmreich & Merritt, 1998). Pilots from Anglo, Scandinavian and German backgrounds rejected steep cockpit gradients, inflexible or inappropriate procedures and a high reliance on automation, whereas pilots from the Asian region had a preference for a highly regulated environment with a rule or procedure for every occasion, relied heavily on the use of automation and preferred a defined hierarchical command structure (Helmreich & Merritt, 1998).

Bond and Hofstede's (1988) additional dimension, long term – short term orientation (Confucian Dynamism), was not examined in the Helmreich and Merritt study of 1998. However the behaviour described in this dimension as being consistent with Asian cultures, future orientated, persistent, emphasis on tradition, preservation of face and recognition of social obligation were considered observable cultural behaviour that might be found in participant descriptions recorded in the narratives for this study.

The participants in this study were not asked to evaluate culture however some participants did raise the issue of culture in their responses. The participants had responses aligned with three of Hofstede's (1980) original cultural dimensions and the additional dimension from Bond and Hofstede's (1988) research thus providing evidence to support a cultural foundation for the Flight Deck Management Pyramid.

Uncertainty Avoidance

Hofstede's (1980) cultural dimension of Uncertainty Avoidance (UA), is related a society's acceptance of uncertainty or ambiguity. Hofstede rated Asian cultures as being high on the UA index with a preference for mitigating uncertainty by minimising change and a reliance on rule based procedures.

In Interview 4 when asked about the difference between the takeoff performance calculation methodology as used by the Chinese crews as compared to the methodology used by the Anglo-European crews the Captain being interviewed said the following;

Captain 4: --- *But in regards to why they don't use it in the first place, it would be because they only do what they are told to do or trained to do,* --- (I4:14)

Captain 5 discussed commercial awareness and operational flexibility. In terms of flight profile adjustment through level selection, track distance or cost index adjustment to achieve a cost benefit his observations were as follows;

Captain 5: --- *in terms of cost management [direct] they won't ask for direct* [track shortening] *that's saving time and money. They won't do that. They'll just sit there and fly the route whereas a Western crew would be in there trying to get direct to save half a mile* --- (I5:24)

Captain 6 also had similar observations in the area of the conduct of the flight especially in regards to cost index adjustment;

Captain 6: --- *Most of the time we use cost index 20 which they formulated as being their most fuel – time efficient formula and that varies with different airlines, but there was no straying over the line so far as using other cost indexes or things like that* --- (I6:26)

Masculinity – Femininity

Hofstede's (1980) Masculinity - Femininity Index (MAS) was based on four pillars, two of which were considered as feminine in nature, a cooperative work environment and security of employment. The other two items were considered as masculine, high wages and opportunity for career advancement. As may be expected this study did not reveal any conclusive insight into this cultural dimension however one interview did show that this dimension was operative and that there was a conflict between career advancement, a cooperative work environment and the regulatory environment.

Captain 4 responded to a question relating to operational threats raised by time pressure caused by delays in the following manner;

Researcher C: --- *have you observed any difference then in the way Chinese crews and Western crews might react to operational threats and time pressure constraints and start off before flight and perhaps move on then to in flight?*

Captain 4: --- *We were sitting there with all the doors closed and all the passengers on board, waiting for them to give us a call to say the runway had been cleared of snow. So I just started talking to this guy and said 'when did you last go to* [Airport]. *He said 'oh* *yesterday. Oh really, How'd that go? Oh we got halfway there and it was snowing. We had to come back again. Then there was a few hours delay and then we went again. I said to him 'so what time did you get back the second time? Oh about midnight. We had been up* [at] *about 5 o'clock in the morning for an early start. So[you were] you did the same flight yesterday, operated all day from 5 o'clock in the morning, got back at midnight and now you are up again to do it again today. [Yeah]. I said well you are out of crew duty limitations. Why are you here? Why didn't you ring up someone and tell them you couldn't do the trip? Oh if I did that then I would never get a command. I would never be Captain if I started doing that type of thing.* (I4: 16)

Long term – Short term Orientation

Hofstede and Bond's (1988) research indicated that Asian cultures tended to be long term orientated and that these cultures rated high in areas concerned with tradition, preservation of face, reciprocation, and social obligation.

In the closing segment of the interview Captain 3 was asked if he had any further insight on the topic of the interview Captain 3 related the following observation;

Captain 3: --- *you may never offend or explain* [to] *someone that he is not able* [to do something] *or is wrong. Wrong is a* [concept] *that is not acceptable, also that means that in the loosing face process that you have, that if someone* [makes] *a wrong decision he must recognise that this decision is not the best one without being pushed to admit that this decision was not the best one without being pushed to admit that he was wrong* --- (I3: 49)

Power Distance and Language

The impact of the dimension of power distance relationships in management has been well documented with studies by Hofsteed commencing in the late 1970s identifying this dimension of culture. Later studies by Helmreich & Merritt, Gatien and others have applied Hofsteed's dimensions of culture to aviation settings and thus it is perhaps not surprising to find evidence confirming its impact in this study. While other research has determined that there are many constituent components to culture, both language and the relationship to others are two universally accepted cultural traits (Hofsteed, 1980, 1982, 1991, 2001; Bond & Hofstede, 1988; Kagitcibasi & Berry, 1989; Barnlund & Yoshioka, 1990; Trompenaars, 1993; Oetzel *et al*, 2001; Oetzel & Ting-Toomey, 2003; Gladwell, 2008; Ryan *et al*, 2008; Heine & Buchtel, 2009; Scherer & Brosch, 2009). From the perspective of flight deck management, culture was seen to underpin power distance relationships and the language skills essential to communication, obtaining knowledge and crew management.

When asked about the use of CRM principles on the flight deck Captain 1 had the following response:

Captain 1: --- *It was obvious, right from the start, that the gradient in the cockpit was huge. The Captain was the boss and the First Officer did what he was told.*

Further evidence was found in Captain 5's transcript. When asked about the power distance relationship on the flight deck of Chinese airliners he had the following to say:

Researcher C: *So from that description then I would assume then that the cockpit gradient is quite steep?*

Captain 5: *Very. --- The Chinese culture tends to not want juniors to question seniors if you like. That would tend to be frowned upon, you know, if your leader says do this you do that and get on with it rather than question and think well should I really do that now.* (I5: 31)

In Captain 5's interview the difference in threat response between an Anglo-European flight crew and a Chinese flight crew was described as follows:

Researcher C: *Can we move on then to can you describe any differences in the way that Western crews and Chinese crews might react to operational threats at all?*

Captain 5: --- *in our Western crew it would be that if the PF* [pilot flying] *wasn't handling it, then it would go through a prompt and review sort of technique. In the Chinese culture it goes straight to action because of a lack of communication skills.* (I5: 5)

The impact of language on flight deck management seems to be a complex issue. The captains interviewed all discussed this issue to some extent and it would seem that there are two facets to the subject. Firstly and perhaps not unexpectedly was the issue of poor communication between Western crew members and Chinese crew members, a situation where there was total reliance on English as the common language. Secondly, there was an issue of Chinese to Chinese communication on the flight deck where communication was of a poor standard despite their ability to communicate Chinese.

8.4.2 Language Formats

It has been observed that there are essentially three different language formats throughout the various cultural groups around the World. The first language format to be considered is that used in English. This style of communication is basically linear in construction. Most sentences commence with an introduction then move on to a description or action and finish with a definite conclusion.

For example ‘We are walking to the shop.’

We – Introduction or Subject – (in this instance who the sentence applies to)

Are walking – Action

Shop – Conclusion – Where we are going.

The next language format observed is that used by the native people of Papua New Guinea but common to the native populations of most Pacific Islands and Africa. This language style involves a discussion that revolves around the subject without necessarily reaching a conclusion. For example in Pidgin the following sentence is not uncommon, ‘dis fella some fella something em e some fella something me no got savvy.’ Literally meaning ‘this thing, this thing which is something, is a thing, something I don’t know. (What it is)’

Subject, Subject, Subject, Subject, Subject, Conclusion.

The third language format is that used by the Chinese and other Asian Cultures:

‘Míng Tiān Wǒ Bū Qù.’ Literally meaning “Tomorrow I not go.”

Conclusion, Introduction or Subject, Action.

Everett (2012) considered that there were even more dimensions to language structure when considering the native languages of the Americas. Language format may be considered as representative of both written and verbal communication and by extension, a reflection of the way in which people in the various cultural groups think and process information, as both written and verbal communication are merely methods for the transmitting and recording of thoughts (Man, 2000; Everett, 2013) . This concept has obvious implications for educators and has been the subject of studies conducted by educational researchers (Huang, 1995; Walker, 1996; Chen & Sanchez, 2001; Walker *et al*, 2001; Abubaker, 2008; An, 2008).

The significance of these observed language formats in the aviation arena is uncertain, however communication was raised regularly by the participants both during the interviews and in post-interview discussions, with participants emphasising the importance of English comprehension as a requirement for dealing with operational documentation. English comprehension skills were also seen to enhance first language communication skills. This ability is judged to be especially valuable in a task and goal-orientated dynamic environment.

8.4.3 Power Distance

All of the participants reported that the power distance relationship between the Chinese captains and others, including other crew members and ATC, affected numerous operational activities. Hofstede (2001) identified that the Chinese national culture had one of the highest power distance index ratings of any culture. In a high power distance culture such as this, subordinates were seen to have little or no cultural defence against the actions of a superior. Subordinates were also reported to be over-optimistic about the capacity and abilities of superiors, which could be seen to lead to deferment to rank and a lack of critical analysis in followership (Hofstede, 2001).

8.4.4 Crew Management and English Comprehension

The participants considered that an important flight deck task was the use of checklists. There are checklists for both normal and non-normal flight situations and their correct usage requires the crew to work together in a collaborative fashion requiring coordination, communication, task-sequencing and prioritisation. The subjects reported that the Chinese crew members were able to use the checklists adequately in normal operations although the responses were seen to vary considerably depending on the English language competency of the crew member concerned. In the situation where checklists were generated through ECAM warnings and there was an increased requirement to follow a specific protocol, English language comprehension was seen to play a valuable role in enabling a successful outcome. Captain 2 observed that normal checklists could be learnt by rote. However rote learning was not considered compatible with checklists generated by the ECAM system due to the number and complexity of the checklists. This is further complicated by the reality that the ECAM display is only presented in English, hence the heightened role of English language competency. In response to a question relating to checklist use, Captain 2 had the following to say:

Captain 2: --- *with the standard checklists, they are ok. But they can't understand, they know the checklists by rote, and they read, but do not understand, it's done by rote.* (I2: 8)

Captain 5 expanded on this theme:

Researcher C: *Have you observed any difference between the checklist use between the Chinese and Western crews?*

Captain 5: *They do the checklists in the Chinese crews however the words and responses are variable. In the Western culture we are very pedantic to having an s to 'flaps' as opposed to 'flap'. The checklist reading can be quite an event due to the lack of communication skills and quite often they will have a checklist in the middle of the aeroplane so the PF [pilot flying] can actually read his response to get it right. ---*

Researcher C: *This then of course then leads on to another question then. With ECAM management if English is somewhat of an issue have you noticed at all weather how well the ECAM section is handled? You know bearing in mind that the ECAM on the system display is in English.*

Captain 5: *So they'll see something come up on ECAM and they think I can read it cracking, I'll read that out and you think hold on, hold on we're actually, we're actually just about to land so we best not do that now, --- The errors won't tend to come through from the reading they'll tend to come through from the timing of when to do it and the formality of it, --- they'll launch into it without any formalities where as in a Western airline you'd tend to go through that formalised structure of it which would then lead to a more pedantic and more time conscious application of it.* (I5, 14-15)

The captains considered that checklist use by the Chinese crew members was problematic in several areas. Firstly with normal checklists while responses could be learnt by rote there seemed to be a disconnect between the challenge and the requirement for confirmation of the action prior to the response. The second observation made was that task and checklist prioritisation was problematic for the Chinese crew. Both of these issues could be related to English comprehension. While the disciplined approach adopted by Anglo-European airlines is clearly understood from the procedures described in the operations manuals in English the procedures seem less structured when presented in Chinese.

8.4.5 English Comprehension and Knowledge

Knowledge is an extremely broad subject and certainly not all knowledge is dependent on English comprehension. In the aviation sphere it is entirely possible to successfully fly an aircraft without knowledge of the English language. This is done in some air force and domestic environments. English language skills are required for operations in international airlines and in high traffic regions. Aircraft operations of this nature require communication in a common language to facilitate interaction between pilots of multiple nationalities, internally on the same aircraft and externally between other aircraft. Communication is required between ATC and pilots for the issuing of clearances and operational information. In support of this requirement ICAO has dictated that airline pilots and ATC personnel must attain at least an ICAO Level 4 English language score on a standardised test.

From the perspective of Western-built aircraft, the systems and procedures under which the aircraft are operated are presented first in English and then translated to other languages. The instruments and display screens retain their English only format regardless of the nationality of the operating airline. Thus it is reasonable to suggest that competent English comprehension is likely to lead to better knowledge when it comes to dealing with operational matters in Western-built aircraft. The interview participants considered that English language skills were linked to knowledge in several areas. Captain 3 made the following observation regarding the use of the MEL (background information on the MEL is provided in Appendix I):

Captain 3: *They will systematically refer to a Chinese MEL that is not the official document but only a translation of the official English MEL --- very few will afterwards have a look at the English MEL. --- most of the time they are too restrictive, they miss some of the items that could favour further flight operations without so many restrictions than what they have. Of course fine for safety but operationally it's not really the best solution.* (I3: 6, 7)

Captain 5's response to a question regarding the pre-flight application of an MEL item appears in the passage below:

Researcher C: *So, our first question is related to the process of working through MEL items for the differences between Chinese crew and Western flight crew?*

Captain 5: *Yeah well, I mean the MEL is the communication issue is the starting point, as I'm sure you're aware. MEL is in both Chinese and English and they have large problems getting through the English version, --- Basically I think it stems from communication, unfamiliarity which leads to overcautious situational awareness. However the core knowledge is not bad. I think their ability to apply it becomes an issue which will come down to applied knowledge you know.* (I5: 1)

The captains identified that the knowledge base of the Chinese crew members consisted of rote learnt knowledge. The conversion of that rote learnt knowledge to applied knowledge was seen to present a challenge in two ways: firstly a basic language or comprehension issue could present difficulties in applying knowledge and secondly Situational Awareness could become compromised in critical situations as clues related to the application of appropriate procedures may be missed or misinterpreted.

8.4.6 English Comprehension and Communication

A large proportion of the communication that is conducted in the aviation environment is conducted in English. The ICAO Level 4 English requirement has already been introduced above. This standard was introduced to compel pilots and controllers to improve the standard of their English language skills. The reality that most aircraft in service with airlines around the world are Western-built aircraft provides further impetus for the use of English in aviation. The final driver for competency in English is provided through the multinational crew composition found in many airlines. The participants in this study observed that English comprehension was an essential skill which was at times missing in the case of the Chinese flight crew. On the subject of communication with other people in aviation settings Captain 4 had the following to say:

Captain 4: *Communication with ATC, I think a lot of the time they especially overseas they don't understand quite often what's been said to them, they don't feel as, I don't know, this loss of face thing, asking for an explanation. You know they will say, 'say again' sometimes. Quite often they will get a clearance and they don't always understand what's been said to them --- coming in to [country] we're given some clearances where I'm the only one that has understood it and there's definitely 3 other pilots up there who haven't. --- A couple of years ago [aviation regulator] sent [company] a list of violations, I think it was about 12 of them in 3 months*--- (I4: 57)

Captain 6 also highlighted English comprehension as a key operational skill. He used an example of a missed approach to highlight the requirement for good English comprehension skills in an international environment:

Captain 6: --- *the missed approach was done because there was other traffic conflicting the flight path, a helicopter conflicted the flight path, so they were instructed to do the missed approach. Now the western pilot understood that, all very straight forward and started to execute the missed approach, where the Chinese crew were still trying to understand why they were told to go around,* --- (I6: 40)

Captain 6 also considered the tendency for crew members to have a diminished ability to operate in a second language in times of stress such as would be the case in event of a systems failure:

Captain 6: ---*I think that if they're put in a stress full situation, I think the first thing that they are going to do is renege to Chinese* --- (I6: 70)

Captain 3 also described the same phenomenon:

Captain 3: --- *the moment there is a non-normal events you must expect a lot of cross communication in Chinese and with the ground and inside the cockpit, and it's then the foreign captain present that they bring some order in it to have a proper translation, to have a proper confirmation with air-traffic control in English*--- (I3: 10)

In the international operational aviation environment it is acknowledged that a universal language is required. The accepted universal language is English and as such acceptable standards of English proficiency have been mandated. Despite establishment of and testing for a minimum standard, English language proficiency continues to be inconsistent amongst Chinese crew members. This inconsistency led to communication failures during periods of high stress when first language reversion occurred. Communication breakdowns were also observed in time-critical situations due to misunderstandings and the failure to recognise linguistic cues for action in both internal and external dialogue.

8.4.7 Power Distance and Knowledge

Research has indicated that power distance relationships not only affected the general relationship of subordinates and superiors but that the relationship impacts on both training delivery and content (Li & Guo, 2012). Training in societies having a high power distance relationship has been seen as being teacher-orientated with the students considered to be passive learners (Song, 1995) who tend to ask few if any questions (Hofstede, 1986; Ishii, 1993; Kawai, 1993; Lockhart, 1994; Richards & Lockhart, 1994; Huijser, Stück & Tanaka, 2002; Lee *et al*, 2005; Kasuya, n.d.). The impact of a high power distance relationship was also seen on the knowledge base of the Chinese flight crew as indicated in the following excerpts. Captain 4 answered a question relating to the differences that he had observed between Western and Chinese airlines particularly in relation to training delivery and outcomes as follows:

Captain 4: --- *just as a general thing I think the way the Chinese learn is by rote and this is the way they learn at school and their writing and everything else they're rote learners and if you give them anything, then they can regurgitate it back to you. No problem at all doing that sort of stuff. Where they are really lacking is thinking through consequences and actions. Reasoning stuff out and asking the question why. They don't ever really ask that question why. --- So what their training seems to be, you know, extensive input from checkers telling them how to do stuff and they just learn it and do it. Give it back to them exactly as told, regardless of if it is written in the book.* (I4: 58, 59)

Captain 1 also observed that for the Chinese flight crew knowledge was gained primarily for passing exams:

Captain 1: *Well, it seems to be fairly obvious from ah attending English classes to assist them with learning English that ah most of their learning is by rote and over-learning. And ah I noticed that ah it's all ah goal related. So overall knowledge, the knowledge seemed to be just purely to ah pass an exam if possible.* (I1: 26)

The Captains interviewed observed that the knowledge base of the Chinese crew members was primarily based on goal-orientated rote-learnt knowledge. There was a lack of critical analysis and lack of questioning to seek clarification or in-depth understanding of systems and procedures. Researchers in other fields have indicated that this phenomenon is consistent with the passive learning style common to high power distance societies (Hofstede, 1986; Ishii, 1993; Kawai, 1993; Lee *et al*, 2005; Paulus *et al*, 2005; Koh & Lim, 2007).

8.4.8 Power Distance and Communication

The link between power distance relationships and communication has been previously identified and has been receiving increased interest in recent years as globalization of industry and governance gathers pace (Hofstede, 1986; Ishii, 1993; Kawai, 1993; ; Lockhart, 1994; Richards & Lockhart, 1994; Helmreich, 2000; Kasuya, n.d.; Huijser, Stück & Tanaka, 2002; Riedel & Karrasch, 2002: Lee, etal, 2005; Abbe, 2008). People from high power distance cultures have been seen to be more formal in their communication activities. Communication is reported to be affected by hierarchy and often subordinates may fail to provide critical information to superiors (Helmreich, 2000; Abbe, 2008). This failure to communicate was observed to be exacerbated by a reluctance to challenge a superior's decision even in the face of near certain catastrophe (Helmreich, 2000; Abbe, 2008; Halpin, 2011). Ridel and Karrasch (2002) also reported communication problems caused by power distance relationships in their study on communication issues in multinational teams. One of the findings from their study was that team members from high power distance cultures were reluctant to ask questions to clarify information as it was against the culture to question one's superior. This situation was not only frustrating for the team members who were from low power distance cultures but it also led to perceptions of decreased ability and a consequent loss of opportunity (Ridel & Karrasch, 2002).

In this study communication was universally raised as an issue. Poor communication styles largely as a result of the high power distance relationship between the Chinese captains and other industry participants were observed. For example in response to a question regarding power distance relationships on the flight deck Captain 1 stated the following:

Captain 1: *The Captain to Captain relationship seems to work ok ah it's not such a steep gradient. However, the Captain to FO gradient is very, very steep. I noticed it with First Officers in particular. When I was flying with them they would be very, very loath to ah speak up. And you could actually make a mistake on purpose and they wouldn't say anything. You'd tend to watch them ah avert their eyes and so I'd say 'What am I doing wrong?' and when questioned they'd say 'Oh, well you're doing this wrong' and I'd say 'Well why didn't you bring it up? Why didn't you mention I'm doing this? Because remember in the briefing at the beginning of the flight I said: "If I make a mistake I want you to bring it to my attention straight away."' And it's obvious that the culture is such that ah they'd rather not bring it up.* (I1: 24)

When considering the role that communication plays pre-flight during the calculation process of the performance data Captain 5 said the following:

Captain 5: *So communication in performance, so we'll just roll through that again in terms of the list you've got for that. The communication style tends to be old school, so they don't tend to communicate freely through the, using CRM techniques* --- (I5: 4)

When asked about his observations of the power distance relationships between the Chinese captains and the first officers on the flight decks of the company he was working for Captain 6 made the following response:

Captain 6: *Yeah. There's quite a strong cross cockpit gradient there. A lot of the captains were trying to prove their point a lot of the time. Yeah, very strong. So I'd say also in the operation where you have a completely Chinese crew some of the captains would be quite strict and less tolerant to suggestions made by the first officers. So, yep, quite strong.* (I6: 38)

The steep cockpit gradient maintained by the Chinese captains was seen to detract from communications both internally and externally to the flight deck. Communication was predominately one-way in format with a lack of feedback and failure to close the communication loop. This was also observed to create a situation where subordinates were loath to advance information and suggestions which could in turn result in missed opportunities for early remedial action in event of an operational threat or error.

8.4.9 Crew Management and Situational Awareness

Developing and maintaining SA is considered to be an essential ingredient in securing safe and efficient flight (de Montalk, 2008; Durso & Gronlund, 1999; Endsley, 1988, 1994, 1998, 1999, 2010; Endsley & Robertson, 2000; Flin *et al*., 2008; Hartel, Smith & Prince, 1991; Helmreich, 2000, 2002; Helmreich & Merritt, 1996, 1998; Henderson, 2009, Kern, 1997; Klampfer *et al*, 2001; Lacagnina, 2007). Mavin (2013) further developed this idea by suggesting that, not only was SA an important skill for pilots, it was an essential constituent for enabling safe and efficient flight.

Situational Awareness has previously been defined as 'the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning and the projection of their status in the near future' (Endsley, 1995, p.36). The effective use of all available resources was considered to be an essential skill for this process. The participants in this study also considered that the resources essential to obtaining and maintaining Situational Awareness extended beyond the flight deck door. This concept is not new and has been seen as a desirable trait on the flight deck by numerous researchers (Endsley, 1988, 1994, 1998, 1999, 2010; Hartel, Smith & Prince, 1991; Helmreich & Merritt, 1996, 1998; Kern, 1997; Durso & Gronlund, 1999; Endsley & Robertson, 2000; Helmreich, 2000, 2002; Klampfer *et al*, 2001; Lacagnina, 2007; de Montalk, 2008; Flin *et al*, 2008; Henderson, 2009). This concept forms a component of CRM training as delivered to Anglo-European flight crew. Considerable emphasis has been placed on ensuring that captains include first officers, cabin crew, ATC, engineering, fire or emergency crew personnel and use any other available information source to expand Situational Awareness. Participants reported that this process was seen to be less developed amongst the Chinese captains than was the case amongst Anglo-

European flight crews. Captain 3 had the following observation regarding information-gathering by Chinese captains on the flight deck:

Captain 3: *Well they do not make full use of the resources, that means for instance the cabin crew is very seldom consulted and the information to them comes fairly late compared to the western world. So they are missing some clues sometimes definitely because they do not involve all of us that could give them relevant information.* (I3: 38)

Captain 4 observed that, not only did the Chinese captains not seek information from other crew members, but they did not pass information on to other crew members:

Captain 4: *And there's no communication between the cabin and the flight deck. They never ask. They wouldn't even consider calling the flight deck and saying can you put the seat belt sign on. They would never do that, and as far as the cockpit calling the cabin and telling them that there's turbulence coming up you need to pack things away, they would just never do that either.* --- (I4: 41)

When discussing CRM in general, a component of which is crew management, Captain 5 said the following:

Captain 5: --- *captain was number 1 and pretty much everyone did as they were told sort of thing. And the crew down the back were consulted not very often and told what to do* --- (I5: 30)

The Chinese captains were observed to have a captain-centric focus to their management style. This myopic focus was seen to lead to a reduction in Situational Awareness as information from other crew members was not sought. Indeed not only was information not sought from other crew members but information was not disseminated to other crew members, having a consequential effect of reducing the Situational Awareness of those other crew members.

8.4.10 Knowledge and Situational Awareness

In Chapter 2 the link between knowledge and Situational Awareness was introduced. Knowledge is required as part of Situational Awareness to enable the crew to react to:

- geographical elements such as terrain, navigation facilities, control area boundaries, clearance limits and proximate traffic.
- spatial elements related to flight path maintenance, altitude, air speed, attitude and configuration.
- systems elements consisting of an awareness of automation level, fuel status, communication status, and issues related to serviceability and safety.
- commercial or tactical items which may include operating costs, noise abatement requirements or on-time-performance considerations (Endsley, 1999; Mavin, 2013).

Participants in this study shared the view that Situational Awareness and knowledge were connected. Captain 1 described a lack of Situational Awareness on the part of the Chinese crew members on a flight from a European city to a Chinese city:

Captain 1: *When I got back, the deck log hadn't been ah touched since I'd been gone, and ah, all the charts I had out were still out, but the relevant ones for the route, where we were at the time, were not out. So, consequently, the situational awareness was lacking because ah they didn't know exactly where they were,* **---** (I1: 13)

Captain 1 also observed that the Chinese pilots had knowledge gaps with aircraft limitations which could affect SA from the aspect of systems status. In answering a question regarding aircraft specific knowledge Captain 1 stated:

Captain 1: *Ah, generally, their general knowledge was fairly good, um from what I could see. --- Ah so there was just small things. Ah the periphery things: anti-icing, when the anti-icing was required etcetera and ah fuel temperatures etcetera. Just ah more obscure things.* (I1: 30)

Captain 3 reported a lack of SA as a result of lack of knowledge regarding the effect of altitude on takeoff performance:

Captain 3*:* *most of the time tailwind is not taken into account even in very limiting airports. There is one example where my current company that is in* [European city], *that's* [name] *airport, located that's 2000 feet with a runway that look fairly long with of course the altitude it's already less comfortable and ah for information at this airport one knot of tailwind gives you a performance penalty of 1000 kilo and most of the crew will not take this take this into account. --- Um also with the crew on limiting airports it would be wise to make the performance calculations before ordering the fuel. This is not yet in the scope of most of the Chinese Captains* [who are] *almost certain that they will be able to take off at the maximum structural takeoff weight at most of the airports they go, while this is not always the case and sometimes presents some interesting sequences with unloading freight or unloading fuel, depending on what the circumstances.* (I3: 3-5)

The captains interviewed in this study described several situations where a lack of knowledge led to lapses in SA. These lapses occurred in a number of areas. Poor record keeping and use navigation charts led one crew to be uncertain of their position. Other crew members demonstrated a lack of understanding by failing to use wing and engine anti-icing as required and failing to monitor fuel temperatures to prevent fuel freezing at high altitude in cold climates. Another instance where a lack of knowledge led to poor decision-making as a result of poor SA related to a failure to apply knowledge regarding the effect of altitude on take-off performance resulting in the offloading of either fuel or payload.

8.4.11 Communication and Situational Awareness

In Chapter 2 the requirement for good communication skills on the flight deck was introduced. Communication skills were recognised as an essential element in developing and maintaining SA in all high-risk team environments, while poor communication was seen to lead to unintended outcomes (Nieva *et al*, 1978; Foushee & Helmreich, 1988; Kanki & Palmer, 1993; Kern, 1998; Edkins, 2005; Flin, O'Connor, Crichton, 2008; Mavin, 2013). Good communication skills have been shown to be instrumental in providing information, maintaining task focus, and in establishing and maintaining both relationships and predictable behavioural patterns (Kanki & Palmer, 1993; Kern 1998; Flin *et al*, 2008). This view was supported by the participants in this research who linked communication to SA in the interview narratives below.

Turbulence may be considered as an aviation hazard. Clear Air Turbulence (CAT) is not usually observable from the flight deck and forecasting is unreliable. There are certain times of the year in China where CAT is prevalent. When asked if he had observed if Chinese crews included non-cockpit resources in their problem-solving processes, Captain 2 chose an example of seeking turbulence reports from other aircraft to enhance SA with regards to CAT on one of the busy Chinese air routes:

Captain 2: *Well I'm thinking now, and the only time I can remember people asking for the, for instance the* [city] *to* [city] *to* [city] *route, asking for turbulence reports were the Caucasians, the seven of us that were working for the company always asked for turbulence* [reports], *I never heard a Chinese ever ask for a turbulence report* --- (I2: 29)

In answering a question regarding the standard of SA as displayed by the Chinese flight crew that he had flown with, Captain 4 described his experiences as follows:

Captain 4: *Their communication is very, very lacking. Although there is a lot of Chinese being spoken around the flight deck that I don't know what's being said. But they don't feel that there's any need to pass on any information to the pilot in command. You know, they'll get calls from the cabin or from ATC or the company and then you're sitting there waiting for the information to be passed on to you and there's nothing said unless you ask, what was that all about and sometimes it's nothing and sometimes it's something and you think why, I wonder what is going through their head to think they can just absorb that information and not pass it on to the pilot in command.* (I4: 31)

The captains interviewed for this study observed that the Chinese crew members displayed poor communication skills and that this impacted on SA on the flight deck. They considered that poor communication was demonstrated in that the Chinese crews did not seek information to enhance their own SA nor did they volunteer information that would expand another crew member's SA.

8.4.12 Linking Situational Awareness the Influence of the Compliance Regime and Outcomes in Decision Making and Flight Path Management

Previous research has shown that SA, decision-making and flight path management are linked. An analysis of the data collected in this study showed that the participants described situations where this connection was evident. This study found that a difference existed between the previous study conducted by Mavin & Roth (2014) and the present study. The participants of this study raised the compliance regime as an issue. The type of compliance regime was seen to act as a filter or influence that affected crew decisions and flight path control inputs made in response to perceived situations.

All participants raised the issue of compliance through punitive measures as being an issue for the Chinese flight crew. The punitive compliance regime as used in the Chinese aviation industry was seen to create a system where compliance was obtained through a series of financial and other penalties. As this was the case, items monitored through the use of the Quick Access Recorder (QAR) or through other forms of data collection and monitoring were seen to be religiously complied with, while those items that were not monitored were disregarded. Captain 1 observed that decision-making was influenced by the imposition of financial penalties:

Captain 1: --- *So ah, anything related to a monetary penalty was ah really important to the Chinese.* (I1: 6)

Captain 3 also observed that concerns relating to punitive action affected decision-making. He observed that this concern led to some practices that reduced safety by reducing the effectiveness or meaning of safety measures through inappropriate procedures, for example inappropriate use of the fasten seat belt sign:

Captain 3: --- *it was almost common practice to keep the seat belt* [sign on] *most of the time to avoid any court case that would happen. While it is not reasonable to pretend that people will have to be seated* [for the entire flight] *on a six, or ten or twelve hour flight what seems to be ridiculous to me*. (I3: 31)

Captain 4 also observed that the punitive compliance regime had an impact on decision-making and flight path management:

Researcher C: *Okay. What about deliberate SOP non-compliance perhaps taxi speeds or other SOP's that are not complied with?*

Captain 4: *Taxi speeds certainly not because there is QAR, so they won't exceed anything when a QAR is going to get them in to trouble. Certainly not taxi speeds. They are right on to that in fact. The taxi speed is a QAR set at 27 knots, so when you get to 25 people start squawking at you that you need to slow down. They'll get nowhere near 30 knots in a straight line taxi, so that's not a problem. Deliberate non-compliance, yeah well look they do if they think there is no consequences once again and it is all about consequences for them really.* (I4: 40)

While Captain 4 found that the use of a punitive compliance regime ensured compliance with limitations, the punitive nature of the industry was seen to create inconsistencies in that risk was simply avoided rather than being actively considered, evaluated and accounted for. Captain 4 considered weather avoidance measures and the seat belt policy of his airline as a case in point:

Captain 4: *They are fairly conservative when it comes to things that, you know things like weather avoidance. They're fairly conservative. They'll go around anything, including islands. They're not too perturbed about being 100 miles off track, about going around stuff, which is not a bad thing because no one in the aircraft wears a seatbelt and the seatbelt policy is nothing short of shambolic. It just doesn't work at all. --- what they do is they think that they can put the seatbelt sign on and leave it on for the whole flight and if they hit turbulence they're covered. If anybody gets injured it's not their fault because the seatbelt sign was on and they just don't get it that you know that it will actually be the exact opposite. That if it comes down to a court case, they will be seen to be negligent in their duties, in actually giving information to the passengers and the crew about whether it is going to be turbulent or not. You can't just leave the seat belt sign on for 10 hours,* (I4: 41)

Captain 3 also considered that the use of a punitive compliance regime had an impact on flight path management. He further observed that this could constrain the flight envelope available to ATC for flow control of traffic to increase movements at an airport and thus minimise delays. STAR and terminal procedures usually call for a speed reduction to 250 knots maximum below 10,000 feet, however subject to air traffic density the actual speed requested by ATC may be either greater or less than 250 knots. In the case of I3's company the QAR is set to record any speed increase above 250 knots below 10,000 feet with any excedence requiring an explanation from the operating captain, a requirement which discourages the optimisation of airspace use:

Captain 3: *About some other items like company STAR limitations there is a big emphasis by my current company with a punitive QAR that emphasizes the 250kt speed limit within the terminal area below FL100 usually so this is absolutely respected and* *any deviation from this requires a Captain's report to explain why it happened and on whose request it happened.* (I3: 27)

The punitive nature of the Chinese compliance regime was also seen to impact on decision-making in regards to defect recording. Captain 3 made the following observations in this area:

Captain 3: --- *China regulations that impose those separations from weather that are huge compared to what we do in Europe and they enforce them by having a punitive system that means the lightening strike in my eyes is something that is in most of the cases is unavoidable will be punished with a fine that ranges in my company from two to three thousand US dollars. So their main concern now is not to lose money of course. And there is a tendency in China to enforce safety by punishing people financially for every floor they or for every safety error or safety error treatment they have committed. This is totally different from the western system where the main rule is to be non-punitive to have a self reporting system of any action that happened to avoid a re-occurrence.*

Researcher C: *Right, do you think that there are occasions in China where damage goes un-reported or lightening strikes go un-reported as a result of the punitive system?*

Captain 3: *Definitely yes. Definitely yes it cannot be shorter than this.*

Researcher C: *Ok have you observed this first hand?*

Captain 3: *Yes* --- (I3: 50 – 52)

The participants presented evidence that identified that the Chinese aviation industry is heavily reliant on compliance being obtained through punitive measures. The punitive compliance regime was observed to rely on a series of financial and other penalties with items monitored through the use of the Quick Access Recorder (QAR) or through other forms of data collection and monitoring being religiously complied with, while those items that were not monitored were disregarded. This situation is not seen to be conducive to decision-making being made on the basis of risk assessment. Risk was considered to be simply avoided rather than mitigated. The punitive nature of the compliance regime was observed to lead to the under-reporting of both incidents and damage.

8.5 Summary of findings

Previous research identified that performance on the flight deck, in essence flight deck management, consisted of six constituents three of which were enabling and three of which were essential. This study has supported this previous research by finding that SA, flying the aircraft within tolerance and decision-making were essential constituents. These elements were supported by three enabling constituents aviation knowledge, crew management and communication skills.

There were four additional constituents revealed by this study. The first additional constituent revealed in this study was foundational in that all human activities begin within a cultural context which, as such, is an essential constituent. The second constituent was the power distance orientation of an individual which was observed to have an impact on many areas of the management process. The third constituent was language competency. In an aviation setting, English language skills were seen to have an impact on the ability to acquire and access knowledge, optimize crew management and be an effective communicator. This being the case language skills and power distance orientation were considered to be enabling constituents.

The final constituent, the compliance regime, was seen to have a direct influence on decision-making and flight path management. Without a compliance regime there would be no framework with which to assess risk, an essential requirement in making appropriate decisions. Thus a compliance regime is considered to be an enabling constituent in that it enables the crew to fly aircraft within tolerances in response to decisions that have been made commensurate of risk.

Chapter 9

Discussion and Conclusion

9.1 Introduction

This study set out to investigate the impact of culture on flight deck management. Previous research had already shown that culture had an impact on management in other industries (Hofsteed, 1980, 1982, 1991, 2001; Bond & Hofstede, 1988; Kagitcibasi & Berry, 1989; Barnlund & Yoshioka, 1990; Kanki & Palmer, 1993; Trompenaars, 1993; Oetzel *et al*, 2001; Oetzel & Ting-Toomey, 2003; Gladwell, 2008; Ryan *et al*, 2008; Heine & Buchtel, 2009; Scherer & Brosch, 2009) and some research had indicated that there was evidence to suggest that there were also cultural aspects to flight deck management (Helmreich & Merritt, 1998; Gladwell, 2008). The issue of culture on the flight deck was of particular interest because for some time there have been negative outcomes when crews of mixed cultural backgrounds have been forced to deal with adverse situations. These situations may have many root causes but these have often been far less relevant to the outcome than the cockpit dynamics at play (Kanki & Palmer, 1993). The impact of culture in aircraft accidents was explored to some degree by Gladwell (2008) however while the link between culture and high accident rates in some regions was drawn, that link was not qualified. It is hoped that this study will begin the process of qualifying the role that culture plays on the flight deck.

Previous research (Blake & Moulton, 1964; Helmreich & Merritt, 1998; Kern, 1998; Thomas, 2003, 2004; Thomas & Petrilli, 2006; Flin *et al*, 2008; Mavin, 2013; Mavin & Roth, 2014) identified that flight crew performance (flight deck management) was made up of both technical and non-technical skills. These studies had common ground in concluding that non-technical skills were ultimately comprised of interrelated elements. Mavin (2013) concluded that there were six such elements. The research conducted for this thesis found that there were four additional elements when cultural aspects were considered. Of these elements one - culture as a foundation to individual thought and action - was considered to be an essential element. The other three - power distance orientation, language competency and compliance regime - were categorised as enabling elements.

This chapter seeks to contribute to the aviation industry by examining the role that the four cultural elements revealed in this study play in flight deck management. There are also recommendations for changes in procedures and training for the Chinese aviation industry to mitigate the impact that these elements may have. Finally there are some thoughts on future directions for research on this subject.

9.2 How the Study was approached

The research subject 'Culture and its Impact on Flight Deck Management' came to be of interest to the researcher in response to an aviation career that has seen him work in numerous airlines in many regions throughout the world. As a result of this varied background the researcher has observed that the operational procedures dictated by aircraft manufacturers and international bodies such as ICAO do not always transplant well into non-Anglo-European environments. This observation led to the researcher's desire to describe these differences in an effort to advance the industry.

This thesis proposed that if evidence could be found to confirm that national or regional culture had a significant impact on flight deck management, then consideration should be given to changing operational procedures and developing training programs that account for these variations. The premise for this approach was that flight deck management was dependent on a combination of culture and pilot performance. To determine the relevant role that culture and pilot performance might play in flight deck management, a literature review covering both subjects was undertaken.

From the literature review it was determined that how culture arose was irrelevant to this study. Culture was however determined to be a foundational element to all human endeavours. In Chapter 2, culture was described as being a tri-layered concept of human interaction. On the macro level the external layer, the explicit area, related to the obvious manifestations of culture such as language, art and food. The middle layer related to the norms and values of a society, while at the core of a culture lay the implicit underlying basic assumptions about existence (Geertz, 1973; Schein, 1985; Trompenaars, 1993). Culture has been identified as occurring on three levels - national, professional and corporate. Culture on these levels and the interaction between their constituents both within and external to the individual has been seen to have great influence in the work environment (Geertz, 1973; Helmreich, 1984; Schein, 1985; Ting-Toomey. 1988, 1994, 1999, 2010; Trompenaars, 1993; Helmreich & Merritt, 1998). In this context cross-cultural issues arose as a result of different meanings being attributed to physical observations. More specifically cross-cultural difficulties arose when the reactions to an observed phenomenon differed between people of different cultural backgrounds, causing a breakdown in shared meanings or expectations (Trompenaars, 1993).

Also in Chapter 2 it could be seen that previous research had shown that the efficiency of any flight was determined by flight crew performance. The crew's performance was to a large extent determined by a combination of both technical and non-technical skills, the combination of which may be considered 'Flight Deck Management.' The technical skills required to operate an aircraft are laid down by the various aviation regulatory bodies such as ICAO, EASA, the FAA, CASA and CAAC. These basic skills have not changed substantially in 50 years or more as they are based on technical and theoretical knowledge and the demonstration of manipulative proficiency. The theoretical and technical requirements cover various theory subjects essential to aviation such as meteorology, engineering, aerodynamics, navigation, flight planning, aviation regulation and aviation law. The manipulative requirements relate to the skills required to operate the aircraft safely in all conditions both normal and emergency.

Non-technical skills are those skills which have been identified as being essential building blocks for improving operational standards and safety, and have been identified as 'the Cognitive and Social skills that complement a worker's technical skills' (Flin *et al.*, 2008, p.1). The non-technical or complementary skills referred to can be placed under the following broad categories:

- Situational Awareness.
- Communication skills.
- Management.
- Decision-making.

(Endsley, 1988, 1994, 1998, 1999, 2010; Hartel, Snith & Prince, 1991; Trompenaars, 1993; Kern, 1997; Durso & Gronlund, 1999; Endsley & Robertson, 2000; Helmreich, 2000, 2002; Klampfer *et al*, 2001; Thomas, 2004; Lacagnina, 2007; de Montalk, 2008; Flin *et al*, 2008; Henderson, 2009)

As discussed, previous research (Blake & Moulton, 1964; Helmreich & Merritt, 1998; Kern, 1998; Thomas, 2003, 2004; Thomas & Petrilli, 2006; Flin *et al*, 2008; Mavin, 2013; Mavin & Roth, 2014) has indicated that these skills are largely complementary and symbiotic in nature. Mavin (2013) described this process in terms of skills consisting of essential and enabling constituents. Situational Awareness was the highest order essential skill required on the flight deck in that this skill was seen as being the trigger mechanism for the decision-making process supported by the enabling elements of aviation knowledge, crew management and communication skills (Mavin, 2013). This combination of skills enables decisions to be made considerate of risk and for the aircraft to be operated within tolerance.

Two research methodologies were used in this study. The initial approach used direct observations made in accordance with the subjective sociology philosophy. These observations were to provide the basis for a direct comparison of the results of targeted observations of flight crew behaviours in two airlines. The data was collected on a similar basis to that used by LOSA. The data collected from this preliminary study was used to inform and refine the research topic for the main study for this thesis. Having refined the research question, selection of a suitable methodology for the main study was required and this process was described in Chapter 5. The data captured in the preliminary study both from direct observation and the data collection instrument revealed that the areas of inquiry for the phenomenological study should concentrate on the key performance areas of:

1. Situational Awareness
2. Flight control competence (stick and rudder skills)
3. Communication skills
4. Aviation knowledge

5. Flight crew management including, team building and workload management

The epistemological basis and overall methodology used for the second study was discussed in Chapters 5 and 6. In Chapter 5 the case for the use of qualitative methodologies in safety and human performance research was made. By following the decision model (Table 5.1), also introduced in Chapter 5, it was determined that the empirical phenomenological method represented a suitable methodology for use in this study. This methodology as a research approach was described in greater detail in Chapter 6. Chapter 6 laid out the empirical phenomenological method as developed and described by Giorgi and Giorgi (2003, p. 243) as the 'descriptive phenomenological psychological method' as it was applied to this study. Chapter 7 detailed how this methodology was specifically applied to the second study conducted for this thesis and Chapter 8 presented the findings of the study.

9.3 Contributions of this study

In the present study the experiences of six Anglo-European airline captains who were operating with Chinese airlines were examined to identify the differences they had experienced when operating with Chinese and Anglo-European flight crew. These captains were interviewed with the purpose of trying to identify the influence of culture on flight deck management. In the previous chapter the Flight Deck Management Pyramid (Figure 8.1) was presented. The pyramid incorporates the six essential elements to flight deck management as previously identified and the additional four elements identified in this study. The four additional elements identified in this study may have significant implications for both the aviation industry and other multinational endeavours and are further discussed below. This study has also demonstrated that phenomenology as a research methodology seems to be a suitable approach for research in high performance safety-critical industries.

9.3.1 The role of culture

Culture and its role in flight deck management was chosen as the subject of this study due to a paucity of information in this area despite the all-encompassing role that culture has been reported to play on human interaction and development. This study found that there were cultural elements at play on the flight deck. To say that culture plays a role in flight management is a very broad statement and indeed while culture as traditionally portrayed was considered as a foundational element in the Flight Deck Management Pyramid this study found that three critical elements were influenced by culture and that these elements were seen to have a direct impact on flight crew performance. Two of these elements, power distance relationship and English language skills were seen to link formative culture with knowledge, crew management and communication skills. The remaining element, the compliance regime, was seen to form the framework with which flight crews assess risk, an essential requirement in making appropriate decisions.

9.3.1.1 Recommendations

Having identified that culture plays a role in flight deck management there are several recommendations that can be made with respect to further research: firstly to verify the role that culture plays in pilot performance; secondly to confirm the relationship between culture and the key constituents as identified and finally to identify other cultural constituents and the role that they may have on pilot performance and flight deck management.

9.3.2 The role of language

Language comprises two components, both related to the transmission of knowledge and ideas. This being the case it may be seen that language is integral to communication, knowledge and management. The importance of English language competency has also been recognised as a safety factor in the Flight Operations Risk Assessment System (FORAS), a risk assessment protocol jointly developed by EVA Airways and the U.S. Naval Research Laboratory (Ho *et al*, 2013). From the studies performed in the course of this thesis it was seen that a written language was important for enabling the transmission of knowledge and ideas. In the aviation industry the various operations manuals and much of the other reference material used is presented first in English. Participants in this study related that high levels of English comprehension led to a better knowledge base, improved communication skills and better crew management.

To give perspective to the importance of English comprehension, the historical background to the development of written language may be of assistance. There are only four reported instances in history where it is probable that writing has arisen independently. This list is based in some cases only on the lack of similarity with other writing forms. These systems of writing are: (1) Sumerian Cuneiform, invented by the Sumerian's of Mesopotamia somewhat before 3000 BC; (2) Egyptian Hieroglyphic, invented by the Egyptian's around 3000 BC; (3) Chinese Idiographic, invented by the Chinese by 1300 BC; (4) Mesoamerican Hieroglyphic, invented by the Maya Indians in southern Mexico before 600 BC (Diamond, 1997, pp.215-238). There are perhaps two conclusions to be drawn from the list above – firstly that the invention of a written language is a rare and difficult task and secondly that these first forms of writing have in three out of four cases been replaced by a more user-friendly form of writing (Diamond, 1997; Man, 2000; Everett, 2013).

Cuneiform, Egyptian Hieroglyphic and Mesoamerican Hieroglyphic writing have all been superseded by writing systems based on an alphabet and Traditional Chinese (in the Peoples' Republic of China at least) has been replaced by Simplified Chinese (Diamond, 1997; Man, 2000; Everett, 2013). There are perhaps two main reasons why the Hieroglyphic or picture based writing forms have been replaced:

1. Ambiguity: For any picture to have meaning there must be some other context. If we look at some hieroglyphs in common use today for example 'the hard hat symbol' on a building site means put on a hard hat. The same symbol on a block of chocolate is probably a trade mark or advertising gimmick. In other words pictures need to be in context to have unambiguous meaning (Man, 2000).

2. The other great problem with hieroglyphs is brain capacity. The average brain is reported to be capable of storing approximately 2,000 images with most literate Chinese being able to use 4,300 or so as opposed to the approximately 50,000 words that may be used by a literate person whose written language is alphabet-based (Man, 2000).

9.3.2.1 Language use in the Training Environment

Enhanced English language skills have been linked to improved training outcomes through the ability for more professional terminology to be utilised by instructors and through changes in the training dynamic, allowing the learning environment to be more student-orientated (Archer, 2000; Fairclough, 2003; Gu, 2009; Li & Guo, 2012). The standard of spoken English has also been seen to have a significant impact on the flight deck during flight training. When Chinese airlines began their expansion in the mid 1990s a major European airline was contracted to train Chinese pilots. The scope of training included extensive line flying on the company's network. In this instance all training was conducted in a second language, the instructors were native French speakers and the trainees were native Chinese speakers. Captain Menestrot (lead instructor for the project) reported numerous issues during the course of this project and subsequently presented a paper covering these issues in 1996.

When an instructor and trainee do not share a common language it is obvious that communication will be more difficult. In aviation, regardless of the native language of the participants, English is the industry wide standard language. This means that for cross-cultural training English is used as the training language. However as most participants in the aviation sphere have not studied English as a language at university level, but have instead studied operational English to obtain an ICAO English Language Certificate for radio communication or similar earlier programs, vocabulary is therefore more limited than would otherwise be the case. Menestrot (1996) raised four points in this area:

1. When vocabulary is limited the message must be simple. As a result of using simple language much detailed information simply cannot be passed on to the trainee.

2. Both the instructor and the trainee use a great deal more mental resources to produce messages that can be understood by each other. This leads to the early onset of mental fatigue and as such reduces the amount of training that can be accomplished in each training session.

3. The use of simple vocabulary reduces the use of normal professional terms during training and this in turn reduces the effectiveness of explanations and other corrective input. The training value of each session is further reduced due to both the instructor and trainee being more sensitive to distractions caused by external noise and interruptions.

4. In this environment it is easy to see that normal non-professional discourse is at best limited. This limiting of non-professional communication creates problems of its own. There is no or limited ability to create a personal bond between the instructor and the trainee. This lack of a personal bond affects several areas of significance. Firstly there may be a lack of trust, secondly there is at best only a limited ability to use general conversation as a means to reduce stress and thirdly it is all but impossible to use general conversation to evaluate the emotional state or to determine the health and fatigue status of the trainee.

All of the above points contribute to a greater number of misunderstandings than would occur in a training environment where both the instructor and the trainee share a common native language. There are of course strategies to help ensure that the training process can proceed in a meaningful fashion. Some of these strategies are as follows:

Briefing

Briefings are not only integral to the training process but in the aviation context, they are central to every stage of every flight. They inform other crew members of future flight routines (Departure, Arrival, Approach and Landing) in terms of what is required and how the desired outcome will be achieved and are essential for all crew to develop and maintain SA. In a multicultural environment a good briefing must be short. If a large amount of information must be relayed then it is considered preferable to dissemble a long briefing into several short briefing segments, and to space these so as to allow the information contained in each segment to be assimilated.

Briefings must be initiated at the correct time as briefings given at the wrong time are forgotten or disregarded. Briefings given for routine situations on routine flights have not been seen to activate short term memory and are therefore considered to be ineffective. The main purpose of any briefing is to generate understanding and to develop an action plan. The information and action plan must be shared and understood by the entire crew so that they are all able to compare the action plan and flight progress. This allows the crew to either rectify deviations between the plan and the actual flight path or modify the plan to account for dynamic flight requirements. Menestrot (1996) had the following advice for training in a multicultural environment:

♦ MONITORING

Always have an action plan active and keep it up to date.

Never accept a significant gap between your action plan and what is happening.

♦ SYNERGY

Do not impose your understanding as a reference on the other pilot.

Speak to the other crew members to cross-check respective action plans.

Use the briefings to establish task-sharing and roles, and to adjust respective action plans.

Speak up if you detect any deviation. There is no stupid question in the cockpit.

♦ IN CASE OF A COMPREHENSION PROBLEM

Come back to a known domain, procedure, check-list, rules of the art.

Review your action plan if your crew partner no longer understands you. Be aware that this is one of the most difficult things for a crew to do.

Delegate, but never transfer a task completely.

Take into account the pace of the slowest crew member. (s.10-11)

Menestrot's advice was valuable during flight operations in China. Flight operations experience with Chinese crews has shown that communication between people with different native languages takes time and effort. Communication was observed to improve when effort was expended to find vocabulary that was simple and unambiguous. The use of standard procedures and standardised phraseology was also seen to promote understanding. However it was also noted that it was simply not possible to cover all events with standard phraseology and procedures.

9.3.2.2 Recommendations

Research

- Further research is required to determine the role and relationship that first languages and English as a second language have in the aviation industry.

- Conduct research into the possibility of creating training facilities that utilise a training environment that immerses future aviation professionals in an English-only environment. The use of English in all classroom, flight and recreational activities, may be a means of improving both the standard of English and building cultural awareness amongst aviation professionals.

- Research into the desirability of establishing a common multicultural professional culture for all aviation professionals.

Training

- In consideration of the connection shown between English comprehension and improved pilot performance, Chinese aviation training organisations could give consideration to immersing their aviation students in an English-only university environment for the duration of their studies.

- English language comprehension skills which support and the use of professional terminology and an appropriate training dynamic may become pivotal as airline training programs progress to a fourth generation training environment (Kearns, 2010). The observations of this study were that the Chinese airlines currently have training programs founded in second generation training syllabi. That is training based on an apprenticeship model using simulation for systems and manipulation training (Kearns, 2010). For Chinese airlines to make the leap from second generation training to fourth generation, performance-based training, significant changes in training delivery, content and methodology will be needed especially if future training directions are to incorporate new platforms such as E-learning and Snap courses (short 5 minute training courses) which are designed to be interactive rather than passive in format (Kearns, 2010; 2013). From the data collected for this thesis it can be concluded that the Chinese airlines have yet to embrace third generation training, training focused on CRM and TEM principals (Kearns, 2010).

Operations

- In consideration to the differences between the written forms of Chinese and English, a review of the translated manuals and reference material and their original English manuals is recommended, to ensure that both versions are consistent.

- It is recommended that the industry should give consideration to a long term plan to phase out all non-English manuals.

Manufacturers

- Manufacturers should review their procedures and manuals to minimise linguistic ambiguity.

9.3.3 The role of power distance relationship

All of the participants reported that the power distance relationship between the Chinese captains and others, including other crew members and ATC, affected numerous operational activities. Hofstede (2001) identified that the Chinese national culture had one of the highest Power Distance Index (PDI) ratings of any culture. In a high power distance culture such as this, subordinates were seen to have little or no cultural defence against the actions of a superior. Subordinates were also reported to be over optimistic about the capacity and abilities of superiors, which could be seen to lead to deferment to rank and a lack of critical analysis in followership (Hofstede, 2001). Some of the known social considerations are as follows: (1) Communist Party position; (2) social or family position; (3) military or ex-military rank; (4) general desire to help superiors; (5) the desire to avoid conflict. These considerations mean that in many situations it is not entirely clear to an observer who has more power, though it is known that often it is an individual's status that determines the outcome. The issue of communication was seen to be related to PDI. In this regard De Mente (1996) observed that the western concept of communication being the art of exchanging ideas, instructions and knowledge is not necessarily shared by the Chinese.

De Mente (1996) noted that Chinese superiors don't tend to view communication in the western context. Instead of open and direct exchanges of information a Chinese manager, superior or Government official seems to only pass on information in general terms. This it seems is intended to leave his or her subordinates with only a vague idea of what and how to proceed. It is believed that there are two main reasons for the sharing of knowledge in this fashion – firstly the need within Chinese society to avoid confrontation and secondly the traditional Chinese belief that a superior should always be aloof and somewhat mysterious in the eyes of his or her subordinates (De Mente, 1996; Williams, 2006).

In the previous chapter the high power distance relationship was shown to impact on many areas that affected flight crew performance. Training, crew management and communication were all seen to be directly impacted by the power distance orientation of the Chinese flight crew. The effect of PDI on training and education has previously been considered in studies in the field of education but has as yet to be studied in depth within the aviation training environment. Power distance relationships and their link to flight crew management, communication and CRM have been made with awareness of the issue considered to be an integral component to the Anglo-European concept of

CRM. This is not yet reported to be the case within the Chinese aviation industry highlighting that the Anglo-European concept of CRM is not universal.

9.3.3.1 Power distance in training

As previously discussed there has been little research conducted on impact of power distance relationships on training in an aviation setting. However in research conducted in the broader educational community the link between power distance and educational outcomes has been the subject of a considerable body of research beginning in the late 1950s. Li and Guo (2012) stated that:

> In 'high-PDI' cultures, every social member expects to maintain suitable status in the society. The less powerful members have to absolutely obey the more powerful members, and the subordinates are also more satisfied with authoritative management methods. In 'low-PDI' cultures, the social members think that power inequality should be reduced to a minimum, and the subordinates try to reduce the importance of absolute obedience to the superiors. They regard people as equal in nature, and only the tasks assigned to them as different. (p. 223)

Their research indicated that power distance relationships not only affect the general relationship of subordinates and superiors but that the relationship impacted on both training delivery and content. As previously introduced, training in societies having a high power distance relationship was seen as being teacher-orientated with the students considered to be passive learners (Song, 1995) who asked few if any questions (Hofstede, 1986; Ishii, 1993; Kawai, 1993; Lockhart, 1994; Richards & Lockhart, 1994; Huijser, Stück & Tanaka, 2002; Lee, etal, 2005; Kasuya, n.d.). The learning outcome was seen to be further impacted due to a lack of critical analysis and criticism with regards to teaching standards, methods or course content. In this system it can be seen that the educational outcome is largely dependent on the teacher's abilities (Hofstede, 2008; Li & Guo, 2012). In a high PDI culture course delivery and class room activities tend to be initiated by the instructor with virtually all communication being one-way from the instructor to the students. Knowledge assimilation was confirmed with a preponderance of yes/no questions rather than where, when and how explanations (Li & Guo, 2012).

In a low power distance setting the instructors and trainees were observed to have a more equal relationship, allowing the training process to become more student-orientated (Hofstede, 2008; Li & Guo, 2012). In this situation trainees are expected to use their initiative and utilise source material. It is also expected that trainees will ask questions and seek clarification when an instructor's course material differs from other source material (Li & Guo, 2012). Li and Guo (2012) determined that in a low power distance teaching environment, communication was largely a two way process with both teachers and students initiating 50% of the class discourse. Question style was also seen to be substantially different to that used in a high power distance setting with the majority of questions being how, where and when questions (Li & Guo, 2012). These factors were seen to lead to enhanced learning outcomes (Paulus *et al*, 2005; Koh & Lim, 2007). Thus Koh & Lim (2007, p, 523) were of the opinion that 'eeducators, instructional designers, and researchers should not underestimate the significance of power distance in teaching and learning situations.'

9.3.3.2 Power distance and communication

In Chapter 8 the link between power distance relationships and communication was raised as an issue. Power distance relationships in communication has been studied to some extent in other fields notably education, business and the military, and have been receiving increased interest in recent years as globalization of industry and governance gathers pace (Hofstede, 1986, 2008; Ishii, 1993; Kawai, 1993; Lockhart, 1994; Richards & Lockhart, 1994; Helmreich, 2000; Huijser, Stück & Tanaka, 2002; Riedel & Karrasch, 2002; Lee, etal, 2005; Abbe, 2008; Halpin, 2011). People from high power distance cultures have been seen to be more formal in their communication activities. Communication is reported to be affected by hierarchy and often subordinates may fail to provide critical information to superiors (Helmreich, 2000). This failure to communicate was observed to be exacerbated by a reluctance to challenge a superior's decision even in the face of near certain catastrophe (Helmreich, 2000). Ridel and Karrasch (2002) also reported communication problems caused by power distance relationships in their study on communication issues in multinational teams. One of the findings from their study was that team members from high power distance cultures were reluctant to ask questions to clarify information as it was against their culture to question one's superior. This situation was not only frustrating for the team members who were from low power distance cultures but also led to perceptions of decreased ability and a consequent loss of opportunity (Ridel & Karrasch, 2002). Individuals from low power distance cultures tend to use informal communication channels. They have also been seen to be less tied to tradition and as such tend to be early adopters of new technology and be more innovative in problem-solving (Ridel & Karrasch, 2002; Abbe, 2008). In group settings a low power distance orientation helped team members assert their individual perspective and raise issues of concern both with other team members and with their superiors (Ridel & Karrasch, 2002).

In this study communication was universally raised as an issue. Participants considered that the poor communication styles that were observed occurred largely as a result of the high power distance relationship between the Chinese captains and other industry participants. This contrasted somewhat with previous studies in communication where other cultural factors were considered to have a more significant impact on communication. These other factors included cultural orientation in the areas of individualism-collectivism and high or low context in terms of message content (Hofstede, 1986, 2008; Ishii, 1993; Kawai, 1993; Lockhart, 1994; Richards & Lockhart, 1994; Helmreich, 2000; Kasuya, n.d.; Huijser, Stück & Tanaka, 2002; Riedel & Karrasch, 2002; Lee, etal, 2005).

9.3.3.3 Recommendations

Research

- Further research into the role that power distance relationships play in communication in aviation settings.
- Research to determine the extent that individualism-collectivism affects communication in aviation.
- Research to determine the impact that high-low context communication styles have in aviation settings.

The research topics introduced above could be approached based on the methodologies previously utilised by research in other fields most notably education where a substantial body of work exists. There is also a need for research to include communication flow both internally and externally to the flight deck.

Training

- Encourage the use of and develop a training environment where a low power distance relationship exists between instructors and trainees.

- Develop training packages to promote improved communication skills and increase awareness of the issues created by a high power distance relationship.

The Aviation industry has a long history of developing training packages to address issues from CRM to Controlled Flight Into Terrain (CFIT). These various programs have been remarkably successful. As traffic density increases communication skills will become ever more important yet as highlighted by this study it is an area that continues to be poorly addressed.

Industry

- Develop a corporate culture that embraces a low power distance relationship not just on the flight deck but across the entire company.

As previously discussed a high power distance relationship has been seen to restrict the flow of information. Management Systems rely on open lines of communication to be effective and deliver benefits in areas of both safety and efficiency.

9.3.4 Power distance and crew management

In the previous chapter it was noted that the participants reported that the power distance relationship between the Chinese captains and others, including other crew members and ATC, affected numerous operational activities. Hofstede's (2001) research identifying that the Chinese national culture had one of the highest Power Distance Index (PDI) ratings of any culture. Other research on the subject of power distance relationships on the flight deck most notably that of Helmreich and Merritt (1998) was also discussed. Their research considered the issue of individualism-collectivism and uncertainty avoidance as being issues related to flight crew performance and management. Interestingly the participants in this study did not discuss these issues in relation to crew management which would seem to indicate that they are subordinate concerns to the power distance issue. In this study the participants provided evidence that supported Hofstede's (2001) conclusions that in a high power distance environment, subordinates were seen to have little or no cultural defence against the actions of a superior and were seen to be overly optimistic about the capacity and abilities of superiors. Participants also raised a concern over a lack of critical analysis in followership also observed by Hofstede (2001). This aspect of a high power distance relationship has obvious implications for the aviation industry.

9.3.4.1 Recommendations

Research

- Further research into the impact of power distance relationships on crew management in an operational setting.

While it is acknowledged that there has already been a considerable body of research conducted on this topic, there is a need to move beyond the ‘attitude to management’ survey-based approach prevalent in research to date and move on to a more observationally-based data capture method. This may give greater insight in to appropriate and culturally sensitive interventions to improve flight deck management practices.

Training

- Raise awareness of this issue during the training process.

All flight crew undergo regular training as part of the normal certification and re-certification process. While there will no doubt be some time before there would be any research-based operational interventions, merely including this topic in the normal training cycle may yield benefits as cultural awareness would be increased.

Industry

- Develop a corporate culture that embraces a low power distance relationship not just on the flight deck but across the entire company.

- Develop procedures that take account of the existing power distance relationships to improve safety. When considering the adoption of any procedural changes effort must be made to formulate, justify and implement the changes as there is the potential to create as many problems as they solve. The other consideration with procedural changes is that they may become redundant as enhanced training, language skills and educational standards all have the potential to create cultural changes at the professional level. Regardless of these issues it is probable that there are some operational procedures open to change.

In consideration of the PDI on the flight decks of Chinese airliners consideration could be given to introducing an approach procedure similar to an approach known as the 'Monitored Approach Procedure' which could bring benefits by having the cockpit dynamic working in concert with the Chinese cultural dynamic. Background information and an explanation of the monitored approach is contained below:

The monitored approach procedure was developed by British European Airways (BEA) during the 1970s. The adoption of this procedure enabled BEA to become arguably the most advanced low-visibility approach operator in the world at that time. The procedure primarily delivered safety improvements over other approach procedures by minimising descent below applicable minimum approach altitude prior to the commencement of a missed approach in the event that visibility criteria were not met at the minimum altitude. From an operational perspective the procedure was mandated for use when the cloud base was within 500 feet of minimum approach altitude for the approach being flown.

The first officer was required to brief and fly the approach, which could be either flown with the auto pilot engaged (preferred) or manually. The first officer remained head-down manipulating and monitoring the aircraft throughout the approach leaving the captain free to monitor the first officer's performance and ensure that the visibility requirements for the approach were met at the minimum altitude. The first officer initiated all standard calls, with an appropriate response by the captain. At the minimum altitude the captain

> assessed the visibility and either assumed control to land the aircraft or called 'Go around' causing the first officer to initiate an immediate missed approach.
>
> This procedure has the obvious advantage of having the cockpit authority gradient working in the culturally correct sense, that is the monitoring and decision making being performed by the most senior crew member. The procedure in its original format has limitations and may not be compatible with category three instrument landing system approaches and other recent additions to the precision approach arsenal. However the procedure could be a good starting point for taking PDI and other cultural issues in to consideration in developing procedures (Addison-Baker, 2014).

Notwithstanding the discussion item above a low power distance relationship has been shown to have benefits in safety-critical, highly dynamic settings. It has also been shown that individuals can modify their cultural orientation by choice.

This being the case behaviour may in some areas be open for modification through the engineering of professional and corporate culture to reflect an internationally determined, unified aviation standard culture. Only in situations where this is not possible would it be considered appropriate for the operating procedures of some airlines to be open for change to ensure procedures do not operate contrary to accepted cultural norms for work flow and procedures.

9.3.5 Power distance, communication and crew management

Participants in this study linked power distance, communication and crew management to CRM. In general terms they observed that the Chinese crew members had a poor understanding of the Anglo-European concept of CRM as a process that combined multiple skills in a decision-making, threat and error management tool, and yet there is an enormous amount of information available on CRM. Pilots from all major airlines undergo CRM training on a regular basis. The Chinese pilots also undergo CRM training and often use the phrase ‘according to our CRM training---.’ When first coming into contact with Chinese pilots it is easy to be impressed with the number of times CRM is mentioned. However it is possible that the devotion to CRM has more to do with the compliant acceptance of propaganda than with subject knowledge.

There is a word for this form of propaganda in ‘Chinese, 标语, B*iaoyu* (Bee-ah-oh-yuu) meaning slogans. During the period from 1949 to 1976 the Chinese government was responsible for indoctrinating the entire population by means of slogans. This slogan-driven method of education persists today with the implication that the slogan is in many cases more important than the content behind the head line’ (De Mente, 1996, p.14).

As previously discussed, observation has shown that CRM training in China seems to be largely concerned with ensuring that the status and position of the captain is maintained. There also seemed to be a significant political component to the training to ensure that the Communist Party line will be maintained on the flight deck. Thus it can be seen that one country’s CRM does not necessarily hold the same values as another countries. In the Anglo-European context CRM is a concept developed to address individual and group performance by improving the team-building, management and decision-making aspects related to flight operations with particular emphasis on threat and error management. Indeed current generations of CRM are largely based on the premise that human error is all pervasive and inevitable (Helmreich & Merritt, 1998). Thus TEM supported by the concepts of earlier generations of CRM is designed to complement the technical competence of the flight crew by recognising threats, errors and the valuable contribution that other crew members and remote specialists such as engineers, air traffic controllers and company dispatch officers can make in an emergency situation.

Individual performance on the flight deck of modern multi crew aircraft encompasses much more than just the obvious requirements of being competent in the traditional 'stick and rudder skills' such as take-off, normal and abnormal flight routines and landing. Modern technology may not have made those skills redundant but it has meant that procedural and interpersonal skills have more pre-eminence than in bygone eras. In a modern multi-crew environment, individual performance encompasses the concepts of interpersonal relationships, cognitive functions and machine interface tasks. Each individual on the flight deck brings with him or her personal attributes that will ultimately decide how well a flight will progress and how safe that operation will be (Childester *et al*, 1991; Helmreich & Foushee, 1993).

As introduced above, individuals on the modern flight deck form part of a crew and as such must perform as members of a team. A team or group must consist of at least two individuals. Therefore there must be a leader and at least one follower. This being the case it is not possible to discuss team-building without introducing the subject of leadership. Research conducted in this field by Ginnett (1993) made some interesting findings. Firstly, that leadership as displayed during the team's formation was absolutely critical to the integrity and performance of the team. It was also determined that some team leaders (captains in the flight crew situation) are highly effective in this area and that some are not. Effective team leadership in the aviation context was found to be somewhat different to effective leadership in other fields (Ginnett, 1993).

In most fields effective team leaders devoted most of their energy to the following three tasks:

1. discussion of the task to be accomplished.

2. discussion of the relevant team boundaries and building a tight-knit working group.

3. discussion of the relevant norms for the group's effective performance. (Ginnett 1993, p.86)

In the aviation field it was discovered that effective captains did the following:

1. They hardly mentioned specific tasks excepting to introduce unusual or non-routine events.

2. Instead of trying to restrict the team boundaries, highly effective captains continually tried to expand the work team to include cabin crew, ground support personnel and air traffic controllers as required, to help facilitate the desired outcome.

3. Instead of concentrating on behaviour as a norming influence the highly effective captains concentrated on communication and cooperation and their relevance to safety. (Helmreich & Foushee 1993, p.27)

Ginnett's other interesting finding was that contrary to the leadership roles in other fields, effective leadership on the flight deck cannot be achieved with a single optimum level of authority. Instead, as shown in figure 9.1 below, highly effective captains shifted their authority between democratic and autocratic methods depending on the operational dictates throughout the flight.

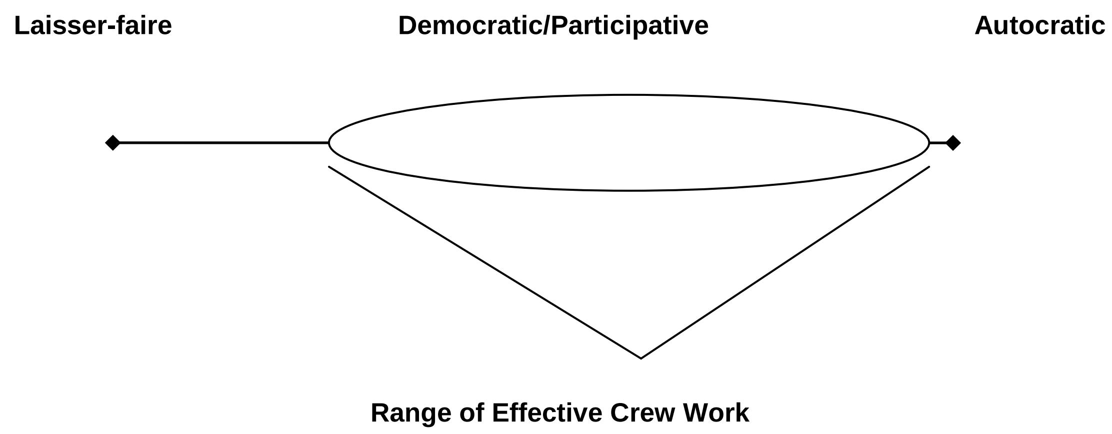

Figure 9.1: Range of Authority Dynamics in Crew Work

Source: Ginnett (1993, In Wiener, Kanki, & Helmreich, Ed., 1993, p.89)

As part of this sliding scale of authority it was determined that effective team leaders in the flight crew arena established their teams by using three main tools: (1) they established competence; (2) rejected perfection; (3) they engaged the crew members (Ginnett, 1993). This process often seems at odds with the high power distance relationship management process preferred by the Chinese captains.

9.3.5.1 Recommendations

Research

- Research is required to investigate Chinese attitudes to CRM and determine the reason for its poor uptake.

Training

- Develop training material that promotes CRM as a discipline.
- Develop training material that develops decision-making skills.

- Develop training material that promotes threat and error management. Most Anglo-European airlines have embraced the concept of TEM within their CRM training programs but many are yet to move TEM from the class room to the simulator. This suggests that while it is some time since research suggested that best practice error management training should see TEM training integrated within simulator training programs, many airlines are struggling with the concept (Thomas, 2004). The implication then is that even as the industry marches toward fourth generation training, many Anglo-European Airlines are yet to meet best practice criteria for third generation training programs. For Chinese airlines the leap forward is likely to be even more problematic as they have yet to embrace the concept of TEM as currently used by the Anglo-European aviation industry. Indeed the acceptance of TEM as used in the west may be met with cultural resistance leading to an even wider gap between the operational and training practices of Anglo-European airlines and their Chinese counterparts. If this was to be an outcome it would most likely prove a major obstacle to allowing the full benefits from the implementation of new and more efficient ATC systems and procedures to flow to the aviation industry.

9.3.6 Compliance

The participants of this study raised the compliance regime as an issue. Compliance in the Chinese aviation industry was seen to be obtained through punitive measures including the imposition of financial and other penalties. This type of compliance regime was seen to act as a filter or influence that affected crew decisions and flight path control inputs made in response to perceived situations. As this was the case, items monitored through the use of the Quick Access Recorder (QAR) or through other forms of data collection and monitoring were seen to be religiously complied with, while those items that were not monitored were disregarded. A review of literature on the subject revealed the following insight. In Anglo-European society rules and laws tend to be obeyed not only in terms of the letter of the law but also in accordance with the intent of the law (De Mente, 1996). This leaves a very rigid framework within which the business and industrial community operates and this is especially so in the case of participants in the aviation industry.

Within Asian countries and China in particular the rigid interpretation of laws and rules is at odds with the cultural tradition in place. Within China rules and laws are interpreted to fit the situation and especially to give Chinese companies a competitive edge over foreign entities (De Mente, 1996; Blackman, 2000). This aspect of the application of law can be seen to create an uneven, confusing legal regime but enforcing the law can be an even greater challenge. Law enforcement in China is challenging because the authorities themselves are reported to consider that rules are only general guidelines and as such are flexible (De Mente, 1996). With this aspect in mind it is not hard to see that in any dispute laws can be applied in such a manner so as to ensure that every advantage in any contest is always given to the side that the authorities deem to be the most deserving. Taking this into account it is possible to deduce that the Chinese do not really consider a codified legal system as an effective method of controlling behaviour. De Mente (1996) observed that the dislike and distrust of codified laws is highly ingrained. This distrust of codified laws relates back to the teachings of Confucius who stated that ‘The more laws a nation has the less law-abiding a people will be, and that nations that base their survival on laws will eventually be torn apart by their own internal violence because people will give up any personal attempt to conduct themselves virtuously and will instead do anything they think they will get by with' (in De Mente, 1996, p.304). The Chinese call this flexible concept of legal code and other rules, *Fa lu shi huo de,* (The law is a living thing).

It may be that this flexible approach to rules in China creates a situation in the aviation environment where rules are not applied in a consistent manner. This would make for a very uncertain and uneven operational environment open to large variations in the areas of standards, flight and duty limits, SOP's, and adherence to checklists. If this is so, the ingrained flexibility towards rules may be at the heart of the punitive compliance regime in force at Chinese airlines.

There were negative outcomes reported as a result of the punitive compliance regime in that matters affecting safety including damage and incidents were observed to be under reported. The highly punitive nature of the compliance regime in Chinese airlines is substantially at odds to the system adopted by most Anglo-European airlines. The majority of Anglo-European airlines have used open reporting systems since the 1980s with a move in more recent times to a 'Just' safety culture. Reason (1997) has made the case for the adoption of a Just culture as a safety platform by stating that the Just culture supports safety in that it is a system based on trust. In such a system people are encouraged and even rewarded for reporting safety critical information (Reason, 1997; GAIN, 2004). It is also a system in which there are acknowledged boundaries to acceptable behaviour (GAIN, 2004). According to Reason (1997) an effective reporting regime depends on how an organisation handles blame and punishment. A no-blame reporting culture was seen to be undesirable in that there was a lack of accountability while a blame culture was seen to be even more undesirable due to a lack of trust and low levels of reporting (Reason, 1997; GAIN, 2004). The challenge then is to balance culpability for unsafe behaviour and excessive blame. This balance will be difficult to strike in the Anglo-European aviation system and for the reasons outlined above is likely to be even more challenging within the Chinese aviation industry.

9.3.6.1 Recommendations

Research

- Research into the role that compliance regimes have on decision-making and flight path management.
- Research the degree to which the punitive compliance regime impacts on the reporting rates in the Chinese aviation industry.

Industry

- Improve safety through developing an appropriate reporting and compliance system.
- Develop and promote an industry standard culture of compliance and reporting so the there is a globally-accepted unified system of reporting, safety and compliance.
- Encourage the use of LOSA to monitor compliance and standards in a non-punitive manner and to enable procedural change based on evidential data.

9.4 Conclusion

This thesis began by considering that culture may have an impact on flight deck management (flight crew performance). In other industries cultural differences were seen to impact on workplace interactions and outcomes because every culture distinguishes itself from other cultures by the specific solutions its members choose to solve certain problems, and yet little progress had been made in quantifying its impact on aviation (Trompenaars, 1993). The research component for this thesis consisted of two studies. The first study, based on the subjective sociological method using direct observation and a data collection instrument, was used to develop an informed interview schedule for the second study for this thesis. The second study used the descriptive phenomenological method as described by Giorgi & Giorgi (2003) to further study culture and its impact on flight deck management (flight crew performance).

In the process of the research conducted, it was determined that there were ten constituents in the flight deck management process. Six of these constituents had previously been identified and linked by Mavin (2013). An additional four elements were identified in the second study. All ten elements and their relationships are included in the Flight Deck Management Pyramid (Figure 8.1). While the specific results of this study describe the interplay between Chinese and Anglo-European flight crew members it is likely that the same culturally-founded elements observed and discussed in this thesis will have an impact on the flight deck management activities of flight crew of all cultural persuasions.

Earlier in this Chapter recommendations for research, training and the industry in general were discussed and while those recommendations were made largely with specific reference to the aviation industry many of the topics presented are valid in almost any setting. There are no simple solutions to the influence that the myriad cultural factors have on flight deck management and this thesis has really only just begun the task of identifying and qualifying those factors. To advance the aviation industry to the next level of safety and efficiency it will be necessary to identify and address the cultural imperative. This will no doubt require a multi-pronged approach including research, training programs, procedural changes, and improvements in compliance methodologies and philosophy. Finally, improved levels of cooperation amongst the world's airlines, industry associations and regulators to truly harmonise and integrate operating procedures, philosophies and develop a more unified and consistent professional culture is needed to enable sustainable growth in the industry.

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APPENDIX A

Ethics scope check

Griffith University Animal Ethics Committee / Griffith University Human Research Ethics Committee

Project Title
CULTURE AND ITS IMPACT ON FLIGHT DECK MANAGEMENT

Applicant
CONSTANTIN VIACHESLAVOVICH FERROFF

Completed the Griffith University Research Ethics Scope Checker on 13 June 2008. In completing the checker they indicated:

1. About or involving humans? Yes

2. Archival research. No

3. Administrative or service delivery. No

4. Quality assurance or audit. Yes

4a) Prior consent will be obtained and recorded. Yes
4b) Participant burden or harm. No

5. Exercise or test for teaching purposes No

6. Routine experiment or procedure for teaching purposes. No

7. Work/ data collection by student only for teaching/ learning. Yes

7a) Published/ presented other than for assessment. No
7b) Formal analysis. No
7c) Vulnerable participant group. No
7d) Participants identifiable. No
7e) Participants placed at risk. No
7f) Sensitive aspects of participants' behaviour. No

On this basis the described activity is outside the scope of the University's animal ethics and human research ethics arrangements, and as such does not require University ethical review.

This is a service maintained by the Office of Research on behalf of AEC and HREC.

APPENDIX B

Approval to use data Airline A

[redacted] [redacted] [redacted]

[redacted] [redacted] [redacted]

15/05/2008 04:46 PM [redacted]

Subject Re: Request to use line audit reportLink

[redacted]

I apologise for not getting back to you earlier. [redacted] has approved the request for you to use the [redacted] data in accordance with the conditions stated in your e-mail. As per that e-mail we would simply ask that we can check the content of the thesis just in case there may have been an oversight in regards to material that should not be distributed externally. Knowing your diligent approach to life and work I am sure that there will be no problem in this regard.

Due to a number of reasons, comparison of statistical LOSA data can prove to be a fruitless exercise when the same agency has not conducted the particular LOSA which is being reviewed and compared. I can explain that concept in further detail if you care to drop in some day. I would also be happy to explain the process in detail if you need further clarification in any areas. Good luck with your endeavours.

Regards [redacted]

[redacted] | Manager Flight Crew Audit

[redacted]

[redacted]

[redacted] [redacted] [redacted]

[redacted] [redacted] [redacted]

[redacted] [redacted]

APPENDIX C

Approval to use data Manufacturer

[redacted])

Sent:

Wednesday, 21 May 2008 7:26:29 AM

To:

c 271artici [redacted]

Security scan upon download

New Custo...pdf (447.1 KB)

[redacted]

I was unable so far to get in touch with [redacted], which is the primary reason for my trip in [redacted]. Will try again today through the Field Rep.

For the assessment, we're using a IOSA form as guideline (enclosed) and a home-made computer program able to collect non only the complying / not complying flags but also the reason(s) for non compliance. It then crunches the data and provides us with a picture helping us to elaborate a possible action plan.

If you are interested, I'll be happy to give you a demo.

As for the result of the assessment itself, this is confidential material protected by a non disclosure agreement signed between [redacted] and the Customer.

However, I could consider sharing with you de-identified material you would find useful for your thesis.

I’ll come back to you as soon as I get a working schedule.

With kind regards,

[redacted]

[redacted]

[redacted]

[redacted]

APPENDIX D

Approval to use data Airline B

[redacted]

To the appropriate Griffith University Officer,

REGARDING APPROVAL SOUGHT TO CONDUCT FIELD RESEARCH AT [redacted]

This is to certify that approval has been given to Costa Ferroff (PhD Student attending Griffith University – Australia) to obtain data for the purposes of Aviation Research.

The data thus obtained can be used and permission is hereby given - for the results of the research to be published without reservation provided that the participants names are withheld and that total anonymity is upheld.

Yours,

[redacted]

[redacted]
Program Manager

[redacted] - Confidential - Page 1 - [illegible]

APPENDIX E

Data Collection Form.

Date	Flight No	Captain

Roster						
Hours Flown						
Month	<20	20 - 40	40 - 60	60 - 80	80 - 100	>100
Year	<100	100 - 300	300 - 500	500 - 700	700 - 900	>900
Fatigue	1	2	3	4	5	
Duty Hours	1	2	3	4	5	
MEL & Performance						
MEL used	Y	N				
Procedure Followed	1	2	3	4	5	
Performance Knowledge	1	2	3	4	5	
Language Differences						
MEL	1	2	3	4	5	
VOL 2	1	2	3	4	5	
CRM						

Knowledge	1	2	3	4	5
Takes Responsibility	1	2	3	4	5
Appropriate Level of Support	1	2	3	4	5
Resistance to time pressure	1	2	3	4	5
Flight Deck Management					
Unexpected events	1	2	3	4	5
Error Management	1	2	3	4	5
Cabin Awareness	1	2	3	4	5
Fuel Conservation	1	2	3	4	5
Commercial Awareness	1	2	3	4	5
Noise Sensitivity	1	2	3	4	5
Refers to flight documentation	1	2	3	4	5
SOPs					
Taxi Speed	1	2	3	4	5
FMA	1	2	3	4	5
FMGEC	1	2	3	4	5
Standard Call Outs	1	2	3	4	5
Check List Use	1	2	3	4	5
Task Sharing	1	2	3	4	5

Dual Inputs	1	2	3	4	5
Task Sequencing	1	2	3	4	5
Paper Work	1	2	3	4	5
Score	Lowest				Highest

Scoring Method

Section 1: Roster

Scoring in section 1 is purely lineal in nature, either as a straight function of hours flown, or represented by a number from 1 to 5 for least fatigued to most fatigued.

Sections 2 through 5:

Are scored using a bench mark system where a score of 3 represents the minimum accepted international standard in each task area. Thus the scores above or below that mark represent a movement in terms of a standard deviation above or below that acceptable standard. This would equate to the "Company Standard" in accordance with the definitions to be stated in a later section.

Observer Scoring Guidelines:

Roster

As stated previously this section is purely lineal in nature either as a straight function of hours flown or as 1 to 5 for least fatigued to most fatigued and as such requires no further explanation.

MEL and Performance

MEL used: yes or no

Procedure followed:

1. MEL not consulted in the case of an MEL item, relying instead on personal memory or totally ignoring the issue.
2. MEL consulted but reference procedure incomplete or not followed.
3. MEL consulted and procedures followed but severity of delay for repairs or other required maintenance action not considered.
4. MEL operational and maintenance procedures followed with departure considerations understood.
5. MEL operational, maintenance and departure considerations understood and applied as well as future problems anticipated.

Performance Knowledge

1. Lack of basic knowledge (charts not used appropriately, principles of accelerate stop distance not understood etc).

2. Basic performance calculation performed but does not correct performance figures for wet runway or pressure variation etc.

3. Basic performance calculation performed but does not consider the performance penalty in event of an intersection departure or similar.

4. Performance calculation performed correctly but unaware of the penalty imposed by wrong line-up technique or similar.

5. Performance computations correct in all aspects and aircraft flown accordingly.

Language Differences

Using the MEL & Operations Manual Volume 2 as a medium through which language difficulties are measured.

(A linear grading depending on the difference or difficulty in understanding created through the process of translation from English to Chinese, should any be found.)

CRM

Knowledge

1. Works as a “one man band” no attempt to participate in a multi-crew concept.

2. Is familiar with the multi-crew concept however does not crosscheck settings made by other crew members nor does he/she allow for crosschecking by other crew members prior to the actioning of changes initiated by him/herself.

3. Mostly ensures that changes are acknowledged by other crew members however when acting as pilot not flying (PNF) will change settings without informing the pilot flying (PF).

4. Almost always acts in a manner consistent with the SOP's with regards to setting and crosschecking changes to various parameters but may make occasional unrequested or unconfirmed changes.

5. Setting always made in accordance with SOP's and well articulated to ensure the entire crew are kept in the loop.

Takes Responsibility

1. Tries to blame someone else for errors or mistakes.

2. Does not advise other crew members of errors so that remedial action can be taken.

3. Errors corrected but no analysis of the circumstances; is excuse driven.

4. Errors corrected and situation analysed.

5. Situation corrected, situation analysed and crew role recognised and long term changes to behaviour considered.

Supportive

1. Does not provide support to other crew members and has no input into the operation.

2. Makes input only when safety of flight may be compromised.

3. Provides the minimum level of support as expected by SOP's or as requested.

4. Actively supports the operation as expected by SOP's and as requested with some anticipation of future requirements.

5. Easily meets all active support requirements and fully anticipates and actively manages future requirements and plans several contingencies.

Resistance to Time Pressure

1. Obvious errors due to time pressure, e.g. commences second engine start prior to first engine start being completed, commences taxiing prior to second engine start etc.

2. Inappropriate speed of communication with ATC, checklist or procedures rushed with inadequate crosschecking or similar signs of rushing.

3. Generally appropriate tempo of procedures and communication with occasional prompts from other crew members to slow down or similar remark.

4. Generally appropriate tempo of procedures and communication.

5. Well considered tempo of procedures and communication ensuring correct sequence and crosschecking completed by all crew members.

Flight Deck Management

Unexpected events

1. Completely frozen in the case of an unanticipated failure or other event.
2. Rushes procedures in event of a technical fault, e.g. ECAM procedure commenced prior to 400ft AGL after takeoff.
3. Actions taken without a full evaluation of the aircraft flight path or other environmental considerations.
4. Flight path correctly managed however some minor lapse in communication, vigilance, monitoring or other management function observed.
5. Situation stabilised, flight path analysed and threats considered and crosschecked in consultation with other crew members and then remedial actions taken.

Error Management:

1. Behaves as if "bullet proof" and lacks Situational Awareness.
2. Continues to follow a course of action even though the desired result is not being achieved, e.g. no analysis of action and reaction.
3. Analysis of action and reaction resulting in continual decision modification to obtain the required outcome, however it can be seen that sometimes the recognition process is slow.
4. Actions evaluated and adapted in a timely, appropriate and confident manner.
5. Flight parameter changes anticipated, planned in consultation with other crew members prior to execution, indication that this crew member is well ahead of the aircraft.

Cabin Awareness:

1. Shows no interest in cabin safety or comfort e.g. turbulence not considered.
2. Safety items only considered, no passenger address or other communication attempted.
3. Minimum use of passenger address for safety purposes.
4. Uses passenger address for both safety and commercial communication.

5. Makes effective use of communication systems and plans communication opportunities to keep both passengers and cabin crew up to date with flight progress including delays etc.

Fuel Conservation:

1. Flying at low levels and at high speeds with no consideration for cost.
2. Inappropriate use of cost index and poor descent planning resulting in higher than planned fuel consumption.
3. Flight conducted according to cost index and flight plan.
4. Flight conducted according to cost index and flight plan at optimum flight level.
5. Flight conducted according to cost index and flight plan with actual conditions used to refine optimum flight level and descent profile.

Commercial Awareness:

1. No consideration given to the problems generated through delays or the loss of business created through cabin defects and lack of catering etc.
2. Understanding restricted to considering missed connections or similar.
3. Has an appreciation of the costs and frustrations caused by missed connections from both customer and company perspectives and makes efforts to inform

passengers of the situation and works with company and ATC to mitigate the situation.

4. As per the previous point but is able to give informative and timely passenger announcements.

5. Has a holistic approach with in depth understanding of the issues and costs. Is able to coordinate all departments, baggage, dispatch, operations, ATC, etc. to achieve the best possible outcome for the passengers as well as keeping all parties informed of the situation.

Noise Sensitivity:

1. No knowledge of the noise abatement requirements.

2. Noise abatement requirements understood however poor standard of compliance observed.

3. Compliance with published procedure.

4. Variables such as performance and weather considered to ensure compliance with safety margin.

5. Integrating all elements including performance, weather and noise monitoring to minimise noise footprint not just to meet the requirements of the published procedure.

Refers to Flight Documentation:

1. Minimal use of onboard documents; relies almost exclusively on memory.

2. Tries to find information in manuals etc. but is unable to locate the sought after material.

3. Has a basic understanding of the document system on board and eventually finds the required information.

4. Has a good general knowledge of the document system.

5. Knows where information is located and can cross reference with other manuals to find supplementary information.

SOP's

Taxi Speed:

1. Excessive taxi speed at all times.

2. Taxi speed within FCOM limits but no consideration given to actual taxiway conditions, e.g. turn speed on a wet taxiway.

3. Taxi speed suitable for conditions.

4. Taxi speed suitable for conditions and preplanning communicated to other crew members.

5. The additional element of passenger comfort added to the elements indicated above (4.).

FMA

1. Inappropriate use of automation, no crosscheck of and/or incorrect read back of FMA annunciations.
2. No crosscheck of FMA changes.
3. Occasional missed read backs following FMA changes.
4. Correct read back and crosschecking of all FMA changes and messages.
5. Anticipates FMA changes and messages and is able to prompt other crew members when corrective action is required.

FMGEC

1. Unable to use the FMGEC as intended.
2. Has basic knowledge of FMGEC functions but is unable to use any advanced functions e.g. offset function.
3. Correct use of FMGEC but no input of additional data e.g. wind, tropopause or cruise temperature.
4. Correct use of FMGEC including input of additional data however improvement could be made to increase passenger comfort particularly during offset in NAV mode etc.
5. Optimum use of FMGEC not only for navigation but also for passenger comfort.

Standard Call Outs

1. No calls or incorrect calls.

2. Confusion as to whether calls should be executed by PNF or PF.

3. Standard calls made but with some missed calls.

4. Standard calls made with only an occasional call missed with those occasional missed calls trapped by other crew members.

5. Standard calls made and prepared for under the “next step concept” of staying ahead of the aircraft being used.

Check List Use

1. A checklist conducted when the flight path is unstable.

2. A normal checklist performed without reference to printed checklist.

3. Checklists performed correctly in accordance with flight sequence.

4. Correct integration of normal and abnormal checklists (taking time to hold checklists when necessary).

5. Integration of normal and non normal checklists with summaries and ECAM procedures in a logical and timely order.

Task Sharing

1. No task sharing evident operates as per ‘one man band’.

2. No time allowance given to the other pilot to perform his duties as required.

3. Task sharing as per SOP’s however there may be a lack of understanding of conditions leading to work overload of the other crew members.

4. Uses all available tools (e.g. extra flight crew members) to ensure tasks accomplished correctly.

5. Crew member adapts his/her working rhythm to ensure that task overload is avoided regardless of extra crew members or crew member ability.

Dual Inputs

1. Taking over without call out and without pressing takeover button on a fly by wire aircraft.

2. Inadvertent dual input (e.g. touching the side stick with the leg).

3. “Back-kick” in case of a late flare (only a brief dual input as allowed by Airbus SOP).

4. Control take-over using the disconnect push button.

5. Control hand-over and if necessary, in consultation with other crew members, the disconnection of a faulty sidestick (As per Airbus SOP).

Task Sequencing

1. Chaos on the flight deck due to lack of briefing by the PF concerning the sequencing of events and tasks as required during the flight.

2. Late or incomplete briefings relating to flight sequences.

3. Correct sequencing of flight tasks following a basic briefing with respect to published procedures.

4. Extended briefing in the case of marginal conditions.

5. Extended briefing for expected conditions including marginal conditions, FMGEC setup down to landing airport and or alternate airports including crosschecks of data validity.

Paperwork

1. Incorrect paperwork entries (e.g. faults not entered on technical log as required or no entries made on flight plan etc.).

2. Insufficient flight plan entries e.g. no crosscheck of ETA fuel etc.

3. Basic completion of flight plan and technical log.

4. Completion of flight plan including ETA, fuel, level changes, frequency changes and ATC clearances correctly logged.

5. Flight plan details recorded as above and correct filing of all documents including flight reports technical reports and any other documents as required.

APPENDIX F

Ethical clearance certificate for study two

HUMAN RESEARCH ETHICS COMMITTEE

ETHICAL CLEARANCE CERTIFICATE

This certificate generated on 09-12-2013.

This certificate comfirms that protocol 'NR: Culture and It's Impact on Flightdeck Management (Part 2, Phenomenological Interview protocol)' (GU Protocol Number BPS/10/11/HREC) has ethical clearance from the Griffith University Human Research Ethics Committee (HREC) and has been issued with authorisation to be commenced.

The ethical clearance for this protocol runs from 20-09-2011 to 31-12-2013.

The named members of the research team for this protocol are:

APro Paul Bates

Capt Costa Ferroff

The research team has been sent correspondence that lists the standard conditions of ethical clearance that apply to Griffith University protocols.

The HREC is established in accordance with the *National Statement on Ethical Conduct on Research Involving Humans.* The operation of this Committee is outlined in the HREC Standard Operating Procedure, which is available fromwww.gu.edu.au/or/ethics.

Please do not hesitate to contact me if you have any further queries about this matter.

Rick Williams
Manager, Research Ethics
Office for Research
Bray Centre, N54 Room 0.15 Nathan Campus
Griffith University
Phone: 07 3735 4375
Facsimile: 07 373 57994
Email: rick.williams@griffith.edu.au

APPENDIX G

Research participant information sheet

GRIFFITH UNIVERSITY

Who is doing this research?

The principal researcher is Ass Prof Paul Bates who is supervising Capt Costa Ferroff who is a PhD student at Griffith University – Australia. The other supervisors are Ass Prof Patrick Murray and Ass Prof Tim Mavin.

Contact Details;

Ass Prof Paul Bates: Ph +61 7 3735 5358, Email p.bates@griffith.edu.au

Capt Costa Ferroff: Ph +61 408 398 605, Email cferroff@hotmail.com

Why is the research being conducted?

The research aim is to determine the effect, if any, of cultural background on the human interactions and flight deck management on commercial aircraft.

What is the expected research outcome?

The research is expected to deliver information that can be used in the improvement of both safety and efficiency within the aviation industry. It is also anticipated that the results may inform further research in other industries.

If I agree what will it involve?

It involves partaking in a face to face interview, which should take no more than 30 minutes of your time. There is also the possibility of a follow up interview in future.

Are there any risks?

There are no risks as the research has been carefully designed and your identity will remain anonymous in any reporting of the results obtained from the data you provide.

Do I have to agree?

There is no requirement or necessity to participate, your participation is entirely voluntary – you don't have to agree.

What if I have concerns, questions or a complaint?

If you have concerns that you think I or my supervisor can help you with, please feel free to contact us at: Costa Ferroff – cferroff@hotmail.com or Dr Paul Bates – p.bates@mailbox.gu.edu

What if I have questions regarding the ethical conduct of this research?

Griffith University conducts research in accordance with the *National Statement on Ethical Conduct in Human Research.* If you have any concerns or complaints about the ethical conduct of the research project please contact the Manager, Research Ethics on +61 7 3735 5585 or research-ethics@griffith.edu.au

Will I receive any feedback with regards to this research?

Feedback will be available on request as both a summary of results and as a full copy of the thesis when published.

Privacy Statement;

The conduct of this research involves the collection, access and / or use of your identified personal information. The information collected is confidential and will not be disclosed to third parties without your consent, except to meet government, legal or other regulatory authority requirements. A de-identified copy of this data may be used for other research purposes. However, your anonymity will at all times be safeguarded. For further information consult the University's Privacy Plan at *http://www.griffith.edu.au/about-griffith/plans-publications/griffith-university-privacy-plan* or telephone +61 7 3735 5585.

APPENDIX H

Participant agreement form

GRIFFITH UNIVERSITY

AGREEMENT TO PARTICIPATE IN RESEARCH PROJECT

I agree to partake in the research project "culture and its impact on flight deck management ": (Griffith University REF C. Ferroff 2008), being conducted by Ass Prof Paul Bates (Principal Supervisor) and Capt Costa Ferroff (PHD student) at Griffith University, School of Aviation, Brisbane , Qld 4111, Australia, Tel: +61 7 3875 5358, Email p.bates@griffith.edu.au or cferroff@hotmail.com .

I understand that the purpose of this study is to find out about the general perceptions of culture on the flight deck through the experiences of air crew operating internationally.

The research aims to determine if cultural imperatives impact on flight operations and if so to discover and describe the degree to which such cultural imperatives may influence actions and decisions of Chinese pilots.

I understand that my participation in this research is voluntary.

I understand that I am free to withdraw my participation from this research project at any time I wish, without consequences, and without giving a reason and without consequence.

I agree that the research data gathered from this project may be published in a form that does not identify me in any way.

I understand that my involvement in this research will involve an interview of approximately 30minutes duration and may also involve a follow up interview.

I have had any questions answered to my satisfaction.

I understand the risks involved.

I understand that there will be no direct benefit to me from my participation in this research.

I understand that if I have additional questions I can contact the research team.

I understand that I can contact the Manager, Research Ethics, at Griffith University Human Research Ethics Committee on +61 7 3735 5585 (or research-ethics@griffith.edu.au) if I have any concerns about the ethical conduct of the project.

Name:..

Signed:..

Dated:........./........./.........

Appendix I

Explanation of the minimum equipment list.

The Airbus description and background information for the minimum equipment is presented below;

When an aircraft is certified by the manufacturer it is certified with all its component equipment installed and serviceable. Experience shows however that it is safe to operate the aircraft for a limited time under specific conditions with some of the installed equipment in an unserviceable condition. (Airbus 2007)The document which allows the aircraft to be operated in this way is the Minimum Equipment List (MEL).

Airbus further states that "The MEL is intended to permit operation with inoperative items of equipment for a period of time until rectifications can be accomplished. It is important that rectifications be accomplished at the earliest opportunity. In order to maintain an acceptable level of safety and reliability the MMEL (*master minimum equipment list*) establishes limitations on the duration of and conditions for operations for operation with inoperative equipment.

MEL utilisation implies that the aircraft is operated within the framework of a controlled and sound program of repairs and parts replacement.

Air carriers are responsible for exercising the necessary operational control to assure that no aircraft is dispatched or flown with one or more MEL items inoperative for an indefinite period."(Airbus 2007, p.87)

When an aircraft is dispatched with an item or items unserviceable, but allowed to be so under the MEL's, the MEL document must be consulted to confirm that all the special conditions imposed as a result of the unserviceability are met. So that flight crew can be sure of complying with these conditions, it is obvious that there must be a standard format that is easy to read and displays all the relevant information for each and every item allowed under the MEL.

Each item recorded in the Airbus MEL is presented in a five column format in the following way.

Column one lists the equipment, system or function which is unserviceable and under which conditions the MEL may be applied.

Column two indicates the rectification interval category applicable to the item. This rectification interval could be one day, three days, ten days, one hundred and twenty days, or an interval specified by the regulator.

Column three indicates the number of identical components installed on the aircraft.

Column four indicates the number of components required to be serviceable for dispatch.

Column five is the remarks column. This is the column reserved for additional requirements such as the placarding of switches, repetitive maintenance procedures, flight crew operational procedures and performance penalties. (Airbus, 2007)

It could be assumed that, as the MEL is a purely technical document, there would be little or no cultural implications to be found, however this is not what was observed. In China even though the MELs of the various airlines are translated from English to Chinese the master document is the Chinese version not the original English version.

Observations in this area have shown that as Chinese is not a continuous and linear language there can be issues with technical documents not being complete. This presents problems where processes, limitations and meanings can, to a large extent, be open to interpretation. This situation is bound to lead to anomalies. Some of the observed anomalies have been listed below;

The 1, 3 or 10 day rectification interval as indicated by the relevant MEL does not mean to the Chinese that the affected system must be repaired; it simply means that the MEL must be reissued so that the 1, 3 or 10 day interval can start again.

Repetitive maintenance procedures, i.e. a procedure to be conducted prior to each flight, are usually interpreted to mean that the procedure is only completed prior to the first flight conducted under the MEL.

3. Performance penalties are only partially applied due to the fact that notations in the MEL are either incomplete or misunderstood.

For example the performance penalties applicable for operations with one brake released MEL

32-42-01 includes the following note. *"Perform takeoff using full thrust"* The significance of this note was not appreciated by the first officer concerned at all until both the English and Chinese MEL were worked through side by side. When the note referring to *"Perform takeoff using full thrust"* was reached in the English version the first officer looked at the Chinese version and exclaimed "Ah that's what that means".

APPENDIX J

Sample of Interview & Transformations for Participant Captain No: 4 (I4)

Meaning Units		Transformation 1 (I1TR1)		Transformation 2 (I1TR2)	Transformation 3 (I1TR3)
I	C: This is interview number 4. I just wanted to confirm that you received all the information from the university on the university letterhead to say that of course you can withdraw from the research at any time and that you also received and signed the approval form to participate in the research.				
I	I4: I did yes.				
I	C: Okay. Thanks. So we are going to ask a series of questions and I would like you to discuss these questions with a view to communication styles, management skills, team building, workload management, situational awareness, and flight control competency and aviation knowledge. So all the major tenements of the CRM aspect of the operation if that is at all possible.				
I	I4: Yep.				
	C: The first question is, from your experience working with both Chinese and Western flight crews , would you be able to describe and preferably have some instances where you may have used had to work through any MEL items and performance calculations and could you describe the difference between working with the Chinese and Western crews in that regard?				
1	I4: Yes. Well first of all we will go to MEL's. It would seem that in China I don't know what training they are given at all in how to handle MEL books. It seems to be so piecemeal and they all, some guys have a bit of an idea what they are doing and some have no idea what they are doing and I am talking about Captains, not First Officers. First officers tend to not even get involved in it. They don't even seem interested. How they apply it seems real hit and miss and you know when they need to apply it and any of that stuff doesn't seem to be laid down and they seem to, well, in some instances they take it fairly seriously and sometimes they seem to pay it a bit of lip service to it, so, there is a bit of inconsistency there, like, you know I have had one guy where we had an operational procedure on MEL that we didn't have a copy of to read and he is just trying to assure me that 'I read it before and there is nothing in that operational procedure.' I said to him 'well I do have to actually read it; I can't just take your word for that I do actually have to read it. We will have to get a copy of it.' 'No no no. It's all right.' Well we do have to get it. So I got one faxed to me and there were considerations in there of things that we had to do airborne. It wasn't a completely disregard procedure like he was trying to tell me.	1	I4 Related that the Chinese crew members have a very piecemeal approach to handling MEL items. I4 observed that there are times when the application of an MEL item is overly conservative and at other times the MEL item may be virtually overlooked. I4 related an incident on one of his flights where a Chinese Captain would have departed without properly assessing the operational requirements associated with an MEL that had been applied to the aircraft. It was only through his intervention that the MEL was properly assessed and the required operational procedures complied with.	1) (1, 2, 3) I4 stated that there was no standardised system covering the application of and acceptance of MEL items. I4 related that the lack of a standardised method of handling MEL issues meant that MEL items could be either handled either too conservatively or too casually. I4 described an occasion where an MEL item would have been improperly handled but for his insistence that there was an important operational procedure to be complied with. I4 described another occasion where a flight he was operating could have departed following the application of an MEL procedure however the Leader on Duty over-rode the Crew and would not let the aircraft depart.	**MEL and Performance Calculation** I4 reported that there was no standardised system covering the application of and acceptance of MEL items. (1) With regards to the MEL manuals themselves there were supposed to be both English and Chinese manuals on the aircraft. The manuals were often found to be in disrepair with pages missing and in the case of the English manual it was often missing completely. (2) I4 related that there were also problems with language and comprehension that exacerbated the difficulties of dealing with the operational aspects of MELs. (4) With regards to general performance calculations I4 stated that he had seen an improvement in the standard of the calculations made offer the four years that he had worked in China. (5) The greatest improvement seen was that the Chinese crew members were considering the influence of tail wind and intersection as part of the calculation process. (5) However this consideration was still not universal. (6) The Chinese crew members had a tendency to down play or disregard some types of operational threat. For example in the case of a windshear report (takeoff or landing) a change to performance and configuration is warranted, however I4 observed that the issue was unlikely to be addressed. (9)
2	I4: And there's other times where the application of the MEL's as far as the Company goes, like particularly I had one a bleed air problem and one the pack problem where we could have had MEL release to complete the flight whereas the company said no. The Chinese are very reluctant to make any decisions on their own and they will get immediately on to the SAT phone and talk to the leader and you know in both those cases I said you know we can go. We have an MEL to cover this and he goes 'no, no, no, we have to talk to the leader' so straight on to the SAT phone and the leader said 'No. You are not taking that aeroplane'. So okay, if that's the way you want to play it.	2	I4 stated that on another flight he had a system malfunction prior to departure and that the aircraft could have departed following the application of an MEL procedure. In this instance however the Chinese Captain contacted the Leader who would not allow the aircraft to depart with the system unserviceable.		

Participant Captain's Number

Interviewer

Meaning Unit Number

TR 1 Number 1, First Summary of Meaning Units

TR 2, Combining Units with Common Themes and Further summarisation.

In this instance TR 2 Number 1 is a summary of TR 1, 2 & 3

TR 3 Developed from a Combination of TR 2 Units.

	C: Right.				
3	I4: So it's a bit, the whole thing I think is a bit hit and miss. So I don't know if you want to talk any more about MEL's, before we go on to performance?	3	I4 restated his observation that there was no standardised system covering the application of and acceptance of MEL items.		
	C: Well just on the MEL issue, you know that when we were with one of the other companies up there we had both English and Chinese MEL manuals on the aeroplane, is that the case with your company?				
4	I4: It is, but quite often the manuals are in a very bad state. They seem to be all over the aeroplane and the manuals they've got often have pages missing. The standard of manuals is quite atrocious and it is not unusual for them to be able to find the Chinese MEL and not the English one.	4	I4 stated that they had both English and Chinese MEL manuals on the aeroplane but they were often in disrepair, with pages missing, and misplaced. It was not unusual for the crew to be able to find the Chinese MEL but not the English one.	2) (4) I4 stated that there were both English and Chinese MEL manuals on the aeroplane. The manuals however often in disrepair with pages missing. There was also an additional issue where the English manual was often missing.	**Compliance** I4 stated that there were several areas where compliance was an issue. I4 reported that compliance was in the most part enforced through a punishment regimen. (14) With regards to complying with the flight and duty limitations the converse applied in that there was a reluctance to address any excedence in this area as junior flight crew members were afraid of being punished for bringing the matter to the attention of the company. (8) The Chinese crew members routinely ignore the speed and altitude restrictions as published on the SIDs, STARs and Approaches. (15) The Chinese crew members also disregard speed instructions issued by ATC. (16) This practice is accepted in China however the Chinese crews have received numerous violations when operating Internationally as a result of this type of noncompliance. (15)
	C: Right. Okay. If you happen to have both manuals on the aeroplane, have you worked through both the Chinese manuals and the English manuals and have you noticed any variation between procedures of both manuals, or the, you know, calculation, performance penalties and stuff.				
5	I4: No. I don't read the Chinese ones of course, the Chinese do, but what tends to happen is, if they read the Chinese one at all they will just do it off on their own and they won't make any comment. They'll just say, you know I will just go through the English one and they will just say they are happy. They are never not happy. Sometimes you do wonder how much they even understand what I am saying in English.	5	Due to communications difficulties I4 stated that is was difficult to ascertain whether there were issues with variation between the Chinese and English manuals. I4 stated that Chinese pilots will often read through the Chinese MEL on their own but have not expressed any issues when comparing the two.	3) (5) 14 stated that it was difficult to ascertain whether there were any variations between the English and Chinese versions of the MEL manual but he was not aware of any discrepancies.	
6	I4: There is definitely language problems there and they'll say 'yes, yes, yes' whether in fact it has all gone over their head or not. Sometimes I wonder if it is even worth talking.	6	I4 stated that there were language and comprehension problems. He developed the impression that Chinese pilots would simply agree with his statements whether they understood him or not.	4) (6, 7) I4 related that there were language and comprehension problems. Through his experiences I4 developed the impression that the Chinese crew members would agree with his statements regardless of what he said. I4 related that when working through MEL procedures he would explain the procedures and their consequences to the Chinese crew members in English. The Chinese crew members always agreed with his interpretation even if they didn't understand what he was saying.	
	C: Right.				
7	I4: What I do because I only speak English is I'll bring out the English MEL and if it's a long one with an involved performance procedure or something then I'll just work through it slowly with them in English and tell them how I think it affects us and ask them if they agree and they have never not agreed. You know, like I say that doesn't mean they even understand what I'm saying.	7	I4 stated that he would go through the English MEL with the Chinese pilots and explain in English the implications of the longer performance procedures. He stated that when asked if they agreed, the Chinese pilots would never not agree, even if they did not understand what he was saying.		
	C: Okay. Well let's move on then to the performance calculation side of things.				

8	I4: Yeah well just standard performance, they are actually getting a lot better. I've been there for four years and when I first got there, it was quite atrocious; you know they just refused to use tail wind, when just about every takeoff had tail wind. They wouldn't use intersection departure charts when we were always taking off at intersections. And to try and like we would always just insist of course and they look at you and carry on as if you come from Mars because you just want to apply some tail wind figures, but they seem to be getting a bit better at that. I think we have been there long enough now that they have started doing that started doing what we want. I don't know what they do when we aren't with them.	8	I4 stated that when it comes to standard performance calculations Chinese crews are getting much better. In the four years that he was with the company I4 had witnessed several improvements. For example in the beginning pilots refused to use tail wind, even though almost every take off had tail wind; and they wouldn't use intersection departure charts, even though they were often taking off at intersections. After four years however this had improved. I4 felt that the presence of foreign pilots in the company had influenced these changes. However he was unaware if this improvement was maintained when a foreign pilot was not a crew member.	5) (8) I4 stated that during the four years that he had worked with airline X he had seen an improvement in the standard of performance calculations. Initially the Chinese crew members did not correct for tail wind or intersection departures. I4 related that due to the influence of the Western Captains these conditions are now considered in the performance calculation process.	**Language** I4 stated that there were language and comprehension problems when dealing with the operational aspects of the application of MELs.(4) But the issue went further that just dealing with one aspect of communication. I4 reported that communication skills in general were quite poor. The junior Chinese crew members did not pass on information to the PIC as a matter of course. There was also a general reluctance to communicate in English and a desire to use Chinese for radio communication with the Western Captains being excluded from the communications loop. (12) I4 also related that in spite of the ICAO level 4 English standard being required there were many occasions where the Chinese crew members did not fully understand the clearances being issued to them. In these instances there was also a reluctance on the part of the Chinese crew members to seek clarification. A reluctance that has led to a significant number of ATC violations. (29)
	C: Right.				
9	I4: I had this one guy for instance that it was obvious on the ATIS that there was tail wind, and I said to him, 'oh we'll use some tail wind'. He was flying, I was PNF and we'll use some tail wind figures and he goes 'oh wind is calm'. I said alright then and I just wrote, I didn't want to ruffle his feathers so I just wrote the tail wind figures on my pad beside me because he put the new wind figures in to the FMC.	9	I4 related an incident where the ATIS indicated a tail wind was evident foe takeoff. The Chinese crew member who was pilot flying stated that the wind was calm and calculated the takeoff performance for nil wind. While taxing for takeoff I4 pointed out the tail wind as evidenced by the wind sock, there were also several other indicators of a tail wind that I4 highlighted for the other pilot, however the Chinese crew member continued to deny the presence of a tail wind. Eventually I4 entered the tail wind figures himself as the other pilot had determined there was no tail wind despite evidence to the contrary.	6) (9, 10, 11, 12, 13) I4 related an incident related to the calculation of performance figures. In the incident recalled there was ample evidence of a tail wind affecting the takeoff runway and as a consequence the appropriate influence should have been applied to the takeoff calculations. The Chinese Captain was insistent that there was no requirement for the influence of tail wind to be considered in spite of the evidence to the contrary. I4 stated that there are several issues raised by this type of behaviour. In a minority of cases the behaviour has to do with resentment. The Western Captains usually operate as PIC1 with the Chinese Captain as PIC2. Some Chinese Captains resent being subordinate to a Western crew member and as such do not appreciate being given instructions. I4 was also of the opinion that there was an element of loss of face in agreeing to apply the tail wind corrections as he should have initiated the process himself. The other aspect to the process of applying the influence of tail wind to the performance calculations related to training. I4 stated that with the high reliance on oral tradition within the training environment the trainees' rellie almost entirely on the instructions given by the Check Captains. This being the case if the Check Captains do not apply the required corrections then the more junior pilots won't either regardless of the FCOM instructions.	
	C: Yeah.				
10	I4: As we were taxing out there was a wind sock and I said, the wind sock is definitely showing a bit of tail wind there and he goes, no, wind is calm. All right then. We are taxiing down and they gave wind to another aircraft and I said I think you'll find that's tail wind. Wind is calm. He just kept saying 'wind is calm' every time. There were all these indicators we've got tail wind. Wind is calm. Finally, we were almost lining up and I just said to him "tell you what, I'm just going to put these tail wind figures in' and changed them myself, because no amount of prompting he was going to put them in. He was just determined we had no tail wind even though all the evidence was to the contrary.				**Situational Awareness** I4 stated that there was evidence of a lack of situational awareness. (11)
	C: Right.				
11	I4: You just wonder where that comes from.	10	I4 stated he wondered how this behaviour arose.		
	C: Yes. It is certainly not something we are used to in the Western world. Do you think that's a problem with the decision making or the situational awareness? What do you think it might be?				
12	I4: There's a bit of different elements in it. With some of these guys there's definitely an element of they just don't want us there, cause we fly with 2 captains, it's always another Chinese Captain and myself.	11	I4 stated that it wasn't simply a matter of poor decision making or situational awareness. It was I4's experience that there was an additional issue with certain Chinese Captains resenting the presence of an additional Western Captain.		
	C: Yep.				
13	I4: We're usually PIC 1 they're the support for, they're PIC2, they call it which is captain, but they are not the PIC, and these guys resent the fact I think and some of them do. I mean it is a small minority, but some of them resent the fact we're there you know they don't want to be told anything by us. In that situation I was talking about there, I think that was simply the case that he thought there was some loss of face involved if I said we had to use tail wind and he hadn't thought of it. I think that was purely what it was down to.	12	I4 stated that the Western crew members were usually the PIC1. I4's experience was that some of the Chinese Captains resented being PIC2 instead of PIC1. He stated that this was the case for only a minority of Chinese Captains, and stemmed from resentment to being given instructions by Western crew members. He felt in the instance related above that the Chinese Captain may have feared a loss of face in agreeing to use the tail wind when he had not initiated the idea himself.		
	C: Right.				

14	I4: But in regards to why they don't use it in the first place, it would be because they only do what they are told to do or trained to do, well they do read the books, but they don't seem to care what's written in the books if it differs from what they've been told, they will always do what they've been told, rather than what's been written in the book. They'll never say to a Check Captain ' oh what you are telling me there is not what's written in FCOM, they'll just accept it and do it, regardless of what's written in the book, and so the like for instance in Beijing there is always tailwind. They take off to the north with southerly winds blowing and just pretend it's not 90% of the time. And if the Check Captains that are flying with them didn't apply tail wind figures then that's not required. They won't do it because they were never trained to do it that way. It was simply never questioned what the Check Captain told them to do.	13	In regards to the use of tail wind in the first place, I4 stated that was not used because most Chinese pilots do only as directed or as their training directs them to do. He stated that Chinese pilots read the books, however they will disregard what is Witten in the books if they are told something contradictory. If a Check Captain says something that is not in the FCOM the Chinese pilots will simply accept the Check Captain's instruction in preference to what is written in the reference material. I4 related one incident in Beijing where operations with a tail wind is a common occurrence with takeoff's to the north with southerly winds blowing. The performance penalties associated with the tail wind are simply disregarded 90% of the time. If the Check Captains flying with them don't apply tail wind figures then the Chinese crew members do not receive training on the importance of applying the corrections. The Chinese crew members are not willing to ask questions of the Check Captains and just assume that the correction is not required.		**SOP Compliance** I4 stated that SOP compliance issues were evident in several areas. Firstly with regards to Checklist use the Chinese didn't respond in a word perfect manner. Secondly the responses were often made prior to confirmation that the called item had been actioned. As a result of this checklist methodology there were a lot of missed items. (10) I4 also stated that there was also a lack of self discipline amongst the Chinese crew members and that this was evident through the reliance on the QAR to record events as a basis to apply punitive measures to ensure compliance in the area of SOPs . (13, 14)
	C:Right. Okay. Well let's move on to the next question then. That relates to, have you observed any difference then in the way a Chinese crews and a Western crews might react to operational threats and time pressure restraints and start off I guess before flight and perhaps move on then to in flight?				
15	I4: Okay. Well to start with time pressure constraints they don't seem to have any. They don't care about time pressure at all. They're not concerned about delays; I mean we have regularly delayed for hours up to 6 or more hours delay. But they don't seem to worry too much about it at all. And it doesn't seem to matter if the delay is due to commercial or crew or ATC they just don't seem to care about delays at all. It doesn't seem to enter in to their thinking. So I would say there is zero time pressure on them at all.	14	In regards to the reaction of Chinese crew members to operational threats and time pressure constraints I4 stated that Chinese crew members don't seem to circum to time pressure. They are not concerned by delays, as evidenced by the fact that they will regularly be delayed by six or more hours. Whether these delays are due to commercial, crew or ATC factors, they don't appear to be concerned in any way. This seems to imply there is no time pressure on these crews at all.	7) (14, 17) I4 related that in his experience the Chinese crew members were highly resilient in the face of time pressure.	
16	I4: They don't consider it at all and even to the extent that they don't even care about crew duty limitations. They start getting nervous when I start talking about crew duty limitations because that might actually ruffle some feathers somewhere. You know it might cause a bit of a problem. They don't want to be seen to be a trouble maker. Refusing to fly or anything of that nature. They just, they don't even consider it. I have had several times where I have found out afterwards that I have had crews that have not had the required crew rest or are outside crew duty limitations and they just, the company doesn't pick it up, they will never bring it to their attention. Like I had a first officer for instance once who, we were going to Harbin. It was snowing there so we were waiting for the runway to be cleared. We were sitting there with all the doors closed and all the passengers on board, waiting for them to give us a call to say the runway had been cleared of snow. So I just started talking to this guy and said 'when did you last go to Harbin. He said 'oh yesterday. Oh really, How'd that go. Oh we got halfway there and it was snowing. We had to come back again. Then there was a few hours delay and then we went again. I said to him 'so what time did you get back the second time. Oh about midnight and we had been up about 5 o'clock in the morning for an early start. So you were, you did the same flight yesterday, operated all day from 5 o'clock in the morning, got back at midnight and now you are up again to do it again today. Yeah. I said well you are out of crew duty limitations. Why are you here? Why didn't you ring up someone and tell them you couldn't do the trip? Oh if I did that then I would never get a command. I would never be Captain if I started doing that type of thing. This is what they think. So you just shake your head at it.	15	I4 stated that this issue extends to crew duty limitations. It was his observation that the Chinese crew members do not raise issues with flight and duty times and continue to fly despite limitation infringements as they do not want to be seen as trouble makers or stand out in any way. In I4 related that there have been several instances where he has discovered in flight that the Chinese members of his crew have not had the required crew rest or are outside crew duty limitations. In these instances the company has failed to make any roster adjustments, and the Chinese crew members have not brought the matter to their attention. I4 related an instance where he was flying to Harbin and the first officer for the flight had worked from 5am to midnight the day before due to weather delays and was well outside of crew duty limitations. When asked why he had not brought this to the company's attention and turned down the flight the pilot stated he was concerned that if he did so he wouldn't be promoted to Captain if he did that kind of thing.	8) (15, 16) I4 stated that the lack of concern on regards to time pressure had an impact on flight and duty limitations. The Chinese crew members did not raise issues with flight and duty times. They would continue to operate despite limitation infringements as they did not want to be seen as trouble makers. Airline X had no formal promotional process, so all promotion was based on recommendation from the Team Leaders. As a consequence of this system junior flight crew members were afraid to bring flight and duty time excedences to the attention of the company. I4 stated that while the company did not openly use punitive measures against the pilots for seeking to have flight and duty time limitations enforced the Team Leaders used promotion as a method of controlling the rank and file.	**Operational Decision Making** I4 made several observations in relation to operational decision making as made by the Chinese crew members. Firstly there was no evidence that the Chinese crew members used a problem solving methodology when making operational decisions. (26) I4 also stated that the Chinese crew members were very reluctant to involve an outside source in any information gathering (9) and with the exception of the team leader on duty in the decision making process. (9, 34) In deed I4 related that the Chinese crew members relied heavily on contact with the team leaders to resolve issues in flight and had abrogated their authority in this regard. (34, 1)
	C: Right.				
17	I4: You know you wonder, the first officers in particular are so concerned that it will be held against them if they call crew duty or anything of that nature.				
	C: Right. So then I guess is that sort of thing very punitively dealt with in the company, do you know?				
	I4: Punitively?				
	C: Yes.				

18	I4: Well, not openly, but see, the way the system works, is there's a team leader with a number of pilots under him, both captains and first officers and they're totally in charge of the guys that are in their team, promotions etc and if they don't like them, they'll go nowhere. Like there is no seniority system, it is just a matter of whether your boss likes you to what happens to you, how quickly you get promoted etc, or if you get promoted, so they have to keep on the right side of the leader. If the leader for some reason, if they go sick and the leader thinks they are going sick too often, they just won't be promoted.	16	I4 stated that the company he worked for did not openly use punitive measures to dissuade the Chinese crew members from seeking the enforcement of flight and duty limitations, however the current company structure with team leaders in charge of a number of pilots, both captains and first officers, and total control over the promotions etc of those team members ensures that those pilots who raise issues do not receive promotions. There is no seniority system, therefore the team leaders have total discretion on the issue of promotions. Therefore in order to be promoted the Chinese crew members need to retain the favour of their respective team leaders.		**CRM** I4 stated that while the Chinese crew members knew what CRM was, CRM as a management tool was not routinely practiced. (26) Due to the lack of use of CRM meant that the Chinese crew members did not consider the cabin crew or other external parties as valuable resources. (26) The highly variable and often steep cockpit gradient (27) and poor level of interaction between the flight crew and cabin crew as observed by I4 (20)are symptomatic of poor CRM.
	C: Right, okay, right.				
19	I4: So anyway time constraints, there really isn't any. What was the other thing you asked?	17	I4 Stated that the Chinese crew members do not react to or consider time constraints.		
	C: Yeah. Operational threats, how do they handle sort of ah operational threats sort of before flight and perhaps during flight if you have some experience in that regard?				
20	I4: The way I see a lot of the times they tend to try to downplay and disregard stuff because it becomes a bit too hard for them if they've got to start thinking. You know like if there's wind shear or something they might have to consider a different flap setting to the one the company has told them to use or use a different runway and they request something from ATC that they're not offering they're very averse to doing it at all. They just want to go with the status quo and if they can do something in the aeroplane which doesn't involve an outside source, they'll do it, but if it means calling somebody or asking for something or anything that might put their name in lights, they are very averse to doing it.	18	In terms of operational threats both before and during flights, I4 stated that the Chinese pilots tend to downplay and disregard issues that may complicate matters. For example, if there was wind shear reported for takeoff or landing which should lead to consideration of a different flap setting being used from the company standard setting, or an ATC request to use a different runway either of which would require the recalculation of the performance figures, there is a high probability that the issue will not be addressed. I4 also stated that the Chinese crew members wish to maintain the status quo, if they are able to address an issue within the aircraft, without involving an outside source, they will do so. However, if an external party becomes involved attention to the pilot involved may be drawn, therefore they are very adverse to doing so.	9) (18,) I4 related that the Chinese crew members had a tendency to downplay or disregard some types of operational threat. I4 used the examples of windshear reports (takeoff or landing) and ATC runway changes as examples where a configuration other than the company standard configuration would be required in the case of windshear reports and in both cases a change to performance calculations is required. I4's observation however was that there was a high degree of probability that the issue would not be addressed. I4 also stated that the Chinese crew members are very reluctant to involve an outside source in any information gathering or decision making process.	**Recurrent Training** I4 stated that there was a poor level of English amongst the training staff and that as a result the training delivered to the western pilots was of a very low standard. (31) The result was that most learning came from self critique. (33) I4 stated that due to the risk adverse nature of the Team Leaders the First Officers were not allowed to fly the aircraft during normal line operations. That being the case the only opportunity for them to practice was during their simulator sessions, but even then they were restricted to flying low level circuits. (32) I4 went on to state that training was primarily given in order to meet regulatory requirements rather than to improve the standards and knowledge base of the participants. (31)
	C: Okay. That's interesting isn't it? All right. I can't think of anything in particular to further to ask on that. So what have you been able to observe with regards to checklist use and ECAM management? Is that similar between the Chinese crews and the Western crews or is it not?				
21	I4: Checklist use to start with – no. There is a lot of non-standard stuff in there. They don't for instance think that it is important to get checklists word perfect. Their response they will just reply to anything really. The worst thing that I have seen them do is they tend to have a big habit of replying to a checklist without actually looking at what their before they give a response. Now they'll just say the words without actually looking to see if what they are saying is even true.	19	In regards to checklist use and ECAM management I4 stated that there were several differences between the use of checklists by Chinese and Western crew members. There were several non standard aspects to the checklist use by the Chinese crew members. In particular they did not feel it was important to get the checklists word perfect. They seemed to respond to any statement even if it was inaccurate, and appeared to have developed a habit of replying to checklists without looking to see if the items called had actually been actioned.	10) (19, 20, 21) I4 observed that there were several differences between the way in which the Chinese crew members and the Western crew members used checklists. Firstly the Chinese crew members didn't call or respond in a word perfect manner. Secondly the Chinese crew members often responded to the checklist items without confirming that the items had been actioned. I4 reported that while the items were often checked after the checklist response had been called there were a lot of items missed as a result of this incorrect checklist methodology. The third issue that I4 reported was that often the pilot not flying (PNF) would complete the After Landing Checklist without including the pilot flying (PF) in the process at all. Under the Airbus procedures the PNF reads and responds to this checklist however the PF is still included in the process to cross check that the checklist items are correctly actioned. I4 related an occasion where he insisted that the After Landing Checklist be repeated. Upon repeating the process it was found that several items had been missed on the first attempt at the checklist.	**Knowledge** I4 observed that the Chinese crew members were rote learners however in spite of this there was extensive use of oral tradition in the learning process. (6, 30) I4 also related that instructional emphasis was placed on what to do with little or no emphasis place on why something should be done (30) leading to a broad lack of in depth systems knowledge. (11)
	C: Right.				
22	I4: They'll often make the response before the action is even done. Like for instance, it's not checklist perse, but when the engineers say set the park brake, they'll say park brake set before they even turn the handle, let alone check if they have any pressure in the brakes. So they tend to say the response. They're not trained to look for an actual indication somewhere and then give the verbal response once they have checked that the indicators are there. They just say it, without checking it at all. Usually they do check it, but after they've made the response if they check it at all and they do miss a lot of things.	20	When completing checklists the Chinese crew members often made the response before the action was completed. For example, if the engineer instructed them to set the park brake, they would respond 'park brake set' before they even turned the handle to set the park brake, let alone checking if they had any pressure in the brakes. They were not trained to look for an actual indication and then give the verbal response once they had checked that the indications were correct. The indications were usually checked after the response had been made and as a result a lot of items were missed.		
	C: Ok.				
23	I4: They have a habit. I don't know where this came from, of doing the after landing check list , for instance the pilot not flying just does it by himself. Doesn't include the pilot flying at all.	21	Often the pilot not flying will complete the after landing check list without including the pilot flying at all. I4 related an incident where the pilot not flying completed the landing checklist individually. I4 requested that they repeat the checklist together, as mandated by the FCOM. Upon repeating the process it was found that several items had been missed for example, the radar was still on. I4 stated that by not completing the checklist as mandated, and racing through the process, the entire purpose of using a checklist can be defeated.		
	C: Uhuh.				
24	I4: And they miss things all the time. You know like, I will call for the after landing checklist and he will say 'oh it's done'. I say oh we'll do it the way EFCOMS say. You give it to me and I'll check and give the responses so they'll reluctantly go through it again and you find the radar is still on or they've missed stuff, you know. And you think this is why we do the checklists this way. This is why you don't have just one person doing it,				

	racing through it because you're not doing it properly, or you miss things.				
	C: Yep.				
25	I4: ECAM – We don't get a lot of ECAM in the aircraft, of course we do in the simulators, you know if you're talking about emergency, non-normal type situations.	22	I4 stated that there were not a lot of situations where ECAM actions were performed in the aircraft. Most were performed in the simulators. I4 stated that in the simulator the Western Captains would be pared with Chinese First Officers. I4 further stated that some of the First Officers showed a high level of proficiency with the procedural component of non-normal situations and the associated ECAM's. However there is a broad lack of in depth systems knowledge. To highlight this point I4 related a simulator incident where he was working with a Chinese First Officer. There were several emergencies to address at once and as a result of the multiple systems failures there was only one electric hydraulic pump powering the flight controls. There were no engine driven hydraulic pumps operating. Additionally one engine had failed and the aircraft was de-pressurised with a missing door. The First Officer insisted they should complete a flap full landing despite I4's objections and the reality that even if only one if the major failures had occurred the landing configuration required would not be flaps full.	11) (22, 23, 24) I4 stated that while the Chinese crew members were proficient with the procedural aspects of the ECAM procedures there was a broad lack of in depth systems knowledge and a lack of situational awareness.	
	C: Yep.				
26	I4: The First Officers, we're always with a first officer in the simulator, when they're running through non-normal well ECAMS, some of them are pretty good. Usually their use of ECAM is no problem it's systems knowledge is quite lacking at times, so of the things they'll be coming out with, you know are just not making any sense. If they had any knowledge of their systems knowledge they'd know that what they were saying made no sense. You know like generally it is not too bad.				
27	I4: I mean I've had like once we've had the usual thing with our simulators, they throw about 15 emergencies at once at you, and so you know, we were running around with one electric hydraulic pump powering the flight controls, that's all we had. We had no engine driven pumps, one engine, aircraft was de-pressurised with a door blown out. That took, that's what took out the engine and a few other bits and pieces. All sorts of stuff going on the aeroplane and the FO insisted that we should be doing a flap full landing. I said I really don't think we'll be doing a flap full landing, you know, we had better have a look at that again. He goes no, no, no it's flap full. I really don't think we will be you know.				
	C: Yeah.				
28	I4: For a start we've only got one engine. I think you'd better have a look at it again. I'm not even looking at it. You wonder why their own situational awareness doesn't realise that what they're saying can't be correct, you know.	23	I4 introduced the concept that the above situation is not only a demonstration of poor systems knowledge but also a demonstration of poor situational awareness. With only one engine operating, the First Officer's statements made no sense, *as in this situation a flap 3 landing is always required.* I4 stated that there is a situational awareness problem when crew members can not establish that their statements simply cannot be correct.		
	C: Yeah. So obviously there's an issue with, or it seems to me there's probably some sort of issue with situational awareness that you've alluded to and a bit of a lack of systems knowledge. Does that, what about their actual work load management and general sort of aviation knowledge?				
29	I4:I think it's generally pretty poor. There is a few of them, there's exceptions to the rule. Of course there's a few of them who are very keen and do have good systems knowledge and situational awareness as well. There are a few around that are quite good pilots, but if you had to generalise, I'd say that this probably stems from a general lack of motivation. There's a real morass about the pilots in [Company X] . Most of them don't want to be there. They hate the company. They think that they're slaves to the company. They're under paid compared to all the other Chinese pilots, you know, in other companies. They don't really want to be there, but they can't leave. And this all extends to their motivation to apply any effort in what they're doing, which is very little.	24	I4 stated that generally situational awareness and systems knowledge is fairly poor. There are a few exceptions, some are quite good pilots, very keen and have good systems knowledge and situational awareness. However, generally there is a lack of motivation. Many of the pilots in the company he works for don't want to be there and consider themselves to be slaves to the company. They are comparatively underpaid but unable to leave. This effects their motivation and as such are loathe to apply the required effort to obtain better proficiency.		
30	I4: Their situational awareness I would say is very lacking. Their self discipline, cockpit discipline, is particularly lacking.	25	I4 stated that the Chinese crew members lacked not only situational awareness but self discipline and cockpit discipline as well.	12) (26, 27, 28) I4 stated that the Chinese crew members had poor communication skills. He stated that the Chinese pilots did not routinely pass on information to the pilot in command. This meant that the PIC could be excluded from access to operationally important information. I4 revealed that there have been occasions where Chinese crew members have asked if they could use Chinese when communicating on the radio, a situation which would have completely excluded the PIC from the communications loop. I4 also stated that a high percentage of the Chinese crew members did not like to speak in English. The standard of English language skills was also seen to be highly variable in spite of the ICAO level 4 English requirement.	
31	I4: Their communication is very, very lacking. Although there is a lot of Chinese being spoken around the flight deck that I don't know what's being said. But they don't feel that there's any need to pass on any information to the pilot in command. You know, they'll get calls from the cabin or from ATC or the company and then you're sitting there waiting for the information to be passed on to you and there's nothing said unless you ask, what was that all about and sometimes it's nothing and sometimes it's something and you think why, I wonder what is going through their head to think they can just absorb that information and not pass it on to the pilot in command.	26	I4 stated that the Chinese crew members lacked communication skills. However he acknowledged that there was a lot of communication in Chinese on the flight deck that he could not understand. I4 stated that the Chinese pilots did not see the importance of passing on information to the pilot in command. He stated that there were many occasions when Chinese crew members have received calls from the cabin or ATC or the company and not passed the information on to the western crew members unless asked directly. Sometimes the information was of little importance, however this was not always the case. I4 stated that he didn't know how this poor standard of communication originated.		

	C: So, obviously there is a bit of a communication issue?				
32	I4: Oh they hate speaking English. They can all speak English. They have to be able to speak English, you know they've got level 4, but some of them their level 4, you wonder how they got it. Some of them are quite good, but regardless there's very few of them that actually enjoy speaking English so they will do anything to avoid speaking in English and they'll regularly say can I speak Chinese on the radio and I go no I'm not allowed to speak Chinese, my license says not to be used for Chinese so you will have to speak in English and they speak in English and they do it fine. You know there's not a problem with their English, they just don't want to do it.	27	I4 stated that the Chinese crew members do not like to speak in English. He points out that they have to be able to speak English, at least at ICAO level 4. I4 stated that in spite of the testing requirements some of the Chinese pilots have poor English language skills. He further stated that some of the pilots speak English quite well, but even so very few of them enjoy speaking the language and will go to great lengths to avoid having to do so. Sometimes the Chinese crew members have asked I4 if they can speak Chinese on the radio. In such cases I4 has had to point out that his license specifies that all communication must take place in English. I4 also stated that in these cases his experience has been that there has been no problem with the standard of English spoken by the Chinese crew member concerned.		
	C: Okay. Right. I can't think of anything more in that particular area. So let's move on then to the next question which relates to your observations in regards to SOP adherence. Any differences between the Chinese crew and Western crews you've flown with, with the compliance with SOP's and standard call outs. You know we can extend that sort of to FMA call outs. What's your observations in that regard?				
33	I4: They only, they play lip service a lot to SOP's. Sometimes they do and sometimes they don't. It all depends. If they think there's any chance of punishment they will do it to the letter of the law. If they don't think there is going to be any consequences to it then they have no problem at all in not adhering to SOP's. They only respond to punishment. They've got, they've really got no self discipline in that regard at all.	28	I4 stated that whenever he left the flight deck he was aware that communication immediately switched to Chinese. Even when he was on the flight deck the Chinese crew members speak Chinese amongst themselves and as a result there is a lot of discussion that I4 is not privy to. I4 established that if there was a major problem with the aircraft where the crew was forced to deal with a complex series of events, he would consider banishing the First Officer/Officers from the flight deck. He was of the opinion that in such a situation the Chinese crew members would communicate in Chinese and thus die-neigh critical information from being passed on the Western crew member who is the Pilot in command and thus the final decision maker. I4 stated that with only one Chinese crew member he could force him to speak English and they might be able to solve the problem together.		
34	I4: They only, they play lip service a lot to SOP's. Sometimes they do and sometimes they don't. It all depends. If they think there's any chance of punishment they will do it to the letter of the law. If they don't think there is going to be any consequences to it then they have no problem at all in not adhering to SOP's. They only respond to punishment. They've got, they've really got no self discipline in that regard at all.	29	When asked to compare Western and Chinese pilots in terms of SOP adherence I4 stated that Chinese pilots pay lip service to the SOPs. If they believe there is the risk of punishment then they will comply to the letter of the law. However, if they don't think there that there are any negative consequences they have no qualms about not adhering to SOPs. I4 stated that the Chinese crew members only seemed to respond to punishment. His observation was that the lack of adherence to SOPs without a punitive element was a symptom of poor self-discipline.	13) (25, 29, 30) I4 stated that there was a lack of self discipline evident amongst the Chinese crew members. He observed that this manifested itself in several ways. Firstly through a lack of adherence to SOPs and secondly though a reliance on punitive measures to ensure compliance in the area of SOPs and other regulations.	
35	When asked to compare Western and Chinese pilots in terms of SOP adherence I4 stated that Chinese pilots pay lip service to the SOPs. If they believe there is the risk of punishment then they will comply to the letter of the law. However, if they don't think there that there are any negative consequences they have no qualms about not adhering to SOPs. I4 stated that the Chinese crew members only seemed to respond to punishment. His observation was that the lack of adherence to SOPs without a punitive element was a symptom of poor self-discipline	30	I4 used smoking on the flight deck as an example of the afore mentioned lack of poor self-discipline. The Chinese crew members smoke on the flight deck even though they know that it is against regulations to do so. I4's company has attempted to deal with this and stated there is to be no smoking, but the Chinese crew members were still smoking on the flight deck because there had been no consequences.		
36	I4: As far as operating the aeroplane and if there is a QAR limit that'll' you know that they'll get pinged by exceeding the QAR, there're very, right on top of the QAR limitations and make sure they keep within them because they don't want to get in to trouble, but if they are not going to get caught by you know somebody being able to see them or QAR telling on them then they are quite happy to just completely disregard SOP's. Standard call outs – well they sort of do them, most of the time, but they really don't care if they miss them. FMA call outs they're pretty good at. They mostly do those.	31	I4 stated that in regards to operation of the airplane the Chinese crew members were very well aware of, and operated well within the constraints created by the QAR limitations because they want to avoid punitive action being taken against themselves. However, when not constrained by a QAR limitation or other recording device, there is a tendency to completely disregard SOPs. As for standard call outs, I4s experience was that there was partial compliance, most of the time, however they didn't care if they missed them. I4 recalled that the compliance rate for FMA call outs was fairly high.	14) (31) I4 stated that adherence to many operational constraints was ensured through the use of the Quick Access Recorder (QAR) to record events and through the use of punitive measures for those involved in violations of the predetermined limits.	
	C: Right. Okay. What about things like speed restrictions or SID or STAR and altitude restrictions on approaches and things like that?				
37	I4: They completely disregard them in China. They don't actually think that they're required and when you know I do and I'm pretty sure most of the other Western captains are the same, we'll continually ask for you know when they give you a clearance for is it unrestricted climb or can we	32	In regards to speed, SID, STAR and altitude restrictions on approaches I4 stated that they are completely disregarded in China. The Chinese crew members do not think they are required though most of the Western Captains do. When they are given clearance the Western	5) (32) I4 related that the published speed and altitude restrictions relating to SIDs, STARs and Approaches are disregarded by the Chinese crew members when operating in China. The Western	

Interview Concludes at Meaning Unit Number 71

	cancel the speed requirement at x etc and ATC always you know cancel it, always cancel the speed restrictions, always cancel the height restrictions. ATC don't actually care if you do them. The pilots know that ATC don't care, so the reality is that they shouldn't be on the SIDs and STARs. They shouldn't be written there because ATC don't want to do it and the Chinese pilots don't do them and no one seems to care. But the reality is that they are written and so we do have to get them cancelled or apply them, but they just think that it's funny that we do it and that. But the problem is that some of them go overseas and think that they can do the same thing overseas as they doing in China and then they get you know violations from ATC you know round the world.		Captains will continually ask whether it is an unrestricted climb, or whether they can cancel the speed restrictions at point 'x'. In I4's experience ATC always cancels the speed and height restrictions. I4 stated that ATC don't seem to care whether the published restrictions are complied with and the Chinese pilots know that ATC doesn't care. In I4's opinion either SIDs and STARs shouldn't be used, or alternatively the speed and altitude restrictions should be deleted because neither ATC or the Chinese pilots comply with the restrictions or communicate their intentions. This is contrary to the operational and communication standards used by the Western pilots who will either attempt to have the restrictions cancelled or comply with them, which the Chinese pilots find humorous. However, when the Chinese pilots operate into overseas airports and think that they can follow the procedures that they use in China they receive violations from ATC in those other Countries.	Captains conform with ATC that the restrictions can be disregarded however the Chinese crew members just assume that the restrictions are not required. The assumption that speed and altitude restrictions do not need to be complied with has led to numerous ATC violations for Chinese crews when operating internationally.	

APPENDIX K

Combined Final Transformation 3 (TR 3) for all six Participants

Constituent	Interview I1	I2	I3
Situational Awareness	I1 observed that situational awareness in flight was of a lower standard for the Chinese crew members that he flew with. This lower level of SA was seen to arise from a poor use of flight documentation and reference material and an over reliance on automation.	I2 described several instances where he observed poor SA displayed by the Chinese crew members he was flying with. The basis for the poor SA in I2's examples related to poor skills in communication and general observation.	I3 reported a lower level of situational awareness displayed by the Chinese crew members than was the case for the Anglo European crew members he had flown with. I3 related that this lower level of SA had resulted in poor threat recognition and management and that a poor use of flight documentation and reference material was an underlying route cause.
Aircraft Knowledge	I1 identified that the aircraft specific knowledge of both the Chinese and Anglo European crews was of a similar standard however the temporal focus for the Chinese crew members was exam focused rather than broad based. This focus led to a lower standard of general knowledge in aviation related subjects and a lack of appreciation for the peripheral aircraft limitations.	I2 observed that the Chinese crew members had a good knowledge base in regards to theoretical knowledge however he reported that there was often a knowledge gap when it came to the practical application of that knowledge. I2 also reported reluctance on the part of the Chinese pilots to seek assistance so as to improve their understanding of the practical operational aspects of the aircraft systems.	I3 observed that a good standard of knowledge was displayed by the Chinese crew members in areas that were supported by rote learning skills. The in depth practical application of knowledge was seen to be problematic however, with the Chinese crew members having a lower level of understanding in this area than the Anglo European crew members.
CRM	Crew resource management (CRM) was a big issue for I1. CRM training was reported to have little impact on crew interaction amongst the Chinese crews.	CRM was also considered as a problematic operational area for the Chinese crews. I2 observed three deficiencies the CRM training:	I3 observed that the Chinese concept of CRM differed considerably from the Anglo European model. The Chinese captains were seen to decide on a course of action without seeking information from other sources.
Power-Distance Relationships	I1 observed that the power distance relationship between the Chinese crew members remained very steep with the Chinese first officers having little input in to the operation.	I2 observed that the Chinese Captains maintained a high power distance relationship on the flight deck contra to the principles of CRM as used on the flight decks of Anglo European Airlines.	A high power distance relationship was also maintained with various methods being employed to maintain the status quoi.
Decision Making Process		CRM training as delivered in the Chinese system did not seem to place any emphasis on the use of a problem solving methodology to allow decisions to be made commensurate with risk;	CRM training as delivered in the Chinese system did not seem to place any emphasis on the use of a problem solving methodology to allow decisions to be made commensurate with risk;
Punitive Measures	I1 also related that compliance in all operational areas was achieved largely through punitive measures. This was seen to impact on flight path management.	I2 related that compliance was achieved through a punitive system and that as such weather avoidance and other operational decisions were made on a pre-primed rote basis rather than on an informed solution specifically formulated for each individual situation.	Operational compliance was seen to be obtained through punitive measures. I3 reported that this action could be detrimental to safety as damage went unreported due to the natural desire of the flight crew to avoid being penalised.
English Comprehension	I1 also observed that when Chinese crew members had poor English comprehension skills there was a similarly poor performance displayed in all the enabling constituents' knowledge, management of crew, and communication.	Communication skills were not seen by the Chinese crews to be an important enabling tool; English language comprehension skills were seen to be a significant factor to enabling a high operational standard. Poor English comprehension was seen to have a negative impact on the knowledge base, management skills and general communication skills of the Chinese crew members. I2 even related that as there were many different Chinese dialects, he had observed that sometimes there was less ambiguity when two Chinese crew members used English on the flight deck rather than Chinese.	English language comprehension was also seen by I3 to be a significant factor in the ability of the Chinese flight crews to be able to obtain a high standard of operational competence having an impact on both knowledge and procedures.

Constituent	Interview I4	I5	I6
Situational Awareness	I4 also observed instances where the Chinese crew members had displayed poor situational awareness. I4 stated that this was at times related to poor prioritisation with the Chinese crew members focusing on reported data that was not representative of the real world as observable from the flight deck.	I5 considered the situational awareness level displayed by the Chinese crew members to be deficient in many areas and this deficiency was seen to impact on ECAM procedures and risk management.	I6 found that generally situational awareness of the Chinese crew members was of a high standard when operating within China but was seen to deteriorate when operating in foreign environments or non-normal situations.
Aircraft Knowledge	I4 observed that the Chinese crew members had a knowledge base derived from rote learning. Interestingly this knowledge was at times supplanted by the information delivered through oral tradition even when this information contradicted the source information in various operations manuals. I4 also related that instructional emphasis was placed on what to do, with little emphasis being placed on why. This was seen to lead to a lack of in-depth systems knowledge.	I5 reported that from the perspective of purely theoretical knowledge the Chinese crew members had an adequate understanding of the required material. There was however a failure by the Chinese crew members to apply this knowledge in a practical manner relevant to the applicable operational setting.	I6 stated that he found that the Chinese crew members he flew with had a good aviation knowledge base.
CRM	I4 stated that CRM was an essential element in enabling high quality decision making. I4's observations were that the CRM as practiced by the Chinese crew members differed from the CRM as practiced in Anglo European airlines in several areas. CRM was not routinely used as a management tool by the Chinese crew members.	I5 observed that there was a poor understanding of the concept of CRM or at least CRM as it is practiced in Anglo European airlines. There was a low emphasis placed on CRM within the training process, and indeed CRM was considered to apply only to the flight crew.	CRM was seen to be problematic, with the Anglo European crew members being excluded from any process being used however from I6 observations the CRM processes used by the Chinese crew members were of a poor standard.
Power-Distance Relationships	There was also a poor level of interaction between the Chinese flight crew and the cabin crew with a high power distance relationship frequently maintained.	I5 related that CRMs purpose seemed to be to ensure that subordinate crew members supported the Captain's decisions. By using CRM in this manner, I5 reported that this reinforced a high power distance relationship on the flight deck and gave the first officers little chance to manage upwards or even openly question a superior.	
Decision Making Process	I4 saw no evidence that a problem solving methodology was employed as part of the decision making process nor was any external source utilised as an information gathering tool.	I5 also found that operational decision making amongst the Chinese crew members was problematic for several reasons: A lack of formal decision making processes, poor use of external resources and a knowledge gap in that the concept of threat and error management as utilised in the Anglo European airline industry appeared to be missing from the Chinese industry.	I6 reported that the decision making processes of the Chinese crew members suffered due to a lack of a formal decision making process. I6 found that the general manipulative skill of the Chinese crew members was of a high standard however when looking at the operation from a holistic perspective there were deficiencies in awareness of external factors such as traffic awareness, coordination with cabin crew and ATC, and task sequencing and prioritisation.
Punitive Measures	I4 found that compliance was obtained through punitive measures.	I5 reported that compliance was obtained through a process of monitoring and enforcement through punitive measures. This practice resulted in a system where items that were monitored were complied with religiously while items not monitored were ignored. I5 also observed that the punitive system often lead to excessively conservative and inconsistent operational practices which resulted in risk avoidance rather than risk mitigation.	I6 also reported that compliance was largely obtained through punitive measures.
English Comprehension	I4 observed that poor English comprehension resulted in the use of an inappropriate checklist methodology, significant knowledge gaps, and poor communication skills leading to miscommunication with ATC.	English comprehension was also seen to be a significant issue for I5. I5 reported that competency in this area was a critical factor in obtaining high quality operational outcomes.	English comprehension was also an issue for I6 who found that pilots with poor English language skills there were issues dealing with flight documentation.