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The Technology-Culture Interface and its Impact on Aviation Safety:
A North African Perspective

By

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ABSTRACT

The aviation industry in the North Africa Region (NAR) is still suffering from a high rate of fatal accidents in comparison to other regions. In 2016, about 128 passengers were killed in the Middle East and NAR, whereas in Europe just two passengers killed despite both regions using a similar aircrafts. Aviation companies within the NAR thus require safety performance improvement. The current research indicates that pilot decision-making performance in the cockpit is responsible for about 60% of aviation fatal accident in the global aviation industry. In addition, the current literature shows that pilots' risk perception is directly influenced by the culture interface, which plays crucial role in shaping their decision-making performance.

Accordingly, this study investigated the national culture impact on pilot decision-making performance in the cockpit within the NAR. A number of professional pilots from the NAR were surveyed and interviewed to explore this phenomenon. A mixed method research approach was implemented in this study, where 143 professional pilots from different levels were surveyed and 12 semi-structured interviews were conducted, to discover the extent to which these pilots are effect by the technology–culture interface within the NAR.

The research investigated this phenomenon mainly based on four themes: cultural attributes, attitude to human and organisational factors, automation and risk perception; these are shown by the literature to be the most significant factors affecting the pilot risk perception in the cockpit. Ten factors were investigated, in addition to assessing the collective pilot's risk perception within the NAR. The result indicated that NAR pilots are negatively affected by power distance, teamwork and automation as direct implications of the technology–culture interface. In addition, these pilots are suffering from high tolerance and acceptance of risk as an indirect impact of the regional national culture.

Therefore, as the aim of this research is to enhance the pilot's decision-making performance in the cockpit, a guideline for cultural calibration of the Crew Resource Management (CRM) training programme was proposed. This cultural calibration relies on development of the CRM curriculum by enhancing the pilot non-technical skills to overcome the effects of the technology–culture interface in the region. It also aims to improve their risk perception through introducing training in domain-specific risky events in the cockpit, which should enhance their ability to identify the cues that exist in risky situations. Furthermore, the limited research of aviation authorities and aviation safety departments' roles regarding monitoring and enforcing the safety regulations and implementing proactive safety programmes in the aviation companies within the NAR negatively affect the progress of improving the safety performance.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

ADM	Aeronautical Decision Making
ASA	Air Services Australia
ASCNI	Advisory Committee on Safe Nuclear Installations
ASD	Aviation Safety Department
ATC	Air Traffic Control
AG	Australian Government
BASI	Bureau of Air Safety Investigation
C	Captain
CAA	Civil Aviation Authority
CASA	Civil Aviation Safety Authority
CFIT	Controlled Flight Into Terrain
CRM	Crew Resource Management
EASA	European Aviation Safety Agency
F/O	First Officer
FAA	Federal Aviation Administration
FMAQ	Flight Management Attitudes Questionnaire
FMC	Flight Management Computer
FMGS	Flight Management and Guidance System
GPWS	Ground Proximity Warning System
HFACS	Human Factor and Classification System
HS	Hunter Scale
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
INPO	Institute of Nuclear Power
IVC	Individualism verses Collectivism
LCAA	Libyan Civil Aviation Authority
LOSA	Line Operations Safety Audit

LTOVSTO	Long-Term Orientations Versus Short-Term Orientations
MENA	Middle East & North Africa region
MVF	Masculinity versus femininity
N	Numbers
NAR	North Africa Region
NASA	National Aeronautics and Space Administration
NDM	Naturalistic Decision Making
Nvivo	Qualitative data analysis computer software package
ORMAQ	Operating Room Management Attitudes Questionnaire
P1	Pilot One
PD	Power Distance
PIC	Pilot In Command
RPS1	Risk Perception 1- Self scale
RPS2	Risk Perception 2- Self scale
SD	Standard deviation
SMS	Safety Management Systems
SMICG	Safety Management International Collaboration Group
SOPs	Standard Operations Procedures
SPSS	Statistical Package for the Social Sciences
TEM	Treat and Error Management
U.S.	United States
UA	Uncertainty Avoidance
UK	United Kingdom
UN	United Nations

1 CHAPTER ONE: Research Introduction

1.1 Research Background and Problem Identification

In high-risk industries, the influence of the surrounding environment, and culture and human or organisational factors on individual behavior is a vital issue. This is because of the high rate of human-error and accidents that can take place in an organisational context (Maurino et al., 1995). The aviation sector is an example of a high-risk industry, in which machine-related accidents have decreased because of cutting-edge technology and the complex systems found in these organisations (Chialastri, 2012). In contrast, however, the proportion of human error has increased (Shappell et al., 2007; Chialastri, 2012). Human-error-related accidents have recently become more common in the aviation industry (Maurino et al., 1995; Dekker, 2005).

To minimise pilot error, a high level of safety and reliability must be instilled within aviation companies. Distinguishing organisational criteria that enhance safety can enhance the understanding of the relationship between pilot behavior and established high-risk situations (SMICG, 2013).

The behaviour of pilots is crucial in maintaining high safety performance. This can be influenced by initiating a positive organisational safety culture (Mearns et al., 2003). Helmreich and Merritt (2001) have traced factors that can affect an individual's safety behaviour, such as national, professional, and organisational factors. They have insisted that a strong and positive organisational safety culture can help to successfully achieve and improve safe behaviour in the workplace. The ability to sense and thus avoid harmful environmental conditions is necessary for the survival of all living organisations.

The identification of human and organisational factors that affect the safety behaviour of pilots in the cockpit is crucial in establishing a positive safety culture (Chauvin, C, 2013). Pilot behaviour and response to any event, depending on how they perceive their work environment and the situation, play a key role in decision-making and influence how pilots are likely to behave. According to Wilde (2001), improvements in safety operation cannot be achieved through training, engineering or enforcement, but rather through reducing the extent of risk-taking. This depends on the values that prevail, not the safety technology available. This means that organisational culture has a direct impact on pilot decision-making and this is directly shaped by the national culture. According to Wilde (2001), safety interventions need to consider risk-perception and reduce the level of risk that people are willing to tolerate, if they are to be successful. Cacciabue and Vella (2010) stated that “safety management is a typical proactive measure for safety assessment, which considers an organisation as an integrated system, and combines standards, guidelines, procedures, auditing, safety policy, and quantitative risk assessment”.

Managing safety in aviation organisations needs to include consideration for how pilots assess risk. Pilots risk perception has a great affect on their decisions, responses and management of a situation (Hunter, 2002). According to Slovic (2000), the evaluation criteria of risk are a result of what we believe to be the likely outcome, the chance of the outcome actually occurring and how concerned we would be if it were to happen.

In summary, risk tolerance and risk management are very important to improving safety in any organisation, especially a high-risk industry like aviation. According to Reason (1990), in his Swiss cheese model, pilots are considered the last line of defence in breaking the chain of error. Improving pilot decision-making performance is very important in mitigating errors during a flight. This improvement can be achieved through perceiving risk correctly and risk management in any situation. According to Slovic (2000), the perception of risk varies with both the individual and the context. The environment, culture and technologies are important aspects to identify, in assessing the risk perception of pilots in the cockpit. In addition, Sjöberg et al., (2004), emphasise that every social group has different perceptions and responds in a different way to risk. This research aims to expose the influence of the national culture on pilot decision-making performance in the cockpit within the region of North Africa.

1.2 Research Gap

Culture can be defined as a set of common understandings, thinking, values, beliefs, and norms that are shared in a society and which constitute behaviour in an organisation, in apparent and sometimes unnoticeable ways (Hofstede, 2009; Pankaj et al., 2011). The behaviours associated with effective and ineffective coping with threat and error have clear ties to national culture (Helmreich, 2000). According to Klein (2012) better decision-making performance can be achieved within any organisation, if there is a greater respect for expertise and for the tacit knowledge of the skilled workers and supervisors. The tacit knowledge profoundly influences responses and decisions. Many researchers have debated whether or not organisational culture is constrained by national culture (Hofstede, 2001; Soares et al., 2007; Hofstede, 2011).

There is a consensus among researchers that national culture leads to large differences among individuals from different countries (Hofstede, 2009). These differences could impede teamwork in a demanding environment or during training and mission preparation (Helmreich, 2000).

Environmental and institutional forces, such as national culture, play a vital role in shaping organisational culture, which in turn affects the individual's behaviour and decision-making performance in everyday practices. To improve pilot decision-making performance, a deep understanding of the effect of national culture requires more attention. According to Helmreich (2000), "cultural values are so deeply ingrained; it is unlikely that exhortation, edict, or generic training programs can modify them. The challenge is to develop organizational initiatives that congruent with the culture".

This study focuses on the aviation companies within the North Africa, and looks to understand of how the North African national culture affects pilot decision-making performance in the cockpit. Three research gaps are assumed for this study:

1. The influence of the North Africa region national culture (if any) on adequate decision-making of pilots during flight. The current literature does not show an influence.
2. How pilots in the North Africa region perceive risk in the cockpit, in comparison to other regions.
3. How the adverse influence of the technology-culture interface in the cockpit within the North African region (if any) on the pilots' decision-making performance can be mitigated.

1.3 Synopsis of Research Aims and Objectives

1.3.1 Aim of the Research

This study looks at the safety of aviation operations in North Africa region aviation companies, including the efficiency and performance of the pilot in decision-making in the cockpit, where they are exposed to the impact of the technology-culture interface. Moreover, this research will attempt to evaluate and assess the pilot's decision-making in light of their risk perception, which is influenced by the regional national culture. This, it is hoped, will help to enhance pilots' decision-making performance and mitigate pilot error by improving their technical skills and cultural awareness (non-technical skills) in the cockpit within the North Africa region.

1.3.2 Research Objectives

The above aims seek after achieving a higher level of educational objectives for this study. These stem from Bloom's taxonomy theory. Bloom (1956, cited in Isaacs, 1996) emphasises that human cognitive development education is considered one of the most essential aspects. It is noticeable that the educational process is fundamental for forming an integrated and qualified personality as well as for human upbringing. It is as essential as diet for the body. The taxonomy classifies the objectives in the cognitive field for their rating components, involving six levels of understanding, in which the characteristics of the lower level are involved in the higher level (Isaacs, 1996). The rating of the taxonomy starts from the lowest to the highest: knowledge, comprehension, application, analysis, synthesis, and evaluation. In the common sense, various forms of question and assessment are used to evaluate the fulfilment and higher-thinking skills of students.

Only the parts of knowing and thinking are focused on by most features in these assessments, apart from any relation with higher-developed skills in the taxonomy of cognitive objectives. Thus, the objectives for this research have taken the form of Bloom's taxonomy approach, and are as follows:

- ❖ To develop a general understanding of how the overall national culture can influence a pilot's decision-making performance in the cockpit.
- ❖ To investigate the influence of the technology-culture interface on pilot decision-making performance in the cockpit.
- ❖ To appraise the influence of the North Africa national culture on pilot decision-making performance in the cockpit.
- ❖ To evaluate pilot risk-perception within the North Africa region in comparison with North America.
- ❖ To evaluate the influence of the technology-culture interface on pilot decision-making performance during flight within the North African region.
- ❖ To propose a guideline to enhance pilot decision-making performance in the cockpit within the North Africa region

1.4 Research Questions

This research aims to answer these questions in order to achieve the aims, which are the focus of this study:

1. To what extent is the North African regional national culture affecting pilot decision-making performance in the cockpit?
2. To what extent are pilots in the North Africa region influenced by cross-culture when they are using advanced technology in the cockpit?
3. How does pilot risk-perception in the North Africa region differ from other pilots in other regions?

4. What are the implications (if any) of the technology-culture interface on pilot decision-making in the cockpit within the North African region?
5. How can non-technical skills of pilots within the North Africa region be improved to enhance pilot risk-perception in the cockpit?

1.5 Motivation and Justification

The aviation safety status in the NAR suffers from a high rate of fatal accidents compared with other regions. According to ICAO (2012), Africa has the highest regional accident rate, and yet accounts for the lowest percentage of global traffic volume. According to IATA (2016), despite the rapid enhancement of aviation technologies, the Middle East and North Africa region (MENA) is still suffering from a high rate of fatal accidents in comparison with other region. According to IATA (2016) the aviation accident statistics indicating the fatality accidents per geographical region for 2014, 2015 and the 5-year average for the period 2010-2014, that Africa has the highest fatality accident in comparison with other region during this period (see Figure 1.1).

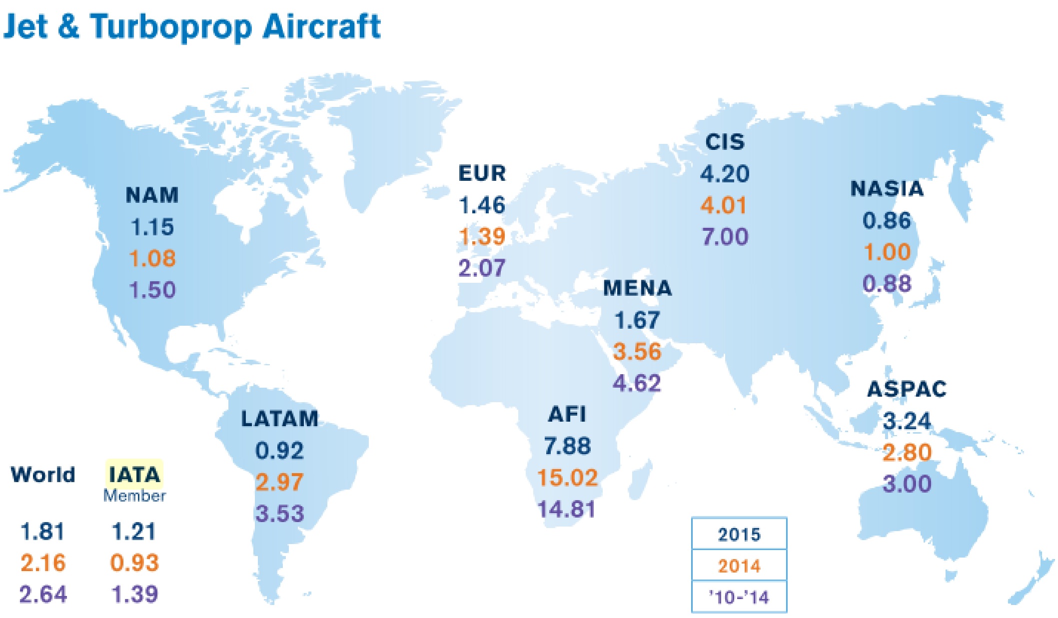


Figure 1-1: Fatal accidents in per million sectors for both Jet & Turboprop aircraft (Source: IATA, (2016))

This was the first driver for this research. The last 10 years have indicated that the safety performance of the world's commercial aviation industry has improved by 54%, with an accident rate of 1.61 accidents per million sector in the last year (IATA, 2017). However, in the 10 ten years a fatal accidents happened in the North Africa region, such as the Afriqiyah airways aircraft Airbus A330-202, 5A-ONG that crashed at Tripoli (Libya) on 12 May 2010. Another fatal accident was the Egyptair 804, Airbus A320 that crashed into the Mediterranean Sea on 19 May 2016, an accident that is still under investigation (PhD thesis submission, April 2018).

The researcher considers the final report of the fatal accident of the Afriqiyah airways aircraft as motivation of this research. This aircraft was a scheduled flight from Tambo International Airport (South Africa) to Tripoli international Airport (Libya). There were 93 passengers and 11 crew on board. The flight crew consisted of a Captain, who was Pilot Not Flying (PNF), a co-pilot, who was Pilot Flying (PF) and a relief co-pilot. 92 passengers and 11 crewmembers were killed. Only one passenger survived (Kevin, 2013). The final report of this accident concluded that low performance of crew coordination, an unstabilised approach and disorientation during a delayed go-around (delayed in decision-making process) led to the fatal accident. According to the LCAA (2013) the main factors of this accident were as follows:

1. Limited Crew Recourse Management (CRM) during the approach stage, which affected the missed approach procedures. This degradation of performance was further affected by numerous radio communications during the final approach and the crew's state of fatigue.
2. Aircraft control inputs being typical in the occurrence of somatogravic perceptual illusions.
3. Inappropriate systematic analysis of flight data and the feedback mechanism within the Afriqiyah airways company.
4. Non-adherence to the company operation manual, Standard Operation Procedures (SOPs) and standard terminology.

In addition, the report indicated some other contributing factors:

1. Weather available to the crew did not reflect the actual weather situation in the final approach segment at Tripoli International Airport.
2. Inadequacy of training received by the crew.
3. Occupancy of tower frequency by both air and ground movements control.

From the above discussion, it is noticeable that these pilots suffered from limited CRM, improper situation awareness, non-adherence to SOPs and misunderstanding the standard terminology, and inadequacy of training. These factors negatively affected their decision-making performance and led to this fatal accident. However, the fact that these professional pilots were certified and qualified for the flight (LCAA, 2013), gave rise to the desire to understand why these professional pilots allowed these factors to affect them. The recent literature has emphasised that the crew in the cockpit are impacted directly by culture (as mentioned in Chapter 2, paragraph 2.7 of this study). According to Hofstede (2001), decision-making is directly connected to national culture, because different national cultures have different decision-making approaches. Therefore, it was crucial to understand the role of national culture in a study of why this region still suffers from a high rate of fatal accidents in comparison to other regions.

In addition, to the above discussed motivation and justification of this research there are two more drivers for this project:

- The limited availability of research explaining how the national culture of the North African region can influences pilot decision-making performance and risk-perception during flight.
- The significance of developing good understanding of the role of national culture in the cockpit, which can help to improve pilot decision-making performance within North Africa aviation companies.

Although the above arguments underpin the importance for research around the effect of national culture on a pilot’s decision-making performance, it is equally important to underline the factors that might help in building a strong and positive safety culture in the cockpit within the North Africa region.

1.6 Originality and Expected Contribution

The pilots in the aviation companies of the region of North Africa suffer from inability to achieve adequate decisions in the cockpit and eliminate human error as a result of the absence of demonstrating the concept of safety culture and because of poor decision-making performance in the cockpit. As a result, this study expects to provide an incentive to improve pilot decision-making performance in the North Africa region in particular and to other regions with similar cultures in general, and address the implication for the technology-culture interface in the cockpit, which will enhance the safety culture in these aviation companies.

1.7 Research Methodology Overview

In order to achieve this research aim, which is the technology-culture interface and its impact on pilot decision-making performance within the North Africa region, which aligns a variety of different factors that are considered to be the most significant criteria effecting pilot decision-making in the cockpit, the criteria have been divided into four themes: cultural attributes, attitude towards human and organisational factors, system design and automation, and risk perception. All of these themes were previously identified in (Chapter 2, paragraph 2.12.1).

This research has sought to select an approach that underlines the overall process and facilitates a description of the reality of a pilot's behaviour and response to risk during flight through understanding the real impact of the four themes in the cockpit.

This research will concentrate on studying social sciences and management to understand the relation between national culture and decision-making of pilots who are dealing with modern and complex technology and high risk tasks within aviation companies in the North Africa region. This research will rely on assumptions that can help to explore the nature of socio-technical and organisational factors that affect this relation, through applying these chosen methods (Saunders et al., 2009). The chosen research methodology should be the most appropriate to reconcile with the context of the assumptions that should lead in turn to the achievement of the research objectives, which will cover the research gaps and the research aims.

1.7.1 Research Framework

The understanding of the research assumptions will lead to the choosing of the right and most applicable approach for this study topic. In addition, it will help the researcher to define the correct research strategy to achieve the research objectives and aim. According, to Saunders et al. (2009), it is essential to define the research activity in terms of phases, layers or stages that give the researcher a sense of sequence and help the researcher to manage the research process as planned.

According to Kagioglou et al., (1998) in his model "Nested approach" cited in Kulatunga et al., (2002), it is crucial to identify the research philosophy that is being employed to achieve the research aim. For the purpose of this study it was crucial to implement this approach as a guide towards reaching the appropriate approach. The nested approach consists of three layers, representing three steps to be followed by a researcher in order to reach the right philosophical standpoints, (as shown in Figure 1.2).

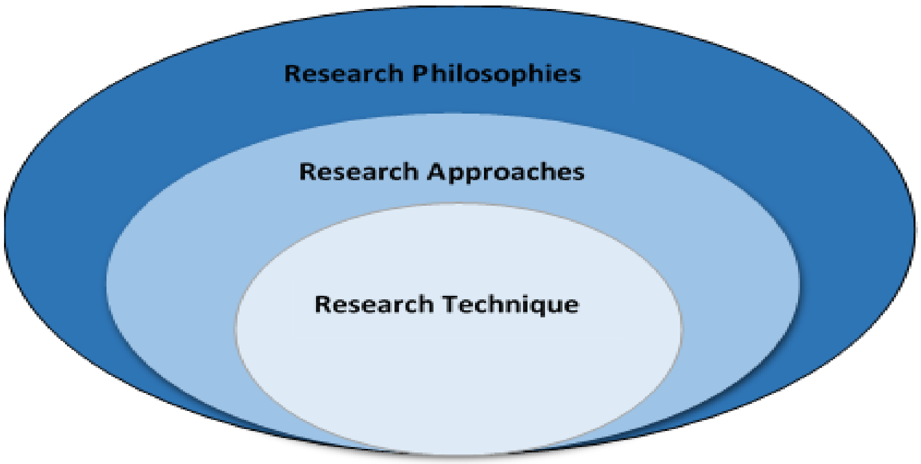


Figure 1-2: Nested approach
(Source: Kagioglou et al. 1998)

In addition, Bhattacherjee, (2012) states that a conceptual framework needs to be built in order to view an organisation through a paradigm. This model consists of three layers: the outer layer is the research philosophies that animate and cover both research approach and research techniques. The research approach layer includes the theory generation and testing methods. Finally, research techniques consists of the data collection tools.

This researcher found it very beneficial to implement the “Nested approach” for this study due to its simplicity and comprehensiveness. This study follows the systematic implementation of this model’s layers to understand the philosophical status of the research.

1.7.2 Research Philosophies

Research philosophy varies from one research to another depending on the researcher themselves. According to Saunders et al., (2009), the researcher’s thinking and assumptions construct the research philosophy. In addition, the research’s quality depends on the compliance with the philosophical issues, such as finding and defending the most suitable research design.

Traditionally, the most popular paradigms in research methodology are positivist and interpretivist, which need to be properly understood before choosing the adequate methods for this research (Creswell, 2003). These paradigms are known as theoretical perspectives, and also as perception of the reality (Tubey et al., 2015). They are respectively associated with quantitative and qualitative research methods. Firstly, the positivist paradigm deals with the social world, which it considers as objective reality, in that this objective reality can be explained by specific laws. According to this paradigm, the real world can be discovered and analysed simply by using the methods that do not affect human apprehension and comprehension (Bhattacherjee, 2012). Thus, understanding the relation between the individual and the surrounding environment might lead to the discovery of new knowledge or phenomena. Secondly, the interpretivist paradigm has dissenting opinions, where it is considered impossible to have direct knowledge of the real world. For more clarification of the main differences between the positivist and interpretivist research philosophies (see Table 1.1), (Easterby-Smith et al., 2002).

Table 1-1: The differences between Positivism and Interpretivism
(Source: Easterby-Smith et al., 2002)

	Positivism	Interpretivism
The observer	Must be independent	Is part of what is being observed
Human interest	Should be irrelevant	Is the main driver of the science
Explanations	Must demonstrate causation	Aim to increase general understanding of the situation
Research progress	Hypotheses and deduction	Gathering rich data from which ideas are induced
Concepts	Need to be operationalized so that they can be measured	Should incorporate stakeholder perspectives
Units of analysis	Should be produced to the simplest terms	May include the complexity of the whole situation
Methods of generalisation	Statistical probability	Theoretical abstraction
Sampling requirement	Large numbers selected randomly	Small number of cases chosen for specific reasons

Accordingly, in this research three main gaps have been identified, these gaps clearly link between the performance of pilot decision-making and the national culture in the cockpit, where the national culture plays a crucial role in individual decision-making. According to Hofstede, (2011) and Pankaj et al., 2011) an individual will respond or act differently from another individual from a different culture or group if they are both involved in or faced with the same situation or risk. The current literature does not explain how the national culture of the North Africa region can influence pilot decision-making performance in the cockpit, in addition to that, the aviation organisations in the region suffer from a high rate of aviation accident in comparison with other regions (ICAO, 2014). The absence of guidelines to help with improving the safety performance for pilots, companies and bureaus of air safety within the region is one of the main drivers for this study.

Discovering the reasons behind the poor pilot's decision making performance in the cockpit within the NAR, it is crucial to gain answers from pilots working in these aviation companies. This way it is more possible to understand the situations they face, as well as their attitude and risk perception. People perceive a situation's risk differently according to their own world view (Saunders et al., 2009). The interpretivist paradigm is more fit for understanding what lies under this phenomena and therefore, it is the appropriate philosophy for this research (Corbin & Strauss, 2015).

1.7.3 Research Approach

A well designed study reflects the extent to which the researcher is clear about the research theory (Saunders et al., 2009). The researcher is obligated to find the most suitable research approach to answer the research questions. According to the previous in-depth discussion of the research philosophy an initial reasoning for the appropriate approach for this research context has been provided. The research approach is composed of the dominant theory generation and testing methods (Kagioglou et al., 2000). According to Zalaghi and Khazaei (2016), deductive and inductive reasoning are important to understand before generating a theory of a research. Deductive theory generation are studies that start with hypothesis and theory, where the hypotheses are built on the collected knowledge of the research field. The process steps of the deductive approach can be summarized as follows: theory formation, hypothesis development, data collection, compilation of findings, confirmation or rejection of hypothesis, and revision of theory (Grix, 2010). Deductive theory generation involves testing theory and many researchers consider the deductive approach to consist of quantitative testing methods (Creswell, 2007). In contrast, inductive theory generation is the outcome of the research or the theory building. Where the theory is built in accordance to the research findings. It is highly concerned with the context in which the events are taking place. It is usual that the inductive approach is combined with qualitative data and the collecting of data through a variety of techniques that underpin an explanation of the phenomena (Bryman and Bell, 2015). The process of inductive theory generation is constructed (as shown in Figure 1.3).

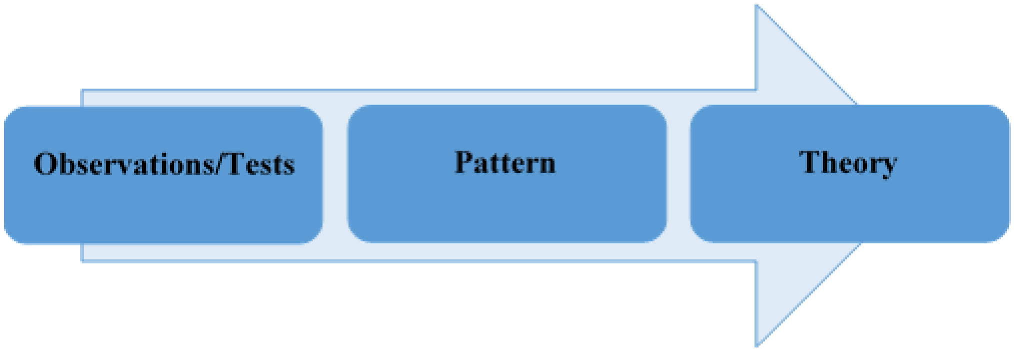


Figure 1-3: Process of inductive theory generation

The characteristics of this research are based on the earlier discussion of the research philosophies. It is clear to this researcher that this research study requires a theory to be built that relies on the participant's views and risk perception in the cockpit. The inductive reasoning approach perfectly suits this research requirement.

According to Mason (2002), inductive reasoning is usually used with the qualitative method. For the purpose of the study the researcher finds that using both methods gives more robust result. The following section will discuss both methods in detail to outline the thinking behind using both methods in this study.

1.7.3.1 Qualitative Methods

Qualitative methods adapt real-world knowledge from a personal perspective. According to Miller (1997), qualitative research is "Involves the close study of everyday life in diverse social contexts. Two major objectives of qualitative research are to describe and analyse both the processes through which social realities are constructed, and the social relationships through which people are connected to one another. It is within, and through, these relationships and processes that organisations, institutions, culture and society emerge and are sustained".

Qualitative methods can be used in their own right or as pre-quantitative methods in novel areas of research, in order to present descriptive information and to generate the theory (Graziano and Raulin, 2007). According to Bhattacherjee (2012), the qualitative research approach can be described as follows:

1. Inductive approach principle which uses grounded theory, in which data is collected by a qualitative approach using different techniques like participant observations and unstructured interviews to build a theory.
2. Case study of social phenomena that enables deep investigation by combining different techniques for data collection.
3. Phenomenology science which illustrates the perceptions, senses, and knowledge of one's experience and actual awareness.
4. Ethnography, which is the most familiar approach in anthropological and sociological research methods, where data can be collected by different means such as interviews, observation and documentary analysis among others.
5. Hermeneutics is a research method that applies the procedure of learning lessons from history by looking for relevant descriptions and collecting and analysing evidence such as artefacts, autobiographies and reminiscences among others.

The qualitative approach usually adopts two research styles: field research and nonreactive research. Field research mainly relies on the observation and study of people and situations, whereas nonreactive research relies on unobtrusive observational techniques, official statistics, artefacts and the evidence of past social life (Brewer and Hunter, 2006). Qualitative methods give very deep descriptions of the phenomena in question by answering the questions “how and why”. It has some weaknesses, however, for example, the assumptions of qualitative research do not take the real world into account during the investigation. It aims to interpret the logic of the social actors connected to the qualitative research method, which can lead to the undermining of the assumptions underlying the qualitative research methods.

This weakness lies in the sample of the study, where there are a limited number of individuals involved in a particular area. In addition, many researchers argue that failures in conducting qualitative research are a result of limited generalisations (Curran and Blackburn, 2001). Moreover, the efficiency of the qualitative method is dependent on the researcher's skills.

In summary, qualitative research is very efficient at providing deep, descriptive information of the phenomenon in question, but there can be difficulties performing qualitative research due to a lack of procedures and basic methods. To overcome this challenge, there is a need to use a different technique where the creation of the research strategy can be creative and innovative. These weaknesses support the assumption that multiple methods for this study will be more adequate.

1.7.3.2 Quantitative Methods

Quantitative methods mainly depend on the principles of natural science. They are based on the assumptions of an objective view of social reality. Objective measurement techniques are also used in the construction of quantitative research measures. These assumptions are applied to human subjects in the course of quantitative methods, in order to attain the aspect of the research topics and assess the subjects' responses to external stimuli together with their behaviour and its consequences in their environment. From this point of view, human behaviour is determined and predictable. Quantitative research is most often used to test a theory rather than to develop one, by using the principles of deductive logic. Therefore, the process is significant in the development of generalisations that contribute to the theory. (Creswell et al,. 2007) state that quantitative research usually includes the collection and analysis of data following procedures and statistical analysis in order to determine the truth, or else the means, assumptions and/or theories.

Hypotheses and research questions are often based on a theoretical framework that has been built on previous research. Concrete data, for example number, mass and weight, are generally linked to quantitative methods. They usually rely on two methods: surveys and experiments. The survey might include either interviews or questionnaires for the participants in a selected sample from a population group, following specific procedures, where the phenomenon of interest occurs. In the experimental method, the observations of the phenomenon of interest occur in the organisation of conditions that are intentionally produced by the researcher.

Quantitative methods have their limits, however, in maintaining explanations for causes and can simply provide statistical associations between variables. For example, a relationship can be given so that the variable X is combined with the occurrence of Y. Quantitative methods can predict the possibility of XY occurring, but cannot explain the reason behind the occurrence of these associations. Sayer (1992) relates the hypothesis in real terms to measured items, such as the owner or the administrator, job satisfaction, and the failure of the company as “fixed qualitatively”. Moreover, the method and assumptions in the nature of the measured variables are not necessarily valid in reality (Bhattacherjee, 2012). Again, this opinion supports the use of multi-methods in a research to validate the collected data in this research. A full detailed of the research strategy are outlined in chapter three.

1.8 Research Process

To ensure a smooth process of this research it was divided into three stages (see Figure 1.4). The first stage was commencing the literature review, in which the researcher conducted an in-depth review of the literature to develop a comprehensive understanding of the current state of aviation safety and the impact of cross-culture on pilot performance in the cockpit. This included reviewing the current guidelines to improve the pilot performance in the cockpit. The outcome of this stage was the finalisation of the research gaps and establishing the research aims, objectives and questions.

The second stage focused on developing a suitable research methodology to achieve this research aim through constructing the research objectives as well as answering the research questions. In addition, through the justifications of the research methodologies selected, which are the mixed methods (qualitative and quantitative), both data collections were conducted in this stage. The final process of this stage was to analyse both the qualitative data and quantitative data. This was achieved by using the Nvivo 11 software for the qualitative data and the SPSS 24 software for the quantitative data.

Finally, was the third stage of this research, in which the researcher merged the findings of both qualitative and quantitative analyses and discussed the research objective and proposed a guideline for enhancing pilot performance in the cockpit. In addition, in this stage the researcher evaluated the achievement of the aim of this study and drew it to a conclusion.

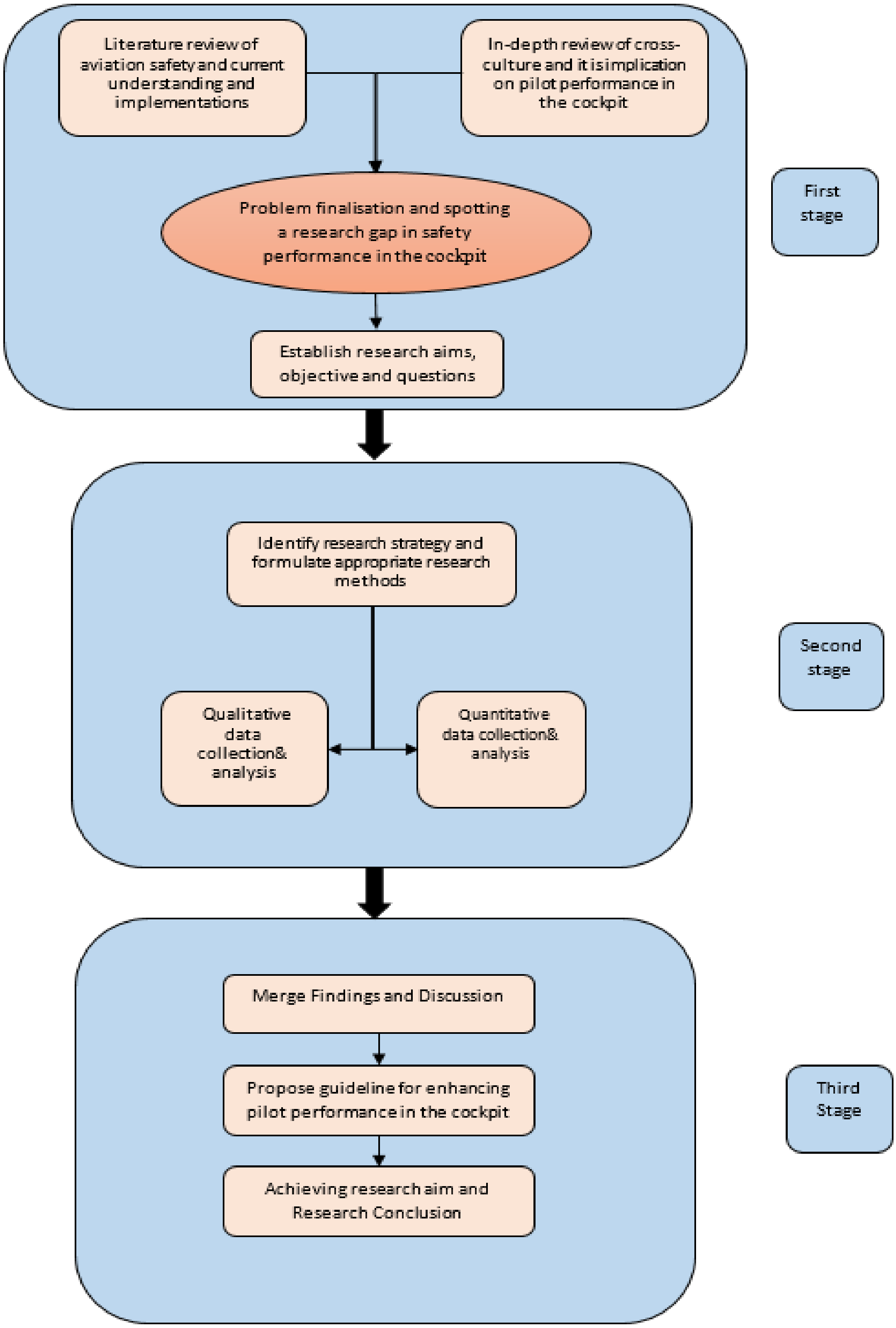


Figure 1-4: Research process

1.9 Thesis Structure

This thesis is comprised of seven chapters, which will cover the three stages of the research process as described above. A short summary of the chapters and the issues therein follows:

1.9.1 Research Introduction

This chapter presents a clear vision of the research background and context. In addition, it elucidates the research problems and the research gap. Moreover, the foundations of this study are described, as are the drivers of the whole research process (the aims, objectives and the research questions). Furthermore, it briefly touches upon the initial view of the expected achievements of this research that lie beyond the scope of this research. Finally, a short description of the research process and thesis structure is presented.

1.9.2 Literature Review

This chapter focuses on addressing the overall concept of aviation safety. In addition, it includes an exploration of the evolution and the current literature regarding aviation safety. It also focuses on the NAR and the current state of aviation safety in this region. The role of culture and organisational culture in aviation safety are discussed in this chapter. In addition, this chapter focuses on identifying of all concepts related to this study that play a significant role in safety performance in the cockpit. Finally, this chapter ends with a summary of the research gaps and of key findings.

1.9.3 Research Methodology

In this chapter, different research methodologies are reviewed to design and select those that are most suited to the present study. It discusses the research's philosophical standpoint and research approach as well as the techniques adapted for the study. In addition, the formulation and design of the data collection methods are discussed and the most appropriate approach for the study identified. In addition, the reliability and validity of the research methods are addressed in this chapter.

1.9.4 Qualitative Findings

This chapter focuses on analysing the qualitative data gathered in the semi-structured interviews. In addition, it outlines the rationale for the sampling process, the coding process, the methods chosen and the qualitative data analysis steps. Furthermore, in this chapter the qualitative data findings, coded using the Nvivo 11 s software programme, are discussed in-depth.

1.9.5 Quantitative Findings

This chapter highlights the quantitative data findings. In addition, it discusses the sampling procedures of the participants in the questionnaire survey; the findings and tests will be using the SPSS 24 software programme.

1.9.6 Research Discussion

This chapter merges the qualitative data findings and the quantitative data findings. The discussion in this chapter is based on achieving the research objectives as set out in the first stage of this study. Moreover, it outlines a means of improving pilot decision-making performance in the cockpit within the NAR, which is the primary aim of this study.

1.9.7 Research Conclusion

The final chapter concludes the thesis by summarising the research key findings, the study's contributions, recommendations and study limitations and further work.

1.10 Chapter summary

This chapter highlighted the background of the research, the research gaps, aims and objectives. In addition, the research questions, motivation, and justification were identified. The research process was discussed and, finally, a brief description of this thesis structure was given.

2 CHAPTER TWO: Literature Review

2.1 Introduction

2.1.1 Literature Target Overview

This chapter will set the scene for aviation safety as a key point of success in the aviation industry. Accordingly, it is crucial to understand the concept of aviation safety and the current state of safety in aviation practices, which will reflect directly on the research field and consequent actions.

The main objective of this chapter is to identify the gaps in the research field and focus on particular research problems. Furthermore, it is to acquire knowledge and update basic information in the field of aviation safety from the existing literature published in the academic world. In addition, the concepts of the research will be defined and various relevant topics will be reviewed which form the backdrop for this research. Moreover, the review will discuss a wide range of styles and techniques applied in this field in addition to shedding light on different data sources.

The chapter begins by describing aviation safety and its stages of evolution. The key elements of aviation safety are deeply discussed as well. Identifying of the regional context where this research has been run, which is North Africa, and the current situation of aviation safety, are two areas that will also be covered. Aeronautical decision-making performance as one of the most important elements in flight safety are dealt with, in addition to identifying the most commonly attributed factors of pilot decision-making performance in the cockpit.

The discussion proceeds to identify the role of the national culture and modern technology in shaping pilot risk perception in flight as found in the current literature, which will lead to the author addressing the current knowledge gaps. Figure 2.1 illustrates the process of identifying the research gaps.

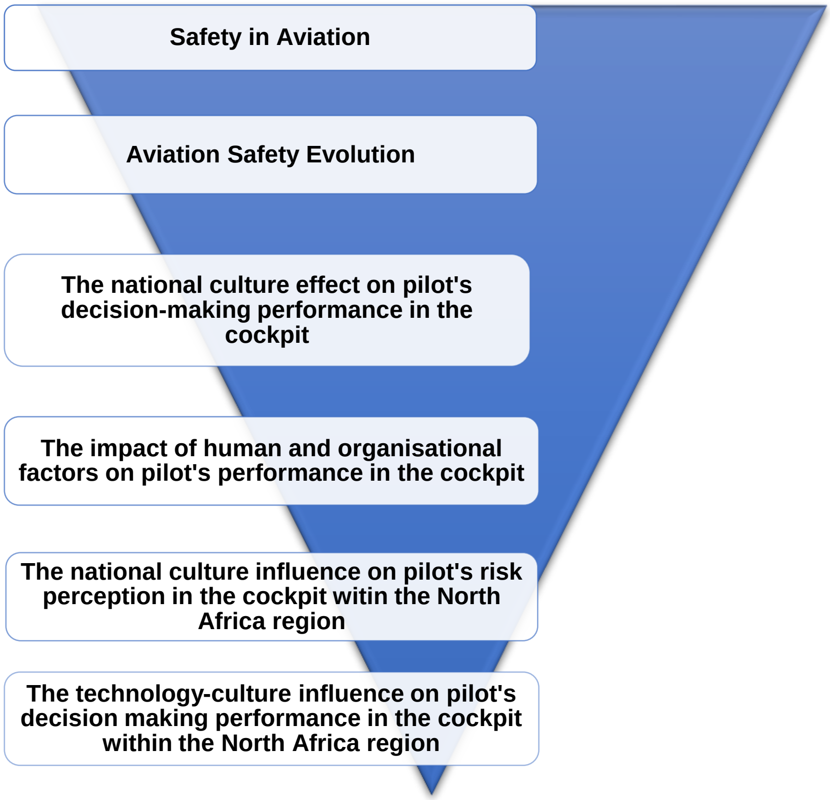


Figure 2-1: Illustrates steps of identifying the research gaps

2.1.2 Overview of the Research Significance

Organisational and human factors have a direct or indirect effect on the safety behaviour of an individual, which in turn have a significant influence in building a positive safety culture within an organisation. Human error occurs in the context of an organization rather than in isolated situations (Reason, 1997). As a result of the swift development in aviation technology, accidents related to machines have noticeably declined since World War II, while the increased complexity of aircraft systems and human-error related accidents have risen (Shappell et al., 2007). Consequently, human errors in aviation are now more frequent than in the early days. Organisational culture has a wide effect on shaping employee attitudes, which influence values, beliefs, and behaviours. It is crucial therefore to understand the effect of national culture on safety behaviour and promote the factors within an organisational culture that minimise human error and improve organisational performance (Chauvin at al., 2013).

Furthermore, understanding the effect of the national culture on the safety behaviour of an individual in a highly complex industry helps to shape and systematically design a positive safety culture (Evidence Scans, 2011). A positive safety culture can help to reduce both an individual's errors and violations of safety rules within these aviation companies. This study is likely to assist in creating a good understanding of the non-technical skills of pilots within the aviation companies based within the NAR, which affect their behaviour (decision-making) in response to any incident during the flight, due to human factors or natural events. This will therefore improve their safety performance (Agha et al., 2015). In addition, it will help to build a positive safety culture in these companies. The study will use the analytical processes of data evidence collected from the field study and will be supported by a comprehensive literature review, as follows below.

2.2 Aviation Safety

2.2.1 Aviation Safety Concept

Safety is a broad concept, but can simply refer to the absence of accidents and the freedom from threats. It can also refer to the absence of risk, but this is unrealistic to some extent. Patankar and Taylor (2004) emphasise that in general: "safety is freedom from risk" and also that "safety is management of risk within a value that is acceptable by the society". Thus, safety can be defined as the balance between risk and accident/incident accuracy or is the acceptable level of risk and zero negative event within an organisation (CASA, AG, 2012). If a particular risk is acceptable then we consider that event or operation acceptable. Therefore it is possible to have higher safety standards within a high risk level, but with higher safety standards. Conversely, when something is unsafe, that usually means its risks are unacceptable (Hollnagel et al., 2015). The absence of a high accident rate over a number of years however cannot form a guarantee against controlling risks, especially in organisations where a low possibility of accidents exists, but where major hazards do appear.

In this case, a historical report cannot be a reliable and authentic indicator of safety performance. Therefore, risk management is considered a constitutional characteristic of being safe (Sydney, 2011; CASA, AG, 2012). Usually, the appearance or conversely the absence of unsafe acts cannot be accepted as strong evidence to consider whether an organisation is safe or not, although, the presence or absence of observed unsafe acts do appear to be logical as a factor in measuring the safety of an organisation (Hollnagel et al., 2015).

Safety is considered as a characteristic which permits a system to operate under pre-determined conditions with the least acceptable accidental loss. Interestingly, ASA (2001) defines 'safety' as "a situation where the risks of an aircraft accident or air safety incident are reduced to a level as low as reasonably practicable". This emphasises the proposition that risk management constitutes a practical definition of safety, and this idea represents the main core of this study in managing and mitigating risk by pilots in the cockpit within the NAR.

2.2.2 Aviation Safety Evolution

The evolution of aviation safety has gone through several stages, evident through the literature. It can be divided into three phases of error causation: technical factors, human factors and organizational factors (ICAO, 2013), (see Figure 2.2), illustrates these stages more clearly. Throughout the early years of the evolution of aviation safety, as mentioned above, most researches focused on deficiencies within safety that were primarily because of technical factors and technological collapse rather than human errors (Wiegmann, D. & Shappell, 2003).

Human factors are considered to be one of the main reason behind aviation accidents for several reasons, one of these is the fact that legal responsibility is more easily assigned to individuals than companies; linking an individual's error to an accident can be done clearly (Chen et al., 2013). In addition, due to the lack of observation of the nature of the relation between accidents and organisational variables, the number of studies manifesting organisational failures is consequently limited (Robertson et al., 2016).

Lastly, putting the blame on individuals rather than corporations has brought financial profit to organisations. Nonetheless, the impact of organisational influences on the complex nature of accidents related to human error has recently been recognised by researchers (Helmreich & Merritt, 2001). Accident causation studies were conducted by the researchers in the aviation field to demonstrate the influence of organisational variables over individual behaviour. This will be discussed in detail in the following paragraphs.

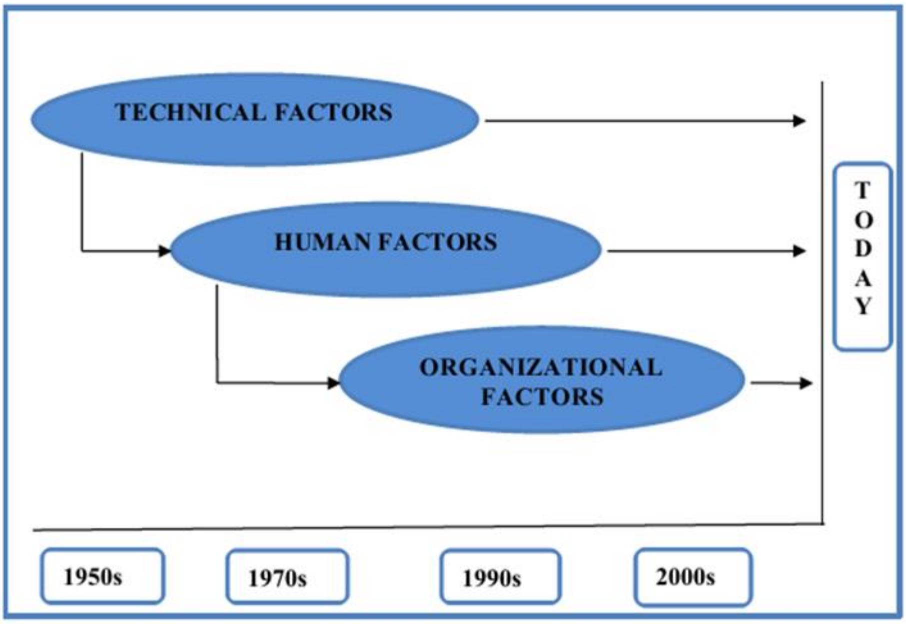


Figure 2-2: Evolution of safety
(Source: ICAO, 2013)

2.2.3 Aviation Accident and Incident Causation

Several factors may contribute to aviation accidents. One of these factors is human error. The definition of human error is "inappropriate human behavior that lowers levels of system effectiveness or safety, which may result in an accident or injury" (Drinkwater & Molesworth, 2010). In the present day the technical causes of aviation accidents have sharply decreased due to the cutting edge of technology. In contrast, the human cusses (human error) are considered to be the most frequent factors contributing to aircraft accidents (FAA, 2008), (see Figure 2.3). Human errors may include the errors of pilots, maintenance staff, air traffic controllers, or others who have a direct effect on flight safety (Chen & Chen, 2014). Approximately 80% of aircraft accidents are a result of human errors and most of these accidents are caused by pilot errors (Shappell & Wiegmann, 2000). According to Diehl et al. (1987), once the government licenses a pilot, they are expected to obey the regulations and refrain from any actions which may impact the safety of others.

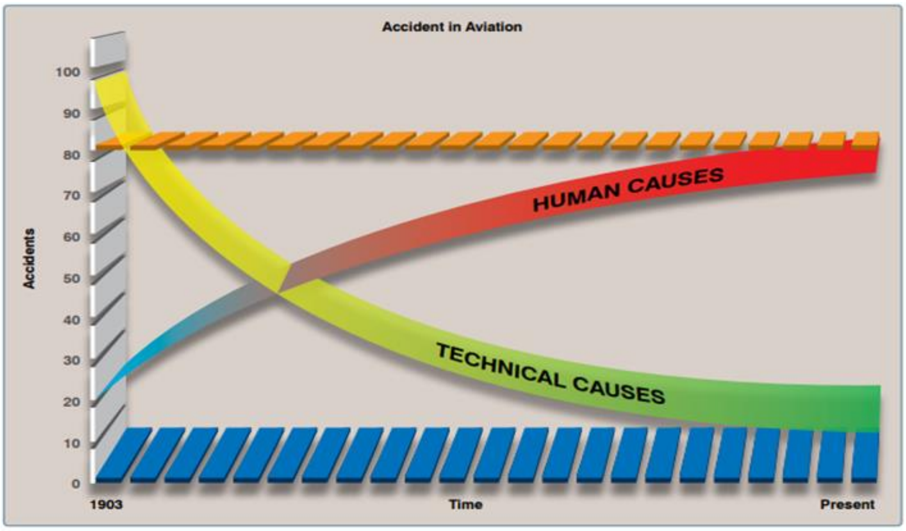


Figure 2-3: 80% of all aviation accidents are caused by human factors (Source: FAA, 2008)

As the regulations note, the pilot should be the final authority for the safe operation of the aircraft. The pilots should be responsible for behaviour and utilise “good judgment” in all situations (Ison, 2015). The decisional activities include self-assessment of skills, knowledge, physical and psychological capabilities, hazard assessment, navigation planning and flight priority adjustment. The natural limitations of pilot as human cognitive processes are reasons for increasing critical stress workload which can negatively affect pilot's performance and increase the probability of operating hazards, (Li, Yu et al., 2015).

In addition, Diehl et al., (1987) states: “their skills or luck is often sufficient to get them out of situations resulting from poor judgment”. Decision-making is a process of applying an action, attention and access to information stored and collected in memories (Drinkwater & Molesworth, 2010). According to Fogarty & Shaw (2010) cognitive biases, physical conditions, and attitudes, can all affect the success of the decision-making process. Some researchers, such as Gibb & Olson (2008), conduct studies to analyse the causes of aviation accidents and find that decision-making plays a major role in these accidents.

Gibb & Olson (2008) conducted a study to analyse 124 U.S. Air Force aviation accidents from 1992 through 2005 and they found most types of accidents included Controlled Flight Into Terrain (CFIT), loss of control and that 48 of the total 124 accidents can be attributed to CFIT. The study found that decision-making errors were the reasons for 40 out of the 48 accidents. Another study conducted by Shappell et al. (2007) analysed the accidents associated with two types of commercial aviation. The study showed that 56.5% associated issues to skills- based error, 36.7 % related to decision-making, and 23.1% contributed to violations. However, some have argued that decision-making and violations are the same. According to Lindvall (2011) one reason for accidents is that people occasionally decide to deviate from safe operating procedures, or rules. Therefore, it might make sense to combine violations of rules with decision-making. Thus, decision-making processes combined with violations would be one of the most prominent reasons for accidents. Therefore, in this study the researcher is focusing on the decision-making as one of the most important dimensions of the non-technical skills of pilot performance in the cockpit to mitigate pilot error and enhance the pilot decision making performance within the NAR. A further in-depth discussion of pilot decision-making comes later.

2.2.4 Human Error in Aviation

The main contributing factor to accidents and incidents in the aviation field is human error (Dekker, 2005). Industries using high risk technology like nuclear power, oil production and aviation are more prone to human errors (Cacciabue, 2004). To understand why significant amounts of human errors are occurring within these complex industries, a large body of research has been published. Although organisational factors are well known, topics that have a significant influence on safety process, such as organisational culture, safety behaviour, and safety performance, have not been sufficiently appreciated in the research studies (Cooper & Phillips, 2004).

It is important to note that human errors can be widely determined in the ways that individuals are most likely to be affected in the application of their judgments. According to Berlin et al. (1982) and (EASA, 2010), a pilot's decisional errors were attributed to his or her attitude, with the cause originating from pilots selecting inappropriate actions in the light of additional information that might have convinced them to select another option.

Therefore, organisations should probably aim to focus on the modification of their workers' attitudes and behavior in order to improve flight safety. If decision-making could be influenced by personal attitudes safety might be improved by modifying those attitudes.

2.2.5 Aviation Accident Causation Models

There are many models of accident causation within an organisation in relation to human factors:

2.2.5.1 Domino Theory Model

According to Bird and Loftus (1974) that the Domino theory is one of the most famous and earliest known theories (cited in Wiegmann & Detwiler, 2005; Ghasemi et al., 2013), (see Figure 2.4). The theory proposes that accidents happen as a result of a series of actions, each one happening as a consequence of another, carrying an influence that steers the event to its logical conclusion. Previously, before the domino theory had been developed, it was thought that the instantaneous actions of individuals were the only essential element responsible for accidents.

However, Bird argues that the last falling domino must be conceded as the final result of an individual action in a series of falling dominos; for instance, a management level failure may proceed to the final action, but at this point be accounted as individual rather than management failure (Wiegmann & Shappell, 2003; Ghasemi et al., 2013). Tactical errors may be associated with an individual‘s behaviour and working conditions.

Operational errors, however, are linked to organisational management behaviour. Examining the reasons for accidents, in addition to recognising the situation of the organisation (standards including safety operations, safety knowledge and regulations) have been studied in relation to the domino theory and additional constructs.

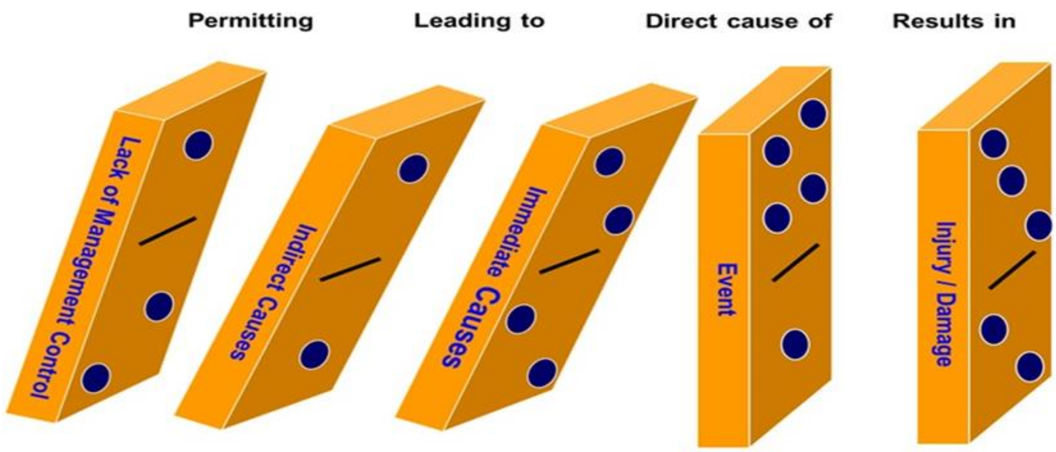


Figure 2-4: Domino theory
(source: Ghasemi et al., 2013)

The theory indicates the possibility of a misunderstanding between individuals' awareness of the organisation's target, the responsibilities and tasks of other members, and the assignment of accountability.

2.2.5.2 Reason’s Swiss Cheese Theory Model

This theory is the most famous theory of human errors. It follows the deep root of error causation by investigation four levels: organisational influence, unsafe supervision, preconditions for unsafe acts and unsafe act (see Figure 2.5). Reason (1990) concentrated on active and latent types of error. Although active errors can be instantly recognised, latent errors are hidden until they unexpectedly cause the accident (Reason et al., 2006). In order to illustrate the connection between three hierarchical layers, the significance of latent errors has been emphasised within the model in relation to human accidents. The layers are: preconditions for unsafe acts, unsafe supervision, and organisational influences, respectively. The "holes" will be manifest if any one or more of these factors has collapsed (Reason et al., 2006).

Thus, the accident will happen with the contribution of these hidden latent factors as consequences of these failures, in which the last one will be the unsafe behaviour of an individual (Helmreich & Merritt, 2001; Reason, 1990). Wiegmann and Shappell (2003) present a more advanced version of Reason's pattern, by introducing a new category for each of the four layers: unsafe behaviour of the individual, preconditions for unsafe acts, unsafe supervision, and organisational influences.

Aviation companies have broadly accepted the analysis and classification of human factor as a strong system to clarify individuals' unsafe behaviour.

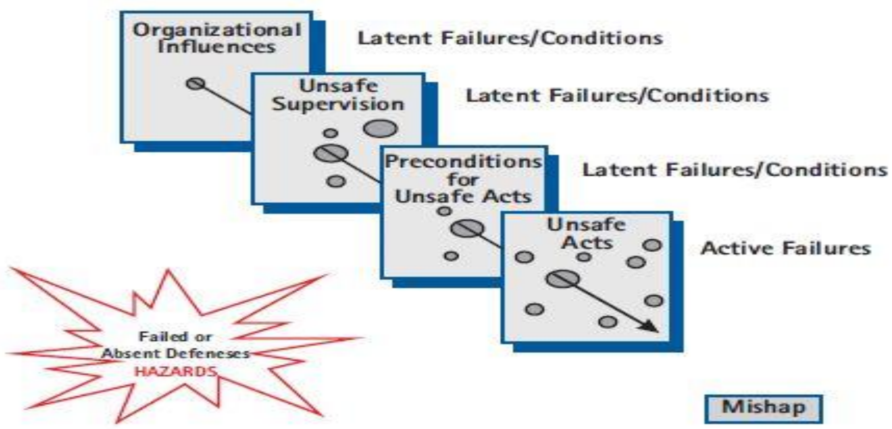


Figure 2-5: Reason's Swiss Cheese Model of accident causation
(Source: Reason, 1996)

2.2.5.3 Human Factor and Classification System Model

In order to investigate the role of human error in aviation accidents, the Human Factor and Classification System (HFACS) model was developed to form an analytical framework, based on Reason's organisational model of human error (Chauvin et al., 2013). However, a clear shift has taken place in investigating the causes of aviation accidents from examining skill deficiencies to decision-making, attitudes, supervisory factors and organisational culture (Diehl et al., 1989). HFACS, as mentioned above, was developed from Reason's organisationally-based model of human error (Reason, 1990). This models the active failure of front-line operators, in which pilot errors combine with latent failures lying dormant in the system to breach defences (see Figure 2.6). These latent failures are generated in the higher rates of the organisation and connected to management and regulatory structures.

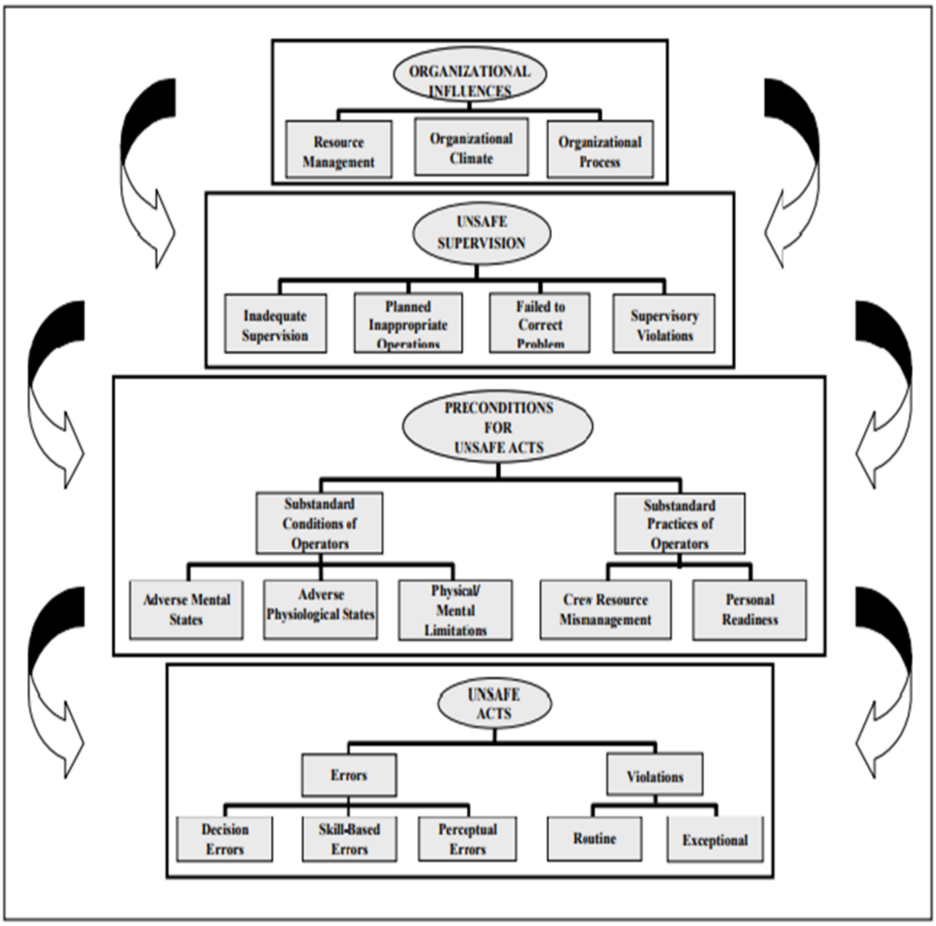


Figure 2-6: Overview of HFACS
(Source: Wiegmann & Shappell, 2001)

HFACS has introduced a regular plan for accident/incident data collection and analysis. It persists in a systematic and comprehensive undertaking of investigations for accidents and incidents. It also assists the counteracting investigator's heuristics and biases as well as admitting comparisons of presented factors across industries (Reinach & Viale, 2006; Hsiao et al., 2013). This system has been applied to analyse accident causation in multiple fields and for the investigation of railroad accidents (Reinach and Viale, 2006).

The framework has been widely accepted as a tool for the analysis of accident causation, but it has been criticized for limitation. For example, does the framework merely highlight a minor connection between human error and work environment? In addition, it has been blamed for providing some misleading links between categorisation and analysis (Chauvin et al., 2013).

The received data of errors in categorisation has no convincing explanation and suggests neither elements that may have contributed to these errors, nor any corrective actions to prevent them in the future (Dekker, 2001; Wiegmann & Shappell 2001). Furthermore, rather than solve the issue of human errors, the framework has only changed their place within the organisation to a higher position. It has not actually solved them.

In summary, the above models have concluded that the core causation of error in organisational factors in aviation accidents could remain ignored for a long period of time by organisational members. Sudden disasters may occur as a result of inactive and apparently unconsidered factors, through setting off an action that could lead to an accident. In addition, aviation organisations are more complex due to cutting-edge technology and the development of management systems.

The likelihood of vulnerability to accidents is higher in complex organizations than in less complex ones. Therefore, aviation accidents are regarded as inherent "normal accidents" because of the complexity of this industry. Strong management can to a certain extent control inherent failure in complex aviation systems; this management has become more significant in such organisations than in the past.

Organisational factors have direct influence on the decision makers within the organisation, which can instantly affect a pilot's behaviour and decisions. Likewise, it is significant to consider organisational processes as well as the organisational climate. The organisational climate indicates a sequence of organisational characteristics, involving the structure of the organisation, designed policies, and organisational culture. The climate and culture of an organisation have been described and developed in a parallel way to human error models, because they have always been considered as latent factors, which have a direct or indirect effect on decision-making and behaviour

Measuring Safety Performance in Aviation Organisation

There is no consensus among researchers regarding a specific way of measuring safety performance in aviation companies. According to SMICG (2013) there are no specific indicators or models that can be entirely adapted to measure safety performance. Safety performance indicators have been gone through different stages of development and remain a controversial topic in the operation of safety process.

A wide ranging research debate regarding safety process has been published recently with different views on safety performance indicators (Reiman & Pietikäinen, 2012). Since then, many organisations have recognised the importance of applying these indicators to assess and evaluate the functions of their own safety objectives and targets (Sinelnikov, Inouye, & Kerper, 2015). Leading and Lagging Indicators are one of the most frequently used indicators for the improvement of safety performance.

Lagging indicators enable the organisation to measure the safety performance. In other words it could enable the organisation to prevent the negative outcome (Reiman & Pietikainen, 2013). It can be used for a specified type of process location or level, due to it is ability to measure the outcomes of an organisation's safety. Furthermore, it can assess the effectiveness of safety measures, actions, or initiatives or validate the system safety performance (SMICG, 2013).

Leading indicators enable the organisation to measure both the probability and the contribution of negative outcomes in the future (SMICG, 2013). From the above discussion, the importance of these indicators is clear in that they provide positive monitoring to enable an improvement in safety management capability and also influence the prioritisation of safety management both in actions taken and in safety improvement (Reiman & Pietikäinen, 2012).

The effectiveness of safety performance measurement will support the identification of opportunities for improvement not only related to safety but also to efficiency and capacity, in terms of measuring safety culture and safety climate as they are represented in the organisation's safety performance status. Díaz-Cabrera et al. (2007) have introduced a cultural instrument focusing on measuring the organisational practices in relation to safety management systems, implementing a survey containing seven dimensions covering safety culture, values and practices.

A safety climate prioritises safety and integrates it into the daily functioning of the organization and the routines of individuals and teams that work within it. Lin et al., (2008) have measured safety climate by using a survey which included many factors: organizational environment, risk judgement and safety precautions.

The measurement tool which is used to evaluate the current status of an organisation's safety performance is very important in assessing an organisation's safety effectiveness, actions, and initiatives, or validating the system's safety performance.

2.3 Aviation Safety in the North Africa Region

2.3.1 The Context of North Africa Region

A deep comprehension of the NAR's characteristics and nature was crucial to facilitate understanding of the national context of the aviation safety performance within the region. These following sections will illustrate the North Africa region's national setting, through reviewing the literature, which includes but is not limited to a description of the physical characteristics, systems governance, national culture and the current state of aviation safety. In addition, the implications of institutional structures, government policies, the socio-cultural environment, and the extent to which these affect the safety of aviation industry in the region will also be covered

There is no consensus among researchers about identifying the boundaries of the NAR, due to the multiplicity of geopolitical considerations and the changing political status of the countries throughout the history of the region (Roy et al,. 2011). According to the department of economic and social affairs of the United Nations secretariat (UN, 2014), the NAR consists of seven countries: Algeria, Egypt, Libya, Mauritania, Morocco, Sudan, and Tunisia.

In contrast, Sharkey (2010) argues that NAR includes Morocco, Algeria, Tunisia, and Libya. He excludes Egypt and Sudan as he considers them as belonging to the Middle East region. For the purpose of this study, the researcher has specified the boundaries of the region as including seven countries as specified in the (UN, 2014), because this seems geographically more accurate, in addition, to reflecting similarities of culture, environment, and ethnicity in these countries.

The NAR is located along the southern coast of the Mediterranean basin. North Africa is the northernmost region of the African continent and is bordered to the east by the Red Sea and to the west by the Atlantic Ocean (Benkerroum, 2013). In addition, some countries have boundaries in the south (see Figure 2.7).

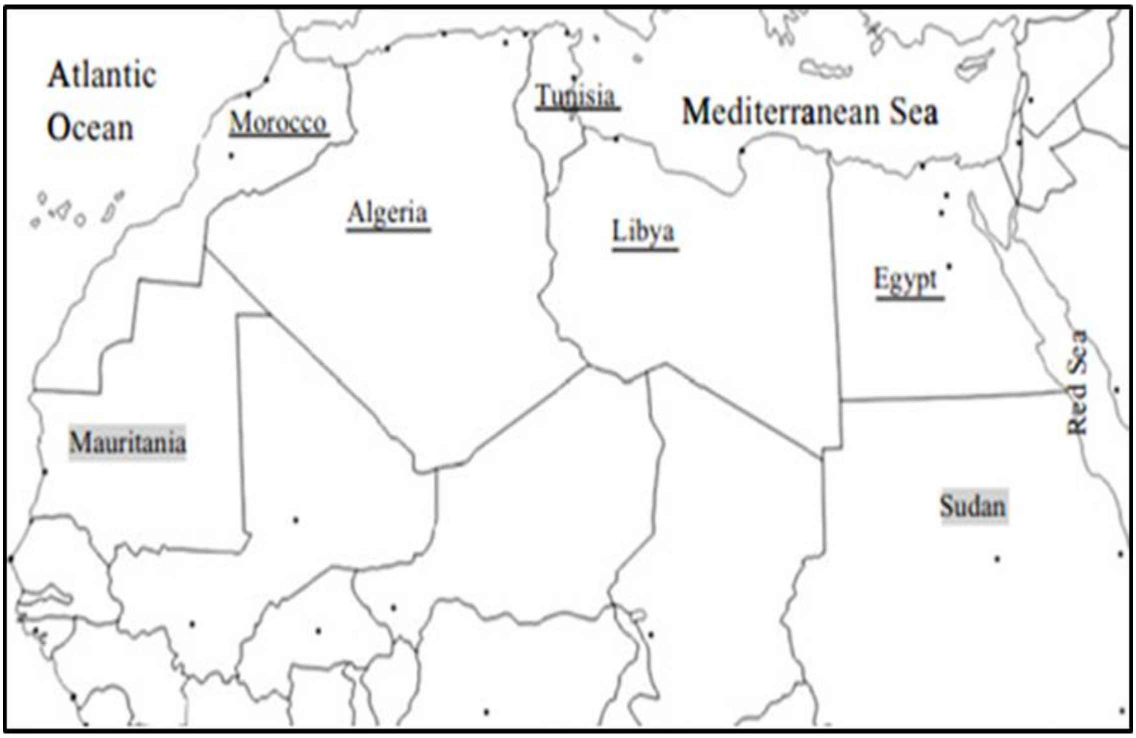


Figure 2-7: The North Africa region boundaries
(Source: Benkerroum, 2013)

2.3.2 Demographic Features of the North Africa Region

The difficulty in defining the NAR has implications for specifying the demographic features of the region as it considered in this study. For instance, the United Nations' definition of NAR includes Sudan but excludes Mauritania, which is considered among the Sahel countries. Furthermore, the fact that Egypt is also considered to be a part of the Middle Eastern region, which with North Africa forms the Arab world, adds some confusion to the definition of the exact geographical boarders and demographic features of region. Nonetheless, regardless of the geographical or geopolitical definition, Morocco, Algeria, Tunisia, Libya, Egypt, Sudan and Mauritania form the core of the NAR for this study. To give an overview of demographic features of this region, five countries were chosen (see Table 2.1), which indicate the main demographic, economic, social, and cultural data for these countries.

Table 2-1: The demographic features for five countries in the region
(Source: Benkerroum, 2013)

Country	Area (km2)	Population (millions)	Urban Population (%)	Main economic activity	Official Religion	Official Languages
Morocco	710,850	32.27	58.8	Agriculture, phosphates mines, tourism, and sea foods	Islam	Arabic + Tamazight
Algeria	2,381,741	35.98	67.1	Oil and natural gas	Islam	Arabic + Tamazight
Tunisia	163,610	10.60	67.7	Agriculture, mining, manufacturing, and tourism	Islam	Arabic + Tamazight
Libya	1,759,541	6.42	78.1	Oil and natural gas	Islam	Arabic + Tamazight
Egypt	1,002,450	82.54	43.5	Agriculture, oil and tourism	Islam	Arabic

2.3.3 Aviation Safety in North Africa Region

As already outlined, the absence of clear definition of the North Africa region boundary in the literature make it more difficult to find clear data regarding the current aviation safety status for this region as specified in this study. To overcome this problem, the researcher has relied on the different data which have a direct link with the North Africa region, such as the Middle East & North Africa (MENA). The aviation safety status in this region, as in other developing countries, suffers from many problems. Fatal accidents are one of the biggest problems in NAR, which has one of the highest rates of fatal accident as compared with other regions. According to ICAO (2012), Africa had the highest regional accident rate, and yet accounted for the lowest percentage of global traffic volume (3% of scheduled commercial traffic), (see Figure 2.8).

UN Region	Traffic (thousands)	Accidents		Fatal Accidents
		Number	Rate[2]	
Africa	891	7	7.9	3
Asia	7,561	22	2.9	3
Europe	7,143	39	5.5	4
Latin America and the Caribbean	2,625	15	5.7	4
North America	10,979	38	3.5	0
Oceania	855	4	4.7	2
World	**30,053**	**126**	**4.2**	**16**

Figure 2-8: Accident statistics and accident rate 2012
(ICAO, 2012)

In addition, according to the International Air Transport Association (IATA, 2016) the highest rate accidents in 2015 had been registered in Africa, at 7.9 accidents per million sectors (see Figure 2.9).

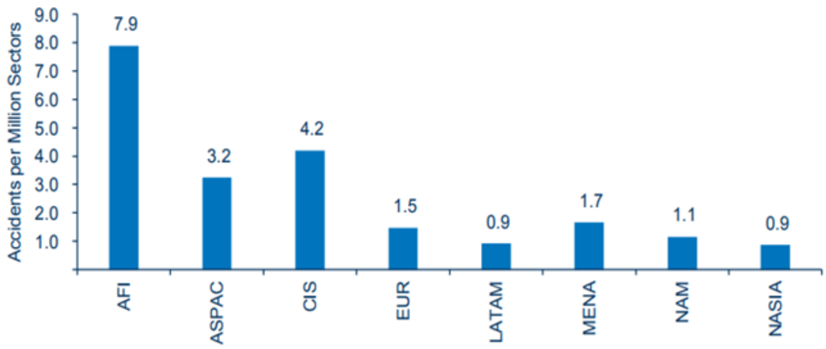


Figure 2-9: Aviation accident analysis by region for 2015
(Source: IATA, 2016)

According to IATA (2016), accidents that occurred in 2015 among commercial international carriers have been classified into different categories, such as hard landing and runway excursion (see Figure 2.10), all abbreviation in the next figures are shown in (Figure 2.11).

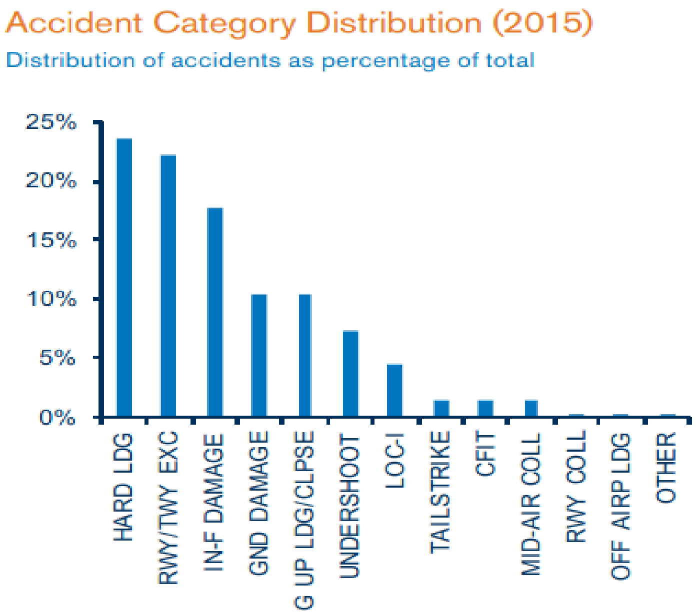


Figure 2-10: Accidents of different categories by region
(Source: IATA, 2016)

Abbreviation	Full Name
RWY/TWY EXC	Runway/Taxiway Excursion
G UP LDG/CLPSE	Gear Up Landing/Gear Collapse
GND DAMAGE	Ground Damage
HARD LDG	Hard Landing
IN-F DAMAGE	In-Flight Damage
LOC-I	Loss of Control In Flight
CFIT	Controlled Flight Into Terrain
TAILSTRIKE	Tailstrike
UNDERSHOOT	Undershoot
OTHER	Other End State
OFF AIRP LDG	Off Airport Landing
MID-AIR COLL	Mid-Air Collision
RWY COLL	Runway Collision

Figure 2-11: Shows abbreviation of Figures 2.10, 2.12 and 2.13

According to IATA (2016), errors of flight crew are involved in these accidents due to the lack of SOPs compliance, poor decision-making and poor flying skills. According to IATA (2016), these pilots suffered from a higher rate of runway/taxiway excursion, rear-up landing/gear collapse, ground damage and hard landing in comparison to other regions for the years from 2011 to 2015 (see Figure 2.12 and 2.13).

The leading factors in the failures in these incidents (for example, a go-around procedure) are deficiencies of stabilised approaches and poor skills in automation operation (Randel, 2008; IATA, 2016).

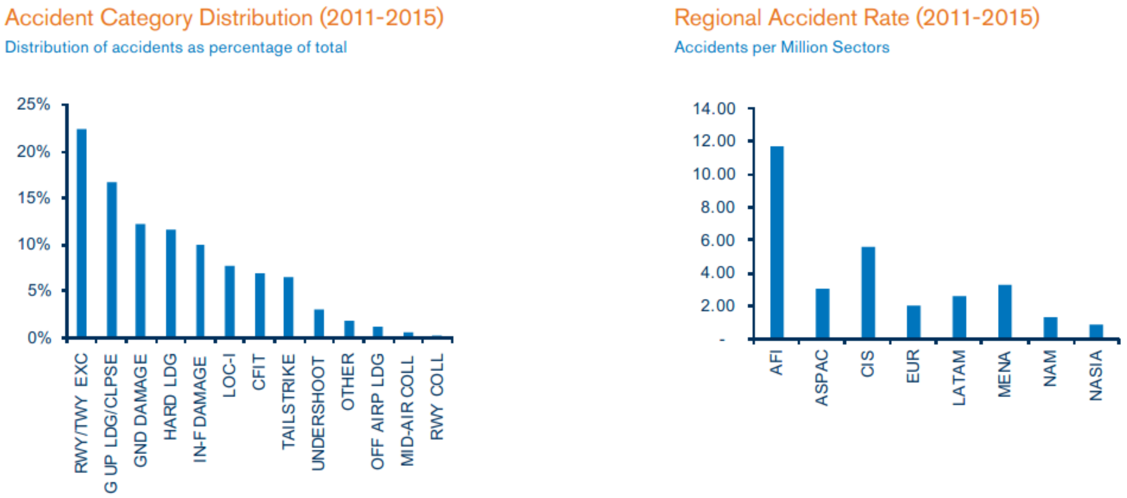


Figure 2-12: Accidents of different categories by region from 2011 to 2015
(Source: IATA, 2016)

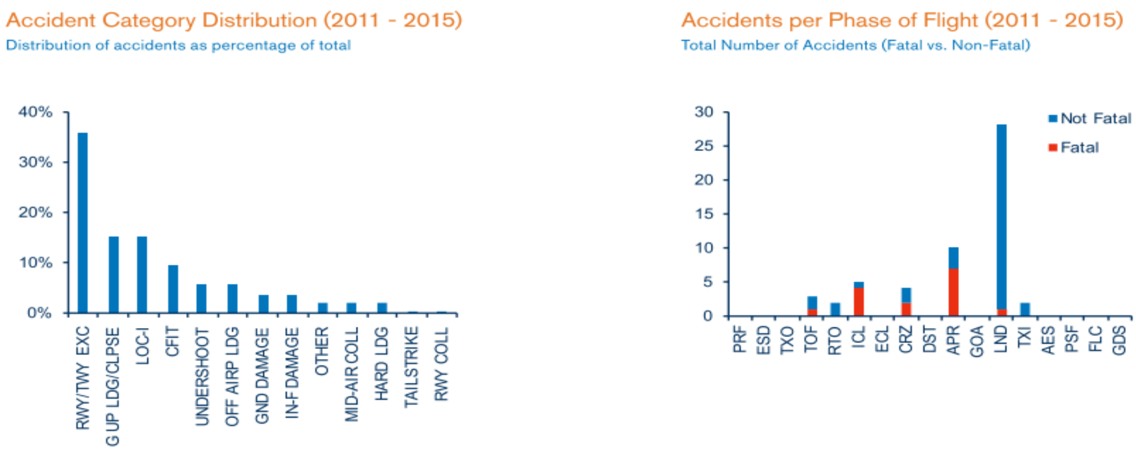


Figure 2-13: Accidents categorised per phase in Africa from 2011 to 2015
(Source: IATA, 2016)

Accordingly, it is clear that that there is a strong link between these accidents and the contributory factors such as poor automation skills and incorrect operational procedures during destabilised approaches among these pilots within the African continent (IATA, 2017). Pilots within the region of North Africa are suffering from deficiencies in performing these tasks.

These deficiencies in performing safety tasks requires a deep understanding of safe operational requirements for these pilots and their decision-making performance in relation to the impact of cross-culture in the cockpit.

2.4 Human Factors in Aviation

2.4.1 Human Factors Concept

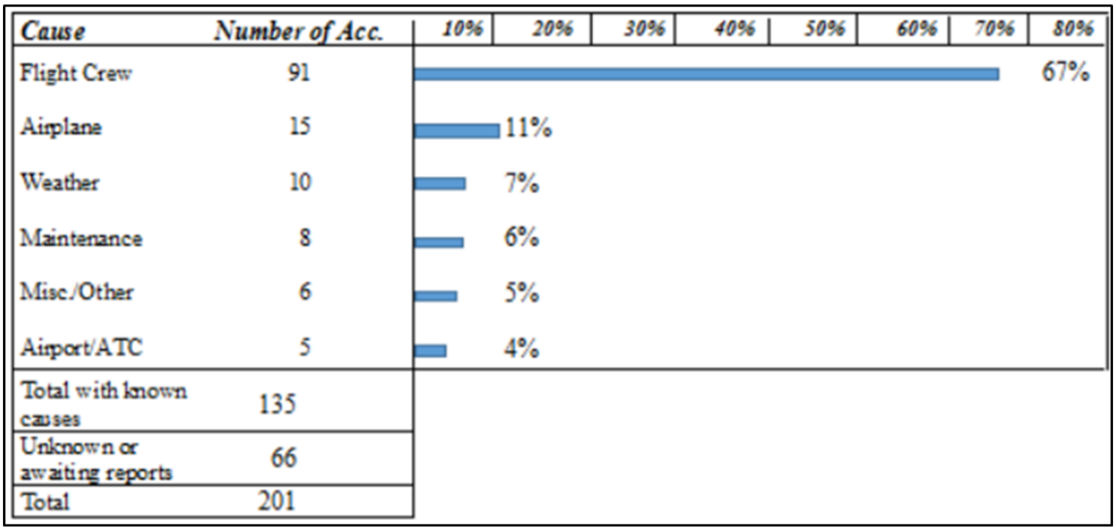
Today, human factors are the most important safety barrier in high risk industries, when it comes to preventing accidents (Virovac et al., 2017). Human factors have been assigned with different definitions. But, put simply, it is the science of understanding the properties of human capability (FAA, 2008). According to Kantowitz and Sorkin (1983), human factors are the link between technology and human. Cacciabue (2004) states that the study of human factors in technology are "concerned with the analysis and optimisation of the relationship between people and their activities, by the integration of human sciences and engineering in systematic applications, in consideration for cognitive aspects and sociotechnical working contexts".

Accordingly, the study of human factors since is concerned with the system designing strategies to cope with human limitation and performance in order to reduce error (Dekker, 2003). Human factors are nowadays playing a very important role in many disciplines that are considered high risk: safety engineering, medical science, organizational psychology and educational psychology (FAA, 2008). According to FAA (2004), human factors could affect the individual in the work performance in very broad ways and this includes different elements that effect the individual differently because humans are different in strengths, weaknesses, capabilities, and limitations (see Figure 2.14).

Figure 2-14: Human factors and how they affect people
(Source: FAA, 2008)

2.4.2 Human Factor in Aviation Safety

The role of human factors in aviation accident causation is today more relevant than ever, especially with the introduction of modern technology in the cockpit. It was found that about 80% of aviation accidents are directly caused or contributed to by human factors (FAA, 2008). According to Fatigue and Pilot (2017), the statistics of years from 1990 to 1999, show the flight crew to be the main cause of fatal accidents (see Figure 2.15).



Cause	Number of Acc.	
Flight Crew	91	67%
Airplane	15	11%
Weather	10	7%
Maintenance	8	6%
Misc./Other	6	5%
Airport/ATC	5	4%
Total with known causes	135	
Unknown or awaiting reports	66	
Total	201	

Figure 2-15: Contributor to aviation accident years from 1990 to 1999
(Source: Fatigue and Pilot, 2017)

Despite the fact that the human element is the most vulnerable in the aviation environment, they are also the most highly adaptable, flexible and valuable in a work environment (Dumitru & Boşcoianu, 2015).

Accordingly, human factors play a crucial role in aviation safety, and need to be broadly understood and handled proactively (ICAO, 1998). This means that the knowledge of human factors should be applied and integrated in parallel with system design, certification, and operation before the systems and individuals are put into service (Taylor, 2004).

The accident investigations results show that human factor has an influence on both risk acceptance criteria and development of risk. Therefore, human factors such as stress and fatigue are responsible for increasing the probability of error made in the cockpit (Abramowicz-Gerigk et al., 2015)

The concept of human error in the early days was considered to be key in aviation accidents caused by crews. Nowadays, this term has been found to be misleading. The main reason for the accident or incident is often hidden. The latent factors that led to this failure therefore need to be revealed if this is to be prevented in the future (Dumitru & Boşcoianu, 2015). An example of a latent factor that leads to human error would be poor training, systems design or incorrect procedures. This means that a human error is not anymore considered as the end of the accident investigation, rather as the starting point to find the real reason behind this accident and put in place measures to avoid a similar accident in the future.

In the field of aviation safety, the term ‘human factor’ mainly led to a focusing on the flight crew. This led to the danger of ignoring the fact that human elements are part of a socio-technical system in the whole field, including: air control traffic systems, maintenance systems, ground operations, and more (Chauvin et al., 2013).

According to Taylor (2004), in 1940 it was calculated that about 70% of all air craft accidents were attributable to individual's performance. In addition to that, the International Air Transport Association (IATA) carried out another study in 1986 in the USA to investigate this situation by looking at the significant causes of 93 aircraft accidents and they found that human error component was still contributing highly in aviation accidents without clear reduction compared to the previous percentage in the 1940s’ study (see Table 2.2).

Table 2-2: Major contributor to 93 aviation fatal accidents in 1986.
(Source: Taylor, 2004)

Causes/ Major contributory factor	% of accidents in which this was a factor
Pilot deviated from basic operational procedures	33
Inadequate cross-check by second crew member	26
Design faults	13
Maintenance and inspection deficiencies	12
Absence of approach guidance	10
Captain ignored crew inputs	10
Air traffic control failures or errors	9
Improper crew response during abnormal conditions	9
Insufficient or incorrect weather information	8
Runway hazards	7
Air traffic control/crew communication defeciencies	6
Improper decision to land	6

The need to manage the human factors in aviation safety is determined by their impact on both system efficiency and the health of operational personnel, which affect each other in harmony (Chen et al., 2013; Dumitru & Boscoianu, 2015). System efficiency is affected by not applying or not having knowledge about human factors.

In addition cockpit system design and display are improving pilot's efficiency and performance. If the pilot had an adequate training they are likely to have improved performance in the cockpit. According to Dumitru and Boscoianu (2015), the pilot in the cockpit could be effected by health conditions like fatigue, stress and sleep deprivation, in addition to other physical or mental health issues, such as workplace design, temperature and humidity.

2.4.3 Human Factors Applications in Aviation Safety

The main aim of a human factors initiative is to improve work efficiency and safety through managing human error either as manifested by individuals or organisations (Merritt & Maurino, 2004). According to CASA (2012) the human factors term can be regarded as covering negative aspects of human error as well as positive aspects of human performance. Simply, the human factors are the social and personal skills such as decision-making and communication in the cockpit, which are crucial for efficient safe flight.

The main core of human factors study in the cockpit is to understand pilot behaviour and performance from an operational prospective in order to optimise the fit between the pilot and the system in the cockpit and ultimately improve safety and performance (CASA, 2014). For the purpose of studying human factors in aviation to contain and control human error, we must be clear that the roots and consequences of human error could be significantly different, even within a similar error. These errors could be due to different reasons, such as poor judgement or carelessness. Or, alternatively, it could be due to improper system design or improper response to a situation (ICAO, 1998).

In aviation many models have been adapted to mitigate pilot error and improve safety performance. Some of these models were mentioned earlier in this chapter: the Swiss cheese model, the Dominoes model, and HFACS. All of them investigate latent factors in an aviation accident. Another model considered to be very important in relation to human factors is the SHELL model (Reason et al., 2006; CAA, 2006).

According to CASA, (2014) the SHELL model gives a better understanding of human factors. It consists of five components (see Figure 2.16). According to CASA (2012) the name of this model comes from the letters “SHELL”:

S) Software: The procedures and other aspects of work design.

H) Hardware: The equipment, tools and technology used in work.

E) Environment: The work environmental conditions.

L) Liveware: The human aspects of the system of work.

L) Liveware: The interrelationships between humans at work.

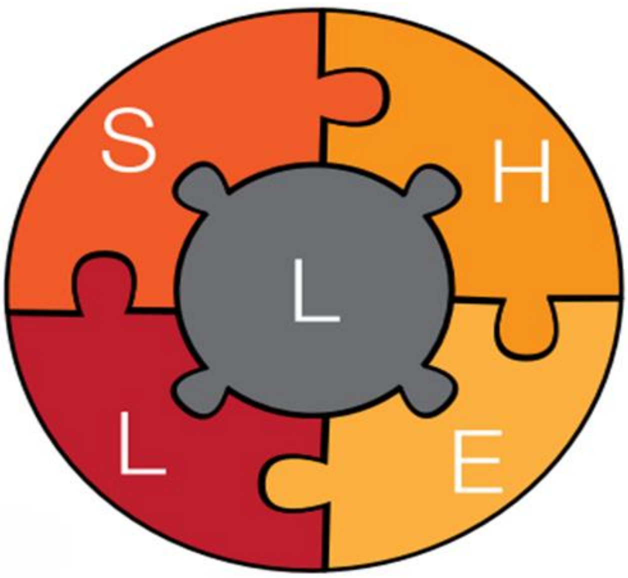


Figure 2-16: The SHELL model
(Source: CASA, 2014)

Applying this model to airline companies can emphasise that the whole system in these companies shapes how their pilots behave regarding safety. It also allows for the reason behind the accident to go far beyond the pilot behaviour in the cockpit (CASA, 2012).

According to Cacciabue (2004) improving safety operation of a system can be achieved by using a suitable measurement tool that tests both human skill and automation ability in preventing or recovering the human error, and in mitigating the consequences of these inevitable human errors.

In summary, this research is focusing on studying the pilot's decision making performance in the cockpit within the NAR. This means that it is crucial to understand the human factors role in the cockpit as one of the most significant factors of human performance. This will allow for the understanding and predicting of pilot's capabilities and limitations, including with using modern technology that has been designed and produced in a different regional culture, where much evidence in aviation accidents shows that the introducing of modern technology in the cockpit has led to new errors, such as: misreading the flight instruments and wrongly selecting cabin contacts. This study could therefore help in the better design of the pilot-cabin interface and lead to enhancing pilot decision-making performance.

2.5 Organisational Culture in Aviation

2.5.1 Culture Concept and Definitions

Culture studies aim to define and analyse the influence of culture over individual, group and societal behaviours (Ostroff et al., 2012). According to Hofstede (2011) national culture has many dimensions that influence human attitudes. Culture can be defined as a pattern of learning behaviour for a person's way of life, such as different manners of speaking and responding (Helmreich, 2000) and (Leng & Botelho, 2010). Culture has been defined by researchers in many different ways, but the most clear and appropriate is that of Hofstede (1991), who states that culture is a "pattern of assumptions, values and beliefs whose shared meaning is acquired by members of a group".

Hofstede (1991) argues that culture expresses a person's intentions, beliefs, attitudes, values and norms. It is clear therefore that a group of people can share the same beliefs, values, institutions and rules as a community culture (Warner-Søderholm, 2011). There is no agreement among researchers about the specific definition of the term culture, but Hofstede's original and pioneering definition (1980) remains the most significant, in which he defines culture as "the collection of program of the mind, which distinguishes the members of one human group from another" (Hofstede, 1980). In addition he has built a conceptual framework to clarify this term, which is still considered as a main source of reference for many researchers in this area.

The causal relationship between personality and culture has long been the centre of debate among psychologists. Brief studies have been conducted on this topic (Berry et al., 2002). The prominent psychologist Bruner assessed the area as a "magnificent failure". Individual personality traits, deep psychological structures or basic tendencies are generally recognised as having biological foundations (Hofstede, 1994, cited in Al-rashidi, 2011). McCrae (2004) suggests that culture is affected by behaviour, which is a combination of biological or psychological personality traits, so that culture does not affect personality, but vice versa.

In addition, McCrae (2004) emphasises that the traits of personality may, after a prolonged period, leave their characteristics on culture, although he emphasises that individual traits are weak predictors of specific behaviors, especially at the cultural level. Culture is "the collective programming of the mind that is derived from the social environment, not genes", connected with human nature to be manipulated: "what one does with these feelings, how one expresses fear, joy and observations" (Phuong-Mai, 2015). Also, Hofstede (2005), emphasizes that national culture is distinctive in the way that it significantly differs not only in terms of language, religion and other factors but also in terms of the way people of that nation perceive, behave, act and hold the values in them. This interaction will produce the human personality: "a unique set of mental programs", where some of these mental programs are learned and some are inherited (Hofstede, 2011).

Other researchers argue that the relation between culture and behaviour is reciprocal. Significantly, Berry et al. (2002) define culture "both as adaptive to, and as changing the ecosystem behaviour is portrayed as being influenced by, and influencing, culture; and the ecosystem is seen as both affecting, and being affected by, individual behaviour". In brief, there is a common general agreement that individual behaviour is generated by personality traits and cultural influences. At the same time, a disagreement exists when it comes to the relationship between individual behaviour and culture. The author adopts the aforementioned reciprocal view and agrees with Berry et al. (2002) that individual psychology and human behaviour are fundamentally determined by culture and biology.

2.5.2 Organisational Culture

The Hawthorne studies from the 1920s, which examine individual and group behaviour, are regarded as the first systematic qualitative analysis, in spite of the important amount of research published during the 1940s and 1950s (Landy & Conte, 2010). Schein, (2004) offers a definition of culture combined with a precise description of culture development within an organisation. He believes that organisations are constructed by founders as purposeful objects, who possess solid assumptions about the mechanism of achieving things. Moreover, they have a strong perspective about reality, human nature, truth, relationships, time, and space, as these have a cultural effect which is shared and composed within an organisation (Schein, 2010).

The significance of leadership behaviours, values, and vision in shaping organisational culture, artefacts and values has been given a strong priority by some theorists. Also Schein (2004) defines organisational culture as "a pattern of shared basic assumptions that a given group has invented, discovered or developed in learning to cope with the problems of external adaptation and internal integration, a pattern of assumptions that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think and feel in relation to those problems".

A large number of issues have been covered by this definition and it is apparent that the culture concept is related to attitude. Organisational culture has been investigated by other theorists from a limited perspective, mentioning business and industry environments as the essential basis of the phenomenon (Ostroff et al., 2003). A diversity of meanings and patterns has been generated in the literature.

Due to the different researches, domains and interests of the theorists, the content of organisational culture has taken different shapes. Culture has three hierarchical layers: artefacts, values, and basic assumptions (Schein, 2010). Artefacts contain concrete, visible, and audible conclusions of events or considerations of the principles (values) and assumptions of an organisation. Artefacts are mostly represented in observable rituals, ceremonies, technologies used, physical environments, uniforms, and furniture (Schein, 2004).

In addition, its comparative importance requires principles and it depends on beliefs or concepts (Ostroff et al., 2003). Values act as a guideline to direct individuals towards the best selection among numerous options; also, they form the basis for an evaluation of the beliefs and actions that play a demanding role in organisational worker practices (Landy & Conte, 2010). Treven, Mulej, & Lynn, (2008) affirm that the impact of national culture on organizational culture can be observed through practices within organisations (See Figure 2.17).

Figure 2-17: Work practice constituted by culture within an organizational
(Source: Developed in this research)

According to Schein (2004), the main assumptions form the body of organisational culture, although it is challenging to observe them precisely. Primarily, it is values that generate assumptions. They cannot be changed easily and are rarely debated (Schein, 2004). Due to the important role of basic assumptions as guidance for organisational members to act in a particular manner and rationalise their attitudes according to circumstances, they are of great importance. The organisational culture can be examined through the organisational climate which represents its codes, values, norms, and rules, and its expectations and valued behaviours. There is a common confusion between organisational culture and organisational climate. Therefore, it is important to identify the similarities and differences between both concepts, in addition to their relation to organisational safety.

2.5.3 Organisational Climate and Culture

The concepts culture and climate have been debated and used between the researchers interchangeably; some of these researchers have argued that culture and climate share the same meaning (Schneider et al., 2013). Culture, from the extant literature, is treated in general as a more complex construct than are the perceptions of individuals. It has many factors, such as artefacts, values and assumptions (Schein, 2010). Climate, however, is conceived and described in the extant literature as perceptions, and some theorists have also debated that the concept of climate has more depth (Zohar, 2008; Zohar, 2010). According to Denison (1996), that “there is a striking similarity between the concepts, but the definitions of both concepts are not independent of the individual theorists and researchers and also reflect their biases and preferences”.

2.5.4 Organisational Safety Culture

The safety culture concept appeared for the first time after the disaster of the Chernobyl nuclear power station. The investigation of the accident in the final report emphasised that a poor safety culture in the organisation was the main reason for the disaster (Antonsen, 2009), (Arslan et al., 2016; Nayak &

Waterson, 2017). Since the disaster, the term safety culture has gained more attention from researchers and has developed a variety of definitions, deriving mostly from the organisational culture literature (INPO, 2004). Safety culture not only describes the root cause of the disaster, but also describes the organisational culture and environment within which the unsafe behaviour was committed (Adjekum, 2014).

According to Antonsen (2009) the Advisory Committee on Safe Nuclear Installations (ASCNI) has defined safety culture as one of most frequently cited definitions, which underpins most of the conducted researches: “The product of individual and group values, attitudes, perceptions, competencies and patterns of behaviour that determine the commitment to, and the style and proficiency of, an organization’s health and safety management”. Another similar definition proposed by Guldenmund (2000), in order to provide a more concrete vision to of the concept, is: “Those aspects of the organizational culture which will impact on attitudes and behaviour related to increasing or decreasing risk”. Antonsen (2009) presents safety culture in his model as the organisation’s culture that affects safety (see Figure 2.18).

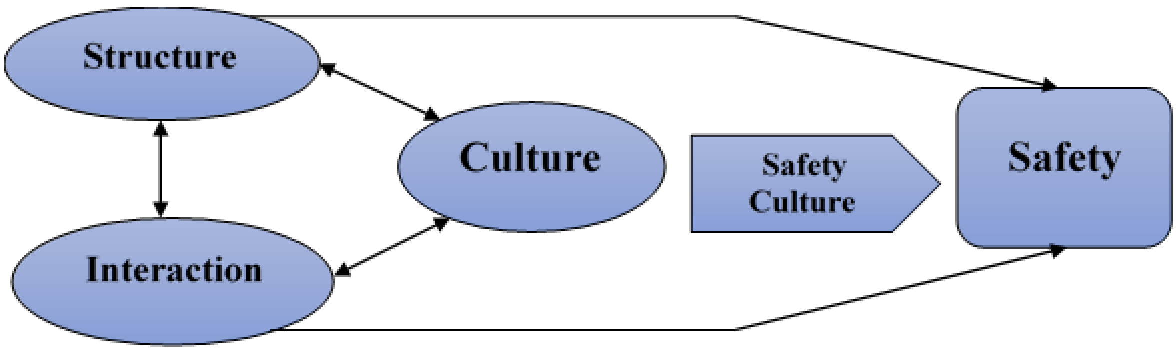


Figure 2-18: The organizational aspects affecting safety
(Source: Antonsen, 2009)

From the above definition, we can see that the research on the culture of safety organisation expectations aims to be generative. It will therefore provide a security approach towards the desired effect, as the generative actively involves seeking new potential for learning and the encouragement of new ideas (Arslan et al., 2016). Also, the desired effect is not achieved with pathological organisations, which serve to inhibit the generative potential. Safety culture is described as the systematic study of an individual's perceptions about safety within an organisation. There is no universal agreement about what to include in the concept of safety culture (Antonsen, 2010).

However, what safety researchers do seem to agree on is that organisational safety culture is about the employees' shared attitudes towards safety and managements' prioritisation of safety within the organisation (Vinodkumar & Bhasi, 2010). Accordingly, organisational safety culture is seen as an important factor in aviation organisations and risk-taking of individuals within it, including their, behaviour and propensity to act in accordance with prevailing rules and procedures.

According to Reason et al. (1998), organisations with low standards of safety culture will encourage an environment of non-compliance to the practices of safe operating. Thus, unsafe behaviour in an aviation organisation is possibly most common where the unspoken attitudes and beliefs do not coincide with the organisation's safety target, in which individual attitudes and beliefs are shaped according to the organisational safety culture itself.

2.5.5 Organisational Safety Climate

According to Zohar (1980, cited in Zohar, 2008) safety climate is a distinct aspect of organisational climate that concentrates on occupational safety. As a derivative of organisational climate, it is a group level variable and can be considered as employees' shared perceptions of the safety policies, procedures and practices in their organisation. These essential safety factors as reported by Zohar (2008) may exist in two types: first; types that are usually revealed formally in explicit explanations or written documents and, second, enacted types which are those required during the daily activities of a company. Employees have to identify these enacted policies and practices through the observation of how other employees perform in the workplace concerning safety

(Zohar, 2008). This involves the reaction of supervisors toward unsafe practices, the commitment of management to safety, the rate at which worn-out protective equipment is replaced, and the state of safety inspections (Vinodkumar & Bhasi, 2009). A safety climate can drive the understanding of safety features among the employees within an organisation, including safety perceptions and the importance of safety as compared to other necessities in the work place such as work speed and performance (Shaheen et al., 2014). Furthermore, according to Shaheen et al. (2014), it raises awareness about safe behaviour and shows to what extent it is supported, rewarded and hence expected; thereby allowing employees to detect the consequences of their own behaviour regarding safety.

2.6 Aeronautical Decision Making

2.6.1 Naturalistic Decision Making

To understand the Aeronautical Decision Making (ADM) it is important to go through the root of this concept which is the term Naturalistic Decision Making (NDM). The emergence of this term was traced to a conference in Dayton, AZ, in 1989 (Klein et al., 2008), It has been further defined by Lipshitz et al., (2001); Lipshitz et al. (2006) and Gore et al. (2015). It is the study of how people use their experiences to make a decision in the context of a situation (Klein, 2015). According to Lipshitz et al. (2001), the NDM has been divided into three approaches as follows:

1. All factors that have a direct or indirect effect on an individual during the process of making a decision, such as uncertainty, stress and pressure among others.
2. The role of individuals, professionals and experts in the field during the process of decision making.
3. The importance of concentrating on situational awareness rather than the chosen course of action.

Many decision-making theories have studied the decision-making process but have failed to consider the decision-making process in real life. In addition, they were not all adequate for modelling decision-making in naturalistic settings (Gore et al., 2015). Klein (1989) has outlined a recognition-primed decision-making theory which is the most popular method in this context. In-depth discussion in the following paragraphs aims towards a better understanding of the naturalistic decision-making process in complex and dynamic settings.

2.6.2 Recognition Primed Decision Making

The Recognition Primed Decision (RPD) model proposes that decision-making by experienced decision-makers in naturalistic settings involves two main processes: situation assessment and mental simulation (Klein, 1998). The situation assessment is more relevant to this research and is used to generate a plausible course of action. Mental simulation is used to evaluate the proposed option.

The RPD model of decision-making was developed from studies of experienced practitioners in the field, people such as fire ground commanders, critical care nurses, military battleground planners, and other real-world decision-makers. According to Klein et al (1993) the decision making methods of these experienced practitioners appears to bear little resemblance to the analytical strategies typified by laboratory based decision research (Klein et al, 1993).

In none of the cases studied did there appear to be evidence for the extensive generation of alternative courses of action. Rarely were even two options contrasted. Often it appeared that a full search for an optimal solution would have delayed the action to the point that control of the situation was lost. Instead, the decision makers relied on their abilities to recognize and appropriately classify a situation. Once this was done, in many cases the required action was obvious. Hence, decision-making was seen as being a recognition process (CAA, 2014). If time permitted, the decision-makers would use mental simulation to evaluate the proposed course of action before implementing it. Klein et al (1993) assert that the decision is primed, rather than absolutely determined by the way the situation is recognised. In addition, they describe the RPD model as consisting of the following elements;

1. Cues enable the recognition of patterns.
2. Patterns activate action scripts.
3. Action scripts are assessed through mental simulation.
4. Mental simulation is driven by mental models.

According to Hutton et al., (2001), there are four important aspects to successful situation assessment. Firstly, the decision-maker must have a good understanding of the types of goals that can realistically be accomplished in the situation. Secondly, they must have the ability to highlight the important cues within the context of the problem environment. Thirdly, they must form expectations that can be used to check the accuracy of their situation assessment. Fourthly, and last, they must be able to identify typical actions to take.

In summary, the RPD model of decision-making is a dynamic process in which situation assessment, based on patterns of cues, activates mental models and action scripts that the decision-maker has available from prior experience (Klein, 2015). This model allows decision-makers to evaluate the possible course of action by imagining how events would unfold if they carried it out.

2.6.3 Aeronautical Decision Making Definition

Many researchers have conceptualised the virtue of emphasising problem recognition, problem formulation and problem solving, which are the main areas of ADM (Klein et al., 2008). In addition, it is phrased in a way that readily embraces the notion of decision-making as a complex, dynamic process (Green et al, 1996). ADM can be defined as the ability to search for and establish the relevance of all available information regarding flying to specify alternative courses of action and to determine the expected outcome from each alternative (Klein, 2012). Jensen (1995) considers that the term decision-making refers to purely rational information processing. Telfer (1989) argues that decision making is “the mental process by which pilots recognise, analyse, and evaluate information about themselves, their aircraft, and the operational environment, leading to a timely decision which contributes to safe flight”. The FAA (1991) define the ADM as the systematic approach to the mental processes used by aircraft pilots to consistently determine the best course of action in response to a given set of circumstances.

In summary, there is no consensus among researchers on a specific definition, but it contains no suggestion that pilot decision-making is primarily about choosing one course of action from a small set of alternatives, While progress is continually being made in the advancement of pilot training methods, aircraft equipment and systems, and services for pilots, accidents still occur, and pilot error is always considered to be reason number one (Ison, 2015).

An action or decision made by the pilot is likely to be the cause of, or a contributing factor towards, an accident. From a broader perspective, the phrase “human factors related” more aptly describes these accidents, since it is usually not a single decision that leads to an accident, but a chain of events triggered by a number of factors (Plant & Stanton, 2015). Two elements that define ADM are hazard and risk. The hazard is a real or perceived condition, event, or circumstance that a pilot encounters. When faced with a hazard the pilot makes an assessment of that hazard based upon various factors. The pilot assigns a value to the potential impact of the hazard, which qualifies the pilot’s assessment of the hazard risk (FAA, 2009). This means that how pilot perceives a risk in the cockpit is crucial in identifying the hazard early and acting proactively rather than reactively. Therefore, how a pilot perceives and assesses risk is a crucial skill for the pilot in the cockpit and needs to be properly understood.

2.6.3.1 Aeronautical Decision-Making Importance

The discipline of ADM has grown significantly since the 1960s, both in terms of theoretical research and practical application. There is a wealth of observational evidence of the growing awareness of ADM as an important aspect of aviation safety (Klein, 2008). This has been reflected in an increasing effort to understand the decision-making behaviour of pilots, and ultimately to increase the quality and performance of aeronautical decision-making in the case of professional pilots (Klein, 2012). Jensen and Benel (1977) carried out a study of pilot decision-making from a psychological viewpoint. This set the scene for ADM research and training for many years to come. They succinctly outlined the problem in a way that is as relevant today as it when it was written over 40 years ago.

Accident statistics reveal that approximately 50 per cent of civil aviation fatalities are in part related to poor flying judgment (FAA, 2009). In addition, accidents that involved human error were classified on the basis of three error types: procedural activities, perceptual-motor activities, and decision activities (Krejci et al., 1992). Data was tabulated separately for fatal and nonfatal accidents. Table 2.3 reproduces the error category definitions and results.

According to Jensen and Benel (1977) decision-making was a significant factor in many aircraft accidents, and decision-related accidents were likely to be serious in nature. Overall, 38.1% of all accidents involved decisional activities. In addition, the majority of fatal accidents (51.6%) involved decision making.

In contrast, the majority of non-fatal accidents (56.3%) involved perceptual-motor activities (Jensen, 1982). In addition, Li and Harris (2013) studied 523 accidents in the Republic of China Air Force and specified 1762 human errors in these accidents that were a direct effect of bad judgment and poor decision-making by pilots.

Table 2-3: Percentage of general aviation accidents of pilot error
(Source: Jensen, 1982)

	Description	Injury level	
		Fatal	Nonfatal
Procedural	Management of the power plant, fuel, vehicle configuration, autopilot, displays, navigation, and communication.	4.6%	8.6%
Perceptual-motor	Vehicle control, judgment of distance, speed, altitude, clearance, hazard detection, and geographic orientation.	43.8%	56.3%
Decisional	Self-assessment of skill, knowledge, physical, and psychological capabilities; assessment of aircraft and ground-system capabilities; hazard assessment; navigation planning; and flight priority adjustment.	51.6%	35.1%

Another study by O'Hare et al. (1994) reported a similar analysis of data from New Zealand civil aviation accidents and incidents involving fixed-wing aircraft between 1983 and 1989. Each accident or incident was coded according to one of three errors: information, decision, or action (see Table 2.4). Again, decision making errors were the most common cause of fatal accidents, while action errors were the most common cause of accidents that resulted in only minor or no injury.

Table 2-4: Percentage of civil aviation accidents of pilot error
(Source: O'Hare et al, 1994)

Error stage	Description	Injury level	
		Fatal or Serious	Minor or Nil
Information	Acquiring information from external cues and cockpit displays; exchanging, communicating and processing that information.	12.5%	23.9%
Decision	Weighing up alternatives, planning courses of action.	62.5%	30.5%
Action	Executing the chosen course of action.	25.0%	45.6%

In addition, according to BASI (1996) about 72 of fatal accidents were caused by human factors (pilot factors). The most common factor in these accidents was poor judgment and decision-making (see Figure 2.19, and Figure 2.20).

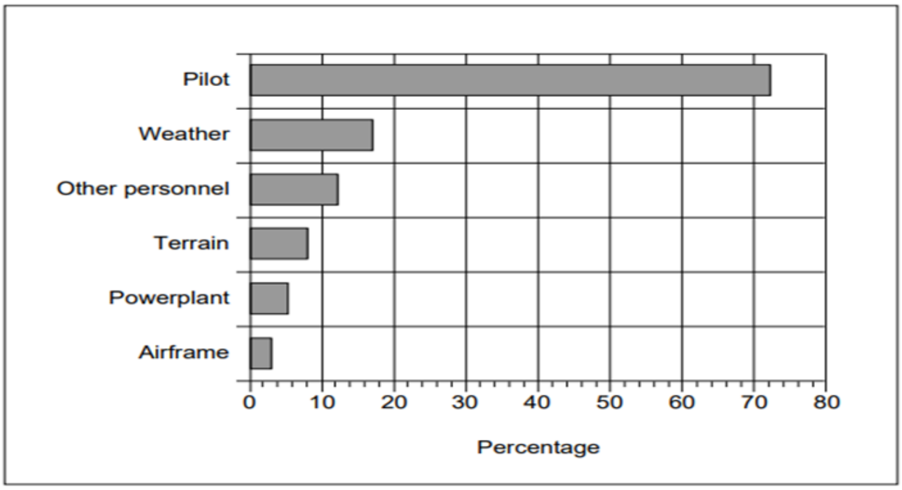


Figure 2-19: Pilot involved in fatal accident
(Source: BASI, 1996)

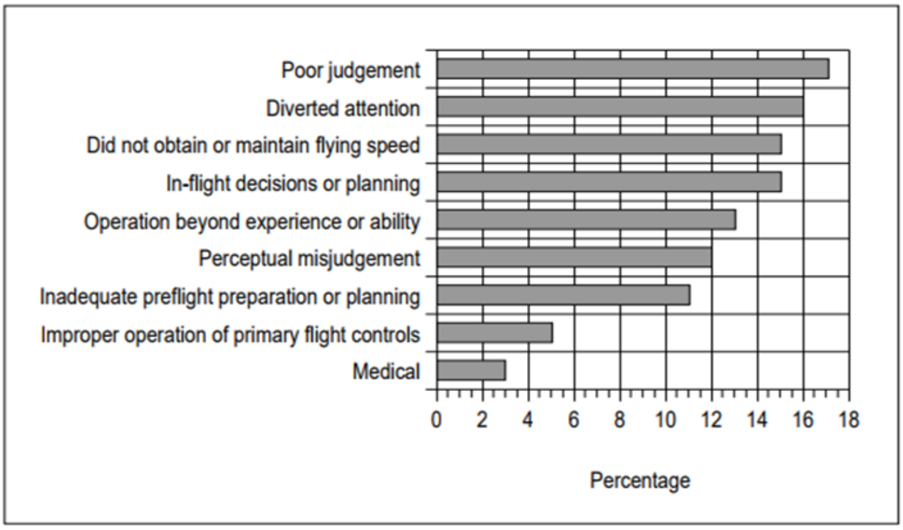


Figure 2-20: Factors contributing to a fatal accident
(Source: BASI, 1996)

EASA (2014) stated in their annual safety report that the most significant contributing factors for serious accidents are inadequate CRM, communication and decision-making (see Figure 2.21).

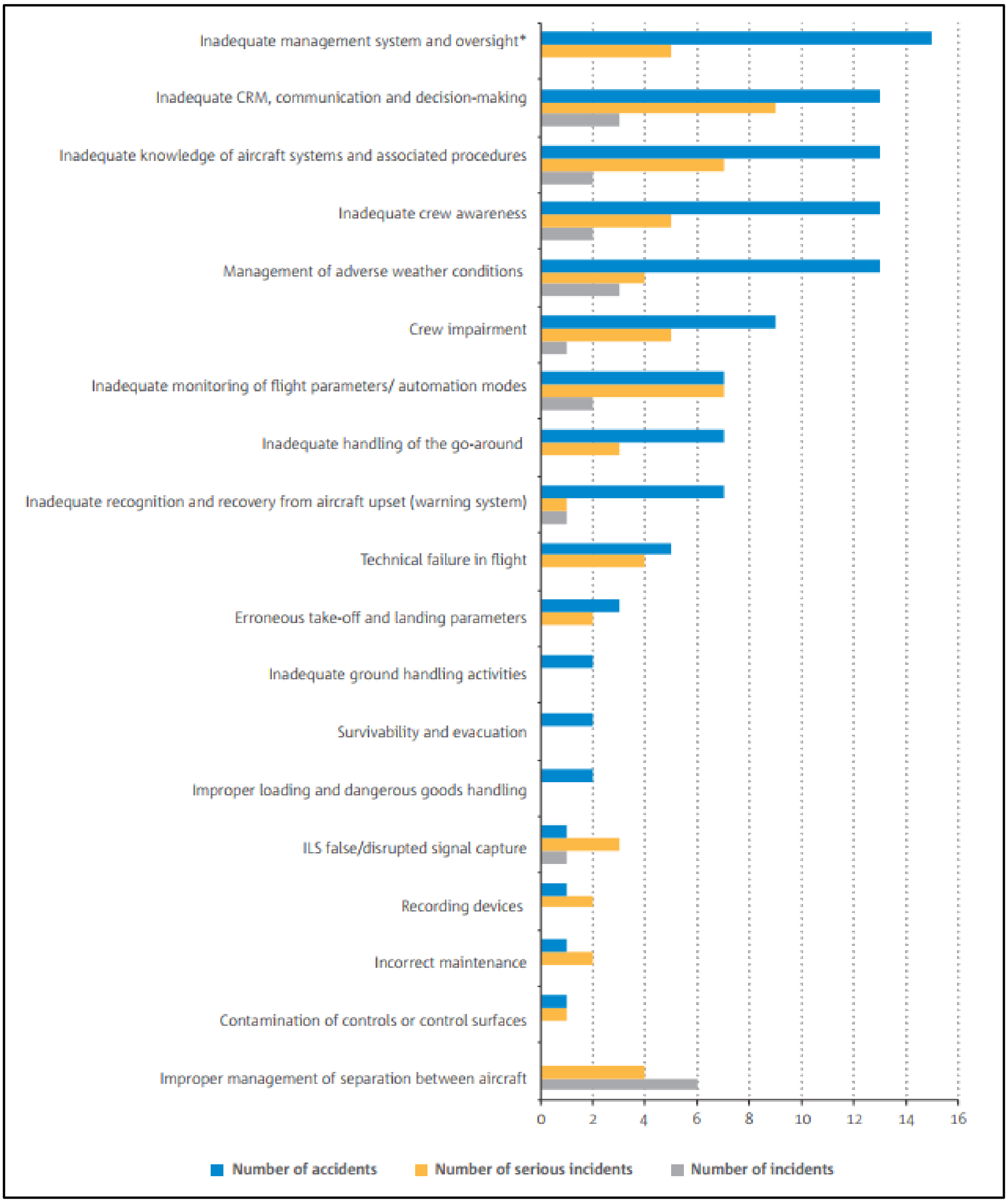


Figure 2-21: Most significant contributing factors for serious accidents, (Source: EASA, 2014)

From the above discussion it is clear that poor judgement and decision-making performance are the most common contributing factors for fatal accidents. Therefore, this research focuses on studying pilot decision-making performance.

2.7 Culture Impact on Aeronautical Decision Making

As mentioned before, this study looks at the effect of national culture on pilot decision making performance in the cockpit in light of their risk perception. Thus, understanding the decision-making concepts in relation with national culture is crucial in enhancing the process of good decision performance within a specific region. Understanding this relation requires a deep understanding of the ADM concept. It is important to illustrate the most common definition of ADM. For Klein (2012), the most popular way to explain decision making is as the process of choosing an action that will solve a problem. Another common definition from Harris (2012) is that decision-making means choosing the best alternative to achieve the goal of the decision-maker. In addition, Klein (2012) argues that the decision making process is based on the decision maker's beliefs, values and preferences.

Decision-making is a process where the decision-maker can identify the action or response that can fit the situation with the expecting outcome, based on his or her beliefs, values and preferences that are directly linked to the culture that form the surrounding environment of the decision-maker. According to Sjöberg et al. (2004), local culture and society have many dimensions that influence human attitudes. The culture can be defined as a pattern of learning behaviour for a person's way of life, such as different manners of speaking and responding (Sjöberg et al., 2004).

According to Hofstede (2001), decision-making is directly connected to national culture, because different national cultures have different decision-making approaches. This view of Hofstede is the main core of this study. It has been found that different individuals from different cultures will take varied action as a response to any situation, even if faced with the same situation (Lindvall, 2011) and (Hofstede, 2011). According to Hofstede (1991), culture is a "pattern of assumptions, values and beliefs whose shared meaning is acquired by members of a group". He argues that culture expresses a person's intentions beliefs, attitudes, values and norms.

In summary, it is clear therefore that a group of people can share the same beliefs, values, institution and rules as a community culture which will directly affect their decision-making in the way of their life. This culture theory of decision-making is the core for this study to understand pilot decision-making performance within the region of NAR. A detailed discussion will be outlined in the following paragraphs to understand the relation between culture and decision-making within Hofstede's cultural dimensions. This is designed to inform better analyses and understandings of the main contributing factors in respect of pilot decision-making and judgment performance while in flight.

2.7.1 Culture and Aeronautical Decisions Making

According to Hofstede's (2001) framework, an individual from a different culture is willing to respond and act in a different way even if they are in the same situation as others who do not share their cultural background. Many researches rely on Hofstede's framework in the field of cultural study. The general idea of this framework is to define and measure culture, relying on five dimensions: masculinity versus femininity, uncertainty and avoidance, individualism versus collectivism, long-term versus short-term orientations and power distance. Some of the most frequently used dimensions are uncertainty and avoidance, masculinity versus femininity, individualism versus collectivism and power distance. Hofstede has criticised various points to build up this framework, which is still used as a watermark in this area. In the next paragraphs, more detail will be given about the main four dimensions, with connection to the specific North Africa regional culture.

- **Masculinity versus femininity (MVF):** This refers to gender roles, a critical debate in every society, where many solutions have been addressed to solve this issue (Hofstede, 2011). The masculine culture correlates to dominance, strength, achievement, materiality and competition. In contrast, the feminine culture is seen as tending to softer values such as quality of life and family life. According to Ghemawat and Reiche (2011), feminine cultures within organisations "place a stronger importance on the overall well-being of the employees than the bottom-line performance of their masculine counterpart".

- **Uncertainty Avoidance (UA):** This is defined as the behaviour of individuals who try to avoid ambiguous situations through established norms, rituals and bureaucratic undertakings (Warner-Søderholm, 2012). A country with a culture of high uncertainty avoidance will produce individuals who try to avoid unforeseen events, which might lead to negative effects in operations (Warner-Søderholm, 2011). In contrast, a country with low uncertainty avoidance is more willing to be involved in ambiguous situations and risk-taking (Ghemawat & Reiche, 2011).

- **Individualism verses Collectivism (IVC):** This dimension expresses the extent to which an individual involves him- or herself in a mixed group. The individual may aim to pursue his or her goals over the group goals. According to Hofstede (2011), collectivism means to what extent individuals are involved in the group, while individualism can be seen as weakness in the relationship between individuals.

- **Long-Term Orientations versus Short-Term Orientations (LTOVSTO):** According to Hofstede & Minkov (2010), long-term-orientation is associated with thrift and perseverance, whereas short-term-orientation is associated with fulfilling social obligations and traditions.

- **Power Distance (PD):** This dimension shows how the less powerful members in an organisation accept unequally distributed power (Hofstede, 2009). For instance, some aviation companies with a high power index expect to see a high level of respect for superiors (Ghemawat & Reiche, 2011). These differences in power distribution are also present in the cockpit. The power index may appear in different ways, such as age difference, family roles and social class. In contrast, an organisation with a low power index affords less value to age difference, organisational hierarchy or social class and decision making can be taken more equally (Ghemawat & Reiche, 2011). According to M (1996), within high PD cultures, safety may suffer from the fact that followers are unwilling to make inputs regarding leaders' actions or decisions. In addition, the high PD culture does not offer a warm climates and open communication among the pilots in the cockpit (Redding and Ogilvie, 1984, cited in Orasanu et al., 1997).

Hofstede's framework was formulated about 25 years ago. This fact should always be considered, because organisations have changed over time. Many researchers no longer rely on this tool as a measure of culture (Roxas & Stoneback, 2004). According to Baskerville (2003), although this measurement tool is 25 years old, this does not mean it is no longer valid even though it may show some weaknesses. The framework therefore remains unique and continues to flourish. In addition, there is no other comparable study of national culture that researchers can rely on, especially in relation to business. Thus, this research will consider Hofstede's dimensions as a reference in the study of the effect of national culture on a pilot's decision making performance in the cockpit within the NAR. According to Merritt (1996) UA and PD are the most important dimensions in the cockpit. She surveyed about 9,000 male commercial airline pilots to replicate Hofstede's 1990 study. She found that these two dimensions are the most relevant for aviation, as the extent to which people are sensible to threats or anxious can be combined with ambiguous situations. These two dimensions are therefore considered as significant factors in this study. In addition, Vandewalle (2006) states that Arabic countries share a common language, religion, cultural values, and other social relationships and claims that the impact of Islam and social relationships upon Arabic cultural values is fundamental in these countries.

Accordingly, the above mentioned discussion underlines the importance of searching culture influence on pilots' behaviour in the cockpit within the NAR by considering four significant factors which are: PD, UA, religion and social relationships.

2.8 Individual's Attitudes Concept

Attitude refers to individual feelings about something, in which an individual's personality is evaluated and generalised. Consequently, this will affect their actions and behaviours. The Theory of Reasoned Action by Ajzen and Fishbein (1980) explains the relation between beliefs, attitudes and behaviour. It emphases how behaviour and prevailing subjective norms have been constructed by an individual's intention, which is further influenced by their attitude: "the person's belief that specific individuals or groups think he should or should not perform the behaviour and his motivation to comply with the specific referents" (Ajzen, 1991).

A decision that has been taken by an individual is usually accompanied with expected outcomes, which are made under a specific attitude and belief. The Reasoned Action model emphasises that a person's attitude makes an evaluation of positive or negative when performing a behaviour (Ajzen, 2005). The attitude that is held toward the behaviour is affected by whether or not the individual thinks that the act will lead to a favourable outcome. The reasoned action theory argues that prediction of an individual's behaviour can be possible if their attitudes towards a particular behaviour are known by the observer (Ajzen and Fishbein, 1980). An individual's intention to perform a behaviour is based on beliefs, norms and attitudes which are governed by the social activity between the employees within an organisation.

2.8.1 Individual's Attitudes Toward Safety

The attitude of an individual regarding safety is attributed to the value of his or her expectancy towards safety (Fogarty & Shaw, 2010). The positive or negative outcome of an individual expectation is inherent within his or her behaviour (Hall & Silva, 2008). Furthermore, the expected behaviour is based on the individual's subjective value assessment. However, an intended behaviour is also subject to value judgements, leading to the development of an attitude which will derive the behaviour of the expected outcome. According to Hall & Silva (2008) the strength of an individual‘s attitude, which is based on behavioural beliefs, is dependent on the expected outcome that has relied on subjective evaluation. Indicators of attitude were designed to evaluate the feeling of an individual regarding risks, safety commitment and safety tool usage and, moreover, their attitudes to the necessity of safety errors, safety violations, and regulations (Fogarty & Shaw, 2010). An individual’s attitude is considered to be one of the main factors in constructing a safety climate. It is an intention that is predictive of the planned behaviour (Ajzen, 2005). The individual’s attitude has a significant correlation with group norms, workplace pressures and management attitude toward safety. An individual attitude related to safety will have a direct influence on following safety procedures and an indirect influence on violation and error behaviours mediated by the intention variable (Ajzen, 2005).

2.8.2 Management Attitudes toward Safety

Management attitudes regarding safety are an indication of their commitment and support to individuals’ safety behaviour (Gerard, Fogarty & Shaw, 2010). Management’s attitudes regarding safety have a great impact on individual safety perceptions, which is proposed as one of the most important predictors of an organisations safety climate (Zohar, 1980; Fogarty & Shaw, 2010). Hence, the importance of the management’s attitude towards safety has been addressed by safety climate, according to Helmreich and Merritt (2001), in an experimental survey study applied to groups of pilots working in two different airline companies to evaluate the perceptions of management attitudes toward safety practices and norms in each group.

In the first company they found that 68% of pilot’s safety suggestions are influenced by management attitudes in comparison to just 19% of pilots who did not agree with that in the second group (Helmreich & Merritt, 2001). Indeed, it is difficult to maintain a high level of safety performance for pilots when the prevailing management attitude is considering a low safety performance (Fogarty & Shaw, 2010). Management attitude is a crucial factor regarding safety, the prediction of intention, and safety decision-making for pilots. Likewise, it was suggested that management attitude toward safety has a significant correlation with an individual‘s own attitude, group norms, and workplace pressures (Fogarty & Shaw, 2010). Moreover, Sexton et al. (2006), state that in aviation it is safer to predict the successful programmes based on studying the attitude and culture of a particular organisation. Therefore, it is crucial to study the pilot’s attitude to human and organisational factors to assess their performance in the cockpit in order to mitigate human error and improve safety behaviour.

In summary, in aviation companies it is important to identify the prevailing attitudes to employees in order to improve their safety behaviour. The evaluations of the individual’s attitudes may be influenced by national culture. The systems used in the aviation companies are also crucial to be examined and improved in non-technical skills in areas such as: situational awareness, workload management, decision-making and communication.

2.9 Automation Systems in the Cockpit

The automation systems were introduced to the cockpit to reduce the human workload and improve pilot performance by reducing human error (Chialastri, 2012). The development of automation systems in the cockpit have played a crucial role in improving the safety record in the field of aviation operation (Dehais et al., 2015). According to Norman (1990), the integration of automation has supported the human performance in the cockpit and improved the safety of aviation.

However, certain evidence has emerged of misunderstanding and misuse of automation by pilots due to factors such as capabilities, limitations and performance (Chialastri, 2012). The introduction of automation has generated new human errors, which transferred the problem from poor piloting skills to improper use of automation (De Boer & Dekker, 2017). Automation has clear improved performance in the cockpit, in addition to bolstering fuel efficiency and reducing overall accident rates (Dudley et al., 2014). But automation has also led to difficulties, such as crew being insufficiently up-to-date with the current state of the systems and therefore being unable to diagnose them in a reasonable timeframe, and a general reliance on automatic systems leading to a degradation of manual skills (Gil et al., 2012).

Accordingly, automation design should be centered on the human factors of the operator rather than forcing him to adapt to the automation system. According to Dudley et al. (2014), ignoring the human factors of the automation operator will result in poor automation implementation, which in turn compromises situation awareness, increases complacency, and may lead to the degradation of cognitive reasoning skills needed for the relevant domain. Thus, in order to improve performance, it is important to evaluate automation systems to determine if they are suitable for the pilots in the cockpit in terms of their capabilities and limitations, human factors and cognitive suitability.

2.10 Risk

2.10.1 Risk Concept

Risk concept is the link between the probability and the severity of harm. It has been found that risk ratings are closely related to the perceived probability of harm rather than the severity of the consequences (Davidson & Moser, 2008). Risks are one of the main safety issues in aviation companies, and this can give an indication of both threats and potential losse of assets. A debate has taken place concerning physical properties and the possibilities of risk identification by human means. According to Miller and Lessard (2007), the identification and measuring of risk might not be easy to obtain. But it is not impossible. In practice, there is a strong connection between the strategy of risk management and organisational behaviour (Power, 2004).

Risk can be defined as the probability of an event, the impact or the utility of its outcome (Miller and Lessard, 2007). Risk is the distinction between reality and possibility, where risk can be related to the probability of an incident occurring. Risk reflects both the likelihood that harm will occur and its severity (Hopkins, 2011). Risk can be manifested in everyday decisions and practices. For instance, crossing a road requires a risk assessment and decisions that profile the exposed risk on an unconscious level. Risk-quantifying can only be gained by probabilities (Hopkins, 2011).

Miller and Lessard (2007) indicate that, scientifically, risk is defined as a measure of the probability of the occurrence of an event and the severity of any adverse effect. Adverse effect indicates an outcome that does not meet the desirable expectations from a failure or risk event. In addition, risk management is crucial to understand how people deal with risk (Fischhoff et al., 2006). Individuals in dealing with risk should be aware of the factors that might affect their risk perception in order to respond in an appropriate way. According to Slovic (1999), risk is inherently subjective. It is dependent on the individual's culture and mind. According to Braithwaite et al., (1998) risk is a social construct stemming primarily or wholly from social and cultural factors. Therefore, from this perspective an individual's attitudes, beliefs, feelings and judgments are involved in risk perception, which are considered as social or cultural values (Slovic, 1999; Hofstede et al., 2010). This means that individuals rely on many dimensions, characteristics or hazards when they evaluate risk.

In summary, it is clear that managing risk within any organisation is very important to keep the level of risk in all operational tasks within an acceptable value, which can be specified by organisational safety goals. Managing risk is critical and important in every day practices and can only be done through the assessment and mitigation of risk factors.

2.10.2 Revealed Preference Approach

This approach is mainly concerned with accepting or declining a risk which is produced by a product or technology among others. According to Slovic (2000), the revealed preferences approach involves the experiences that helped a society arrive at an essentially optimum balance between risks and benefits by trial and error associated with any activity. Likewise, this approach tries to answer the question: "how safe is safe enough?". (Fischhoff et al., 1978). In summary, this approach studies the relation and balance between risks and benefits in terms of decision-making.

2.10.3 Psychometric Approach of Risk

The term psychometric derives from the methodology conducted to assess the risk perception of individuals through conducting and studying questionnaires to measure an individual's attitude towards risk. In psychometric studies, respondents are asked to express their preferences regarding a range of hazards. Fischhoff et al., (1978) introduced the first study of perceived risk, in which they asked participants in the survey to evaluate 30 activities and technologies with regard to perceived risk, perceived benefit, and the acceptability of its current risk level, and were asked to rate each activity depending on nine dimensions of risk (Fischhoff, 1995).

Slovic (1987) identifies two distinct types of public concern associated with risks: Concerns about the unknown, and dread. Unknown risks are hazards unobservable by the public and labelled observability, knowledge, immediacy of consequences, and familiarity. According to Slovic (2000), dread risks "whose severity is believed to be uncontrollable tend also to be seen as dread, catastrophic, hard to prevent, fatal, inequitable, threatening to future generations, not easily reduced, increasing, involuntary". This can include risks such as those associated with nuclear power or nuclear weapons. In addition, for dread risk (Slovic, 2000; Slovic, 2010), "the higher its perceived risk, the more people will want to see its current risks reduced, and the more they want to see strict regulation employed to achieve the desired reduction in risk". Studies on expressed preferences show that perceived risk is quantifiable and predictable (Slovic, 1987).

Studies also seek to elicit the point at which people tend to view current risk levels as unacceptably high. Another interesting outcome of the research is that people differ in terms of their definitions of risk concept (Slovic, 2010). Lay people, for example, can make good estimates for annual fatalities, but their judgment mainly depends on different characteristics, such as threats to future generations, dread and catastrophic potential (Slovic, 2010). On the other hand, experts generally correlate risk with expected annual mortality and they are influenced less by the qualitative characteristics when compared to lay people's judgment (Slovic, 2000). For example, nuclear risk seems extremely high for lay people due to its catastrophic potential, whereas it seems less risky to experts because the number of deaths resulting from nuclear activities is relatively low up to now (Slovic, 2010).

2.10.4 Risk Perception

Risk perception is seen as a phenomenon where every group in any different culture aims to cope with some risk and ignore others to maintain their way of life (Sejrbge et al, 2004). The understanding of the factors that affect the risk perception of pilots from different cultural backgrounds is crucial to improve the pilot's decision-making performance in any specific country or region (You et al., 2013). According to Slovic (1987), "technologically sophisticated analysts employ risk assessment to evaluate hazards and the majority of citizens rely on intuitive risk judgments, typically called risk perceptions". In addition, Slovic (1999), stated that risk perceptions are inherited in people's attitudes, beliefs, feelings and judgments as cultural or social values that have been adapted towards benefit or hazard. Slovic (2000) argues that geography, sociology, political science, anthropology, and psychology make valuable contributions to the study of risk perception.

Slovic, (2000) emphasises that sociological and anthropological studies show that social and cultural factors deeply affect perception and the acceptance of risk. As such, this present research paper focuses on studying the impact of national culture on pilot decision-making performance in the cockpit, which requires us to investigate pilot risk perception from a culture prospective.

2.10.4.1 Cultural Theory of Risk Perception

Cultural theory is mainly involved in explaining the collective phenomena of risk perception (Sjöberg et al., 2004). The first study of this approach was introduced by Douglas (1966) and then Thompson (1980, cited in Oltedal et al., 2004), where they tried to link risk perception with social and institutional arrangements, rather than a psychometric perspective. According to Sjöberg et al (2004), cultural theory proposes that human attitudes toward risk and danger are heterogeneous and vary according to cultural biases. An individual's cultural bias is linked with the so-called grid and group. The grid refers to norms and rules. The concept of the group refers to the extent to which a person becomes incorporated into relationships with others (Sjöberg et al, 2004). By linking grid and group, four types of people are specified: hierarchists, egalitarians, fatalists, and individualists. Each group is concerned with a different type of hazard (Oltedal et al., 2004).

There have been some critics of this approach. Many researchers argue that cultural theory fails to consider changes in worldviews over time, and that it undervalues the dynamic aspects of social life (Sjöberg et al., 2004). Another criticism of this approach is that there exists little empirical evidence to support it (Sjöberg, 2003). Despite criticisms, cultural theory has made substantial contributions to risk perception research and has provided different perspectives on risk and tolerance.

In summary, the above discussion shows the importance of studying how pilots perceive risk in the cockpit to improve their safety performance. In addition, it is crucial to understand how pilots perceive risk in the cockpit within the specific environment. The next section discusses some models for measuring risk perception.

2.10.4.2 Integrated model of risk perception

The term "perception" in psychology refers to the mental processes of individuals to interpret sensory information in order to give meaning to their environment (Robbins, 2000). According to Renn (2008), the word risk is the probability of adverse effects that might happen as a result of natural phenomena or human actions. Thus, risk is a process and has different evaluations depending on the individual. Many factors also play a vital role in this process, like the experiences, information, practices, the seriousness of risk and also the tolerance of risk (Moen and Rundmo, 2004; Renn 2008). The response to risk is directly affected by the individual evaluation of risk (risk perception).

For Renn (2008), risk perception plays a key role in influencing an individual's behaviour. Risk perception is a subjective assessment which is part of an individual's ability to evaluate uncertainties through their social and cultural learning and from changes in the surrounding environment (Tulloch and Lupton, 2003; Renn, 2008). Sjoberg et al. (2004) argue that individuals conceptualise risk differently depending on their culture background. The risk perception relies on many issues which have a direct or indirect effect, including values, experiences and emotions, as well as social, cultural and political factors (Sjöberg et al., 2004; Renn, 2008). All of these issues need to be considered when studying risk perception and every situation needs to be analysed differently.

There is no consensus between scientists about what are the main factors that shape the risk perception of an individual. Also, there are no scientific grounds for risk perception and its reliance on emotional and subjective evaluation. Some scientists, however, consider risk perceptions as certain patterns which are shaped by social and cultural norms (Tulloch and Lupton, 2003).

Risk experience is a contextual aspect that should be taken into consideration when managing risk. A model has been built by Renn and Rohrmann (2000), by using one of the popular technical-scientific approaches to understand how people evaluate risk. Theirs is a psychometric method that relies on empirical data to explain the factors that impact on risk evaluation. According to Fischhoff et al. (1978), Sjöberg, (2003) and Renn, (2008), this research method relies mainly on two patterns:

- The properties from the source of the risk.
- The characteristics of the situation from which the risk is manifest.

In summary, the importance of this model is that it incorporates social, cultural and psychological issues that may have a direct or indirect effect on individual risk perception. This was missing in previous studies. Traditionally, risk perception was always bound to risk characteristics, ignoring the relation between risk, technology and its context in an event or accident (Sjöberg, 2003) and (Zinn, 2008).

According to Renn and Rohrmann, (2000), this model consists of different criteria (see Figure 2.22), which representing across four contextual levels as follows:

A. The level of Information-processing Heuristics
B. The level of Cognitive and Effective factors.
C. The level of Social and Political institutions.
D. The level of Cultural background.

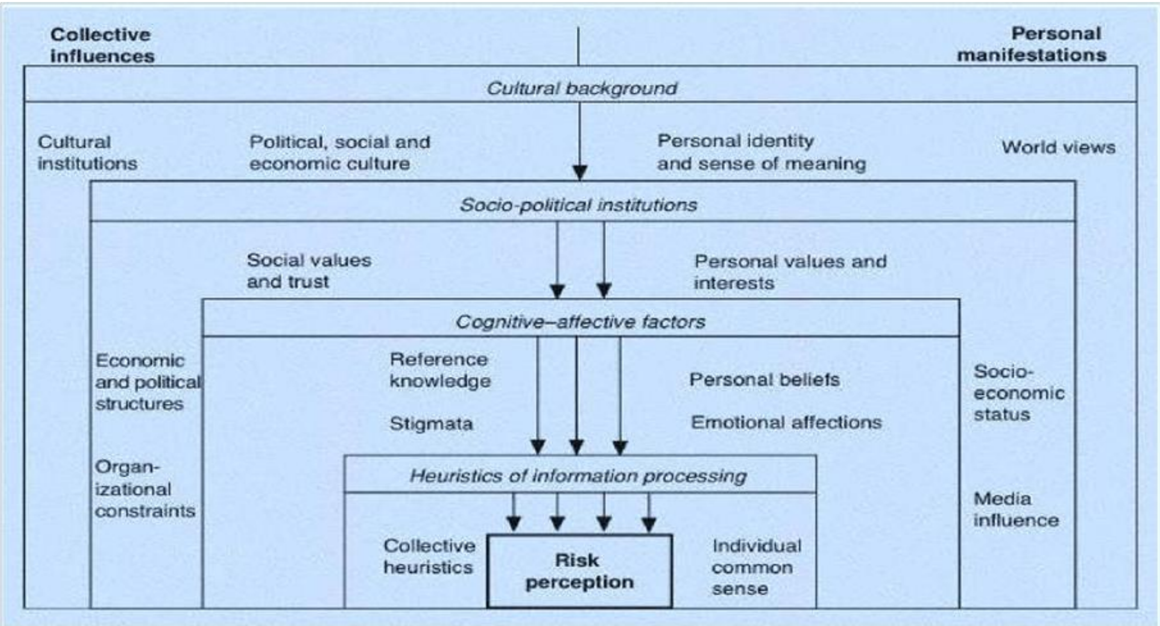


Figure 2-22: Context levels of risk perception
(Source: Renn and Rohrmann, 2000).

The first two levels are related to the risk experience from a psychological perspective, which will give a deep understanding of how individuals evaluate risk under different aspects, to produce the final response. The other two levels, social and cultural, are covered in the top level and are partially affected by the risk characteristic from the psychological prospective, which directly forms the risk perceptions. These two levels give a deep insight into the social and cultural dimensions inherent in the risk characteristic and reaction.

In addition, the model consists of two further dimensions, which are the expressions of individual and collective risk perceptions. According to Renn (2008) each level is connected to the next level in order to indicate the interrelationship among all levels in formulating risk perceptions.

2.10.4.3 Hunter Scales of Measuring Risk Perception

It is mentioned earlier in this chapter that the main cause of aviation fatal accidents is bad decision-making due to the misunderstanding of risk (Burian et al., 2006). Risk perception and risk tolerance are constructs that are suggested as explanations for behaviour that results from pilots in incidents and accidents. In addition, one of the explanations for behaviour that leads to an accident or incident is that the person does not perceive the risk inherent in the situation, and hence does not undertake avoidance or other risk mitigating actions.

Moreover, another explanation is that when individuals correctly perceive the risk within a situation, some may elect to continue because the risk is not considered sufficiently threatening. Those individuals would be described as having a greater tolerance or acceptance of risk, compared to the mainstream (Hunter, 2006). A model of risk perception measurement was developed by Hunter (2006), where he gives a very simple and direct scale to measure risk perception tolerance among pilots where he describes two scales (other-scale and self-scale) of pilots' risk perception.

The first is the "other-scale", which is applied by assessing the pilots' perception of the level of risk experienced by other fictional pilots. This scale is rated from 1 (low risk) to 100 (high risk) to evaluate the level of risk in the situation. It contains seventeen short scenarios depicting aviation situations.

An example of these scenarios is the fifth scenario: "Just after take-off a pilot hears a banging noise on the passenger side of the aircraft. He looks over at the passenger seat and finds that he can't locate one end of the seatbelt. He trims the aircraft for level flight, releases the controls, and tries to open the door to retrieve the seatbelt“. In this scenario Hunter asked the third party to evaluate the scenario from 1(low) to 100 (high risk) to assess the participant’s risk perception.

The second is the “self-scale”, which evaluates pilot perception of the level of risk they would experience if they were personally involved in a set of scenarios. This scale consists of twenty short scenarios depicting aviation situations and five depicting normal life situations, as if the participant were involved tomorrow in the same situation.

For instance, the following is an example of an aviation related scenario: “During the daytime, take a cross-country flight in which you land with 30 minutes of fuel remaining.” An example of a non-aviation scenario is: “Drive your car on a motorway near your home, during the day, at 70 MPH in moderate traffic, during heavy rain.”

2.11 Crew Resource Management in the Cockpit

In order to mitigate pilot error and enhance performance in the cockpit, a CRM training programme was implemented in aviation companies to optimise the pilot-system interface, in addition to improving non-technical skills such as decision-making, effective team formation, problem-solving, and situation awareness (Helmreich, 2010). According to Helmreich et al. (1999), the CRM was designed to enable pilots to use their resources sufficiently in the cockpit. According to Wagener and Ison (2014), the inability of crewmembers to work as a team and handle the overload of work could lead to mismanagement of an airplane malfunction and lost situational awareness. An example of this is what happened to a commercial airliner that crashed in 1978 due to the inability of the crew members to work as team. This crash changed aviation safety specialists’ focus to human factors training, with specific concentration on leadership and decision-making. This ultimately led to the creation of the CRM training programme. Extensive reviews of the CRM training programme have led to many changes in the programme and the evolution of a different CRM generation (Helmreic et al., 1999; Kanki et al., 2010).

The first generation of CRM was designed by National Aeronautics and Space Administration “NASA” in 1981 to reduce pilot error, as they found that pilot error was involved in the majority of air accidents (Helmreich et al., 1999). Helmreich et al., (1999) described the CRM training programme as one of the most critical interventions implemented by an organisation to enhance aviation safety by risk detection and management.

The CRM training programme focuses on reducing negative behaviour of first officers and encourages captains to work as team members in the cockpit rather than as dictators or managers (Tsang & Vidulich, 2003; Hughes et al., 2014). The CRM was very effective in reinforcing the interpersonal behaviours between pilots in the cockpit through class exercises. The regular review of CRM training curricula was crucial to cope with evolution in the aviation industry (Merritt & Helmreich, 1997).

The second generation of CRM was implemented in 1986 with modifications in training elements such as teamwork improvement, situational awareness and stress management (Helmreich et al., 1999),in addition to underpinning decision-making strategies that should mitigate error consequences. Overall, the second CRM generation was more accepted among crewmembers than the first generation (Helmreic et al., 1999; Kanki et al., 2010).

Improvements in the CRM training programme went through many generations. The main improvement concentrated on improving pilot performance through emerging concepts like organisational culture and human factors.

The major changes in the fourth generation CRM training programme is that it gives airlines the ability to develop innovative training reflecting the needs and culture of their organisations, known as an Advanced Qualification Programs (AQP), (Helmreic et al., 1999; Kanki et al., 2010).

According to (B. Helmreich, 2006) the fifth and the sixth generation of CRM training are a return to the original CRM as an error reduction and management strategy, and the sixth generation of CRM is considered as a logical extension of the fifth generation. The difference between the fifth and the sixth generation training is the greater awareness of the contextual risks that must be tackled in the cockpit. The success of these generations of CRM is relying on Reason model of organisational accident which recognises that human errors are inevitable and a non-punitive attitude towards error is needed (threat recognition and management), (Reason et al., 2006).

Despite the fact that the fifth and the sixth generation of CRM training significantly reveals much greater awareness of the contextual risks that must be handled in the cockpit, yet the attempts to export CRM to other cultures is sometimes met with resistance (B. Helmreich, 2006).

Therefore, aviation companies in the NAR must make sure before delivering a CRM training to their crews that it is culturally calibrated , in order to be effective and mitigate the implications of the culture interface in the cockpit (Merritt & Maurino 2004).

2.12 Research Gap and Proposed Solutions

2.12.1 Research Gap

People from different regions are willing to interact with technologies in different ways depending on their cultures (Paul et al., 1997). This concept is the core of this study, which means that pilots from different cultures interact in different ways with the systems in the cockpit. For example, In countries like the United States and Ireland, which are considered to be individualistic and egalitarian nations, the pilots interact with automation system without any problem (Strauch, 2010), whereas in countries with hierarchical cultures ,such as Taiwan and China, the pilot has difficulty managing the automation systems (Berry et al., 2002; Paul J et al., 1997). Therefore, different culture might have a direct impact on pilots' willingness to interface with automation systems (Paul et al., 1997). According to Merritt and Maurino (2004), if "members of one culture come into contact with artefacts of another culture, this can be identified as “cultural interface”.

According to Satava & Ellis, (1994) Human interface technology “enhances a person's abilities while performing a task which requires a tool or synthetic device”, and simply is the interaction of human with a tool, machine, computer, or other instrument in a work place. Likewise, the enhancing of pilot interface with technology in the cockpit requires considering many aspects such as training, procedures and operational books for these technologies in the cockpit.

For example pilots who fly aircraft designed and built in another part of the world are exposed to a cultural interface impact in the cockpit and they need to be adapted to these automated systems. This culture interface is not only as direct impact of operating these technologies in the cockpit, but also as direct impact of other issues which were produced in a different culture such as the CRM training programme, operational books and standard operating procedures.

Furthermore, an implementation of a model of accident causation can give more understanding of the technology-culture interface phenomena in the cockpit. For example SHELL model give good understanding how the pilot behave regarding the safe interface with the technology in the cockpit and It also allows for the reason behind an accident to go far beyond the pilot behaviour in the cockpit (CASA, 2012). An expanded version of SHELL model has been introduced which is the SCHELL model (CASA, 2012). This version gives an idea of the human factors scope in the operational tasks. Likewise, technology-culture interface in the cockpit can be linked to SCHELL model as follows:

S) Software: The procedures of operational tasks in the cockpit.
C) Culture: The national cultures influencing interactions.
H) Hardware: The technologies in the cockpit.
E) Environment: The work environmental conditions in the cockpit.
L) Liveware: The pilot use of the technologies in the cockpit.
L) Liveware: The interrelationships among the crewmembers in the cockpit.

Pilot adaption to foreign aircraft does not mean to change the culture, rather to mitigate the risk generated from the cultural interface in the cockpit. Merritt & Maurino (2004) state that: “The aim of investigating the culture interface in the cockpit is not to eliminate culture or make us all the same; the goal is to recognise and manage the potential threats posed by different cultural interfaces”. According to Price (2012), the two primary causes of technology-culture interface in the cockpit, which effect pilot decision-making performance, are “Misuse and Disuse”.

Both terms describe how pilots in the cockpit implement the automation systems in performing the tasks, where ‘misuse’ refers to inappropriate usage and the reliance on automation systems in the cockpit, and ‘disuse’ means insufficient usage and distrust of the automation systems (Lee and See, 2004) and (Price, 2012).

Accordingly, from the above discussion it is clear that pilots from one culture which are using technologies were produced in another culture are under the impact of the implications of culture interface in the cockpit. These implications for the culture interface might lead to inappropriate and insufficient usage of automation systems in the cockpit.

This directly affects the pilot’s decision-making performance, as they will mis-evaluate the actual risk involved (perceived risk) in their tasks. According to Merritt and Maurino (2004), the cultural difference in the operating context is applied where an aircraft manufacturer with the latest advanced safety automation systems in one culture could bemuse pilots from another culture that does not support this operating context due to poor infrastructure or any other reason.

It is crucial to investigate how pilots can become bemused when they use certain technologies in order to improve their ability to adapt to automation systems and enhance their performance in the cockpit. This is the main core of this study. It is studying the pilot's decision-making performance in the cockpit within the North Africa region, where these pilots come from developing countries and operate technologies that are mostly manufactured in Western, developed countries.

The difference in operating context between developed countries and developing countries is very big. This means socially, economically and politically. According to Merritt and Maurino (2004), "because of the potential for confusion, misunderstanding, and misapplication, these cultural interfaces deserve closer scrutiny". Through the above discussion it is clear that the technology-culture interface in the cockpit is a system failure phenomena rather than a pilot error, where many factors are causing this interface, including human factors, organisational factors, and environmental and political factors.

According to James Reason in his model of aviation safety (cited in Merritt & Maurino, 2004) an accident cannot happen by an individual working in isolation from their surrounding environment, but rather with the accumulated factors that create a vulnerable situation and unsafe acts. Many analyses of technological system accidents show that the preconditions of accidents can often be traced back to the deficiencies of systemic safety barriers to defend the system from undesirable factors. These are undesirable factors hidden in the system for years until abnormal operating conditions trigger an accident (Merritt and Maurino, 2004; Chauvin et al., 2013; Robertson et al., 2016).

The Reason model considers cultural interfaces as a latent condition of technological system accidents. For the purpose of this study the literature shows that the NAR suffers from a high rate of fatal accidents (see Chapter 1, Section 1.5). In addition, one of the main causes of these fatal accidents in aviation is bad decision-making performance (see Tables 2.2, 2.3, and 2.4, also Figure 2.18). Pilot error in decision-making has been identified as a key factor in aviation accidents, and it is always accompanied with challenging situations (Burian et al., 2005). According to Hunter (2002), risk perception is "the recognition of the risk inherent in a situation".

The contribution of these factors to accidents is influenced by the surrounding environment, situation and individual characteristics (You et al., 2013). The subjective judgment that pilots make about the characteristics and severity of a risk are different (Wiggins, 2014). Moreover, the perception of risk varies with both the individual and the context (Hunter, 2002). According to Elnaga (2012), individuals have differences in how they perceive the work environment, the tasks at hand, their skills and capabilities. Based on such perceptions, they make decisions on how they are going to behave. Perceived risk is thus not universal and individuals conceptualise risk differently, depending on their culture background (Sjobery et al., 2004). Consequently, assessing risk perception from a culture theory standpoint is crucial for aviation safety, because it plays such an important role in pilot decision-making and in their way of flying.

In summary, it appears that there is the need to assess the technology-culture interface impact on pilot decision-making performance in the region of North Africa through the evaluation of the most significant factors in pilot risk perception in the cockpit. These significant factors, according to the literature review and the previous in-depth discussion, are: cultural attributes, attitude to human and organisational factors, system design/automation and collective risk perception. These significant Themes have led us to identify the latent factors of "culture interface" as contributing to both good and poor pilot decision-making performance within the North Africa region. Figure (2.23), illustrates the process of this study.

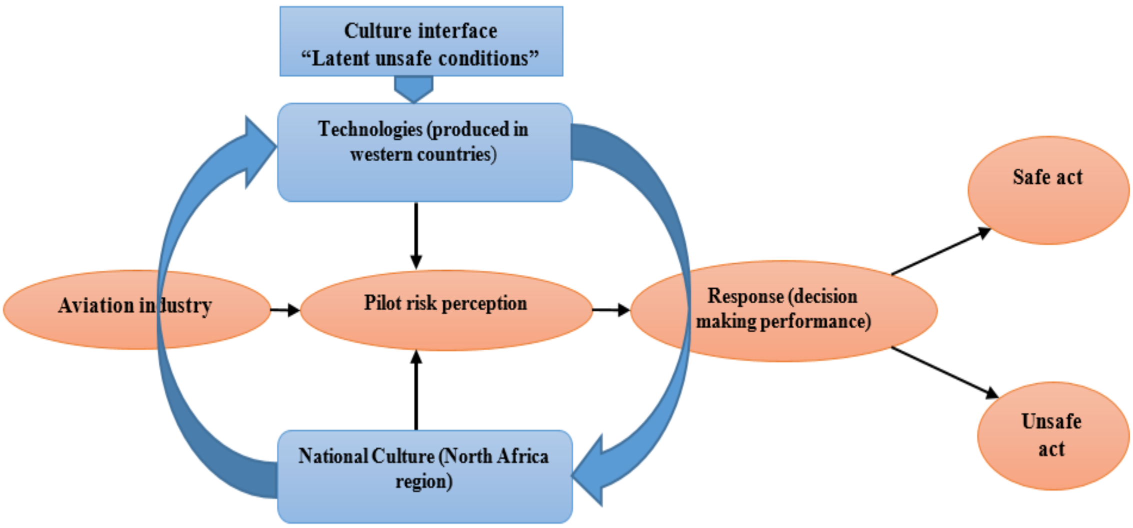


Figure 2-23: Technology–culture interface in the cockpit

2.12.2 Proposed Solutions

The difference in regional culture is in applying a different value of threat recognition and error management, where the CRM training programme that works well in the North America region might not work as well in the North Africa region. The error management and the description of relevant behavioural countermeasures rationale need to be accepted within the specific cultural context. For example, assertiveness on the part of junior crew members can be accepted as an effective strategy and practiced comfortably in individualistic, low power distance cultures such as the U.S. In contrast, simply advocating the use of assertion by juniors in many high power distance cultures is likely to be seen as a bizarre and unworkable proposal in countries such as Morocco, the Philippines, Taiwan, and Brazil, which have very high scores, of accepting unequally distributed of power (Helmreich et al., 1999).On the other hand, assertive behaviour could be acceptable if it is seen as a means of protecting the organisation and as a means of saving the face of the captain by keeping him from making a consequential error.

However, there is still much to be learned about fitting training strategies to cultures in order to develop effective training programs that provide the required knowledge, skills and abilities to pilots in the cockpit to perform high decision making performance (Elnaga & Imran 2013). According to Helmreich et al., (1999) testing error management approaches is a challenge for both researchers and practitioners and the area where cultural calibration will be essential.

According to Fletcher et al., (2003), Cultural differences at the organizational, professional or national level have been found to have a considerable impact on crew resource management attitudes and behaviour, and so should be taken into account when developing a training programme. In addition, Frygell et al 2017) The cultural factors are very important, but not stressed enough in the CRM training programme, that led to fail in the implementation in multi-national companies in China, Poland, Russia, Middle East, Dubai, Pakistan, Iran, Korea and Japan, which have extensive experience in implementing systems in its different global subsidiaries, and has planned the implementation well. Likewise, understanding the difference between the culture in which the CRM training programme was developed and the national culture where it will be implemented is crucial, to adjust to cultural values “culturally-calibrated” for a successful implementation.

Therefore, calibrate the CRM training programme to fit the pilots’ needs within the NAR in order to improve their ability to adapt to automation systems and enhance their performance in the cockpit

In summary, the CRM training programme is one of the mechanisms to manage error and improve the performance of crewmembers in the cockpit, but will never eliminate human error as an inevitable issue due to human nature and performance limitation. The safety of operations is influenced by national culture and safety requires focusing on it toward enhancing an organizational safety culture that deals with errors non-positively and proactively. In addition, the CRM training programme needs to be culturally-calibrated to fit with the pilots in that specific culture or region.

2.13 Chapter Summary

In this chapter the researcher tried to explore the background setting for this study in the safety of the aviation industry through reviewing the evolution in the aviation safety concept and accident causation. An in-depth discussion of the models that have been applied in the field of accident investigation and managing human error were given, as well as an overview of the region where this study was applied (NAR).

Through the literature review conducted, it is clear that pilot decision-making performance in the cockpit is crucial for enhancing the aviation safety within the region.

Regarding national culture, it was found to play a very important role in the cockpit, positive and negative. Crewmembers who might face a culture interface in the cockpit may be exposed to negative consequences during operational tasks due to system design and automation as direct effects of national cultural differences of both operators and designers.

Four significant factors were found to play very important roles in pilot decision-making performance in the cockpit: cultural attributes, attitude to human and organisational factors, system design/ automation and pilot risk perception.

In summary, this chapter has provided the researcher with a good understanding of the research topic and with a justification of the research aims. The gaps of the research were defined and various relevant topics were reviewed in order to define the research concepts. The CRM training program was discussed as one of the most important mechanisms in improving pilot performance in the cockpit.

3 CHAPTER THREE: Research Methodology

3.1 Introduction

This chapter discusses in detail the research fundamental and process that were followed in this research. In order to implement an effective research approach it is crucial to identify the investigation's key area (Fielding, 2012). From the questions outlined in Chapter 1, a range of areas for investigation have been specified in this research. This includes not only the influence of the North African regional national culture on pilot decision-making and the most contributing factors involved in a pilot's decision-making performance, but also how these pilots practise it in reality.

3.2 Research Strategy

Choosing the most suitable research strategy for any research is crucial for continuing with the research process. In order to ensure consistency in the research, the selection of the research strategy should be inspired by the researcher's opinion of their philosophy and approach. According to Saunders et al., (2009) the researcher can make a good plan of the research process by having a research strategy. In addition, it gives them the ability to achieve the research objectives by answering the research questions.

According to Yin (2009), in order to choose the most suitable research strategy three conditions must be considered: the research questions type, the researcher control of behavioural events, and the degree of focus on recent events as opposed to historical events. According to Saunders et al (2009), there are seven types of research strategy: survey, experimentation, action research, grounded theory, case study, archival research, and ethnography. Table (3.1), shows the advantages of the chosen strategy for this research which is a "survey" in comparison with other strategies which emphasised in the literature.

Table 3-1: The main differences between the research strategies

Research Strategies	Advantages	Disadvantages	Form of the research questions	Requires control of behavioural events?	Focus on contemporary events?
Experiment	Clear possibility and answer; controlled context, replicable and generable; save time and resources; causal relationship	Requires specific knowledge; artificial; ethical problem due to variable control; quantitative does not really explain	How Why	Yes	Yes
Survey	Widely used; qualitative and quantitative; directive; affordability of large data; high predictability	Risk of misplacing findings; difficult to obtain truthful data; may subject to bias; less detail and depth; may not be applicable to phenomenon studies	Who What Where How How many How much	No	Yes
Case study	In-depth, capture complexities, relationship; multiple data sources and methods; flexible time and space; less artificial	Problem of generalization; focus on natural situation; unpredictable; unacceptable for some course	How Why	No	Yes
Action research	Collaborative; the researchers and context integrity; for practitioner-researchers; professional and personal development; practical	Difficult for new researcher; exclusive; work setting influence; unacceptable for some course	How	Yes	Yes
Grounded theory	Generating theory from a research; flexible structure; detailed set of rules and procedures	Too specific; ignore the previous knowledge to the analysis; many variants of the strategy	How (Focus on process)	No	Yes
Ethnography	Feasible within the constraint of time and researchers; direct observation; no specific data collection methods; rich data; deal with culture, inclusive.	Difficult for new researcher; high skill needed; descriptive to explanative; ethical issues; limited accessibility; problem of generalization.	Why (To understand context and perception)	No	Yes
Archival research	Independent researcher; researcher has no influence on the quality of documents; can be reviewed repeatedly	The documents might be produced for specific reason; lead to bias; irretrievability.	Who What Where How many How much	No	Yes/No
History	Applicable deal with 'dead' sources of evidence; can be reviewed repeatedly	The data is limited in term of in-depth descriptions (no specific reason produced)	How Why	No	No

(Source: Saunders et al., 2009)

A research strategy could be a general orientation, around which business research can be conducted (Bryman and Bell, 2007). It also can be classified as either qualitative or quantitative. The selection of the research strategy in this study was decided at the start in order to answer the research question, where the researcher has built a framework to ease collection and analysis of the data.

In order to select the most suitable methodological approach for the study the researcher embarked on revising these research questions. This is a crucial role for this selection, as mentioned in earlier discussion. There are five research questions in this study:

1. To what extent is the North African regional national culture affecting pilot decision-making performance in the cockpit?
2. To what extent are pilots in the North Africa region influenced by cross-culture when they are using advanced technology in the cockpit?
3. How does pilot risk-perception in the North Africa region differ from other pilots in other regions?
4. What are the implications (if any) of the technology-culture interface on pilot decision-making in the cockpit within the North African region?
5. How can non-technical skills of pilots within the North Africa region be improved to enhance pilot risk-perception in the cockpit?

According to these questions the data for this research will be collected depending on the social interaction with the pilots who grew up and work within the North Africa region. This does not require any control of behavioural events, due to the information richness provided by the social interaction. Thus, the experiment and action research methodological approaches will be eliminated from this study due to the absence of behavioural events control.

In addition to the type of the research questions used in trying to answering the "How" and "What", it is clear that grounded theory, action research, ethnography and history research strategies are not suitable for this research. The richness of information will be revealed through professionals in the aviation industry (pilots). The achievable research strategy will be eliminated due to its requirement of researching periodic documents and archives. The strategies of survey and case study were left as choices for this study. The following paragraphs discuss both strategies to find the most suitable one for this research.

Firstly, the survey strategy is mostly commonly used to answer “who” and “what” research questions. In addition, it is usually combined with qualitative or quantitative as method (Saunders et al., 2009). The researcher viewed the survey strategy as a suitable strategy for this research.

Secondly, the case study is usually combined with an empirical study to investigate the phenomena within its context. The case study is a qualitative approach, where the investigator tries to discover the bounded system or multiple bounded systems. In addition, in the case study the researcher aims to understand the specific case as an object of interest. This strategy has a lot of advantages, but for the nature of this research study’s questions – which are mostly “What” questions, which are most suitable to use with the survey strategy (Yin, 2009) – and thus the case study strategy has been eliminated as well.

Accordingly, the survey strategy was considered by the researcher as the most suitable strategy to achieve this research aim. This strategy has implemented through combining both primary and secondary data. The primary data of this research, which was collected through a deep investigation among professional pilots within the North Africa region, was gathered with a combination of “qualitative” and “quantitative” approaches. The secondary was gathered through a comprehensive review of the literature. Both the primary and the secondary data will give the study more robust conclusions, through a triangulation view. The next section discusses the mixed methods design and triangulation technique in details.

3.2.1 Mixed Methods Design and Triangulation

3.2.1.1 Mixed Methods

Following the previous discussion of the research philosophies, the researcher has concluded that the mixed methodologies design is the most suitable for this research. This research is relying on an interpretivist paradigm, which is commonly combined with qualitative methods. The use of quantitative methods in this research will be to gather general data that support the more specific data generated through the qualitative methods.

Mixed methodology research considers both qualitative and quantitative data in one study, which are collected sequentially or concurrently. It also involves integrating the data at some stage of the research (Creswell et al., 2003). A convergent parallel mixed methods design was chosen for this study and will be discussed in detail in the next paragraphs.

The combination of both approaches (quantitative and qualitative) in collecting data and analysis is becoming more common and is now suggested in methodological literature and research (Creswell and Clark, 2007) and (Fielding, 2012). The use of both methods (qualitative and quantitative) is labelled in the literature as mixed methods, in which both assumptions express the poles of two extremes. Whereas the qualitative method tends to emphasise an inductive and subjective approach, the quantitative method emphasises the deductive and objective approach (Morgan, 2007). Although it is rare that research problems in practice tie in with the assumptions of both philosophical approaches, a better understanding of the research problem can be gained by adopting them both rather than using only one (Curran and Blackburn, 2001).

Different advantages can be gained from these different approaches. Mixed methods take the advantages of each approach to overcome the weaknesses of both. For Creswell and Clark (2007), using mixed methods in research strategy can provide a comprehensive approach for the study of a problem that cannot be solved by using a single method. In addition, the mixed approach can provide the researcher with more flexibility in using a wide range of tools at the data collection stage, which will lead to a better response to the research questions and avoid the restrictions of tools specific to either qualitative or quantitative methods alone.

Accordingly, this research employs methods that aim to consider social reality from the world view and assumptions of both quantitative and qualitative methods. The significance behind this choice is that the research questions will be better answered by using both methods rather than one, due to the narrow focus of the study problems. In addition, it will give the researcher more flexibility to choose the appropriate tools that can suit the problem of the research question.

By taking this approach the researcher possesses more flexibility while conducting the inquiry and collecting and analysing the data. In addition, using both approaches encourages triangulation methods, which can give more accuracy and validation for the research outcome, although a number of limitations might be faced while using mixed methods, such as the real integrating of both approaches. However, these are minor limitations.

Relying on one paradigm to obtain a full picture of the real world would indeed be incorrect (Mingers, 1997). This argument strengthens the prevailing opinion that the use of multiple views of social reality gives strong validity to collecting the data and to the outcomes of research.

3.2.1.2 Triangulation

Recently, triangulation methods have attracted larger number of researchers in the social context (Philpott, 2005). Researchers argue that the implementation of multiple methods in data collection and interpretation will enhance the presentation of the reality of the phenomena (Denzin and Lincoln, 2000). The combination of multiple methods in research can give more criteria to the investigation of the phenomena being studied (Hussein, 2009) and (Fielding, 2012). Moreover, using triangulation in exploring the influence of the national culture on a pilot’s decision making will lend the investigation of the phenomena a multiplicity of different perspectives, which will lead to coherent data, consequently improving the validity and accuracy of the final result.

3.3 Adapting the Mixed Methods and Triangulation

Mixed methods as mentioned above, refers to the combining of both quantitative and qualitative methods (Creswell and Clark, 2007; Fielding, 2012).

Brewer and Hunter (2006) pointed out that the strategy of using the mixed method is to “attack a research problem with an arsenal of methods that have no overlapping weaknesses, in addition to their complementary strengths”. The imperative of adopting mixed methods comes from the nature of the social issues, where diverse information needs to be collected by different methods, which will provide a comprehensive understanding, rather than using one method.

In addition, studying the research problems by using the mixed methods approach can lead to answers to research questions that have a firmer empirical base and greater theoretical scope, because various paradigms can provide these methods (Brewer and Hunter, 2006; Fielding, N. G., 2012). The single use of either the qualitative or quantitative approach might lead to some weaknesses in the answers to the research questions. For instance, using the quantitative method alone is more likely to be done through a survey, in which the answers to the research questions will be more generalised.

Moreover, using the qualitative method alone will not provide a boarder view of the phenomenon. According to Bhattacherjee (2012), the advantages of using mixed methods can be summarised as follows:

1. Multiple measures can improve the validity test in the theoretical concepts.
2. In some situations during the research process, a single method might be difficult to apply equally to the research objectives. In addition, the strength of each method is different (Curran and Blackburn, 2001).
3. Mixed methods can guarantee a better result.
4. Using mixed methods can guarantee more diverse data than a single method.
5. Mixed methods can limit the methodological biases which can be associated with a single method.

The triangulation approach, which uses multiple methods in collecting and interpreting data leads to more specificness in the presenting of the reality of a phenomena (Hussein, 2009; Fielding, 2012). Considering a multiple methods combination in one study gives a depth and breadth to the investigation, in addition, to deep understanding of the dilemma of the research (Fielding, 2012).

The pilots studied here are exposed to different factors, ranging from individual to social and political and involving many challenges, which gives the researcher no doubt that a single method approach could not capture all of these. Moreover, the recent literature shows that a triangulation method is widely used in the social sciences as a robust strategy (Hussein, 2009).

In summary, this study adopts the mixed methods approach as it is the most appropriate and advantageous for this research, which is related to a multi-paradigm view. It is impossible to use a single method of observation to capture the complex, multiple realities of the world. In addition, this study is implementing the triangulation strategy, which gives advantages in covering the phenomena from different views.

3.4 Implementing the Convergent Parallel Mixed Methods Design

The mixed methods analysis systems classification has been evaluated in different research fields, such as behavioural, social and public health research. The most common mixed methods designs are: exploratory, explanatory sequential and convergent parallel mixed methods (Creswell et al., 2011), (see Figure 3.1).

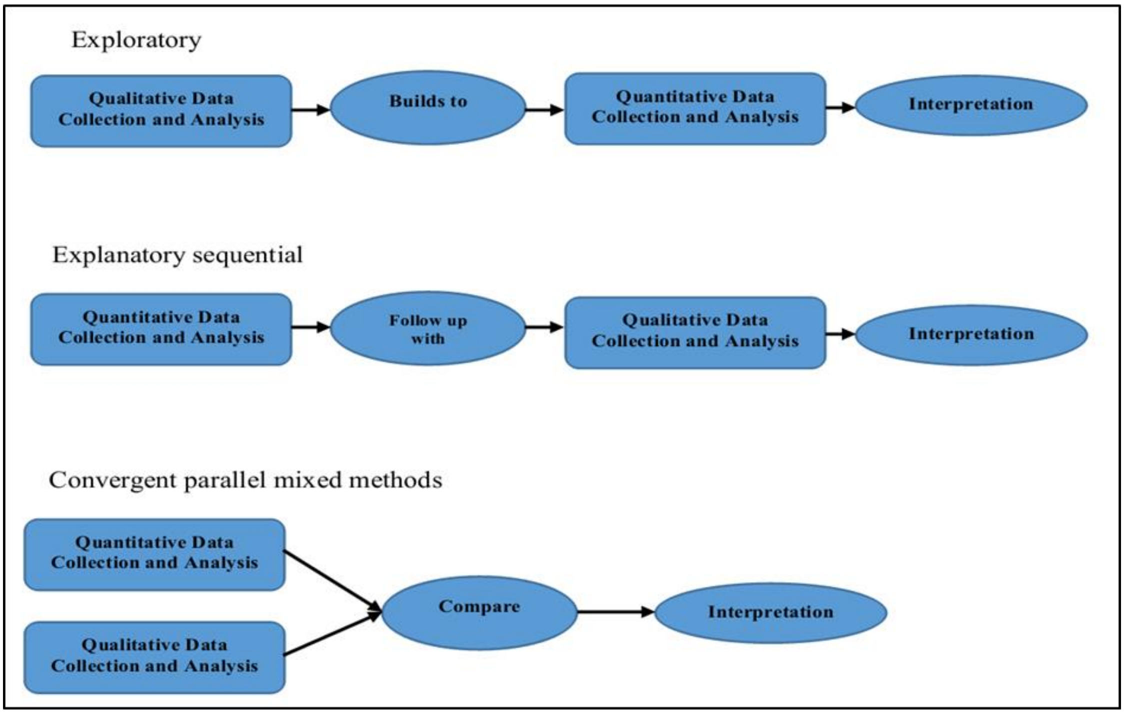


Figure 3-1: The different common mixed methods designs

In this study the convergent mixed methods was implemented in data collection and analysis procedures. Implementing the convergent parallel mixed methods approach in this study has many advantages. It is the simplest design. It gives more capability to the researcher in collecting the data in the same phase and yet to analyse it separately. It allows the researcher to compare the findings of both methods to find out if they confirm or disconfirm each other, which bolsters the research conclusion (Creswell et al., 2011).

As mentioned above, the qualitative data for this research is the semi-structured interview as the main method. This involved 12 Pilots working in aviation companies based in the NAR, eight First Officers and four Captains. This sample size of the qualitative data was adequate. There was also no choice to increase the number of the interviews conducted due to some financial difficulties and the nature of the pilot’s work in the field of aviation.

According to Smith (2003) the optimum range of interviews in qualitative data is six to eight. Rubin and Rubin (2005) proposed that the optimum interviews number is 10 to15.

The semi-structured interviews as one of the main methods for this study enabled the researcher to search deeply in the phenomena of the pilot's situation in the cockpit. The second main method for this study is the questionnaire, which represents the quantitative data and involved 143 respondents from pilots working within the region of North Africa. Both of the methods were merged together with the secondary data (literature) to perform the triangulation and strengthen the final conclusion and achieve the aim of the study. For more clarification of the stages of this see the below full road map in (Figure 3.2).

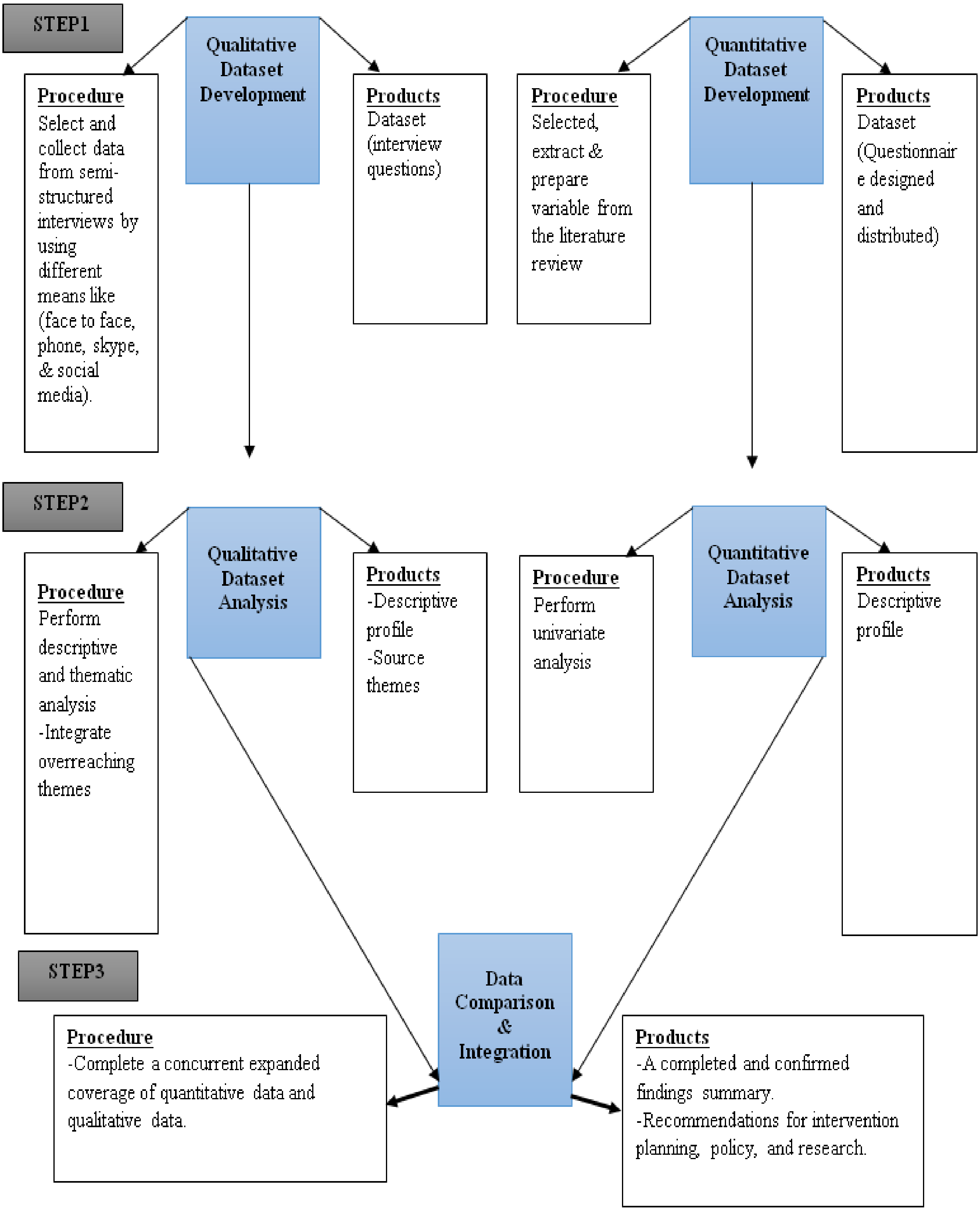


Figure 3-2: Convergent parallel mixed methods design

3.5 Research Techniques

For the purpose of reaching the research target it was required to follow a suitable research technique. In this study a mixed methodology was implemented, which benefits the study's in-depth review of the phenomena through semi-structured interviews (qualitative data) and the capture of the generic opinions of professionals in the cockpit regarding the phenomena (quantitative data) within the NAR.

In this research a survey deign were applied for both methods, the (quantitative and qualitative) of which were derived from the literature.

3.5.1 Literature Review

The literature review is a process which starts in the early stage of the research setting and finishes at the same time as the research finishing. According to Bryman and Bell (2007) the literature review is crucial to developing a significant research argument and findings. In addition, Kulatunga et al., (2002) stated that the literature review is important to the researcher working on novel research and keeping up-to-date in the field of the research.

As such, the main aim of the literature review in this study was to identify the research gap regarding pilot decision-making performance in light of the technology-culture interface in the cockpit. This was secondary data. Whereas the review conducted included various literature regarding aeronautical decision making, national culture and the human factor in the cockpit.

3.5.2 Semi-Structured Interviews

The semi-structured interviews approach was applied to collect the qualitative data. The researcher viewed this as the most suitable method for this research context. The interviews were conducted both face-to-face and by media (Skype) that give full interaction between the researcher and interviewee and accordingly lend richness to the data collected. Full details of the advantages and disadvantages of using this method in this study are included in Chapter 4, in addition to the participant's characteristics, the interview sessions and the data analysis, which was conducted using the NVivo 11 software.

3.5.3 The Questionnaire

The questionnaire was deployed as the method to collect the quantitative data in this study, which assists the researcher in gaining the general opinions and understanding of the professional pilots regarding their risk perception in the cockpit. In addition, it assists the researcher in collecting data from a larger group of the participants within a limited time and allows the researcher to make comparisons with data collected from the interviewee that are more natural. Full details of the benefits of this methods in this study are discussed in Chapter 5, in addition, to the sampling strategy, distribution of the survey and data analysis, which are run using the SPSS 24 software.

3.5.4 Objectives Achievement of the Research Methods

The main target of the research techniques was to achieve the research objectives. Accordingly, the research methods mentioned earlier were deployed in this research to fulfil these objectives. Table 3.2 displays this research objective achievement in relation to the corresponding methods of investigation used in this study.

Table 3-2: Achievement of this study's objectives

No	Objective of the research	Investigation method		
		Literature review	Semi-structured interviews	Questionnaire
1	To develop a general understanding of how the overall national culture can influence a pilot's decision-making performance in the cockpit.	X		
2	To investigate the influence of the technology-culture interface on pilot decision-making performance in the cockpit.	X		
3	To appraise the influence of the North Africa national culture on pilot decision-making performance in the cockpit.		X	X
4	To evaluate pilot risk-perception within the North Africa region in comparison with other regions.		X	X
5	To evaluate the influence of the technology-culture interface on pilot decision-making performance during flight within the North African region.		X	X
6	To propose a guideline to enhance pilot decision-making performance in the cockpit within the North Africa region.	X	X	X

The purpose of this research technique is the fulfilment of the research strategy through using the multi-methodology and triangulation approaches of deploying the qualitative data (semi-structured interviews) and quantitative data (questionnaire) as the main data and the literature review as the secondary data. In addition, both research methods were carried out based on four themes, which appeared to be the most significant impact themes on the pilot's risk perception in the cockpit within the NAR from the secondary data (literature review) and reflect the research objectives. These four themes are:

1. Cultural attributes
2. Attitude to human factors and origination factors
3. System design and automation

4. Risk perception

These four themes acted as the main guidance to build both the interview questions and questionnaire items, which provided the researcher more ability ease in comparing both the qualitative and quantitative data. In addition, the interview questions were developed according to the themes mentioned previously and the questions were organized based on the themes to ensure a smooth transition of topics during the interview sessions, which are included in appendix A. The items included in the questionnaires were derived from the factors found in the literature as the most significant criteria on the four themes. The questionnaire form is included in appendix B, as well as in this thesis.

3.6 Reliability and Validity of the Research Methods

This research is implementing both qualitative and quantitative data. These have different characteristics regarding reliability and validity, which are very crucial for the research accuracy. This is why the researcher decided to use both in this study. The validity is used to evaluate the instrument quality, such as coding frame, questionnaire or a test (Schreier, 2012).

For the purpose of qualitative data analysis testing the reliability can be run through the coding frame and the consistency of translation. According to Schreier (2012), the reliability can be carried out by two methods, as follows:

1. The same coding frame used by two or more coders to analyse one unit independently, which are considered to be reliable if the result of the different coders are applied. This method is called a comparison across persons.
2. The same coding frame used by one person to analyse one unit in a certain period of time, which is considered to be reliable if the result is constant over time. This method is called a comparison across points in time.

In this research, for the purpose of reliability, the author has used the result of the coding frame across person where same code was used to compare the coding by different person. Where the researcher asked another researcher who has experience working on content analysis to analyses two interviews with using the same code and also review the interviews translation, the result of these interviews analysis and translation in comparison with the researcher analysis and translation result were identical agreed. The coding frame was found to be reliable according to the extent that the coding is consistent.

For the purpose of qualitative instrument validity for this study the researcher has relied on the following signifies procedures test. According to Creswell, (2013) following a significant qualitative validity procedure to test the qualitative validity is crucial. In this study the author has followed these specific steps:

1. Participant or respondent validation: in this step the author has checked the findings of the interview with the interviewee to find out whether he agrees with the finding.
2. Rich descriptions: this step is to keep thick and rich description of the qualitative data analysis process by the author as much as possible to show it is genuine and simplify the understanding of the research setting by the readers.
3. Discrepant information included: this step concerns including contradictory information of the researcher's general perspective in the findings discussion.

In addition, the reliability of quantitative data means that the findings of the instrument are constant and robust under different conditions and at different times (Saunders et al, 2009). According to Bryman and Bell (2007) to test the reliability of a research instrument there are three common methods:

1. Inter-observer consistency
2. Stability (test-retest method)
3. Internal reliability (Cronbach's Alpha)

Inter-observer consistency requires finding out if two observers have constant observations. This test needs to be done by more than one observer to collect data and requires very high subjective judgement (Bryman and Bell.2007).This method is not applicable for quantitative reliability testing in this study as the researcher is alone in conducting this research.

The stability test (test-retest method) requires distributing the questionnaire twice to the participants in order to check the correlation between both times to determine the instrument's reliability. Administering the questionnaire twice to the same respondents was not possible in this study. In addition, the possibility of the time interval could potentially negatively affect the respondents' answers (Saunders et al, 2009).

The last method is Cronbach's Alpha, which is the most common method in measuring the internal reliability. According to Saunders et al. (2009) the internal consistency can be determined through testing the average correlation of the items in the questionnaire, where the value can be ranged between 0, which means no correlation, and 1.0, which means perfect correlation and the questionnaire is reliable (Saunders et al, 2009). For the purpose of the reliability test of the questionnaire tool in this research the SPSS 24 software was used for 52 items in the survey and the result showed that the questionnaire tool had a Cronbach's alpha value of 0.748 (see Table 3.3). Many researchers consider a Cronbach's alpha test value between (0.7 and 0.8) is indicating that the instrument is reliable (Field, 2009). The last ten items in the questionnaire was adapted from Hunter scale of risk perception which is reliable and valid scale (Hunter, 2006).

Table 3-3: Reliability statistics results from SPSS 24

Cronbach's Alpha	**Number of items**
0.748	**52**

Furthermore, for the purpose of quantitative tool (questionnaire) validity there are different methods such as: content validity, construct validity and criterion validity (Saunders et al, 2009). For this study the content validity was implemented, which is very important for quantitative instrument validity (Creswell et al., 2011).

The content validity is “established through the judgment of the external experts whether the items or questions are representative of the construct investigated” (Creswell et al., 2011). In this study to establish the content validity of the questionnaire tool in evaluating the pilot risk perception subjectively and objectively in the cockpit within the region of North Africa a pilot study was conducted with six experts in the field of aviation from the region of North Africa.

According to Polit et al., (2001), conducting the pilot study can be used as a "small scale version or trial run in preparation for a major study". In addition, Weisberg et al., (1996) emphasise that in terms of validating the questions of the survey, it should measure the concept and moreover in order to be reliable should be answered in the same way each time it is used. Although a pilot study does not guarantee success in the main study, it greatly increases the likelihood. Baker, (1994) argues that a pilot study may help to define logistical issues at an early stage and support the research strategy by defining these factors:

1. To make sure that the instructions are understandable.
2. To make sure that the skills and procedures of the investigation technicians are sufficient.
3. To make sure of the clarity of the wording in the survey.
4. To make sure that the result will be reliable and valid.

In order to conduct the pilot study in this research, as mentioned earlier a sample of six experts in the aviation field within the NAR were chosen. This sample consists of five pilots and one engineer. A six coded survey were then sent to the participants by different means (email and by hand), to complete and to make comments. The English language was used in the pilot study because it is the language of aviation and also to assess if the participants could fully understand the English language version.

The responses of the participants in this pilot study were helpful in constructing a more adequate measurement tool. In addition, some difficulties were encountered with understanding the questions. However, there was no necessity to make substantial changes to the main questionnaire structure or the questions. The most frequently cited problem in all the responses was the length of the questionnaire and the need for an Arabic language version.

The Arabic version of the survey was done by the researcher, and it was reviewed and corrected by the second supervisor of the researcher as he is a professional in the field of aviation and originally comes from the NAR (see Appendix C).

In addition, many attempts were taken to make it more convenient by reducing the length of the questionnaire, but it was very difficult to remove any questions without compromising the results. The resultant questionnaire is still considered to be long. Since there was only a single chance to obtain reliable information from very busy professionals, the researcher decided that further shortening the questionnaire could jeopardise the gathering of important information. Other minor problems were pointed out and have since been resolved.

In summary the result of the pilot study was helpful in supporting the research methodology, in which measurement tool content validity was obtained.

3.7 Chapter Summary

In summary, in this chapter the researcher has embarked on reviewing the research philosophies in the literature to determine the most suitable and appropriate philosophical methodology approach to achieve the research target.

According to the nature of the research context and reviewing the available theories in the literature, the researcher became convinced that the interpretivist paradigm research philosophy for this study was the most suitable philosophy. This means investigating the data in depth through qualitative methods. However, in this study the quantitative method was used for a generalisation purpose, in order to gather data from professional pilots within the NAR regarding pilot decision-making performance in light of their risk perception in the cockpit.

For the purpose of qualitative data collection the interviews tool was chosen and for the quantitative data collection the questionnaire tool was chosen and designed. The use of mixed methods methodology was found by the researcher to be the best approach for the nature of this study and most likely to produce a robust result.

In addition, the researcher has discussed the appropriate research techniques to answer the research questions for this study, Furthermore, the issue of reliability and validity in data collection are also deliberated and given thoughtful consideration, to ensure the methods employed in this study will yield quality and consistent results.

4 CHAPTER FOUR: Qualitative Data Analysis

4.1 Introduction

This chapter elaborates on the analysis of the qualitative data obtained from the interviews, (as mentioned in Chapter 3, Section 3.6). The NVivo11 software programme was chosen to analyse the interviews with high accuracy. The interview tool is not the only data source for this research; it merely supports the survey findings to perform the mixed-methods approach. According to Alshenqeeti (2014) and Class and Martin (2016), interviews are verbal interchanges, usually conducted face-to-face, where the interviewer tries to reveal the beliefs or opinions of the participant regarding the researched phenomena.

Likewise, the interview tool was chosen to collect the qualitative data, as it was believed to meet the targets of the research, which explores the opinions and beliefs of the participants working in the field of aviation by eliciting deeper information regarding the technology–culture interface in the cockpit and its effect on pilot decision-making. According to Cohen et al. (2007), the interview tool is more suitable for eliciting deeper information and opinions of people working in the field than the survey.

Accordingly, the interview tool was seen as essential to support the understanding of pilots' decision-making performance in the cockpit along with the questionnaire tool. Although there were some problems with applying this tool, like the consumption of time, the interview tool was useful in the target context.

The next paragraphs provide an overview of the researcher's point view of the chosen type of interview for this study. In addition, they show the steps taken to better organise the interview data (e.g. transcribing the interviews to simplify the entry of data to the NVivo11 programme, selecting the themes and nodes for particular answers).

4.2 Qualitative data collection (semi-structured interviews)

As mentioned earlier in (Chapter 3, Section 3.8.2), the qualitative data for this study was collected by conducting semi-structured interviews. To understand this type of interview, the next paragraphs elaborate on the semi-structured interview process and the importance of conducting semi-structured interviews in this study.

4.3 Importance of the interview tool in this research

This study is an exploratory research study that tries to answer the research questions and consequently accomplish the project aims and objectives. As mentioned in (Chapter 3, paragraph 3.6), this research used the mixed-methods and triangulation approaches, which helped to understand the technology–culture interface in the cockpit within aviation companies based in the North Africa region from a different perspective. The justification for using the semi-structured interview tool as a qualitative method was to understand the technology–culture interface in depth and to compensate for the weaknesses of the questionnaire tool, as mentioned in (Chapter 3, Section 3.5.1.1). In addition, it was done to strengthen the outcome of this study. Semi-structured interviews tend to provide detailed descriptions of individuals and events in their natural settings. In addition, they are extendable conversations between partners aimed at yielding in-depth information about a research topic through which a phenomenon can be interpreted in terms of the meaning interviewees bring (Alshenqeeti, 2014).

The semi-structured interviews were conducted with (what & how) questions by using in-depth discussions (face-to-face and through social media) to enhance the collected data regarding the research context. According to Babbie (2010), the interaction between the researcher and participant in the semi-structured interview is essential. The researcher not only uses specific questions prepared for the interviews but also continues the discussion to include additional topics (Biggerstaff, 2012).

In addition, the interactive nature of semi-structured interviews provides a relaxed atmosphere for collecting qualitative data (Seidman, 2006), where the participants have more room to speak and engage in easy conversation with the researcher (Iacono et al., 2016).

Accordingly, selecting the semi-structured interview for the qualitative data collection was crucial for this study due to all the above-mentioned benefits of the tool itself. In addition, it enhanced the researcher's understanding of the phenomena of the study and strengthened the findings obtained from the data.

4.4 Interview design strategy

The strategy of data collection for the qualitative method was built on four themes, as mentioned in (Chapter 2, Section 2.12.1): cultural attributes, attitude towards human and organisational factors, system design and automation and risk perception. These four themes were drawn from the literature review as criteria affecting the pilot's decision-making performance in the cockpit. A schedule of the semi-structured interview sessions is included in (Appendix A). The semi-structured interview strategy for the four themes is briefly illustrated in the next paragraphs in addition to the demographic section.

Theme 1: Cultural attributes

This theme is divided into four sections: power distance, uncertainty avoidance, religious beliefs/norms and social relationships. All these criteria have been drawn from the literature. These criteria are the most significant factors affecting pilot behaviour in the cockpit, (see Chapter 2, Section 2.12.1). In this theme, the researcher tried to understand the participants' opinions and behaviours under the effect of these four criteria in the cockpit. In addition, the participants were asked about the extent to which these criteria involve other colleagues in the cockpit according to their perceptions and flying experience.

Theme 2: Attitude towards human and organisational factors

This theme is comprised of five sections: stress and fatigue, teamwork, work values, error/ procedural compliance and organisational climate. As mentioned in (Chapter 2, Section 2.4.3 and Section 2.5.2), attitudes towards human factors and organisational behaviour are crucial in relation to safety behaviour. Accordingly, in this theme, the researcher tried to discover the most important criteria affecting participants' safety behaviour in the cockpit regarding human and organisational factors.

Theme 3: System design/automation

This theme is divided into five criteria: crew awareness, data entry and error detection, automation extent in the cockpit, surprise of automation and understanding the language of Flight Management Computer (FMC) or Flight Management and Guidance System (FMGS). These criteria represent the interface between the pilots and the advanced technology in the cockpit, as mentioned in (Chapter 2, Section 2.12.1). Accordingly, the researcher tried to understand how the current advanced technologies such as FMC (see Figure 4.1) in the cockpit affects the pilot decision-making process within the target region.

Figure 4-1: Flight management computer in the cockpit

Theme 4: Risk perception

This theme is different from the previous themes, as the researcher tried to discover the actual risky events from the viewpoint of pilots in the target region (participants) in light of their risk perception.

Demographic section

This general section aimed to collect general information on the participants' backgrounds (e.g. experience, flying hours). This section was very important to identify the participants' profiles for verifying information, like position level. It should be mentioned that although the names of participants and their organisations are not mentioned in the semi-structured interview schedule, for the purpose of anonymity, these names are not published in the analysis or anywhere in this thesis in order to fulfil the university's ethical requirement.

4.5 Sampling strategy

The aviation industry in the North Africa region is like that in most developed countries supports tourism and international business by providing the regions' only rapid worldwide transportation network. According to Perovic (2013) and Melanie et al. (2012), airlines transported 2.8 billion passengers and 47.6 million metric tonnes of air cargo in 2011, connecting the world's cities with 36,000 routes. Accordingly, the aviation industry plays an important role in enabling economic growth and providing various economic and social benefits for the region, like domestic products, jobs and tax revenues generated by the sector and its supply chain. However, these North African-based aviation companies are still suffering from low safety performance, as clearly represented in the international civil aviation organisation annual safety report (ICAO, 2014)

To investigate this phenomenon qualitatively it is important to define the sample of the study carefully to avoid the chance of systematic errors and sampling biases, also to make sure that the sample is representative and generalisable to the population In order to answer research questions.

According to Taherdoost, (2016) “In order to answer the research questions, it is doubtful that researcher should be able to collect data from all cases, thus, there is a need to select a sample”. In addition to that, Alvi, (2007) stated that a sample random sampling technique has many advantages such as reducing the systematic errors, sample bias, and achieving a generalisable sample of the target population.

Accordingly, for the purpose of sampling strategy for the qualitative data collection the researcher was convinced that the sample random sampling technique is the most suitable sample strategy in this study. The sample random sampling technique was applied relying on a sampling frame that contains four steps as follows:

- Defining the aviation companies within the North Africa region

In this step, the researcher put the criteria of choosing the aviation companies that fit this study requirements which includes: to have ten years working experience based in the North Africa aviation market, to be covering international destinations within and out of the region and to be equipped with different aircraft categories.

- Defining the characteristics that constitute the target population.

This step is very important where the nominated participants for the random choice were set relying on four criteria of the participants: to be not less than two years’ experience within the company, to be a Captain (C) or a First Officer (F), flew a different aircraft categories and lastly to be involved in flying within the last six months.

- Using a random choice technique of the participants’ list was defined through computer or any other resource.

In this step, the random choice of the participants were set through a computer facility.

- The selected participants are approached and investigation is done.

This step is the last step in this sampling strategy where the researcher had to investigate and confirm that the chosen participants' characteristics fit the target population.

A total of 12 semi-structured interviews were conducted with 12 professional pilots at different levels in these companies which represent the target population of this study. The nomination of the participants was conducted through the flight operation departments of these chosen companies and via the aviation safety department in Tripoli, which cooperates with the target contexts according to the above-mentioned criteria. As mentioned earlier in this chapter, the interviews were conducted face-to-face and through the internet via Skype. This was the only medium available for the mentioned contexts due to the remote location and the high cost of travel. The target number of the semi-structured interviews of this research was 14 interviews, but only 12 interviews were performed due to reaching the saturation point at 10 interviews, the saturation point at which no new information are observed in the data (Guest el al,. 2006).

Likewise, the researcher noticed that the last two interviews did not add any new important information which means that the saturation point was reached at 10 interviews and he decided to stop at 12 interviews. According to Smith (2003) the optimum range of interviews in qualitative data is from 6-8, in addition, Rubin and Rubin (2005) proposes that the optimum interviews number is from 10-15.

Thus, the researcher was convinced that with the 12 interviews conducted, the data required for this study was collected, because the saturation of data was reached at 10 interviews. Ultimately, 12 interviews were conducted, including four (C) and eight (F). All interviews were recorded for the purpose of transcription and analysis.

In addition, to ensure anonymity and to meet the ethical approval requirement, (see Appendix E) the participants were labelled P1, P2, P3 etc. in no particular order. The following Table (4.1) shows the details of the sample interviewed for this research.

Table 4-1: Participants' numbers and categories.

Participant	Flying hours	Position in the company	Type rating
P1	> 3000	Captain (C)	BOEING 737-200
P2	2000–2999	Captain (C)	AN26/ TWN OTTER
P3	> 3000	Captain (C)	A320
P4	> 3000	Captain (C)	BOEING 737/ A320
P5	1000–1999	First officer (F)	AN26/ CRJ
P6	1000–1999	First officer (F)	AN/A320
P7	1000–1999	First officer (F)	TWN OTTER
P8	1000–1999	First officer (F)	A320
P9	1000–1999	First officer (F)	A320
P10	2000–2999	First officer (F)	BOEING 737
P11	> 3000	First officer (F)	TWN OTTER
P12	1000–1999	First officer (F)	AN26/CRJ

At the data-collection stage, the researcher had trouble conveying the main concept of safety culture. This could have been because the participants were unable to relate to the terminologies used, which were technical in nature and content specific to risk perception. It also could have been because of the linguistic limitations of the participants themselves, as the interview guide and questions were prepared in English. The researcher then resolved this problem by providing a translated version of the interview guide to the participants. However, the limitations in the participants' linguistic skills also resulted in the researcher having to interview the participants in English and Arabic alternatively during the interview sessions. Consequently, the interview transcripts were combinations of transcription and translation. The complete process of translating and transcribing the interview transcripts in English took much longer than initially anticipated.

4.6 Application of content analysis

The qualitative data collected from the interviews in this study was analysed using the content analysis approach, which sometimes called thematic analysis approach by some researcher. Both approaches, however, are very similar. Vaismoradi et. al., (2016) emphasises that there are many similarities between the content analysis approach and the thematic analysis approach (e.g. cutting across data, philosophical background, attention to both description and interpretation in data analysis, consideration of data context).

Accordingly, for the purpose of this study, the researcher employed content analysis, as the themes of the analysis had been identified prior to the analysis process. In addition, according to Elo and Kyngäs (2008) and Elo et, al., (2014), an exploratory research study such as this one should be done inductively, as knowledge of non-technical skills within the NAR is scant. Moreover, Green and Thorogood (2014) emphasise that content analysis in exploratory research benefits from the simple reporting of common issues. In this analysis, the categories for coding were derived from the data itself. The next section discusses the coding and categorising strategy.

4.7 Coding and categorising procedures

A code, according to Saldana (2009), is 'most often a word or short phrase that symbolically assigns a summative, salient, essence-capturing, and/or evocative attribute for a portion of language-based or visual data'. Due to the large amount of data that interviews provide, codes play a major role in summing up and illustrating such data. Saldana (2009) suggests that the process of coding requires the researcher to create particular filters that lead to focused interpretations for the research questions and objectives from the researcher's perspective. Therefore, codes were created and assigned to categories depicting participants' answers, which in turn contributed to identifying themes relating to the research questions.

As mentioned above, this research used NVivo 11 software to develop and enter codes. Each group of related codes was placed under a particular category that represented the answers of the participants.

As mentioned in (Chapter 3, Section 3.8.2), the qualitative data was analysed using NVivo11 software, but to fully understand the content analysis approach to the interviews, one interview that with pilot 1 (P1) (C) was chosen for traditional hand coding and categorising.

The four themes which were defined in (Chapter 2, Section 2.12.1) as main significant criteria to find out the research objectives were singed as codes and assigned to categories depicting participants' answers, which in turn contributed to identifying themes relating to the research questions. Each group of related codes was placed under a particular category. Five categories were defined, which subsequently led to the previous identified four themes: cultural attributes, attitudes towards human factors and organisational behaviour, system design/automation and risk perception, as illustrated in (Figure 4.2) below.

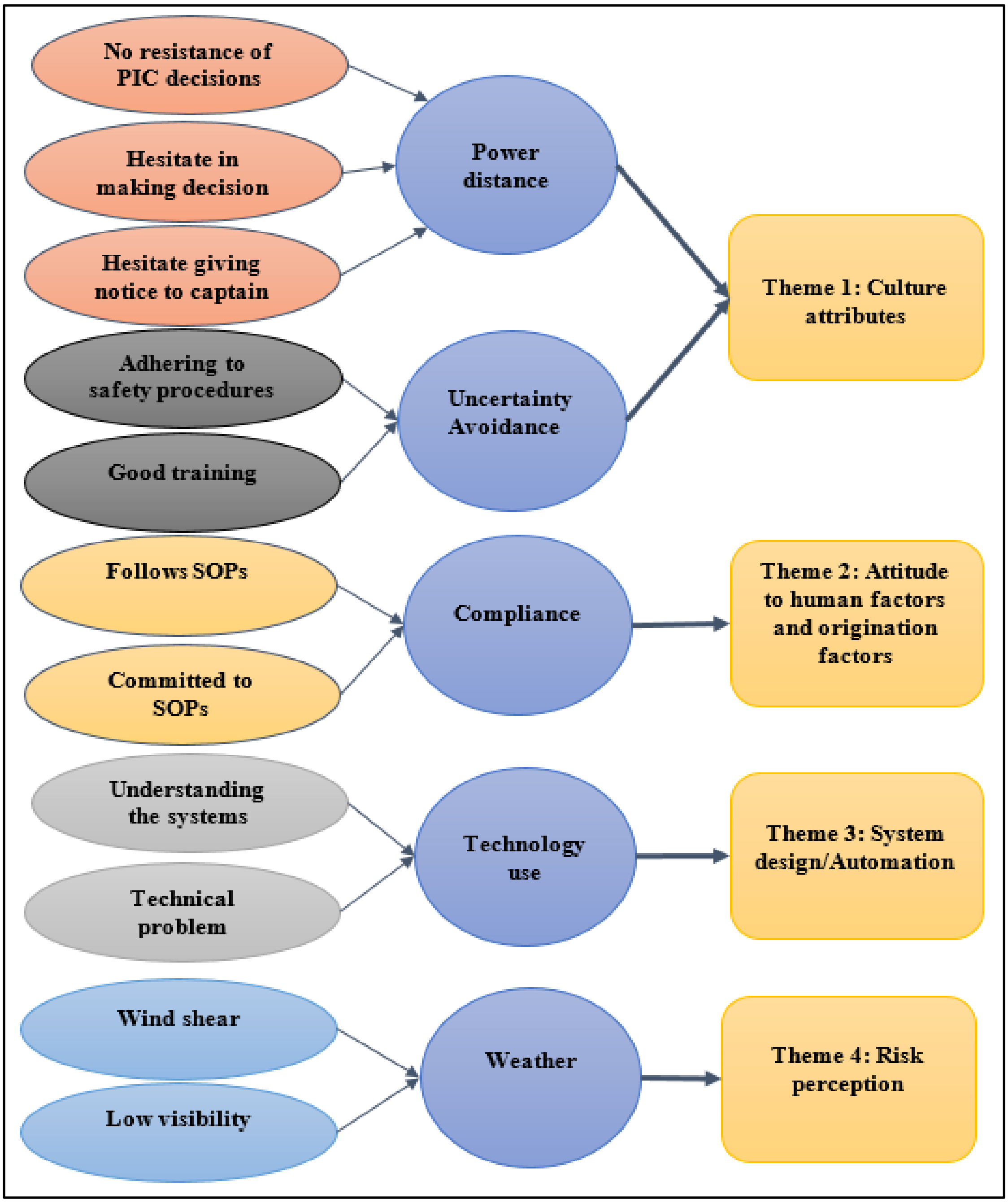


Figure 4-2: Codes, categories and themes for P1 interview

This introduces the research findings of the (P1) interview. The findings of the interview are presented according to the relevance to the research questions. The descriptive data of the interview provided initial answers for two research questions out of five. The full conversation was transcribed and saved.

1. **To what extent is the North African regional national culture affecting pilot decision-making performance in the cockpit?**

The participants were asked about the recurring problems with flight crewmembers during flight regarding decision-making. The response was ‘discipline is number one’, as indicated in the data. The respondent explained that compliance with the SOPs is important for a pilot to make good decisions, as he said ‘the more disciplined the co-pilot, the more committed he is to the SOPs of the company and the better his decision-making’.

Moreover, when the interviewee was asked about problems faced with other pilots, he explained the hesitation to participate in making decisions and to give notice to the captain of any mistakes, where he stated ‘Some co-pilots are hesitant to be involved in decision-making and to give you notice about mistakes or to warn you about small mistakes’. Furthermore, the captain classified such behaviour as a problem of discipline and safety culture. This suggests that some crewmembers do not completely follow SOPs.

The participant was also asked if he faced any resistance from the other pilots on any decisions taken, and he replied that in his 15 years of flying and six years as a captain, no problems were faced with the co-pilot regarding any decision-making. He said, ‘I’ve never faced such a problem. There is never resistance to any decision. The decision-making is always synchronised in the cockpit’. This implies that co-pilots react carefully to decision-making.

The interviewee further explained that adhering to safety procedures is the way to avoid uncertainty. He said, ‘Following the company SOPs, the procedure mentioned in the box, the company operation manual… Also, training helps to avoid these situations. So as I said, following SOPs and manuals and training… If everybody does this, they will definitely avoid uncertain situations’.

In addition, we talked about religion and asked about the extent to which pilots rely on “God’s will” rather than following safety procedures. The participant replied that this does not have a large influence, as pilots need to operate according to SOPs. He assumed that religious beliefs do not contradict safety operations.

Moreover, the interviewee was asked if being with a friend in the cockpit would influence the captain's decision-making. The participant stated that this would not influence any procedure, as they have to act professionally.

Furthermore, the participant was asked whether there are any actions in the final approach and landing that are considered high risk and are thus not recommended. He commented on some pilots who speak after the take-off position and before reaching 10,000 feet, which violates SOPs, he declared 'Some pilots request the hosts when we have just finished take-off, and this is not recommended in this phase'.

In summary, the data of the interview shows that there is no strict discipline or incompliance with SOPs in the cockpit. In addition, the co-pilot's hesitation to share or discuss the captain's decisions reflects the high power distance in the cockpit. Likewise, the data presented suggests that national culture affects pilots' decision-making at certain points, such as poor judgement of risk, poor communication between pilots, incompliance with SOPs and captains' failure to share decision-making and consequent poor crew resource management (CRM).

2. **To what extent are the pilots in the North Africa region influenced by cross-cultural differences when using advanced technology in the cockpit?**

The interviewee was asked about the most critical event encountered, and he mentioned two situations. The first was a result of low visibility and a technical problem. The second was due to a conflict taking place on the ground where they had to change direction to avoid bullets.

In addition, a question was asked about problems faced with modern technology. The response was that training is important and solves any problem with technology. The participant reported that there some pilots who face functional problems, such as with entering information and interpreting messages.

In summary, the data reveals that pilots encounter problems with technology at two points: when entering information and interpreting messages. This shows the pilot's weakness in understanding the technology used and interpreting its outcome, which affects the pilot's decision-making process.

Accordingly, the next paragraphs show the findings of the qualitative data obtained using NVivo11.

4.8 Content analysis process with NVivo11

The process of qualitative data analysis with NVivo11 started by transcribing the semi-structured interviews, organising the layout, numbering the lines for simplifying data entry and translating from Arabic to English. The main benefit of using NVivo11 is data organisation. Accordingly, the whole process of content qualitative data analysis for this research is summarised below.

- ❖ **Open coding**

This first step was done manually by reviewing the interview transcripts. This was achieved by reading carefully, writing notes and highlighting text and then reading the transcripts again and highlighting more text. Then, all these texts were collected to form the categories.

- ❖ **Category creation**

This step was done using the software, where the categories had been created and grouped according to the interview questions. The categories were organised and reduced at this stage.

- ❖ **Abstraction**

This step was taken to discover the findings, where the research topic was described by formulating a general description by yielding concise categories for the data.

In addition, to ensure reliability and validity, member checking was conducted on some of the interviews, and the participants verified the accuracy of the interview transcripts. Likewise, measures were taken to ensure the quality of the analysis conducted on the interview data, as described in (Chapter 3, Section 3.9). The use of NVivo11 software enabled the researcher to simplify the tedious process of content analysis by displaying the number of responses coded at each node. From this stage, the researcher was able to determine the pattern that existed in the data to draw conclusions on them.

4.9 Findings

The process of exploring the results of the qualitative data was done using content analysis by using NVivo11. This enabled the researcher to easily organise and code the data, and it illustrated the frequencies that occurred within the data.

Accordingly, the interview data were entered into the software. Then, these data were organised according to each theme, as planned in the interview as mentioned above. A coding plan was derived from the participants' own responses to the interview questions. This coding plan was then applied to the data, and all responses related to the codes were housed in parent nodes represented in themes 1, 2, 3 and 4, as shown in (Figure 4.3). The frequency of data appearing in each node was recorded, and the analysis was run based on this classification.

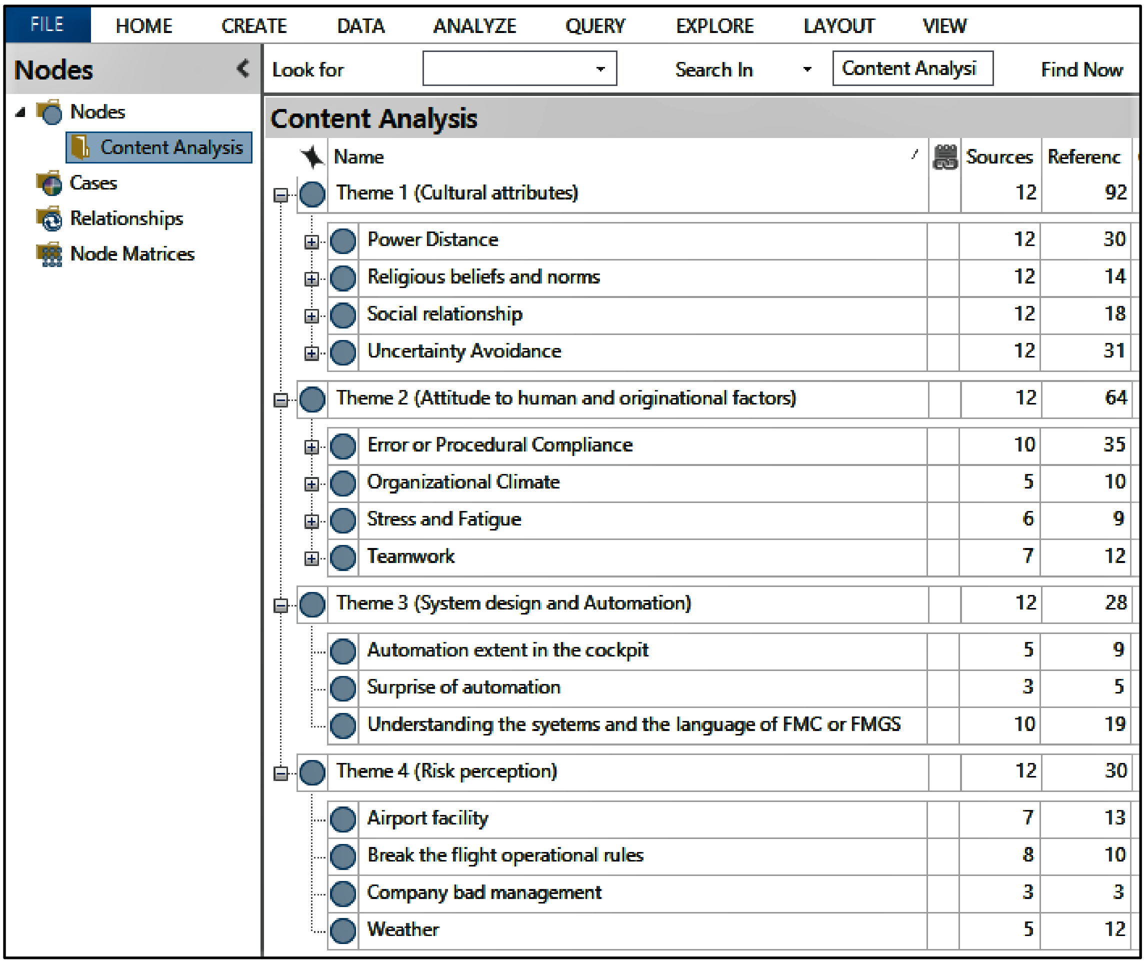


Figure 4-3: Screenshot of NVivo11, coding process

As shown in (Figure 4.3) above, the nodes were created in the NVivo11 software, and it shows the sources and the references for each node.

According to QSR International (2014), the coding strategy of the researcher is the base of the references account in the NVivo11 software. Likewise, the number of references in this finding was counted according to the frequencies of coded texts, which means the total number of references may or may not appear. Accordingly, a full explanation of the analysis process and the findings of qualitative data (interviews) is offered in the next paragraphs.

4.9.1 Theme 1: Cultural Attributes

This theme of the interview data refers to the North Africa region's national culture and its influence on the pilot's decision-making performance in the cockpit. This theme determines the national culture of this region among the participants from the sample according to four factors: power distance, religious beliefs/norms, social relationships and uncertainty avoidance. These factors were derived according to the content analysis, (see Figure 4.4). The screenshot shows the parent nodes of national culture criteria, which represent the risks in the decision-making process in the cockpit within the North Africa region.

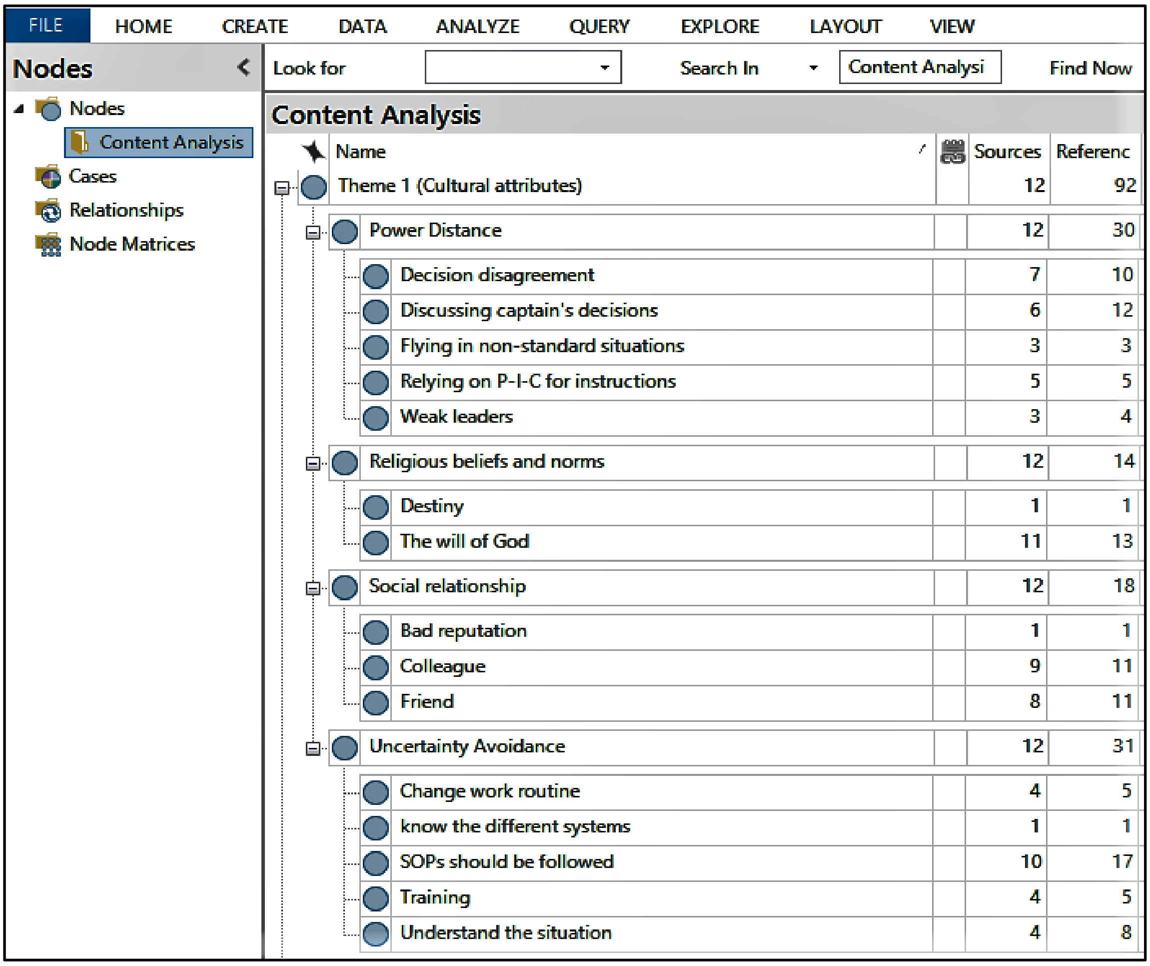


Figure 4-4: Screenshot of NVivo11, theme 1 (parent nodes, child nodes)

Accordingly, this theme is divided into four factors, as shown in the survey questions form, (see Appendix B). These four factors were devised to understand the extent to which these factors represent risks to the pilots in this region by a comparison with other studies in the literature from other regions.

The analysis was accomplished by running the descriptive frequencies of the participants' responses in the interviews to each factor. This led to the results showing in (Table 4.2), where the first theme is divided into four factors representing the parent nodes. In addition, the number of sources represents the number of interviews that involved this theme or parent node, and the number of references represents the number of comments given by the participants in these interviews regarding these factors. The comments placed in the child nodes were labelled according to the participants' responses using the coding strategy of content analysis.

Table 4-2: Theme 1, cultural attributes and parent node summary

❖	Node	No. of Sources	No. of References
❖	Theme 1 (Cultural attributes)	12	91
1	Power distance (Parent node)	12	30
2	Uncertainty avoidance (Parent node)	12	31
3	Social relationships (Parent node)	12	18
4	Religious beliefs and norms (Parent	12	14

Accordingly, 91 comments were specified in the 12 interviews in this theme. The first parent node in this theme, (Power distance), was analysed as described below.

❖ **Power distance (parent node)**

Power distance is one of Hofstede's dimensions of the culture model, which reflects the extent to which subordinates accept the power relationship in the cockpit (Hofstede, 2001). The content analysis shows that in 30 comments, as shown in (Table 4.3), interviewees emphasised this criteria, and the findings of this parent node illustrated that power distance criteria play a negative role in the cockpit among these pilots from the North Africa region. The first officer is afraid to express disagreement, he cannot question the captain's decisions and relies on Pilot In Command (PIC) to control and fly the aircraft in emergency and non-standard situations.

Table 4-3: First parent node findings summary (theme 1)

Theme 1	Parent Node	No. of Sources	Agree	Disagree	No. of References
1	Power Distance	12	10	2	30

The findings also indicate that ten pilots agreed that there are problems regarding the decision-making in the cockpit with other crewmembers, and two pilots did not agree, as seen in (Table 4.3) above.

In addition, for detailed clarification, this parent node's findings were divided into five child nodes, as shown in (Table 4.4). Please note that all tables of child node in this theme illustrate the participants' comments either agreed or disagreed. A full description of this parent node is offered in the next paragraphs.

Table 4-4: Child node summary in first parent node (theme 1)

❖	Child Node	No. of Sources	No. of References
1	Decision disagreement	7	10
2	Discussing captain's decisions	6	12
3	Flying in non-standard situations	3	3
4	Relying on P-I-C for instructions	5	5
5	Weak leaders	3	4

The first child node (decision disagreement) in the cockpit determined the disagreement among the crewmembers in the cockpit. Ten comments were derived from the participants and about seven of the interviewees emphasised that decision disagreement happen in the cockpit. For example, P2 (C) stated, 'It varies from captain to captain… With some captains, you will share similar decisions and similar views', which means that crewmembers often take individual decisions due to their agreement with each other. However, P8 (F) stated, ‘Some captains are sensitive about sharing their decisions’.

The findings in this child node show that six pilots out of seven of study sample emphasised that they suffered from decision disagreement in the cockpit (see Table (4.4). This reflects the cultural influence in the cockpit, where some pilots still believe there should be only one decision maker, as described by P12 (F): ‘We still have a dictator’s mentality’.

The second child node, (Discussing captain’s decisions), represents the ability of the first Officer or Captain to discuss the PIC’s decisions. According to the findings of this child node, six interviewers emphasised the inability to discuss the captain’s decisions in 12 comments, as shown in (Table 4.4). For example, P11 (F) stated, ‘He does not accept discussions regarding his procedures if he breaks the rules’, and P12 (F) stated, ‘If he makes a mistake and I tell him it’s wrong and you have to do so and so, he does not accept that from me’. These answers show that there are problems preventing these pilots from cooperating in the cockpit due to the cultural influence in the cockpit. This is shown in answers like P1 (C): ‘Sometimes, there are some co-pilots who are hesitant to be involved in decision-making and to give you a notice about some mistakes or to warn you about small mistakes, but you know even though they are small mistakes, they lead to bigger problems’. Moreover, P8 (F) said, ‘Some captains are sensitive about sharing their decisions’. In addition, P9 (F) said, ‘I am a first officer with 1,000 flying hours on an A320 flying with a captain that has more than 15,000 flying hours of experience, which sometimes deviates from teamwork point of flying. I mean, I cannot give him advice; it is difficult’. From these two comments, it would appear that the difference in the age and experience of these pilots produces problems with decision performance in the cockpit.

For the third child node, (Flying in non-standard situations), the researcher tried to understand the leadership nature in the cockpit among the participants, as shown in (Table 4.4). Three of the participants expressed that the PIC should take control in emergency situations. For example, P7 (F) stated, ‘In the final approach, sometimes I fly as a pilot in command, and the captain starts to take control of the aircraft with me. I mean, he starts to make the decisions'. Moreover, P12 (F) stated, 'I do not take the decisions; I just offer suggestions if there is any problem, so I just give suggestions to the captain, but the final decision is for the captain'. This means that some first officers rely on their captains to take control in any ambiguous events.

The fourth node, (Relying on PIC for instructions), means the inability of the first officer to take decisions. As shown in (Table 4.4), five interviewees each gave one comment regarding this issue, one of the interviewee did not agree with the node and the other four interviewees agreed that they rely on PIC for instructions in critical situation. For example, P7 (F) stated, 'In the final approach, sometimes I fly as a pilot in command, and the captain starts to take control of the aircraft with me. I mean, he starts to make the decisions'. That means some pilots rely on their captains' instructions due to a lack of confidence, knowledge or training. This is discussed further in the next chapters.

For the fifth child node, (Weak leaders), the researcher tried to understand both captains and first officers' opinions regarding how captains encourage suggestions and discuss their decisions with other pilots in the cockpit. As shown in (Table 4.4), three of the interviewees gave four comments on this child node. For example, P12 (F) stated, 'I mean, crewmembers do not like those who are younger or less experienced to give them advice or instructions, because they think this makes them look weak as leaders, so they do not share decisions'. Moreover, P7 (F) stated, 'Yes, even if he is sure that you are descending and will do a perfect landing, he will ask you this question because he is a weak leader'.

In general, the negative role of the NAR in the cockpit was raised by the power distance criteria among the participants. According to the content analysis, the participants agreed that first officers are afraid to express disagreement with the captain's decisions as described by (P1) (C). He said, 'Sometimes, there are some co-pilots who are hesitant to be involved in decision-making and to give you a notice about some mistakes or to warn you about small mistakes, but you know even though they are small mistakes, they lead to bigger problems'. In addition, the participants agreed that pilots should not discuss captains' decisions, as they do not accept that, which represents a high risk of low performance of pilot decision-making in the cockpit. For example, P12 (F) said, 'If he makes a mistake and I tell him it's wrong and you have to do so and so, he does not accept that from me'. The following two criteria (relying on PIC for instructions and relying on PIC to fly in non-standard situations) were supported by the participants. For example, P7 (F) stated, 'Also, of course, if any problems happen, the final decision is for the captain in any ambiguous situation'. P11 (F) said, 'In the final approach, sometimes I fly as a pilot in command, and the captain starts to take control of the aircraft with me. I mean, he starts to make the decisions'. Three participants agreed that the last criteria (captains who encourage suggestions are perceived to be weak leaders) is a cultural problem in the cockpit. For example, P10 (F) stated, 'I mean, crewmembers do not like those who are younger or less experienced to give them advice or instructions, because they think this makes them look weak as leaders, so they do not share decisions'. Moreover, P7 (F) stated, 'Yes, even if he is sure that you are descending and will do a perfect landing, he will ask you this question because he is a weak leader'.

Accordingly, the findings of this parent node showed a cultural role in the cockpit, where the pilots in the NAR perceive their work as more autocratic than it should be in the cockpit. For example, P7 (F) stated, 'It is always 6 to 4: I mean 6 to the captain and 4 to the first officer. It should be 5 to 5, but in our culture, it's impossible'. This may reflect the tightly regulated aviation environment. Pilots are allowed very little flexibility in how they do their jobs due to the surrounding environment.

❖ **Uncertainty avoidance (Parent node)**

Uncertainty avoidance is one of Hofstede's dimensions of the culture model, which has a great effect on pilot behaviour in the cockpit, as stated by Merritt (1996), Uncertainty avoidance reflects the extent to which people are sensitive to threats or anxious, which can be combined with ambiguous situations. The findings of this parent node indicated that the majority of the participants showed positive awareness of avoiding uncertain situations by different criteria highlighted in the literature as leading factors of avoiding risky events.

The content analysis showed that 12 participants gave clear answers of these criteria, with 31 comments, as shown in (Table 4.5). In addition, all participants agreed that the criteria represent the technique of avoiding uncertainty in the cockpit, (see Table (4.5). The next paragraphs discuss these findings in detail.

Table 4-5: Second parent node findings summary (theme 1)

Theme 1	Parent Node	No. of Sources	Agree	Disagree	No. of References
1	Uncertainty avoidance	12	12	0	31

Accordingly, this parent node was divided into five child nodes derived from the content analysis, as shown in Table (4.6). The first child node is (Change work routine), where four out of ten participants gave five comments regarding positive awareness of changing the work routine to cope with these tasks.

Table 4-6: Child node summary in second parent node (theme 1)

❖	Child Node	No. of Sources	No. of References
1	Change work routine	4	5
2	Know the different systems	1	1
3	SOPs should be followed	10	17
4	Training	4	5
5	Understand the situation	4	8

For example, P8 (F) stated, ‘Always be ready to cope with any task and avoid thinking that cannot happen to me’. Moreover, P12 (F) stated, ‘Use all the resources that you have, both internal and external (e.g. Air Traffic Control (ATC), ground features, communication with other pilots) if you understand and operate them well, and use the aircraft manual to cope with new tasks’. The second child node is (Know the different systems). As shown in Table (4.6), just one of the participants showed positive awareness of knowing the different systems by one comment. P2 (F) said, ‘You should have good aircraft system knowledge, and I think when you are very familiar with the plane and the system, then you will feel comfortable’.

The third child node, (SOPs should be followed), revealed the awareness of the participants in tackling flight situations. The results showed a high positive awareness of SOPs all the time, as shown in the table above, where ten participants expressed its importance in 17 comments. For example, P1 stated, ‘So as I said, following SOPs and manuals and training… If everybody does this, they will definitely avoid uncertain situations’. In addition, P3 said, ‘There are operations, procedures and SOPs, and there are technical books for the aircraft that we use when we face any problem’.

The remaining two child nodes in this parent node are (Training) and (Understand the situation). They represent the importance of training and situation awareness in good decision-making. Four pilots gave five comments emphasising that training is important to avoid errors. For example, P1 said, ‘Training helps to avoid these situations’. The importance of situation awareness was described positively by four pilots who gave eight comments such as P6 when asked why pilots get themselves into dangerous situations. He said, ‘They do not evaluate the situations they are faced with’.

In summary, most of the participants in this parent node showed positive awareness of avoiding uncertain situations by different criteria highlighted in the literature as leading factors for avoiding uncertain situations. The pilots in this region were well aware of the importance of avoiding uncertain situations in flight. However, the findings showed that one pilots realised the importance of knowing the different systems in the aircraft, as shown in (Table 4.6) in the second child node, and this criteria is very important to ensuring good decision-making performance during flight.

❖ **Social relationships (Parent node)**

The social relationship is playing a strong role among the North Africa region as one of the national culture criteria as mentioned in (Chapter 2, Section 2.7.1), and according to the content analysis was derived from the participant's interviews. In addition, Hofstede (2001) emphasises that social relationships has direct effects on uncertainty avoidance, where the participant asked a question if there are any effect of social relationship on their decision-making in the cockpit.

The findings of this parent node indicated that most of the pilots showed positive awareness of keeping social relationships away from the work environment and that they had no effect on their behaviour in the cockpit. Just two participants agreed that their social relationships had some effect in the cockpit, while nine participants disagreed, (see Table 4.7).

Table 4-7: Third parent node findings summary (theme 1)

Theme 1	Parent Node	No. of Sources	Agreed	Disagreed	No. of References
1	Social relationships	12	10	2	18

This parent node was divided into three child nodes (friends, colleagues and bad reputation), as shown in (Table 4.8), and it consisted of 18 comments from 12 interviews (see Table 4.7). The next paragraphs discuss these results in detail.

Table 4-8: Child node summary in third parent node (theme 1)

❖	Child Node	No. of Sources	No. of References
1	Bad reputation	1	1
2	Colleagues	9	11
3	Friends	8	11

Accordingly, the majority of the participants did not agree that social relationships had an effect on their work. For example, P1 (C) stated, ‘The first rule is to keep friendship out of work’ and, ‘We work professionally, we act professionally and we go back professionally so that when we get out of the plane, then we are normal friends’.

However, some pilots emphasised that there are some positive and negative effects of these relationships in the cockpit. As an example of the positive effects, P10 (F) stated, ‘When I know someone in the cockpit as a friend, I never hesitate, and if something happens during a flight, I tell him straight away if there are any mistakes, and of course, if I make a mistake, he tells me as well’. Regarding the negative side, P8 (F) was asked the question, ‘Would you write a report if another pilot is your friend and he is involved in an incident or accident?’ He answered, ‘I would not report him if it did not affect the safety, but if something affects the safety, I have to do it. We have the captain report system without names, and you write what you want and put it in the specified place’. In addition, the child node (bad reputation) was mentioned by P12. When asked the question ‘Would you write a report if another pilot is your friend and he is involved in an incident or accident?’ he answered, ‘It is not acceptable in our culture to do that’.

In general, according to the qualitative data findings the social relationships do not impact pilots’ behaviour in the region, and they mostly act as professional pilots in the cockpit. For example, P4 (C) stated, ‘No, in the cockpit, they don’t exist. We try to make official flights safe and legal. This is our goal. If he is my brother, I can’t accept that and he can’t accept that. This is the culture of aviation’. In addition, some participants agreed that relationships can have positive and negative effects in the cockpit.

- **Religious beliefs and norms**

Religious beliefs and norms was assigned as most important criteria in the NAR, (Vandewalle, 2006), (see Chapter 2, 2.7.1). In addition to their crucial role in uncertainty avoidance, as stated by Hofstede (2001), the researcher tried to discover if there were any effects of these criteria in the cockpit among these pilots. The findings of this parent node illustrated that religious beliefs and norms do not really influence pilots' behaviour. However, some pilots mentioned religious beliefs and norms in the cockpit.

The findings showed that 12 participants gave 14 comments regarding this parent node, as shown in Table (4.9). In addition, nine participants disagreed with the statement that religious beliefs and norms play a role in the cockpit, and only two pilots agreed (see Table (4.9).

Table 4-9: Fourth parent node summary in (theme 1)

Theme 1	Parent Node	No. of Sources	Agreed	Disagreed	No. of References
1	Religious beliefs and norms	12	3	9	14

For the purpose of deep analysis, two child nodes were revealed according to the content analysis from the interview transcript: "Destiny" and the "Will of God" (see Table 4.10). Full details of this result are presented in the next paragraphs.

Table 4-10: Child node summary in fourth parent node (theme 1)

❖	Child Node	No. of Sources	No. of References
1	Destiny	1	1
2	The will of God	11	13

It appears there is no real effect of these criteria among pilots in the North Africa region. For example, P1 (C) stated, 'In general, pilots do not rely on religious beliefs; it is very rare to find a pilot like that', and P4 said, 'We depend on God's will in everything. But to say that and take a wrong step is unacceptable in aviation'.

In addition, the two child nodes derived from this parent node according to the content analysis were (Destiny) and the (Will of God). For example, P12 (F) mentioned, 'We all believe in God and destiny, but you do your work properly and leave the rest to God'. Moreover, P1 (C) said, 'Relying on God's will doesn't mean you shouldn't protect yourself and avoid risk taking… even if you have to do your best', and P10 (C) said, 'No one just thinks, Go with the will of God'.

In summary, according to the sample in this study, religious beliefs and norms have no real impact on pilots' decision-making performance in the cockpit in the North Africa region.

4.9.2 Theme 2: Attitude towards Human and Organisational Factors

This theme examined participants' attitudes to human factors and organisational factors in the cockpit within the North Africa region that directly affect their decision-making process and risk perception in any situation. Fogarty and Shaw (2010) state that managing employees' attitudes regarding safety has a great impact on individual safety perceptions and performance. In addition, Flin et al. (2006) emphasise that measuring individuals' attitudes towards human and organisational factors can have a crucial impact on effective team performance. Accordingly, 12 interviewees (No. of sources) gave 63 comments (No. of references) as shown in theme 2, the screenshot of NVivo11 (see Figure 4.5).

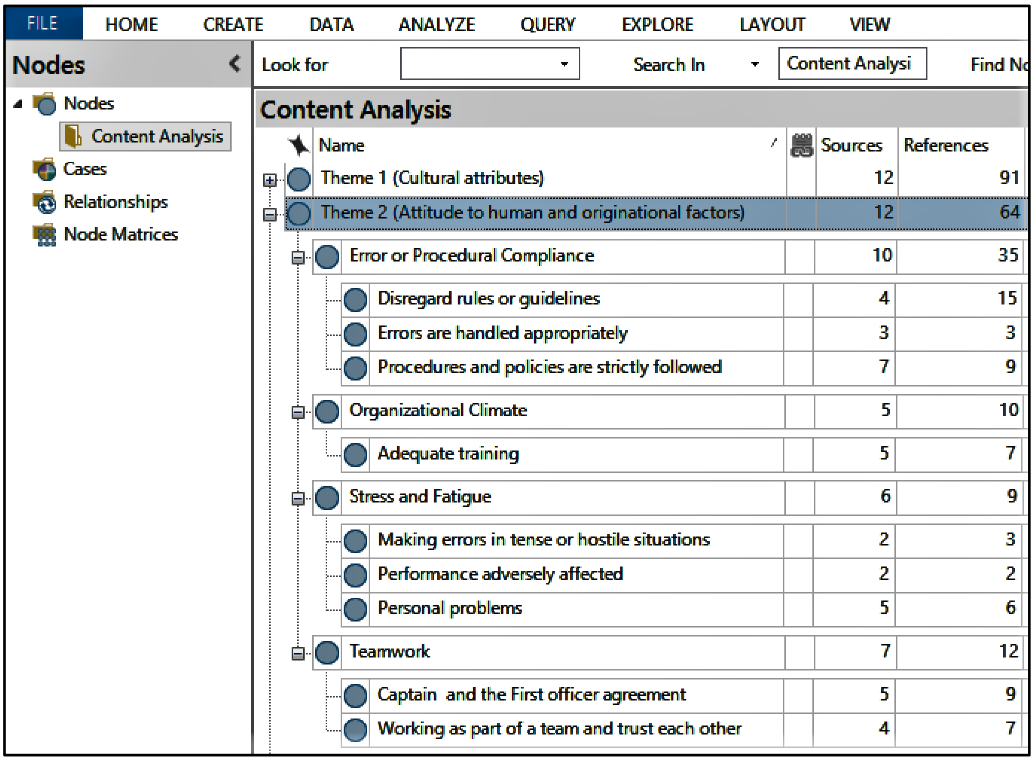


Figure 4-5: Screenshot of NVivo11, theme 2 (parent nodes, child nodes)

According to the content analysis, this theme was divided into four parent nodes, as shown in (Table 4.11), which expresses participants' attitudes towards human and organisational factors.

Table 4-11: Theme 2 parent node summary

❖	Node	No. of Sources	No. of References
❖	Theme 2 (Attitude towards human and	12	63
1	Error or Procedural Compliance (Parent node)	10	35
2	Organisational Climate (Parent node)	5	10
3	Stress and Fatigue (Parent node)	6	9
4	Teamwork (Parent node)	7	12

In addition, each parent node was divided into a number of child nodes as the criteria most significantly affecting pilots in the cockpit within the NAR according to the descriptive analysis. The findings are outlined below.

❖ Error or Procedural Compliance (Parent node)

The first parent node in this theme is (Error or Procedural Compliance), and the researcher tried to understand the participants' attitudes towards human error and compliance with SOPs in flight. The descriptive analysis showed that 10 participants gave 24 comments regarding these criteria, as shown in (Table 4.12). The findings illustrate that most of the pilots from the study sample had positive awareness of the importance of error or procedural compliance in good decision-making performance.

Table 4-12: First parent node summary in (theme 2)

Theme 2	Parent Node	No. of Sources	Agreed	Disagreed	No. of References
1	Error or Procedural Compliance	10	9	1	24

Nine pilots agreed with the interview question regarding proper error management and procedure compliance, and just one pilot disagreed, (see Table 4.12). In addition, for a better understanding of these parent node findings, it was divided into three child nodes derived from the content analysis of the interview data, as shown in (Table 4.13).

Table 4-13: Child node summary in first parent node (theme 2)

❖	Child Node	No. of Sources	No. of References
1	Disregard rules or guidelines	4	15
2	Errors are handled appropriately	3	3
3	Procedures and policies are followed	7	9

Accordingly, the first child node is (Disregard rules or guidelines), which expresses the extent to which these pilots fail to comply with their organisational role. In this node, four pilots out of 10 gave 15 comments, where all of them showed positive awareness of the importance of complying with the company role. For example, P11 (F) stated, ‘The pilots who I flew with flew based on these roles’, and P1 (C) stated, ‘It’s all about discipline and following the procedure’. However, some of these pilots stated that not all pilots comply with their organisational role. For example, P12 (C) said, ‘There are always kinds of indiscipline on all flights’ and P6 (F) said, ‘I don’t think they work according to the safety procedures’.

The second child node is (Errors are handled appropriately), which shows how these pilots and their organisations deal with errors. Three participants out of 12 gave three comments regarding this factor. Two of the participants expressed their satisfaction with error handling in the cockpit. For example, P10 (F) said, ‘We have the captain report system without names, and you write what you want and put it in the specified place’ and P4 (C) said, ‘You can say that for most of us, when something happens in the system, we try to discuss the issue; we don’t go directly to the book’. However, P6 (F) mentioned that his company did not apply a performance-monitoring system to check pilot compliance. He said, ‘Some pilots don’t follow the SOPs of the company, because there aren’t checks or programmes to record or analyse mistakes’.

The last child node in this factor is (Procedures and policies are followed), which shows the extent to which these pilots strictly follow the operation procedures, as shown in Table (4.13). Seven pilots out of 12 gave nine comments, in which most of them showed positive awareness of the importance of following flight operation producers. For example, P1 (C) said, ‘To be professional, you have to follow your decisions and you have to follow the procedure accordingly’ and P12 (F) said, ‘Some of them are very disciplined’. However, some of these participants mentioned that some pilots who work in these organisations do not strictly follow the procedures. For example, P11 (F) stated, ‘He does not accept discussion regarding his procedures and he breaks the rules’.

In summary, the majority of the participants had positive awareness of the importance of error or procedural compliance to safety. For example, P1 (C) stated, ‘The more disciplined the co-pilot, the more committed he is to the SOPs of the company and the better his decision-making’. In addition, some weaknesses in pilots’ compliance with procedures and following SOPs were noted by P12: ‘captains do not follow SOPs properly’ and they ‘descend below the minimum’. In addition, P6 (F) mentioned that his organisation did not have a system of monitoring pilot performance, which shows a lack of error handling and risk assessment in the cockpit.

❖ **Organisational Climate**

Organisational climate is the second parent node in theme 2, and the researcher tried to understand the participants’ perceptions of their organisations’ events, procedures and practices, which have direct impacts on behaviour and performance (Patterson and Dawson, 2005). Five participants out of 12 gave seven comments regarding this node, as shown in (Table 4.14). The findings of this parent node showed that most of the participants are satisfied with the training offered by their companies. Three out of five were very satisfied and agreed to the criteria, and two participants were not satisfied and disagreed (see Table 4.14).

Table 4-14: Second parent node summary in (theme 2)

Theme 2	Parent Node	No. of Sources	Agreed	Disagreed	No. of References
1	Organisational Climate	5	3	2	7

Therefore, one child node was derived from this parent node according to the interviews answers (see Table 4.15). This child node was named as (Adequate training). Five pilots commented on this node. Three pilots commented that they were very satisfied with the training programme in the company. For example, P8 (F) stated, 'The training that we had was very good from very qualified people' and P9 (F) stated, 'It was very good; we did our training in Toulouse in France with a very experienced instructor'.

Table 4-15: Child node summary in first parent node (theme 2)

❖	Child Node	No. of Sources	No. of References
1	Adequate training	5	7

However, two of these participants said that their companies suffered from a lack of training. For example P10 (F) stated, 'I can say that there is a lack of training and CRM program in our company'. Accordingly, the majority of the commenting pilots believed their company offered adequate training for their staff. However, these pilots facing some difficulties in making good decisions, which might be connected to the lack of training at some levels, as said by P12 (F): 'The difficulty comes from the lack of training'.

❖ Stress and Fatigue

The third parent node is stress and fatigue, which plays a crucial role in decision-making in the cockpit. According to Flin et al. (2006), individuals are more likely to make errors when they are fatigued or under stress. In addition, it negatively affects teamwork, which adversely affects the pilots' decision-making performance in the cockpit. In general, the pilots indicated a positive awareness regarding the negative effect of stress and fatigue on the decision-making performance among these participants. In addition, this node showed that six participants out 12, as shown in (Table 4.16), expressed their opinions regarding this node in nine comments, which emphasised a positive awareness of the negative role of stress and fatigue in the cockpit. Four participants disagreed with the statement on the consequences of stress and fatigue on the pilot's decision-making in the cockpit, and just two agreed with the statement, which reflect their negative influence of stress and fatigue in the cockpit, (see Table 4.16).

Table 4-16: (Stress and Fatigue) the third parent node summary

Theme 2	Parent Node	No. of Sources	Agreed	Disagreed	No. of References
3	Stress and Fatigue	6	2	4	9

This parent node was divided into three child nodes, (see Table 4.17). The first child node, (Making errors in tense or hostile situations), shows the extent to which stress and fatigue can cause these pilots to commit errors in the cockpit. Two pilots agreed that stress plays a negative role in the cockpit. For example, P8 (F) stated, 'Some pilots ignore the small issues to avoid stress, which might lead to bigger mistakes' and P7 (F) stated, 'The problem we face with the captains is that they are always stressed and touching the controls'.

Table 4-17: Child node summary for third parent node (theme 2)

❖	Child Node	No. of Sources	No. of References
1	Making errors in tense or hostile	2	3
2	Performance adversely affected	2	2
3	Personal problems	5	6

The second child node is (Performance adversely affected), and the researcher tried to understand the impact of stress and fatigue on participants' performance. Two pilots expressed that they try to avoid that to keep their performance sufficient. For example, P12 (F) said, 'I try to avoid letting issues affect my flight performance'.

Personal problems is the third and last node, and the researcher investigated if the pilots in the cockpit are aware of each other's personal problems. Five pilots commented on this node, four of them disagreed to the negative impact of personal problem on their performance by saying that pilots are ignoring their personal problems in the cockpit. An agreement with the effect of personal problems in the cockpit was described by P6 (F). When asked, 'Do others consider your personal problems?' he said, 'It always makes me stressed in flight'.

In summary, there was a positive awareness of the negative role of stress and fatigue on decision-making performance. However, the researcher noticed that only six participants commented on this child node, which is very weak and might represent poor knowledge of the crucial role of stress and fatigue in the cockpit among other pilots.

❖ **Teamwork**

The fourth parent node is teamwork behaviours, which are crucial to enhance safety performance (Flin et al., 2006). The researcher tried to understand how much these pilots appreciate teamwork in the cockpit. The findings showed that 7 participants gave 12 comments regarding teamwork in the cockpit. The findings of this parent node indicated that the majority of these pilots emphasised that the teamwork in the cockpit is very weak. Five participants disagreed that there is teamwork in the cockpit, and just two pilots stated that they were satisfied with the teamwork and the crew trusting each other during flight, as shown in (Table 4.18)

Table 4-18: Fourth parent node findings summary (theme 2)

Theme 2	Parent Node	No. of Sources	Agreed	Disagreed	No. of Reference
4	Teamwork	7	2	5	12

In addition, two child nodes were derived from this parent node according to the content analysis as the most effective criteria of teamwork in the cockpit, as shown in (Table 4.19). The first child node is (Captain and the first Officer agreement), which explains the synchronisation among the crew in their work as a team. Four pilots commented on this node. Three of them stated that teamwork is very weak. For example, P9 (F) stated, ‘flying with captain that has more than 15000 flying hour of experience which sometimes deviate from the main point of flying, I mean I cannot give him an advice it is difficult’. Moreover, P12 (F) said, ‘If he makes a mistake and I tell him it’s wrong and you have to do so and so, he does not accept that from me’. These comments indicate a weakness in the agreement among the crew.

Table 4-19: Child nodes summary for forth parent node (theme 2)

❖	Child Node	No. of Sources	No. of References
1	Captain and the First Officer	4	8
2	Working as part of a team and trust	5	8

The second child node, (Working as part of a team), aimed to understand if the participants work as part of a team and complete each other. The findings indicated that five pilots mentioned this child node in eight comments. Just one pilot agreed that he felt he was working as part of a team. For example, P1 (C) stated, ‘The decision-making is always synchronised in the cockpit’. The other four participants disagreed with this child node. For example, P9 (F) stated, ‘In general, about 60% of environments are not collaborative and harmonious’.

In summary, this parent node shows that the majority of the pilots from the study sample were not satisfied with the teamwork in the cockpit, which represents a high risk of low pilot decision-making performance.

4.9.3 Theme 3: System Design and Automation

In this theme, the researcher tried to understand how the current advanced technology in the cockpit affects pilots’ decision-making performance within the North Africa region. Merritt and Maurino (2004) stated that when a pilot from one culture flies in a cockpit made by a different culture, it introduces uncertainty due to cross-cultural differences in the cockpit. This uncertainty could be due to social or economic variables that differ from culture to culture. For example, the advanced safety technology in the cockpits from developed countries might confuse pilots from developing countries that do not have the infrastructure to support it (ICAO, 2004). Thus, it is crucial to measure how these pilots interface with the advanced technology in the region.

This theme was divided into three parent nodes that represented the theme. As shown in (Figure 4.6), a screenshot of NVivo11, these three parent nodes were derived from the literature as the factors having the greatest effect on the pilot's interface with automation in the cockpit. In addition, the participants emphasised that these three parent nodes were the biggest problems according to the descriptive frequencies of these criteria in the interviews.

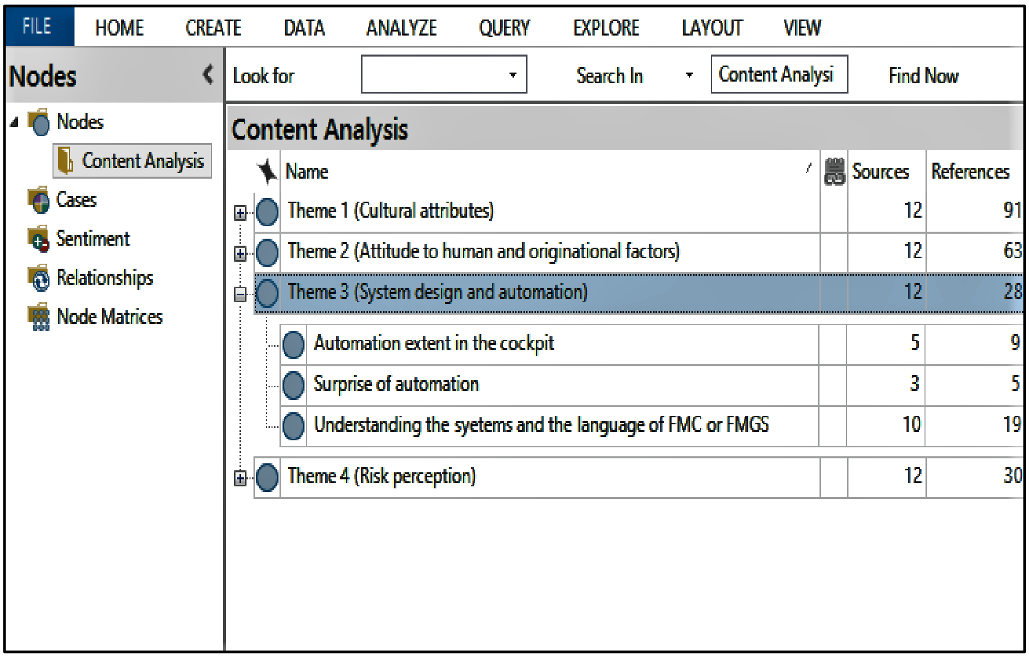


Figure 4-6: Screenshot of NVivo11, theme 3 (parent nodes)

Content analyses were applied to these three criteria: automation extent in the cockpit, surprise of automation and understanding the language of FMC/FMGS, as illustrated in (Table 4.20).

Table 4-20: Theme 3, parent node summary

❖	Node	No. of Sources	No. of References
❖	Theme 3 (System design and automation)	12	28
1	Automation extent in the cockpit (Parent node)	5	9
3	Surprise of automation (Parent node)	3	5
4	Understanding the language of FMC/FMGS	10	19

The participants' responses to the interview questions were descriptively analysed, as shown in (Table 4.20). As mentioned earlier in this chapter, (No. of Sources) represents the number of participants that answered these criteria, and (No. of References) represents the number of comments of all interviewees for each criteria. **Note:** that there could be multiple references for one criterion. For example, there were 28 references for theme 3 (system design and automation). This does not mean that 28 references are count of the three parent nodes references in this because one reference may be assigned to more than one parent node as shown in (Table 4.20).

The findings indicated that 28 comments were derived from 12 participants in the interviews and showed a weakness in dealing with advanced technology at some level. The question of this theme was 'Do you face problems with advanced technology in the cockpit?' Seven pilots agreed that they faced problems with dealing with advanced technology, and five participants disagreed with the question, as they felt satisfied with their ability to use advanced technology in the cockpit, as illustrated in (Table 4.21).

Table 4-21: Theme 3 findings summary

❖	Node	No. of Sources	Agreed	Disagreed	No. of References
❖	Theme 3 (System design and automation)	12	7	5	28

Accordingly, more than half of the pilots in the study sample agreed that they faced problems with advanced technology in the cockpit, and to further clarify these findings, each parent node is discussed in more detail below.

❖ **Automation extent in the cockpit**

This parent node was derived from the interviews to understand the extent to which these participants accepted the current level of automation in the cockpit due to evidence of the existence of new pilot errors in the cockpit (e.g. unawareness of the mode characteristics of the aircraft). The findings of this parent node indicated that five participants commented on these criteria. Four of them agreed that they had gone too far with the advanced technology, and just one disagreed, as shown in (Table 4.22).

Table 4-22: First parent node findings summary (theme 3)

Theme 3	Parent Node	No. of Sources	Agreed	Disagreed	No. of References
1	Automation extent in the cockpit	5	4	1	9

Interestingly, three of the participants who agreed with the question were first officers. For example, P9 (F) said, ‘Learning how to adapt to a specific type of rating, like a glass cockpit, was very hard, and understanding the FMC took me a while’. In addition, just one captain agreed with this question. P2 (C) said, ‘It’s not like conventional aircrafts with cables’. The last participant in this parent node was satisfied with the automation extent in the cockpit. P3 (C) said, ‘New modern technology is always very clear and does most of the work. You do not have to search; everything is clear if you just read, do and follow’.

❖ **Surprise of automation**

This parent node expresses surprising situations related to aircraft performance, which means that there are still weaknesses in the pilot’s mental model of the automated environment where the actual performance differs from the expected performance. The findings of this parent node illustrate that three participants mentioned this criteria as a point of weakness in the cockpit, as shown in (Table 4.23).

Table 4-23: Second parent node findings summary (theme 3)

Theme 3	Parent Node	No. of Sources	Agreed	Disagreed	No. of Referen
2	Surprise of automation	3	3	0	5

Accordingly, the majority of the participants agreed that they still get surprised by the automation in the cockpit. For example, P2 (C) said, 'To be honest, in modern aircrafts, there are some new things that come out, but there is always a computer that you can reset, which is the circuit breaker'. Moreover, P (F) stated, 'Ok, I will say there are some pilots that don't understand the FMC, the process or how to interpret it'.

❖ **Understanding the systems and the language of FMC/FMGS**

This parent node was derived from the participants' answers to the interview questions according to the content analysis that represented the extent to which the participants in the study sample understood the systems and the automation terminology in the cockpit. According to Western aircraft manufacturers, this terminology is an issue involving cross-cultural differences in the cockpit, as it is affected by the different culture and environment. Interestingly, the findings of this parent node indicated a high number of participant comments, where ten pilots out of twelve gave 19 comments regarding difficulty in understanding the system and terminology in the cockpit, as illustrated in (Table 4.24).

Table 4-24: Third parent node findings summary (theme 3)

Theme 3	Parent Node	No. of Sources	Agreed	Disagree	No. of References
3	Understanding the systems and the language of FMC/FMGS	10	6	4	19

Accordingly, the question of this theme was, 'Do you face any problems with the systems and the language of FMC/FMGS?' As shown in (Table 4.24), six pilots agreed that they faced problems with understanding the systems and language of FMC/FMGS. For example, P1 (C) said, 'I think there are some who face problems entering information to the system, interpreting messages or dealing with the functions of some systems or function problems'. Moreover, P4 (C) said, 'It's either due to a lack of knowledge or a misunderstanding of the system itself, you know'. In addition, the first officers showed this weakness. For example, P5 (F) stated, 'Misunderstanding of the system' and P6 (F) said, 'Ok, I will say there are some pilots that don't understand the FMS, the process or how to interpret it'. In summary, the majority of the participants in this study stated that there is misunderstanding of systems and language of the FMC/FMGS and both Captains and First officers agreed that they had problems with understanding the systems and language of the FMC/FMGS.

4.9.4 Theme 4: Risk Perception

The notion of risk perception refers to the intuitive risk judgments of individuals and social groups in the context of limited and uncertain information (Slovic, 1992). How risk is understood depends partly upon theoretical perspectives from which risk is studied and paradigms on the study of human behaviour. This theme is crucial to enable the researcher to understand what are considered high-risk events by the participants (objective risk) during flight by measuring the risk perception of the participants in the study sample objectively. To this end, the researcher asked the participants, 'What is the riskiest event or situation in flight you could imagine or you have faced in your flight experience?' The findings showed that 12 participants gave 30 comments indicating the riskiest event or situation according to their risk perception, as illustrated in (Figure 4.7).

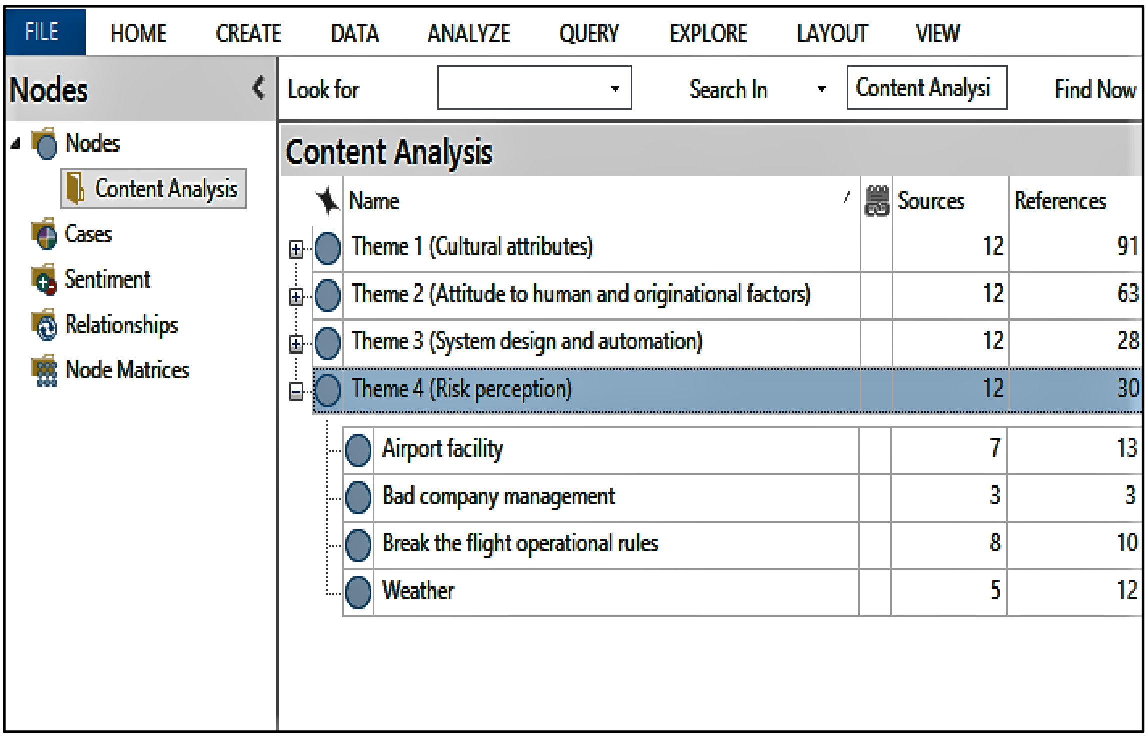


Figure 4-7: Screenshot of NVivo11, Theme 4 (parent nodes)

Accordingly, the findings showed that the participants mentioned 30 comments describing risky events from their experience, and according to the content analysis, these 30 risky events were classified under four parent nodes: airport facilities, bad company management, break the flight operational rules, and weather, as shown in (Table 4.25).

Table 4-25: Theme 4 (risk perception) and parent node summary

❖	Node	No. of	No. of
❖	Theme 4 (risk perception)	12	30
1	Airport facilities (Parent node)	7	13
2	Bad company management (Parent node)	3	3
3	Break the flight operation rules (Parent node)	8	10
4	Weather (Parent node)	5	12

Thus, the participants emphasised that these risky events, according to their risk perception, were direct or indirect results of these four criteria, and to further clarify these findings, each parent node is discussed in detail below.

❖ **Airport facilities**

In this parent node, seven pilots stated that the riskiest event was either a direct or indirect impact of the lack of facilities in some of the airports within the region. Thirteen comments were taken from the interview transcripts, as shown in (Table 4.26).

Table 4-26: First parent node findings summary (theme 4)

Theme 4	Parent Node	No. of Sources	No. of References
1	Airport facilities	7	13

The participants stated some problems with the airport facilities, like poor weather forecast stations. For example, P11 (F) stated, 'We do not have good weather forecasts'. Moreover, P3 (C) said, 'The biggest problem that we always face is the shortage of airport facilities. Most of the jobs must be done by the pilot due to weaknesses in many of the facilities, like poor weather forecasts, which sometimes leads to rules and SOPs'. In addition, some of the participants mentioned the uncontrolled vehicle movement in the airport. For example, P4 (C) said, 'The uncontrolled vehicle movement inside the airport itself' and P5 (F) said, 'Civilian cars and buses moving on the terminal without any permission from the ATC'.

❖ **Bad company management**

The second parent node was bad company management, and the participants indicated that the management level of their company played a negative role and increased the risk of accidents during flight. The analysis of this parent node indicated that three pilots stated that their companies were not active in reducing the risk level in flight operations, as illustrated in (Table 4.27).

Table 4-27: Second parent node findings summary (theme 4)

Theme 4	Parent Node	No. of Sources	No. of References
2	Bad company management	3	3

Accordingly, each of these three pilots gave a comment. For example, P (3) said, 'We have a weakness in the company management and in the government flight department' and P (9) stated, 'To be honest, I am just concerned about the management in our company regarding their priorities in flight operation'. Clearly, they thought that there were some weaknesses at the management level in their companies regarding safety priorities during flight operation.

❖ Break the flight operation rules

This parent node describes participants' risk perceptions of risky events resulting from pilots breaking the flight operation rules during flight in the cockpit. The findings illustrated that eight pilots gave 10 comments on this parent node, as shown in (Table 4.28).

Table 4-28: Third parent node findings summary (theme 4)

Theme 4	Parent Node	No. of Sources	No. of References
3	Breaking the flight operation rules	8	10

The participants indicated 10 high-risk situations where the pilots broke the flight operation rules. For example, P12 (F) stated, 'descended below the minimum' and P1 (C) noted, 'indiscipline in the cockpit'.

❖ Weather

The last parent node in this theme is weather. In this parent node, the participants showed their actual risk perceptions of weather in the cockpit, which is one of the riskiest events during flight (Eurocontrol, 2013). The findings showed that five pilots mentioned that they found weather events risky by giving 12 comments, as indicated in (Table 4.29).

Table 4-29: Fourth parent node findings summary (theme 4)

Theme 4	Parent Node	No. of Sources	No. of References
4	Weather	5	12

The riskiest events mentioned in the 12 comments by the pilots included low visibility, wind shear, fog, turbulence and bad weather. For example, P1 (C) stated, ‘There was low visibility, so we did an ILS approach from Tripoli Airport. Suddenly, we heard wind shear’ and P2 (C) said, ‘Because of bad weather and bad NAV aids’. In addition, P6 (F) stated, ‘The lack of information, especially during bad weather. When that happens, they face confusion; they can’t specify the problem. For example, when there is bad weather and visibility below the minimum’.

4.10 Chapter summary

In summary, this chapter analysed the qualitative data obtained by implementing the semi- structured interview tool using NVivo11. The analysis relied on the four themes that were found to be the most important criteria to understand the participants' risk perception (objectively and subjectively), and the findings of these themes were derived from the interviewees' responses, as noted below.

The findings showed that cultural attributes played a negative role in the pilot's decision-making in the cockpit due to the power distance, where the participants perceived the leadership form in the cockpit as autocratic. This form of leadership can be clearly seen in the participant's answer indicating that first officers are afraid to express disagreement with the captains' decisions. In addition, it can be clearly seen in their inability to discuss captains' decisions, as these captains do not accept that from less experienced pilots. This view of the leadership in the cockpit represents a high risk to pilots' decision-making performance as a team. Furthermore, some pilots perceived the captains who encouraged suggestions as weak leaders who should fly the aircraft in non-standard situations. In general, the findings on cultural attributes indicated that the majority of the participants were influenced by the power distance criteria in the cockpit and that it played a negative role in the cockpit. The other three criteria related to cultural attributes did not have a real impact on these pilots. Most of them showed a positive awareness of uncertainty avoidance, religious beliefs/norms and social relationships.

It is also apparent from the findings that the majority of the participants showed positive attitudes to human factors and organisational factors in the cockpit for most of this theme's criteria. However, the finding indicated that the majority of these pilots emphasised that the teamwork in the cockpit was very weak and there was no harmony among the crew. In general, the participants had problems working as a team in the cockpit, which is a high risk to these pilots' decision-making performance.

In addition, it can be seen that the participants faced some problems with advanced technology, as they stated some weaknesses in dealing with the rapid development in the technology. Moreover, some of the pilots expressed experiencing surprising situations with the technology in the cockpit. In addition, the majority of the participants indicated that they faced problems with understanding the system and terminology in the cockpit. In general, these participants faced some problems with the advanced technology in the cockpit, especially understanding the systems, and this is something that needs to be considered by the companies' management.

Lastly, the majority of the participants demonstrated high risk perceptions of the weather conditions in the cockpit and the airport facilities, especially the facilities providing the weather forecasts, which indicates the importance of weather risk perception to these pilots. Moreover, some pilots mentioned that the management of their companies were responsible for increasing the risk during flight, as they did not employ data analysis programmes to monitor the pilots' performance and improve safety in their companies.

5 CHAPTER FIVE: Findings of Quantitative Data

5.1 Introduction

This chapter focuses on analysing the quantitative data. The SPSS software programme has been chosen to analyse the quantitative data. The analysis was performed relying on a questionnaire as the method of qualitative data gathering, as mentioned in (Chapter 3, Section 3.8.3). The output of this analysis will assist in evaluating and assessing the performance of a pilot's decision-making in the light of their risk perception, as well as enhancing pilot decision making performance and mitigating pilot error. In addition, it will improve technical skills and cultural awareness (non-technical skills) of pilots in the region of North Africa.

An effective research approach, design and procedures were followed in order to meet the above goals. The approach for this study was the triangulation approach (see Chapter 3, Section 3.5.1.2), which relied on a mixed method approach, by using the convergent parallel design. This chapter deals with the questionnaire method as a second method of the study primary data. The questions outlined in this survey form have a range of areas for investigation, which include but are not limited to the influence of cultural factors in the North African region that impact on pilot decision-making performance (subjective risk) and the greatest physical contributing factors involved in a pilot's decision-making process (objective risks), (Hansson, 2010). It also looks at how these pilots behave in reality in response to fictional scenarios that could happen in real flight. **Note:** that a copy of the questionnaire was added in the end of this chapter.

5.2 The Questionnaire Distribution and Response

In this study the questionnaire was built to answer the research questions and meet the research objectives. The questionnaire was divided into four main themes. The first theme explores the cultural attributes that impact a pilot's decision-making in light of their risk perception. The second theme is the pilot's attitude to human and origination factors. The third theme is the system design and automation in the cockpit. The last theme is the risk perception of pilots in the cockpit, in addition to the respondents' profiles.

The research is concerned with the NAR as specified in (Chapter 2, Section 2.3). The researcher aimed to reach different countries in the region, in order to amplify the study sample size, accuracy and reliability. The quantitative data collection samples were restricted to five countries for the availability and ease of communication. Involving more countries was not possible due to lack of financial support and difficulty to travel. Two means have been used to distribute the survey: Qualtrics software and hard copies.

5.3 The Strategy of the Questionnaire Design

The designed questionnaire gave more ability to the researcher to reach as many as possible of the respondents, thus adding rigour to the study sample. The target sample of this study was professional pilots in the NAR. Likewise, a clear and simple question was attached to the first page of the survey which describes the idea of the research focus, and its use of both hard copy and the Qualtrics software (see appendixes B and C)

The questionnaire employed in this research has fulfilled all ethical requirements as passed by the Cranfield University ethical policy (reference: CURES/1029/2016), (see appendix E). Accordingly, the data includes 143 responses, collected from North African pilots from different levels. All the responses are anonymised, according to the ethical requirement.

Likewise, the questionnaire design was built upon the research strategy mentioned in (Chapter 3, Section 3.8), and was divided into four themes. In addition to the participant profiles as mentioned earlier, the next paragraphs discuss each theme in more detail.

Theme 1: Cultural Attributes

This theme includes four factors which are believed to be the most significant criteria in the NAR culture, namely: power distance, uncertainty avoidance, social relationships and religious beliefs/norms. Each of these factors is measured with a number of closed-ended questions. All the factors are chosen from a literature review of the previous researches and current literature of aviation safety, for example the power distance & uncertainty avoidance factors are adopted from the Flight Management Attitudes Questionnaire (FMAQ), which are considered as successful discriminators identified in the country-level analyses of 14 countries in a replication study performed by Merritt (1996) cited (The National Culture and Work Attitudes in Commercial Aviation: A Cross-Cultural Investigation). All chosen questions were based on initial findings of the interviews in the qualitative data analysis. The social relationships and religious belief factors were also considered in the decision making process, because these factors are important characteristics of North African culture and they have a direct or indirect impact on risk perception (see Chapter 2, Section 2.7.1). Furthermore, all these questions were modified in order to be easily understood by the study sample.

Theme 2: Attitude to Human Factors and Origination Factors

This theme is pilot attitudes to human factors and origination factors. This is discovering the participant's attitude to five factors: stress and fatigue, teamwork, work values, error/procedural compliance and organizational climate. These factors were adapted from the Operating Room Management Attitudes Questionnaire (ORMAQ) and modified to be easily understood by the study sample. The ORMAQ has been conducted as part of the non-technical skills for surgeons project published by Flin et, al., (2006). The importance of implementing this theme in this research is to understand pilot attitude to human and organizational factors, which can have a crucial impact on effective team performance and consequently on safety performance in the cockpit (Yule et, al., 2004).

Theme 3: System Design/Automation

The third theme is automation, which has been adapted from a survey that was developed by the Bureau of Air Safety Investigation (BASI) to explore the safety issues of advanced technology aircraft (BASI, 1998). The questions have been modified and some items were added to fit the study sample and to know how much these pilots cope with modern technology and discover any adverse effects on decision making performance; or even the non-acceptance of this modern technology.

Theme 4: Risk Perception

The risk perception theme was built to evaluate the North African pilot's actual risk perceptions and tolerance risk in the cockpit. The Hunter scale (Hunter, 2006), has been adopted, as mentioned in (Chapter 2, Section 2.10.4.3). This scale consists of two scales (Risk Perception 2- Self scales and Risk Perception 1- Other). Due to the inability to implement all questions for scale one and all the scenarios of scale two five questions and five scenarios have been chosen from each scale as follows: according to the item's order number in the original Hunter scale one (Risk Perception 1- Other) questions are (1, 2, 3, 4, and 6) and for scale two (Risk Perception 2- Self scales), the scenarios are (4, 8, 9, 15 and 19) which are five questions and five scenarios. All these questions and scenarios were chosen depending on their clarity to fit the participants' understanding.

Demographic Section

This part of the survey mainly focuses on the study sample, where each participant's background is given. In addition, private and personal information, such as names and any recognisable features are avoided, as per the University policy. This section is included only to demonstrate the sample characteristics of the study.

5.4 Sampling Strategy

This study concerned with aviation safety including the cultural aspects, therefore, choosing an appropriate sampling method was very important due to the sensitivity of the aviation industry and the cultural aspects of each group of people. The snowball sampling method is more suitable for studies interested in sensitive populations who are hard to reach, and where there is a difficulty in compiling a list of the population (Etikan, 2016). In addition, the snowball sampling technique can be very active when there is ambiguity of the size of the population; also, the researcher used this sampling method because the sample of the study is limited to active professional pilots in the NAR who are considered to be a subgroup of the population of NAR. The sampling technique of snowball method facilitated reaching the participants by identifying initial subjects such as pilots, aviation companies, and aviation departments and provided assistance to identify and communicate with other participants. It is then down to the researcher to stop considering more responses when satisfactory or sufficient relative data has been gathered (Dragan et, al., 2013).

Accordingly, the snowball sampling technique is suitable for this study as an exploratory research. The non-probabilistic convenience sampling with snowball technique enables the researcher to gain initial respondents through professional pilots, the Libyan Civil Aviation Authority (LCAA) and the Aviation Safety Department (ASD) in Libya as well as through aviation companies in Libya, which enabled the researcher to distribute the questionnaire to the professional pilots in the region of North Africa who represent the population.

The aimed means to distribute the survey was through hard copies but due to the difficulties mentioned in (Section 5.2) during the data collection stage the researcher was forced to implement another means which is Qualtrics software. This software is licenced and provided by the university and it gives the researcher more ability to generalise the survey among professional pilots in the NAR. Therefore, two means were used to distribute the survey: Qualtrics software and hard copies. Of the hard copies that were distributed to reachable participants, about 200 copies were distributed. 58 valid responses were collected, which constitutes about 20% of the distributed copies.

In addition, it was very difficult to reach all countries and aviation companies in the region. Adhering to the recommendation of the Libyan civil aviation authority to distribute the survey link to some aviation companies in the region, the target sample size was 450 professional pilots at different levels. 85 valid responses were collected by using the Qualtrics software. The Libyan aviation companies collaborated in distributing the survey. Also a number of friends in the field assisted in distributing it to a number of pilots in these countries.

A sum of 143 responses were collected through the use of Qualtrics software and distributed hard copies. According to (Creswell, 2006), a specified sample size is more needed in quantitative research to rigor the outcome of the study. This study aims to understand the pilots' behaviour in the cockpit, a study with sample size of less than 30 or larger than 500 have no justification in behavioural research (Robin, 1998). In addition, the estimated active professional pilots in the NAR are about 1500 (CAE, 2017). Thus, according to (Robin, 1998), the sample size within the limits of (30 to 500) is recommended when it represents 10% of the sample population. The responses collected for this study were 143 and considered to be about 10% of the active professional pilots in the NAR, thus regarded to be a satisfactory and realistic figure for this study.

5.5 Findings

The analysis of the quantitative date mainly considers four main themes: cultural attributes, attitude to human factor and origination factors, system design and automation, and risk perception. The analysis strategy of quantitative data in this chapter is built on answering the research questions, which are appraising the national cultural influence on a pilot's decision making, a pilot's interface with system design and automation in the cockpit, and the pilot's risk perception level. The next paragraphs offer a description of the study sample countries of origin.

5.5.1 Participant's Country of Origin

The research area of this study is concerned with the North Africa region, as mentioned in (Chapter 2, Section 2.3). Thus, the researcher aimed to reach different countries in the region in order to amplify the sample size, accuracy and reliability. Samples were distributed to five countries in the region: Libya, Egypt, Sudan, Tunisia and Mauritania. The data collection sample was restricted to these countries for availability and ease of communication. Involving more countries was not possible due to lack of financial support and difficulty to travel.

Adhering to the recommendation of the Libyan civil aviation authority and the department of aviation safety the survey was distributed to certain aviation companies in the region, which can be easily contacted and helped in distributing the survey locally within their countries through Qualtrics software. The total number of valid responses received from these countries (including Qualtrics & hard copies) were 143 (see Figure 5.1).

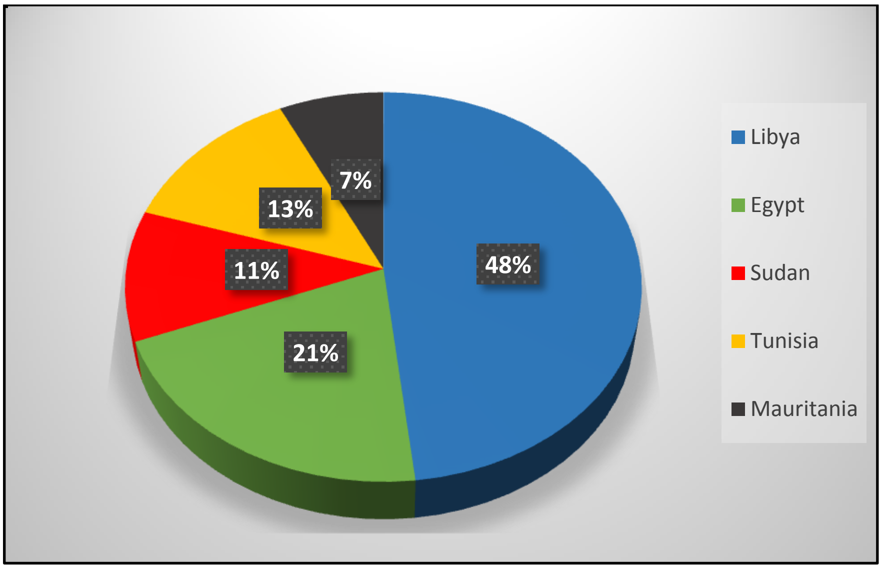


Figure 5-1: Sample size by country

5.5.2 Respondent's Current Position within the Company

It was important to discover the current position of all respondents so that any variations in attitudes between the captains and first officers could be identified, and so that any differences in the expertise in risk evaluation within the cockpit of these two grades of personnel could also be seen. As shown in (Figure 5.2), 73% of the sample were at First Officer level, and 27% were at the level of Captain.

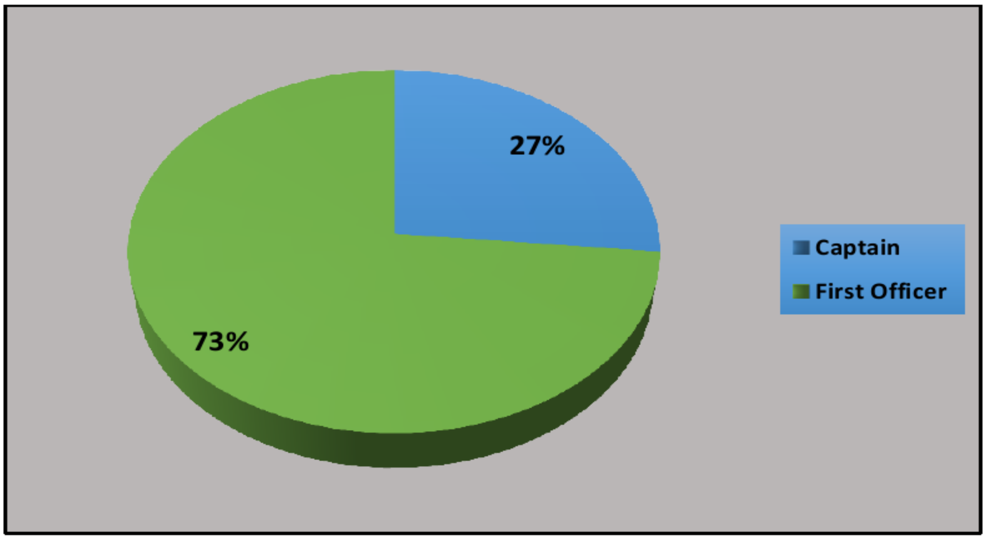


Figure 5-2: Positions of the Respondents

5.5.3 Question One

"To what extent does the North African regional culture affects the pilot's decision-making performance in the cockpit?"

In this section of the analysis the researcher is answering the above research question by describing the findings of theme one and theme two in the questionnaire, considered to be theme one and theme two, which represents the national cultural impact on a pilot's decision making in the cockpit. Likewise, this result is discovering the cultural attribute and attitude to human and organisational factors in the cockpit on a pilot's risk perception within the

North Africa region. Both themes consist of a number of factors and each factor was included with a number of variables. The next paragraphs illustrate these findings in detail.

5.5.3.1 Cultural Attributes (Theme 1)

This part of the survey sought to determine North African regional cultural attributes, in order to understand its actual influence on pilot decision-making performance in the cockpit. Likewise, the factors of this part were chosen according to most and significant criteria of the regional culture in the NAR, as specified in (Chapter 2, Section 2.7.1). This theme included four factors: power distance, uncertainty avoidance, religious beliefs and norms, and social relationship. All these factors were analysed by running the descriptive frequencies of the participant's responses using the SPSS software. The first factor findings are included with a tables and figures of the SPSS output, whereas the remaining factors' findings in this chapter are illustrated with figures only. According to Field, (2013) to optimize the understanding of data that have more than 20 variable is more useful to merely using graphs. All figures and tables are included in (Appendix D). The findings are as follows:

- **Factor One: Power Distance (items from 1 to 5)**

The first factor in this theme is power distance factor (PD), which consists of five items (see Table 5.1). These reflect the extent to which subordinates are accepted and on the diversity of the leadership and power relationships.

Table 5-1: Power Distance (items from 1 to 5)

Item No	Power Distance	Valid	Missing
Item1	F/Os are afraid to express disagreement in the flight deck.	143	0
Item 2	P-I-C should take physical control and fly the aircraft in emergency and non-standard situations.	137	6
Item 3	Captains who encourage suggestions are perceived to be weak leaders.	141	2
Item 4	F/Os shouldn't question Captains' decisions.	142	1
Item 5	In abnormal situations, I rely on P-I-C to tell me what to do.	141	2

The findings indicated that it is very obvious that the PD factor plays a high negative role among North African pilots in the cockpit, which means that the North Africa region has a high power distance, according to Hofstede, (2011) and Phuong-Mai, (2015).

Countries with a high level of power distance have a greater focus on superiors and tend to be autocratic rather than prepared to consult subordinates and share with them in their decisions. This result is obtained from answers of items 1, 2 and 5. Where in item 1 approximately 62% of the participants answered that they either agree or strongly agree that “F/Os are afraid to express disagreement in the flight deck”, in item 2 about 79% of the participants agreed or strongly agreed that P-I-C should take physical control and fly the aircraft in emergency and non-standard situations.

In addition, item 5 displays a high score of agreement 48% with the statement “In abnormal situations, I rely on P-I-C to tell me what to do”. On the other hand, the factor was not approved or supported by participants in item 3 and item 4, where in both questions about 80% of pilots disagreed or strongly disagreed.

Accordingly, for a better understanding of the findings, the next paragraph details each question in this factor, to reveal the valid percentage average of each response, from strongly agree to strongly disagree.

- **Item One**

“F/O are afraid to express disagreement in the cockpit”, showed in (Table 5.2 and Figure 5.3), illustrates that the majority of respondents 62% agreed with the statement. The high score of agreement on this statement means that first officer is afraid to express disagreement with the captain’s decisions, which supports the probability of a strong negative influence of culture on a pilot’s decision making in the cockpit.

Table 5-2: The average percentage of the participant's agreement (item1)

	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly agree	16	11.2	11.2	1.2
Agree	72	50.3	50.3	61.5
Neither Agree nor Disagree	15	10.5	10.5	72
Disagree	31	21.7	21.7	93.7
Strongly disagree	9	6.3	6.3	100
Total	143	100	100	

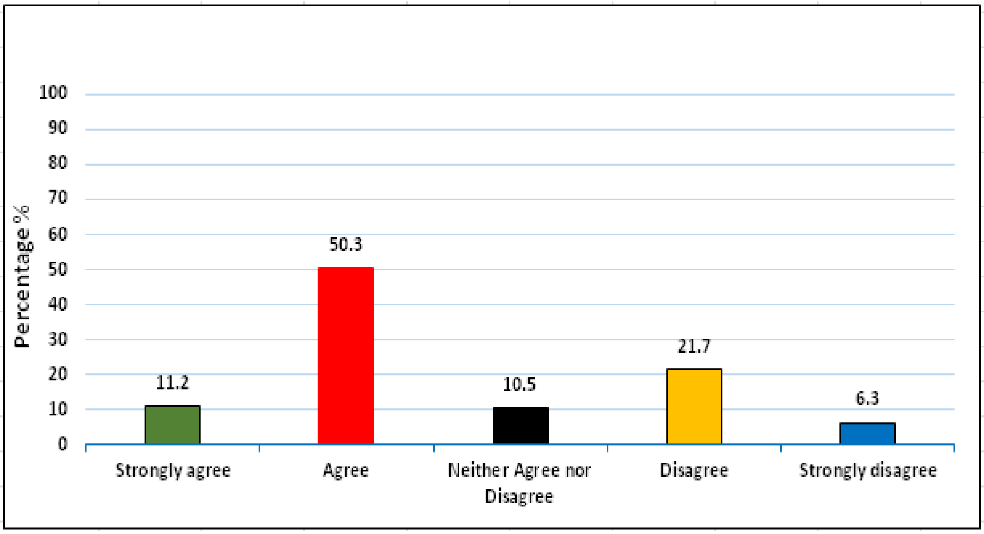


Figure 5-3: The participant's percentage's agreement of item1, (*n*-143)

- **Item Two**

In the second item "P-I-C should take physical control and fly the aircraft in emergency and non-standard situations" (see Table 5.3 and Figure 5.4), 79% of respondents either agreed or strongly agreed with the statement. This is a high level of positive agreement, which means that most pilots agree that the captain should control the air aircraft in emergency and non-standard situations.

Table 5-3: The average percentage of the participant's agreement (item 2)

	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly agree	53	37.1	38.7	38.7
Agree	55	38.5	40.1	78.8
Neither Agree nor Disagree	11	7.7	8	86.9
Disagree	13	9.1	9.5	96.4
Strongly disagree	5	3.5	3.6	100
Total	137	95.8	100	
Missing system	6	4.2		
Total	143	100		

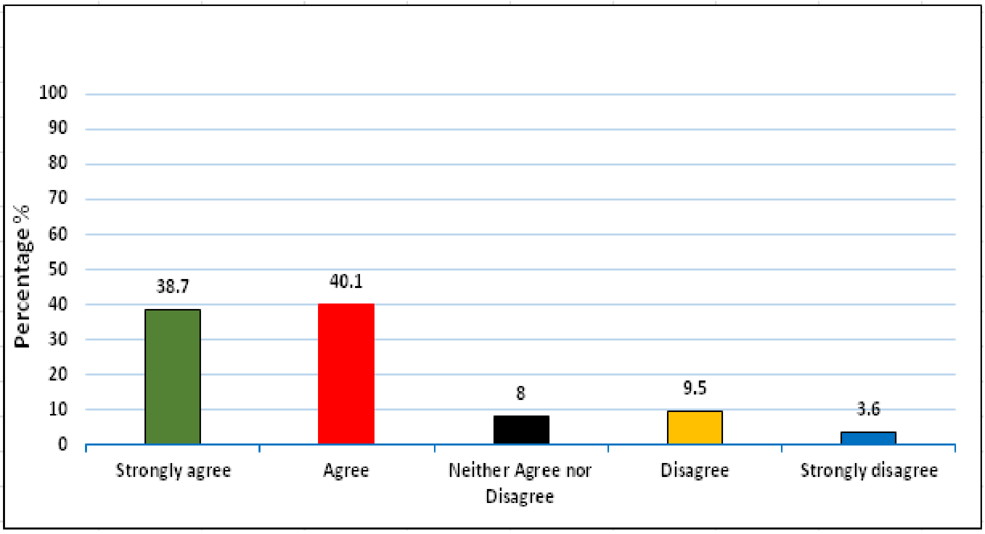


Figure 5-4: The participant's percentage's agreement of item 2, (*n*-137)

- **Item Three**

The third item in this factor is "Captains who encourage suggestions are perceived to be weak leaders". This registered a high negative score. 39.7% disagreed with the statement. 38.3% strongly disagreed. This totals 78% of the pilots in the region not considering such captains weak leaders (see Table 5.4 and Figure 5.5).

Table 5-4: The average percentage of the participant's agreement (item 3)

	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly agree	5	3.5	3.5	3.5
Agree	15	10.5	10.6	14.2
Neither Agree nor Disagree	11	7.7	7.8	22
Disagree	56	39.2	39.7	61.7
Strongly disagree	54	37.8	38.8	100
Total	141	98.6	100	
Missing system	2	1.4		
Total	143	100		

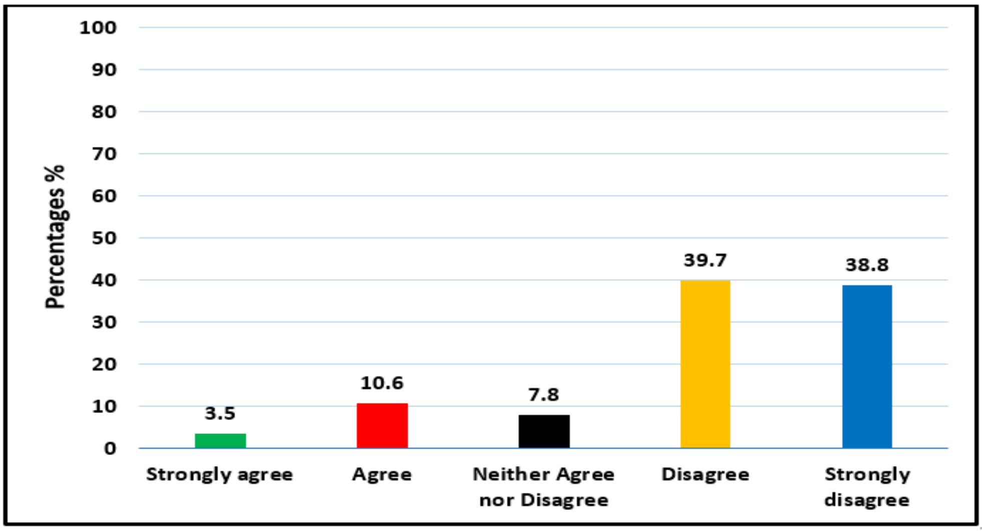


Figure 5-5: The participant's percentage's agreement of item 3, (*n*-141)

- **Item Four**

In item four "F/Os shouldn't question Captains' decisions" (see Table 5.5 and Figure 5.6), respondents demonstrated a high negative score disagreeing with the statement, where 53% of participants disagreed with the statement and 31% strongly disagreed, meaning that the majority of pilots in the region do not accept this statement.

Table 5-5: The average percentage of the participant's agreement (item 4

	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly agree	3	2.1	2.1	2.1
Agree	5	3.5	3.5	5.6
Neither Agree nor Disagree	15	10.5	10.6	16.2
Disagree	75	52.4	52.8	69
Strongly disagree	44	30.8	31.0	100
Total	142	99.3	100	
Missing system	1	0.7		
Total	143	100		

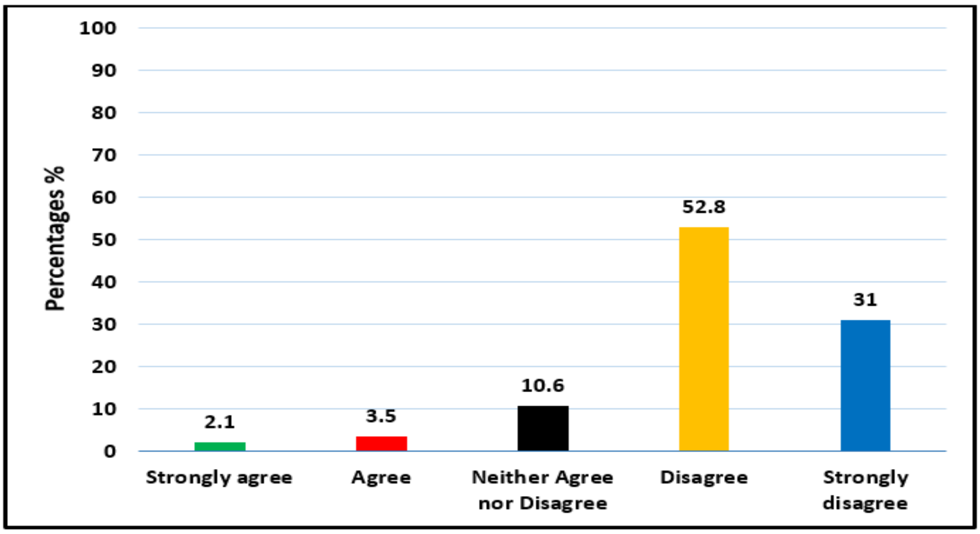


Figure 5-6: The participant's percentage's agreement of item 4, (*n*-142)

- **Item Five**

The fifth statement in this factor is "In abnormal situations, I rely on P-I-C to tell me what to do" (see Table 5.6 and Figure 5.7). 48% of participants either agreed or strongly agreed with the statement. In contrast, nearly 34% either disagreed or strongly disagreed, which means that the majority of pilots in the region rely on the captain's instructions in abnormal situations.

Table 5-6: The average percentage of the participant's agreement (item 5)

	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly agree	18	12.6	12.8	12.8
Agree	50	35.0	35.5	48.2
Neither Agree nor Disagree	24	16.8	17	65.2
Disagree	40	28.0	28.4	93.6
Strongly disagree	9	6.3	6.4	100
Total	141	98.6	100.0	
Missing system	6	1.4		
Total	143	100.0		

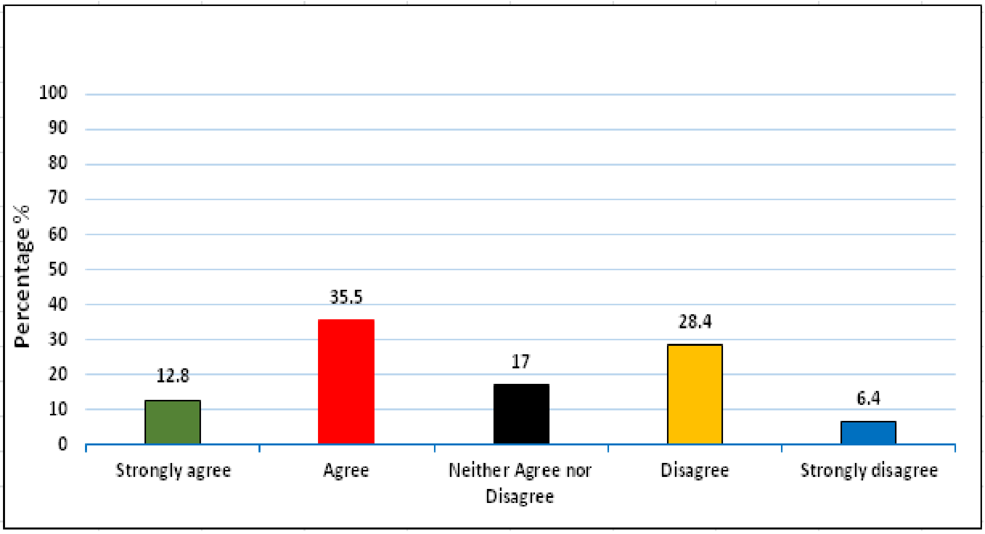


Figure 5-7: The participant's percentage's agreement of item 5, (*n*-141)

In summary, the frequency analysis of this factor revealed a large PD among pilots in cockpits within the North African region due to the high scores of item 1, item 2 & item 5. Pilots are suffering from problems which are affecting their decision making due to the misperception of risk in the cockpit. These problems can be summarised as follows:

a. Disagreement between pilots in reaching united decisions.
b. The Captain does not share his/her decision-making with the First Officer
c. The First Officer hesitates to discuss the Captain's decisions.

The second factor in this theme is uncertainty avoidance. The next paragraph describes the findings of this factor.

- **Factor two: Uncertainty Avoidance (Item from 6 to 10)**

Uncertainty avoidance (UA) is one of the most important dimensions effecting pilot behavior in the cockpit. It has direct influence on the pilot's risk perceptions and risk tolerance. According to Merritt (1996), in her replicate study of Hofstede's framework (1990), the UA dimension is most relevant for aviation as the extent to which pilots are sensible to threats or anxious. This can be combined with ambiguous situations. This means that they are keen to adhere to the rules and regulations that they believe will safeguard them from blame should they make a wrong decision in a risky situation. Likewise, this factor includes six statements, as illustrated in (Table 5.7, see appendix D).

The findings relating to UA revealed that most of the study sample (*n*-143) had high positive scores in all questions, which reflects pilots' positive awareness of organisational roles, SOPs, work resilience, cognitive knowledge, and situation awareness, which consequently effectively influence the pilot decision making performance in the cockpit within the North Africa region. The findings of this factor are discussed in detail in the next paragraphs.

- **Item Six**

The first statement in this factor is item six in the survey "Organization rules should not be broken, even when pilots think it is the company's best interest". The frequency analysis of this question shows that 37.3% of participants agreed and about 35.2% strongly agreed with the statement, this mean that about 73% of the participants were agreed with the statement (see Figure 5.8).

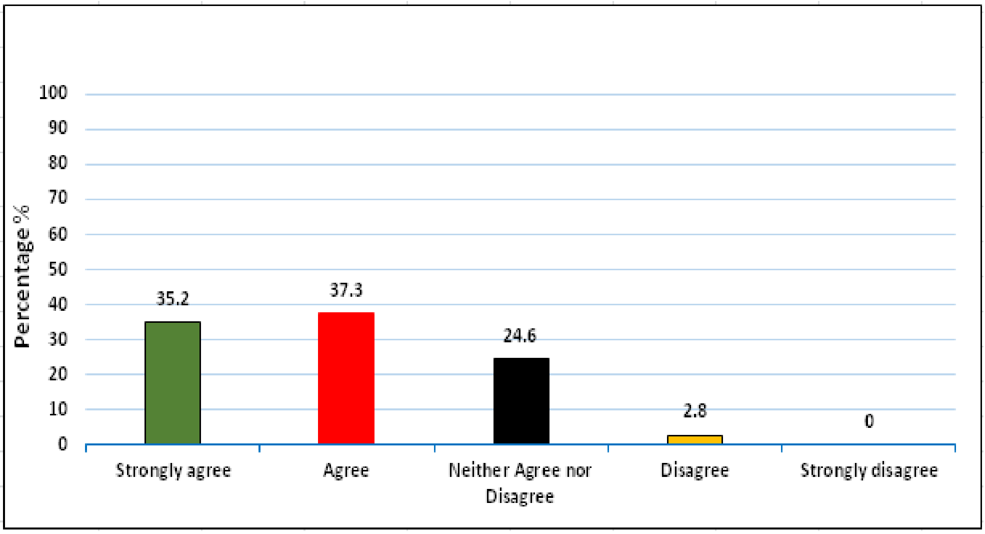


Figure 5-8: The participant's percentage's agreement of item 6, (*n*-142)

According to the answers of the participants, this statement has the strong positive agreement of the majority of pilots in the region. It signals strong compliance to company rules.

- **Item Seven**

Item seven is "SOPs should be followed to tackle any flight situation" (see Figure 5.9). This statement is expressing the extent to which the pilots comply to SOPs during flight. According to the frequency analysis the majority of the sample either agreed or strongly agreed with the statement, where about 40% agreed and 43% strongly agreed. Consequently, with 83% overall agreement, it can be seen that the majority of pilots believe they should adhere to the SOPs in all flight situations.

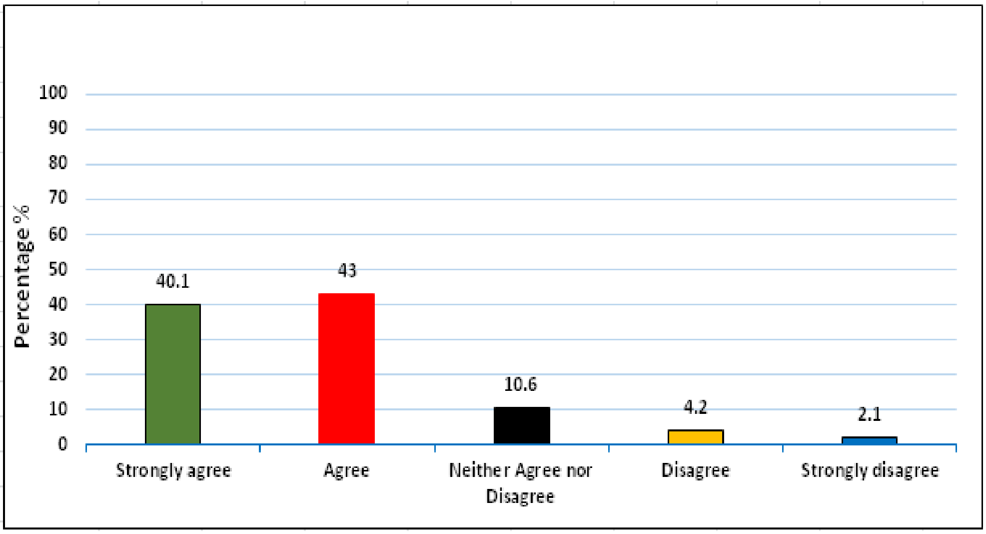


Figure 5-9: The participant's percentage's agreement of item 7, (*n*-142)

- **Item Eight**

The third statement in this factor is item eight: "It is important to change work routine in order to cope with a new unfamiliar task". This question is examining the extent to which pilots in the region have the ability to cope with new tasks and unusual situations. As shown below in Figure 5.10, about 56% of participants agreed with the statement, in addition to 16% who strongly agreed. This produces a majority 72% of the pilots in the sample size having positive agreement about their ability to cope with new tasks and unusual situations.

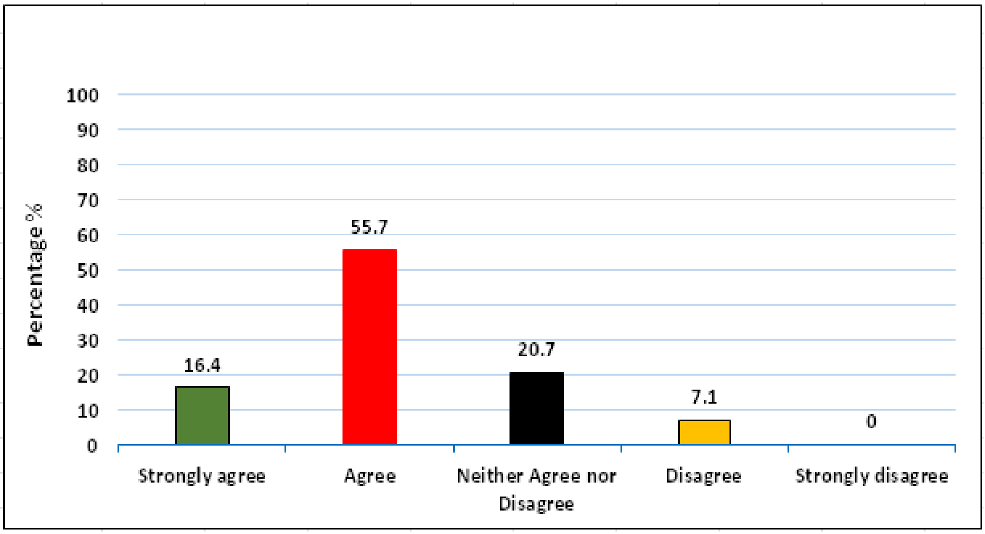


Figure 5-10: The participant's percentage's agreement of item 8, (*n*-142)

- **Item Nine**

Item nine is the fourth statement in this factor: “Pilots must know everything about the different systems to avoid surprises in the cockpit”. 74% of the participants strongly agreed with the statement. 16% agreed of pilots have agreed (see Figure 5.11). This large majority of 90% positive agreement with the statement reflects the pilots’ opinion about the importance of being familiar with cockpit systems.

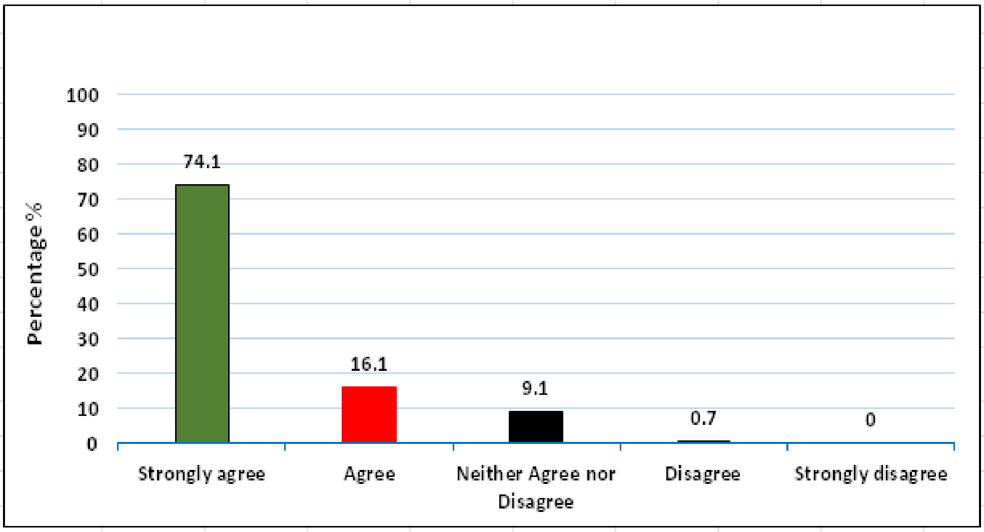


Figure 5-11: The participant’s percentage’s agreement of item 9, (*n*-143)

- **Item Ten**

Item ten is “It is important to understand the situation and find the one correct decision”. As shown below in (Figure 5.12), the answers of participants to this question show high agreement, where about 75% strongly agreed and 17% agreed, a majority of 92% pilots appreciating the importance of situation awareness.

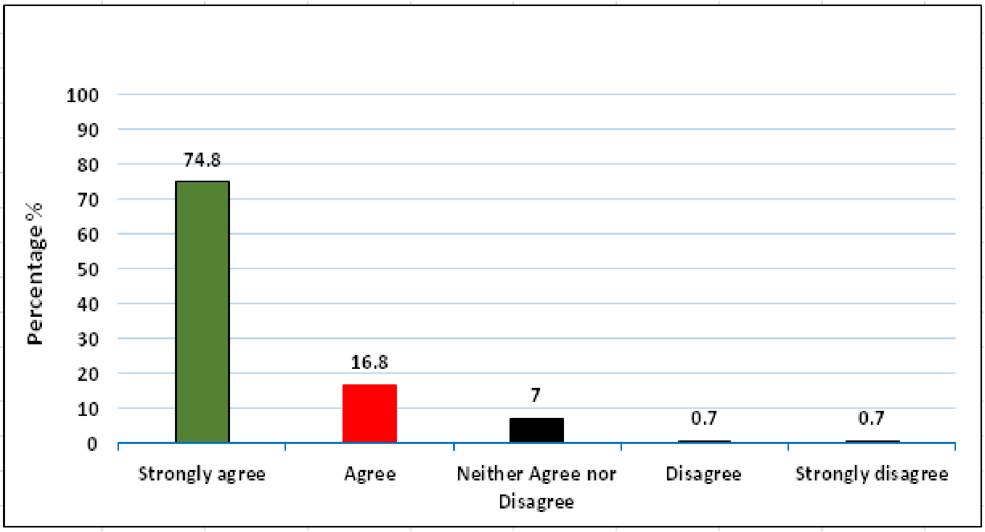


Figure 5-12: The participant's percentage's agreement of item 10, (*n*-143)

In summary, it is clear from the findings of this factor that the majority of the pilots have strong positive awareness of uncertainty avoidance, which effectively improves their risk perception and minimises risk tolerance in the cockpit.

- **Factor Three: Religious Beliefs and Norms (items from 11 to 16)**

Religious beliefs and norms have a great connection to the national culture for any region. According to Hofstede, (2011); Kogan et, al., (2013) as mentioned in (Chapter 3, Section 2.7.1), it is important because it has a direct effect on uncertainty avoidance. To evaluate and understand the effect of this factor on the pilot's decision-making performance within the NAR six statements have been implemented (see Table 5.14 in Appendix D).

According to frequency analysis of this factor, findings show that religious norms in the NAR have no effect on pilot judgement in the cockpit. This factor does not have a negative influence on the pilot's decision-making performance during the flight. The next paragraphs discuss these findings in detail.

- **Item 11**

The first statement in this factor is item 11 “Accidents cannot be controlled or mitigated if it is our destiny”. This item had negative agreement from the participants, where about 57% of pilots either disagreed or strongly disagreed with the statement (see Figure 5.13). In addition, about 27% of the participants agreed with the statement, a relatively high percentage and an alert of an adverse effect of national culture. This suggests that 57% of the pilots believe that managing error, and controlling the risk, can prevent or mitigate accident. In contrast, about 27% of pilots in the region agreed with the statement due to religious belief, which is extremely dangerous for pilot decision-making performance.

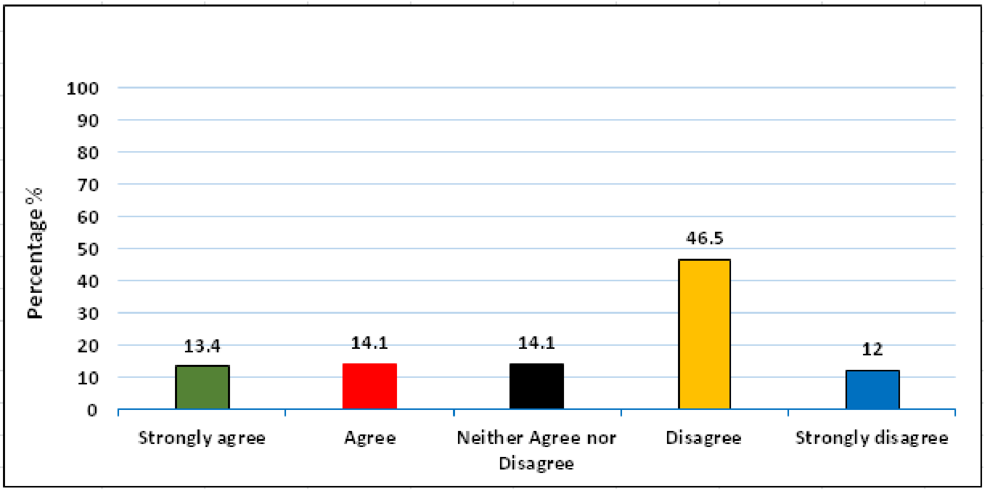


Figure 5-13: The participant’s percentage’s agreement of item 11, (*n*-142)

- **Item 12**

The second statement is item 12: “Following SOPs will not prevent accidents from happening”. In contrast to the previous question, in this question about 61% of the participants agreed with the statement (see Figure 5.14). This means that most of the pilots in the sample believe that following SOPs in all operational steps will not prevent accidents from happening. This reflects the result in the previous question that pilots in the region do not rely heavily on

SOPs to manage error and prevent accidents. This could be an effect of religious beliefs and norms.

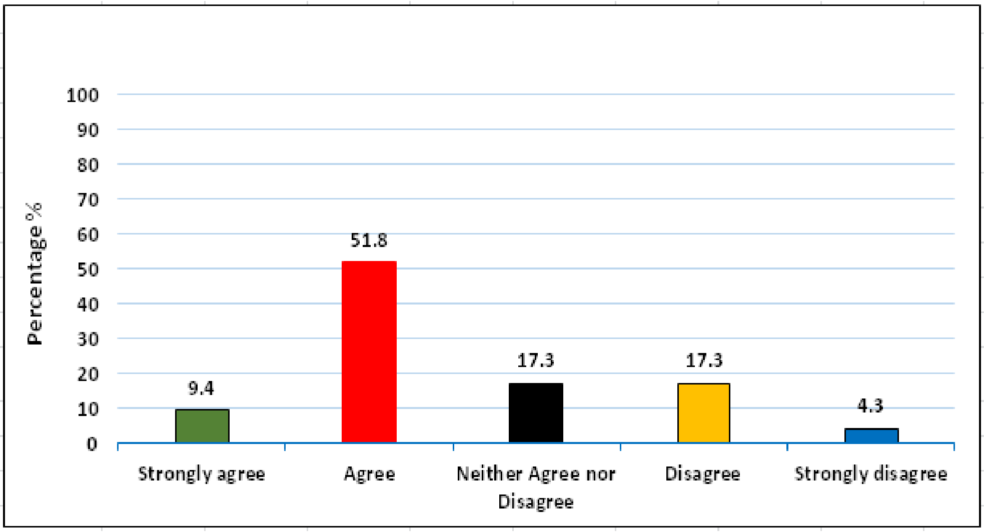


Figure 5-14: The participant's percentage's agreement of item 12, (*n*-142)

- **Item 13**

The last closed-ended question in this factor is "Accidents can still happen even if pilots do everything correctly and in such a case this is the will of God". Interestingly, in this question around 84% of the participants have high agreement with the statement (see Figure 5.15). This means that the majority of the pilots in the sample are affected by religion.

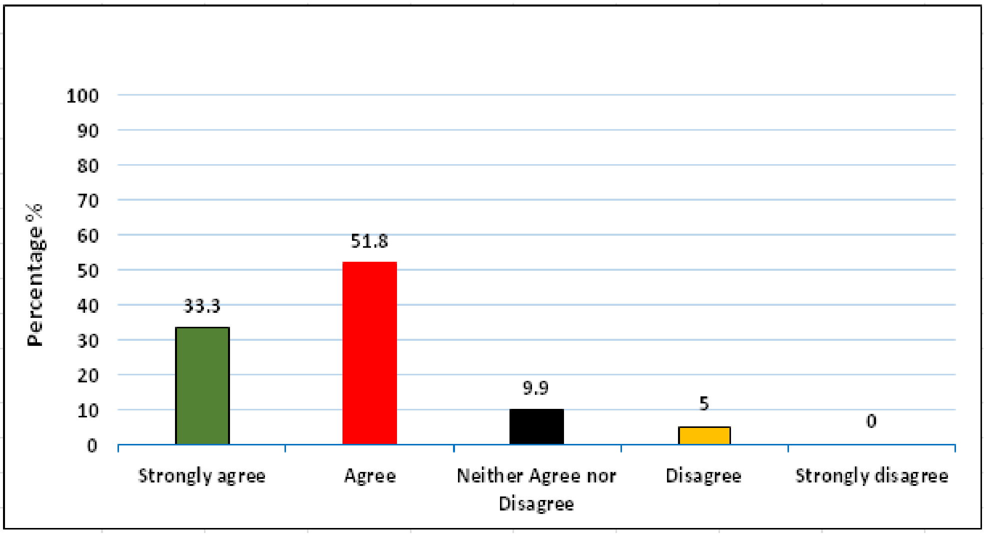


Figure 5-15: The participant's percentage's agreement of item 13, (*n*-142)

- **Items 14, 15 and 16**

The last three items 14, 15 and 16 are imaginary scenario questions to explore the effect of religion and norms on pilot decision-making performance in practical flight. The majority of participants answered these three questions with disagree or strongly disagree. Most of the pilots in the sample showed high negative agreement to these three scenarios, and they are as follows:

In item 14 the participants were asked to agree or disagree with the statement "The pilot took a decision which you are not sure about, but you preferred to carry on accounting on the "will of God" that everything it's going to be ok", about 77% of these pilot have disagreed with the statement (see Figure 5.16). This result reflects the pilots' attitude to religion and norms impact in the cockpit, which is indicate that these pilot are not influenced by this factor in the cockpit.

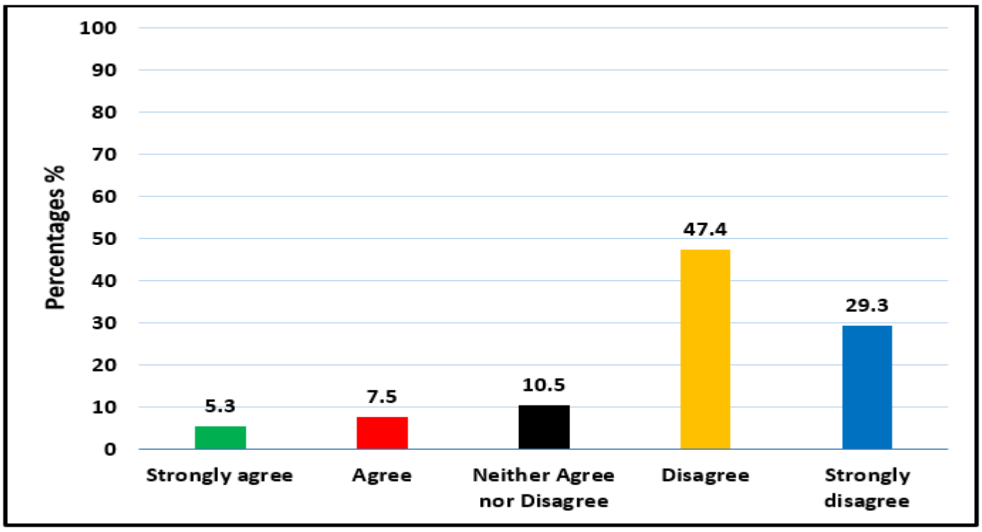


Figure 5-16: The participant's percentage's agreement of item 14, (*n*-133)

In addition, the result of item 15, shows that these pilots are not impacted by the religion and norms factor in the cockpit, where they were asked to agree or disagree with the statement "In the engine run up check, you were not sure about an instrument reading in one of the aircraft back-up systems, but you decided to carry on your flight relying on the "will of God"", and 83% of these pilots were disagreed to the statement (see Figure 5.17).

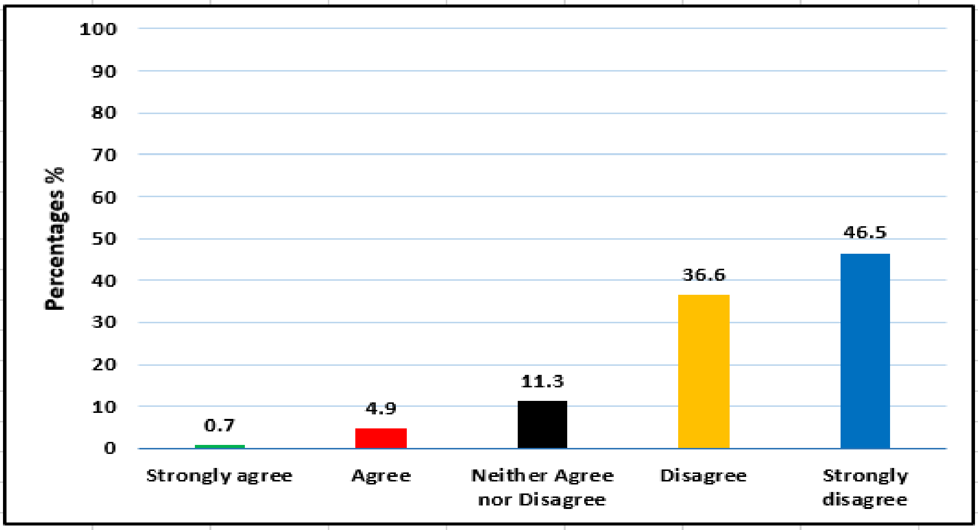


Figure 5-17: The participant's percentage's agreement of item 15, (*n*-142)

The last scenario in this factor is item 16, “The air craft in the final approach phase flying in IFR condition, but you could not see the runway features on the Minimum Decision Altitude (MDA) so you decided to go 150 feet below the minimum to see the runway relying on the “will of God””, 95% of the participants have disagreed to the statement (see Figure 5.18), this mean that the majority are not influenced by religion and norms in their decision-making process in the cockpit.

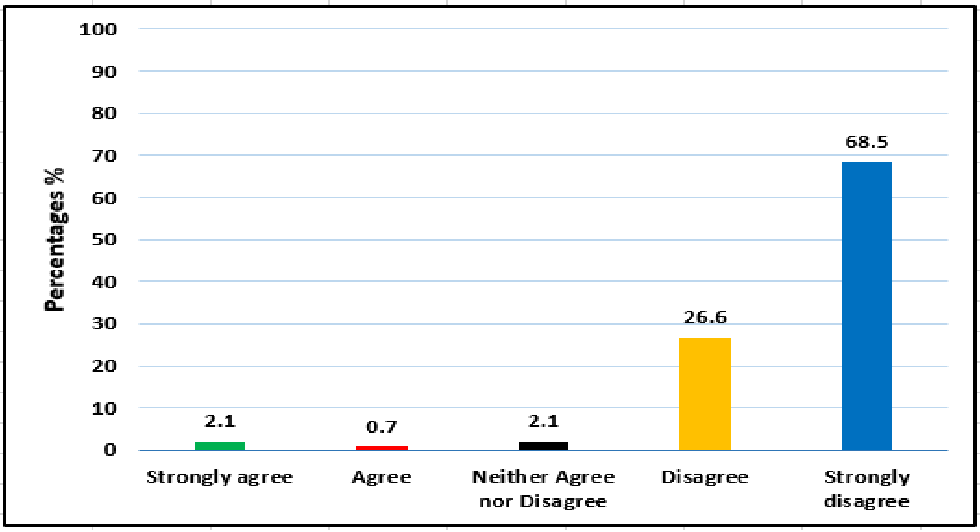


Figure 5-18: The participant’s percentage’s agreement of item 16, (*n*-143)

In summary, the analysis of this factor showed a negative agreement with item 11 by about 57% of the participants, in addition to about 27% of the participants positively agreeing to the statement, a relatively high percentage and an alert to an adverse effect of national culture relative to the effect of religion and norms on pilot decision-making performance. Furthermore, the high positive agreement of pilots with items 12 and 13 reflects the impact of religion and norms. Very interestingly, in item 13 84% of the sample size (*n*-141) agreed with the statement: “Accidents can still happen even if pilots do everything correctly and in such a case this is the will of God”. This shows that religion and norms have an effect on pilots’ opinion at some level, despite the answers to items 14, 15 and 16 where most of the pilots showed negative agreement to all questions, there is no sufficient effect of religion and norms on pilot decision-making performance in cockpit.

- **Factor Four: Social Relationship (items from 17 to 21)**

This factor has been added to the survey due to the strong role played by social relationship in the national culture of the North Africa region. This was mentioned in (Chapter 2, Section 2.7.1). In addition, social relationship has a direct effect on uncertainty avoidance, according to Hofstede, (2001). Five closed ended questions were allocated to examine the factor's effect on decision-making: items 17, 18, 19, 20 and 21 (see Appendix B).

The findings of this factor indicate that the majority of the participants emphasised that there is no effect of their social relationship in the cockpit. There was very high negative agreement and about 60% to 70% of participants disagreed or strongly disagreed with the statements in these items (see Figures 5.19, 5.20, 5.21, 5.22, and 5.23) below.

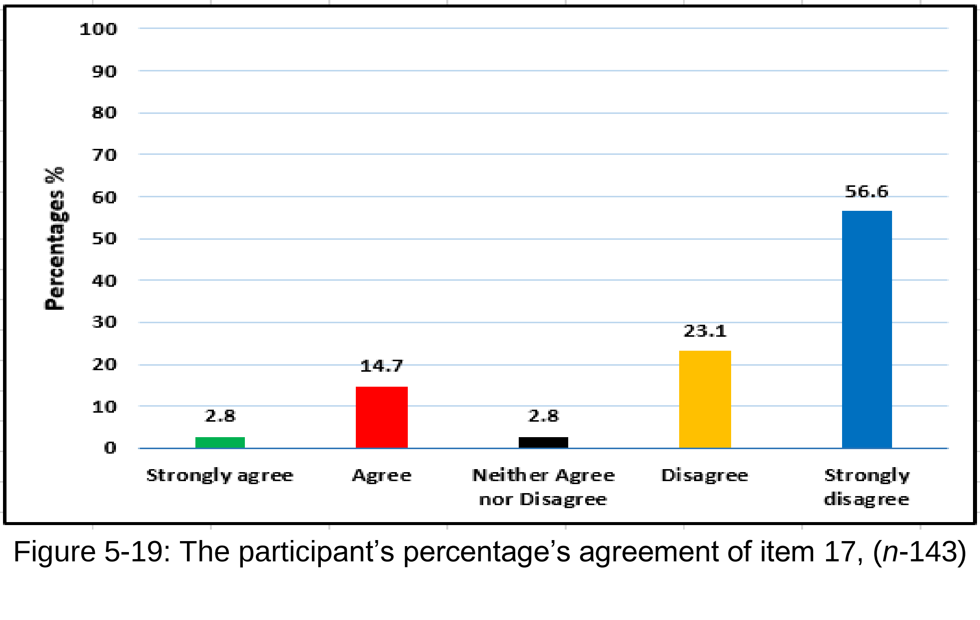


Figure 5-19: The participant's percentage's agreement of item 17, (*n*-143)

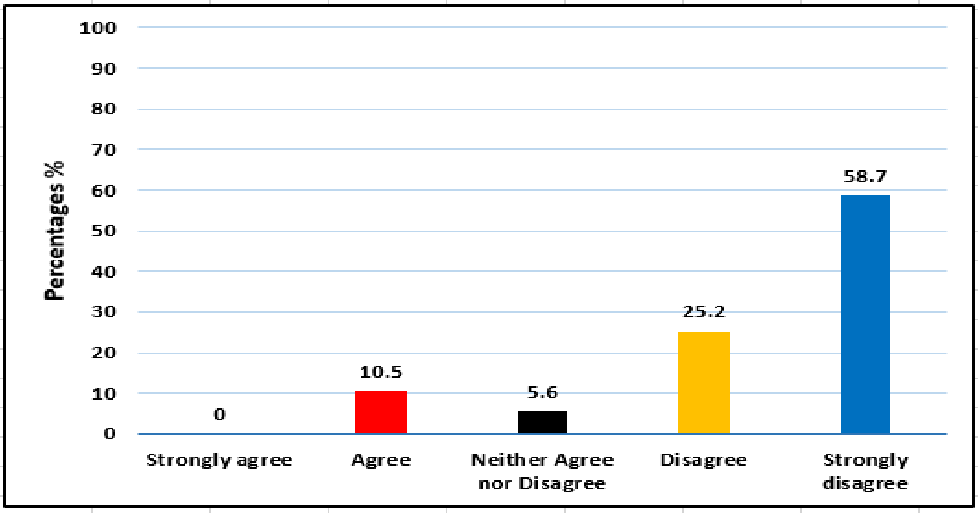


Figure 5-20: The participant's percentage's agreement of item 18, (*n*-143)

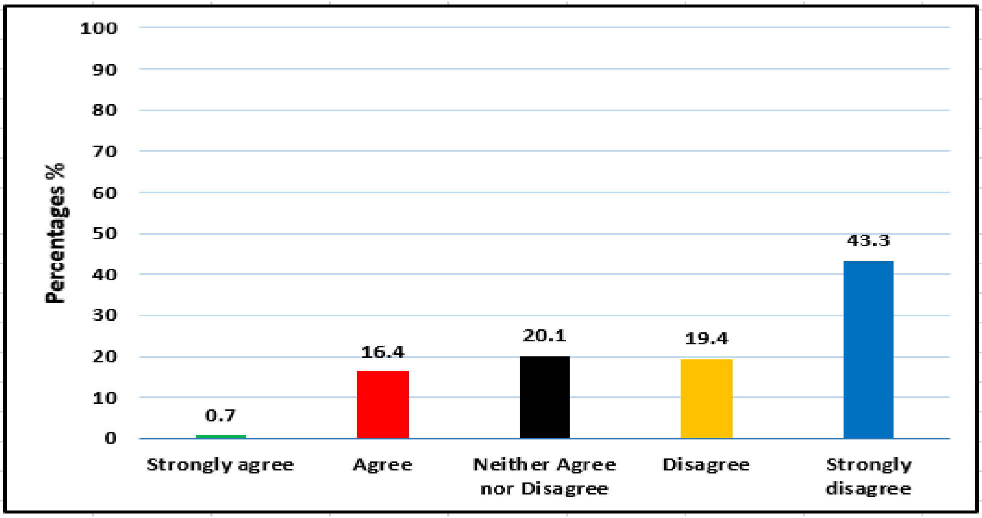


Figure 5-21: The participant's percentage's agreement of item 19, (*n*-134)

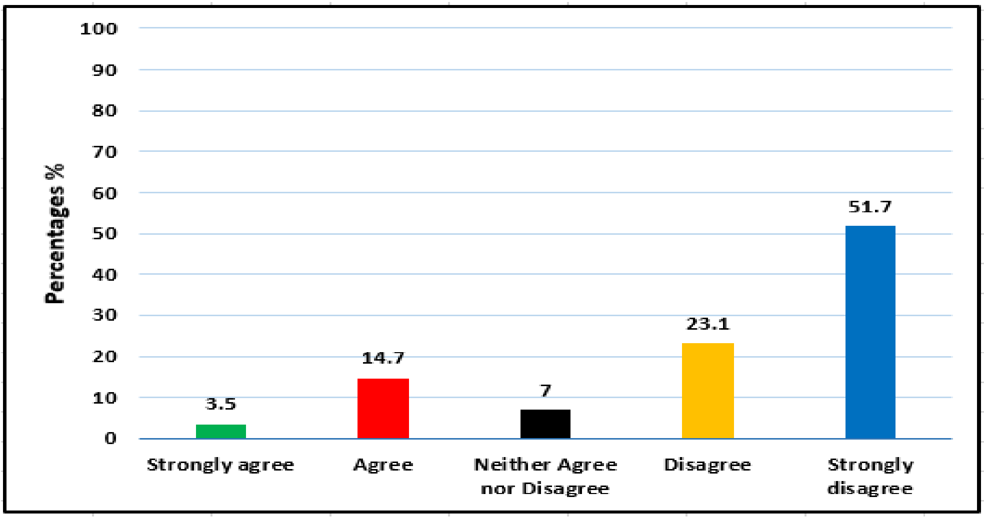


Figure 5-22: The participant's percentage's agreement of item 20, (*n*-143)

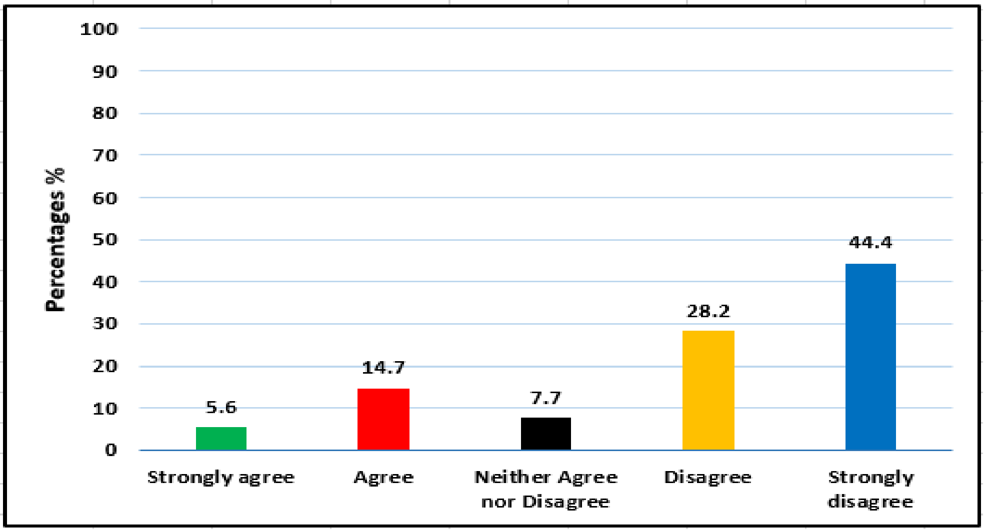


Figure 5-23: The participant's percentage's agreement of item 21, (*n*-143)

In summary, the findings regarding this factor show that the social relationship has no influence on the pilot's risk perception and accordingly the pilot's decision-making performance in the cockpit within the NAR. This result reflects the UA factor result.

Summary of culture attributes findings (Theme 1)

The frequency analysis of the culture attributes part revealed a high negative role of power distance among pilots in cockpits within the NAR. This is revealed in the high scores of item 1, item 2 and item 5. There are a number of problems facing pilots in the cockpit such as: disagreement between pilots in united decision-making, captains not sharing his/her decision-making with the First Officer, and the First Officer hesitating to discuss a captain's decisions.

Most of the pilots in the sample showed positive awareness of the organisational role, SOPs, work resilience, cognitive knowledge, and situation awareness, which consequently enhances uncertainty avoidance and risk tolerance.

Interestingly, in item 11 about 27% of the participants agreed with the statement, which is a relatively high percentage and an alert to a role of religion and norms in the cockpit.

Furthermore, the findings in items 12 and 13 reflect the impact of religion and norms. In item 13 about 84% of the sample agreed with the statement: “Accidents can still happen even if pilots do everything correctly and in such a case this is the will of God”, which means that the religion and norms have a moderate effect on the pilot judgement at some point.

Likewise, the findings were sufficient evidence of religion and norms moderately influencing pilot performance in the cockpit, In general the religion and norms factor has a not intangible negative impact on pilot decision-making performance within the NAR. Also, the result of question 13 reflects strong religious beliefs in the region.

5.5.3.2 Attitude to Human and Origination Factors (Theme 2)

This part of the survey was customised from the ORMAQ. This measures pilot attitude towards human and organisational factors, which are a part of the national culture of the region and can have an impact on effective team performance and consequently on safety performance in the cockpit. Referring to the literature review in (Chapter 2, Section 2.8), managing employee’s attitudes regarding safety has a great impact on individual safety perceptions and performance (Fogarty and Shaw, 2010). In addition, according to Leonard (2004), Lund & Rundmo (2009) and Fogarty and Shaw (2010), it is difficult to maintain a high level of safety performance for employees when the prevailing management attitude is considering a low safety performance. Accordingly, it is crucial to keep the pilot’s attitude focused on a high safety performance level. This part was designed to evaluate pilot attitude to stress/fatigue, teamwork, work values, error and organizational climate within aviation companies in the North Africa region under the impact of the surrounding environment and national culture, in order to ascertain their level of awareness regarding the non-technical factors influencing crew performance. Moreover, a pilot’s attitudes to non-technical skills give a strong indication of unexpected behaviour patterns and can signify the prevailing culture among pilots in the region of North Africa. Each factor has a number of items to cover the criteria of crew attitude in the cockpit. The findings of the theme are as follows:

- **Factor Five: Stress and Fatigue (items from 22 to 27)**

Stress and fatigue have a crucial impact on pilot performance and effectiveness in the cockpit. This factor consists of six questions (see Table 5.27 in appendix D) and reflects the effect of stress and fatigue on a pilot's decision making performance. According to Sexton et al., (2000) and CAA (2014), stress and fatigue have a negative impact on teamwork and increase the probability of error occurrence, due to the misperception of personal invulnerability and the consequent effect of this on pilot decision-making performance in the cockpit.

According to the frequency analysis of this factor, the findings indicate that the majority of participants suffer from bad management of stress and fatigue in the cockpit. This result is revealed in the answers to items 22, 23 and 24. A detailed discussion of this result is given in the next paragraph.

- **Items 22 and 23**

In item 22 "We should be aware of, and sensitive to, the personal problems of the other pilot" and item 23 "I let the other pilot know when my workload is becoming or is about to become excessive" most of the participant's responses showed a high positive awareness of crew member personality and sharing the work load with the other pilot (see Figures 5.24 and 5.25). In item 22 about 88% of pilots agreed with the statement and in item 23 about 94 % agreed with the statement.

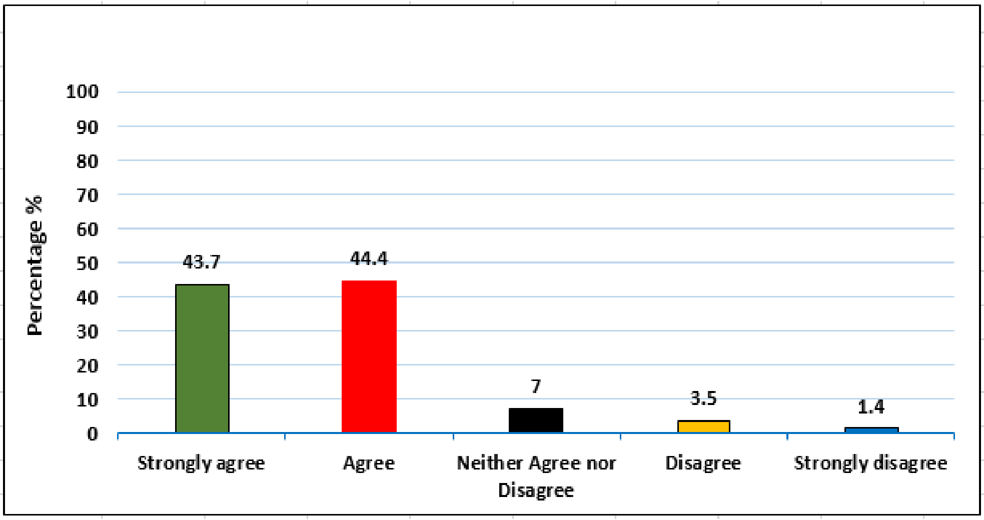


Figure 5-24: The participant's percentage's agreement of item 22, (*n*-142)

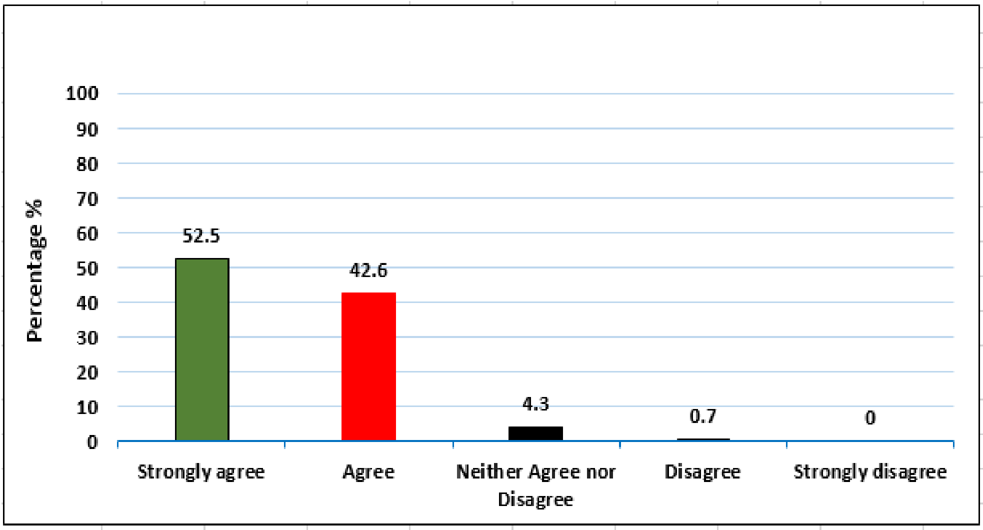


Figure 5-25: The participant's percentage's agreement of item 23, (*n*-141)

- **Items 24**

In contrast, in item 24 - "My decision-making is as good in emergencies as it is in routine situations" (see Figure 5.26) - about 53% agreed. However, 34 % disagreed with the statement and this reflects a higher effect of stress and over-work on the pilot's performance in the region of North Africa, thus an affect on the pilot's decision-making performance in the region.

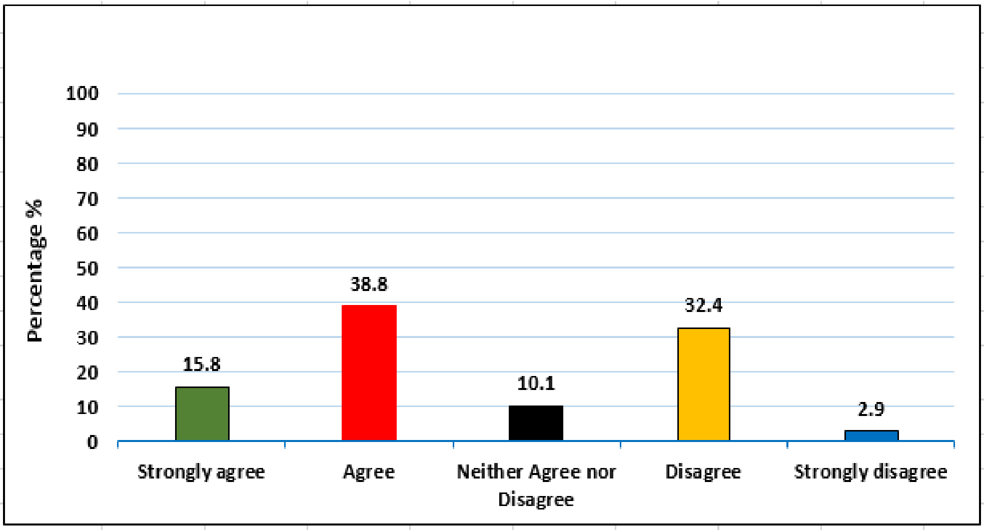


Figure 5-26: The Participant's Percentage's Agreement of item 24, (*n*-139)

- **Items 25**

The result in item 25 (see Figure 5.27) clearly reflects the above question findings in terms of the difficulty of managing stress and fatigue in the cockpit, where about 70% agreed with the statement: “I am more likely to make an error in a tense or hostile situation”. About 17% disagreed.

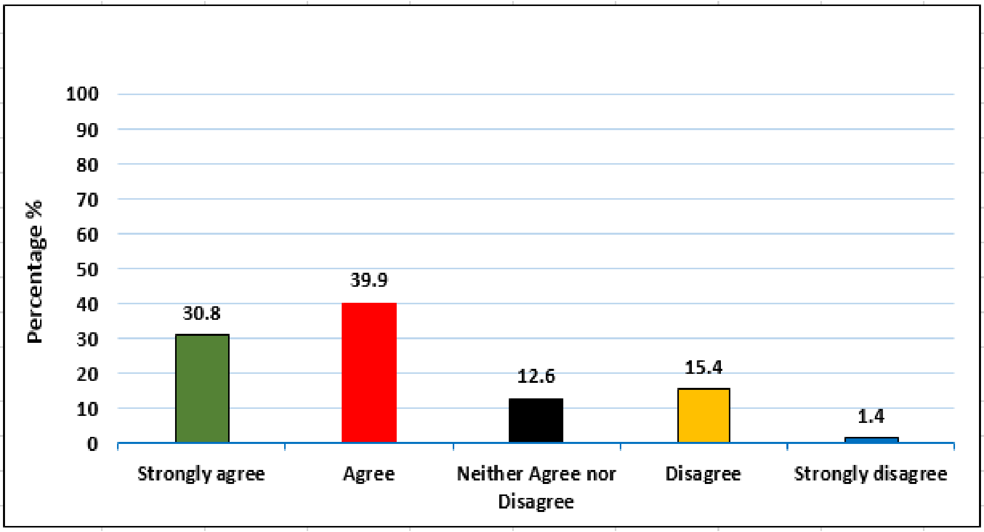


Figure 5-27: The participant’s percentage’s agreement of item 25, (*n*-143)

- **Items 26**

In item 26 (see Figure 5.28) about 72% of the pilots agreed with the statement: “my performance is not adversely affected by working with an inexperienced or less capable pilot”, This is a very high percentage in comparison to the previous study of Flin et, al. (2003), where, in the operation room, about 39% of anaesthetists agreed with this statement and 55% disagreed.

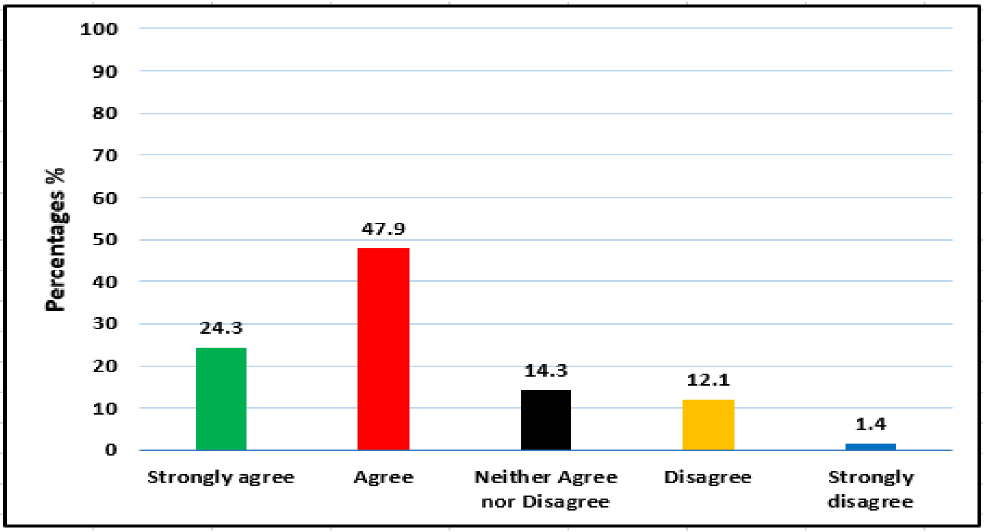


Figure 5-28: The participant's percentage's agreement of item 26, (*n*-140)

- **Items 27**

The last question in this factor is item 27 "Personal problems can adversely affect my performance". The analysis shows that about 70% of the participants agreed with this statement and about 23% disagreed (see Figure 5.29).This shows the high effect of personal problems on pilot performance in the cockpit. This result reflects previous studies (Flin et al., 2003).

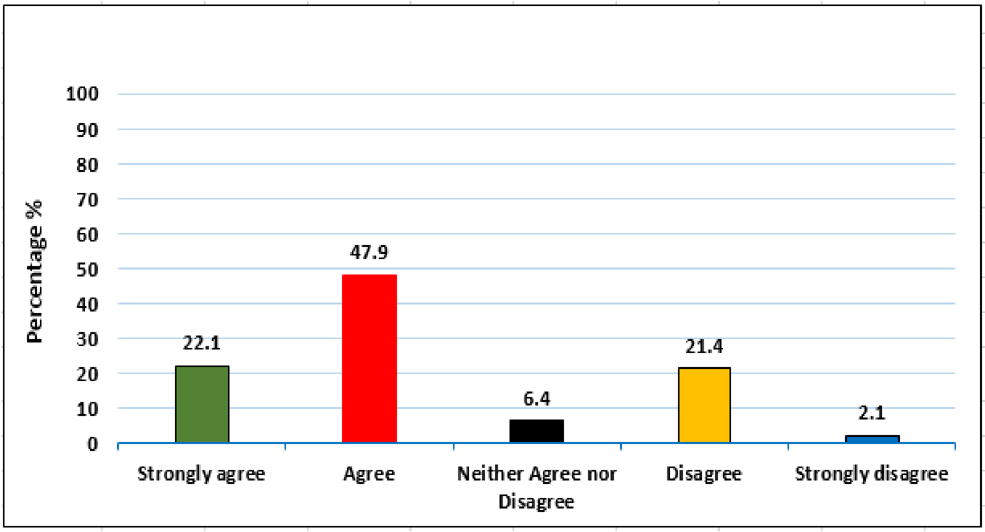


Figure 5-29: The participant's percentage's agreement of item 27, (*n*-140)

In summary, the findings of stress and fatigue showed that the pilots in the North Africa region showed difficulty in dealing with and managing stress and fatigue in the cockpit. Consequently, pilot decision-making performance was affected. In addition, the result in item 23 reflects the result in item 22, where 70% of pilots are more likely to make an error when stressed and/or fatigued. Moreover, personal problems have an insufficient effect on pilot performance, as showed in item 25, where 70% of pilots were effected by personal problems.

- **Factor Six: Teamwork (items from 28 to 32)**

Teamwork is directly correlated with crew member performance, which consequently affects the pilot's decision-making performance. The teamwork factor, as shown in (Table 5.34 in appendix D), consists of five questions to express the pilot's teamwork criteria in the cockpit.

The findings of this factor in general indicated that the participants have positive attitudes when it comes to effective teamwork. However, in item 28, most of the pilots (73%) agreed with the statement: "It is better that the P-I-C and the F/O agree than to voice different opinion". This conflicts with previous studies (Flin et al., 2003); (Flin et al., 2006), where the result of this research was disagreement by about 88% of anaesthetists (*n*-222) and 85% of consultant surgeons (*n*-138). Likewise, the result of item 28 supports the findings from factor one, item one "F/Os are afraid to express disagreement in the flight deck". 62% agreed with the statement. These results express the effect of the national culture on PD and, consequently, weakness in teamwork at some level in accepting different opinions in the cockpit.

- **Items 28**

The findings of this factor were as follows: the frequency analysis of item 28 "It is better that the P-I-C and the F/O agree than to voice a different opinion", showed a high positive agreement. With the statement "It is better that the P-I-C and the F/O agree than to voice different opinion", about 73% of participants agreed (as shown in Figure 5.30).

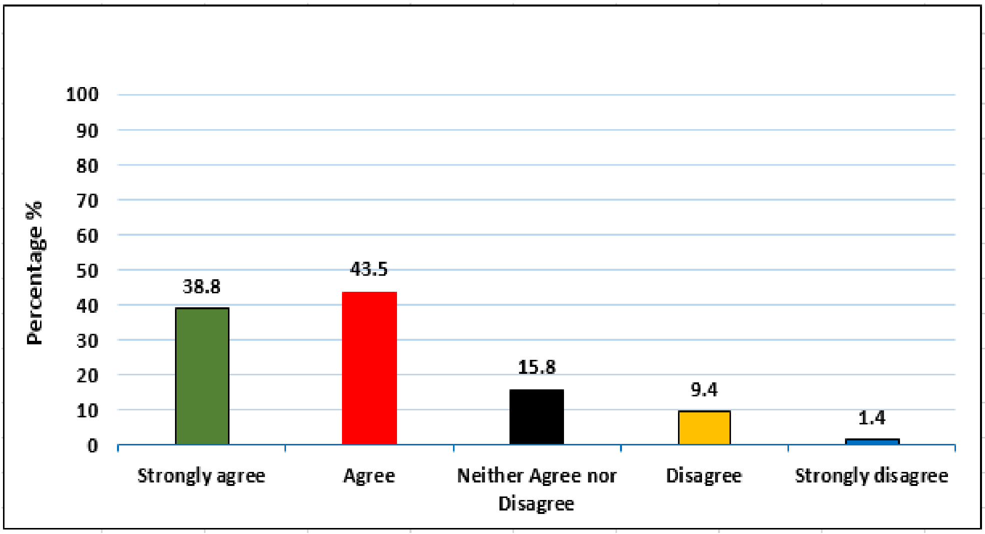


Figure 5-30: The participant's percentage's agreement of item 28, (*n*-139)

- **Items 29**

In item 29 "Both pilots in the cockpit share responsibility for prioritising activities in high workload situations", most of the participants (89%) agreed with the statement. This result is high positive agreement, reflecting awareness of the importance of sharing responsibility in the cockpit. The results reflect previous results of teamwork in the ORMAQ (Flin et, al., 2003).

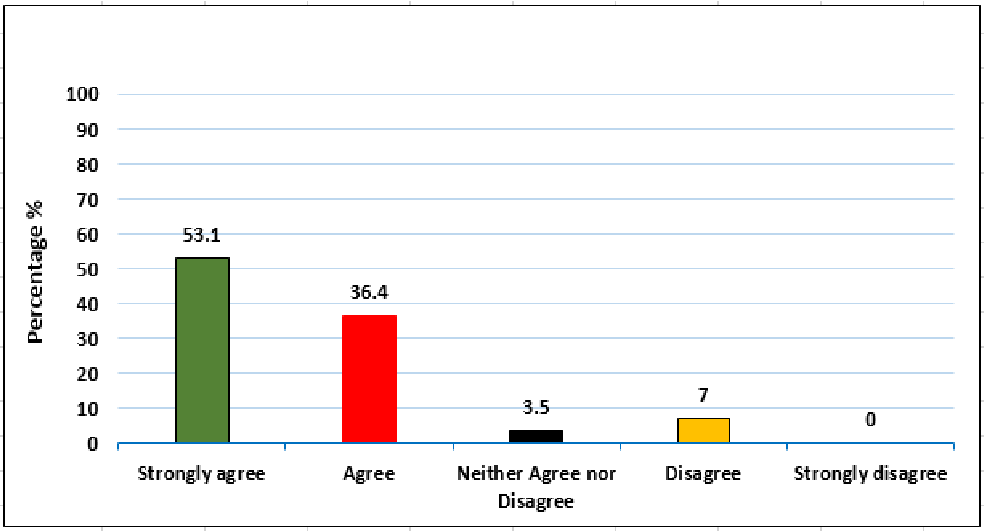


Figure 5-31: The participant's percentage's agreement of item 29, (*n*-143)

- **Items 30, 31 and 32**

The findings of the last three items which are item 30, “I enjoy working as part of a team”, item 31 “All members of the cockpit are qualified to give feedback to each other” and item 32 “Effective flight crew co-ordination requires them to take into account the personalities of each other”, show high positive agreement with the statements. Most pilots in the region appear to be happy and enjoying working in their companies (see Figure 5.32), which consequently positively affects their performance in the cockpit.

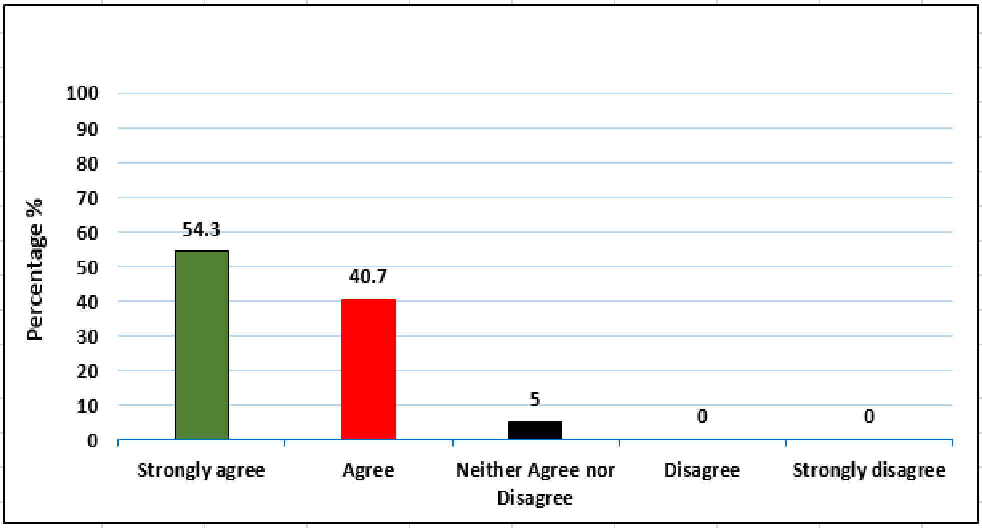


Figure 5-32: The participant’s percentage’s agreement of item 30, (*n*-143)

In addition, in item 31 and 32 the pilots showed high positive agreement of both accepting feedback from each other and taking into consideration each other’s personalities (see Figure 5.33 and Figure 5.34).

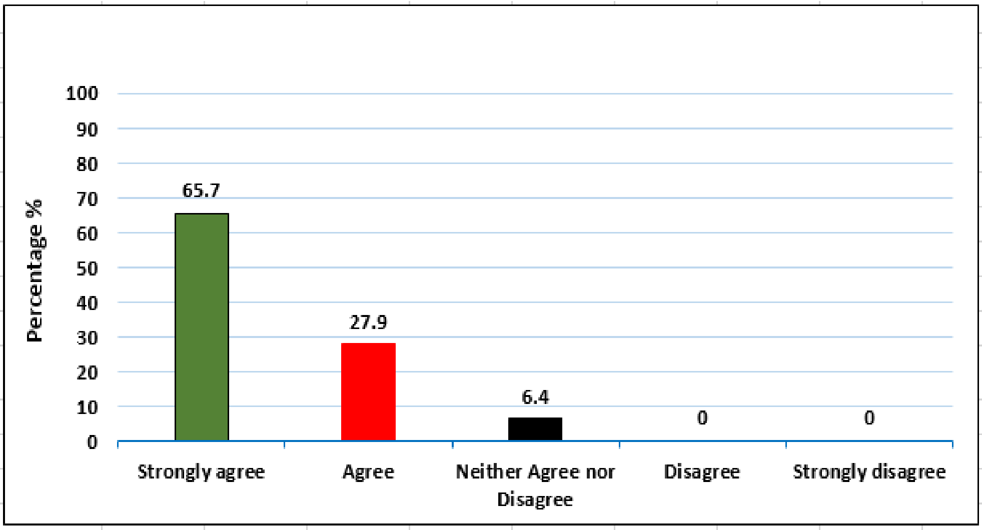


Figure 5-33: The participant's percentage's agreement of item 31, (*n*-143)

The results in both items reflect previous findings, where all members from the same field, such as consultant surgeons (*n*-138) agreed by 75% to accept feedback from each other and 84% to take into consideration each other's personalities (Flin et al., 2006).

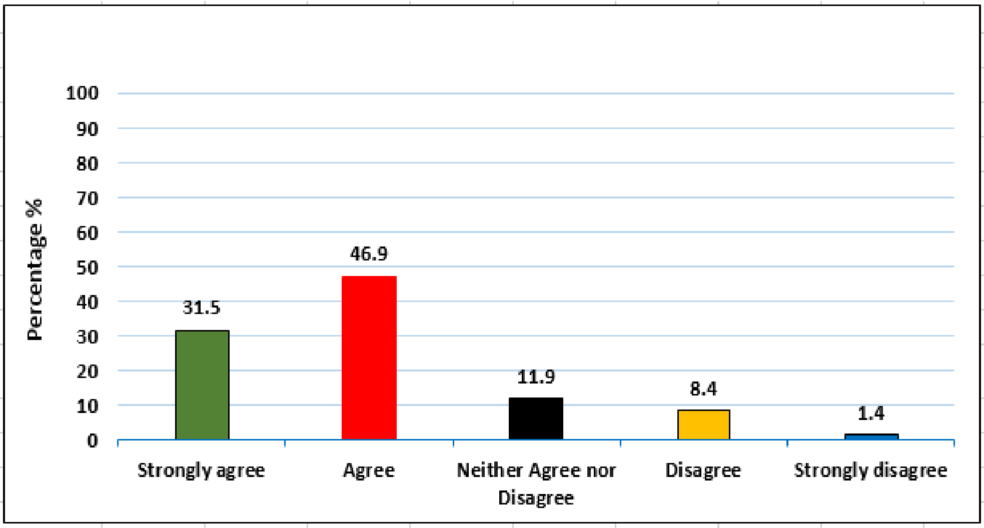


Figure 5-34: The participant's percentage's agreement of item 32, (*n*-143)

In summary, the finding of the teamwork factor in items 29, 30, 31 and 32 showed high positive agreement and consensus about the statements. This indicates that most of the pilots in the NAR are aware of the importance of teamwork effectiveness in performance and in pilot decision-making performance in the cockpit. However, the findings in item 28, where the participants agreed with the statement “It is better that the P-I-C and the F/O agree than to voice different opinion” by 73%, indicate weakness in teamwork among these pilots.

- **Factor Seven: Work Values (items from 33 to 37)**

Work value is an important element of culture and other social and technical systems in an organization. In addition, a society value is a guided behaviour for any person and every organization or society has its own values, which provide the underlying force for individual and group action. Consequently, measuring work value of pilots in the North Africa region is crucial to predict their decision-making performance in light of their risk perception. This factor consists of five questions (see Table 5.40 in appendix D).

The findings of this factor indicate that most of the participants showed a negative value of the work environment, which could affect negatively the crew member team working performance in the cockpit. In addition there were negative attitudes towards the importance of team harmony, which could affect negatively the crew member team working performance. More clarification of these findings are contained in the following analysis.

- **Items 33**

The first item in this factor is item 33 “Captains deserve extra benefits and privileges”, 46 % of participants agreed and about 25% disagreed with the statement (see Table 5.35). This result illustrates that the pilots perceive the importance of receiving professional recognition positively and the captain not receiving adequate benefits in their organisation.

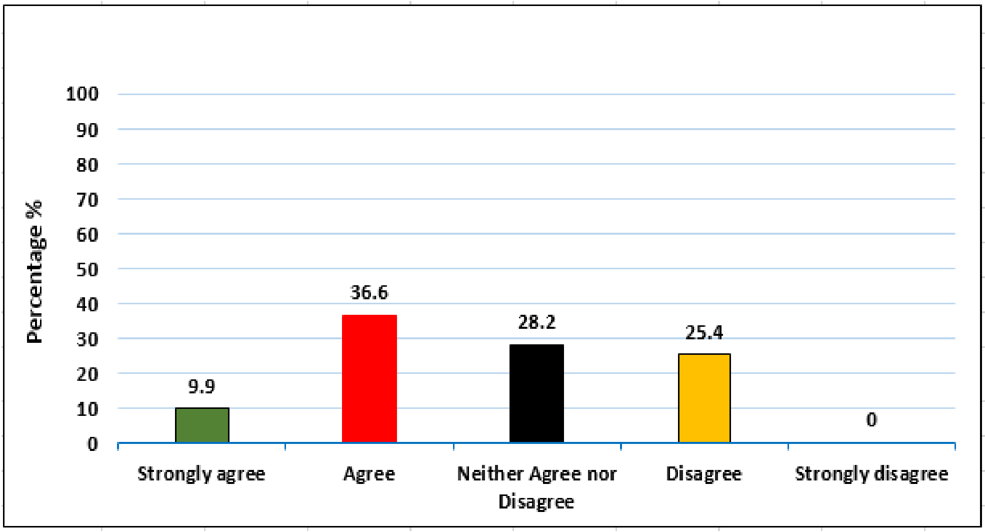


Figure 5-35: The participant's percentage's agreement of item 33, (*n*-142)

- **Items 34**

Interestingly, in item 34 "As long as the job gets done, I don't care what others think of me", the majority of participants stated a high positive agreement with the statement. About 95% either strongly agreed or agreed with the statement (see Figure 5.36). This result reflects the misunderstanding of safe operation in the cockpit. In addition, it means that there is very weak harmony among crew members in the cockpit.

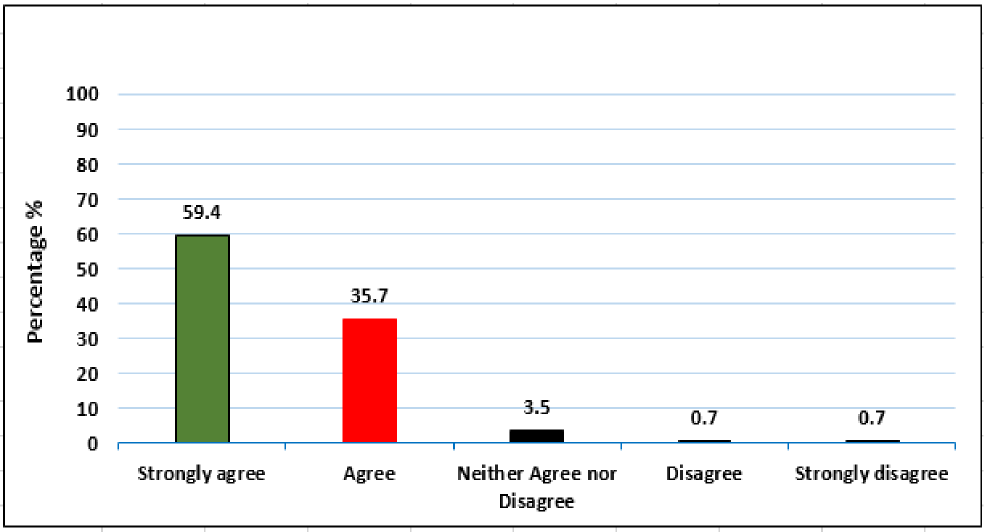


Figure 5-36: The participant's percentage's agreement of item 34, (*n*-143)

- **Items 35**

The next item is item 35, which regards reputation in the cockpit “A good reputation in the cockpit is important to me”, and which most of the participants 90% agreed with (see Table 5.37). This result expresses pilot opinion regarding the importance of reputation in the cockpit.

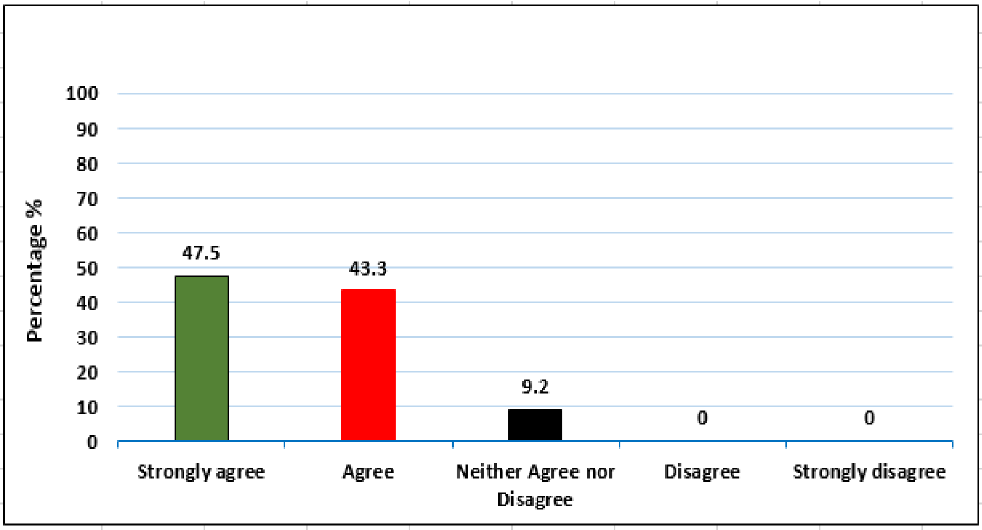


Figure 5-37: The participant’s percentage’s agreement of item 35, (*n*-143)

- **Items 36 and 37**

In the next items 36 and 37 (see Figures 5.38 and 5.39), the majority of participants showed high positive agreement with the statement. In item 36 “It is an insult to be forced to wait unnecessarily for other members of the flight crew”, about 47% of pilots agreed and 23% disagreed. In item 37 “In the cockpit, I get the respect that a person of my profession deserves”, about 79% of pilots agreed and 3% disagreed.

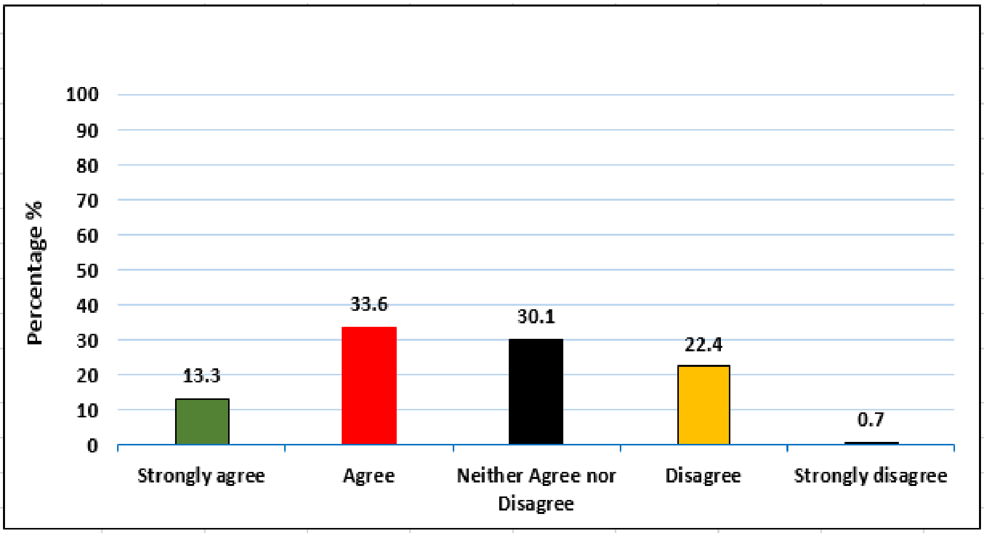


Figure 5-38: The participant's percentage's agreement of item 36, (*n*-143)

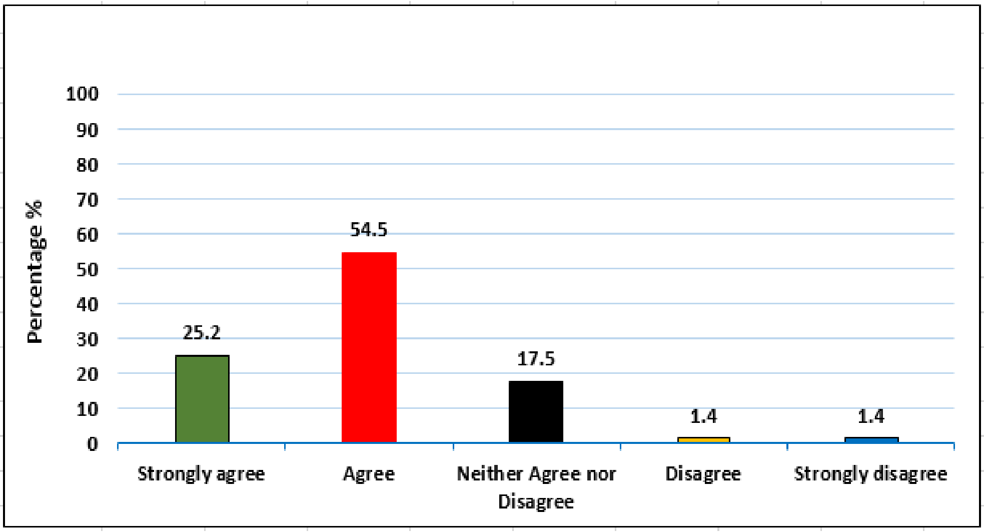


Figure 5-39: The participant's percentage's agreement of item 37, (*n*-143)

These results indicate a high positive awareness of respect among crew members. According to Tolbiz, (2008), individuals in the workplace showing each other expectations of respect is a big challenge for active performance..

In summary, the frequency analysis of this factor indicated in general that the majority of participants hold a negative value of the work environment. This result was revealed in the findings from items 33, 34 and 36. The negative attitude of team harmony among pilots in the cockpit could be very harmful to team working and give a good prediction of poor understanding of each other as a team, poor motivation to work as team and the likely communication style in the cockpit. In the other work value questions, the participants showed positive value.

- **Factor Eight: Error/Procedural Compliance (item from 38 to 42)**

It is very important to examine attitudes to human error and procedural compliance in the cockpit, in order to evaluate the pilot's attitude to safety management systems within the North Africa region. This factor consists of five questions (see Table 46 in appendix D). These five questions were modified and implemented from ORMAQ (Flin et al., 2003).

In general, the findings of this factor indicated that most participants show a positive altitude to human error and procedural compliance in the cockpit within the North Africa region. However, the findings of item 38 showed a higher percentage of agreement with this statement in comparison with previous studies, which could be a sign of some weakness of pilot attitude towards error accuracy in the cockpit. The next paragraphs discuss these findings in detail.

- **Items 38**

The first item of this factor was item 38, where most of the participants disagreed with the statement: "Errors are a sign of incompetence". 55% disagreed, in contrast with about 26% who agreed with the statement (see Figure 5.40). About 55% of pilots showed positive awareness of the risk of error accuracy and errors as inevitable regardless of competence (Reason, 1990). However, about 26% of participants agreed that errors are a sign of competence, which is a relatively high percentage of negative awareness of error risk in the cockpit as an inevitable element of human nature. The comparison of this result with a previous study of ORMAQ in the operating room is relatively low. The range of agreement with this statement was between 13% (*n*-138) to 14% (*n*-222) and disagreement 72% (*n*-138) to 77% (*n*-222). The differential between the two results gives a sign of inappropriate attitude of pilots towards error management in the cockpit, affecting the pilot's decision making.

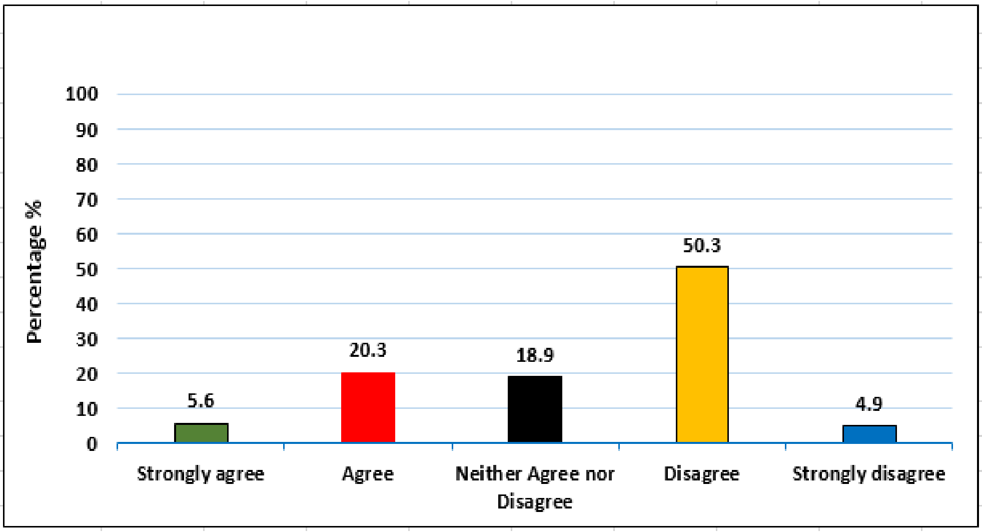


Figure 5-40: The participant's percentage's agreement of item 38, (*n*-143)

- **Items 39, 40, 41 and 42**

In items 39, 40, 41 and 42 (see Figures 5.41, 5.42, 5.43 and 5.44), the majority of pilots illustrated a positive altitude to human error and procedural compliance, a result that reflects a previous study in the operating room (Yule et, al., 2004) and (Flin et, al., 2006).

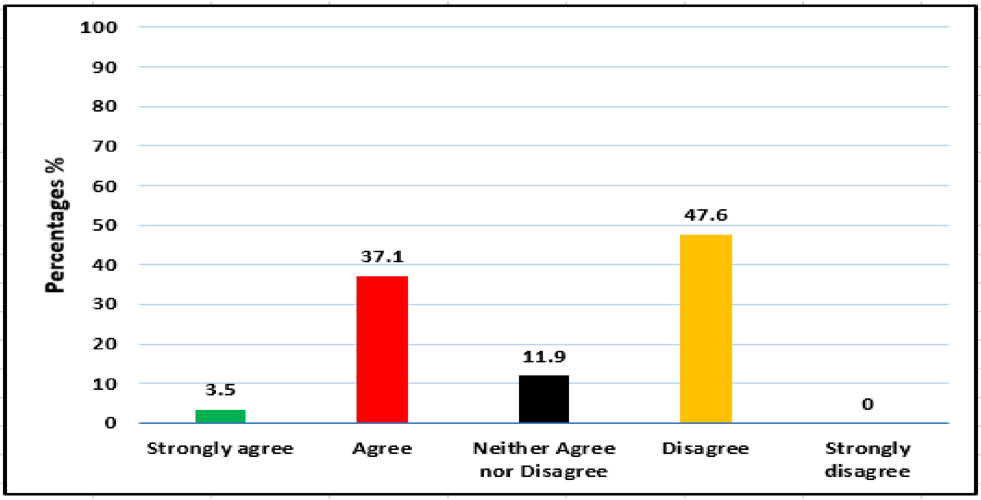


Figure 5-41: The participant's percentage's agreement of item 39, (*n*-143)

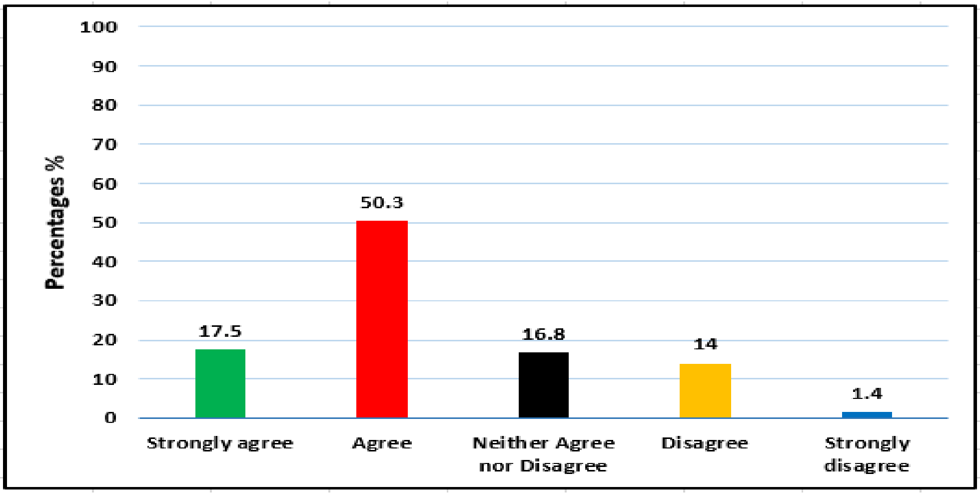


Figure 5-42: The participant's percentage's agreement of item 40, (*n*-143)

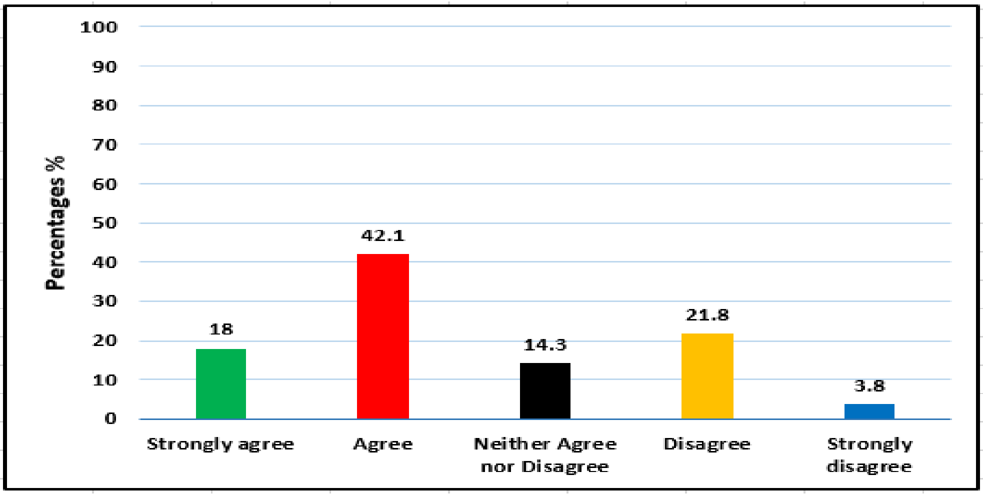


Figure 5-43: The participant's percentage's agreement of item 41, (*n*-133)

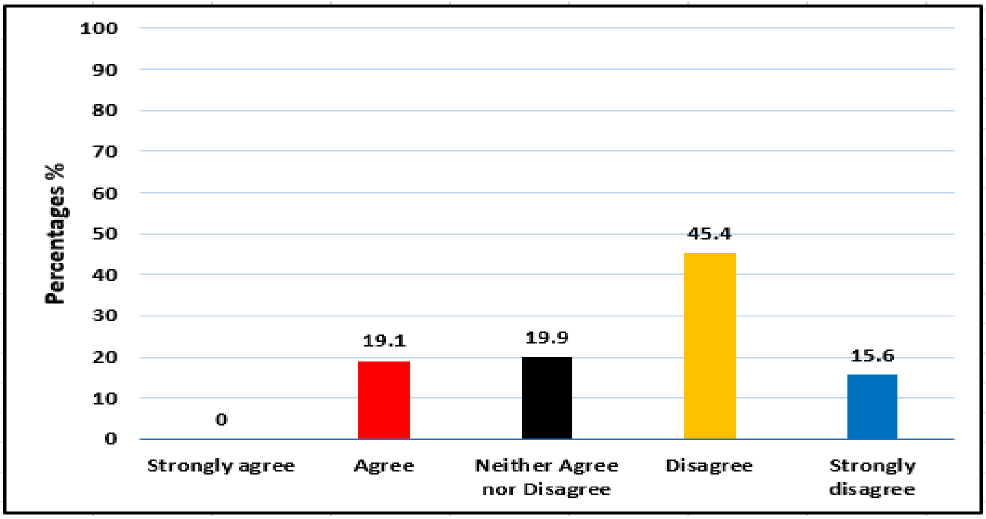


Figure 5-44: The participant's percentage's agreement of item 42, (*n*-141)

Attitudes to human error and procedural compliance of pilots within the region of North Africa in general are positive, however, a sign of some weakness in awareness error accuracy were detected in the cockpit, where human error considered as an inevitable human factor, regardless of experience or training (Reason, 1990), which effects the pilots risk judgement and decision making performance (Wiegmann and Detwiler, 2005).

- **Factor Nine: Organizational Climate (items from 43 to 46)**

Organizational Climate is a powerful factor that has a tremendous effect on performance and job satisfaction of employees in any organization (Ostroff et, al., 2014). Itis usually associated with perceptions and behaviour. Measuring the organizational climate of an aviation company in the North Africa region, four questions were modified and implemented from ORMAQ (see Table 5.52 in appendix D).

The findings of organisational climate factor indicate that most of the participants shewed high positive agreements to all statements, this giving a good prediction of a good safety culture in these organisations.

Accordingly, most of the participants agreed with items 43, 44, 45 and 46 (see appendix B) the findings of this factor illustrated in (Figures 5.45, 5.46, 5.47 and 5.48) below.

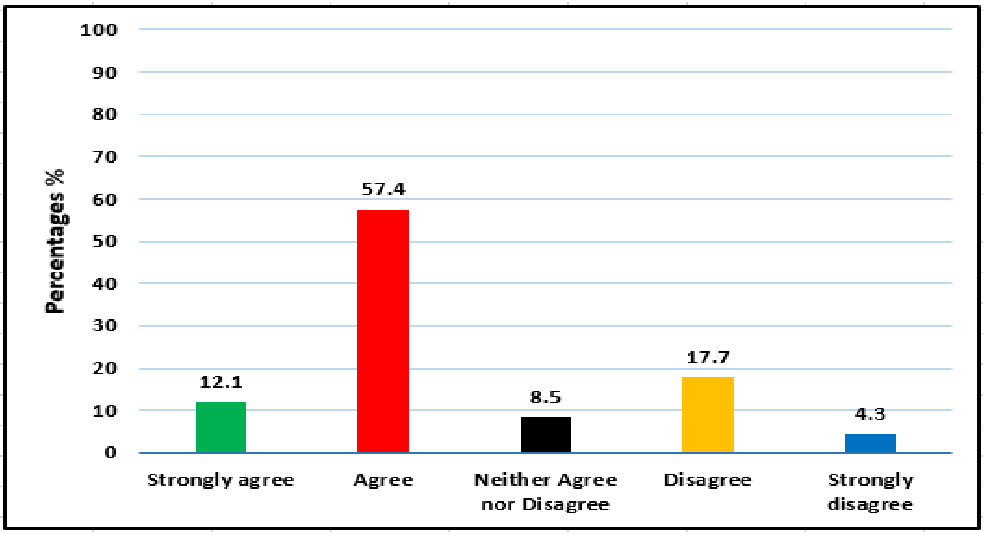


Figure 5-45: The participant’s percentage’s agreement of item 43, (*n*-141)

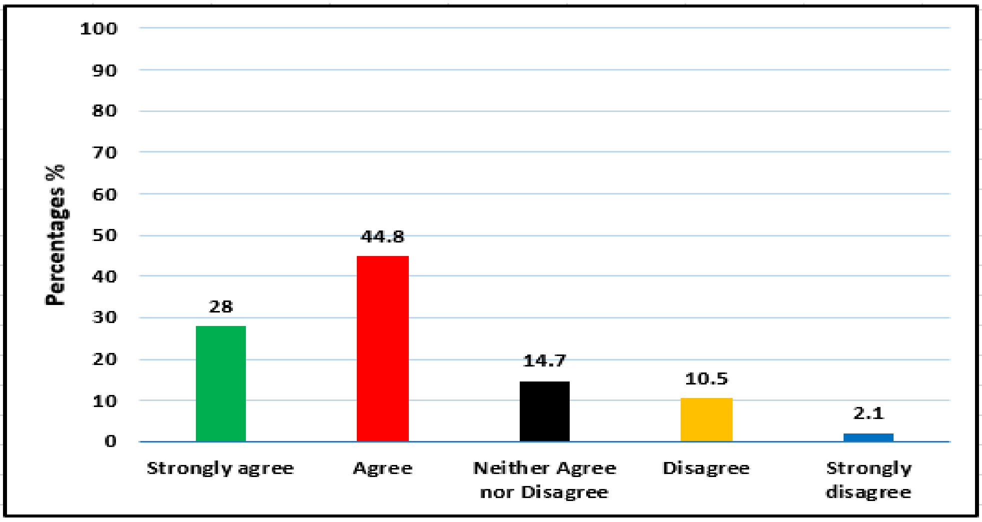


Figure 5-46: The participant's percentage's agreement of item 44, (*n*-143)

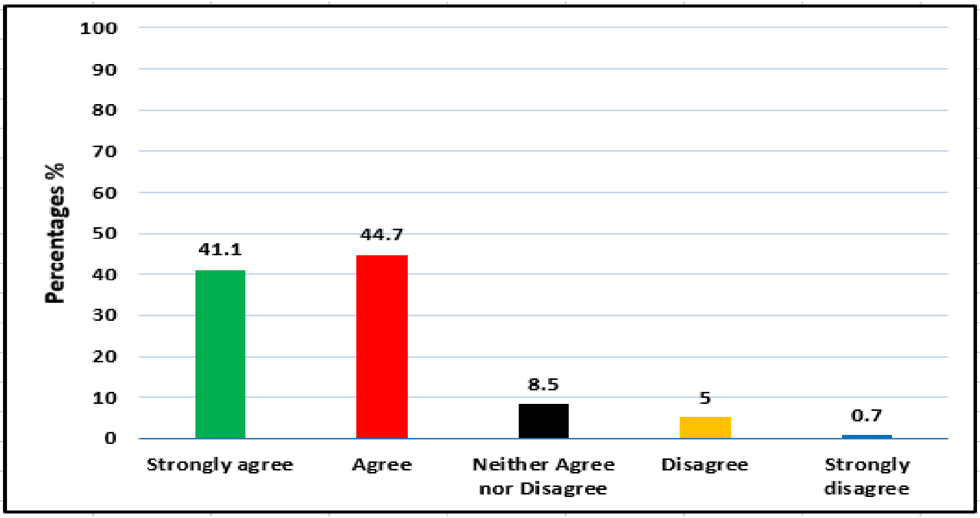


Figure 5-47: The participant's percentage's agreement of item 45, (*n*-141)

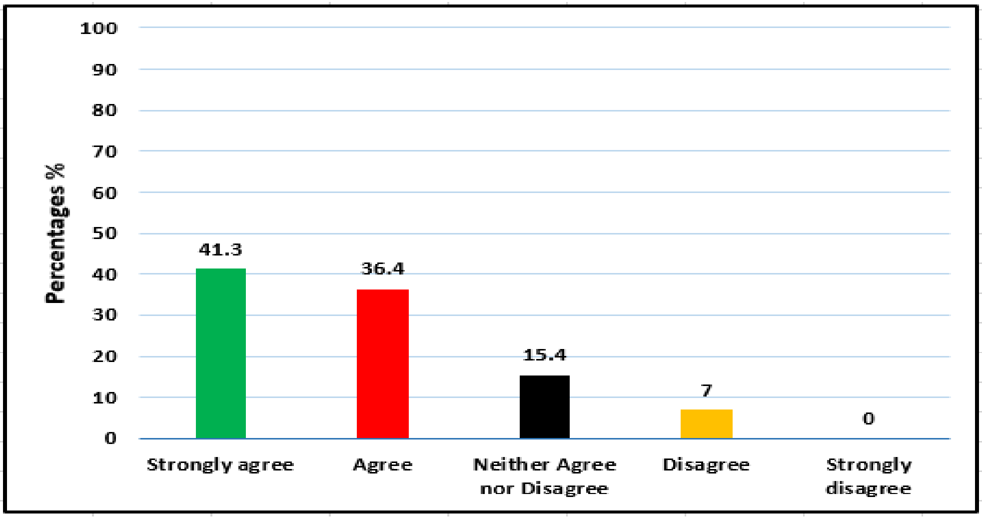


Figure 5-48: The participant's percentage's agreement of item 46, (*n*-143)

The range of agreement of the participants with these questions ranging between 69% to 85%, is a very good prediction of safety culture in these organisations (Zohar, 1980, cited in Dedobbeleer and Béland, 1991; Fogarty and Shaw, 2010; Yule et al., 2004). It also reflects results in previous studies of effective team performance in patient safety within UK hospitals (Flin et al., 2003; Flin et, al., 2006).

In conclusion of the organisational climate findings, most of the participants showed high positive agreements to all statements, which gives a good prediction of safety culture in these organisations. These results suggest that it might be worthwhile to examine organisational climate in more detail, especially in regard to factors known to influence safety, such as perceived management commitment to safety.

Summary of Attitude to Human and Organization Factors (Theme 2)

The findings of these factors, which represent attitudes of the participants towards human and organisational factors (theme 2), indicated that these pilots are suffering from negative attitudes towards some human and organisational factors, which is having a negative impact on pilot performance, badly affecting pilot risk perception and decision-making in the cockpit. The result shows that participants are suffering from weakness in dealing with stress and fatigue in the cockpit. The study sample illustrates a positive attitude to teamwork effectiveness. However, these pilots were not willing to accept different opinions in the cockpit (as indicated in item 28), which is a sign of moderate weakness in teamwork in the cockpit. The results show weakness in teamwork in accepting different opinions in the cockpit, as well as negative attitudes to the importance of team harmony. This gives a prediction of poor understanding of each other as a team, poor motivation to work as a team and an unhelpful communication style in the cockpit. In both factors “work value and error/procedures compliance” the majority illustrated a positive attitude. However, the awareness of risk of error accuracy in the cockpit as an inevitable human factor was very weak, which negatively affects pilots’ risk judgement and, consequently, decision-making performance.

Answer to Research Question One

The answer to question one illustrated through a cross-tabulation, which indicate the most significant influencing factors of North African culture on pilot decision-making performance in the cockpit in light of their risk perception (see Table 5.7).

Table 5-7: National culture factors influencing pilots in the cockpit

Factor	Item ID	Survey Items
Power Distance	Item1	F/Os are afraid to express disagreement in the flight deck.
	Item 2	P-I-C should take physical control and fly the aircraft in emergency and non-standard situations.
	Item 5	In abnormal situations, I rely on P-I-C to tell me what to do.
Stress and Fatigue	Item 24	My decision making is as good in emergencies as it is in routine situations.
	Item 25	I am more likely to make errors in tense or hostile situations.
	Item 26	My performance is not adversely affected by working with an inexperienced or less capable pilot.
Teamwork	Item 28	It is better that the P-I-C and the F/O agree than to voice a different opinion.
Work Value	Item 33	Captains deserve extra benefits and privileges.
	Item 34	As long as the job gets done, I don't care what others think of me.
	Item 36	It is an insult to be forced to wait unnecessarily for other members of the flight crew.

Therefore, the (Table 5.7) illustrates four factors that have an impact on the pilot's risk perception in the cockpit. These four factors have an impact on the pilot's risk perception in the NAR. Accordingly, the answer of question one that is the most significant factors which influences the pilot's risk perception in the NAR according to the quantitative data findings is as follows: power distance, stress and fatigue, teamwork and work value.In addition, the quantitative data findings shows a clear different impact of the national culture among the Captains and First Officers. In the majority of these factors, First Officers indicated a higher impact rate than the Captains (see Table 5.8).

Table 5-8: Descriptive statistics of the themes one and two

Factor	Item No	Percentage of participants (*n*-143) Agreement or Disagreement	Captains (*n*-38)			First officer (*n*-105)		
			%	Mean	SD	%	Mean	SD
Power Distance	Item 1	(62%) Agreed	53%	2.74	1.107	68%	2.57	1.142
	Item 2	(79%) Agreed	71%	2.23	1.165	81%	1.91	1.054
	Item 5	(48%) Agreed	37%	2.97	1.284	52%	2.74	1.129
Stress and Fatigue	Item 24	(55%) Agreed	60%	2.80	1.158	53%	2.63	1.175
	Item 25	(71%) Agreed	66%	2.29	1.137	72%	2.12	1.053
	Item 26	(72%) Agreed	65%	2.43	0.929	75%	2.10	.995
Teamwork	Item 28	(73%) Agreed	77%	1.82	1.029	72%	2.06	1.027
Work Value	Item 33	(47%) Agreed	35%	2.84	0.986	51%	2.64	.952
	Item 34	(95%) Agreed	90%	1.68	0.739	97%	1.40	.629
	Item 36	(47%) Agreed	37%	2.92	0.818	51%	2.53	1.038

However, the Captains indicated a higher percentage in item 24 and item 28. In item 24, the Captains showed higher because they have more experience and better ability for good decision-making performance and evaluating the risk level in both emergency and routine situations. According to Jensen et, al., (1987), pilots with a higher rate of flight hours experience show less rate of accidents and this rate decreases more and more as more hours are built up.

Accordingly, the higher percentage rate in item 24 for pilots reflects the Captains' experience and their ability to deal with emergency and routine situations more effectively than First officers who how have less experience.

In addition, in item 28 Captains showed a higher percentage than First Officers (see Table 5.8). This result supports the findings of this research that the high power distance plays a negative role in the cockpit with the North Africa region. In this item, it is clear that the captains do not accept different opinions from other crew in the cockpit. Therefore, the findings of the qualitative data indicated that there is a difference in the National culture impact on the Captains and the First Officers response, to explore if this deference is significant "One way ANOVA" test was implemented in this study as follows:

➢ **One Way ANOVA Test**

In order to determine if there is a significant difference of the national culture impact in cockpit among the captains and first officers a one-way analysis of variance (ANOVA) test was conducted. The fact that these quantitative data are approximately normal distributed (see Appendix F), thus, it requires a parametric statistical tests for a further intensive analyse, in addition to that, there is a difference in the sample sizes between the captains and first officers means that "One Way ANOVA" is the most suitable test in this case because it includes a Welch's test, which is able to compare two means with unequal variances or sample sizes (Derrick et al,. 2016). In other words, this test is the independent samples t-test corrected for unequal variances or sample size and is considered a robust alternative to the independent samples t-test.

The null hypothesis was there is no deference between the Captains and the First Officer responses. Therefore, to reject the null hypothesis the significance levels should be ($p < 0.05$), which is implies that there is a significant difference between the captains and first officer responses. (Table 5.9) indicates the significance levels for all items, which is specified as having the most significant impact on pilot decision-making performance in the NAR.

Table 5-9: Result of One Way ANOVA and the distractive statistics

Factors	Item No	Captains (*n*-38)			First officer (*n*-105)			p-value
		M	SD	N	M	SD	n	
Power Distance	Item 1	2.74	1.107	38	2.57	1.142	105	0.43
	Item 2	2.23	1.165	35	1.91	1.054	102	0.16
	Item 5	2.97	1.284	38	2.74	1.129	103	0.32
Stress and Fatigue	Item 24	2.80	1.158	35	2.63	1.175	104	0.46
	Item 25	2.29	1.137	38	2.12	1.053	105	0.43
	Item 26	2.43	0.929	37	2.10	.995	103	0.06
Teamwork	Item 28	1.82	1.029	34	2.06	1.027	105	0.25
Work Value	Item 33	2.84	0.986	37	2.64	0.952	105	0.28
	Item 34	1.68	0.739	38	1.40	0.629	105	0.03
	Item 36	2.92	0.818	38	2.53	1.038	105	0.02

The result from the "One Way ANOVA" analysis indicates that for all factors except the "work value factor" that the null hypothesis cannot be rejected (see Table 5.9), which means that there are not any differences between the Captain and the First Officer responses for these factors. The result for the "work value factor" shows that the null hypothesis can be rejected where the significance level for two items out of three are (0.02 and 0.03) which yields significance level ($p<0.05$). As the significance deferent level between the Captain and the First officer responses found in the "work value factor" therefore, it is concluded that the First Officer are more effect from national culture in term of work value factor.

Accordingly, the significant deference among the Captain and First Officers responses about the work value factor reflects that the Captains' experience in term of their appreciation of team harmony in the cockpit and the First officers are more influenced by the national culture of the NAR in the cockpit.

5.5.4 Question Two

"To what extent are the pilots in the North Africa region influenced by the cross-culture when they are using advanced technology in the cockpit?"

This question will be answered by describing the findings of theme three, which represents Theme three in the questionnaire regarding system design and automation in the cockpit.

5.5.4.1 Automation (Theme 3)

Automation has resolved many safety problems in the cockpit. But ultimately, other types of safety problem have been discovered, which cause new and different accidents (Chialastri, 2012). These new accidents stem from a different view by pilots of safety, systems, human contribution to accidents and, consequently, corrective actions. According to Parasuraman et, al. (2000) that "automation can be applied to four classes of function: information acquisition, information analysis, decision/action selection, and action implementation".

This study relied more on decision and action selection, adopting a decision-making model based on risk perception, identification, action, follow-up and feedback, information acquisition. This could be likened to the first step, which is risk perception. This theme is included with one factor, which is system design and automation. In addition, this factor was divided into six items, which represents this factor in the cockpit.

- **Factor Ten: System Design and Automation (items from 47 to 52)**

This section analyses the data related to system design and automation in the cockpit. This section of the survey shows the responses of pilots in relation to automated systems hardware and software. This includes: crew awareness, data entry, error detection and correction, automation surprise, the ability to understand the FMC/FMGS language and jargon messages, and understanding how the current advanced technology in the cockpit effects pilot's decision-making performance in the region of North Africa. According to Turney, (2007) one of the reason of the mid-air collision at Überlingen is safety culture, where the Tupelov Russian aircraft was equipped with the Traffic Collision Avoidance System (TCAS), but the Russians did not consider using the TCAS system is important in the cockpit and the TCAS alarm was ambiguous to them.

This represents the implications of culture interface in the cockpit. This part of the survey contains six variables (see Table 5.57 in appendix D). The findings of this factor indicate that these pilots suffer hardly at all in some aspects of understanding the FMC/FMGS software and hardware design in the cockpit.

- **Items 47: Crew Awareness**

The first variable is to explore to what extent crew members in the cockpit within the North Africa region are aware of their colleague control inputs. This directly affects response to any event and consequently affects decision-making performance.

According to the frequency analysis of item 47 "I always know what the other pilot is doing with the automated systems", as shown in (Figure 5.49), about 87% of participants agreed with the statement and about 4% disagreed. This is relatively similar to the results of a previous study in the Asia Pacific region, where about 55% agreed with this statement (BASI, 1998).

In addition, the difference in percentage between these regions might express the current revolution in advanced technology and safety programmes, where the Asia Pacific region study dates from 1998.

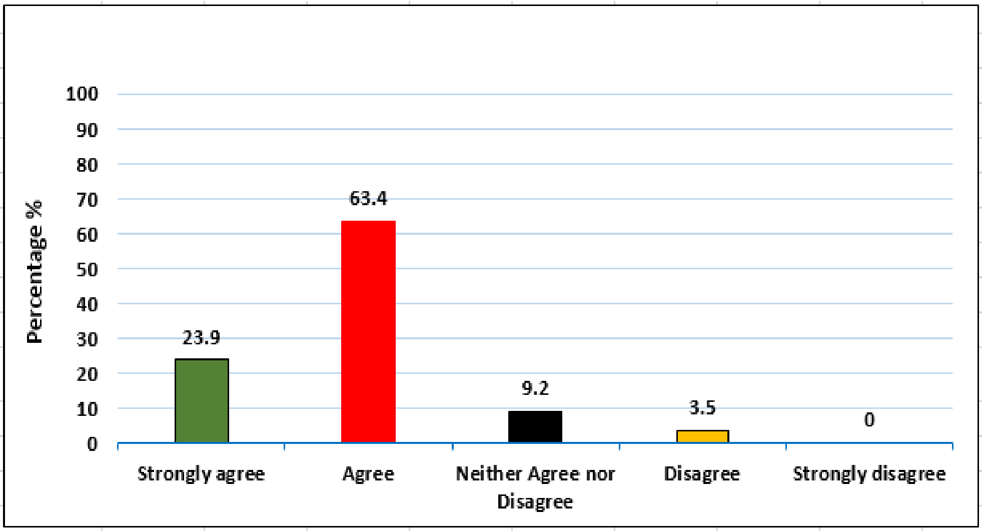


Figure 5-49: The participant's percentage's agreement of item 47 (*n*-142)

- **Items 48: Data entry and error detection**

For item 48 "It is easy to detect when incorrect data has been entered by error", according to bureau of air safety investigation (BASI) this question consists of two aspects, which are the acceptance of incorrect data entry by the FMC/FMGS and the detection of incorrect data. The output of analysing this question showed that about 71% of the participants agreed and about 9% disagreed with the statement (see Figure 5.50). This means that they have good interface with the cockpit automation and software. This result supports a previous study about the possibility of entering wrong data into FMC/FMGS (BASI, 1998). The easy detection of entering wrong data in the advanced technology was expressed by the pilots who rely on physical sensation and electronic detection.

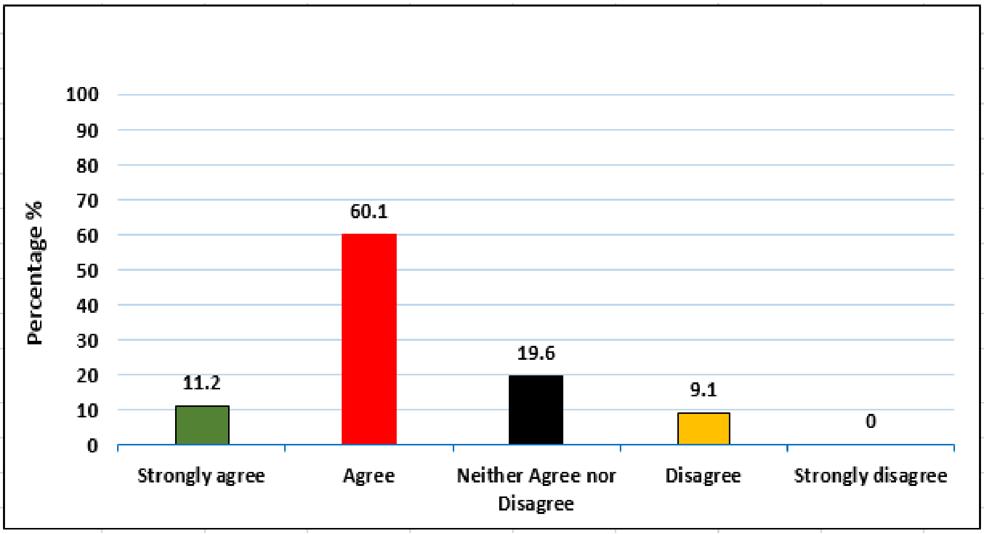


Figure 5-50: The participant's percentage's agreement of item 48, (*n*-143)

- **Items 49: Automation Extent in the Cockpit**

Advanced technology in modern aircraft has led to a high level of automation in the cockpit. This has reduced the workload of the pilot and increased safety performance of flight. But other problems have emerged, like the awareness of flight mode characteristics and the response of the aircraft. The response of the participants on item 49 "They've gone too far with automation", was 76% agreeing with the statement (see Figure 5.51). This is relatively very high in comparison with a previous study by BASI (1998), where just 10% agreed with the same statement. This reflects the rapid development in advanced technology in the cockpit, where complexity has increased. In addition it shows the difference between the North Africa region and the Asia-Pacific region where this previous study was done (BASI, 1998).

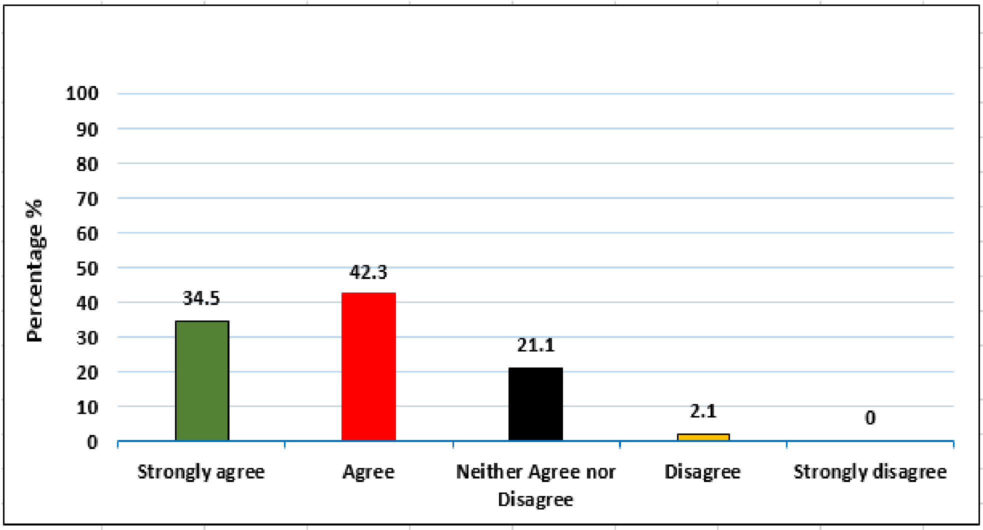


Figure 5-51: The participant's percentage's agreement of item 49, (*n*-142)

- **Items 50: Surprise of Automation**

According to Chialastri (2012) and Dehais et, al. (2015), automation surprise is the conflict between the pilot and the automation in the cockpit. This happens when a pilot detects any event in the cockpit but does not understand the situation. This threatens the flight. BASI (1998) defined automation surprise as a weakness in a pilot's mental model of the automated environment that results in the pilot being 'surprised' by the difference between the expected and actual performance of the aircraft. The result of item 50 "With automation there are still some things that take me by surprise", shows the responses of those pilots who agreed with the statements at about 64% (see Table 5.52), which is a statistically very high positive agreement. This means that weakness in the pilot's mental model is obvious, but this weakness in the mental model is not necessarily the fault of the pilot It could be a cultural effect due to technology interface.

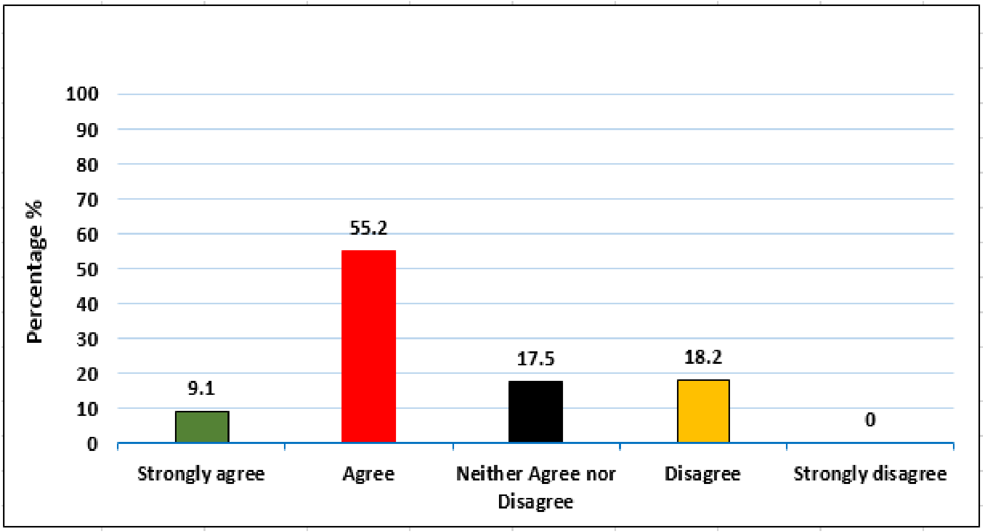


Figure 5-52: The participant's percentage's agreement of item 50, (*n*-143)

- **Items 51: Understanding the language of FMC/FMGS**

According to the frequency analysis of item 51, "I sometimes find it hard to understand the language or technical jargon in messages presented by the FMC/FMGS", about 29% of participants agreed and 47% disagreed (see Table 5.53). This means that about 29% found it hard to understand the language or technical jargon in messages presented by the FMUFMGS. About 24% of the participants were not sure about their answer. The technology-culture interface could play a crucial role at this point, where the automation terminology and design are addressed to western aircraft manufacturers. This brings an issue of cross-culture into the cockpit. The high percentage in terms of misunderstanding of FMC/FMGS language and technical jargon by the pilots in this region shows the need to calibrate the standard terms of automated components, modes and messages. This result supports a previous study by BASI (1998), which showed that a common language of automated hardware and software would be beneficial to users both in the North American region and the Asia Pacific region.

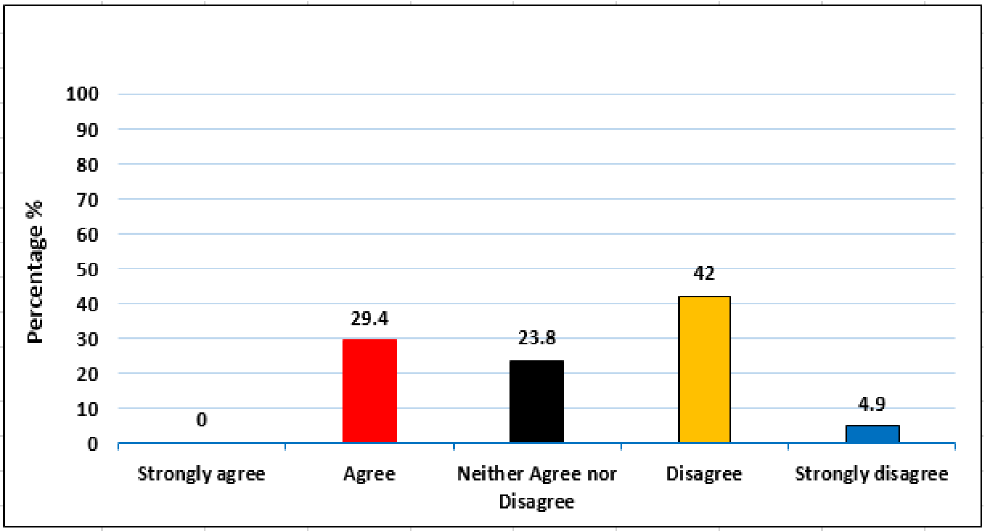


Figure 5-53: The participant's percentage's agreement of item 51, (*n*-142)

- **Items 52: Correction of Wrong Data Entered**

The analysis of item 52 "Incorrect data entered by error in automated systems is easily corrected", shows high positive agreement to the statement. About 80% of the participants either agreed or strongly agreed (see Table 5.54). This means that the most wrongly entered data was easily corrected before execution; consequently, this positively affected pilot decision-making performance in flight by either early error correction or good output expectation. This result reflects the findings of a previous study by BASI (1998), where about 72% of pilots agreed with this question. There was only a small difference of about 6%, which might reflects the optimizing deign of advanced technology today.

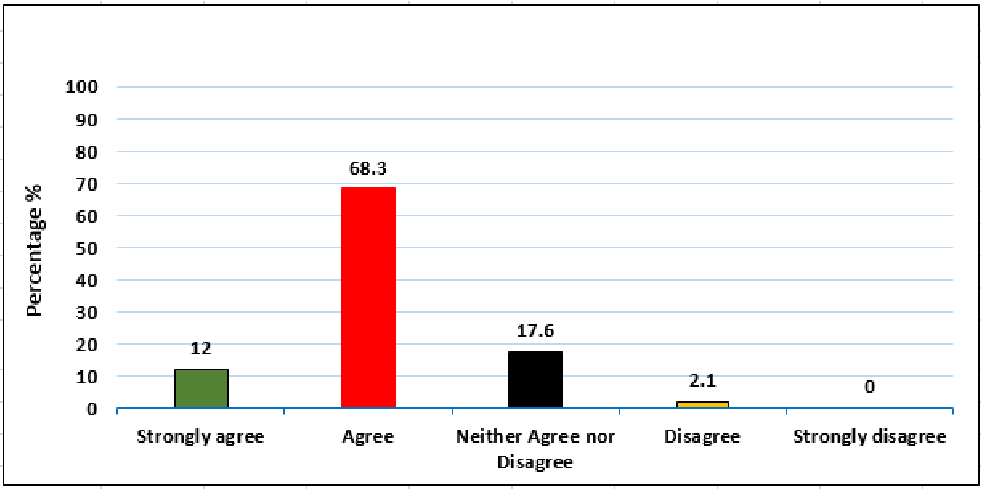


Figure 5-54: The participant’s percentage’s agreement of item 52, (*n*-142)

Summary of Automation Findings (Theme 3)

The result of this section reflects the contemporary revolution in advanced technology in the cockpit, especially of automated products and automation software. The pilots in the North Africa region showed high positive awareness of other crew input, which positively affects their decision-making performance. The wrong data entered by mistake was easily detected by pilots in the North Africa region, where this result reflects a previous study by BASI (1998). This means there is no special need for pilots of the North Africa region to be seen to be suffering adverse effects of national culture vis-a-vis advanced technology interface.

Interestingly, there was a high positive agreement with item 49, where about 77% of the pilots agreed with the statement. This stands in comparison with the previous BASI (1998) study (Wiener, 1989) showing that pilots in North Africa struggle to cope with the rapid change of advanced technology. The findings of items 50 and 51 reflect the result in item 49, where a high percentage of agreement was shown by these pilots to the difficulty in understanding the automation language and technical jargon, in addition to automation surprises. This result raises many questions for these companies and their training programs and strategy and quality in preparing their pilots with basic concepts and information regarding advanced technology in the cockpit.

Moreover, the high agreement with automation surprise item is unacceptable, in comparison with Wiener (1989), findings cited in BASI, (1998), where the result was 60% of the participants. In this study about 75% of the pilots in the region are suffering from automation surprise. According to BASI (1998) this is a weakness in a pilot's mental model of the automation environment. This weakness is likely to be a direct cause of poor interface between technology and culture and a poor decision making performance in the cockpit.

These results are obvious in the last questions “They've gone too far with automation, and “With automation there are still some things that take me by surprise”, and “I sometimes find it hard to understand the language or technical jargon in messages presented by the FMC/FMG”. It is clear that these pilots are suffering from weakness in understanding the FMC/FMGS software/hardware design. An example of this shortfall of technology-culture interface in the region of North Africa is the Libyan Afriqiyah Airways accident in 2010, where the Ground Proximity Warning System (GPWS) started sounding “terrain, pull up”. The First Officer waited for the Captain's instruction before he pulled up. The captain then pushed the stick forward again (Kevin L, 2013). This was part of the accident chain. This example explains some issues such as poor decision-making performance, the effect of national culture, and poor understanding of FMC/FMGS language or technical jargon messages.

Answer to Research Question Two

The answer to question two is revealed in the answers of questions 49, 50 and 51 as shown in (Tables 5.10). This represents strong evidence that pilots in the NAR are highly influenced by the cross-culture in the cockpit. Therefore, poor risk management, insufficient decision-making performance, and poor understanding of FMC/FMGS language or technical jargon messages prevail.

Table 5-10: Factors influencing pilots in the cockpit within the NAR

Factor	Item ID	Items
Automation extent in the cockpit	Item 49	They've gone too far with automation.
Surprise of automation	Item 50	With automation there are still some things that take me by surprise.
Understanding the language of FMC/FMGS	Item 51	I sometimes find it hard to understand the language or technical jargon in messages presented by the FMC/FMGS.

The findings of this factor indicates that there is a different impact of these items between Captains and First Officers, as illustrated in (Table 5.11). The findings shows that in item 49, "They've gone too far with automation", about 78% of Captains agree with this statement. This is higher than First Officers by 2%. This result could be due to the long-time experience and use of a different generation of advanced technologies by the Captains in the cockpit.

Table 5-11: Cross-tabulation of theme three findings

Automation Factor	Item ID	Percentage of participants (*n*-143) Agreement or Disagreement	Captains (*n*-38)			First officer (*n*-105)		
			%	Mean	SD	%	Mean	SD
Automation extent in the cockpit	Item 49	(77%) Agreed	78%	1.86	0.751	76%	1.92	0.817
Surprise of automation	Item 50	(64%) Agreed	47%	2.87	0.906	71%	2.30	0.843
Understanding the language of FMC/FMGS	Item 51	(29%) Agreed	26%	3.37	0.883	31%	3.17	0.945

In item 50, "With automation there are still some things that take me by surprise", and item 51, "I sometimes find it hard to understand the language or technical jargon in messages presented by the FMC/FMGS", it is clear that experience plays a crucial role in mitigating the cross-culture interface in the cockpit especially in item 50, which shows high difference between Captains and First Officers responses. Likewise, it is important to test if this difference is significant, in order to find out that the researcher decided to run a “One Way ANOVA” to explore this deference.

- **One Way ANOVA Test**

The one-way ANOVA is the most suitable test for this comparison due to the difference in the sample size between captains and first officers, as mentioned earlier in answering Research Question 1 (see Section 5.5.3). Therefore, in order to determine if there is significant difference of the cross-cultural interface in the cockpit among the Captains and first Officers a one-way ANOVA test was implemented. The null hypothesis was that there is no difference between the influences of the cross-culture interface in the cockpit on the Captains’ and the first Officers’. Statistical significance is set at ($p < 0.05$) for the analysis; the null hypothesis will be rejected if this standard is met. Table 5.12 indicates the significance levels for items that represent the most significant factors of the cross-culture interface in the NAR on the captains and the first officers.

Table 5-12**:** Result of One Way ANOVA and distractive statistics of all items

Factors	**Item No**	**Captains (*n*-38)**			**First officer (*n*-105)**			**p-value**
		M	**SD**	**N**	**M**	**SD**	**n**	
Automation extent in the cockpit	Item 49	1.86	0.751	37	1.92	0.817	105	0.69
Surprise of automation	Item 50	2.87	0.906	38	2.30	0.843	105	0.00
Understanding the language of FMC/FMGS	Item 51	3.37	0.883	38	3.17	0.945	105	0.25

The result from the One Way ANOVA analysis indicates that for items 49 and 51, the null hypothesis cannot be rejected (see Table 5.12), which means that there is not any differences between the Captain and the First Officer responses for these factors. The result of item 50 shows that the null hypothesis can be rejected where the significance level are (0.001) which implies the significance level ($p<0.05$). This means that there is a significant deference level between the Captain and the First Officer responses. Therefore, it is concluded that First officers are more affected from cross-culture in the cockpit within the NAR.

Accordingly, the significance deference among the Captains and the First Officers responses reflects the Captains' experience in understanding the modern technologies which produced by other regional culture.

5.5.5 Question Three

"How does pilot risk perception in the North Africa region differ from other pilots in other regions?"

This part is designed to discover pilot risk perception in practical flight by using the Hunter Scale (HS) (Hunter, 2006), as mentioned in (Chapter 2, Section 2.10.4.3). In this scale Hunter emphasises that it seems that higher levels of perceived risk in the two exercises can be associated with lower accident involvement and risk tolerance (Hunter, 2006). According to Ferraro et, al.(2015) misunderstanding of risk can directly affect pilot decision-making performance. Berlin et al. (1982) state that a pilot's decisional errors are caused from pilots selecting inappropriate actions due to bad judgment and evaluation of risk. This part was designed to understand the pilot's judgment and evaluation of risk in the cockpit among pilots within the region of North Africa. The analysis was run initially by frequency analysis as follows:

5.5.5.1 Risk Perception (Theme 4)

This part of the survey evaluated pilot risk perception within the region of North Africa. The HS consists of two scale types: Hunter's risk perception scale 1 (Other) and risk perception scale 2 (Self). Participants are asked to evaluate the risk in both scales by using a scale from 1 (low risk) to 100 (high risk). In both scales just five questions were chosen due to the inability to add more questions to the survey, in order to keep it convenient to all participants.

The first scale consisted of 17 scenarios depicting aviation situations. All the scenarios were written in the third person, so that respondents would rate the risk for the person described in the scenario, and not for themselves. The five questions chosen for this study as most easy understandable to the participants from the NAR according to their order numbers in the original Hunter sale are: 1, 2, 3, 4, and 6 (see appendix G).

The second scale consists of 25 short descriptions of events or situations that could occur to the participants and the respondent is asked to evaluate the risk in each situation. This scale contains two types of scenario, which are flight and driving scenario. In this study, a five flight scenario was implemented. The five scenarios which were chosen from this scale in Hunter's original scale are as follows: 4, 8, 9, 15, and 19 (see Appendix G). Table 5.13 shows the ranking number of these scenarios in this study (Technology–Culture interface) with comparison to the original scale (Hunter's scale of risk perception).

Table 5-13: Questions in order of the original HS and this study.

Technology–Culture interface (questions and scenarios order)	Hunter's Scale of Risk Perception (questions and scenarios order)
53	**15**
54	**9**
55	**8**
56	**4**
57	**19**
58	**1**
59	**6**
60	**2**
61	**4**
62	**3**

As shown in the tables above, the analysis started with part two because it represents the pilot opinion as if he was involved in the scenario, and then scale two as third party.

A frequency analysis was run for both scales to find out the (Mean, Std-deviation and Max-Min) for each scenario and to compare this result with Hunter's original result, in which Hunter examined pilot risk perception as part of a major study in which several hundred American pilots completed a series of questionnaires online.

The findings of this theme indicated that pilots risk perception in the NAR are lower than pilots in the North America region according to HS. Accordingly, they are more willing to tolerate risk and be involved in accidents.

Scale 2 (the Self scale) findings indicate that in all scenarios the participants gave a lower mean than in the original Hunter study (as shown in Table 5.14 and Figure 5.55).

Table 5-14: Comparison between this study findings and HS finding

Risk Perception 2- Self scale (RPS2)									
Items	**Item No in this research**	**Item No in HS**	**Number of participants**	**Min**	**Max**	**Mean**	**SD**	**HS Mean**	**HS SD**
1	**Item 53**	RPS2 Item 15	143	10	70	39.51	15.48	45.6	20.5
2	**Item 54**	RPS2 Item 9	143	30	90	58.32	16.44	67.2	17.4
3	**Item 55**	RPS2 Item 8	143	10	90	48.81	20.05	62.4	18.2
4	**Item 56**	RPS2 Item 4	143	30	70	49.16	11.47	52.9	21.4
5	**Item 57**	RPS2 Item 19	143	10	70	38.25	16.11	47.5	13.5

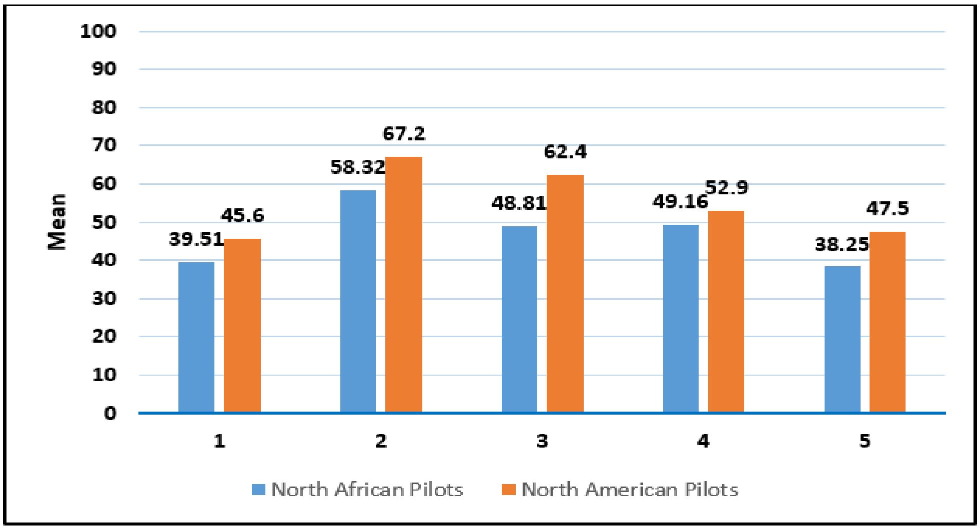


Figure 5-55: Risk Perception of pilots from North America & NAR

Scale 1 (Other-scale) gives findings indicating that the participants have a lower risk evaluation in the majority of this scale scenario (see Table 5.15 and Figure 5.56) .However, in item 59, "During the planning for a two-hour cross-country flight a pilot makes a mistake in computing the fuel consumption. He believes that he will have over an hour of fuel remaining upon arrival, but he will really only have about 15 minutes of fuel left", the findings showed that these pilots gave a higher level of risk in this scenario. This result might reflect the previous result in error and procedural compliance factor and that these pilots do not appreciate the human error as an inevitable issue and they cannot accept this mistake.

Table 5-15: Comparison of these study's findings and HS Findings

Risk Perception 1- Other (RPS1)									
Item No	**Item No in this research**	**Item No in HS**	**Number of participants**	**Min**	**Max**	**Mean**	**SD**	**HS Mean**	**HS SD**
1	**Item 58**	RPS1 Item 1	143	40	100	76.85	16.02	79.6	17.6
2	**Item 59**	RPS1 Item 6	143	60	100	80.77	11.69	74.9	18.3
3	**Item 60**	RPS1 Item 2	143	60	100	79.58	10.20	85.1	14.2
4	**Item 61**	RPS1 Item 4	143	70	100	89.72	8.79	96.8	5.8
5	**Item 62**	RPS1 Item 3	143	60	100	80.77	12.67	89.4	10.5

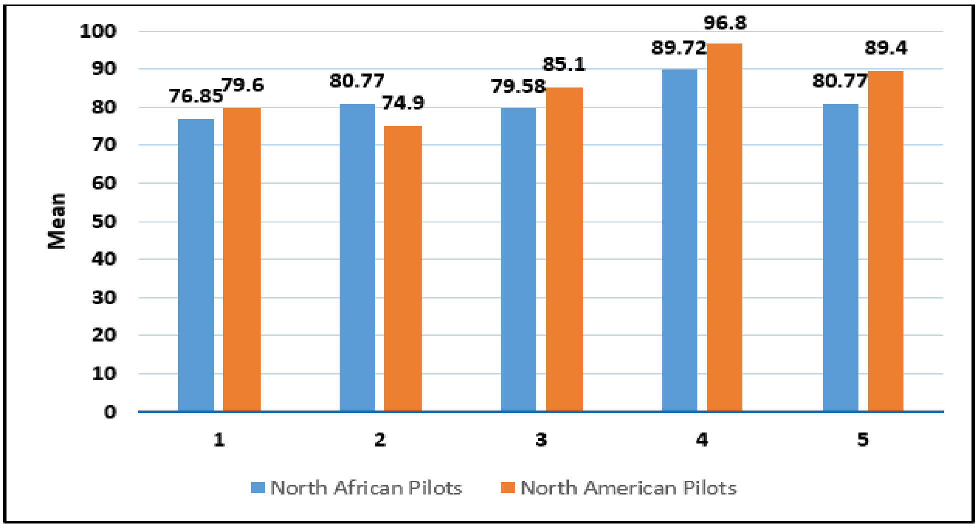


Figure 5-56: Risk perception level of pilots from North America & NAR

Conclusion of the risk perception findings

The findings of this theme showed the pilots in North Africa suffering from insufficient evaluation of the risk in the flight situation. Both HSs for risk perception give very strong evidence that the risk evaluation for the pilots from NAR was less than Hunter‘s finding in both scales for the pilots from the North America region.

Answer to Research Question Three

The answer to Research Question 3 is that the pilots in the NAR, in comparison to the pilots in the North America region, had less evaluation of risk (lower level of risk inherited) (see Figures 5.55 and 5.56). According to Hunter (2006), one explanation for behavior that leads to an accident or incident is that the person did not perceive the risk inherent in the situation, and hence did not undertake avoidance or other risk-mitigating actions. Those pilots who incorrectly perceived risks involved in this situation will continue under-recognising risk, as they do not consider the risks properly. Furthermore, these pilots would be described as having a greater tolerance or acceptance of risk, compared to the pilots in the North America region

Furthermore, to explore whether this difference in risk perception evaluation between the North African pilots and North American pilots is significant in shaping the decision-making performance in the cockpit, a one-sample t-test is used.

- **One-Sample T-Test**

The second intensive analysis in the quantitative data is the one-sample t-Test, in order to determine the significance of risk perception difference between captains and first officer. The reason behind using this analytical tool is its ability to identify the statistical difference between a sample mean and a known or hypothesized value of the mean in the population (which represents the mean of the population in all HS items). The test was conducted on both HSs, from item 53 to 62 (see Tables 5.16 and Table 5.17). Each mean of this study of the items from 53 to 62 was tested with the same mean of the same item in HS.

Table 5-16: One Sample *t*-Test result of (RPS2)

One Sample T-Test (RPS2)						
Item ID	**Number of participants**	**Mean**	**SD**	**HS Mean**	**HS SD**	**p-value**
Item 53	143	39.51	15.48	45.6	20.5	0.00
Item 54	143	58.32	16.44	67.2	17.4	0.00
Item 55	143	48.81	20.05	62.4	18.2	0.00
Item 56	143	49.16	11.47	52.9	21.4	0.00
Item 57	143	38.25	16.11	47.5	13.5	0.00

Table 5-17: One Sample *t*-Test result of (RPS1)

One Sample T-Test (RPS1)						
Item ID	**Number of participants**	**Mean**	**SD**	**HS Mean**	**HS SD**	**p-value**
Item 58	143	76.85	16.02	79.6	17.6	0.42
Item 59	143	80.77	11.69	74.9	18.3	0.00
Item 60	143	79.58	10.20	85.1	14.2	0.00
Item 61	143	89.72	8.79	96.8	5.8	0.00
Item 62	143	80.77	12.67	89.4	10.5	0.00

The results of one sample t-test for all items in both scales indicate that the null hypothesis can be rejected where the significance level ($p<0.05$) for all items, as shown in Tables 5.16 and 5.17.

Accordingly, the pilots' risk perception in the NAR is significantly different from that of pilots in the North America region; thus, this difference might an indirect effect of the regional national culture and is negatively affect pilots' decision-making performance within the NAR.

5.6 Chapter Summary

This chapter has discussed the findings of the questionnaire which was conducted for the purpose of data collection in this research. In addition, this chapter has explained the design process of the questionnaire. A detailed exploration of the questionnaire findings have been included. These findings were analysed with the implementation of SPSS 24 software, which was relied on for descriptive frequency statistics. The descriptive frequency statistics were built relying on the four themes, including the most significant factors in the pilot decision-making performance within the North Africa region, and relying on evaluation of the pilot's risk perception in the cockpit objectively and subjectively. The findings of these themes were as follows:

The findings of theme one indicated that the power distance factor has a negative impact on the pilot decision making performance in the cockpit within the North Africa region due to united decision-making in the cockpit among pilots, Captains not sharing his/her decisions with First Officers, and First Officers hesitating to discuss a Captain's decisions. In addition, the majority of the participants showed a positive awareness of uncertainty avoidance in the cockpit and risk mitigation.

The findings indicated that both factors religion and norms, and social relationship, have not got real influence on pilot decision-making in the cockpit The attitudes of the participants towards human and organisational factors indicated that the participants suffer from negative attitudes towards some human and organisational factors, which has a negative impact on a pilot's performance, and badly affects the pilot's risk perception and decision-making performance in the cockpit. The result shows that participants are suffering from weakness in dealing with stress and fatigue in the cockpit. In addition, the study sample illustrates a positive attitude to teamwork effectiveness. However, these pilots are not willing to accept different opinions in the cockpit, which is a sign of moderate weakness in teamwork in the cockpit.

The results also showed negative attitudes to the importance of team harmony in the cockpit, which gives a prediction of poor understanding of each other as a team, poor motivation to work as a team and an unhelpful communication style in the cockpit. In the factors of “work value and error/procedures compliance” the majority illustrated a positive attitude. However, the awareness of risk of error accuracy in the cockpit as an inevitable human factor was very weak, which negatively affects pilot risk judgement and leads to poor decision-making performance. In addition, the result of one way ANOVA in theme one findings indicated that First officers are fundamentally affected by the work value from captains in the cockpit, which might reflect that the Captains’ experience in term of their appreciation of team harmony.

The findings of theme three reflect the modern revolution of advanced technology in the cockpit, especially of automated products and automation software. The pilots in the North Africa region showed high positive awareness of other crew input, positively affecting their decision-making performance. The wrong data entered by mistake was easily detected by pilots in the North Africa region. There is no special need for pilots in the North Africa region regarding the adverse effect of national culture or an adverse effect with advanced technology interface regarding this issue.

The pilots in North Africa struggle with the rapid change of advanced technology. These pilots also face challenges and difficulty in understanding the automation language and technical jargon and they are still surprised by automation, which reflects the poor interface of technology and culture in the cockpit, In addition, the one way ANOVA test showed that First officers are significantly affected by the surprise of automation from Captains in the cockpit, which could be due to lack of knowledge and experience.

Lastly, the findings in theme four showed that the participants in this survey are insufficiently able to evaluate the risk inherent in the flight situation and they have a high level of risk tolerance or acceptance of risk. According to the One Sample *t*-Test pilots in the NAR evaluating the risk inherited in critical situations are significantly lower than pilots in the North America region. This might lead them to be involved in fatal accidents more than others.

5.6.1 Questionnaire Form

National culture can have a great impact on effective pilots 'decision making performance in the cockpit and consequently affecting the flight operation safety. This questionnaire will try to answer the question below:

- ❖ How does the national culture affecting the pilots' decision making performance in the cockpit within the North Africa region?

This survey is with just closed-ended questions. Please use the scale below and rate the extent to which you agree with or disagree with the statement in the schedule based on your flying experience in the last 6 month.

A	B	C	D	E
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

For example:

No	Statement	Rate
0	Aviation safety in North Africa region has strong attention	D

Note: In the example above the respondent slightly agree with the statement.

Part 1:

A	B	C	D	E
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

No	Power Distance	Rate
1	F/Os are afraid to express disagreement in the flight deck.	
2	P-I-C should take physical control and fly the aircraft in emergency and non-standard situations.	
3	Captains who encourage suggestions are perceived to be weak leaders.	
4	F/Os shouldn't question Captains' decisions.	
5	In abnormal situations, I rely on P-I-C to tell me what to do.	
	Uncertainty Avoidance	
6	Organization rules should not be broken, even when pilots think it is the company's best interest.	
7	SOPs should be followed to tackle any flight situation.	
8	It's important to change work routine in order to cope with a new unfamiliar task.	
9	Pilots must know everything about the different systems to avoid surprises in the cockpit.	
10	It's important to understand the situation and find the one correct decision.	
	Religious beliefs and norms	
11	Accidents cannot be controlled or mitigated if it is our destiny.	
12	Following SOPs will not prevent accidents from happening.	
13	Accident can still happen even if pilots do everything correctly and in such a case this the will of God.	
	The next three questions are formed as scenarios to be answered as if you face it in flight within the next 24 hours.	
14	The pilot took a decision which you are not sure about, but you preferred to carry on accounting on the will of God that everything it's going to be ok.	
15	In the engine run up check, you were not sure about an instrument reading in one of the aircraft back-up systems, but you decided to carry on your flight relying on the will of God.	
16	The air craft in the final approach phase flying in IFR condition, but you could not see the runway features on the MDA so you decided to go 150 feet below the minimum to see the runway relying on the will of God.	

A	B	C	D	E
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

Social relationship		
17	A Crew member took a wrong decision; his colleague will be less willing to tell him if he is a friend.	
18	Your F/O is from the same town that you come from, and he does not follow procedures, but you feel reluctant to tell him that.	
19	During the final approach, the F/O has committed a big mistake which could result in fatal accident, but you cannot write a report because he is a friend.	
20	It is shameful in this company for pilots to discuss each other's mistakes if they are friends as well as colleague.	
21	There is a culture in this company that pilot who writes reports about an incident caused by another pilot is not a good man.	
Stress and Fatigue		
22	We should be aware of, and sensitive to, the personal problems of the other pilot.	
23	I let the other pilot know when my workload is becoming (or is about to become) excessive.	
24	My decision making is as good in emergencies as it is in routine situations.	
25	I am more likely to make errors in tense or hostile situations.	
26	My performance is not adversely affected by working with an inexperienced or less capable pilot.	
27	Personal problems can adversely affect my performance.	
Team Work		
28	It is better that the P-I-C and the F/O agree than to voice a different opinion.	
29	Both pilots in the cockpit share responsibility for prioritising activities in high workload situations.	
30	I enjoy working as part of a team.	
31	All members of the cockpit are qualified to give feedback to each other.	
32	Effective flight crew co-ordination requires them to take into account the personalities of each other.	
Work Values		
33	Captains deserve extra benefits and privileges.	
34	As long as the job gets done, I don't care what others think of me.	
35	A good reputation in the cockpit is important to me.	
36	It is an insult to be forced to wait unnecessarily for other members of the flight crew.	
37	In the cockpit, I get the respect that a person of my profession deserves.	

A	B	C	D	E
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

Error/ Procedural Compliance		
38	Errors are a sign of incompetence.	
39	I am ashamed when I make an error in front of other pilots.	
40	Procedures and policies are strictly followed in our flight operation.	
41	Errors are handled appropriately in this company.	
42	Pilots frequently disregard rules or guidelines developed for our flight Operations.	
Organizational Climate		
43	The flight operation department listens to pilots about their concerns and keeps us up to date with all information which might affect our flight	
44	Working in this company is like being a member of a large family.	
45	I am provided with adequate training to successfully accomplish my job.	
46	I am proud to work for this company.	
System Design and Automation		
47	I always know what the other pilot is doing with the automated systems.	
48	It is easy to detect when incorrect data has been entered by error.	
49	They've gone too far with automation.	
50	With automation there are still some things that take me by surprise.	
51	I sometimes find it hard to understand the language or technical jargon in messages presented by the FMC/FMGS.	
52	Incorrect data entered by error in automated systems is easily corrected.	

Part 2:

Risk perception

Hunters' risk perception model

In this exercise, you will be given descriptions of common aviation and everyday situations. After you have read the description of each situation, as a pilot you will evaluate the level of risk in each situation as if you were involved in it tomorrow. Base your answer relying on your flight experiences using the scale of 1 to 100 risk rating scale as shown below.
The scale 1 to 100 risk rating will be defined as follows:

Description	Rate
Zero risk involved in this situation. It is about as safe as sitting on the couch watching TV.	1
The same amount of risk as driving your car on a freeway in moderate traffic and good weather conditions during the day.	50
Extremely high risk of a serious, probably fatal accident. The pilot will be very fortunate to escape from this situation alive and with the aircraft undamaged.	100

53	Fly a traffic pattern so that you end up turning for final with about a 30 degree bank	
54	Fly a traffic pattern so that you end up turning for final with about a 45 degree bank.	
55	During the daytime, take a cross-country flight in which you land with 30 minutes of fuel remaining	
56	At night, following a cross-country route, you landed with over an hour of fuel remaining.	
57	At night, take a cross-country flight in which you land with 30 minutes of fuel remaining.	
The next five questions are formed as scenarios to be answered as if you face it in flight within the next 24 hours		
58	On the short final the P-I-C drops his microphone on the floor. He looks down while bending over trying to reach it. He inadvertently moves the control column and the aircraft banks sharply.	
59	During the planning for a 2 hour cross-country flight, a pilot makes a mistake in computing the fuel consumption. He believes that he will have over an hour of fuel remaining upon arrival, but he will really only have about 15 minutes of fuel left.	
60	The pilot is in a hurry to get going and does not carefully check his seat, seat belt, and shoulder harness. When he rotates, the seat moves backward on its tracks. As it slides backward, the pilot pulls back on the control column, sending the nose of the aircraft upward. As the airspeed begins to decay, he strains forward to push the column back to a neutral position.	
61	Low ceilings obscure the tops of the mountains, but the pilot thinks that he can see through the pass to clear sky on the other side of the mountain ridges. He starts	

	up the wide valley that gradually gets narrower. As he approaches the pass he notices that he occasionally loses sight of the blue sky on the other side. He drops down closer to the road leading through the pass and presses on. As he goes through the pass, the ceiling continues to drop and he finds himself suddenly in the clouds. He holds his heading and altitude and hopes for the best.	
62	A line of thunderstorms block the route of flight, but a pilot sees that there is a space of about 10 miles between two of the cells. He can see all the way to clear sky on the other side of the thunderstorm line, and there does not seem to be any precipitation along the route, although it does go under the extended anvil of one of the cells. As he tries to go between the storms, he suddenly encounters severe turbulence and the aircraft begins to be pelted with hail.	

Part 3: (participant's background)

Please answer the following questions

- **General information of the participants**

1. **What is your gender?**

Male ☐ **Female** ☐

2. **What are your age groups?**

25 to 34 ☐ **35 to 44** ☐
45 to 5 ☐ **55 & above** ☐

- **Position and experiences of the participants**

❖ **What is your position in the company?**

☐ **Captain** ☐ **First officer**

❖ **What is your flying hour's number range?**

0000 to 0999 h ☐ **1000 h to 1999 h** ☐
2000 to 2999 h ☐ **3000 h & above** ☐

Thank you for your cooperation

6 CHAPTER SIX: Research Discussion

6.1 Introduction

This chapter discusses the findings of both quantitative data and qualitative data in comparison with the literature to perform the triangulation approach as discussed in Chapter 3 (see Figure 3.4). This is done in order to add robustness to the conclusion of this study. The discussion in this chapter revisits the key findings of this research in accordance with the proposed objectives of this study.

Through the journey of conducting this research and up to this point the researcher developed a good understanding of the technology-culture interface in the cockpit and its impact on the pilot performance. In addition, a strategic approach to improving pilots' decision making performance within the aviation companies in NAR by mitigating the generated threat from the phenomena of technology-culture interface in the cockpit has been proposed.

This chapter offers a guideline for improving pilot decision-making performance in light of their risk perception with respect to the regional national culture, as well as highlighting the contributions of current models of improving safety in the aviation industry.

6.2 Discussion

As mentioned above, this final discussion is built on achieving the objectives of this research as highlighted in Chapter 1. Writing this thesis, the researcher has paved a path in understanding the construct of developing a strategic approach for improving pilot performance when exposed to cross-culture influence in the cockpit. Chapter 2 of this thesis started by reviewing the literature to discover the evolution of aviation safety and the current state of safety knowledge in high risk industries. It also described the current rate of aviation accidents in the NAR in comparison with other regions. In addition it highlighted the most significant factors of culture that affect pilot decision-making in the cockpit. Risk perception was also given a space in the literature, defined and understood as an important criteria in shaping pilot decision-making. This offered an illustration of the relationship between regional national culture and risk perception. Finally, the evolution of CRM training programme advantages in improving the pilot's performance in the cockpit was shown.

The next paragraphs revisit and summarise the key findings from the primary and secondary data of this study based around the six objectives of the study.

6.2.1 Objective One

"To develop a general understanding of how the overall national culture can influence a pilot's decision making performance in the cockpit".

The culture and decision-making relationship addresses a crucial role of pilot behaviour in the cockpit, where pilots from different cultures tend to make decisions differently. This differentiation of decision-making reflects variations of attitude, values and beliefs. These stem from the national culture, (see Section 2.7 of Chapter 2). Klein (2012) emphasises that the decision-making process is based on the decision-maker's beliefs, values and attitudes. Hofstede (2001) states that decision-making has a direct connection with national culture, because different national cultures present a variety of decision-making approaches.

The decision-making strategies of pilots in the cockpit to respond to, and act against any situational "risk" mainly stem from their cultural background. The role of national culture in shaping pilot decision-making style must be linked with the corresponding national culture, values and norms. This means that decision-making is culturally contingent, and in each step of the decision-making process culture influences pilot behavior. In addition, the style of the decision-making is influenced by individual characteristics and organizational factors (see, Figure 6.1).

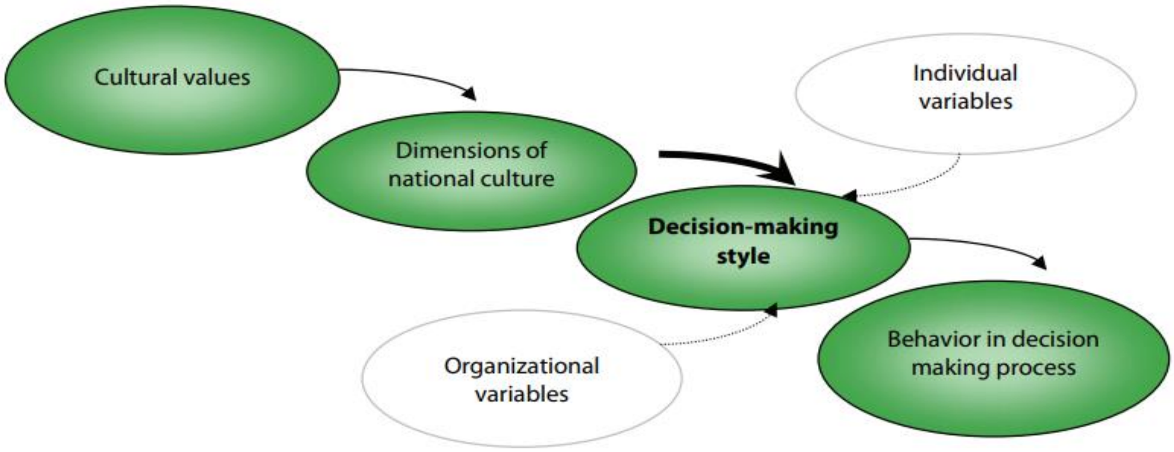


Figure 6-1: The national culture's influence on decision-making.
(Source: Podrug, 2011)

According to Geert Hofstede's framework of national culture (see Section 2.7.1 of Chapter 2), individuals from a different culture are willing to respond and act in a different way even if they are in the same situation as others who do not share their cultural background. For example, if two pilots from different cultural backgrounds were involved in very bad weather on final approach which generates a cumulonimbus clouds associated with thunderstorm and atmospheric instability, one of these pilots might decide to go around and deviate to another airport; the other might decide to continue and land at the airport (see Section 2.4.2 of Chapter 2).

The Hofstede's framework assigns four main dimensions of culture. Two of these dimensions play a crucial role in the cockpit: Power Distance "PD" and Uncertainty Avoidance "UA" (as mentioned in paragraph 2.7.1 of Chapter 2). In crews with high power distance the captains are less willing to share their decision with first officers. This raises the risk of pilot error in taking decisions, and vice versa for the crews with low power distance. In addition, crews with high UA tend to be more cautious of threats or anxious, which can be combined with ambiguous situations. So they are not willing to tolerate risk and vice versa.

According to Dumitru and Boscoianu (2015), approximately 75-80% of aviation accidents are caused by the decrease in human performance, directly affected to fatigue, stress and sleep deprivation (so called human factors). Human factors play a crucial role in the cockpit. According to Helmreich et al. (1996) the pilot attitude towards human factors is governed by cultural differences between nations. This leads to the importance of considering pilot attitudes to human factors when seeking to understand the influence of national culture on pilot performance in the cockpit.

Moreover, national culture influences the organisational culture at all levels of practice (see Table 2.7 and Section 2.5.2 of Chapter 2). Cultures differ significantly not only in individual interactions, such as in language-use, but also in terms of perception, behaviour and actions in the environment. Organisational culture stems from individuals values, beliefs and assumptions.

The above discussion helps us to understand the influence of national culture on pilot decision-making in the cockpit. It is crucial to understand the impact of the three factors: PD, UA and human and organisational factors (see Section 2.11 of Chapter 2). Stressing the factors that influence the decision making process is important in identifying the risk inherent in the process.

These three factors playing an important role in shaping pilot decision-making in the cockpit. All of the factors represent a risk in the cockpit and the cultural deference of the pilot will govern his behaviour in relation to risk. In other words, the pilot's background will affect the way that he perceives the risk in the cockpit. It is important to understand each of these factors independently.

Firstly, the PD factor, according to Hofstede's (2001), pilots with high power distance are less willing to share decisions and may perceive the risk inherent in the situation as low. He may think that he does not need to share his decisions with other pilots, which might be lesser than him in experience or training. He may decide to handle that risk alone rather than share it with other pilot in order to keep the power distance. This behaviour can be seen as stemming from his background or culture.

Secondly, the UA dimension, according to Hofstede's (2001), pilots with high uncertainty avoidance are less willing to take or tolerate risky situations as they perceive the risk in that situation to be high. This means that his risk perception is higher than the other person who comes from culture with low uncertainty avoidance.

Thirdly, the human and organisational factors are considered as one of the most important safety barriers in preventing aviation accidents (see Section 2.4.1 and 2.5 of Chapter 2). The human and organisational factors are the discipline that is concerned with understanding the interaction among humans and organisation and elements of the whole system. For a better understanding of both terms in-depth were deeply discussed as follows:

Human factors relate to human characteristics, capabilities and limitations in dealing with the surrounding environment. As mentioned in (Section 2.42 of Chapter 2), the knowledge of human factors should, in parallel, integrate with the systems design, certification, and operator before the systems and individuals be put into service. The reason behind this is that human factors influence both risk acceptance criteria and development of risk. For example, stress brings up the risk of error-making in the process of pilot decision-making in the cockpit (see Section 2.4.2).

The evaluation of the influence of human factors on pilot decision-making within specific cultures allows for the determining of the probability of decision error. This in turn allows for the predicting of the risk of poor pilot decision-making performance in the cockpit.

Finally, the organisational factors that directly contribute to aviation accidents are considered to be the cornerstone in achieving positive performance. According to Reason's organisational accident model, (Reason et al., 2006), organisational factors are the latent factors behind an organisational failure (see Section 2.2.5.2 of Chapter 2). Reason suggests that aviation accidents are mostly induced by human factor elements, but this is only the first-order cause of an accident, the history of which is in fact based on pre-existing organisational factors. The human factors show the cause of the accident and organisational factors is the conditions and the mechanisms that increased the probability of the accident. Organizational factors such as workload, training, available recourses and management sharply affect pilot decision-making performance. For example, the work assigned to, or expected from a pilot, such as increasing the flying hours per day due to a shortness of crew, will lead to poor pilot decision-making performance in the cockpit, this could assigned as an organisational management factor.

This objective of the study was to examine the influence of national culture on a pilots' decision-making performance. As illustrated in the discussion above, it is understandable that national culture could increase the risk of the probability of human error within the decision-making process.

6.2.2 Objective Two

"To investigate the influence of the technology-culture interface on pilot performance in the cockpit".

The concept of the technology-culture interface in the cockpit comes from the cross-culture factors in aviation safety, as members of one culture come into contact with artefacts of another culture (see paragraph 2.11). Therefore, the performance of pilots working on foreign aircraft will be exposed to the technology-culture interface in the cockpit because they are not necessarily adapted to these technologies. These technologies are designed and produced by another culture. The difference in operating context between the developed countries and the developing countries is very big. This could mean socially, economically or politically. Thus, the technology-culture interface in the cockpit is a system failure phenomena rather than a pilot error phenomena, where many factors cause this problematic interface, including human and organisational factors. The technology-culture interface phenomena are defined in this research as the implications for technical and non-technical skills of a pilot of one culture interfaces with technologies of another culture.

Reason (1996) in his model of organisational accident (see Section 2.2.5.2 of Chapter 2), states an accident cannot be caused by one individual working in isolation from their surrounding environment, but rather with the accumulated factors that create a vulnerable situation for an unsafe act "pilot error". The investigations of many accidents caused by technological systems indicated that the preconditions for these accidents could be traced back to deficiencies of systemic safety barriers in defending the system from undesirable factors. These undesirable factors were hidden in the system for years until abnormal operating conditions triggered them and caused the accident.

A good example of these implications for technology-culture interface and its impact on pilot risk perception in the cockpit is the mid-air collision at Überlingen 2002, in which a pilot of one culture interfaced with technology of another culture and led to pilot error in decision-making. According to Turney (2007), the Tupelov Russian aircraft was equipped with the Traffic Collision Avoidance System (TCAS), but the Russian Federation region did not support this technology. In other words, at that time the western aviation companies and authorities provided a sufficient training program and clear instructions of using TCAS, which made it clear that TCAS alarm must be followed. In contrast, the Russians did not consider using the TCAS as an important system in the cockpit and the TCAS alarm was ambiguous to them. In addition to that, the culture of the Russian Federation region is different from the western countries where this device was produced. According to Balykina (2013), Russian culture is characterised as a high power distance and a hierarchical one, based on power separation. This could lead to a number of consequences, for example, the boss of an organization is the main source of decisions and the subordinates prefer not to argue with them and do not criticise their orders. This might be one of the reasons that led to this accident. Turney (2007), stated that "The autocratic way in which the decision was made (by the instructor) could have affected the other crewmembers in their willing- ness to communicate relevant information or any discomfort they felt with the situation".

This reflects the culture interface in the cockpit as proposed by Paul et al., (1997) who emphasized that different cultures interact in various ways with the systems in the cockpit. Moreover, the cultural difference in the cockpit is applied when an aircraft manufacturer with the latest advanced safety automation systems in one culture could mislead pilots from another culture that does not obligate operators to use this advanced safety automation systems such as TCAS system, due to poor infrastructure or any other reasons (Merritt and Maurino, 2004).

Likewise, the mid-air collision at Überlingen 2002, gives a clear example of the connection between technology-culture interface, pilot risk perception and pilot error in decision-making, where the pilots from Europe were complied with the TCAS alarm because they understood it sufficiently and they perceived the risk inherited with TCAS alarm, In contrast, pilots from Russia did not perceive the level of risk inherited with this alarm and the Captain made decisions to follow the ATC man instructions as a safer option. Due to pilot error in judging the risk inherited with the TCAS alarm and bad communication with other crewmembers, which resulted in poor understanding of the TACS alarm that was informing them they were going to crash with another airplane. The final report of mid-air collision at Überlingen 2002, indicates that the pilot error in this accident was a result of little experience and understanding of TCAS system (Turney, 2007). This demonstrates the Russian culture influence on pilot decision making in following the TCAS system and how they preferred to follow ATC orders which perceived as a safer and a lower risk option.

The Reason model considers the technology-culture interface as a latent condition of technological systems accidents. In this study, the NAR suffers from a high rate of fatal accidents (see Chapter 2, Section 2.3.3 and Figures 2.9, 2.10, 2.11 and 2.12). In addition, one of the main causes of these fatal accidents is poor decision-making performance (see Tables 2.3, 2.4 and Figures 2.17, 2.18). Pilot error in decision-making has been identified as a key factor in aviation accidents, and it is always accompanied with challenging situations.

The contributory factors of these accidents are influenced by the surrounding environment, as well as situational and individual characteristics. The subjective judgment that pilots make about the characteristics and severity of a risk depend their background. Moreover, the perception of a risk varies with both the individual and the context. The pilots from different cultures have differences in how they perceive the work environment, the tasks at hand, their skills and their capabilities. Based on such perceptions, they make decisions on how they are going to behave. Perceived risk is thus not universal and individuals conceptualise risk differently, depending on their cultural background (see Chapter 2, Section 2.5.1).

Consequently, assessing pilot risk perception in the cockpit from a culture theory standpoint is crucial in understanding the influence of the technology-culture interface on pilot performance in aviation safety. The assessment of pilot risk-perception must include several significant factors: cultural attributes, attitude to human and organisational factors, and the system design and automation.

In summary, this objective of the research has been achieved. The indication is that the technology-culture interface is important phenomena when it comes to evaluating pilot risk-perception in the cockpit through assessing the most influencing factors of this phenomena on pilot decision-making performance. These significant factors, according to the literature review and the previous in-depth discussion, are: cultural attributes, attitude to human and organisational factors, and system design/automation. Therefore, these significant factors will lead to the identifying of the latent factors that contribute towards either good or poor pilot decision-making performance within aviation companies in a specific region (see Figure 6.2).

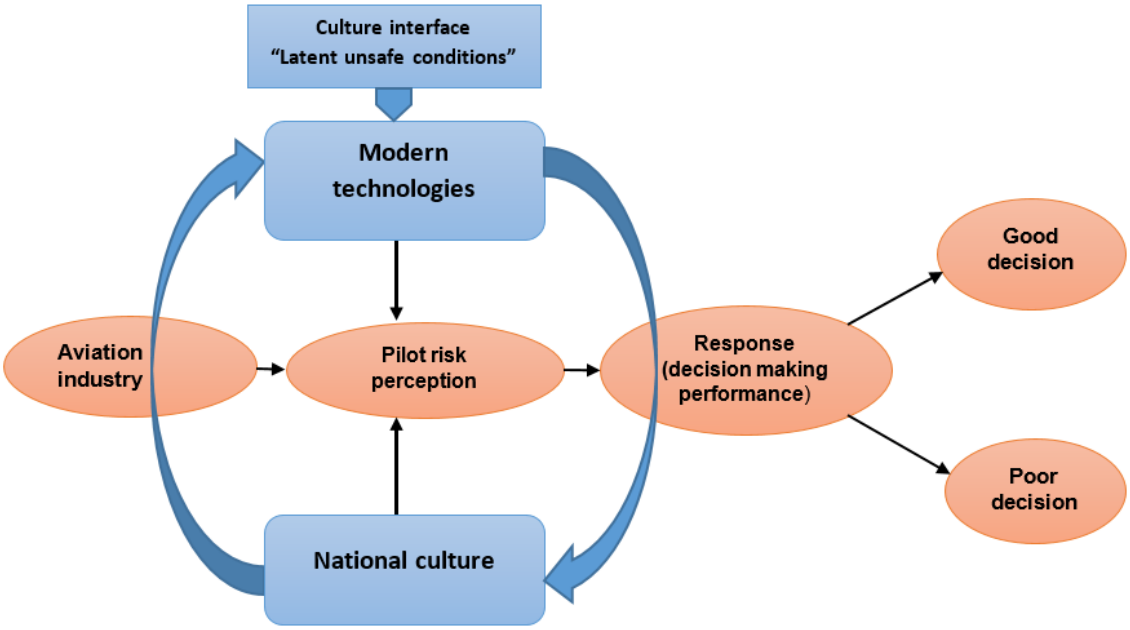


Figure 6-2: Technology–Culture interface and its impact on pilot decision-making performance (Source: Developed in this research)

6.2.3 Objective Three

"To appraise the influence of the North African culture on pilot decision-making performance in the cockpit".

Based on the arguments put forward in Chapter 1, this research seeks to examine the influence of the technology-culture interface on pilot decision-making performance in the cockpit within the NAR. The understanding of this influence can enable the mitigation of its negative impact on pilot decision-making performance and improve aviation safety in the region. The third objective of this research is an appraisal of the influence of the North Africa national culture on pilot decision-making performance in the cockpit. This objective was investigated by collecting data through two themes (1 and 2): cultural attributes and attitudes to human and origination factors.

Pilot decision-making performance in relation to national culture can be explored through two themes. The first theme (culture attributes) includes four factors: PD, UA, social relationship and religious beliefs and norms (see Chapter 4, Section 4.9.1). The findings of the qualitative data gathered through interviews conducted among pilots in the NAR indicated a high score of PD and its negative role in the cockpit among pilots in the NAR. In contrast, the majority of these pilots showed positive awareness of avoiding uncertain situations, meaning that these pilots have a high UA score in the cockpit. The positive awareness of UA is clearly indicated in the last two criteria (social relationship and religious beliefs or norms), where both of them are seen to directly affect the UA, as noted by Hofstede (2001). This finding indicates that most of the pilots show positive awareness of keeping social relationships and religious beliefs or norms away from the work environment and these factors had no effect on their behaviour in the cockpit (see Chapter 4, Section 4.9.1).

The results show a high PD culture in the cockpit. This means that first officers are unwilling to input regarding a captains' actions or decisions. In addition, they are more sensitive to the importance of congenial relations in the cockpit, and they perceive and accept barriers to open communication due to status inequalities (see Chapter 2, Section 2.7.1). According to the qualitative findings regarding the first themes, PD affects cockpits in the NAR negatively, and can be summarised as follows:

1. Poor decision making;
2. Bad communication between the crew;
3. Weakness in the first officer's response and decision-making;
4. Unwilling to share decisions between crew members;
5. First officer relying on captain in all decisions;
5. Unwarm environment in the cockpit;
6. Ineffectiveness of CRM training program in the cockpit.

Theme number two is attitude to human factors and origination factors. This theme was divided into four factors: error or procedural compliance, organisational climate, stress and fatigue, and teamwork (see Chapter 4, Section 4.9.2). The qualitative findings of this theme indicated that most of the pilots from the study sample have a positive awareness of the error mitigation or procedural compliance in decision-making, where this positive awareness of following SOPs and compliance with operational guidelines in the cockpit helps to improve pilot decision-making performance. In addition, the organisational climate findings showed most of the participants to be satisfied with the training offered by their companies. Adequate training helps in improving pilot performance and reducing risk. The third criteria in this theme is stress and fatigue, which have long been considered important criteria of human error in the cockpit (see Section 2.4.2 of Chapter 2 and Section 4.8.2 of Chapter 4).

The quantitative finding of this criteria indicated that a positive awareness regarding the negative role stress and fatigue on the decision making performance among these participants.

The last criteria in this theme is teamwork behaviours in the cockpit, which are crucial to the enhancing of safety performance through reducing workload and keeping a harmonious environment in the cockpit. The qualitative findings showed the majority of pilots emphasising that teamwork in the cockpit is very weak. The findings of this criteria reflect the findings of theme 1, where it the pilots did not generally share their decisions in the cockpit. The weakness in crewmember teamwork in the cockpit increases the risk human error and consequent accidents.

The quantitative data findings were used to work towards the achievement of this objective. The purpose of gathering quantitative data was to gain a general opinion among professional pilots in the aviation companies within the NAR. These quantitative data findings are considered to complement the qualitative data findings.

The quantitative data indicated that four factors have an impact on pilot decision-making in the NAR: power distance, teamwork, stress and fatigue, and work value.

The below table shows the findings of both the qualitative and quantitative parts of the study. They are put together in comparison so that their relative impact can be compared (see Table 6.1).

Table 6-1: Factors influencing pilot decision-making in the NAR

Qualitative data (Interviews)	Quantitative data (Survey)
PD	PD
Teamwork	Teamwork
	Stress and Fatigue
	Work Value

According to the results shown in (Table 6.1), it is clear that there is consensus among both data findings that the PD and teamwork factors are the most significant factors of the NAR national culture. These two greatly influence pilot decision-making performance in the cockpit. In addition, the quantitative data indicated that the stress and fatigue and work value factors have some negative influence on pilot decision-making performance. Therefore, improvement in these areas would help to improve pilot performance in the cockpit within the NAR. Improvement in these areas would also likely lead to improvement in other areas;, for example, improving the PD factor would help to improve communication between crewmembers and produce a warmer environment in the cockpit.

The discussion above shows a robust process that has been followed to achieve the third objective of this study, namely, appraising the influence of the North Africa national culture on pilot decision-making performance in the cockpit. Both data findings (qualitative and quantitative) have assigned high impact factors (PD and teamwork) as well as identifying low impact factors (stress and fatigue, and work value factors). In addition, to that through the running of one way ANOVA test it was found that the national culture impact in cockpit on First officers is higher than Captains. Based on these research findings it can be concluded that the third research objective has been achieved.

6.2.4 Objective Four

“To evaluate pilot risk perception within the North Africa region in comparison with pilot from North America region”.

The fourth objective of this study is to explore pilot risk perception in the NAR in comparison with other regions. The identification of any significant differences in risk perception of pilots from different regions would ideally help in improving understanding of the diversity of risk perception perspectives. This could lead to identifying pilot characteristics in collective risk perception that might help in improving pilot decision-making performance in the cockpit. Risk perception and risk tolerance are the main drivers of pilot behaviour, which is likely to result in incidents and accidents where they either did not perceive a risk in a situation, and hence did not avoid that risk or mitigate it, or did not correctly perceive the risk in that situation and did not consider it a sufficient threat (see Chapter 2, Section 2.10.4.3),

This objective was investigated by collecting data regarding risk perception. Qualitative data from the interviews were collected to understand pilot opinion in the NAR about a risky event faced in the cockpit. The findings show that four criteria were perceived by these participants as the most prominent causes of a risky event in the cockpit: airport facilities, bad company management, breaking of flight operation rules, and weather. These qualitative findings are very important and will be used in providing recommendations for the aviation companies.

For the purpose of evaluating pilot risk perception in NAR in comparison with other regions, the quantitative data study was conducted by implementing the Hunter scales of measuring risk perception (see Chapter 2, Section 2.10.4.3). The Risk perception and risk tolerance are the main drivers of pilot behaviour that would be likely to result in incidents and accidents, where the pilots either did not perceive the risk in a situation and hence did not avoid that risk or mitigate it or did not correctly perceive the risk consider it a sufficient threat. The Hunter scale in this model measured the risk perception of professional pilots from the North America region, which represents a good sample for this research.

Five items were chosen from each scale (RPS2 and RPS1) (see paragraph 5.5.3.2 of Chapter 5). The findings of both scales indicate that in most scenarios the participants gave a lower mean value than in the original Hunter study (see Table 5.71 and Figure 5.49). However, in the RPS1 item 2, which ranked as item 59 in this research (see Table 5.70 of Chapter 5), participants in this study evaluated the risk in the situation higher than the original scale. The risk value (mean) assigned by the pilots in the North America region was 74.9 and in this study 80.77. This difference could reflect the result of item 38 of this research ("Errors are a sign of incompetence"), in which these pilots agreed with this item higher than in the previous study (see Section 5.5.3.2 of Chapter 5, in Factor Four: Error and Procedural Compliance). These pilots did not appreciate human error as inevitable in human nature. This is in addition to the result of factor one (PD) (see Section 5.5.5.1 of Chapter 5), where pilots suffering from high PD in the cockpit might deny this mistake and consider it high risk.

Finally, to achieve the main core of this particular objective, which is to identify if there is a significant difference in risk perception between pilots in NAR and pilots from the North America region, a one sample t-test was run (see Section 5.5.5.1 of Chapter 5). The result of this test showed significant difference in perceived risk magnitude between the two groups. These pilots would be described as having a greater tolerance or acceptance of risk, as compared with pilots in the North America region. This result is supported by Sjöberg et al (2004), as he states that human attitudes toward risk and danger are heterogeneous and vary according to cultural biases. In addition to that, (Hunter, 2006) emphasises that when individuals correctly perceive the risks involved in a situation, some may elect to continue because the risk is not considered sufficiently threatening. Those individuals would be described as having a greater tolerance or acceptance of risk, compared to the mainstream.

6.2.5 Objective Five

“To evaluate the influence of the technology-culture interface on pilot decision-making performance during flight within the North Africa region”.

The fifth objective of this study is to explore the impact of the technology-culture interface on pilot decision-making performance in the cockpit within the North Africa region. The investigation of this objective was run by collecting data through four themes: cultural attributes, attitude to human factors and origination factors, risk perception, and system design and automation. The exploration in the research findings of these themes in both qualitative and quantitative data led the author to understand the true impact of the technology-culture interface. According to the literature review in Chapter 2 (see Section 2.11), the technology-culture interface is a latent unsafe condition that increases the chance of pilot error in the cockpit. Based on the exploration of the latent unsafe conditions generated from this interface, the literature review revealed that pilot decision-making is significantly influenced by the four themes noted above.

The unsafe conditions of themes 1 and 2, as discovered in the third objective, are the high impact of PD and Team Work, and the moderate impact of Stress and Fatigue and work value factors. Regarding the unsafe conditions revealed within theme 3, there is significant difference in risk perception between pilots in the NAR and pilots in the North America region. This difference indicates that participants in this research showed greater tolerance and acceptance of risk.

In order to achieve this objective, it is crucial to explore the research findings of the fourth theme (system design and automation) and examine the impact of the technology-culture interface on pilot decision-making performance in the cockpit in the NAR. The qualitative finding of this theme indicated that more than half of the participants in the interview faced problems with advanced technology in the cockpit. These problems were described as difficulty in understanding the FMC as advanced technology some of the pilots were surprised at the automation outcome and had difficulties understanding the system and the terminology of the advanced technology. This misunderstanding of the system and terminology is a result of cross-cultural differences in the cockpit. These unsafe conditions could lead to pilot error in the cockpit. The quantitative data regarding the fourth theme reveals that the quantitative findings are assurance the qualitative data findings (see Table 6.2).

Table 6-2: System design and automation findings of both methods

Qualitative data (Interviews)	**Quantitative data (Survey)**
Automation extent in the cockpit	Automation extent in the cockpit
Surprise of automation	Surprise of automation
Understanding the FMC/FMGS	Understanding the FMC/FMGS

According to the results shown in (Table 6.2), there is a consensus in both data findings. The participants in the interviews and survey faced problems with modern technology (Automation extent in the cockpit) in the cockpit in terms of the fast development of Technologies in the cockpit. In addition to that they showed surprises with outcome of the automation (Surprise of automation). Finally, these pilots faced problems in understanding the automation systems in the cockpit (Understanding the FMC/FMGS). The conclusion is that that the cross-culture interface of these pilots affected their performance negatively.

The findings of these four themes are important as they are context-specific, and can lead to the ability to anticipate or detect a particular pilot's decision-making performance in the cockpit in NAR. Figure 6.3 below maps out the findings of this research that would help the researcher construct a process of achieving a proactive system for aviation companies in the NAR.

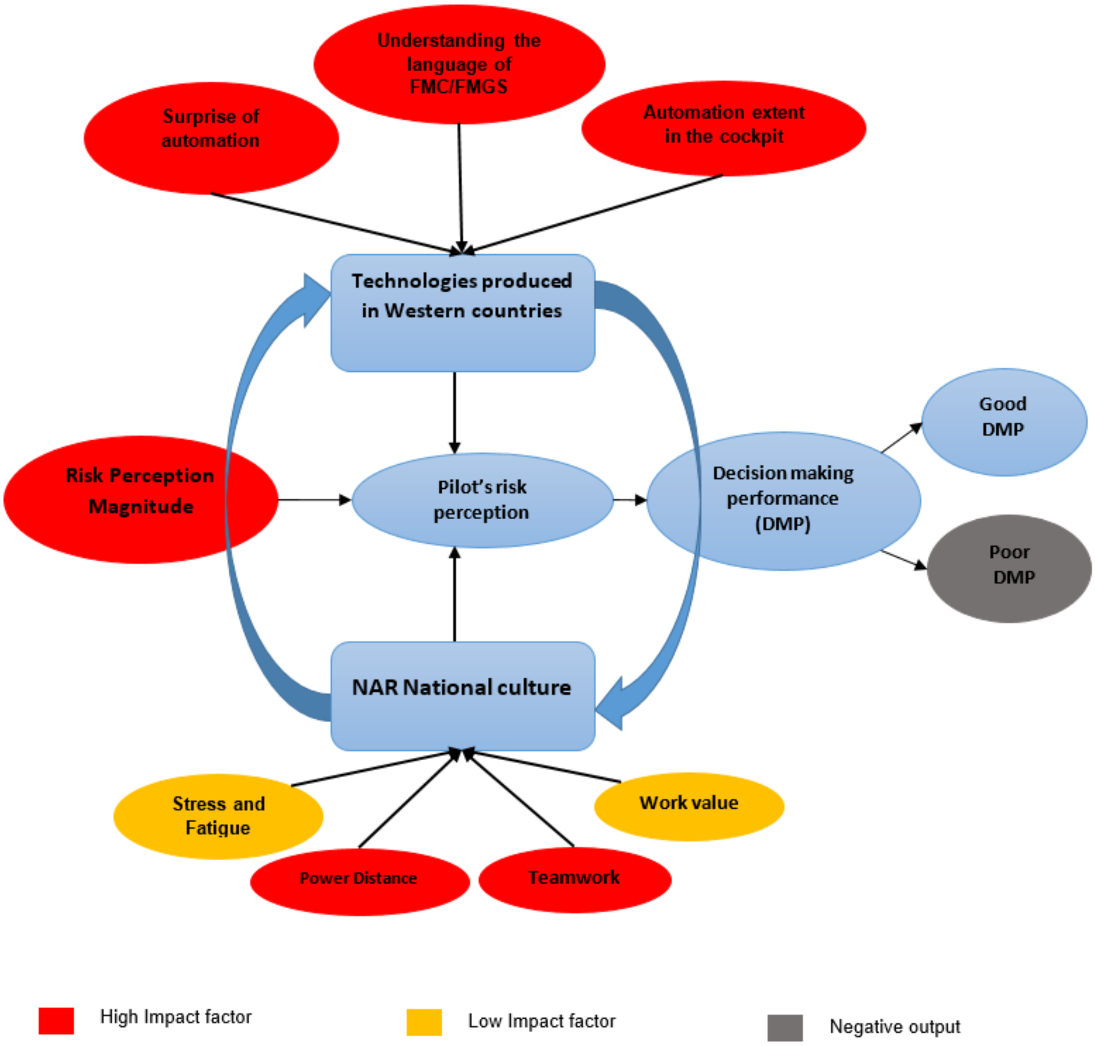


Figure 6-3: Impact of technology-culture interface on pilot DMP in flight within the NAR.
(Source: Developed in this research)

Figure 6.3 indicates the latent unsafe conditions that affect pilot DMP in the cockpit within the NAR that could lead to an incident or accident. Based on this, it is clear that the fifth objective of this research, which is to evaluate the influence of the technology-culture interface on pilot decision-making performance during flight within the North Africa region, has been achieved. In addition, the achievement of this objective answering the fourth research question in this study which are: (what are the implications (if any) of the technology-culture interface on pilot decision-making in the cockpit within the North African region?), hence, Figure 6.3 indicates the implications for technology-culture interface on pilot DMP in the cockpit within the NAR

6.2.6 Objective Six

"To propose a guideline to enhance the pilot decision-making performance in the cockpit within the North Africa region".

This is the last objective of this research, in which the researcher tries to propose a solution to the research problems identified. This objective is implementing the findings of both qualitative and quantitative data. The concepts and theories explored from the literature review are developed towards a proactive safety programme designed to overcome the influence of the technology-culture interface on pilot decision making performance in the NAR. The CRM training programme, still widely used, is the most effective and sufficient training programme to improve crews performance in the cockpit.

This training programme was developed to the sixth generation, implemented in aviation companies to optimise the operation of flight safety. It focuses on the non-technical skills and Threat and Error Management (TEM) (see Section 2.11 of Chapter 2). However, the fact that the CRM is not culturally calibrated to aviation companies in the NAR shows the need for the modification of the sixth generation of the CRM (see Sections 2.11 and 2.12.2, of Chapter 2), and it needs to be culturally calibrated.

The cultural calibration of the CRM training curriculum can be achieved by concentration on the latent unsafe conditions that have been discovered in the achieved objectives 3, 4 and 5 of this study. The latent unsafe conditions were found to play a role in increasing the chance of pilot error in the cockpit within the NAR. These latent unsafe conditions were identified as being a direct result of the technology-culture interface and risk perception. Modifying the CRM training curriculum would likely improve the standard level of non-technical skills and treat and error management, consequently enhancing pilot decision-making performance in the region. Figure 6.4 depicts a flow chart of a modification to the sixth generation of the CRM.

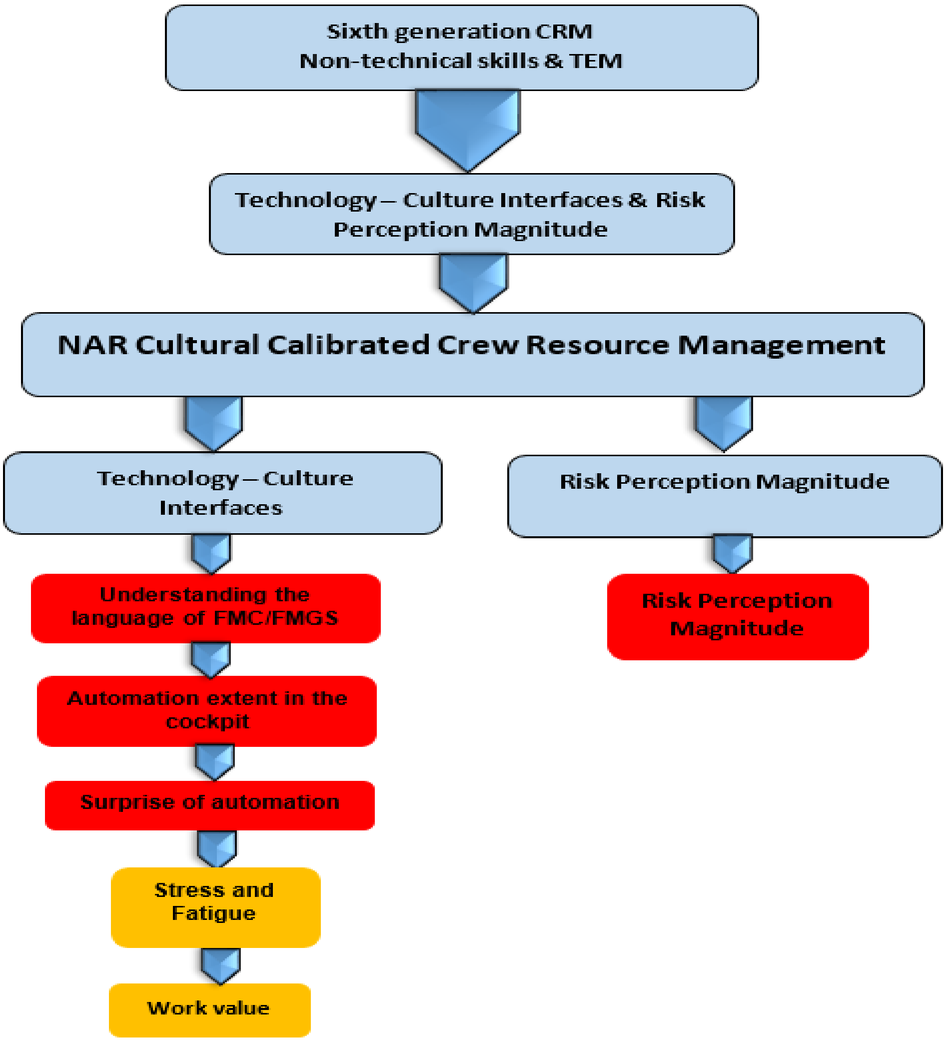


Figure 6-4: Flow process of NAR cultural calibrated CRM

To diminish the negative impact of the technology–culture interface which is divided into two negative impact factors; the high negative impact factors which include: the automation extent in the cockpit, surprise of automation, understanding the FMC/FMGS, power distance, and teamwork. The low negative impact factors which include: stress, fatigue, and work value, as shown in (Figure 6.4).

The process of NAR cultural calibration of the CRM would rely on calibrating the sixth generation of the CRM by involving two phases: demolishing the implications of technology–culture interface and adjusting the risk perception magnitude.

Firstly, the phase of demolishing the implications of technology–culture interface, which could be implemented by involving training to improve the cultural awareness in general and the mitigation of the implication of the technology–culture interface in specific, which could be gained by focusing on the findings of this study to mitigate the negative impact of these factors on pilots' decision making performance in the cockpit. This incorporation of training course might lead to keep the risk of human error at acceptable level during the flight.

In addition, it should be taken in consideration to concentrate much more on First Officers than Captains either by giving them more often training or further training hours as they are significantly affected by the culture interface in the cockpit. This consideration might help First Officers in mitigating these implications and give them more familiarity with automation in the cockpit.

Secondly, adjusting the risk perception magnitude phase, this phase built to reduce the collective risk perception magnitude. According to Renn (2008) risk perception is a subjective assessment which is part of an individual's ability to evaluate uncertainties through their social and cultural learning and from changes in the surrounding environment (see Section 2.10.2.4, Chapter 2).

Accordingly, these pilots have built their subjective risk assessment under impact of the social and cultural dimensions, thus, it has been discovered in this study that these pilots have a greater tolerance or acceptance of risk compared to pilots from other regions. To overcome this negative influence of the social and cultural dimensions, a specific training is suggested to enhance pilots' risk perception. This training course of a domain-specific risky event must be incorporated with the sixth generation of the CRM in the cockpit, which might lead to enhance pilots' ability to accurately identify cues that exist in risky situations.

This guideline of the sixth generation CRM cultural calibration would, the researcher believes, improve the current situation of pilot decision-making performance in the NAR. This assertion is based on the empirical findings of this research and the concepts and theories explored from the literature. Although this guideline is developed based on the regional culture of the NAR context, it could likely also be applied to other developing countries, whose circumstances and national culture are similar to the NAR region. Based on this, it can be concluded that the sixth and last research objective of this study has been achieved. The achievement of this objective also gives an answer of the fifth research question in this study.

Accordingly, from the above discussion of this chapter the researcher are convinced and satisfied that the findings of this research have successfully answered all research questions of this study, which are as follows:

1. To what extent is the North African regional national culture affecting pilot decision-making performance in the cockpit?
2. To what extent are pilots in the North Africa region influenced by cross-culture when they are using advanced technology in the cockpit?
3. How does pilot risk-perception in the North Africa region differ from other pilots in other regions?
4. What are the implications (if any) of the technology-culture interface on pilot decision-making in the cockpit within the North African region?
5. How can non-technical skills of pilots within the North Africa region be improved to enhance pilot risk-perception in the cockpit?

6.3 Chapter Summary

This chapter has discussed the achievement of the research objectives as specified in Chapter 1. The aim of this research was to evaluate and assess the pilot decision-making in the light of their risk perception, which is influenced by the regional national culture in the NAR. Based on the above discussion, six objectives were achieved. This chapter showed how pilot decision-making could be enhanced and errors eliminated by improving technical skills and cultural awareness (non-technical skills) in the cockpit within the NAR. Finally, this chapter answered the last two research questions of this study.

7 CHAPTER SEVEN: Research Conclusions

7.1 Introduction

This chapter, the final chapter of this thesis, summarises the key research findings and identifies the unique contribution to knowledge of the research. The chapter highlights the research recommendations as well as the limitations of the study, in addition to considering areas for further study.

7.2 Key Research Findings

The exploration and understanding of the technology-culture interface phenomena through the theoretical concepts and the applied methodology all implied that pilot performance is negatively influenced by cross-culture in the cockpit. This research has successfully determined that pilot decision-making performance in the NAR could be enhanced through the cultural calibration of the CRM training programme and indicates that the NAR national culture plays a negative role in the cockpit.

The results showed that several aspects of the technology-culture interface are not conducive to good pilot decision-making performance within the NAR. Pilots in NAR significantly perceive lower risk in the cockpit compared with pilots from other regions. This leads them to greater tolerance or acceptance of risk. In addition, the factors the automation extent in the cockpit, surprise of automation, understanding the FMC/FMGS, power distance, teamwork, stress and fatigue and work value negatively influence pilot risk perception.

Interestingly, the findings of this research show that pilots in the NAR have strong religion faith that does not have intangible negative impact on pilot decision-making performance in the cockpit.

The in-depth investigation conducted has shown that aviation companies in the NAR are still suffering from a high rate of fatal accidents in comparison to other regions in the world. This is despite the fact that innovation in automation systems in aircraft has improved sharply. NAR aviation companies need to collectively develop a safety culture concept in their organisational cultures that will impact their pilots' attitudes and behaviour in relation to decreasing the risk inherent within the critical tasks they have to perform in the cockpit.

The findings also indicate that the understanding of the culture interface in the cockpit is critical to developing appropriate pilots behaviour and leading to high performance in pilot decision-making.

In summary, it could be concluded that regional national culture could play a dominant role in the successful improvement of pilot decision-making performance in the cockpit within the NAR. This improvement in performance could be achieved through the proposed guidelines of CRM cultural calibration to the NAR national culture. This might enable pilot awareness that the technology-culture interface can generate potentially negative factors that lead to increases in risk tolerance or acceptance, and might well enhance pilot risk perception. This is highly critical not only in advancing pilot decision-making performance in the cockpit within the NAR, but also in other regions that face similar challenges such as sub-Saharan Africa regions (Central Africa region, East and West Africa regions).

7.3 Study Contribution to Knowledge

This research focused on highlighting the impact of the technology-culture interface on pilot decision-making performance in the cockpit. This is a subject that has scarcely been touched in the current literature. The concept of culture interface was first discussed by Merritt and Maurino (2004) when they stated: "members of one culture come into contact with members or artefacts of another culture." The research mainly concentrated on the cultural diversity of crewmembers. This research has contributed to knowledge in its novel investigation of the impact of the technology-culture interface on pilot's decision-making performance in the cockpit. In addition, it is contributed in define the technology-culture interface phenomena as the implications for technical and non-technical skills of a pilot of one culture interfaces with technologies of another culture.

This research has further contributed knowledge in conducting an extensive literature review to identify and compile the most significant influencing factors on pilot decision-making performance in the cockpit. This strategic approach of an extensive literature review has led to the identification of gaps within the knowledge regarding national culture interface in the cockpit. Also, this research contributes to the body of knowledge in the novelty of its research methodology approach: a mixed methodology and triangulation approach to answer the research questions through a designed survey.

This research has contributed to the body of knowledge in understanding the implications of the identified impact of the technology-culture interface on pilot decision-making performance within the NAR. It has, moreover, identified the influence of these implications on pilot risk-perception, which directly affects their decision-making performance in the NAR. The understanding of these implications for the NAR, and the theories pertaining to pilot decision-making performance in the cockpit, has led to the proposal here of a guideline for improving pilot decision-making performance, through enhancing their risk-perception in the cockpit either directly or indirectly.

7.4 Research Recommendations

Based on the final results of this research, a number of recommendations were addressed to the management of aviation companies in the NAR. These recommendations, it is advised, would improve the performance of the aviation companies in general and crewmembers in particular. These recommendations are as follows:

1. A majority of pilots' poor decision making performance events in the cockpit occurred due to four main factors: high power distance between crewmembers, teamwork, pilots' adaption to technology and pilots' acceptance and tolerance to risk magnitude. This result is a strong indication that these factors were due to the culture interface in the cockpit, where the First Officers are not willing to discuss or share Captains decision which directly affects the teamwork. Also, the fact that

the automation technology in the cockpit was designed and produced by another culture, involve different levels of difficulties to these pilots in terms of adaption and understanding of the automation systems, where regions like western countries, for example have sophisticated infrastructures and legislations. Finally, the result indicated that these pilots have a greater tolerance or acceptance of risk, as compared with pilots from other regions, this means that these pilots are influenced by the national culture of their region. These negative implications of the national culture will adversely influence these pilots CRM skills if left without remedies.

2. The fact that stress/fatigue and work value factors do have a moderate negative impact on these pilots decision making performance in the cockpit. Therefore, more attention needs to be spotted on fatigue risk management and work value in terms of improving the CRM training programme curriculum.

3. The result showed that the national cultural attributes and automation factors in the cockpits are impacting First Officers significantly higher than Captains. This would indicate that pilots with long flying experience are less influenced by the implication for the technology-culture interface in the cockpit and consequently, they are highly sensitive to risk and are perceive higher risk magnitude than those pilots with less experience. This indicates that the deviations from average risk perceptions become larger with less flying experience. Therefore, First Officer needs more attention in the CRM training programme regarding improving their risk perception magnitude.

4. The findings of the qualitative data illustrated that there are a weaknesses in the facilities providing the weather forecasts in some airports within the region, especially in the desert area. These weaknesses in weather forecasters' accuracy increase the risk of human

error during the process of pilot decision making and consequently, might lead to fatal accident. Therefore, it is recommended to re-evaluate the weather forecasts services in these stations within the region.

5. The CRM mangers in the NAR aviation companies should ensure that the crewmembers are educated in the concept of automation technology in the cockpit, and implications of the national culture on their adaption to these technologies.

6. The CRM training programme should employ appropriate methods and examples of the implications for the culture interface on flying safety during the flight. Such as not understanding the outcome of the automation and the hesitation to discuss that with the other pilots due to high power distance.

7. The management level of the aviation companies in the NAR should ensure that their flight crewmembers are aware of the importance of both technical and non-technical skills and the implications of this on their performance in the cockpit.

8. The management level of the aviation companies should ensure all training courses provided to their crewmembers are culturally calibrated, with specific curricula that do not conflict with the national culture of the NAR.

9. The management level of the aviation companies should include simple guidelines and a comprehensive statement of automation operation policy, taking into consideration the culture interface implications and the need to simplify their pilots' understanding of the general operations manual of automation systems.

10. The management level of the aviation companies should provide training courses in domain-specific risky events that can happen in the cockpit, so that their crewmembers develop aversions to risky cues and enhance their risk-perception in the cockpit.

11. The management level of the aviation companies in the NAR should strictly adhere to the ICAO recommended practical and IATA guidelines of safety and flight operation, in addition to implementing programs that help in mitigating risk and pilot error, such as the Line Operations Safety Audit (LOSA).

7.5 Study Limitations

The limitations and problems encountered in some levels or stages of this research have identified:

1. The limited research in the literature investigating the role of management in aviation companies in the NAR. Further work in this area could enhance research findings in improving the pilots' performance in the cockpit in terms of safety targets, safety priorities and SOPs compliance.

2. The lack of research appraising the role of the aviation authorities and aviation safety departments regarding monitoring and enforcing of safety regulations within the aviation companies in the NAR. Such work could support the present research's recommendation regarding the alignment of these aviation companies with international regulations.

3. The unstable situation in the NAR directly limited and affected the process of data collection. A larger sample size in both approaches (qualitative and quantitative) would give more robustness to the research outcome.

4. The translation of the survey questions from English to Arabic and the data from Arabic to English could have placed some restrictions on fully communicating the ideas. The second supervisor did check the accuracy of the survey translation as he is a native Arabic speaker. In addition, another researcher who has experience working on content analysis was involved to analyse some interviews to check the accuracy of the conversations. No deficiencies were indicated.

7.6 Future Work

Future works related to the areas of this research that need further enhancement are as follows:

1. Investigation of the role of management in aviation companies in the NAR in terms of safety targets, safety priorities and SOPs compliance.

2. An appraisal of the role of the aviation authorities and aviation safety departments regarding monitoring and enforcing of safety regulations within the aviation companies in the NAR, in addition to implementing the Safety Management Systems (SMS).

3. Evaluation of pilots' decision-making performance within the North Africa Region by relying on bigger sample size, which can be gained through building a data base of the major aviation companies in the region.

4. Investigation of the aviation companies safety performance in the North Africa region through three levels: pilots, air traffic controllers and maintenance engineers.

5. Evaluation of the North Africa region civil aviation authorities performance in cooperation and complies with the International Air Transport Association regulation to enhance their safety performance.

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Appendix A

Semi-Structured Interview Questions

Belaid, Zakria

School of Aerospace, Transport Systems and Manufacture

Year 2015/2016

These interviews questions shall focus on the national culture influence on pilot decision making performance in the cockpit in terms of the sounded environment and the interface with the automation systems, which are directly effecting their risk perception. In addition, these interviews are aiming to gain further understanding and identify the role of the national culture in the cockpit, where national culture can have a great impact on effective pilots 'decision making performance and consequently affecting the flight operational safety. Accordingly, these semi-structured interviews try to answer the question below:

- How does the national culture affecting the pilots' decision making performance in the cockpit within the North Africa region?

These interview's questions are includes with just open-ended questions. Thank you for agreeing to participate in this study.

Section One: (Interview questions)

1. What are the most frequent problems that you encounter with other flight crew members during flight regarding decision making?
2. How do you think uncertain situations during flight can be avoided?
3. To what extent do you think some of your colleagues pilots miss-interprets the concept of (God's will) when they making the decisions?
4. How does your social relationship with the other crew member affect your decision making in the cockpit?
5. What are the most common problems that you face with advanced technology?
6. From your flying experience as pilot in a North African based company, what are the most risky events that you have faced?
7. Do you think that in the final approach and the landing phase there are some actions that pilots do in this company which you consider them as high risk event and should not be done?

❖ Section Two: (Participant's background)

Please answer the following questions

- General information of the interviewee

3. What is your gender?

Male ☐ Female ☐

4. What are your age groups?

25 to 34 ☐ 35 to 44 ☐
45 to 54 ☐ 55 & above ☐

- Position and experiences of the interviewee

❖ What is your position in the company?

☐ Captain ☐ First officer

❖ What is your flying hour's number range?

0000 to 0999 h ☐ 1000 h to 1999 ☐
2000 to 2999 h ☐ 3000 h & abov ☐

Thank you for your cooperation

Appendix B

Pilot Decision Making Performance Survey

Belaid, Zakria

School of Aerospace, Transport and Manufacture

Year 2015/2016

National culture can have a great impact on effective pilots ‘decision making performance in the cockpit and consequently affecting the flight operation safety. This questionnaire will try to answer the question below:

- How does the national culture affecting the pilots’ decision making performance in the cockpit within the North Africa region?

This survey is with just closed-ended questions. Please use the scale below and rate the extent to which you agree with or disagree with the statement in the schedule based on your flying experience in the last 6 month.

A	B	C	D	E
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

For example:

No	**Statement**	**Rate**
0	Aviation safety in North Africa region has strong attention	D

Note: In the example above the respondent slightly agree with the statement.

Part 1:

A	B	C	D	E
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

No	Power Distance	Rate
1	F/Os are afraid to express disagreement in the flight deck.	
2	P-I-C should take physical control and fly the aircraft in emergency and non-standard situations.	
3	Captains who encourage suggestions are perceived to be weak leaders.	
4	F/Os shouldn't question Captains' decisions.	
5	In abnormal situations, I rely on P-I-C to tell me what to do.	
	Uncertainty Avoidance	
6	Organization rules should not be broken, even when pilots think it is the company's best interest.	
7	SOPs should be followed to tackle any flight situation.	
8	It's important to change work routine in order to cope with a new unfamiliar task.	
9	Pilots must know everything about the different systems to avoid surprises in the cockpit.	
10	It's important to understand the situation and find the one correct decision.	
	Religious beliefs and norms	
11	Accidents cannot be controlled or mitigated if it is our destiny.	
12	Following SOPs will not prevent accidents from happening.	
13	Accident can still happen even if pilots do everything correctly and in such a case this the will of God.	
	The next three questions are formed as scenarios to be answered as if you face it in flight within the next 24 hours.	
14	The pilot took a decision which you are not sure about, but you preferred to carry on accounting on the will of God that everything it's going to be ok.	
15	In the engine run up check, you were not sure about an instrument reading in one of the aircraft back-up systems, but you decided to carry on your flight relying on the will of God.	
16	The air craft in the final approach phase flying in IFR condition, but you could not see the runway features on the MDA so you decided to go 150 feet below the minimum to see the runway relying on the will of God.	

A	B	C	D	E
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

Social relationship		
17	A Crew member took a wrong decision; his colleague will be less willing to tell him if he is a friend.	
18	Your F/O is from the same town that you come from, and he does not follow procedures, but you feel reluctant to tell him that.	
19	During the final approach, the F/O has committed a big mistake which could result in fatal accident, but you cannot write a report because he is a friend.	
20	It is shameful in this company for pilots to discuss each other's mistakes if they are friends as well as colleague.	
21	There is a culture in this company that pilot who writes reports about an incident caused by another pilot is not a good man.	
Stress and Fatigue		
22	We should be aware of, and sensitive to, the personal problems of the other pilot.	
23	I let the other pilot know when my workload is becoming (or is about to become) excessive.	
24	My decision making is as good in emergencies as it is in routine situations.	
25	I am more likely to make errors in tense or hostile situations.	
26	My performance is not adversely affected by working with an inexperienced or less capable pilot.	
27	Personal problems can adversely affect my performance.	
Team Work		
28	It is better that the P-I-C and the F/O agree than to voice a different opinion.	
29	Both pilots in the cockpit share responsibility for prioritising activities in high workload situations.	
30	I enjoy working as part of a team.	
31	All members of the cockpit are qualified to give feedback to each other.	
32	Effective flight crew co-ordination requires them to take into account the personalities of each other.	
Work Values		
33	Captains deserve extra benefits and privileges.	
34	As long as the job gets done, I don't care what others think of me.	
35	A good reputation in the cockpit is important to me.	
36	It is an insult to be forced to wait unnecessarily for other members of the flight crew.	
37	In the cockpit, I get the respect that a person of my profession deserves.	

A	B	C	D	E
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

Error/ Procedural Compliance		
38	Errors are a sign of incompetence.	
39	I am ashamed when I make an error in front of other pilots.	
40	Procedures and policies are strictly followed in our flight operation.	
41	Errors are handled appropriately in this company.	
42	Pilots frequently disregard rules or guidelines developed for our flight Operations.	
Organizational Climate		
43	The flight operation department listens to pilots about their concerns and keeps us up to date with all information which might affect our flight	
44	Working in this company is like being a member of a large family.	
45	I am provided with adequate training to successfully accomplish my job.	
46	I am proud to work for this company.	
System Design and Automation		
47	I always know what the other pilot is doing with the automated systems.	
48	It is easy to detect when incorrect data has been entered by error.	
49	They’ve gone too far with automation.	
50	With automation there are still some things that take me by surprise.	
51	I sometimes find it hard to understand the language or technical jargon in messages presented by the FMC/FMGS.	
52	Incorrect data entered by error in automated systems is easily corrected.	

Part 2:

Risk perception

Hunters' risk perception model

In this exercise, you will be given descriptions of common aviation and everyday situations. After you have read the description of each situation, as a pilot you will evaluate the level of risk in each situation as if you were involved in it tomorrow. Base your answer relying on your flight experiences using the scale of 1 to 100 risk rating scale as shown below.
The scale 1 to 100 risk rating will be defined as follows:

Description	Rate
Zero risk involved in this situation. It is about as safe as sitting on the couch watching TV.	1
The same amount of risk as driving your car on a freeway in moderate traffic and good weather conditions during the day.	50
Extremely high risk of a serious, probably fatal accident. The pilot will be very fortunate to escape from this situation alive and with the aircraft undamaged.	100

53	Fly a traffic pattern so that you end up turning for final with about a 30 degree bank	
54	Fly a traffic pattern so that you end up turning for final with about a 45 degree bank**.**	
55	During the daytime, take a cross-country flight in which you land with 30 minutes of fuel remaining	
56	At night, following a cross-country route, you landed with over an hour of fuel remaining.	
57	At night, take a cross-country flight in which you land with 30 minutes of fuel remaining.	
The next five questions are formed as scenarios to be answered as if you face it in flight within the next 24 hours		
58	On the short final the P-I-C drops his microphone on the floor. He looks down while bending over trying to reach it. He inadvertently moves the control column and the aircraft banks sharply.	
59	During the planning for a 2 hour cross-country flight, a pilot makes a mistake in computing the fuel consumption. He believes that he will have over an hour of fuel remaining upon arrival, but he will really only have about 15 minutes of fuel left.	
60	The pilot is in a hurry to get going and does not carefully check his seat, seat belt, and shoulder harness. When he rotates, the seat moves backward on its tracks. As it slides backward, the pilot pulls back on the control column, sending the nose of the aircraft upward. As the airspeed begins to decay, he strains forward to push the column back to a neutral position.	
61	Low ceilings obscure the tops of the mountains, but the pilot thinks that he can see through the pass to clear sky on the other side of the mountain ridges. He starts up the wide valley that gradually gets narrower. As he approaches the pass he	

	notices that he occasionally loses sight of the blue sky on the other side. He drops down closer to the road leading through the pass and presses on. As he goes through the pass, the ceiling continues to drop and he finds himself suddenly in the clouds. He holds his heading and altitude and hopes for the best.	
62	A line of thunderstorms block the route of flight, but a pilot sees that there is a space of about 10 miles between two of the cells. He can see all the way to clear sky on the other side of the thunderstorm line, and there does not seem to be any precipitation along the route, although it does go under the extended anvil of one of the cells. As he tries to go between the storms, he suddenly encounters severe turbulence and the aircraft begins to be pelted with hail.	

Part 3: (participant's background)

Please answer the following questions

- **General information of the participants**

5. What is your gender?

Male ☐ **Female** ☐

6. What are your age groups?

25 to 34 ☐ **35 to 44** ☐
45 to 5 ☐ **55 & above** ☐

- **Position and experiences of the participants**

❖ **What is your position in the company?**

☐ **Captain** ☐ **First officer**

❖ **What is your flying hour's number range?**

0000 to 0999 h ☐ **1000 h to 1999 h** ☐
2000 to 2999 h ☐ **3000 h & above** ☐

Thank you for your cooperation

Appendix C

Introduction

أستبيان حول تصور و إدراك الطيارين للمخاطرالمتعلقة بعملهم

تصورالمخاطر للطيارين المتعلقة بعملهم, يمكن أن يكون لها تأثير كبير على القدرة او الكفائة في صنع القرارالصحيح أثناء الطيران, وبالتالي على سلامة الطيران. وهذا الاستبيان سوف يساعد في محاولة للإجابة على السؤال التالي:

- كيف يتصور او يدرك الطيارين المخاطر في الطائرات الحديثة وكيف يتصرفون بناءا علي هذا التصور للخطر. سوف يكون التركيز في هذه الدراسة بشكل خاص على المرحلتين الأخيرتين من رحلة الطيران وهي (مرحلة الاقتراب النهائي من المهبط ومرحلة الهبوط).

يحتوي هذا الاستبيان علي نوعين من الاسئلة, وهي اسئلة اختيارية الاجابة واسئلة حرة الاجابة. لإجابة الاسئلة الاختيارية ارجو استخدام المقياس المبين. والذي يحدد مدى قبولك او رفضك للفكرة المطروحة في كل جملة او سؤال معتمدا علي خبرتك في الطيران خلال السنتين الماضيتين .

Power Distance

خلال رحلة الطيران بعض الطيارين المساعدين يترددون في التعبير عن عدم موافقته مع قرار الكابتن .

- ○ اوافق بشدة
- ○ اوافق
- ○ محايد
- ○ لا اوافق
- ○ لا اوافق ابداً

يجب علي الكابتن اخد الاسبقية في التعامل مع كل الحلات الطارئة والغير مالوفة خلال رحلة الطيران.

- ○ اوافق بشدة
- ○ اوافق
- ○ محايد
- ○ لا اوافق
- ○ لا اوافق ابداً

الكابتن الذي يشارك باقي الطاقم في اقتراح القرار المناسب ينظر له كا قائد ضعيف.

- ○ اوافق بشدة
- ○ اوافق
- ○ محايد
- ○ لا اوافق
- ○ لا اوافق ابداً

الطيار المساعد يجب ان لا يناقش الكابتن في قرارته خلال الرحلة.

○

اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابداً

في الحلات الطارئة يعتمد مساعدو الطيار دائما علي الكابتن ليوجهوهم بالتصرف الملائم.

- اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابداً

Uncertainty Avoidance

يجب الالتزام بلوائح وقوانين الشركات وعدم اختراقها حتىٰ لو اعتقد الطيار انه سوف يكون في صالح الشركة.

- اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابداً

يجب اتباع اجرائات التشغيل الاساسية (SOP) في التعامل مع جميع حالات الطيران الاعتيادية والخطيرة.

- اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابداً

من المهم التاقلم وتغير الاساليب في التعامل مع الحلات والمهام الغير المعتادة.

- اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابداً

يجب علي الطيارين معرفة كل الانظمة الموجودة في قمرة الطائرة وكيفية التعامل معها, لتجنب المفاجئات.

- اوافق بشدة
- اوافق
- محايد

لا اوافق

لا اوافق ابداً

من المهم معرفة و ادراك الحالة التي تمر بها الطائرة سواء اعتيادية او طارئة لإتخاذ القرار الصحيح.

- اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابداً

Religious beliefs and norms

الحوادث لايمكن التحكم فيها او تقليلها اذا كانت قدرنا.

- اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابداً

اتباع اجراءات التشغيل الاساسية (SOPs) لا تمنع وقوع حوادث الطيران.

- اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابداً

الحادث يمكن ان يقع حتى في حالة التزام الطيار بجميع الاجراءات السليمة وفي هذه الحالة يكون لأمر مقدراً من الله تعالى.

- اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابداً

الاسئلة التالية عبارة عن سيناريوهات تخيلية مختلفة, وضح مدى موافقتك علي كل منها لو كنت أنت الشخص المعني في كل من تلك السيناريوهات:

الطيار يتخذ قراراً وهو غير متاكد ابداً من صحة ذلك القرار ويستمر في تنفيذه رغم ذلك اعتماداً ورجوعاً لحسن ظنه بالمولى عزّ وجلّ.

- اوافق بشدة
- اوافق
- محايد
- لا اوافق

لا اوافق ابداً

في رحلة اعتيادية واثناء مرحلة فحص تشغيل المحرك وباقي منظومات الطائرة (Engine Run Up) لم يكن الطيار متاكد ان احدى المنظومات الاحتياطية الهامة تشتغل بالكفائة المطلوبة, ولكن رغم ذلك قرر الاستمرارفي الرحلة اعتماداًعلي حسن ظنه بالمولى عزّ وجلّ وانه سبحانه لن يخذله ابداً.

اوافق بشدة

اوافق

محايد

لا اوافق

لا اوافق ابداً

في مرحلة الاقتراب النهائي من المهبط مستخدما الطيار وضع الطيران بالعدادات (ILS Approach), وصل الي اقل ارتفاع لاتخاد القرار ولم يستطع الطيار روية المهبط فقرر الاستمرار في الهبوط تحت هذا الارتفاع 150 قدم, معتمدا علي ثقته في الله عزّ وجلّ انه سوف يتمكن من روية المهبط والاستمرار في الهبوط

اوافق بشدة

اوافق

محايد

لا اوافق

لا اوافق ابداً

Social relationship

اذا اتخذ احد الطيارين قرار خاطئاً, فان زميله قد يتردد في اخباره بانه اخطأ اذا كانت بينهما صداقة عميقة.

اوافق بشدة

اوافق

محايد

لا اوافق

لا اوافق ابداً

اذا كان الطيار المرافق لك من نفس مدينتك او منطقتك فانك قد تتردد في التحدث إليه لتنبيهه اذا لم يتبع اجراءات التشغيل الاساسية (SOPs).

اوافق بشدة

اوافق

محايد

لا اوافق

لا اوافق ابداً

خلال مرحلة الاقتراب النهائي من المهبط, الطيار المرافق أخطاء خطأً كبيراً كان من الممكن ان يودي الي حادث قاتل, ولكنك لا تستطع كتابة اي تقرير او اي اجراء اخر لانه صديقك.

اوافق بشدة

اوافق

محايد

لا اوافق

لا اوافق ابداً

في هذه الشركة من العيب ان يناقش الطيارين اخطائهم التي ارتكبوها في الطيران لانهم اصدقاء وزملاء.

- اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابدأ

في ثقافة هذه الشركة فان الطيار الذي يكتب تقارير حول الحوادث او لأحداث التي ينبغي التبليغ عنها التي تحدث من الطيارين الاخرين, هو يعتبر شخص من اصحاب الصفات السيئة.

- اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابدأ

Stress and Fatigue

يجب علينا ان نكون مدركين و متفهمين لمشاكل الطيارين الاخرين.

- اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابدأ

في حالة عدم قدرتي علي أداء جميع الوظائف بسبب ازديادها (Over Load Time), فانني أحيط الطيار المرافق علما بذلك.

- اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابدأ

ان قدرة اتخادي للقرارات تكون بنفس الكفائة سواء في الحالات العادية والطارئة.

- اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابدأ

يزداد وقوعي في الاخطاء اكثر اثناء الطيران في حالات التسنج والتوتر (Stress).

- اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابداً

قدرتي علي الطيران بكفاءة لاتتاثر في حالة كون الطيار المرافق ذو خبرة كبيرة او كان طياراً حديثاً (ذو خبرة قليلة).

- اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابداً

المشاكل الشخصية لها تاثير سلبي علي قدرتي في الاداء.

- اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابداً

Teamwork

الافضل ان يكون الكابتن متفق مع الطيار المساعد من ان يكون مختلف معه في التفكير.

- اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابداً

كلا من الطيارين في قمرة الطائرة مسئولين بصورة مشتركة علي تحديد الاولويات ثم التعامل معها في حلات ازدياد ضعط العمل.

- اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابداً

استمتع بالعمل كا جزء من فريق عمل.

- اوافق بشدة
- اوافق
- محايد

لا اوافق

لا اوافق ابدأ

يجب ان يكونو اعضاء طاقم الطائرة في قمرة القيادة قادرين علي نصيحة بعضهم البعض.

- اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابدأ

لتوفير العمل الجماعي الجيد و المنسجم داخل قمرة القيادة يجب علي اعضاء الفريق جميعا الاخد في الاعتبار المواصفات الشخصية لكل منهم.

- اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابدأ

Work Values

الكباتنة يستحقون ترقيات وميزات اكثر.

- اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابدأ

اذا انجزت عملي علي اكمل وجه, لايهمني ما يعتقده الاخرون عني.

- اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابدأ

السمعة الحسنة داخل قمرة القيادة مهمة جدا لدي.

- اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابدأ

من غير اللائق ابدأ ان نجبر علي انتظار اعضاء طاقم الرحلة الاخرين.

- اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابدأ

دئماً احصل علي ما استحقه من احترام من الزملاء في قمرة الطائرة.

- اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابدأ

Error/ Procedural Compliance

حدوث الاخطاء من علامات عدم الكفائة.

- اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابدأ

اشعر بالخجل عندما اقع في خطاء امام الطيار المرافق لي في الرحلة.

- اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابدأ

في كل رحلات هذه الشركة يتم اتباع كل اجراءات ولوائح التشغيل (SOPs) بكل دقة.

- اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابدأ

يتم التعامل مع الاخطاء بالشكل المناسب في هذه الشركة.

- اوافق بشدة
- اوافق

- محايد
- لا اوافق
- لا اوافق ابداً

يتجاهل الطيارون بشكل متكرر التوجيهات المتعلقة بعمليات التشغيل اثناء الرحلة.

- اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابداً

Organizational Climate

مكتب عمليات الطيران يهتم باراء الطيارين ومشاغلهم حول مايستجد من معلومات قد تؤثر علي رحلات الطيران.

- اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابداً

العمل في هذه الشركة يجعلك تشعر كانك فرد من عائلة كبيرة.

- اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابداً

لقد تحصلت علي تدريب جيد جدا يجعلني اؤدي عملي بكفاءة.

- اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابداً

العمل في هذه الشركة يجعلني اشعر بالفخر.

- اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابداً

System design/Automation

عندي إلمام تام بجميع الوظائف التي يقوم بها الطيارون لتشغيل وتفعيل الانظمة الالية.

- اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابداً

من السهل اكتشاف المعلومات الخاطئة التي تم ادخالها خطأ الي الانظمة الالية.

- اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابداً

لقد تطورت الانظمة الالية بشكل سريع جدا هذه الايام واعتقد أنني اواكب كل التطورات فيها.

- اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابداً

لايزال استخدام الانظمة الالية يجعلني أتفاجأ من بعض الاشياء الجديدة أحياناً.

- اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابداً

.في بعض الاحيان يصعب علي فهم رسائل التشغيل الظاهرة علي اجهزة FMC/FMGS.

- اوافق بشدة
- اوافق
- محايد
- لا اوافق
- لا اوافق ابداً

من السهل تصحيح المعلومات الخاطئة التي ادخلت الي الانظمة الالية.

- اوافق بشدة

- اوافق
- محايد
- لا اوافق
- لا اوافق ابداً

Risk perception

في هذا التمرين سوف يتم عرض بعض الحالات والحوادث التي تحدث بشكل متكرر ويومي في الطيران, وبعد قرائتك لكل حالة ومن موقعك كطيار او طيار مساعد كيف تقيم نسبة الخطر في كل حالة في حال وقعت لك برحلة الغد. ارجو وضع إجابتك مستعينا بالمقياس الموضح بالاسفل.

مقياس معدل الخطر من 10 الي 100 سوف يعرف كما يلي:

Description	Rate
نسبة الخطر في هدة الحالة يكون صفر. ودرجة السلامة تكون مساوية للجلوس علي الاريكة ومشاهدة التلفاز.	10
نسبة الخطر في هذه الحالة يكون مساويا لقيادة سيارتك في طريق سريع وحديث وفي طقس جميل في النهار.	50
نسبة الخطر في هذه الحالة عالي جدا, واحتمالية وقوع حادث قاتل عالية جداً, والطيار سوف يكون محظوظ جدا اذا خرج من هذه الحالة حيا ومن غير تحطم الطائرة.	100

تدويرالطائرة المدنية بدرجة 30 خلال الدوران للدخول الي مرحلة الاقتراب النهائي الي المهبط.

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تدويرالطائرة المدنية بدرجة 45 خلال الدوران للدخول الي مرحلة الاقتراب النهائي الي المهبط.

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خلال رحلة طيران عبر المدن في فترة النهار فقط, وقمت بالهبوط في المطار المحدد ونسبة الوقود الموجود علي الطائرة تكفيك لمدة نصف ساعة طيران فقط.

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خلال رحلة طيران عبر المدن في فترة الليل, وقمت بالهبوط في المطار المحدد ونسبة الوقود الموجود علي الطائرة تكفيك اكثر من ساعة طيران.

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خلال رحلة طيران عبر المدن في فترة الليل, وقمت بالهبوط في المطار المحدد ونسبة الوقود الموجود علي الطائرة تكفيك نصف ساعة طيران فقد.

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الاسئلة التالية عبارة عن سيناريوهات تخيلية مختلفة, وضح نسة الخطر في كل منها حسب اعتقادك لو كنت أنت الشخص المعني في كل من تلك السيناريوهات:

في مرحلة الإقتراب النهائي من المهبط سقطت سماعة الكابتن على أرضية الطائرة, وفي لحظة محاولته التقاط السماعة من الأرضية قام بإدارة مقود الطائرة بقوة مما تسبب في استدارة الطائرة بشكل حاد.

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خلال التخطيط لرحلة عبر المدن لمدة ساعتين، اخطأ الطيارفي حساب استهلاك الوقود, مما جعله يعتقد انه سوف يصل الي المطار المطلوب مع كمية وقود متبقي تكفي لساعة طيران, ولكن في الحقيقة الوقود المتبقي سوف يكفي 15 دقيقة طيران فقد.

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الطياركان مستعجلا للاقلاع ولم يتحقق من بربط حزام الامان واحزمة الاكتاف بعناية, عندما بداء بالدوران بالطائرة المقعد تحرك الي الخلف, في لحظة انزلاق الكرسي الي الخلف سحب الطيار مقود الطائرة الي الخلف مسببا ارتفاع مقدمة الطائرة بحدة, في هذه اللحظة بدائت سرعة الطائرة في الانخفاض واندفع الطيار الي الامام لإرجاع الطائرة الي الوضع الطبيعي.

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السحب كانت منخفضة علي قمم الجبال واعتقد الطيار انه يستطيع الطيران خلال هذه السحب للوصول الي الجيهة الاخري للجبال حيث السماء صافية والرؤية اوضح, واسمر في الطيران خلال السحب وفقد الرؤية تماما, واستمر في الطيران في السحب مع الحفاظ علي الاتجاه والارتفاع متمنياً الافضل.

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خلال الرحلة ظهرت عاصفة جوية قوية في خط سير الرحلة ولكن الطيار لاحظ انه هناك مسافة بين خلايا العاصفة تقدر بعشرة مايل, و يستطيع رؤية السماء صافية بعد العاصفة ولا يوجد اي تساقط للامطار او الثلوج, فقرر الاسمرار و بدء في العبور خلال العاصفة وفجاه دخلت الطائرة في مطبات هوائية قوية وبدء تساقط الثلوج.

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Participant's background

الجنس

- ذكر
- انثي

العمر

- 25 الي 34
- 35 الي 44
- 45 الي 54
- 55 او اكثر

ماهو تصنيفك الوظيفي في الشركة

- كابتن
- مساعد طيار

ماهي فترة عملك في هذه الشركة؟

كم عدد ساعات الطيران لديك؟

- 0 الي 999 ساعة
- 1000 الي 1999 ساعة
- 2000 الي 2999 ساعة
- 3000 ساعة او اكثر

هل لديك اي اهليات طيران اخرى ؟

Block 13

هل لديك اي تعليق او تنبيه بخصوص طريقة طرح الاسئلة و تكوينها؟

Appendix D

SPSS Output of the Four Themes Analysis

PART1

THEME ONE: Cultural attributes findings

- **Factoe One: Power Destance (item from 1 to 5)**

		F/Os are afraid to express disagreement in the flight deck.	P-I-C should take physical control and fly the aircraft in emergency and non-standard situations.	Captains who encourage suggestions are perceived to be weak leaders.	F/Os shouldn't question Captains' decisions.	In abnormal situations, I rely on P-I-C to tell me what to do.
N	Valid	143	137	141	142	141
	Missing	0	6	2	1	2

Table 5.1: Valid and missing value of power destance factor

Item 1: F/Os are afraid to express disagreement in the flight deck.

F/Os are afraid to express disagreement in the flight deck.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	16	11.2	11.2	11.2
	Agree	72	50.3	50.3	61.5
	Neither Agree nor Disagree	15	10.5	10.5	72.0
	Disagree	31	21.7	21.7	93.7
	Strongly Disagree	9	6.3	6.3	100.0
	Total	143	100.0	100.0	

Table 5.2: The average percentage of agreement

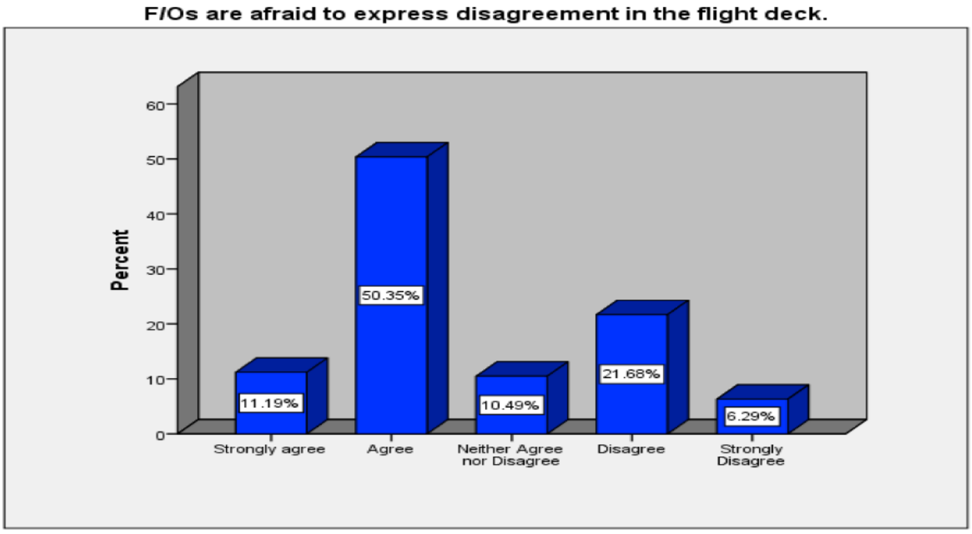

Figure 5.3: shows the percentage's agreement

Item 2: P-I-C should take physical control and fly the aircraft in emergency and non-standard situations.

P-I-C should take physical control and fly the aircraft in emergency and non-standard situations.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	53	37.1	38.7	38.7
	Agree	55	38.5	40.1	78.8
	Neither Agree nor Disagree	11	7.7	8.0	86.9
	Disagree	13	9.1	9.5	96.4
	Strongly Disagree	5	3.5	3.6	100.0
	Total	137	95.8	100.0	
Missing	System	6	4.2		
Total		143	100.0		

Table 5.3: The average percentage of agreement

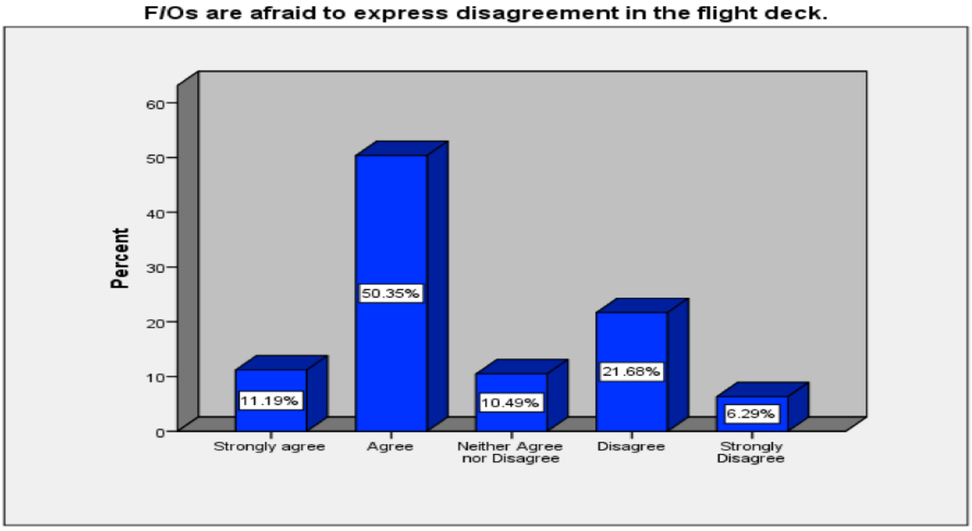

Figure 5.4: shows the percentage's agreement

Item 3: Captains who encourage suggestions are perceived to be weak leaders.

Captains who encourage suggestions are perceived to be weak leaders.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	5	3.5	3.5	3.5
	Agree	15	10.5	10.6	14.2
	Neither Agree nor Disagree	11	7.7	7.8	22.0
	Disagree	56	39.2	39.7	61.7
	Strongly Disagree	54	37.8	38.3	100.0
	Total	141	98.6	100.0	
Missing	System	2	1.4		
Total		143	100.0		

Table 5.4: The average percentage of agreement

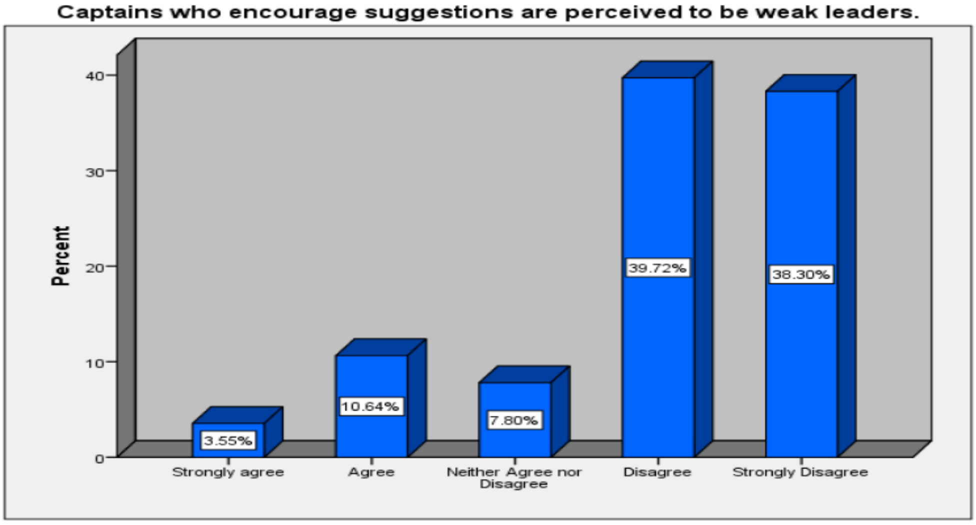

Figure 5.5: shows the percentage's agreement

Item 4: F/Os shouldn't question Captains' decisions.

F/Os shouldn't question Captains' decisions.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	3	2.1	2.1	2.1
	Agree	5	3.5	3.5	5.6
	Neither Agree nor Disagree	15	10.5	10.6	16.2
	Disagree	75	52.4	52.8	69.0
	Strongly Disagree	44	30.8	31.0	100.0
	Total	142	99.3	100.0	
Missing	System	1	.7		
Total		143	100.0		

Table 5.5: shows the average percentage of agreement

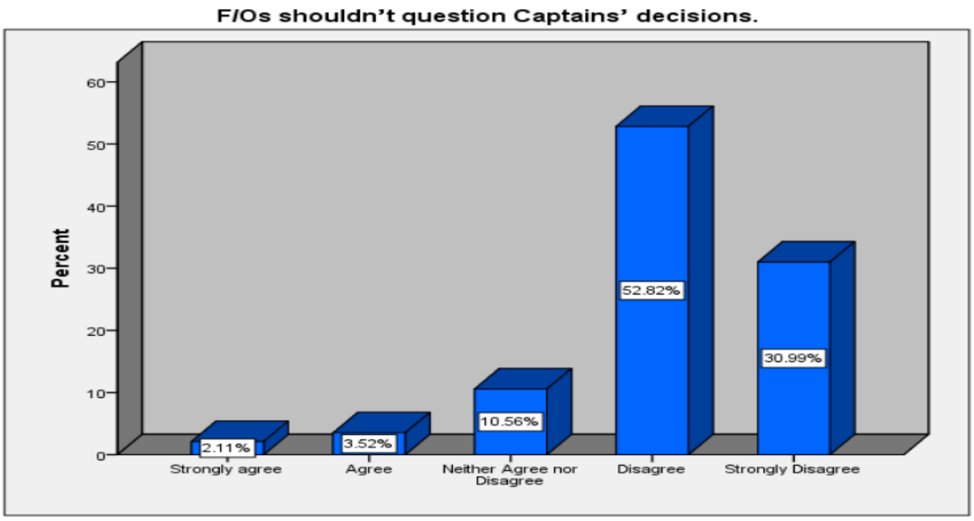

Figure 5.6: shows the percentage's agreement

Item 5: In abnormal situations, I rely on P-I-C to tell me what to do.

In abnormal situations, I rely on P-I-C to tell me what to do.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	18	12.6	12.8	12.8
	Agree	50	35.0	35.5	48.2
	Neither Agree nor Disagree	24	16.8	17.0	65.2
	Disagree	40	28.0	28.4	93.6
	Strongly Disagree	9	6.3	6.4	100.0
	Total	141	98.6	100.0	
Missing	System	2	1.4		
Total		143	100.0		

Table 5.6: shows the average percentage of agreement in Q5.

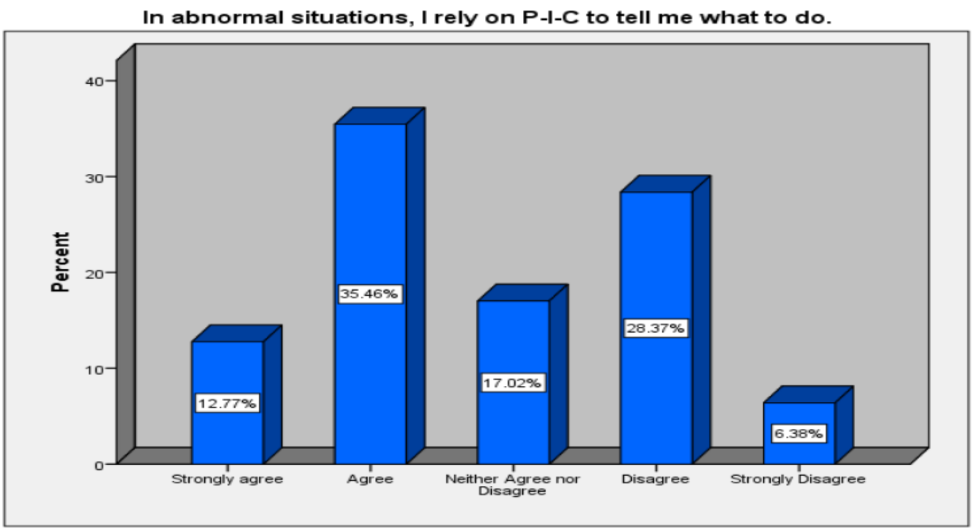

Figure 5.7: shows the percentage's agreement

➢ Factor Two: Uncertainty Avoidance (items from 6 to 10)

		Organization rules should not be broken, even when pilots think it is the company's best interest.	SOPs should be followed to tackle any flight situation.	It's important to change work routine in order to cope with a new unfamiliar task.	Pilots must know everything about the different systems to avoid surprises in the cockpit.	It's important to understand the situation and find the one correct decision.
N	Valid	142	142	140	143	143
	Missing	1	1	3	0	0

Table 5.7: shows valid and missing value of uncertainty avoidance factor.

Item6: Organization rules should not be broken, even when pilots think it is the company's best interest.

Organization rules should not be broken, even when pilots think it is the company's best interest.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	50	35.0	35.2	35.2
	Agree	53	37.1	37.3	72.5
	Neither Agree nor Disagree	35	24.5	24.6	97.2
	Disagree	4	2.8	2.8	100.0
	Total	142	99.3	100.0	
Missing	System	1	.7		
Total		143	100.0		

Table 5.8: shows the average percentage of agreement in Q7.

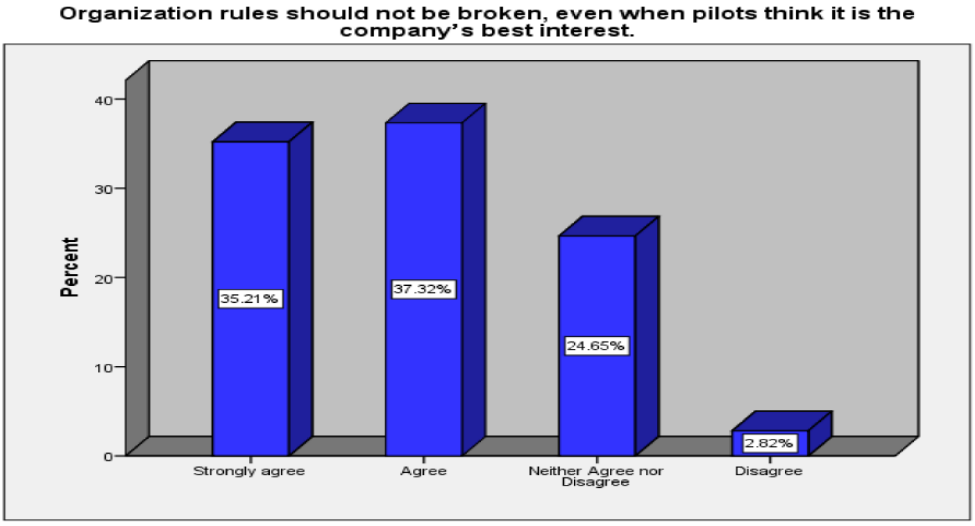

Figure 5.8: shows the percentages of agreement

Item 7: SOPs should be followed to tackle any flight situation.

SOPs should be followed to tackle any flight situation.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	57	39.9	40.1	40.1
	Agree	61	42.7	43.0	83.1
	Neither Agree nor Disagree	15	10.5	10.6	93.7
	Disagree	6	4.2	4.2	97.9
	Strongly Disagree	3	2.1	2.1	100.0
	Total	142	99.3	100.0	
Missing	System	1	.7		
Total		143	100.0		

Table 5.10: shows the average percentage of agreement.

SOPs should be followed to tackle any flight situation.

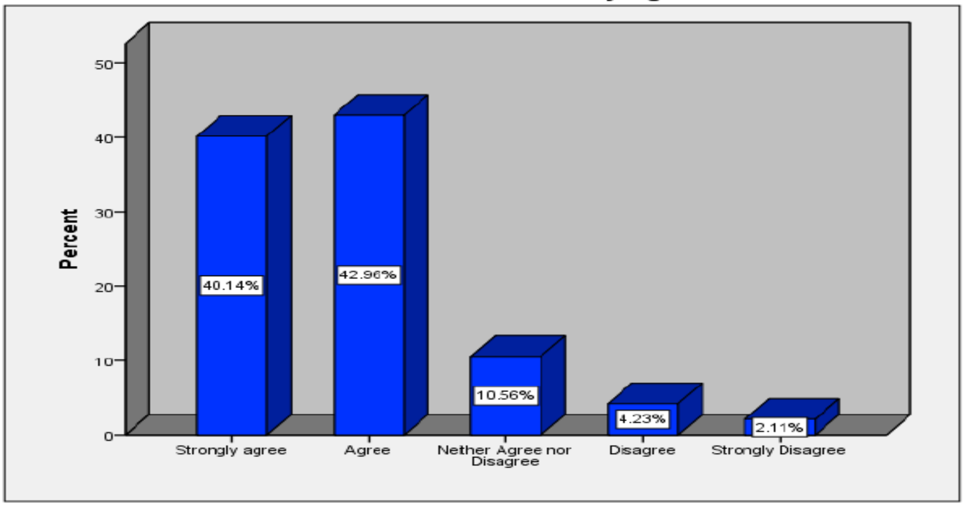

Figure 5.9: shows the percentages of agreement

Item 8: It's important to change work routine in order to cope with a new unfamiliar task.

It's important to change work routine in order to cope with a new unfamiliar task.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	23	16.1	16.4	16.4
	Agree	78	54.5	55.7	72.1
	Neither Agree nor Disagree	29	20.3	20.7	92.9
	Disagree	10	7.0	7.1	100.0
	Total	140	97.9	100.0	
Missing	System	3	2.1		
Total		143	100.0		

Table 5.11: shows the average percentage of agreement

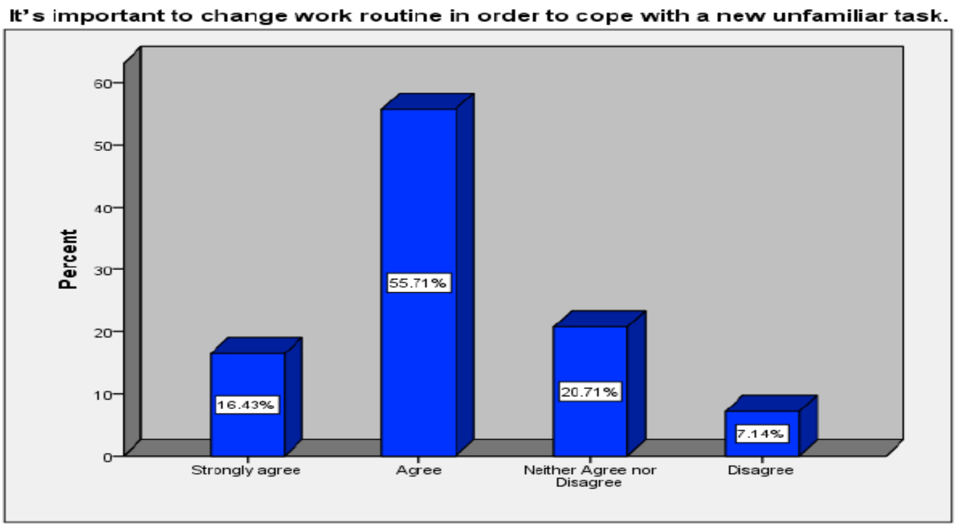

Figure 5.10: shows the percentages of agreement

Item 9: Pilots must know everything about the different systems to avoid surprises in the cockpit.

Pilots must know everything about the different systems to avoid surprises in the cockpit.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	106	74.1	74.1	74.1
	Agree	23	16.1	16.1	90.2
	Neither Agree nor Disagree	13	9.1	9.1	99.3
	Disagree	1	.7	.7	100.0
	Total	143	100.0	100.0	

Table 5.12: shows the average percentage of agreement

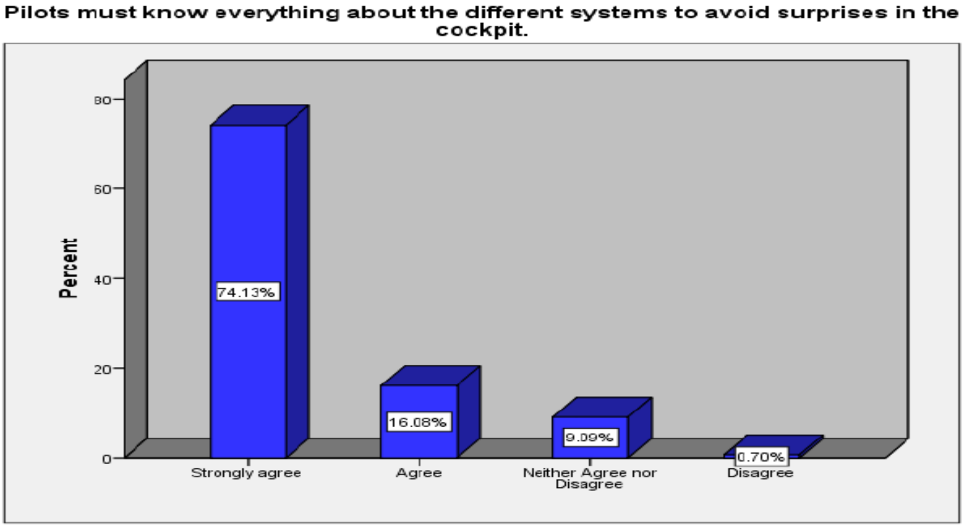

Figure 5.11: shows the percentages of agreement

Item 10: It's important to understand the situation and find the one correct decision.

It's important to understand the situation and find the one correct decision.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	107	74.8	74.8	74.8
	Agree	24	16.8	16.8	91.6
	Neither Agree nor Disagree	10	7.0	7.0	98.6
	Disagree	1	.7	.7	99.3
	Strongly Disagree	1	.7	.7	100.0
	Total	143	100.0	100.0	

Table 5.13: shows the average percentage of agreement.

It's important to understand the situation and find the one correct decision.

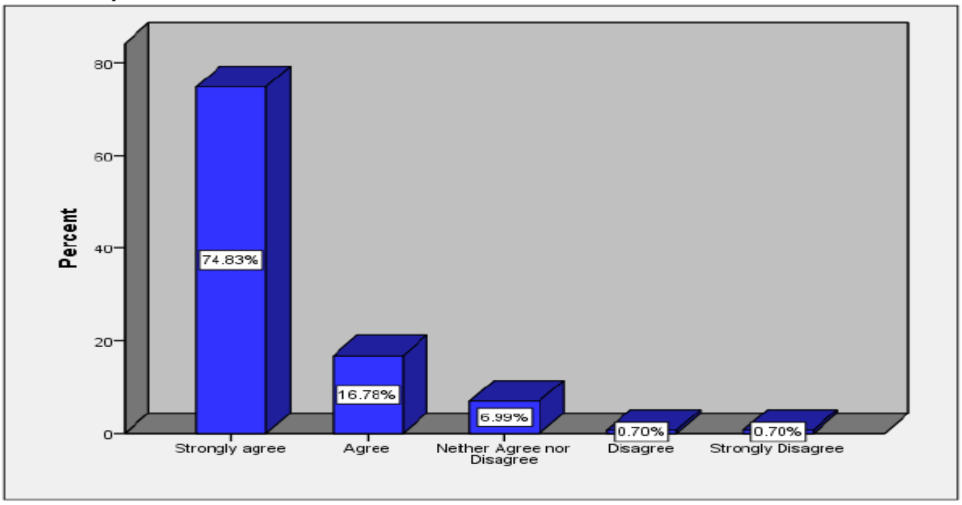

Figure 5.12: shows the percentages of agreement

- **Factor Three: Religious beliefs and norms (items from 11 to 16)**

		Accidents cannot be controlled or mitigated if it is our destiny.	Following SOPs will not prevent accidents from happening.	Accident can still happen even if pilots do everything correctly and in such a case this the will of God.	The pilot took a decision which is not not sure about, but he preferred to carry on accounting on the will of God that everything it's going to be ok.	In the engine run up check, the pilot was not sure about an instrument reading in one of the aircraft back-up systems, but he decided to carry on the flight relying on the will of God.	The aircraft in the final approach phase, flying in IFR condition. The pilot could not see the runway features on the MDA so he decided to go 150 feet below the minimum to see the runway relying on the will of God.
N	Valid	142	139	141	133	142	143
	Missing	1	4	2	10	1	0

Table 5.14: shows valid and missing value of Religious beliefs and norms factor

Item 11: Accidents cannot be controlled or mitigated if it is our destiny.

Accidents cannot be controlled or mitigated if it is our destiny.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	19	13.3	13.4	13.4
	Agree	20	14.0	14.1	27.5
	Neither Agree nor Disagree	20	14.0	14.1	41.5
	Disagree	66	46.2	46.5	88.0
	Strongly Disagree	17	11.9	12.0	100.0
	Total	142	99.3	100.0	
Missing	System	1	.7		
Total		143	100.0		

Table 5.15: shows the average percentage of agreement

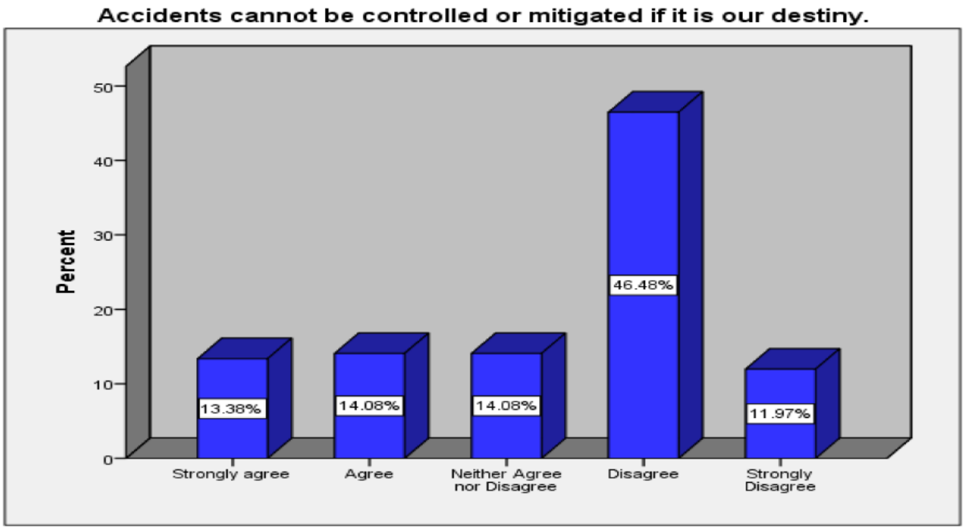

Figure 5.13: shows the percentages of agreement

Item 12: Following SOPs will not prevent accidents from happening.

Following SOPs will not prevent accidents from happening.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	13	9.1	9.4	9.4
	Agree	72	50.3	51.8	61.2
	Neither Agree nor Disagree	24	16.8	17.3	78.4
	Disagree	24	16.8	17.3	95.7
	Strongly Disagree	6	4.2	4.3	100.0
	Total	139	97.2	100.0	
Missing	System	4	2.8		
Total		143	100.0		

Table 5.16: shows the average percentage of agreement

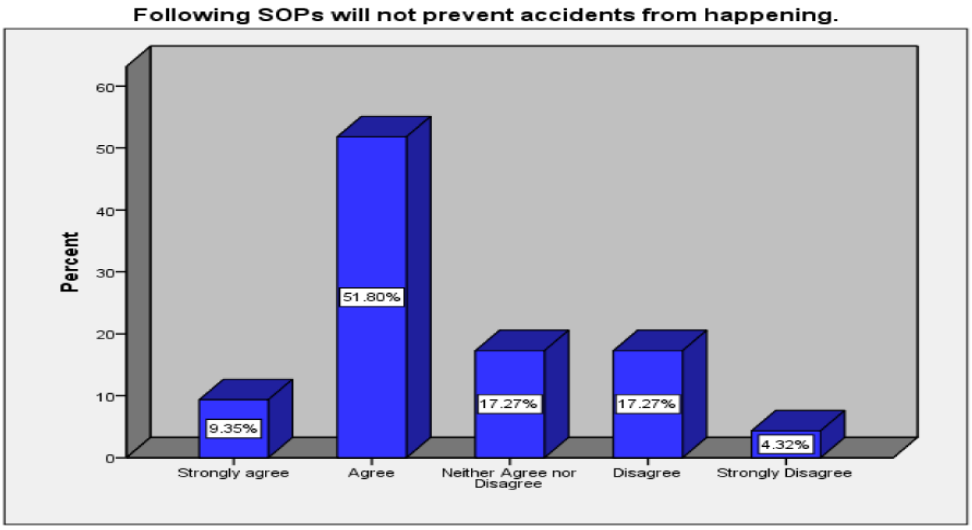

Figure 5.14: shows the percentages of agreement

Item 13: Accident can still happen even if pilots do everything correctly and in such a case this the will of God.

Accident can still happen even if pilots do everything correctly and in such a case this the will of God.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	47	32.9	33.3	33.3
	Agree	73	51.0	51.8	85.1
	Neither Agree nor Disagree	14	9.8	9.9	95.0
	Disagree	7	4.9	5.0	100.0
	Total	141	98.6	100.0	
Missing	System	2	1.4		
Total		143	100.0		

Table 5.17: shows the average percentage of agreement

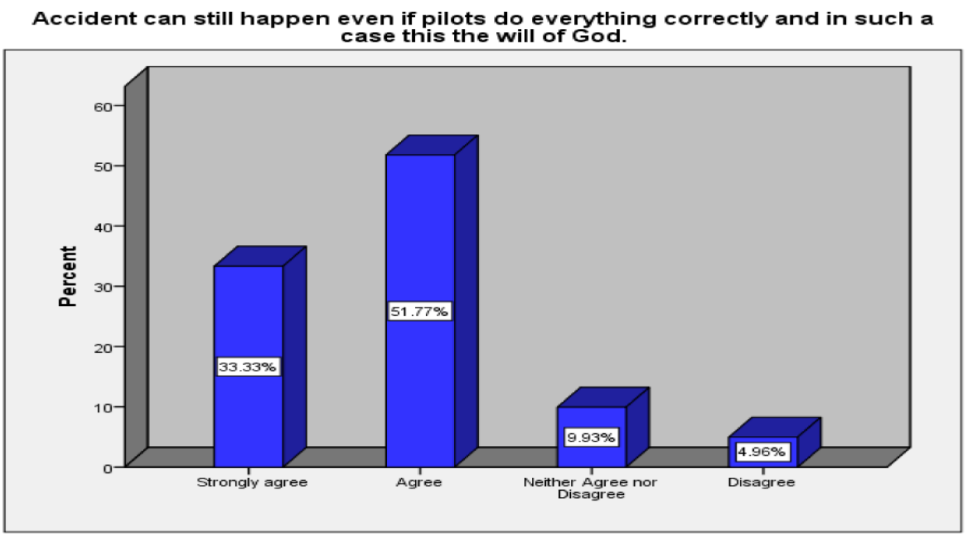

Figure 5.15: shows the percentages of agreement

Item 14: You took a decision which you are not sure about, but you preferred to carry on accounting on the will of God that everything it's going to be ok.

The pilot took a decision which is not not sure about, but he preferred to carry on accounting on the will of God that everything it's going to be ok.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	7	4.9	5.3	5.3
	Agree	10	7.0	7.5	12.8
	Neither Agree nor Disagree	14	9.8	10.5	23.3
	Disagree	63	44.1	47.4	70.7
	Strongly Disagree	39	27.3	29.3	100.0
	Total	133	93.0	100.0	
Missing	System	10	7.0		
Total		143	100.0		

Table 5.18: shows the average percentage of agreement

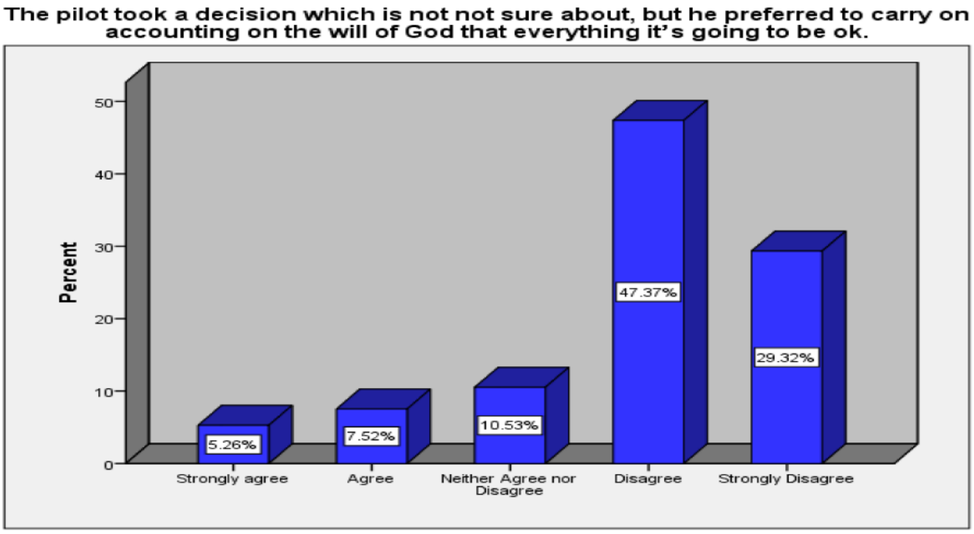

Figure 5.16: shows the percentages of agreement

Item 15: In the engine run up check, you were not sure about an instrument reading in one of the aircraft back-up systems, but you decided to carry on your flight relying on the will of God.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	1	.7	.7	.7
	Agree	7	4.9	4.9	5.6
	Neither Agree nor Disagree	16	11.2	11.3	16.9
	Disagree	52	36.4	36.6	53.5
	Strongly Disagree	66	46.2	46.5	100.0
	Total	142	99.3	100.0	
Missing	System	1	.7		
Total		143	100.0		

Table 5.19: shows the average percentage of agreement

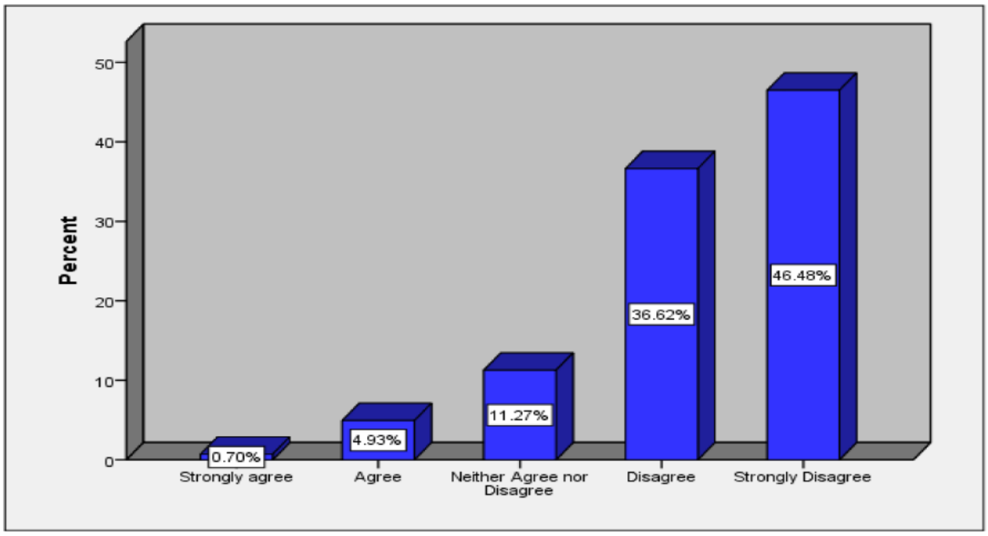

Figure 5.17: shows the percentages of agreement

Item 16: You are in the final approach phase flying in IFR condition, but you could not see the runway features on the MDA so you decided to go 150 feet below the minimum to see the runway relying on the will of God.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	3	2.1	2.1	2.1
	Agree	1	.7	.7	2.8
	Neither Agree nor Disagree	3	2.1	2.1	4.9
	Disagree	38	26.6	26.6	31.5
	Strongly Disagree	98	68.5	68.5	100.0
	Total	143	100.0	100.0	

Table 5.20: shows the average percentage of agreement

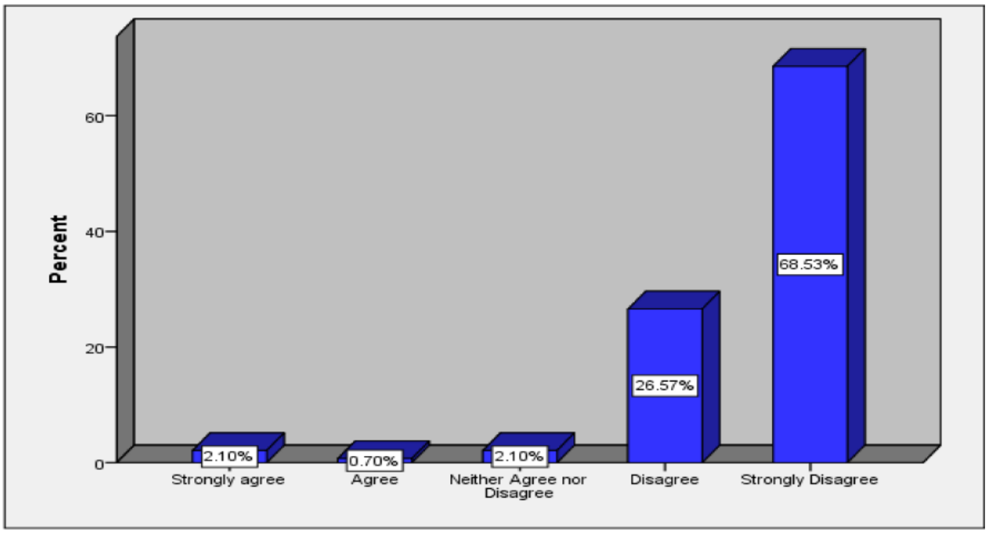

Figure 5.18: shows the percentages of agreement

➢ Factor Four: Social relationship (items from 17 to 21)

		A Crew member took a wrong decision; his colleague will be less willing to tell him if he is a friend.	Your F/O is from the same town that you come from, and he does not follow procedures, but you feel reluctant to tell him that.	During the final approach, the F/O has committed a big mistake which could result in fatal accident, but you cannot write a report because he is a friend.	It is shameful in this company for pilots to discuss each other's mistakes if they are friends as well as colleague.	There is a culture in this company that pilot who writes reports about an incident caused by another pilot is not a good man.
N	Valid	143	143	134	143	142
	Missing	0	0	9	0	1

Table 5.21: shows valid and missing value of social relationship and norms factor.

Item 17: A Crew member took a wrong decision; his colleague will be less willing to tell him if he is a friend.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	4	2.8	2.8	2.8
	Agree	21	14.7	14.7	17.5
	Neither Agree nor Disagree	4	2.8	2.8	20.3
	Disagree	33	23.1	23.1	43.4
	Strongly Disagree	81	56.6	56.6	100.0
	Total	143	100.0	100.0	

Table 5.22: shows the average percentage

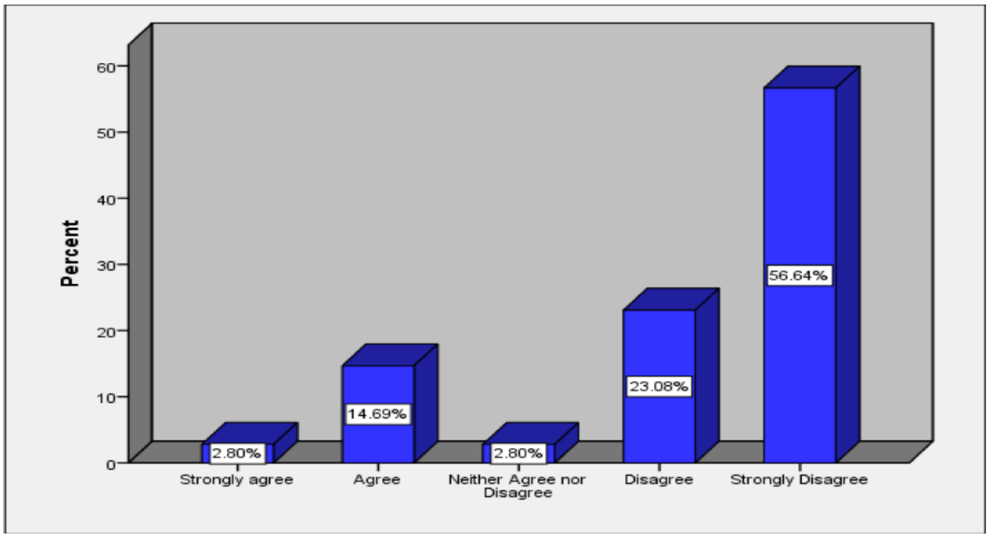

Figure 5.19: shows the percentages of agreement

Item 18: Your F/O is from the same town that you come from, and he does not follow procedures, but you feel reluctant to tell him that.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	15	10.5	10.5	10.5
	Neither Agree nor Disagree	8	5.6	5.6	16.1
	Disagree	36	25.2	25.2	41.3
	Strongly Disagree	84	58.7	58.7	100.0
	Total	143	100.0	100.0	

Table 5.23: shows the average percentage

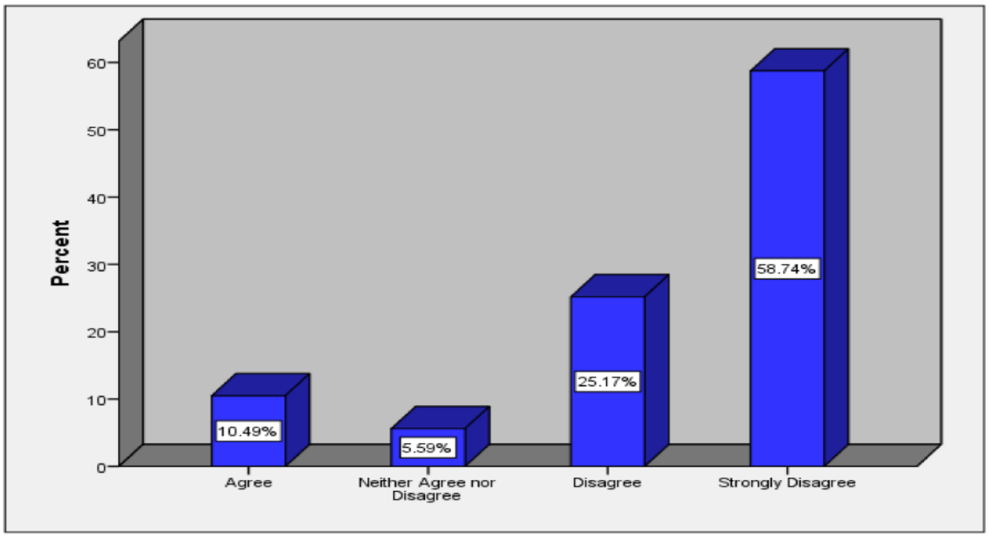

Figure 5.20: shows the percentages of agreement

Item 19: During the final approach, the F/O has committed a big mistake which could result in fatal accident, but you cannot write a report because he is a friend.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	1	.7	.7	.7
	Agree	22	15.4	16.4	17.2
	Neither Agree nor Disagree	27	18.9	20.1	37.3
	Disagree	26	18.2	19.4	56.7
	Strongly Disagree	58	40.6	43.3	100.0
	Total	134	93.7	100.0	
Missing	System	9	6.3		
Total		143	100.0		

Table 5.24: shows the average percentage

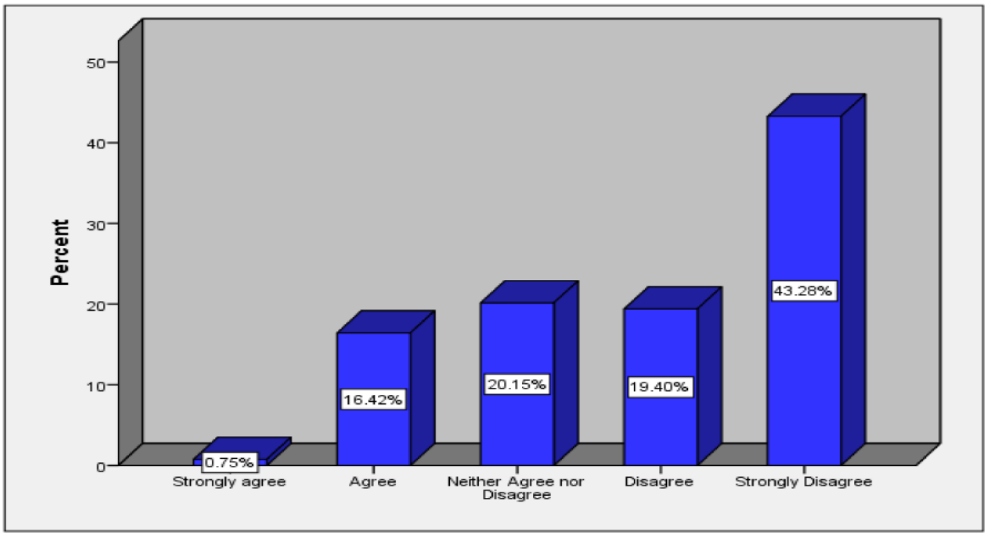

Figure 5.21: shows the percentages of agreement

Item 20: It is shameful in this company for pilots to discuss each other's mistakes if they are friends as well as colleague.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	5	3.5	3.5	3.5
	Agree	21	14.7	14.7	18.2
	Neither Agree nor Disagree	10	7.0	7.0	25.2
	Disagree	33	23.1	23.1	48.3
	Strongly Disagree	74	51.7	51.7	100.0
	Total	143	100.0	100.0	

Table 5.25: shows the average percentage

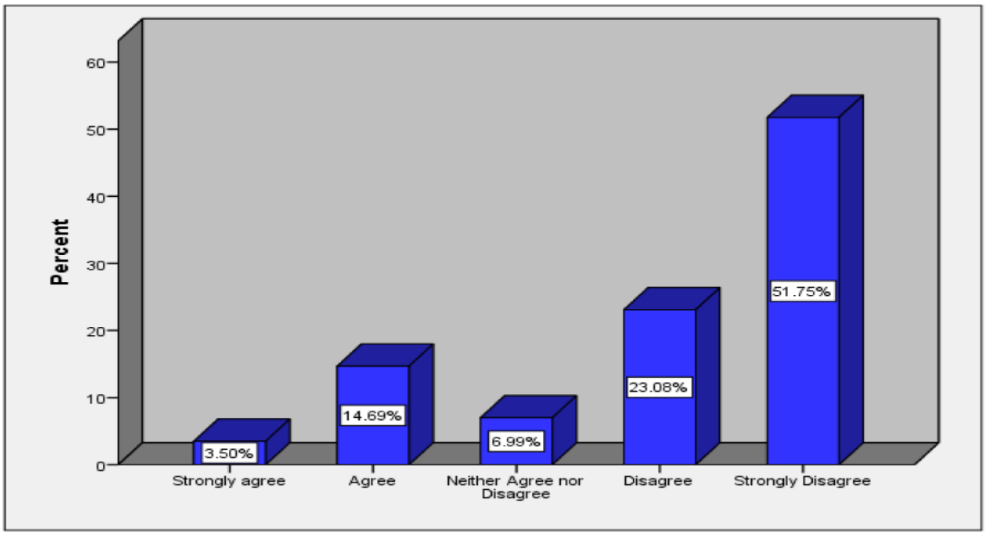

Figure 5.22: shows the percentages of agreement

Item 21: There is a culture in this company that pilot who writes reports about an incident caused by another pilot is not a good man.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	8	5.6	5.6	5.6
	Agree	20	14.0	14.1	19.7
	Neither Agree nor Disagree	11	7.7	7.7	27.5
	Disagree	40	28.0	28.2	55.6
	Strongly Disagree	63	44.1	44.4	100.0
	Total	142	99.3	100.0	
Missing	System	1	.7		
Total		143	100.0		

Table 5.26: shows the average percentage

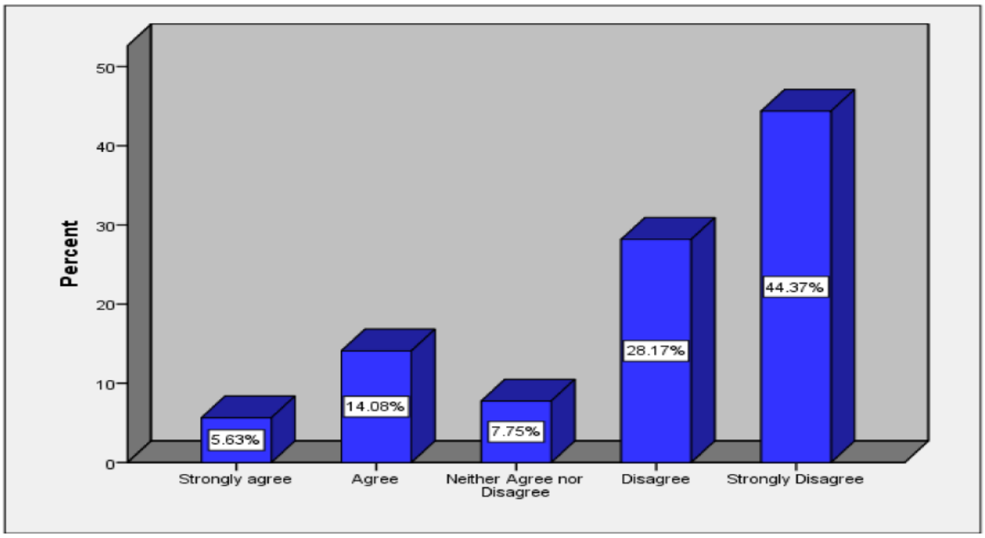

Figure 5.23: shows the percentage

es of agreement

THEME TWO: Attitude to human and origination factors findings

- **Factor Five: Stress and Fatigue(items from 22 to 27)**

		We should be aware of, and sensitive to, the personal problems of the other pilot.	I let the other pilot know when my workload is becoming (or is about to become) excessive.	My decision making is as good in emergencies as it is in routine situations.	I am more likely to make errors in tense or hostile situations.	My performance is not adversely affected by working with an inexperienced or less capable pilot.	Personal problems can adversely affect my performance.
N	Valid	142	141	139	143	140	140
	Missing	1	2	4	0	3	3

Table 5.27: shows valid and missing value of Stress and Fatigue factor.

Item 22: We should be aware of, and sensitive to, the personal problems of the other pilot.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	62	43.4	43.7	43.7
	Agree	63	44.1	44.4	88.0
	Neither Agree nor Disagree	10	7.0	7.0	95.1
	Disagree	5	3.5	3.5	98.6
	Strongly Disagree	2	1.4	1.4	100.0
	Total	142	99.3	100.0	
Missing	System	1	.7		
Total		143	100.0		

Table 5.28: shows the average percentage of agreement

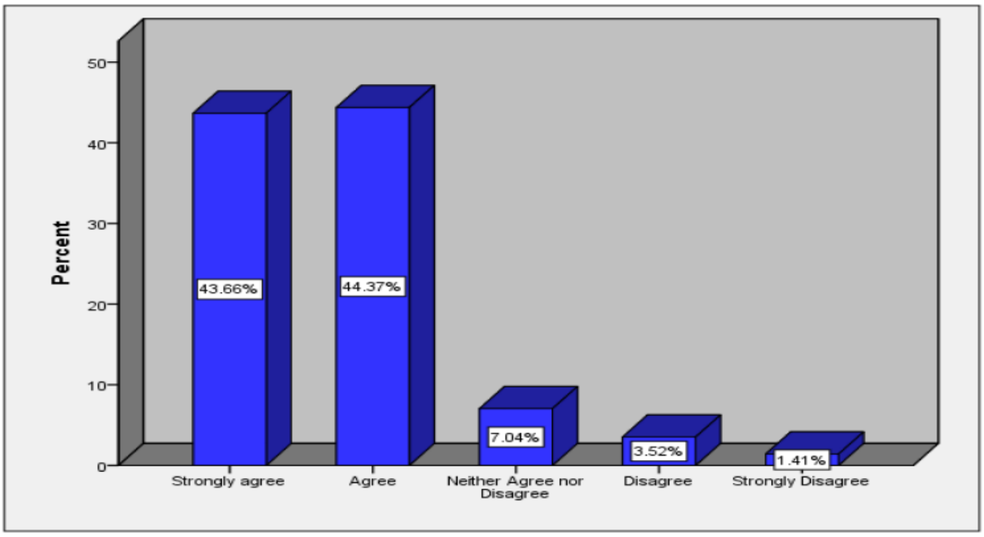

Figure 5.24: shows bar chart indicate the percentage's agreement

Item 23: I let the other pilot know when my workload is becoming (or is about to become) excessive.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	74	51.7	52.5	52.5
	Agree	60	42.0	42.6	95.0
	Neither Agree nor Disagree	6	4.2	4.3	99.3
	Disagree	1	.7	.7	100.0
	Total	141	98.6	100.0	
Missing	System	2	1.4		
Total		143	100.0		

Table 5.29: shows the average percentage of agreement

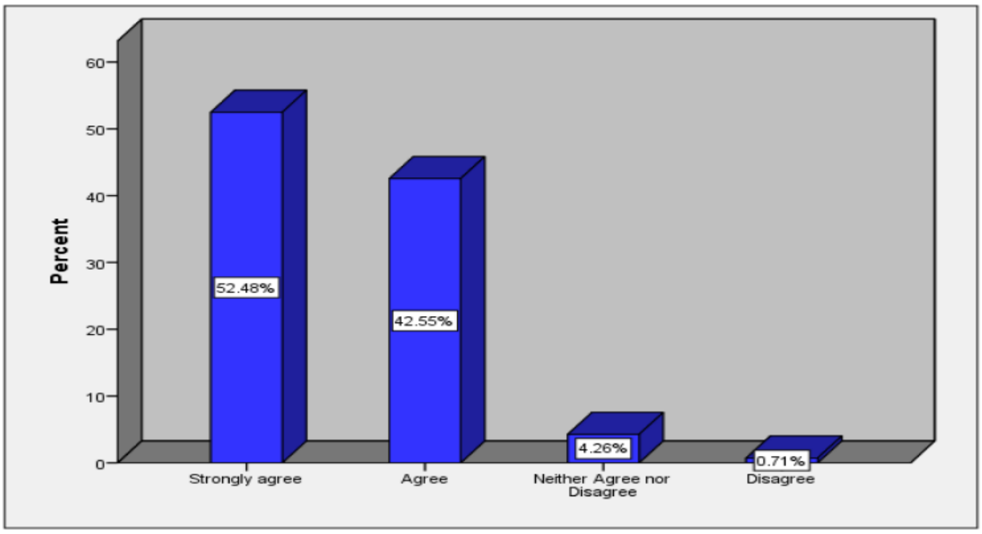

Figure 5.25: shows bar chart indicate the percentage's agreement

Item 24: My decision making is as good in emergencies as it is in routine situations.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	22	15.4	15.8	15.8
	Agree	54	37.8	38.8	54.7
	Neither Agree nor Disagree	14	9.8	10.1	64.7
	Disagree	45	31.5	32.4	97.1
	Strongly Disagree	4	2.8	2.9	100.0
	Total	139	97.2	100.0	
Missing	System	4	2.8		
Total		143	100.0		

Table 5.30: shows the average percentage of agreement

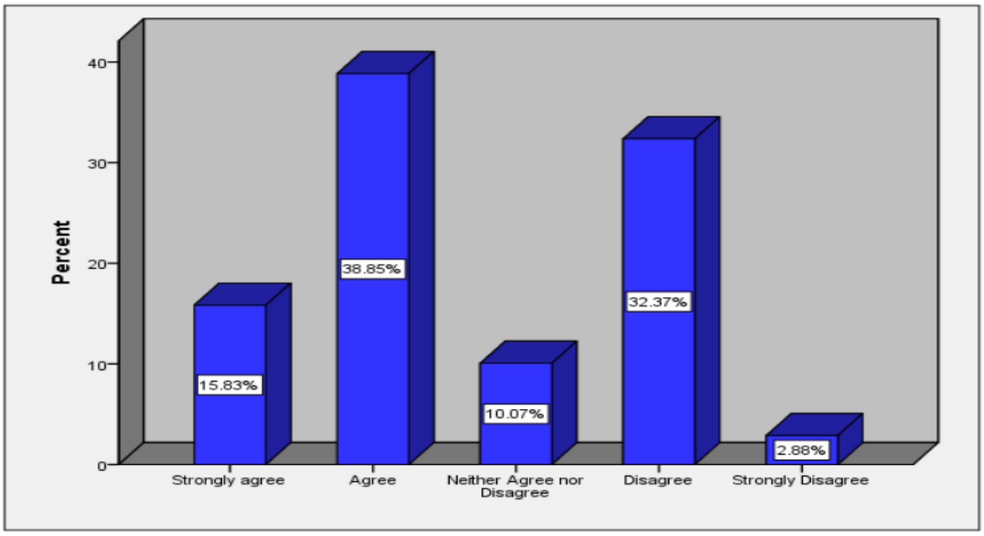

Figure 5.26: shows bar chart indicate the percentage's agreement

Item 25: I am more likely to make errors in tense or hostile situations.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	44	30.8	30.8	30.8
	Agree	57	39.9	39.9	70.6
	Neither Agree nor Disagree	18	12.6	12.6	83.2
	Disagree	22	15.4	15.4	98.6
	Strongly Disagree	2	1.4	1.4	100.0
	Total	143	100.0	100.0	

Table 5.31: shows the average percentage of agreement

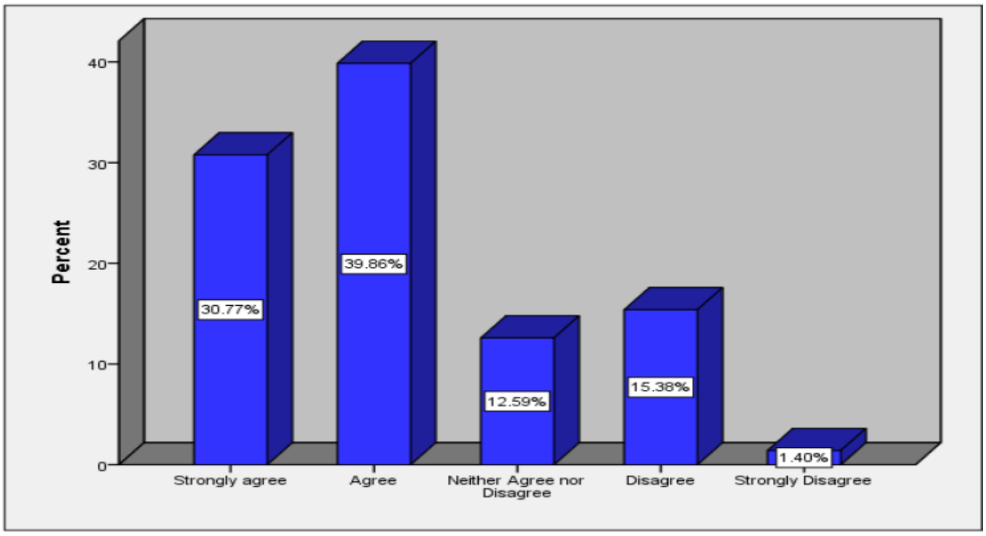

Figure 5.27: shows bar chart indicate the percentage's agreement

Item 26: My performance is not adversely affected by working with an inexperienced or less capable pilot.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	34	23.8	24.3	24.3
	Agree	67	46.9	47.9	72.1
	Neither Agree nor Disagree	20	14.0	14.3	86.4
	Disagree	17	11.9	12.1	98.6
	Strongly Disagree	2	1.4	1.4	100.0
	Total	140	97.9	100.0	
Missing	System	3	2.1		
Total		143	100.0		

Table 5.32: shows the average percentage of **agreement**

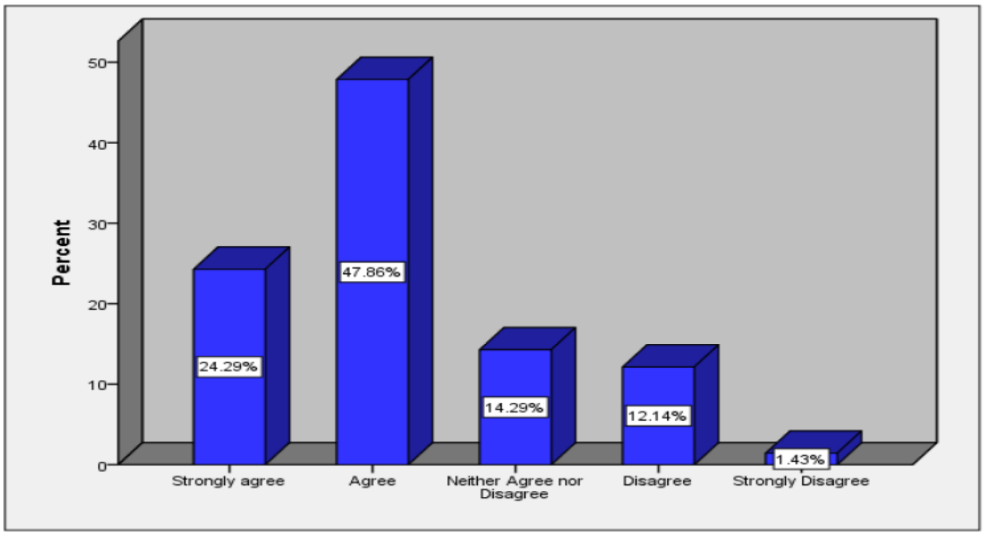

Figure 5.28: shows bar chart indicate the percentage's agreement

Item 27: Personal problems can adversely affect my performance.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	31	21.7	22.1	22.1
	Agree	67	46.9	47.9	70.0
	Neither Agree nor Disagree	9	6.3	6.4	76.4
	Disagree	30	21.0	21.4	97.9
	Strongly Disagree	3	2.1	2.1	100.0
	Total	140	97.9	100.0	
Missing	System	3	2.1		
Total		143	100.0		

Table 5.33: shows the average percentage of **agreement**

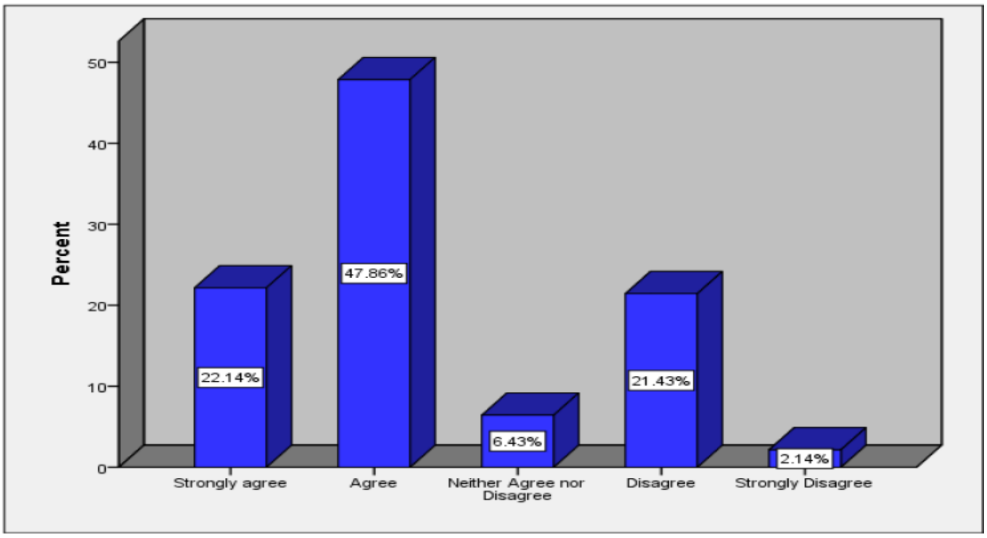

Figure 5.29: shows bar chart indicate the percentage's agreement

➢ Factor Six: Teamwork (items from 28 to 32)

		It is better that the P-I-C and the F/O agree than to voice a different opinion.	Both pilots in the cockpit share responsibility for prioritising activities in high workload situations.	I enjoy working as part of a team.	All members of the cockpit are qualified to give feedback to each other.	Effective flight crew co-ordination requires them to take into account the personalities of each other.
N	Valid	139	143	140	140	143
	Missing	4	0	3	3	0

Table 5.34: shows valid and missing value of teamwork factor

Item 28: It is better that the P-I-C and the F/O agree than to voice a different opinion.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	54	37.8	38.8	38.8
	Agree	48	33.6	34.5	73.4
	Neither Agree nor Disagree	22	15.4	15.8	89.2
	Disagree	13	9.1	9.4	98.6
	Strongly Disagree	2	1.4	1.4	100.0
	Total	139	97.2	100.0	
Missing	System	4	2.8		
Total		143	100.0		

Table 5.35: shows the average percentage of agreement

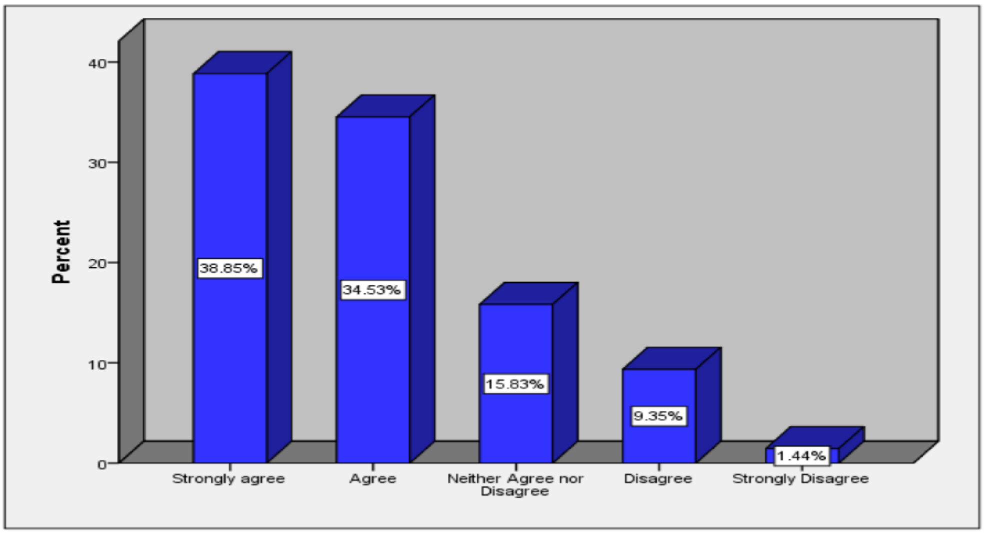

Figure 5.30: shows bar chart indicate the percentage's agreement

Item 29: Both pilots in the cockpit share responsibility for prioritising activities in high workload situations.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	76	53.1	53.1	53.1
	Agree	52	36.4	36.4	89.5
	Neither Agree nor Disagree	5	3.5	3.5	93.0
	Disagree	10	7.0	7.0	100.0
	Total	143	100.0	100.0	

Table 5.36: shows the average percentage of agreement

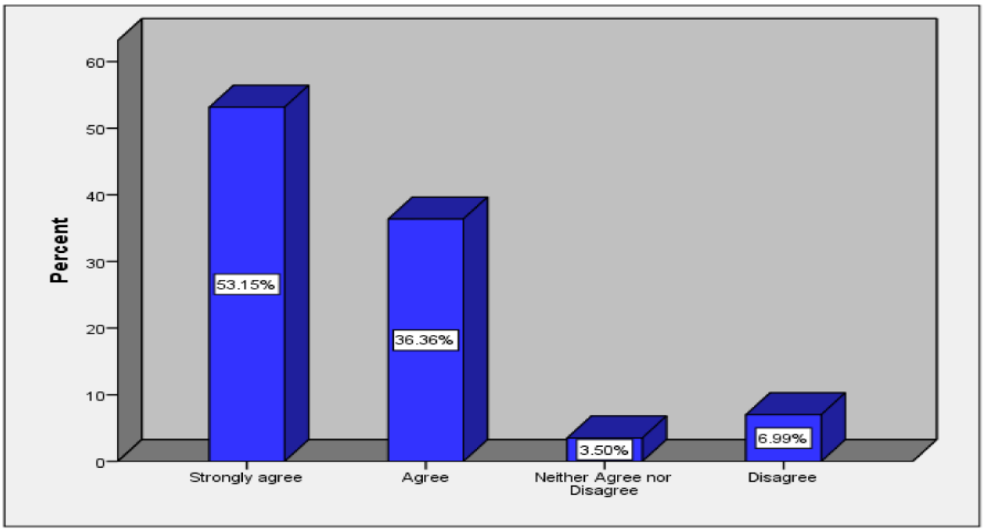

Figure 5.31: shows bar chart indicate the percentage's agreement

Item 30: I enjoy working as part of a team.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	76	53.1	54.3	54.3
	Agree	57	39.9	40.7	95.0
	Neither Agree nor Disagree	7	4.9	5.0	100.0
	Total	140	97.9	100.0	
Missing	System	3	2.1		
Total		143	100.0		

Table 5.37: shows the average percentage of agreement

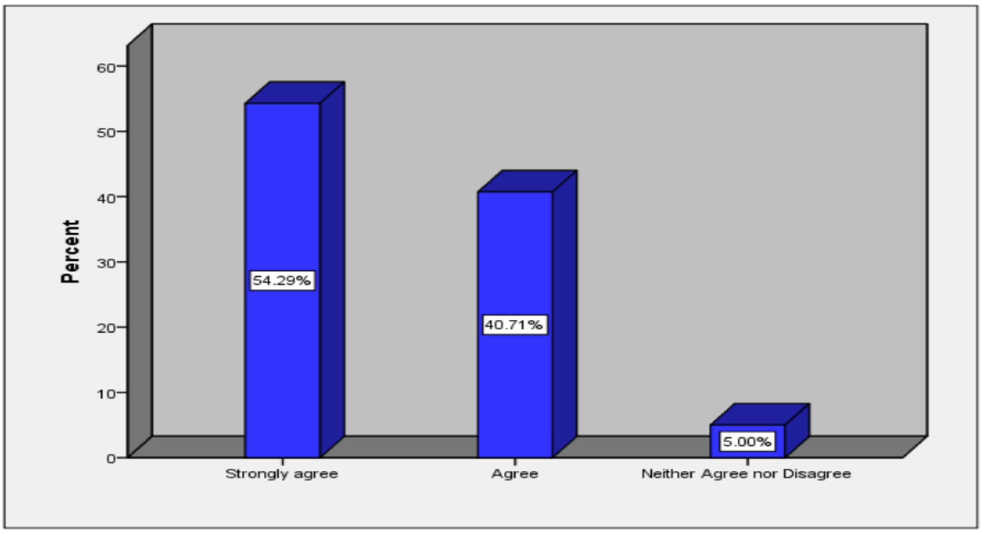

Figure 5.32: shows bar chart indicate the percentage's agreement

Item 31: All members of the cockpit are qualified to give feedback to each other.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	92	64.3	65.7	65.7
	Agree	39	27.3	27.9	93.6
	Neither Agree nor Disagree	9	6.3	6.4	100.0
	Total	140	97.9	100.0	
Missing	System	3	2.1		
Total		143	100.0		

Table 5.38: shows the average percentage of agreement

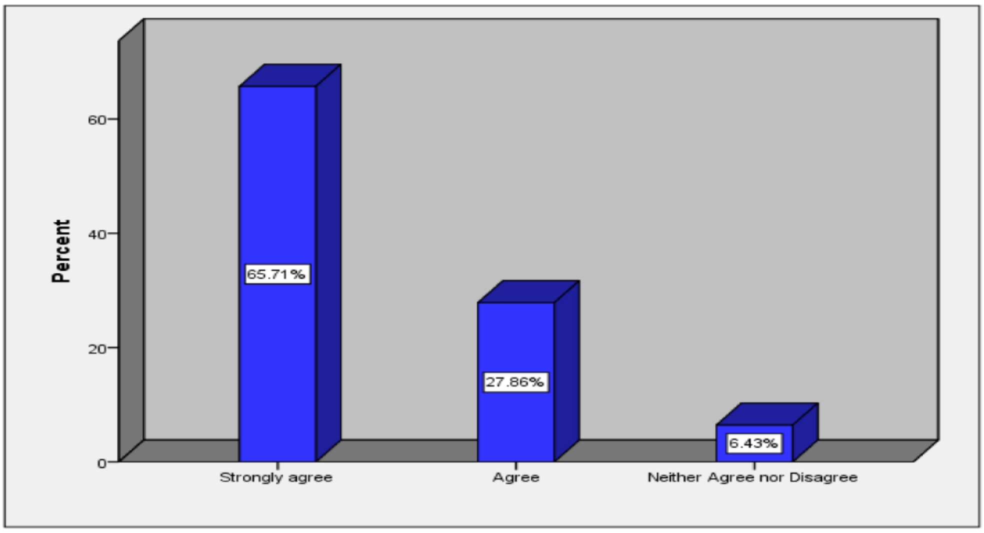

Figure 5.33: shows bar chart indicate the percentage's agreement

Item 32: Effective flight crew co-ordination requires them to take into account the personalities of each other.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	45	31.5	31.5	31.5
	Agree	67	46.9	46.9	78.3
	Neither Agree nor Disagree	17	11.9	11.9	90.2
	Disagree	12	8.4	8.4	98.6
	Strongly Disagree	2	1.4	1.4	100.0
	Total	143	100.0	100.0	

Table 5.39: shows the average percentage of agreement

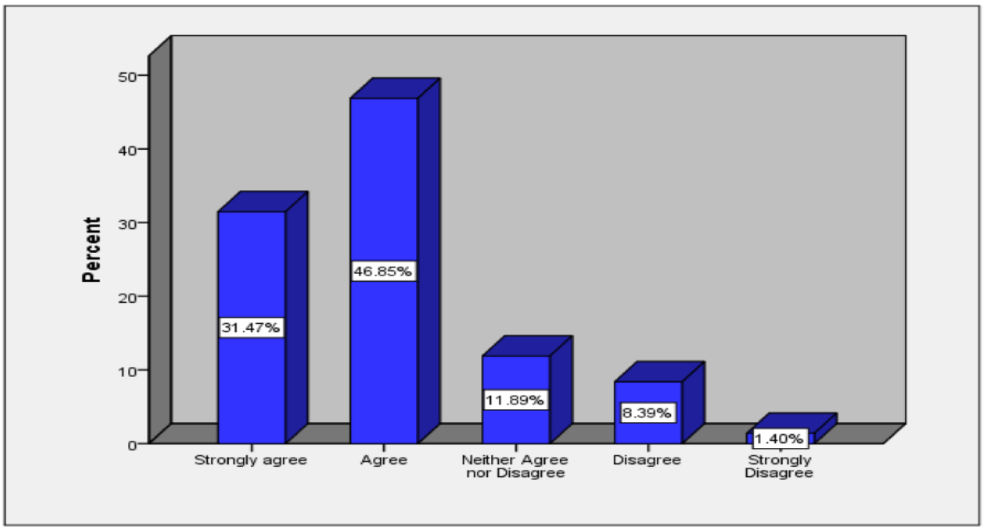

Figure 5.34: shows bar chart indicate the percentage's agreement

➢ Factor Seven: Work Values (items from 33 to 37)

		Captains deserve extra benefits and privileges.	As long as the job gets done, I don't care what others think of me.	A good reputation in the cockpit is important to me.	It is an insult to be forced to wait unnecessarily for other members of the flight crew.	In the cockpit, I get the respect that a person of my profession deserves.
N	Valid	142	143	141	143	143
	Missing	1	0	2	0	0

Table 5.40: shows valid and missing value of participants on Work Values factor questions.

Item 33: Captains deserve extra benefits and privileges.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	14	9.8	9.9	9.9
	Agree	52	36.4	36.6	46.5
	Neither Agree nor Disagree	40	28.0	28.2	74.6
	Disagree	36	25.2	25.4	100.0
	Total	142	99.3	100.0	
Missing	System	1	.7		
Total		143	100.0		

Table 5.41: shows the average percentage of agreement

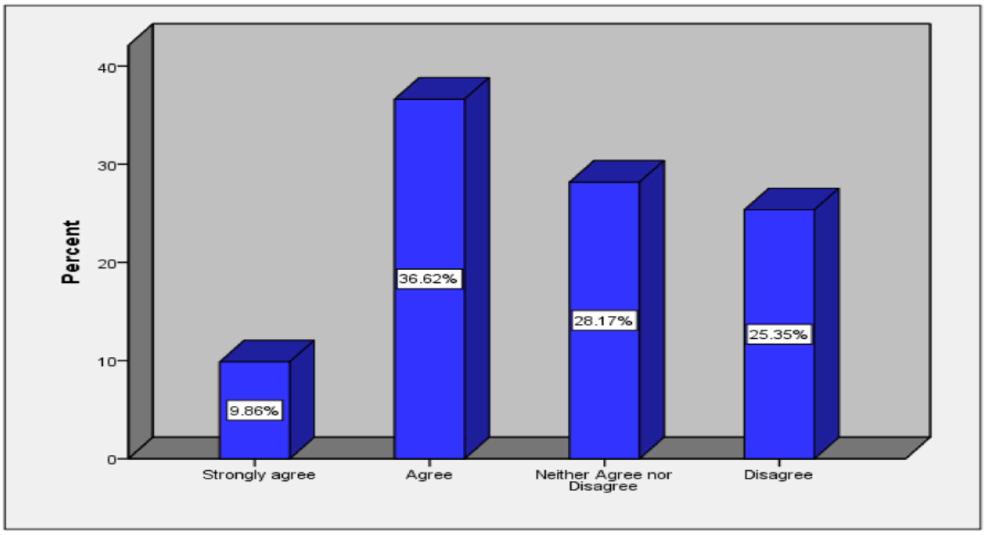

Figure 5.35: shows bar chart indicate the percentage's agreement.

Item 34: As long as the job gets done, I don't care what others think of me.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	85	59.4	59.4	59.4
	Agree	51	35.7	35.7	95.1
	Neither Agree nor Disagree	5	3.5	3.5	98.6
	Disagree	1	.7	.7	99.3
	Strongly Disagree	1	.7	.7	100.0
	Total	143	100.0	100.0	

Table 5.42: shows the average percentage of agreement

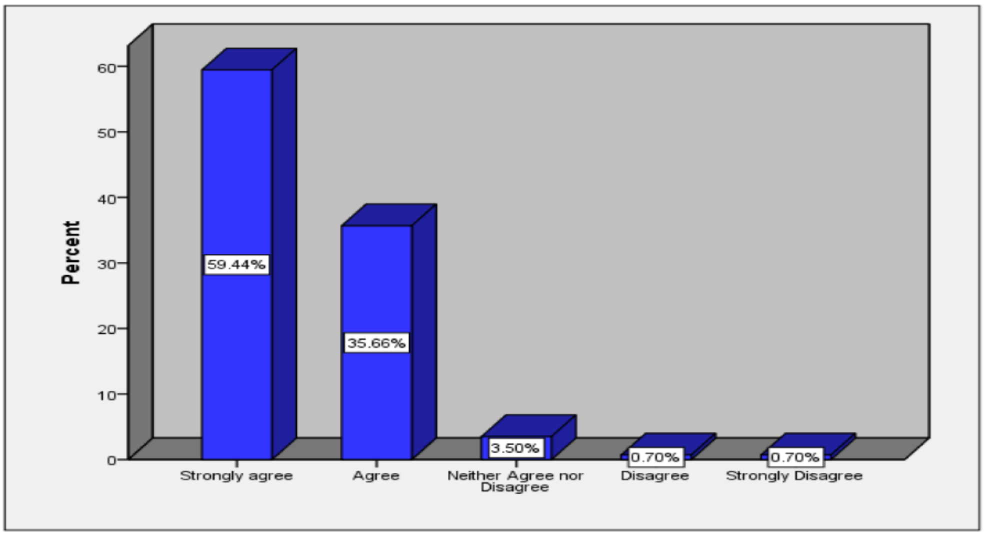

Figure 5.36: shows bar chart indicate the percentage's agreement

Item 35: A good reputation in the cockpit is important to me.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	67	46.9	47.5	47.5
	Agree	61	42.7	43.3	90.8
	Neither Agree nor Disagree	13	9.1	9.2	100.0
	Total	141	98.6	100.0	
Missing	System	2	1.4		
Total		143	100.0		

Table 5.43: shows the average percentage of agreement

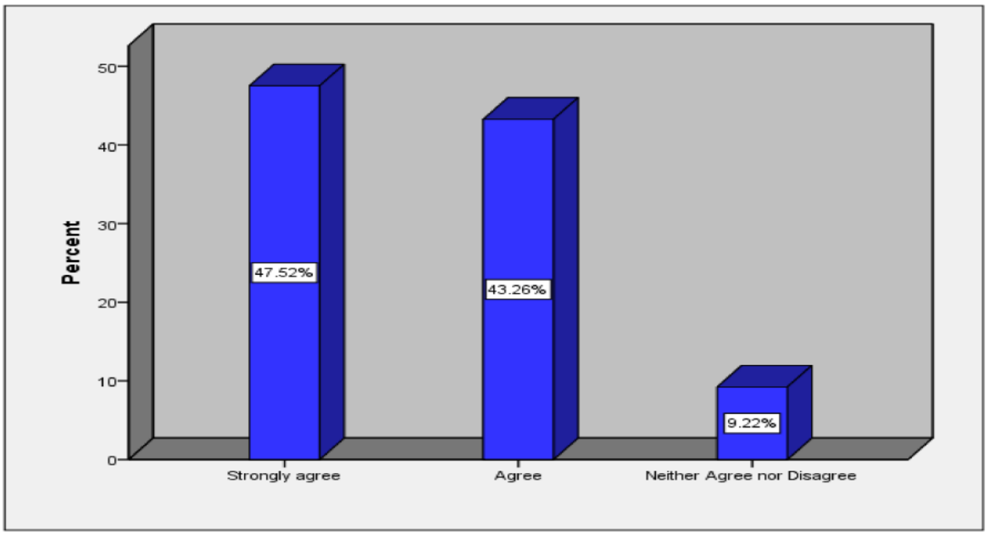

Figure 5.37: shows bar chart indicate the percentage's agreement

Item 36: It is an insult to be forced to wait unnecessarily for other members of the flight crew.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	19	13.3	13.3	13.3
	Agree	48	33.6	33.6	46.9
	Neither Agree nor Disagree	43	30.1	30.1	76.9
	Disagree	32	22.4	22.4	99.3
	Strongly Disagree	1	.7	.7	100.0
	Total	143	100.0	100.0	

Table 5.44: shows the average percentage of agreement

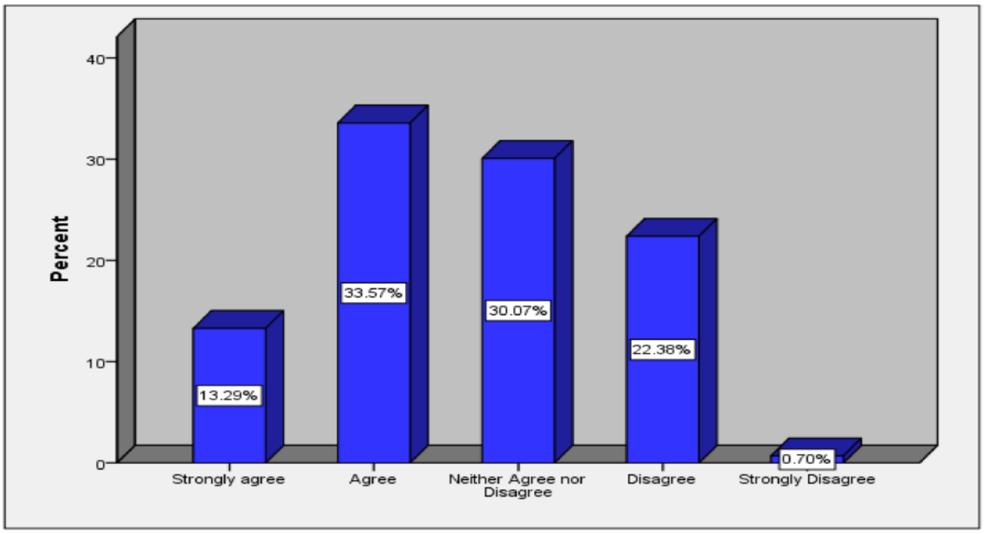

Figure 5.38: shows bar chart indicate the percentage's agreement

Item 37: In the cockpit, I get the respect that a person of my profession deserves.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	36	25.2	25.2	25.2
	Agree	78	54.5	54.5	79.7
	Neither Agree nor Disagree	25	17.5	17.5	97.2
	Disagree	2	1.4	1.4	98.6
	Strongly Disagree	2	1.4	1.4	100.0
	Total	143	100.0	100.0	

Table 5.45: shows the average percentage of agreement

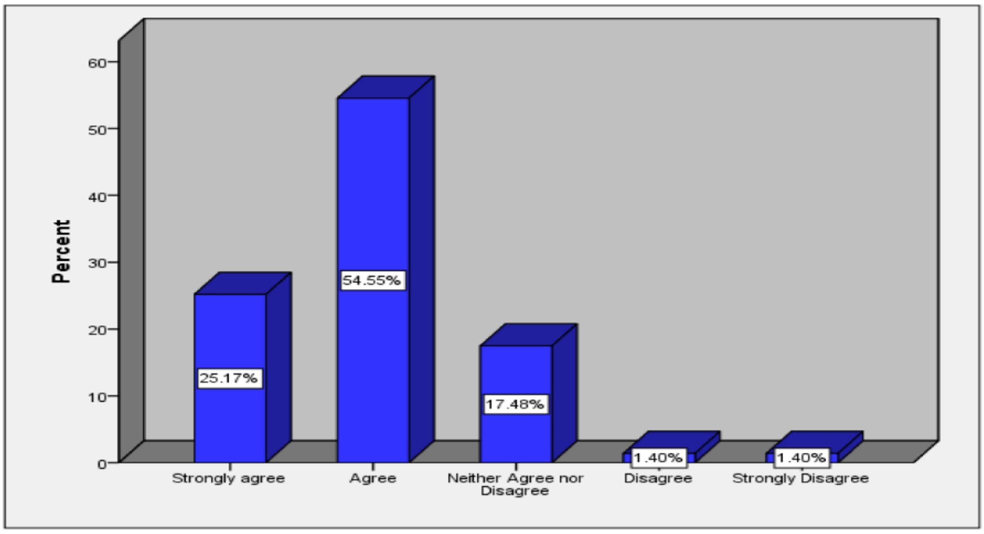

Figure 5.39: shows bar chart indicate the percentage's agreement

- **Factor eight: Error/ Procedural Compliance (items from 38 to 42)**

		Errors are a sign of incompetence.	I am ashamed when I make an error in front of other pilots.	Procedures and policies are strictly followed in our flight operation.	Errors are handled appropriately in this company.	Pilots frequently disregard rules or guidelines developed for our flight Operations.
N	Valid	143	143	143	133	141
	Missing	0	0	0	10	2

Table 5.46: valid and missing value of participants on Error/ Procedural Compliance

Item 38: Errors are a sign of incompetence.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	8	5.6	5.6	5.6
	Agree	29	20.3	20.3	25.9
	Neither Agree nor Disagree	27	18.9	18.9	44.8
	Disagree	72	50.3	50.3	95.1
	Strongly Disagree	7	4.9	4.9	100.0
	Total	143	100.0	100.0	

Table 5.47: shows the average percentage of agreement

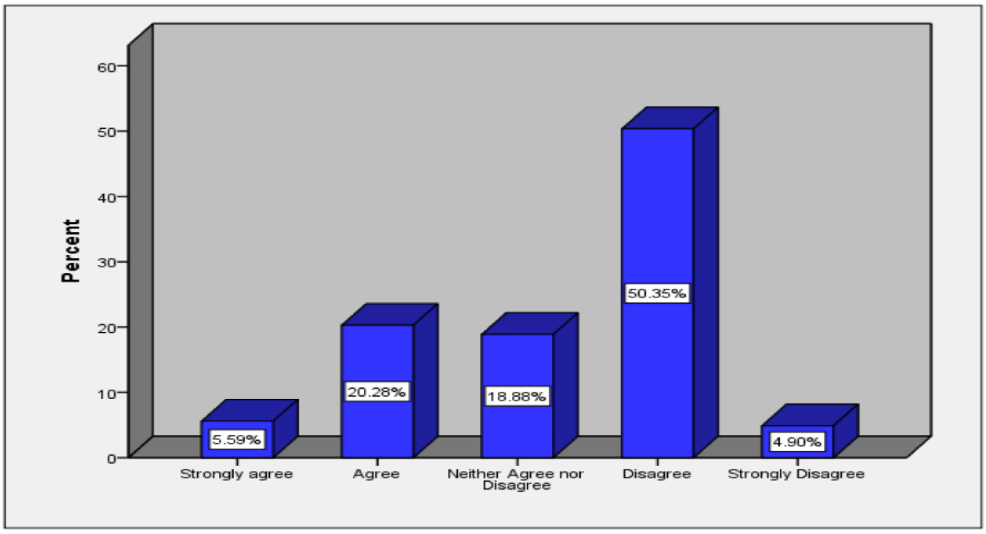

Figure 5.40: shows bar chart indicate the percentage's agreement

Item 39: I am ashamed when I make an error in front of other pilots.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	5	3.5	3.5	3.5
	Agree	53	37.1	37.1	40.6
	Neither Agree nor Disagree	17	11.9	11.9	52.4
	Disagree	68	47.6	47.6	100.0
	Total	143	100.0	100.0	

Table 5.48: shows the average percentage of agreement

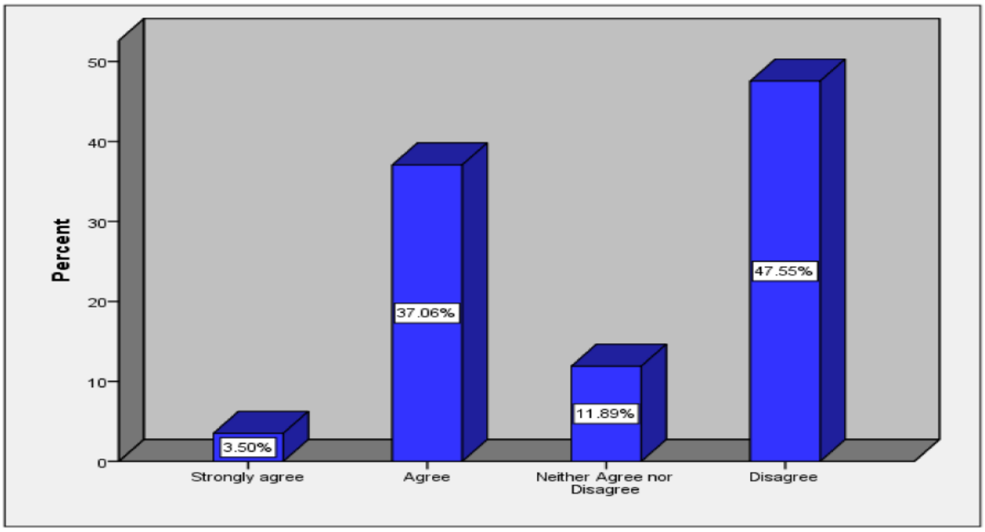

Figure 5.41: shows bar chart indicate the percentage's agreement

Item 40: Procedures and policies are strictly followed in our flight operation.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	25	17.5	17.5	17.5
	Agree	72	50.3	50.3	67.8
	Neither Agree nor Disagree	24	16.8	16.8	84.6
	Disagree	20	14.0	14.0	98.6
	Strongly Disagree	2	1.4	1.4	100.0
	Total	143	100.0	100.0	

Table 5.49: shows the average percentage of agreement

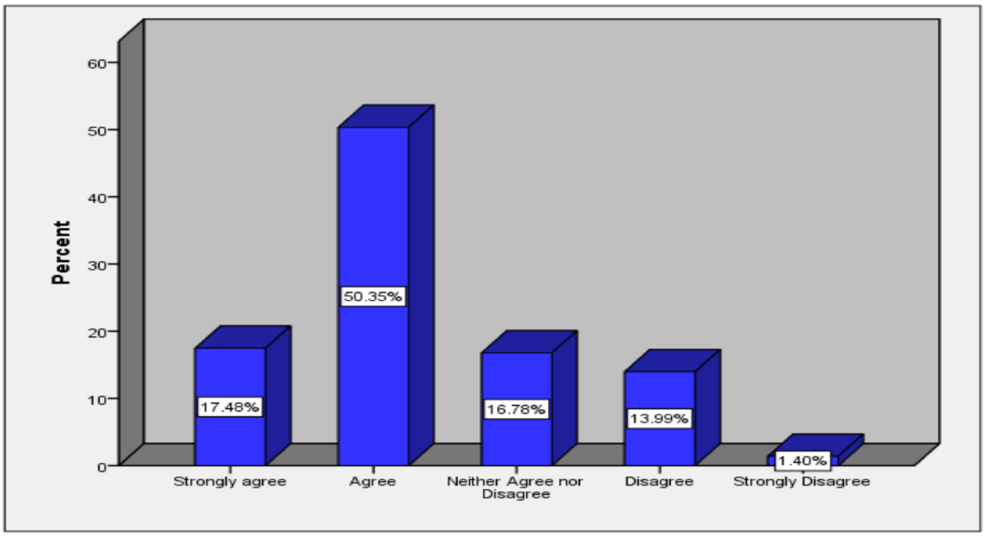

Figure 5.42: shows bar chart indicate the percentage's agreement

Item 41: Errors are handled appropriately in this company.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	24	16.8	18.0	18.0
	Agree	56	39.2	42.1	60.2
	Neither Agree nor Disagree	19	13.3	14.3	74.4
	Disagree	29	20.3	21.8	96.2
	Strongly Disagree	5	3.5	3.8	100.0
	Total	133	93.0	100.0	
Missing	System	10	7.0		
Total		143	100.0		

Table 5.50: shows the average percentage of agreement

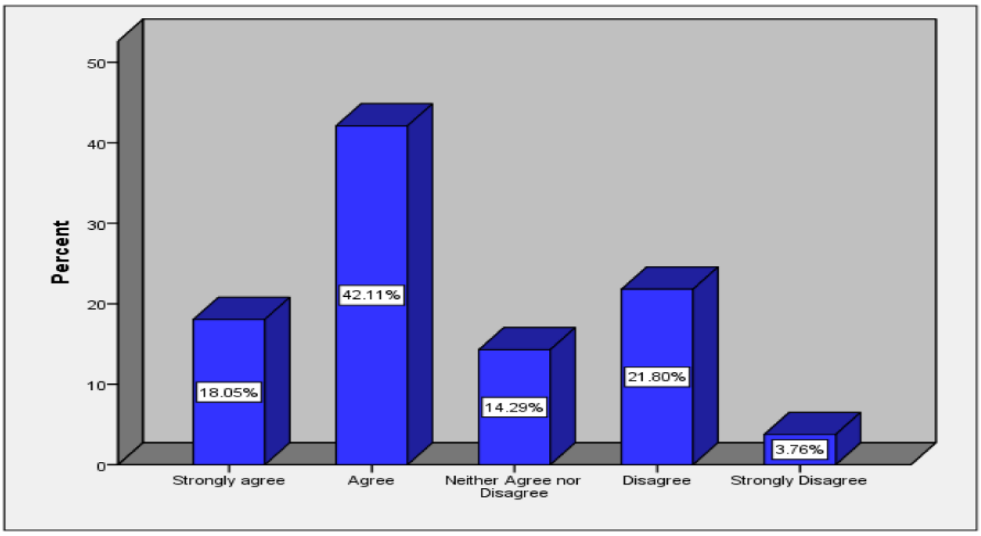

Figure 5.43: shows bar chart indicate the percentage's agreement

Item 42: Pilots frequently disregard rules or guidelines developed for our flight Operations.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	27	18.9	19.1	19.1
	Neither Agree nor Disagree	28	19.6	19.9	39.0
	Disagree	64	44.8	45.4	84.4
	Strongly Disagree	22	15.4	15.6	100.0
	Total	141	98.6	100.0	
Missing	System	2	1.4		
Total		143	100.0		

Table 5.51: shows the average percentage of agreement

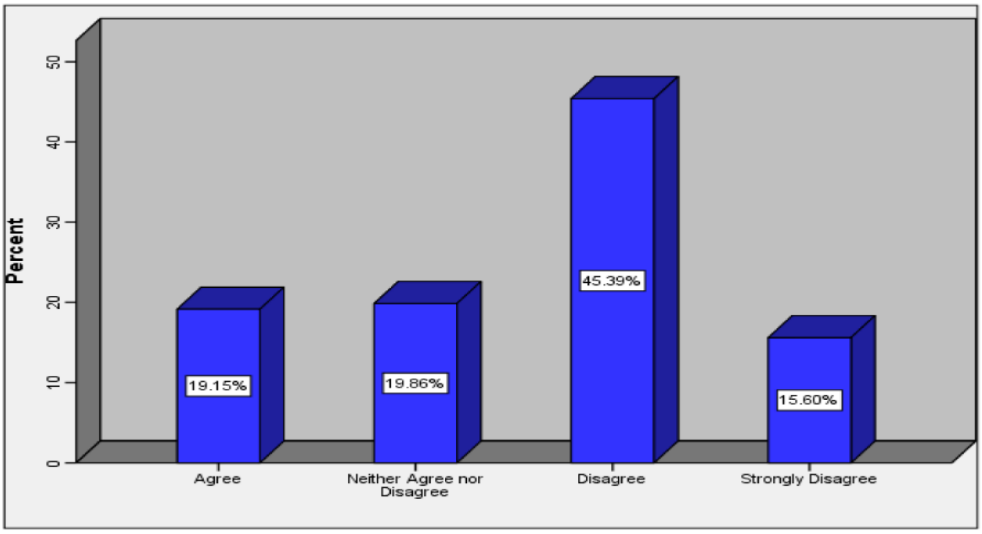

Figure 5.44: shows bar chart indicate the percentage's agreement

➢ Factor Nine: Organizational Climate (items from 43 to 46)

		The flight operation department listens to pilots about their concerns and keeps us up to date with all information which might affect our flight	Working in this company is like being a member of a large family.	I am provided with adequate training to successfully accomplish my job.	I am proud to work for this company.
N	Valid	141	143	141	143
	Missing	2	0	2	0

Table 5.52: shows valid and missing value of participants on Organizational Climate

Item 43: The flight operation department listens to pilots about their concerns and keeps us up to date with all information which might affect our flight

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	17	11.9	12.1	12.1
	Agree	81	56.6	57.4	69.5
	Neither Agree nor Disagree	12	8.4	8.5	78.0
	Disagree	25	17.5	17.7	95.7
	Strongly Disagree	6	4.2	4.3	100.0
	Total	141	98.6	100.0	
Missing	System	2	1.4		
Total		143	100.0		

Table 5.53: shows the average percentage of agreement

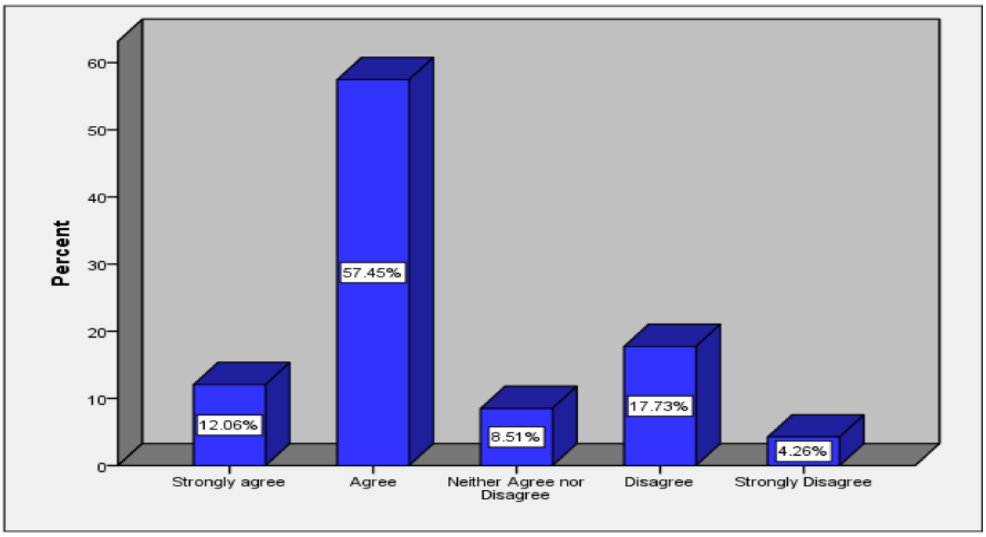

Figure 5.45: shows bar chart indicate the percentage's agreement

Item 44: Working in this company is like being a member of a large family.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	40	28.0	28.0	28.0
	Agree	64	44.8	44.8	72.7
	Neither Agree nor Disagree	21	14.7	14.7	87.4
	Disagree	15	10.5	10.5	97.9
	Strongly Disagree	3	2.1	2.1	100.0
	Total	143	100.0	100.0	

Table 5.54: shows the average percentage of agreement

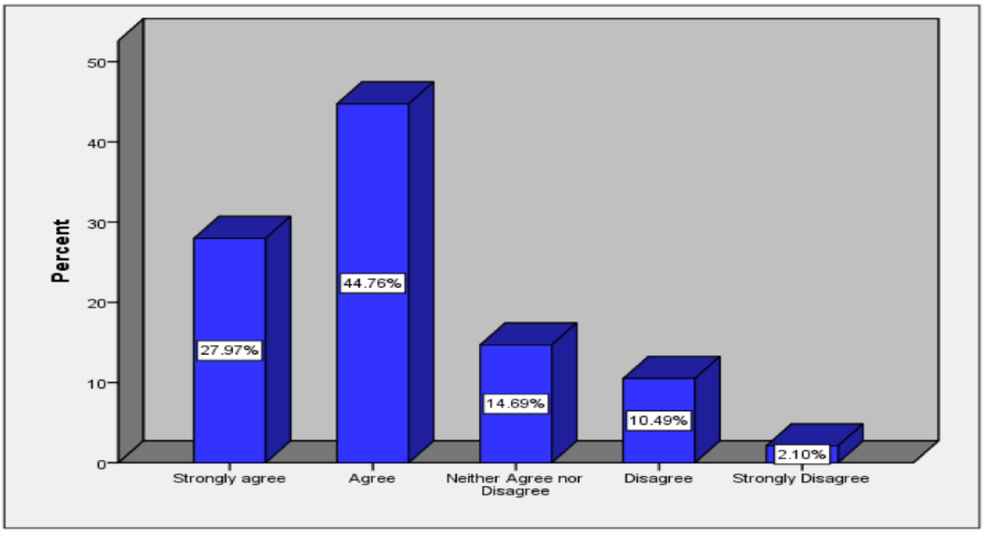

Figure 5.46: shows bar chart indicate the percentage's agreement

Item 45: I am provided with adequate training to successfully accomplish my job.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	58	40.6	41.1	41.1
	Agree	63	44.1	44.7	85.8
	Neither Agree nor Disagree	12	8.4	8.5	94.3
	Disagree	7	4.9	5.0	99.3
	Strongly Disagree	1	.7	.7	100.0
	Total	141	98.6	100.0	
Missing	System	2	1.4		
Total		143	100.0		

Table 5.55: shows the average percentage of agreement

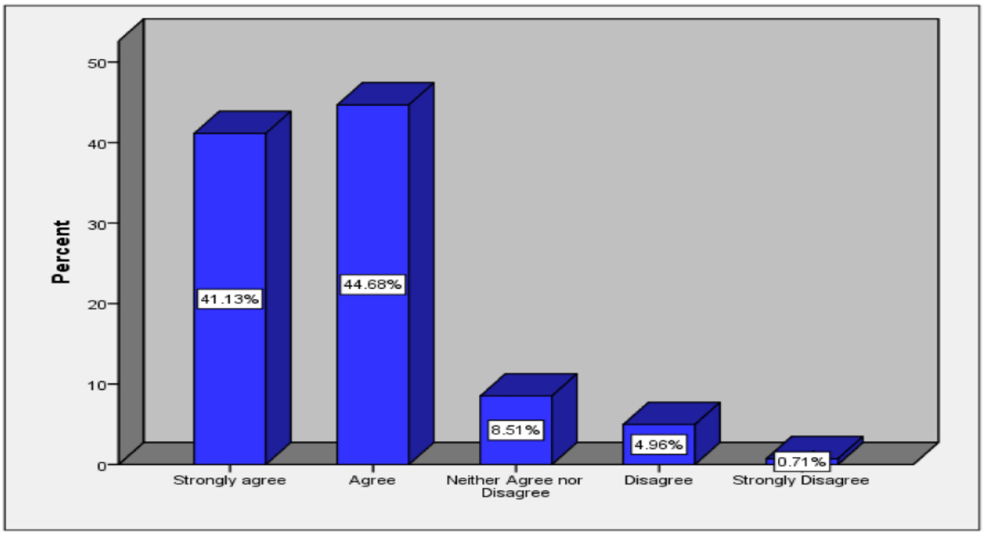

Figure 5.47: shows bar chart indicate the percentage's agreement

Item 46: I am proud to work for this company.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	59	41.3	41.3	41.3
	Agree	52	36.4	36.4	77.6
	Neither Agree nor Disagree	22	15.4	15.4	93.0
	Disagree	10	7.0	7.0	100.0
	Total	143	100.0	100.0	

Table 5.56: shows the average percentage of agreement

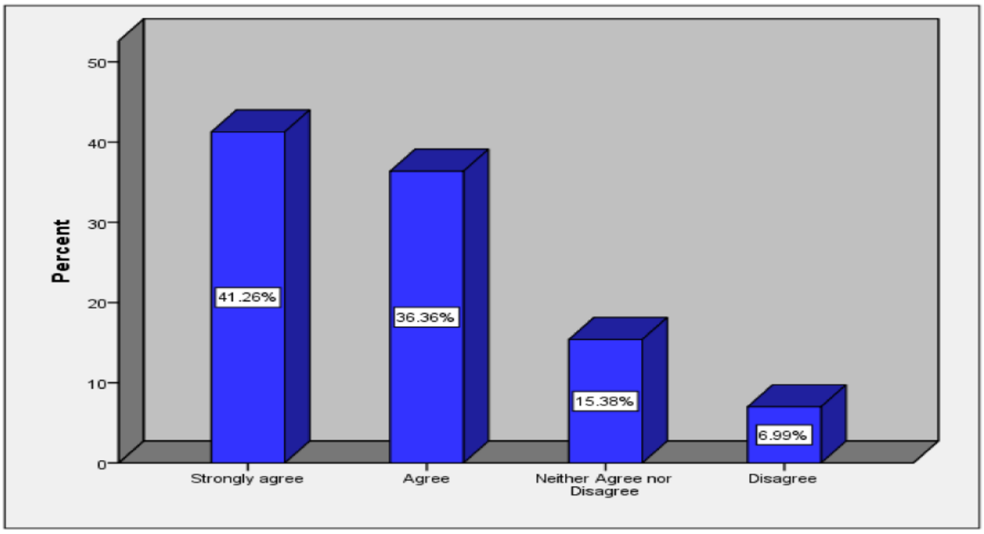

Figure 5.48: shows bar chart indicate the percentage's agreement

THEME THREE: Systems Design & Automation findings

➢ Factor 10: Systems Design & Automation (items from 47 to 52)

		I always know what the other pilot is doing with the automated systems.	It is easy to detect when incorrect data has been entered by error.	They've gone too far with automation.	With automation there are still some things that take me by surprise.	I sometimes find it hard to understand the language or technical jargon in messages presented by the FMC/FMGS.	Incorrect data entered by error in automated systems is easily corrected.
N	Valid	142	143	142	143	143	142
	Missing	1	0	1	0	0	1

Table 5.57: shows valid and missing value of participants on System design and automation

Item 47: I always know what the other pilot is doing with the automated systems.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	34	23.8	23.9	23.9
	Agree	90	62.9	63.4	87.3
	Neither Agree nor Disagree	13	9.1	9.2	96.5
	Disagree	5	3.5	3.5	100.0
	Total	142	99.3	100.0	
Missing	System	1	.7		
Total		143	100.0		

Table 5.58: shows the average percentage of agreement

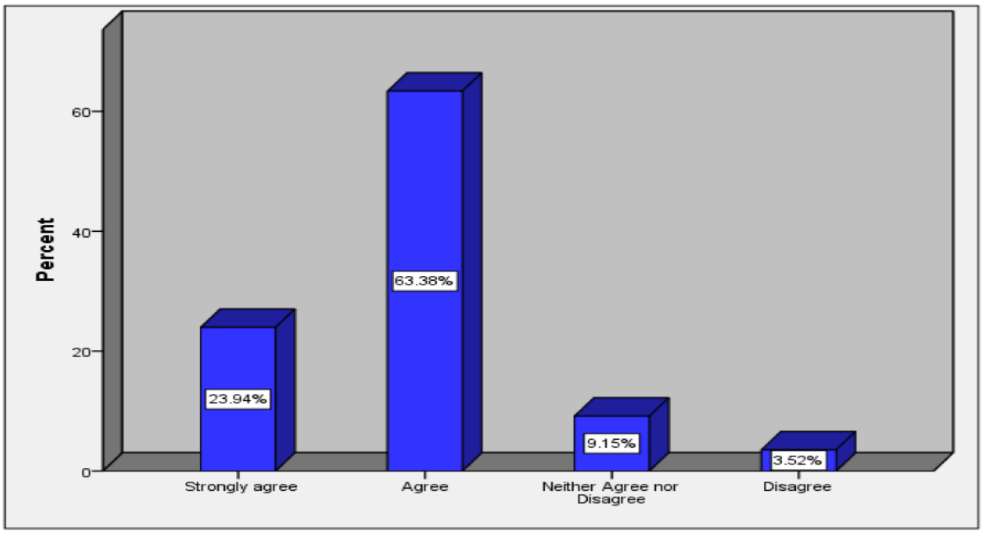

Figure 5.49: shows bar chart indicate the percentage's agreement

Item 48: It is easy to detect when incorrect data has been entered by error.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	16	11.2	11.2	11.2
	Agree	86	60.1	60.1	71.3
	Neither Agree nor Disagree	28	19.6	19.6	90.9
	Disagree	13	9.1	9.1	100.0
	Total	143	100.0	100.0	

Table 5.59: shows the average percentage of agreement

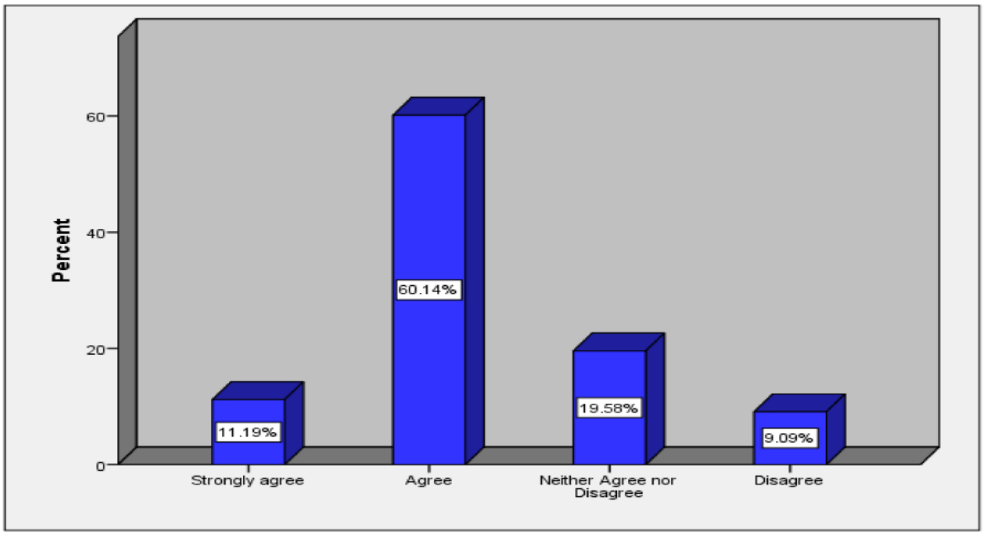

Figure 5.50: shows bar chart indicate the percentage's agreement

Item 49: They've gone too far with automation.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	49	34.3	34.5	34.5
	Agree	60	42.0	42.3	76.8
	Neither Agree nor Disagree	30	21.0	21.1	97.9
	Disagree	3	2.1	2.1	100.0
	Total	142	99.3	100.0	
Missing	System	1	.7		
Total		143	100.0		

Table 5.60: shows the average percentage of agreement

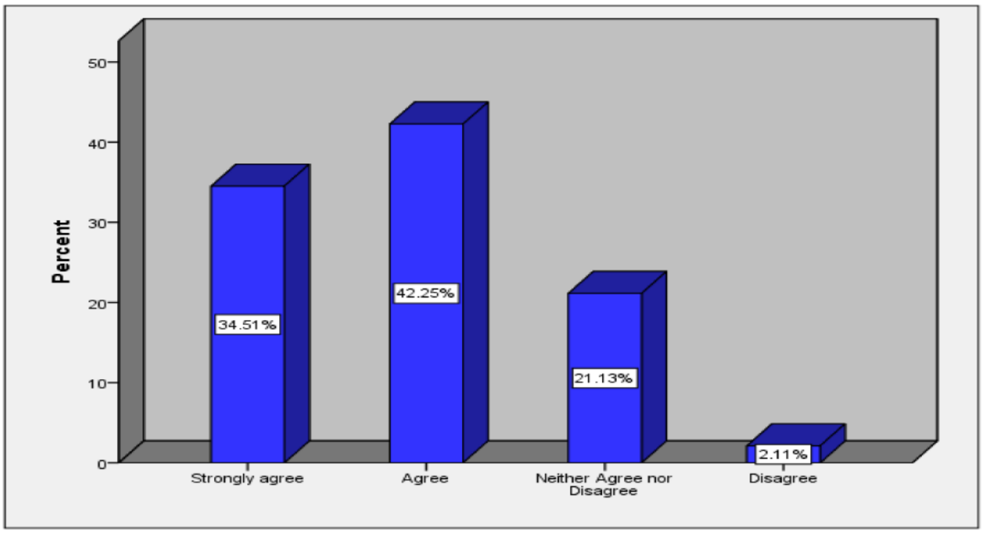

Figure 5.51: shows bar chart indicate the percentage's agreement

Item 50- With automation there are still some things that take me by surprise.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	13	9.1	9.1	9.1
	Agree	79	55.2	55.2	64.3
	Neither Agree nor Disagree	25	17.5	17.5	81.8
	Disagree	26	18.2	18.2	100.0
	Total	143	100.0	100.0	

Table 5.61: shows the average percentage of agreement

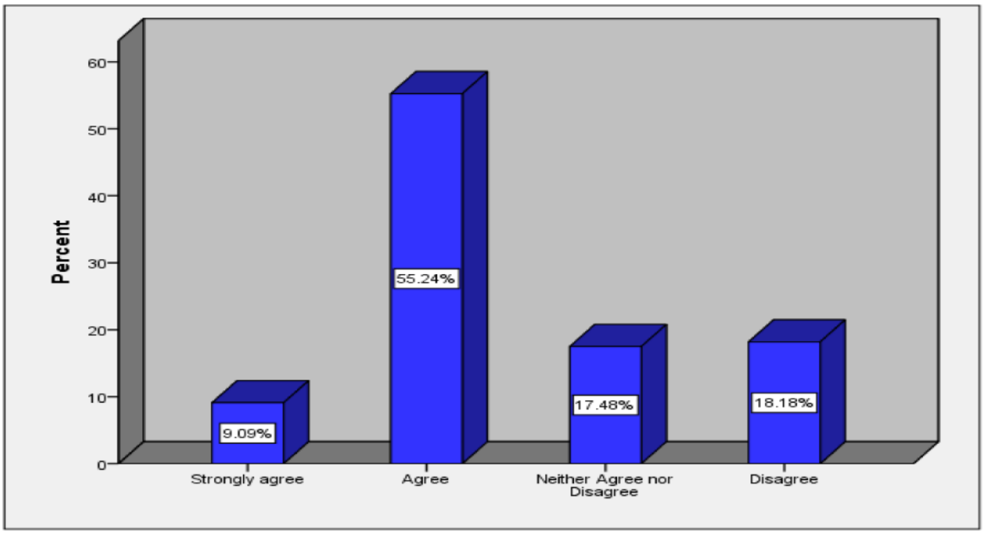

Figure 5.52: shows bar chart indicate the percentage's agreement

Item 51- I sometimes find it hard to understand the language or technical jargon in messages presented by the FMC/FMGS.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	42	29.4	29.4	29.4
	Neither Agree nor Disagree	34	23.8	23.8	53.1
	Disagree	60	42.0	42.0	95.1
	Strongly Disagree	7	4.9	4.9	100.0
	Total	143	100.0	100.0	

Table 5.62: shows the average percentage of agreement

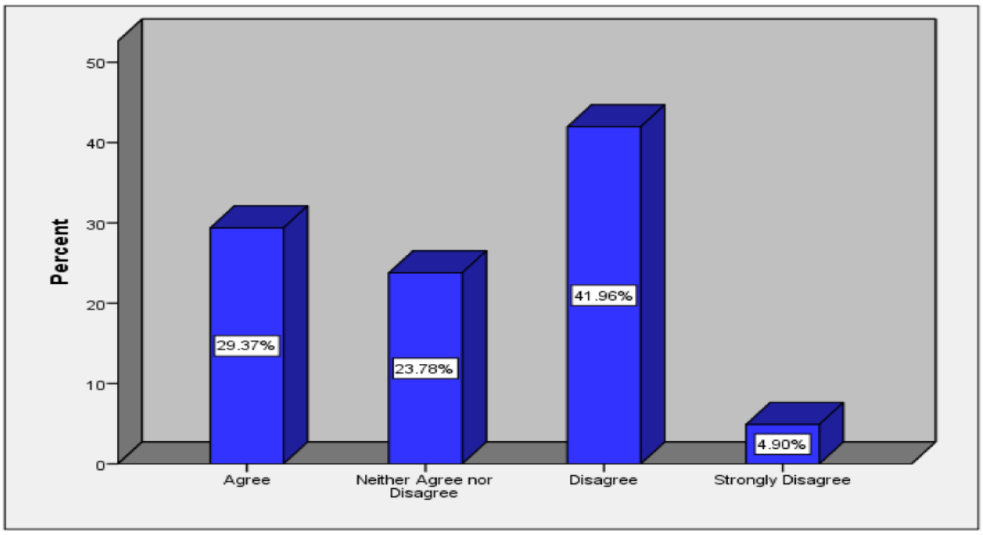

Figure 5.53: shows bar chart indicate the percentage's agreement

Item 52- Incorrect data entered by error in automated systems is easily corrected.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	17	11.9	12.0	12.0
	Agree	97	67.8	68.3	80.3
	Neither Agree nor Disagree	25	17.5	17.6	97.9
	Disagree	3	2.1	2.1	100.0
	Total	142	99.3	100.0	
Missing	System	1	.7		
Total		143	100.0		

Table 5.63: shows the average percentage of agreement

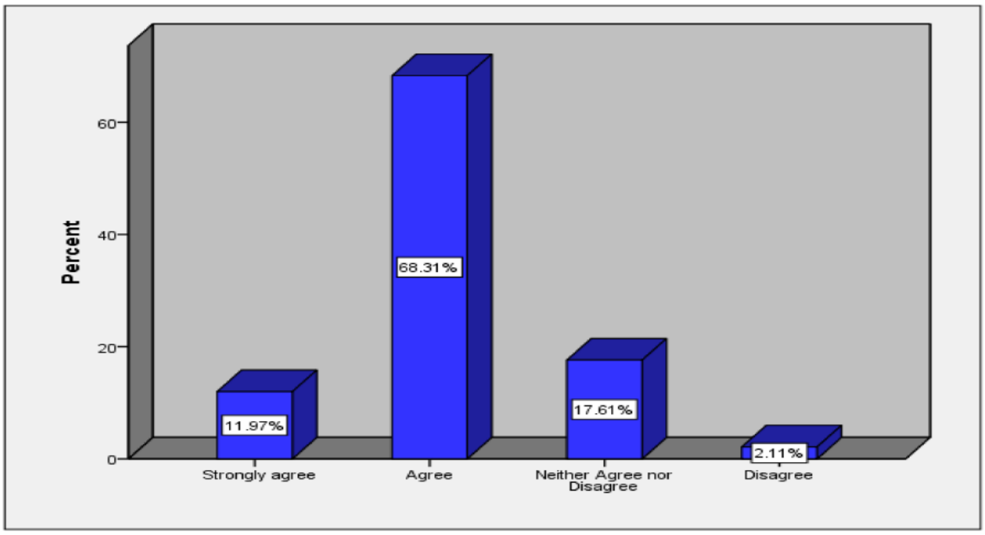

Figure 5.54: shows bar chart indicate the percentage's agreement

THEME FOUR: Risk Perception findings

- **Hunter risk perception scale 2– (Self scale)**

		Fly a traffic pattern so that you end up turning for final with about a 30 degree bank	Fly a traffic pattern so that you end up turning for final with about a 45 degree bank.	During the daytime, take a cross-country flight in which you land with 30 minutes of fuel remaining.	At night, following a cross-country route, you landed with over an hour of fuel remaining.	At night, take a cross-country flight in which you land with 30 minutes of fuel remaining.
N	Valid	143	143	143	143	143
	Missing	0	0	0	0	0
Mean		39.51	58.32	48.81	49.16	38.25
Median		40.00	60.00	50.00	50.00	40.00
Std. Deviation		15.489	16.444	20.052	11.475	16.112
Minimum		10	30	10	30	10
Maximum		70	90	90	70	70

Table 5.64: summary of Hunter's risk perception scale 2 (Self scale)

Item 53- Fly a traffic pattern so that you end up turning for final with about a 30 degree bank.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	10	8	5.6	5.6	5.6
	20	20	14.0	14.0	19.6
	30	27	18.9	18.9	38.5
	40	36	25.2	25.2	63.6
	Medium risk	27	18.9	18.9	82.5
	60	18	12.6	12.6	95.1
	70	7	4.9	4.9	100.0
	Total	143	100.0	100.0	

Table 5.65: shows the participant's risk perception level

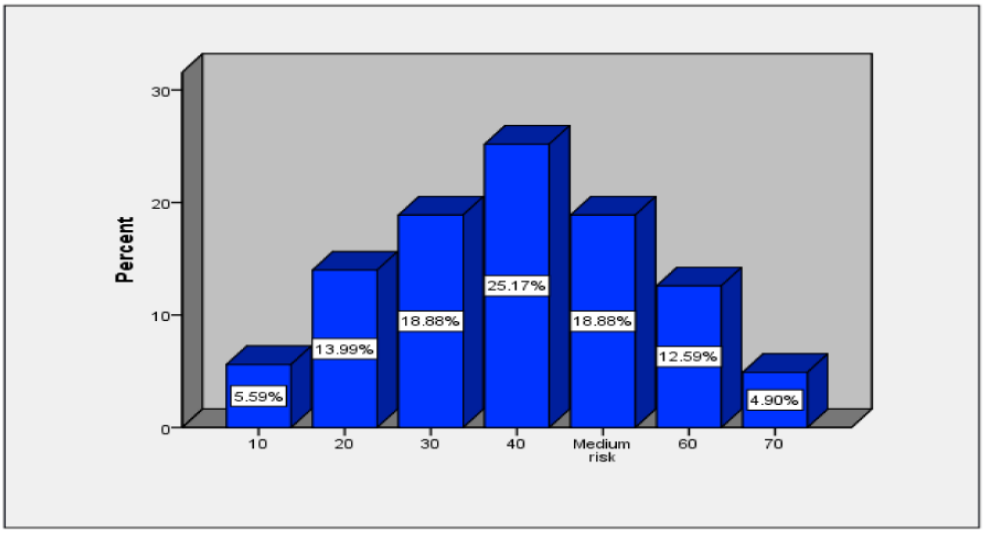

Figure 5.54: shows bar chart indicate the participant's risk perception level

Item 54: Fly a traffic pattern so that you end up turning for final with about a 45 degree bank

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	30	13	9.1	9.1	9.1
	40	19	13.3	13.3	22.4
	Medium risk	28	19.6	19.6	42.0
	60	35	24.5	24.5	66.4
	70	25	17.5	17.5	83.9
	80	13	9.1	9.1	93.0
	90	10	7.0	7.0	100.0
	Total	143	100.0	100.0	

Table 5.66: shows the participant's risk perception level

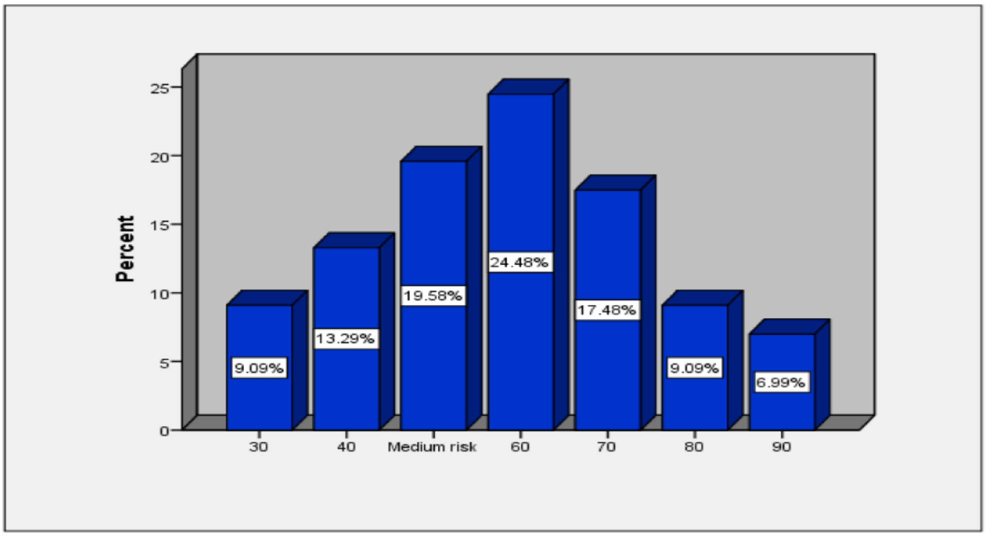

Figure 5.55: shows bar chart indicate the participant's risk perception level

Item 55: During the daytime, take a cross-country flight in which you land with 30 minutes of fuel remaining.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	10	7	4.9	4.9	4.9
	20	12	8.4	8.4	13.3
	30	18	12.6	12.6	25.9
	40	24	16.8	16.8	42.7
	Medium risk	26	18.2	18.2	60.8
	60	25	17.5	17.5	78.3
	70	15	10.5	10.5	88.8
	80	12	8.4	8.4	97.2
	90	4	2.8	2.8	100.0
	Total	143	100.0	100.0	

Table 5.67: shows the participant's risk perception level

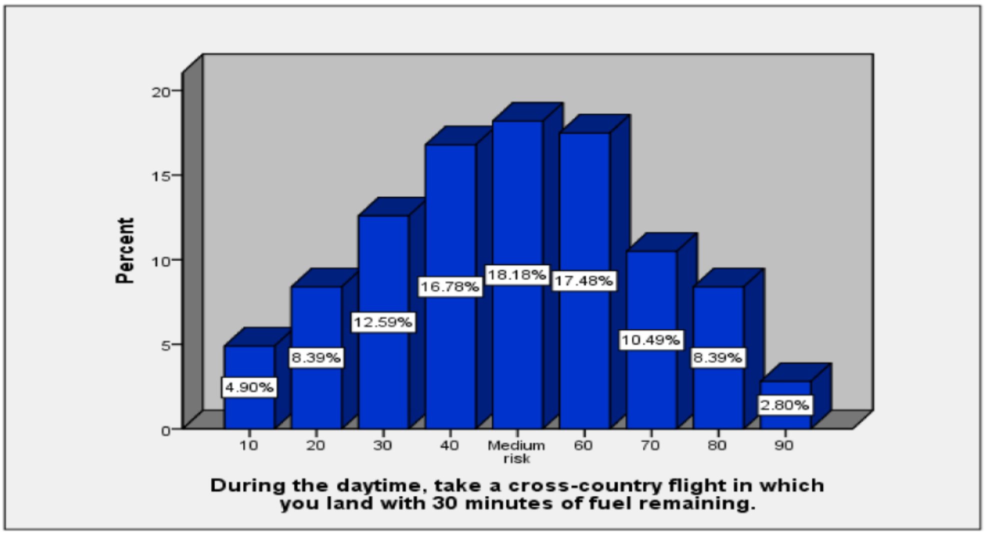

Figure 5.56: shows bar chart indicate the participant's risk perception level

Item 56: At night, following a cross-country route, you landed with over an hour of fuel remaining.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	30	16	11.2	11.2	11.2
	40	36	25.2	25.2	36.4
	Medium risk	51	35.7	35.7	72.0
	60	24	16.8	16.8	88.8
	70	16	11.2	11.2	100.0
	Total	143	100.0	100.0	

Table 5.68: shows the participant's risk perception level

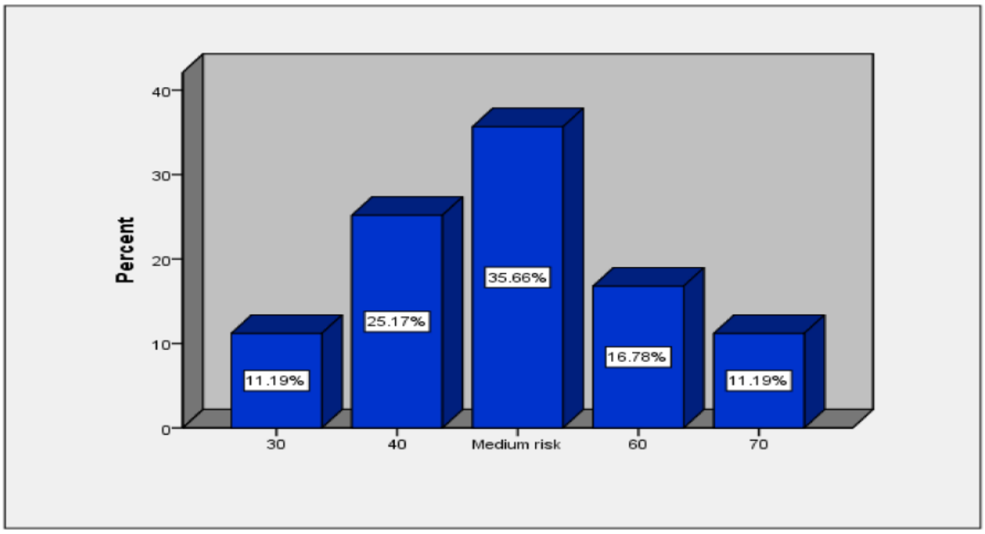

Figure 5.57: shows bar chart indicate the participant's risk perception level

Item 57: At night, take a cross-country flight in which you land with 30 minutes of fuel remaining.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	10	11	7.7	7.7	7.7
	20	18	12.6	12.6	20.3
	30	35	24.5	24.5	44.8
	40	34	23.8	23.8	68.5
	Medium risk	21	14.7	14.7	83.2
	60	14	9.8	9.8	93.0
	70	10	7.0	7.0	100.0
	Total	143	100.0	100.0	

Table 5.69: shows the participant's risk perception level

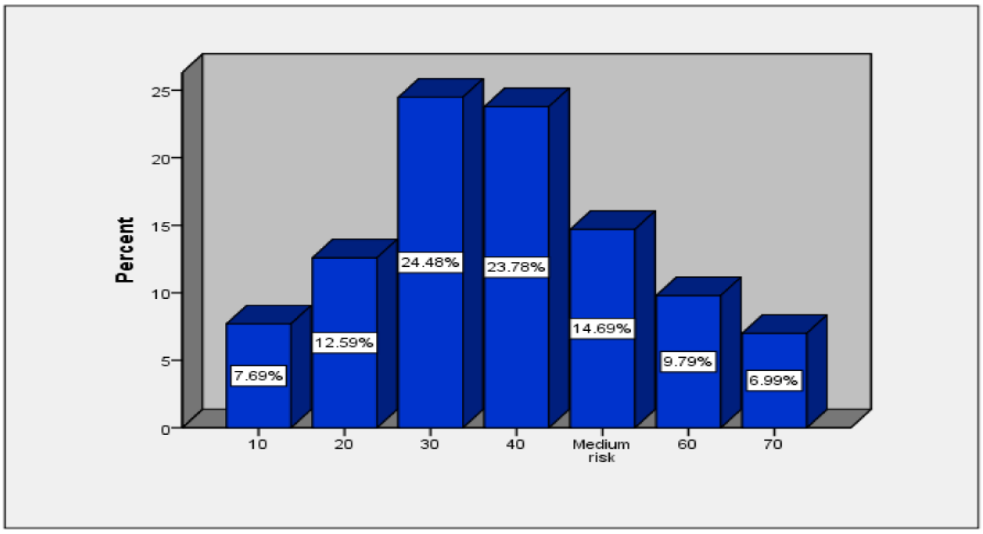

Figure 5.58: shows bar chart indicate the participant's risk perception level

➢ Hunter risk perception scale 1– (Other)

		On the short final the P-I-C drops his microphone on the floor. He looks down while bending over trying to reach it. He inadvertently moves the control column and the aircraft banks sharply.	During the planning for a 2 hour cross-country flight, a pilot makes a mistake in computing the fuel consumption. He believes that he will have over an hour of fuel remaining upon arrival, but he will really only have about 15 minutes of fuel left.	The pilot is in a hurry to get going and does not carefully check his seat, seat belt, and shoulder harness. When he rotates, the seat moves backward on its tracks. As it slides backward, the pilot pulls back on the control column, sending the nose of the	Low ceilings obscure the tops of the mountains, but the pilot thinks that he can see through the pass to clear sky on the other side of the mountain ridges. He starts up the wide valley that gradually gets narrower. As he approaches the pass he notices th	A line of thunderstorms block the route of flight, but a pilot sees that there is a space of about 10 miles between two of the cells. He can see all the way to clear sky on the other side of the thunderstorm line, and there does not seem to be any precipi
N	Valid	143	143	143	143	143
	Missing	0	0	0	0	0
Mean		76.85	80.77	79.58	89.72	80.77
Median		80.00	80.00	80.00	90.00	80.00
Std. Deviation		16.029	11.693	10.200	8.797	12.676
Minimum		40	60	60	70	60
Maximum		100	100	100	100	100

Table 5.70: show summary of Hunter's risk perception scale 1 (Other).

Item 58: On the short final the P-I-C drops his microphone on the floor. He looks down while bending over trying to reach it. He inadvertently moves the control column and the aircraft banks sharply.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	40	10	7.0	7.0	7.0
	60	20	14.0	14.0	21.0
	70	32	22.4	22.4	43.4
	80	34	23.8	23.8	67.1
	90	27	18.9	18.9	86.0
	High risl	20	14.0	14.0	100.0
	Total	143	100.0	100.0	

Table 5.71: shows the participant's risk perception level

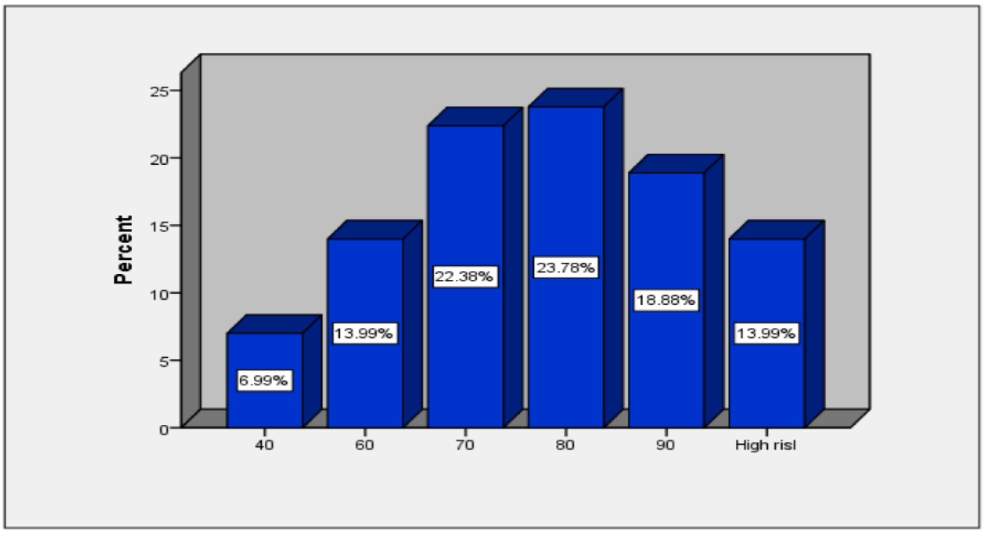

Figure 5.57: shows bar chart indicate the participant's risk perception level

Item 59: During the planning for a 2 hour cross-country flight, a pilot makes a mistake in computing the fuel consumption. He believes that he will have over an hour of fuel remaining upon arrival, but he will really only have about 15 minutes of fuel left

.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	60	15	10.5	10.5	10.5
	70	29	20.3	20.3	30.8
	80	47	32.9	32.9	63.6
	90	34	23.8	23.8	87.4
	High risl	18	12.6	12.6	100.0
	Total	143	100.0	100.0	

Table 5.72: shows the participant's risk perception level

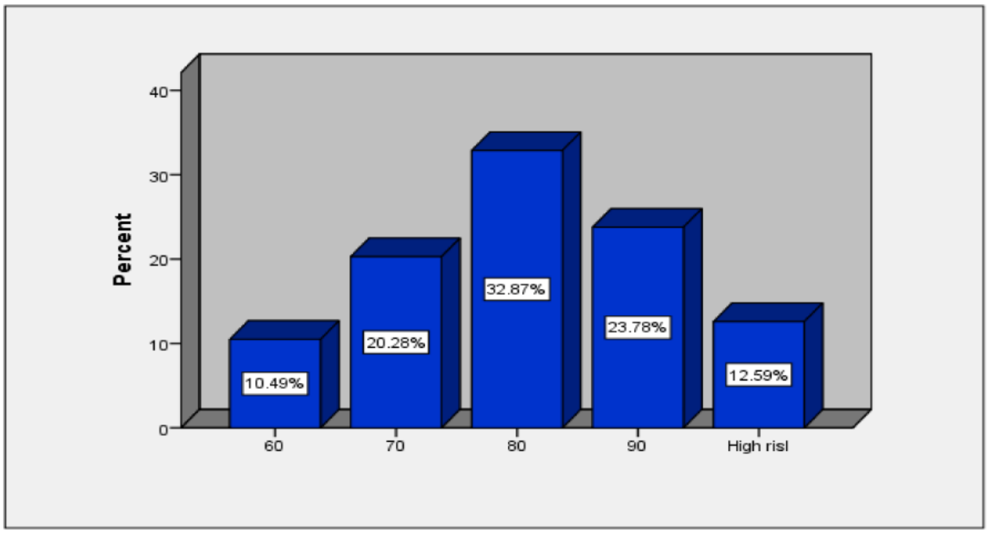

Figure 5.58: shows bar chart indicate the participant's risk perception level

Item 60: The pilot is in a hurry to get going and does not carefully check his seat, seat belt, and shoulder harness. When he rotates, the seat moves backward on its tracks. As it slides backward, the pilot pulls back on the control column, sending the nose of the aircraft upward. As the airspeed begins to decay, he strains forward to push the column back to a neutral position.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	60	10	7.0	7.0	7.0
	70	36	25.2	25.2	32.2
	80	58	40.6	40.6	72.7
	90	28	19.6	19.6	92.3
	High risl	11	7.7	7.7	100.0
	Total	143	100.0	100.0	

Table 5.73: shows the participant's risk perception level

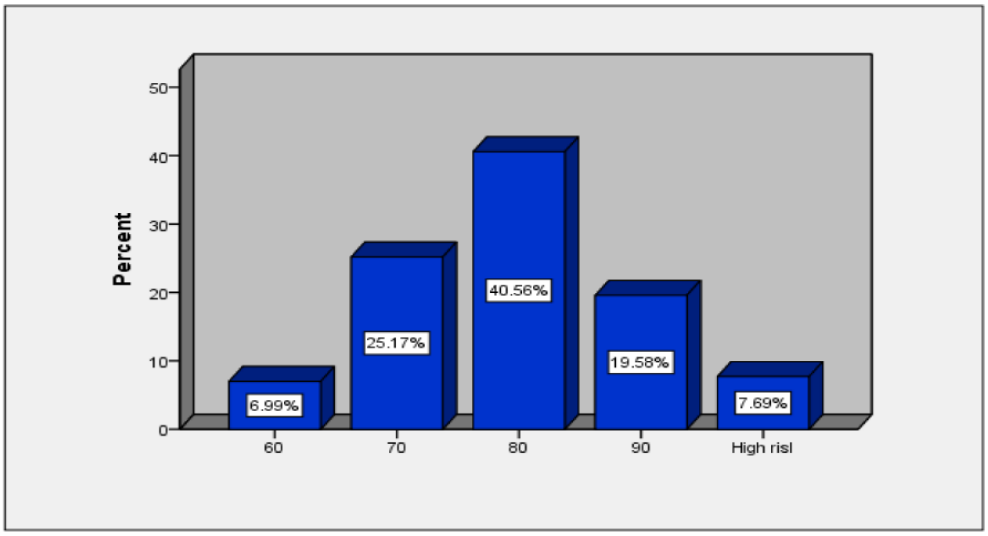

Figure 5.59: shows bar chart indicate the participant's risk perception level

Item 61: Low ceilings obscure the tops of the mountains, but the pilot thinks that he can see through the pass to clear sky on the other side of the mountain ridges. He starts up the wide valley that gradually gets narrower. As he approaches the pass he notices that he occasionally loses sight of the blue sky on the other side. He drops down closer to the road leading through the pass and presses on. As he goes through the pass, the ceiling continues to drop and he finds himself suddenly in the clouds. He holds his heading and altitude and hopes for the best.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	70	9	6.3	6.3	6.3
	80	30	21.0	21.0	27.3
	90	60	42.0	42.0	69.2
	High risl	44	30.8	30.8	100.0
	Total	143	100.0	100.0	

Table 5.74: shows the participant's risk perception level

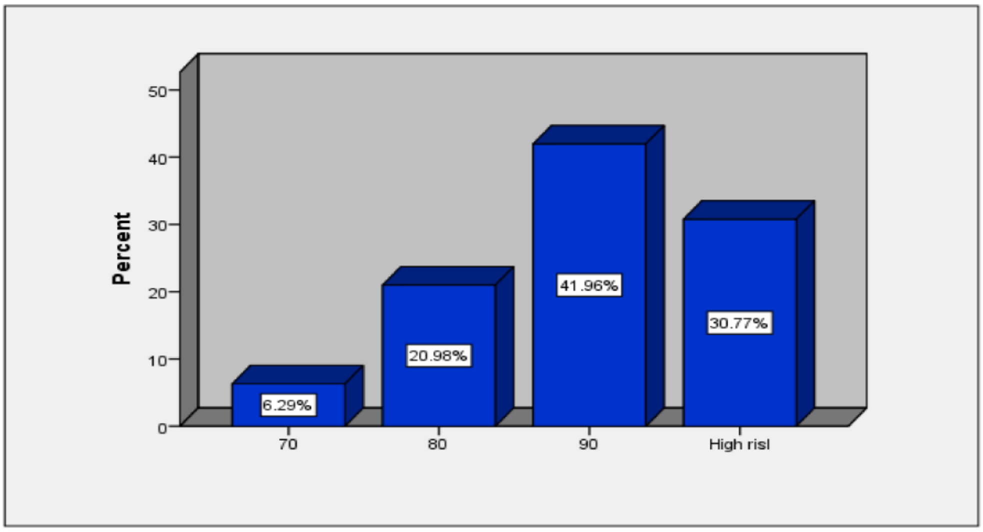

Figure 5.60: shows bar chart indicate the participant's risk perception level

Item 62: A line of thunderstorms block the route of flight, but a pilot sees that there is a space of about 10 miles between two of the cells. He can see all the way to clear sky on the other side of the thunderstorm line, and there does not seem to be any precipitation along the route, although it does go under the extended anvil of one of the cells. As he tries to go between the storms, he suddenly encounters severe turbulence and the aircraft begins to be pelted with hail.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	60	18	12.6	12.6	12.6
	70	32	22.4	22.4	35.0
	80	37	25.9	25.9	60.8
	90	33	23.1	23.1	83.9
	High risl	23	16.1	16.1	100.0
	Total	143	100.0	100.0	

Table 5.75: shows the participant's risk perception level

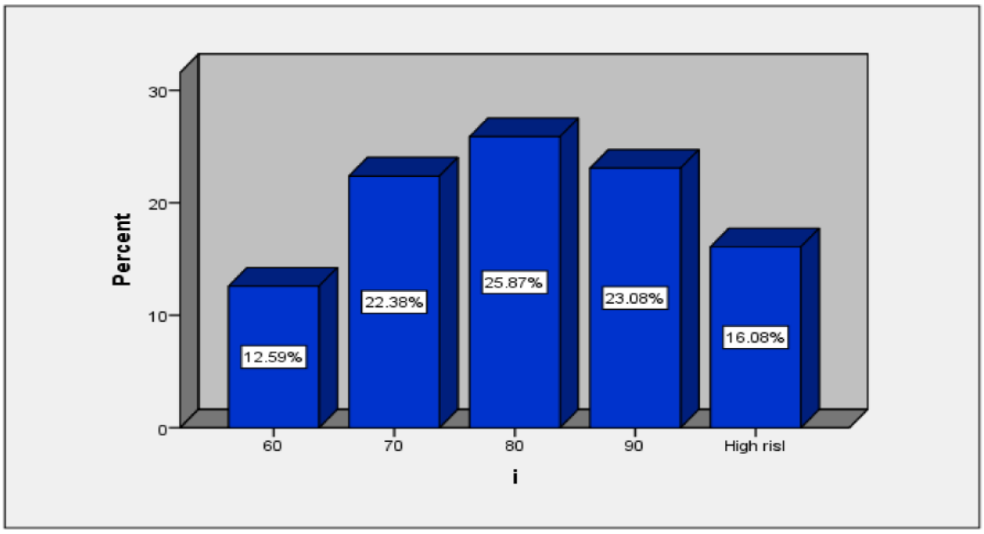

Figure 5.61: shows bar chart indicate the participant's risk perception level

Appendix E

Confirmation Email of Ethical Approval

2/2/2018 CURES Submission: Approved - Belaid, Zakria

CURES Submission: Approved

donotreply@infonetica.net

Wed 20/04/2016 13:00

To: Belaid, Zakria <z.a.belaid@cranfield.ac.uk>;

Cc: Braithwaite, Graham <g.r.braithwaite@cranfield.ac.uk>;

Dear Zakria

Reference: CURES/1029/2016
Title: The Technology-Culture Interference and its Impact on Aviation Safety: A North African Perspective

Thank you for your application to the Cranfield University Research Ethics System (CURES).

Your proposed research activity has been confirmed as Level 2b risk in terms of research ethics. You may now proceed with the research activities you have sought approval for.

Please remember that CURES occasionally conducts audits of projects. We may therefore contact you during or following execution of your fieldwork. Guidance on good practice is available on the research ethics intranet pages.

If you have any queries, please contact cures-support@cranfield.ac.uk

We wish you every success with your project.

Regards

CURES Team

May we remind you of the importance of addressing health and safety issues in your research. Templates and further guidance are available here.

https://outlookanywhere.cranfield.ac.uk/owa/#viewmodel=ReadMessageItem&ItemID=AAMkADg0NjRmYWY4LTlwMjgtNGM0MC1hNWNmLWViN... 1/1

Appendix F

SPSS Normality Distribution for Data

There are many different approaches to determine the normality of data, for this study the author implemented the graphical technique which is a popular way to assess the normality distribution of data. A random choice of three items from the survey in part one was chosen for the purpose of running the assessment. One of the common approach in graphical technique is to create a histogram to make a s subjective appraisal as to see weather normality seems reasonable (Tukey J W (1977). As shown in Figure A, B and C, by using the SPSS 24 the Histogram of the three chosen items indicated that these data are approximately normal distributed.

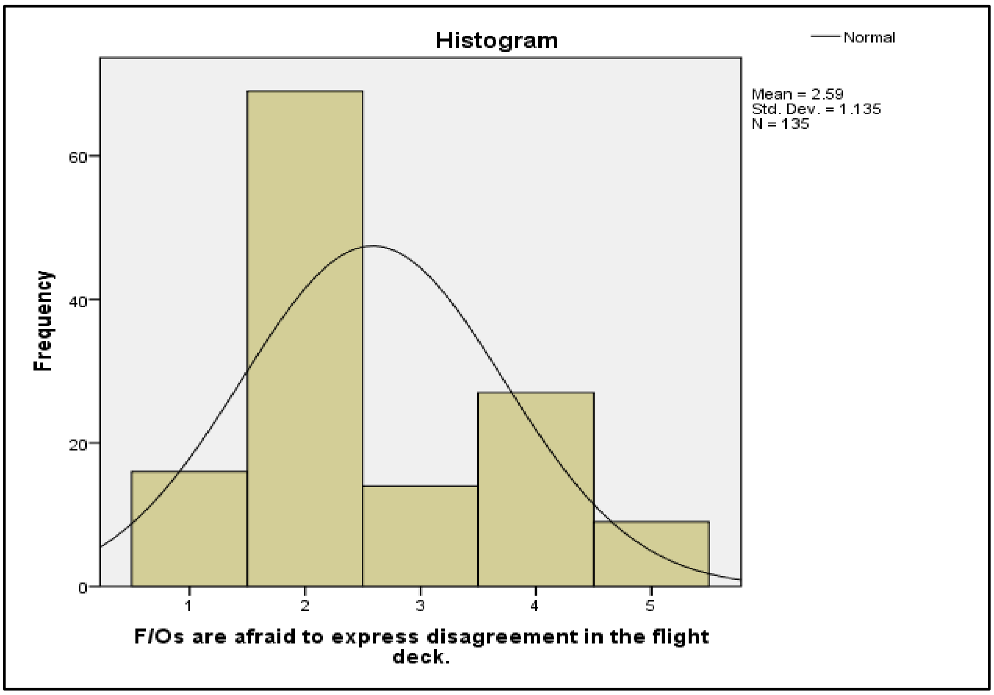

Figure A: Histogram of normal data including the normal curve

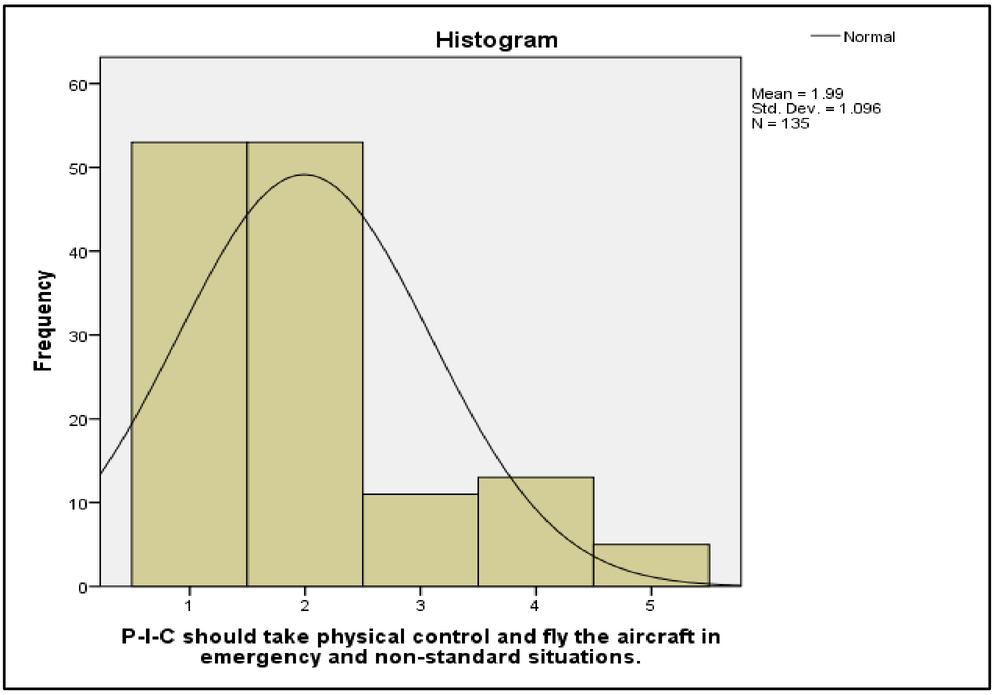

Figure B: Histogram of normal data including the normal curve

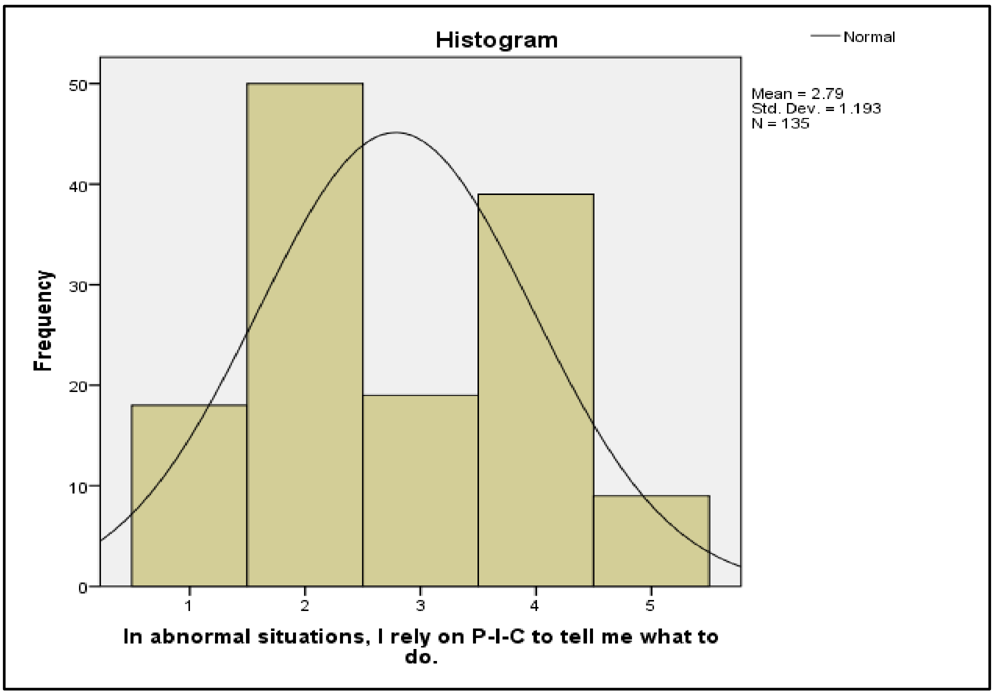

Figure C: Histogram of normal data including the normal curve

Appendix G

Hunter's risk perception scale 1 (Other)

In this exercise, you will see several descriptions of other pilots who are involved in aviation situations. Your task will be to decide how risky each situation is. Unless the description says otherwise, you may assume that the pilot involved in the situation is an average general aviation pilot, with about 300 hours of total experience, who has flown about 30 hours over the last 12 months.

You will rate the risk in each of the situations on a scale of 1 to 100.

The 1 to 100 risk scale is defined as follows:

1 -- Virtually zero risk involved in this situation. It is about as safe as sitting on the couch watching TV.

50 -- The same amount of risk as driving your car on a motorway in moderate traffic and good weather conditions during the day.

100 -- Extremely high risk of a serious, probably fatal accident. The pilot will be very fortunate to escape from this situation alive and with the aircraft undamaged.

1- On short final a pilot drops his microphone on the floor. He looks down while bending over trying to reach it. He inadvertently moves the control column and the aircraft banks sharply.

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2- The pilot is in a hurry to get going and does not carefully check his seat, seat belt, and shoulder harness. When he rotates, the seat moves backward on its tracks. As it slides backward, the pilot pulls back on the control column, sending the nose of the aircraft upward. As the airspeed begins to decay, he strains forward to push the column back to a neutral position.

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3- A line of thunderstorms block the route of flight, but a pilot sees that there is a space of about 10 miles between two of the cells. He can see all the way to clear sky on the other side of the thunderstorm line, and there does not seem to be any precipitation along the route, although it does go under the extended anvil of one of the cells. As he tries to go between the storms, he suddenly encounters severe turbulence and the aircraft begins to be pelted with hail.

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4- Low ceilings obscure the tops of the mountains, but the pilot thinks that he can see through the pass to clear sky on the other side of the mountain ridges. He starts up the wide valley that gradually gets narrower. As he approaches the pass he notices that he occasionally loses sight of the blue sky on the other side. He drops down closer to the road leading through the pass and presses on. As he goes through the pass, the ceiling continues to drop and he finds himself suddenly in the clouds. He holds his heading and altitude and hopes for the best

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5- Just after takeoff a pilot hears a banging noise on the passenger side of the aircraft. He looks over at the passenger seat and finds that he can't locate one end of the seatbelt. He trims the aircraft for level flight, releases the controls, and tries to open the door to retrieve the seatbelt.

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6- During the planning for a 2 hour cross-country flight, a pilot makes a mistake in computing the fuel consumption. He believes that he will have over an hour of fuel remaining upon arrival, but he will really only have about 15 minutes of fuel left.

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7- After working a full day, a businesswoman drives out to the airport for her three hour flight home. She is tired, and the sun is setting, but the weather forecast is for clear sky and good visibility. About an hour after takeoff, she begins to feel very tired and sleepy. She regrets not bringing any coffee along, and opens the cockpit air vent to get some fresh, cool air.

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8- It is late afternoon and the VFR pilot is flying west into the setting sun. For the last hour, the visibility has been steadily decreasing, however his arrival airport remains VFR, with 4 miles visibility and haze. This is a busy uncontrolled airfield with a single East-West runway. He decides to do a straight-in approach.

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9- When he took off about an hour earlier, there was an oblique wind with a headwind component of about 15 knots. He made it into the air, but it was a rocky takeoff, and one he hoped none of the other pilots at the small airport noticed. Now as he entered the downwind leg for landing, he noticed that the windsock was indicating almost a direct crosswind of about the same strength. On final he is holding a large crab to keep from drifting away from the centerline, and as he starts the flare he begins to drift toward the side of the runway.

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10- While on a local sightseeing flight, the pilot notices that the weather is deteriorating to the west. A line of clouds is moving in his direction, but they are still over 20 miles away. He decides to cut his flight short and turns to return to his home airfield about 25 miles east of his present position.

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11- The instructor pilot had been suffering from a cold and when he arose in the morning, he took an over-the-counter antihistamine to try and control his runny nose. After a morning of giving instruction in the flight simulator, he had a lesson scheduled after lunch with a pilot working on his commercial certificate. He felt a little drowsy, but the weather was good and they were going to be working on short-field landings, so he did not cancel the lesson.

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12- A pilot is cruising in good weather to a destination airport about an hour away. It is midday, and there are three hours of fuel on board.

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13- An experienced pilot with a pilot-rated passenger are taxiing out for takeoff. They are at a controlled airfield, on the ground-control radio frequency. They have been cleared to "taxi to and hold short of Runway 31" and are now approaching the hold-short line.

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14- An instrument-rated pilot on an IFR flight plan has just climbed through a 4000 foot thick layer of clouds. Although icing was not forecast, he notices a trace of ice on the edges of the windscreen. The aircraft is not equipped for flight into known or forecast icing conditions. As he approaches his destination airport, air traffic control issues a clearance that will require him to hold for approximately 15 minutes in the cloud layer.

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15- For the first part of this late night flight, the low-time VFR pilot has enjoyed a spectacular view of the stars as he cruised at 8,500 feet with over 25 miles visibility. As he nears his destination airport, which sits on the far side of a large lake, he notices that the visibility is decreasing because of haze nearer the surface. As he starts across the lake at about 2,500 feet he loses sight of the lights on the shore, and the dim lights scattered far apart on the ground seem to be indistinguishable from the stars.

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16- It is time for an oil change and the pilot/owner decides to do it himself. He consults with his local aircraft mechanic and then follows his instructions. He does not have the work inspected afterwards and makes the appropriate log book notation himself.

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17- While cruising at 4,500 feet AGL, the engine on the single-engine aircraft sputters and quits. The pilot checks the fuel settings and tries to restart the engine but is unsuccessful. He sees a level field within gliding distance and turns toward it. He will be landing into the wind.

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Hunter's risk perception scale 2 (Self)

In this exercise, you will be given descriptions of common aviation and everyday situations. After you have read the description of each situation, you will decide how risky the situation would be if YOU were in that situation tomorrow. Base your rating on your personal training and experiences, and use the 1 to 100 risk rating scale shown below.

The 1 to 100 risk rating scale is defined as follows:

1 -- Virtually zero risk involved in this situation. It is about as safe as sitting on the couch watching TV.

50 -- The same amount of risk as driving your car on a freeway in moderate traffic and good weather conditions during the day.

100 -- Extremely high risk of a serious, probably fatal accident. The pilot will be very fortunate to escape from this situation alive and with the aircraft undamaged.

1- During the daytime, fly from your local airport to another airport about 150 miles away, in clear weather, in a well-maintained aircraft.

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2- Make a two-hour cross-country flight with friends, after checking your weight and balance.

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3- Fly across a large lake or inlet at 500 feet above ground level.

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4- At night, take a cross-country flight in which you land with over an hour of fuel remaining.

....assuming you have night rating

5- Climb up a 10-foot ladder to replace an outside light bulb.

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6- Fly in clear air at 6,500 feet between two thunderstorms about 25 miles apart

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7- Take a two-hour sightseeing flight over an area of wooded valleys and hills, at 3,000 above ground level.

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8- During the daytime, take a cross-country flight in which you land with 30 minutes of fuel remaining.

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9- Fly a traffic pattern so that you end up turning for final with about a 45 degree bank

…………………………… ……………………………………………………

10- Drive your car on a motorway near your home at night, at 70 MPH in moderate traffic.

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11- Take a two-hour flight in a jet aircraft on a major UK air carrier.

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12- During the daytime, take a cross-country flight in which you land with over an hour of fuel remaining.

……………………………………………………………………………………..

13- During the daytime, fly from your local airport to another airport about 150 miles away, in a well-maintained aircraft, when the weather is marginal VFR (3 miles visibility and 2,000 foot overcast).

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14- Fly across a large lake or inlet at 1,500 feet above ground level.

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15- Fly a traffic pattern so that you end up turning for final with about a 30 degree bank

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16- Drive your car on a motorway near your home, during the day, at 70 MPH in moderate traffic, during heavy rain.

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17- Make a two-hour cross country flight with friends, without checking your weight and balance.

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18- Drive your car on a motorway near your home during the day, at 70 MPH in moderate traffic.

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19- At night, take a cross-country flight in which you land with 30 minutes of fuel remaining.

……………………………………………………..assuming you have night rating

20- Take a two-hour sightseeing flight over an area of wooded valleys and hills, at 1,000 above ground level.

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21- At night, fly from your local airport to another airport about 150 miles away, in clear weather, in a well-maintained aircraft.

……………… ………………………………………………………………………..

22- Fly across a large lake or inlet at 3,500 feet above ground level.

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23- Ride a lift from the ground floor to the 25th floor of an office building.

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24- At night, fly from your local airport to another airport about 150 miles away, in a well-maintained aircraft, when the weather is marginal VFR (3 miles visibility and 2,000 foot overcast.

……………………………………….......assuming you have night rat

25- Start a light aircraft with a dead battery by hand-propping it.

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