

# **OCCUPATIONAL STRESS AND COPING RESOURCES IN AIR TRAFFIC CONTROL**

by

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## DECLARATION

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I declare that **OCCUPATIONAL STRESS AND COPING RESOURCES IN AIR TRAFFIC CONTROL** is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

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SIGNATURE

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DATE

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## **SUMMARY**

The aim of this study was to investigate how air traffic controllers cope with stress and also to determine whether there were statistically significant differences in the coping behaviour of air traffic control staff from different groups.

The study was conducted on a sample of Air Traffic Controllers who control civilian aircraft in the South African airspace. The coping resources inventory (CRI) assessment was used to collect data and analysed to determine how controllers cope with stress and whether there are differences in the coping behaviour of air traffic control staff from different groups.

The results showed that air traffic controllers use emotional coping resources to cope with stressful work situations and make less use of cognitive coping resources. The results also showed that there were no statistically significant differences in the coping behaviour of air traffic control staff from different groups.

## **KEY TERMS**

Air traffic control, coping, coping resources inventory, critical incident stress management, human factors, occupational stress, stress

## CHAPTER 1

### SCIENTIFIC ORIENTATION TO THE RESEARCH

#### 1.1 BACKGROUND AND MOTIVATION

Work stress is a major concern in all developing and industrialised countries, affecting not only employees whose health is at stake but also organisations and society as a whole (Le Blanc, De Jange & Schaufeli, 2008). South Africa will need more than 170 new aircraft to meet its growing air traffic demand in the next 20 years (<http://www.busrep.co.za.index.php?ArticleId=5362799>). The annual air traffic growth is estimated to rise 6.3 percent over the next 20 years. This means more stress for air traffic controllers (ATCOs) as they have to ensure safety of those in the sky.

Air traffic controllers are widely recognised as an occupational group that works in a highly stressful environment (Proctor & Van Zandt, 1994). Schultz and Schultz (2010) reported that air traffic controllers' work is hectic, difficult, and demanding, and has the additional burden of making them responsible for thousands of lives daily. Everybody is exposed to stress in the workplace but some are more often and more intensely exposed than others (Cartwright & Whatmore, 2005). Costa (1995) argued that air traffic controllers are some of the individuals who are exposed most to stress in the workplace and that they intensely experience work-related stress.

Many studies on stress, workload and complexity in air traffic control have been conducted internationally (Collet, Averty & Dittmar, 2009; Costa, 1995; Pawlak, Brinton, Crouch & Lancaster, 1996). According to Costa (1995) occupational stress has become an increasingly global phenomenon that can no longer be considered an occasional, personal problem to be remedied with just comforting. It affects all categories of workers, all workplaces and all countries. This phenomenon coupled with its rising cost to society, industry and individuals has greatly sensitized people about the need for effective and innovative ways of dealing with stress (Costa, 1995). Costa (1995) further reported that stress in the workplace can be prevented by

attacking its cause and roots, rather than simply treating its effects. Ramesar, Koortzen and Oosthuizen (2009) also reported that coping with stress is regarded as successful if the source of the problem is dealt with or if the experience of the stress is directly reduced.

The task of air traffic controllers is to ensure safe separation of aircraft and the complexity of the work makes them more vulnerable to the stressors of that environment (Costa, 1995; Vogt & Leonhardt, 2005). When controlling air traffic, controllers exercise constant vigilance, tracking aircraft at various speeds and altitudes converging on or departing from the same point (Schultz & Schultz, 2010). Vogt and Leonhardt (2005) argued that the combination of high workload, high responsibility for safety and shift work makes air traffic control a stressful job.

Stress in the workplace becomes a health problem if not managed well (Schultz & Schultz, 2010). Stress becomes a harmful risk factor for health when it is perceived as an imbalance between an excess of demands and the individual ability to meet them (Costa, 1995; Landy & Conte, 2010). Williams and Cooper (2002) also reported that stress occurs when pressures combine in such a way that they exceed individual capacity to cope.

Research has shown that stress at work can be caused by different sources such as job demands, an individual's characteristics, environmental conditions, work organisation and human relations (Ivancevich & Matteson, 2002; Dewe, O'Driscoll & Cooper, 2010). Schultz and Schultz (2010) reported that the incidence of hypertension among air traffic controllers is three times higher than normal for their age group. Research indicate that the demanding work of air traffic controllers is a risk factor in the development of stress-related symptoms, such as headaches, burnout, chronic fatigue, heartburn, as well as such serious illnesses as hypertension and coronary heart disease (Proctor & Van Zandt, 1994; Stress prevention in air traffic control, para.5, n.d.).

In organisations one of the obstacles preventing people from operating to their maximum potential is stress (Landy & Conte, 2007). Organisations have designed programs to educate employees about the dangers of stress and coping mechanisms. In many cases these programs do not yield the desired results because they focus on the negatives, that is, the focus is on human pathology or on what is wrong with and lacking in individuals (Cameron, Dutton & Quinn,

2003). In recent times the focus has shifted to positive psychology where the focus is on individuals' strengths (Cameron et al., 2003). Folkman and Moskowitz (2000) argued that the growing interest in positive aspects of the stress process is paralleled by a growing interest in positive emotions and the possibility that they may have important adaptational significance during the stress process.

This research will assist in identifying how air traffic controllers cope with stress. Organisations in air traffic management can use the information to design programmes to either eliminate stressors or educate them on how to deal with the stressful situations.

## **1.2 PROBLEM STATEMENT**

The background of this study indicates that stress plays a major role in peoples' lives and as a result need to be managed and controlled. Stress in the workplace has negative impact on productivity and many organisations are affected by this phenomenon (Weinberg & Cooper, 2007). Mental health problems and stress-related disorders are the biggest overall cause of early death in Europe (Levi, 2006). In the South African context, Oosthuizen and Van Lill (2008) noted that South Africans from all walks of life experience abnormally high levels of stress.

Knowledge has been gained in industrial psychology on the effects of stress and how groups such as teachers, engineers, scientists, unemployed African graduates, police officers and accounting professionals cope with stress (Coetzee & Esterhuizen, 2010; Coetzee, Jansen & Muller, 2009; Cope, 2003; Louw & Viviers, 2010). However, little research has been conducted on the stress levels of South African air traffic controllers and how they cope with stress. Brink (2009) conducted research to determine the relationship between emotional intelligence, stress and coping strategies in the occupation of air traffic control in South Africa. The main finding of this study was that there was no significant relationship between the total scores of coping and stress, between stress and emotional intelligence (self) or stress and emotional intelligence (manager), nor was there a relationship between the total correlation result of emotional intelligence (self) and emotional intelligence (manager) and coping. However a significant

relationship between emotional intelligence (self) and emotional intelligence (manager) was found.

The effects of stress manifest themselves differently in individuals as not everyone respond to stress in the same way. Landy and Conte (2007) noted that researchers have studied several individual characteristics as potential moderators of stressor–strain relationship, and that the characteristics that have received the most attention are locus of control, hardiness, self esteem, and the Type A behaviour pattern. In this study the focus was on the coping resources that air traffic controllers use to mitigate the effects of stress.

Coping resources are useful for wellbeing and health, and resources such as social support at work and job control are defined as factors in the job stress process that protect from detrimental immediate psychological, physiological, and behavioural responses to job stressors (Grebner, Elfering & Semmer, 2010). Coetzee and Esterhuizen (2010) also reported that the presence of coping resources provides both deterring and coping functions, and that they reduce anguish and preserve people’s psychological and social balance. This might explain why air traffic controllers are able to survive the stressors they are constantly exposed to during the course of their working life.

The research questions of this study can be formulated as:

- (1) What coping resources do air traffic controllers use to mitigate the effects of stress in the workplace?
- (2) Are there statistically significant differences in the coping behaviour of air traffic control staff from different groups?

### **1.3 AIMS OF THE RESEARCH**

The general aim of this study is to investigate how air traffic controllers cope with stress using coping resources.

The specific empirical aim is to investigate coping resources used by air traffic controllers to deal with stress through the use of an appropriate measuring instrument.

## **1.4 PARADIGM PERSPECTIVE**

The origin of paradigm is found in Kuhn's 1962 book called 'The structure of scientific revolutions' (Mouton & Marais, 1990). Kuhn (1970, p.viii) described a paradigm "to be universally recognized scientific achievements that for a time provide model problems and solutions to a community of practitioners".

### **1.4.1 Field of study**

The focus of this research is on industrial psychology as a discipline which, according to Schultz and Schultz (1998), involves the application of the methods and principles of psychology at work. Psychology is the science of behaviour and mental or cognitive processes (Schultz & Schultz, 2010). The sub-disciplines on which the research focused on are organisational behaviour and occupational mental health. Organisational behaviour as Robbins, Judge, Millet and Waters-Marsh (2008) put it, is a field of study that investigates the impact that individuals, groups and structure have on behaviour within organisations for the purpose of applying such knowledge towards improving an organisation's effectiveness. On the other hand occupational mental health is concerned with individuals' behaviour, thoughts and feelings in the workplace (Robbins et al., 2008).

### **1.4.2 The salutogenic paradigm**

In the past decade there has been a movement towards the understanding and application of the positive aspects of psychological functioning (Guse, 2010). This movement developed because for many years the focus in psychology has been on disease model of human functioning (Peterson & Seligman, 2003). Peterson and Seligman (2003) further noted that the underlying assumptions of psychology are that humans are flawed and fragile. Strümpfer (2005) concurred when he argued that the health and social sciences have traditionally been functioning in a

pathogenic paradigm. The focus of positive psychology is on strengths as much as weaknesses and that we should challenge the assumptions of the disease model that psychology has been focusing on for many years. Peterson and Seligman (2003) reported that the trigger for positive psychology was the idea that psychology since World War II has focused much of its efforts on human problems and how to remedy them.

Linley, Joseph, Harrington and Wood (2006) defined positive psychology as follows:

“Positive psychology is the scientific study of optimal human functioning. At the meta-psychological level, it aims to redress the imbalance in psychological research and practice by calling attention to the positive aspects of human functioning and experience, and integrating them with our understanding of the negative aspects of human functioning and experience. At the pragmatic level, it is about understanding the wellsprings, processes and mechanisms that lead to desirable outcomes” (p. 8).

In this study the salutogenic paradigm will be followed, as the problem statement can best be explained by this paradigm. The salutogenic model, developed by Antonovsky (1987), as opposed to pathogenic model focuses on exploring the origin of health rather than explaining the causes of disease. The salutogenic approach is an alternative to the traditional pathogenic model and it is an approach that looks for the health promoting factors within societies and individuals. Compared to the pathological orientation (the health vs. disease dichotomy), in Antonovsky's model, health is viewed as a continuum from health to disease (Dickinson, 2007). The pathological perspective focuses on why and how people become sick, while the salutogenic orientation try to discover why and how certain people are situated on the health side of the continuum (Antonovsky, 1987). Strümpfer (1990) noted that the focus of the pathogenic approach is on identifying and dealing with risk factors in individuals.

The construct of salutogenesis is derived from the Latin *salus* meaning ‘health’, and the Greek *genesis* meaning ‘origins’ (Strumpfer, 1995). The salutogenic model highlights the strengths of individuals and their capacity for successful adjustment and tries to explain why certain people seem to preserve health and well-being and successfully cope with tension and the exposure to life's stresses and difficulties (Antonovsky, 1987). Antonovsky (1987) further reported that if

stress is handled well, its outcome can be positive or neutral, and the individual moves toward the health-ease end of the continuum, whereas if stress is poorly handled, the person moves toward the disease end of the continuum.

Central to the salutogenic model is the notion that stressors are everywhere, and even with a high level of stressors, many people survive and even cope well under those stressful situations (Antonovsky, 1987). As discussed previously, ATCOs are constantly exposed to stress but seem to cope well when exposed to stressful situations. Schultz and Schultz (2010) suggested that the rate of stress related illness is higher among air traffic controllers than among the rest of the population, but research indicates that this is not so. This approach will be ideal to explain how ATCOs manage to deal with stress effectively.

## **1.5 RESEARCH DESIGN**

The aim of the research design is to enhance validity and reliability and also to align the pursuit of a research goal with the practical considerations and limitations of the project (Mouton & Marais, 1990).

### **1.5.1 Variables**

Cozby (2009) described a variable as any event, situation, behaviour, or individual characteristic that varies. The variables are usually conceptualised as having a cause and effect connection (Cozby, 2009). The variable that is considered to be the “cause” is the independent variable, and the variable that is the “effect” is the dependant variable. In this research the variables being studied were coping resources as dependant variable for each of the ATCOs groups, namely, age, seniority level, race and gender as independent variables.

### **1.5.2 Survey Methodology**

The type of the study that was conducted was the survey study. Primary data was collected and no previously existing data was used. According to Denscombe (2007) the word survey means

“to view comprehensively and in detail” (p.7). Surveys have emerged in recent times as one of the most popular and commonplace approaches to social research (Denscombe, 2007). A whole range of different methods can be used in the survey, for example, questionnaires, interviews, documents and observation. Survey research in general offers advantages in terms of the amount of data that can be collected, economy, and the chance to sample the whole population (Babbie, 2007).

#### 1.5.2.1 Type of survey

This research was exploratory in nature because of the limitation in size and scope, and since little research has been done in the South African context about this topic. The research explored how different groups from air traffic control staff cope with stress. Questionnaires were used and distributed to the respondents to complete. They were sent via mail to the different air traffic control centers around the country.

#### 1.5.2.2 Unit of analysis

In this research the units of analysis are groups from air traffic control staff based on age, race, gender, and seniority level.

#### 1.5.2.3 Reliability

According to Cozby (2009) reliability refers to the consistency or stability of a measure of behaviour. In this research reliability was ensured by firstly, using the reliable research questionnaire such as coping resource inventory (Hammer, 1988). The detailed reliability scores of this instrument will be discussed under the measuring instrument section. Secondly, participants were not required to reveal their identity, hence assurance of anonymity and confidentiality.

#### 1.5.2.4 Validity

Validity is defined by Cozby (2009) as the truth and accurate representation of information. He further mentioned that something is said to be valid if it is true in the sense that it is supported by available evidence. To ensure validity in this research conceptual description of all relevant constructs and concepts that were used in the research were provided. It was also ensured that the collected data was accurate and reliable, and that it was analysed in an appropriate manner.

#### 1.5.2.5 Sampling

There are two kinds of sampling techniques that can be used by social researchers. They are known as probability sampling and non-probability sampling. Probability sampling, also known as simple random sampling (Fife-Schaw, 2000) is based on the idea that the people or events that are chosen as the sample are chosen because the researcher has some notion of the probability that these will be a representative cross-section of people or events in the whole population being studied. Non-probability sampling is conducted without the knowledge about whether those included in the sample are representative of the overall population. The intention is not to produce the sample which is statistically representative (Ritchie, Lewis & Elam, 2003).

A non-probability sampling method called convenience sampling was used in this research. Convenience sampling is built upon selections which suit the convenience of the researcher and which are first to hand (Denscombe, 2007). It is cautioned that convenience sampling itself offers nothing by way of justification for the inclusion of people or events in the sample. Berg (2007) mentioned that under certain circumstances this strategy is an excellent means of obtaining preliminary information about some research question quickly and inexpensively. The reason this strategy was used in this research is because of the difficulty of accessibility of the participant population.

Questionnaires were sent to the managers, supervisors and operations secretaries around the country to give to air traffic controllers who were willing to participate in the study. In some instances the researcher asked the controllers personally to complete the questionnaires.

Employing a different sampling method like random sampling would have limited the number of responses, as there are already limited numbers of ATCOs in the country. Only ATCOs that control civilian aircraft were sampled. These controllers are employed by the organisation called Air Traffic and Navigation Services (ATNS).

## **1.6 RESEARCH METHOD**

### **1.6.1 Measuring instrument**

The 60-item Coping Resources Inventory (CRI) was used to determine what type of resources ATCOs use to cope with stress. CRI is designed to identify the personal coping resources available to individuals for managing stress at a particular point in time (Pollard & Baker, 2000). It is an instrument with demonstrated reliability and validity in addition to being gender normed (Pollard & Baker, 2000). The obtained scores are transformed into T-scores with a mean of 50 and a standard deviation of 10. Scores below or equal to 30 are interpreted as below average and scores above or equal to 70 are interpreted as above average. It is reported that CRI appears to be a reliable measure to use in the South African context with Cronbach's alpha of 0.93 reported by Jooste and Foxcroft (2005).

Hammer (1988) reported test-retest reliability and Cronbach's alpha coefficients of CRI as varying from .84 (emotional), .80 (spiritual/philosophical), .79 (social), .77 (cognitive) to .71 (physical). In the South African context Coetzee, Jansen and Muller (2009) conducted a study to confirm the psychometric reliability and validity of the CRI for South African samples, and their results yielded Cronbach's alpha coefficients for the CRI varying from .83 (emotional), .81 (social), .73 (physical), .71 (spiritual/philosophical) to .68 (cognitive). For each item in the inventory individuals have to indicate how representative the statement is of them in the last 6 months with N=never or rarely, S=sometimes, O=often and A=always or almost always as response options. The responses are then grouped and profiled according to one of five domains: Cognitive, Social, Emotional, Spiritual/Philosophical and Physical. Definitions for each of these domains are as follows (Hammer, 1988):

Cognitive - The extent to which individuals maintain a positive sense of self-worth, a positive outlook towards others, and optimism in general (for example, 'I feel as worthwhile as anyone else').

Social - The degree to which individuals are embedded in a social network able to provide support in times of stress. (for example, 'I am part of a group, other than my family that cares about me').

Emotional - The degree to which individuals are able to accept and express a range of affect, aiding the amelioration of long term negative consequences (for example, 'I can cry when sad').

Spiritual - The degree to which actions of individuals are guided by stable and consistent values such as those derived from religious, familial or cultural traditions or personal philosophies. (for example, 'I know what is important in life').

Physical - The degree to which individuals enact health-promoting behaviours thought to improve physical well-being (for example, 'I exercise vigorously 3-4 times a week').

As previously stated, air traffic control is one of the mostly stressful jobs and it is interesting to note that ATCOs cope for many years being exposed to stressful situations with no visible signs of distress. This instrument is ideal as it allows identification of the kind of resources ATCOs rely on to survive the effects of stress. Coping resources as opposed to coping strategies act as antecedent of behaviour and as background or protective factors to stress (Pollard & Baker, 2000).

### **1.6.2 Data analysis**

Statistical analysis was computed using SPSS Statistics, Version 19 (Argyrous, 2000). Analysis of variance was used to investigate the differences between the race groups. T-test was used to investigate the differences between gender, age and seniority groups.

Descriptive statistics (mean and standard deviations) was used to provide data of the total sample as well as the different groups.

### **1.6.3 Research hypothesis**

The purpose of the research hypothesis is to state the relationship between the variables being studied. The demographic variables such as gender, experience, age and race were investigated in this study in order to establish whether there is a difference in how these different groups deal with stress. The research hypothesis was as follows:

There are statistically significant differences in the coping behaviour of Air Traffic Control staff from different groups.

Sub-hypotheses:

H<sub>1</sub>: There is a statistically significant difference in the coping styles preferred by male and female ATCOs.

H<sub>2</sub>: There is a statistically significant difference in the coping styles preferred by senior and junior ATCOs

H<sub>3</sub>: There is a statistically significant difference in the coping styles preferred by older and younger ATCOs

H<sub>4</sub>: There is a statistically significant difference in the coping styles preferred by different race groups of ATCOs

## **1.7 CHAPTER LAY-OUT**

The lay-out of the chapters for the research will be as follows:

Chapter 2: Literature review

Chapter 3: Research article

Chapter 4: Conclusions, limitations and recommendations

## **1.8 CHAPTER SUMMARY**

In this chapter the scientific orientation to the research was discussed. This contained the background and motivation of why the research was necessary, the research problem, aims of the research, the paradigm perspective, the research design and method. Lastly the chapter ended with the chapter layout.

## **CHAPTER 2**

### **STRESS AND COPING**

#### **2.1 INTRODUCTION**

In this chapter, research and models pertinent to the concepts of stress and coping, and their relevance to air traffic control will be discussed. Firstly, the concept of stress will be defined and explained in terms of how stress affects air traffic controllers. Secondly, the concept of coping will be discussed with specific focus on how controllers cope with stressful situations. The role of air traffic controllers will also be discussed in order to understand how the work itself influences how controllers experience stress. Lastly, how stress is managed in the air traffic control environment will be discussed.

#### **2.2 STRESS**

Stress affects many people all over the world and it has devastating consequences if not properly managed (Ivancevich & Matteson, 2002). Cartwright and Whatmore (2005) reported that stress has been identified as a major factor in ill-health, mainly psychological health. Stress can be all pervasive and can affect people in all occupations and of all ages irrespective of sex, nationality, education background or role (Williams & Cooper, 2002). According to Dickinson (2007) stress was the focus of much research well before the 1950s, although the term “stress” was not used. Dickinson (2007) further reported that the term stress was coined by Seyle in 1956 for use in biomedical research who used it to refer to the body’s response to a harmful external stimulus, and theorized that this response was always non-specific in nature. In the following paragraphs the definition and the models of stress are discussed.

##### **2.2.1 Definition of stress**

Buunk, de Jonge, Ybema and de Wolff (1998) noted that there is little agreement as to how stress should be defined. For instance, Van Dijkhuizen (cited in Buunk et al., 1998) found more than 40

definitions of the concept of stress in the literature, all of them at least slightly different. Fletcher (1988) also reported that the definitional difficulty of stress is compounded by the potentially multifaceted manifestations of stress. One of the main reasons for this lack of agreement lies in the large number of disciplines involved in stress research, such as biology, psychology, sociology, and epidemiology (Buunk et al., 1998; Le Blanc et al., 2008).

Robbins et al. (2008) define stress as “a dynamic condition in which an individual is confronted with an opportunity, demand or resource related to what the individual desires and for which the outcome is perceived to be both uncertain and important” (p. 623). They further argued that stress is not necessarily bad in and of itself. Stress has a positive value, although is typically discussed in a negative context. This definition was chosen for the present study because of the fact that stress is seen as a dynamic condition, and it is relevant to the aviation sector especially the air traffic control environment where there is constant change. The environment that we live in is not stable but unpredictable and always evolving. Employees are uncertain of what will transpire in their organisations and as a result experience anxiety and stress.

Le Blanc et al. (2008) noted that as much as there is lack of consensus on the definition, nonetheless, most researchers in the field of stress do agree that three different meanings of the term stress can be distinguished: stress as a stimulus, stress as a response, and stress as meditational process between stressor (stimulus) and reaction (response). Coetzee, Jansen and Muller (2009) also noted that the term stress has also been used to refer to the level of pressure and demands made on the individual. Occupational stress, that is, stress experienced by people at work will be discussed in the next section.

## **2.3 OCCUPATIONAL STRESS**

Occupational stress is the stress that is experienced in the workplace and it is studied and researched in a different way from the general stress concept (Jackson & Saunders, 2006). Occupational stress and well-being continues to be an intriguing and exciting area for researchers (Perrewe & Gangster, 2006). People spend most of their time at work and it is inevitable that they will be affected by stress in the workplace. Dewe et al. (2010) reported that for many the

workplace can be a source of stress, depression and anxiety, and that it is the relationship between work and stress that has captured the attention of many researchers. Muchinsky (2009) also argued that the most pressing health related issue in the workplace today is stress and that is common to all industrialised nations.

The effect of stress in the workplace is damaging and some organisations have devised strategies to deal with its effects (Dewe et al., 2010). For example, through their employee wellness programmes organisations have counseling and stress management interventions (Dewe et al., 2010). Van der Colff and Rothmann (2009) noted that the potential direct and indirect costs associated with various stress-related consequences command more than just minimal attention from the manager of any business. Williams and Cooper (2002) argued that the complex interrelationship between factors and the wide variety of symptoms and causes of stress make it difficult to manage stress at work. They noted that this variability of the stress process is like hitting a moving target for managers and researchers. Kenny and McIntyre (2005) concurred when they reported that occupational stress is a complex, multilayered phenomenon that requires a systematic or ecological analysis using multiple perspectives.

Rosen, Chang, Djurdjevic and Eatough (2010) noted that more recent work on occupational stress has acknowledged that behavioural responses to stressors may include actions that are harmful for not only the individual employees, but also for the organisation. Absenteeism, accidents, and turnover have been cited as some of the behaviours associated with encountering stressors at work (Schultz & Schultz, 2010). Different models of occupational stress have been cited in the literature and will be described in the following paragraphs.

### **2.3.1 Models of occupational stress**

Various models have been developed focusing specifically on understanding occupational stress. These models have been with us for many years and only the most well known will be mentioned and discussed, such as, the Social Environment Model, the Person-Environment Fit Model, the Job Demand-Control Model, and the Vitamin Model (Buunk et al., 1998; Furnham, 2005; Sulsky & Smith, 2005; Weinberg & Cooper, 2007).

### 2.3.1.1 Social environment model

According to Buunk et al. (1998) this is the best known occupational stress model. This is an influential model that has inspired considerable research, and it focuses on the employees' perceptions of the work environment (Weinberg & Cooper, 2007). Furnham (2005) noted that this model was created in an attempt to categorise and describe the main groups of variables that causally interact to produce stress. It is based on a combination of a number of conceptual categories, that is, types of variables rather than a coherent theory. Within the model the conceptual categories have been identified as:

- a) *Objective environment.* The objective environment refers to organisational characteristics such as company size, hierarchical structure and job description. The environment is believed to be independent of the worker's perception of it.
  
- a) *Subjective environment.* The subjective environment is part of the worker's perceptions. It contains phenomena called stressors such as role conflict, role ambiguity, lack of participation and role overload.

Weinberg and Cooper (2007) reported that the way in which the workers interpret the workplace can mean that they view certain aspects of their work as sources of pressure, which could lead to stress related outcomes. The model postulate that stressors lead to strains which may manifest themselves as behavioural, emotional and physical reactions (Furnham, 2005).

### 2.3.1.2 Person environment fit model

The model is based on the view that behaviour is a function of both the person and the environment (Buunk et al., 1998). According to the P-E Fit model, occupational stress is the result of a discrepancy between what the individual desires and what the job supplies. (Buunk et al., 1998).

The amount of stress a person feels at work is influenced by perceptions of the demands made by the environment, and by perceptions of that person's capability to deal with those demands (Landy & Conte, 2007). Proctor and Van Zandt (1994) noted that the degree to which a worker is not well matched to her or his job in part determines the level of stress that the worker will experience. The model makes the distinction between subjective and objective misfit. Subjective misfit refers to the discrepancy between peoples' view of themselves and their view of the environment. Objective misfit on the other hand concerns the discrepancy between how the person functions and the objective characteristics of the work environment.

### 2.3.1.3 Job Demand-control model

Karasek (1979) developed a model that predicted that mental strain results from the interaction of job demands and job decision latitude. The key idea behind the Job Demand-Control (JD-C) Model is that control buffers the impact of job demands on strain (Karasek, 1979). The JD-C model emphasised the necessity of reducing work-related strains and the importance of promoting work motivation, learning and growth. According to the JD-C model the strongest aversive job-related strain reactions (for example, exhaustion and anxiety) will occur when job demands are high and the worker's control is low (Karasek, 1979). Loughlin and Lang (2005) support that view as they mentioned that high demands at work are not considered problematic per se, unless accompanied by lack of control.

The Job Demand-Control Model is one of the most widely studied models of occupational stress and perhaps the best known of all models relating job characteristics to wellbeing (Kelloway, Sivanathan, Francis & Barling, 2005; Sulsky & Smith, 2005; Weinberg & Cooper, 2007). The empirical tests of Karasek (1979) JD-C Model have primarily focused on work overload, role conflict and time pressure as indicators of job demands, and on skill discretion and decision latitude as indicators of job control. The basic principle of the Job Demands-Control Model is that the most stressful jobs are those in which employees are subjected to high level of demands, yet at the same time have very little control over their work (Karasek, 1979).

#### 2.3.1.4 Vitamin model

The vitamin model was built upon the job characteristics model and suggests that there is an optimum level of certain aspects of the workplace to which we should be exposed (Warr, 1987). The central idea underlying the vitamin model of Warr is that mental health is affected by job characteristics in a way that is comparable to the effects that vitamins have on physical health (Buunk et al., 1998). Generally, vitamin intake initially improves health and physical functioning, but beyond a particular intake level no further improvement is observed (De Jong & Schaufeli, 1998).

Warr's vitamin model (Warr, 1987) listed nine environmental conditions as sources of stress in the workplace such as the opportunity for control, the opportunity for skill use, externally generated goals, task variety, environmental clarity, the availability of money, physical security (freedom from physical threat and danger), the opportunity for interpersonal contact, and valued social position. Six of these features, that is, job demands, job autonomy, social support, skill utilization, skill variety, and task feedback have curvilinear effects. The lack of such features as well as an excess of such features will affect mental health negatively. The other three job characteristics, that is, safety, salary, and task significance follow a linear pattern: the more such a characteristic is present in the work situation, the higher the level of mental health will be.

From the discussion above, the Job Demands-Control Model is particularly relevant to air traffic controllers in that the nature of the job is very demanding and sometimes controllers encounter situations where there is little control over the complexity and volume of traffic in their jurisdiction. It is expected that when they encounter such a situation where the demand is very high and they do not have control, they will experience increased stress. Sulky and Smith (2005) noted that a perceived lack of control is reported to be one of the most potent stressors for air traffic controllers. They often have little control over potential crisis or an emergency and have to deal with the situation when it happens. With little or no control over this situation the controller will experience stress as predicted by the Job Demands-Control Model.

### 2.3.2 Consequences of stress

The effect of stress has been studied by many researchers and divided into three categories, that is, psychological, behavioural and physiological consequences (Landy & Conte, 2010; Ross & Altmaier, 1994). Prolonged exposure to stress has negative consequences on individuals' wellbeing and the three categories are discussed in the following paragraphs.

#### 2.3.2.1 Psychological consequences of stress

The symptoms of stress related to psychological wellbeing are those emotional and cognitive problems that occur under conditions of job stress (Ross & Altmaier, 1994). Psychological consequences of stress as highlighted by Landy and Conte (2010) include anxiety, depression, burnout, fatigue, job tension, and dissatisfaction with one's job and life. Fatigue and burnout are particularly relevant and have been extensively discussed in the literature dealing with air traffic control (Marcil & Vincent, 2000; Martinussen & Richardsen, 2006).

##### a. Fatigue

Fatigue is an especially important and well researched consequence of stress in air traffic control. Fatigue refers to the wide range of situations in which an individual feels tired and includes not only feelings of tiredness but also boredom (Proctor & Van Zandt, 1994). Proctor and Van Zandt (1994) further noted that high levels of fatigue and disruptions of circadian rhythms increase stress. Some typical manifestations of fatigue involve reduced alertness, slower reaction time, irritability, mood swings, and the need to recheck the same information several times (Franco, 2008).

Dionisio (2010) noted that the job of an air traffic controller requires their constant attention and being in any way fatigued on position is unacceptable as it may put people's lives at risk. Fatigue has usually been associated with potential inadequate human actions namely, error, poor decision making, reduced situational awareness and an overall degradation of performance (Franco, 2008). Stress and fatigue can create safety hazards in the workplace, particularly in safety-critical

or safety-sensitive jobs and are especially critical where other workers or members of the public may be affected (Hill, 2003). For example, a fatigued air traffic controller is likely to place many more lives at risk than their own. The research has consistently shown that fatigue degrades human performance and can contribute to or cause error (Strauch, 2004).

Hopkins (2007) observed that two of the greatest threats to air traffic control safety are controller fatigue and controller overload, and that both the controllers and their managers should be well aware of these threats and manage them carefully. In air traffic management fatigue is a major factor that can affect controllers' performance and safe conduct of traffic (Cebola & Kilner, 2009). Marcil and Vincent (2000) noted that air traffic controllers often experience fatigue on the job due to shiftwork, workload, and stress. Marcil and Vincent (2000) further argued that the impairment of air traffic control performance due to fatigue is an important concern for system safety and requires the development of countermeasures. Due to the complexity of the job, air traffic controllers need to be vigilant at all times and being fatigued undermines the safety of the system and puts the lives of the air traffic service users at risk (Cebola & Kilner, 2009).

Roske-Hofstrand (as cited in Marcil & Vincent, 2000) observed that 21% of reported incidents in the Aviation Safety Reporting System (ASRS) mention factors related to fatigue (for both pilots and ATCOs), and categorised types of fatigue mentioned by ATCOs as:

- physical fatigue (related to lack of sleep and sluggishness at start of a shift);
- shift/schedules related fatigue;
- end of shift and workload fatigue;
- emotional stress (lack of sleep related to problems with supervisors and/or co-workers).

Isaac (2011) noted that the main effects of fatigue on people at work are psychological and that the key skills and behaviours affected by fatigue are the following:

- Slower information processing and degraded mental performance:

This involves taking longer to transform data or process information; including confusion, poor concentration, narrowed perception and forgetfulness which leads to degraded vigilance and poor response to changing situations. With air traffic controllers this result in committing errors such as giving incorrect clearances and not listening to the readbacks.

- Faulty memory recall of recent events:

The operator who is fatigued might find it difficult to remember recent information obtained from others. For example, a controller might forget the message from the pilot or from another controller.

- Omissions and carelessness:

People affected by fatigue increasingly take short cuts, skip steps, miss checks and commit errors.

- Slower comprehension and learning:

When people are fatigued it takes longer and longer to understand any written or spoken information, or display patterns such as a map or a charts.

- Worsening team performance:

This includes decreased interaction with other team members and degraded communication due to lower sensitivity to other people's needs and feelings. People who are fatigued may become moody, irritable, argumentative or socially withdrawn, all of which can adversely affect team relations.

- Diminished personal safety:

Reduced self and situation awareness lead to apathy, neglect of normal safety precautions, and more risk taking. Air traffic controllers must follow the rules and procedures at all times and being fatigued can lead to non-adherence to the set procedures and this may lead to safety being compromised.

- Impaired leadership:

Being fatigued may lead to some people taking longer to make decisions while others make poorer ones. In many instances people are not aware of this impairment, and not being aware continues with poor decision making with negative consequences.

#### b. Burnout

Since the early 1970s, burnout research has developed from a science derogatively classified as a 'pop-psychology' into an important branch of stress research in occupational and organisational psychology (Enzmann, 2005). Burnout is a psychological process brought about by prolonged exposure and unrelieved work stress (Ivancevich & Matteson, 2002). Ivancevich and Matteson (2002) further highlighted that burnout tends to be a particular problem among people whose jobs require extensive contact with and/or responsibility for other people. Because of the amount of responsibility placed on them in ensuring safety in the airspace, air traffic controllers can be classified among those people who might be at risk of experiencing burnout. Martinussen and Richardsen (2006) reported that ATCO's responsibility for safety is high, and errors and mistakes may have disastrous consequences.

If not properly managed in the organisation, burnout can have negative consequences for both the individual in terms of health and being productive, and the organisation in terms of the quality of work and work performance, and as a result it is important to find ways to prevent workers from developing such job-related strain (Martinussen & Richardsen, 2006). Maslach (2006) described burnout as a psychological syndrome that involves a prolonged response to

chronic interpersonal stressors on the job. She noted that the three key dimensions of this response are overwhelming exhaustion, feelings of cynicism and detachment from the job, and a sense of ineffectiveness and a lack of accomplishment.

The *exhaustion* dimension represents the basic individual stress component of burnout, and refers to feelings of being overextended and depleted of one's emotional and physical resources (Maslach, 2006). The major sources of this exhaustion are work overload and personal conflict on the job. The *cynicism* dimension represents the interpersonal context component of burnout, and refers to a negative, callous, or excessively detached response to various aspects of the job. It usually develops in response to the overload of emotional exhaustion (Maslach, 2006). The *inefficiency* dimension represents the self evaluation component of burnout, and refers to feelings of incompetence and a lack of achievement and productivity in work. This lowered sense of self-efficacy is exacerbated by a lack of job resources, as well as by lack of social support and of opportunities to develop professionally (Maslach, 2006).

Organisations contribute to employee burnout in many ways and researchers have identified four factors as important contributors to burnout: high levels of work overload, dead-end jobs, excessive red tape and paper work, and poor communication and feedback, particularly regarding job performance (Ivancevich & Matteson, 2002). Bakker, Demerouti and Euwema (2005) argued that in trying to protect their employees, organisations should design the job demands in ways that people can fulfill them without harming their health. They noted that if in some cases it is impossible to reduce or optimize specific demands, for example, the cognitive load of an air traffic controller during rush hours at the airport, additional job resources should be provided, for example, in this case the help of a colleague and the freedom to take a break before or after the rush hour.

According to Schultz and Schultz (2010) age is a significant predictor of burnout with younger workers more likely to experience burnout than older workers over age 40. In air traffic control different results were reported (Martinussen & Richardsen, 2006). For example, research by Martinussen and Richardsen (2006) with 209 Norwegian ATCOs found older air traffic controllers experience higher levels of burnout than younger workers. The finding from the study

according to them may reflect that some aspects of the work of an ATCO become more demanding with increasing age. Martinussen and Richardsen (2006) cited another research conducted with Italian ATCOs that also found increasing levels of burnout with age.

Schultz and Schultz (2010) reported that women are no more likely than men to experience burnout, but marital status is related to the condition of burnout. Single and divorce persons have been found to be more likely than married persons to experience emotional exhaustion (Schultz & Schultz, 2010).

#### 2.3.2.2 Behavioural consequences of stress

Behavioural consequences of stress can be classified into two categories, that is, those that affect the worker and those that affect the organisation (Ross & Altmaier, 1994). Those that affect the worker include increased alcohol and drug use, aggression towards fellow workers, information processing and poor job performance. Behaviours that affect the organisation include absenteeism, loss of productivity and proneness to accidents.

Two behavioural outcomes of the effects of stressors relevant to air traffic control such as information processing and performance are discussed.

##### a. Information processing

Landy and Conte (2010) noted that the influence of stress on information processing has been extensively investigated. The human information processing approach characterises the human as a communication system that receives input from the environment, acts on that information, and then outputs a response back to the environment (Proctor & Van Zandt, 1994). Stress affects an array of tasks that have to be carried out at a cognitive level and as a result have a negative impact on performance. Humans have limited cognitive resources and stressful situations restrict such resources and impair our ability to cope with the tasks at hand (Landy & Conte, 2010). In air traffic control such impairment has to be minimised or eliminated as there will be serious consequences if not attended to.

## b. Performance

The relationship between stressors at work and job performance has been an interest of researchers for many years, but unfortunately according to Rosen et al. (2010) organisational scientists have had difficulty explaining why and how work stressors relate to job performance. They suggested that the main reason why it is not clear how job stress relates to performance is because there are a large number of definitions for each of these constructs.

However, through research of over a century, psychologists have been able to determine the relationship between stress and performance, that is, the relationship is curvilinear or has an inverted-U shape (Ivancevich & Matteson, 2002; Landy & Conte, 2010; Rosen et al., 2010; Stranks, 2005). According to this model the demand placed on individuals increases performance up to a certain level and then performance declines thereafter. Stress can have either beneficial or debilitating effects on performance depending on the intensity and the level of exposure to stressful situation or the stressor (Landy & Conte, 2010).

The curvilinear relationship between stress and performance indicates that as stress increases performance increases up to a certain level, and if stress continues to increase and becomes too high performance declines (Rosen et al., 2010). Low levels of stress (boredom) also results in lower performance. Many incidents or safety events experienced in air traffic control happened during the period of low traffic. Isaac (2011) reported that having too little to do can equally put safety at risk since boredom and monotony are as fatiguing as heavy workload. Vogt and Leonhardt (2005) also agree as they noted that not only overload, but also underload and boredom can lead to safety problems. Compared to situations with moderate stress or arousal, both low levels of arousal and high levels of arousal result in lower performance (Landy & Conte, 2010). Rosen et al. (2010) reported that unfortunately very little empirical research has been conducted to evaluate the effects of acute stressors on performance in field settings.

Cognitive psychology has produced some promising leads on the effects of stress on human performance, although little research has been conducted in this domain (Bourne & Yaroush, 2003). Bourne and Yaroush (2003) reported that there is evidence for a continuum of

performance, ranging from: (a) no effect (the person handles the emergency situation as he or she would in the absence of stress) to (b) facilitation (a small amount of stress actually improves performance), to (c) varying degrees of degradation (the person makes errors or inadequately slow responses) to (d) choking (characterised by performance failure due to “overthinking” the problem and attending to aspects of the situation that are irrelevant to the task at hand) to (e) outright panic (resulting in primitive ineffective responses, as if no training had ever been given, or complete paralysis). With further research this might assist researchers to better understand the relationship between stress and performance.

### 2.3.2.3 Physiological consequences of stress

Exposure to a stressful situation leads to physiological changes in the body which causes over activation of the sympathetic nervous system (Landy & Conte, 2010). Schultz and Schultz (2010) reported that during stress, adrenaline released from the adrenal glands speeds up all bodily functions, namely, rise in blood pressure, heart rate increase, and extra sugar is released into the bloodstream. Too much exposure to stress and prolonged activation of these bodily functions can have negative consequences on an individual in the long term (Landy & Conte, 2010).

Kemeny (2003) noted that the general belief in the field of stress research assumes a stereotyped physiological response to all stressors (the generality model). Kemeny’s generality model as depicted in figure 2.1, proposes that exposure to stressors and the cognitive appraisals of those events can lead to distress and that the nature of this relationship depends on the resources available to deal with the stressors (for example, coping skills, social support, personality factors, genetics, environmental resources).

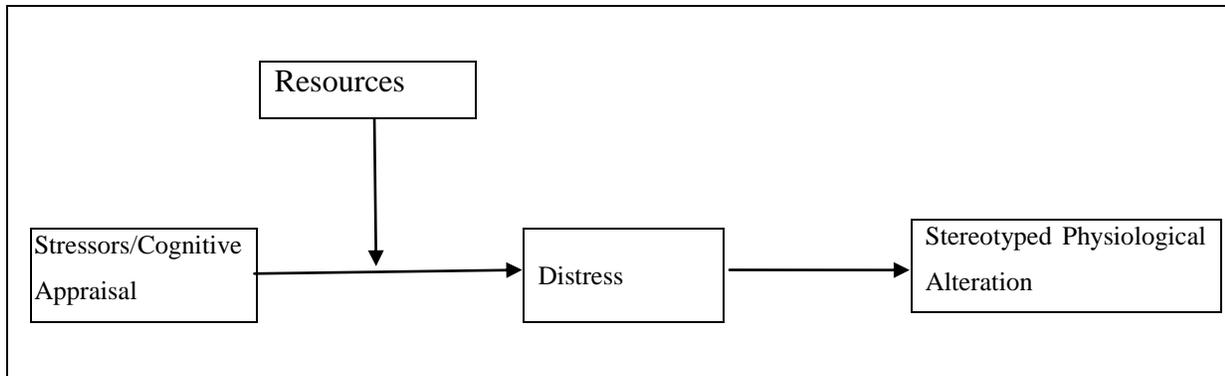


Figure 2.1. The generality model of stress (Adapted from Kemeny, 2003, p.127)

Growing evidence proposes that specific stressful conditions and the specific way an organism appraises these conditions can elicit qualitatively and quantitatively distinct emotional and physiological responses (the integrated specificity model) (Kemeny, 2003). The integrated specificity model according to Kemeny (2003) (see figure 2.2), proposes that exposure to specific stressful conditions and cognitive appraisals of those conditions shape the specific nature of an integrated psychobiological response (including emotion-motivation and physiology) to promote adaptive responses to the threat. As in the generality model, resources available to deal with the stressors can moderate this relationship.

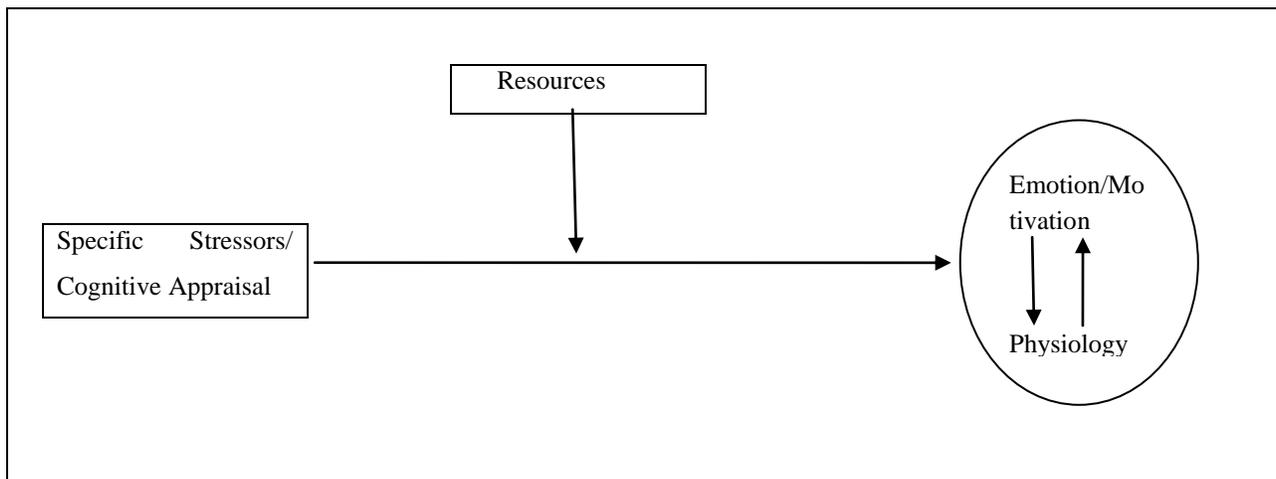


Figure 2.2. The integrated specificity model of stress (Adapted from Kemeny, 2003, p. 127)

To deal with stress effectively and mitigate against the negative consequences of exposure to stress, individuals need to have mechanisms or resources to cope with stress, and the concept of coping will be discussed next.

## **2.4 COPING**

Coping has remained a key feature of the stress literature and studies show that it can reduce the intensity of stress experiences, thereby minimize the harmful effects of stress (Brandes & Das, 2006). Coetzee et al. (2009) distinguished between coping strategies and coping resources, where coping strategies refer to behaviours occurring after the appearance of the stressor or in response to chronic stressors, and coping resources refer to those resources inherent in individuals that enable them to handle stressors more effectively, to experience fewer or less intense symptoms upon exposure to a stressor, or to recover faster after being exposed to stressors. Coping resources was the focus of this study.

Monat and Lazarus (1991) reported that while stress and its damaging effects have been studied extensively, less systematic attention has been devoted to the ways in which humans respond to stress positively. However, in the literature it has been acknowledged that a person's wellbeing is influenced not only by the amount of stress experienced, but also by how the person cope with stress (Edwards, 1988). Edwards (1988) reported that although there is widespread agreement concerning the importance of coping, there is little agreement concerning the meaning of coping and the mechanisms by which it influences stress and wellbeing. Van der Colff and Rothmann (2009) noted that as a strategy, coping refers to the different methods that individuals employ to manage their specific circumstances and the eventual outcomes of the chosen strategy for the individual.

In contrast, Monat and Lazarus (1991) said there seems to be growing agreement among professionals that coping refers to “an individual's efforts to master demands (conditions of harm, threat, or challenge) that are appraised (or perceived) as exceeding or taxing his or her resources” (p.5). According to Buunk et al. (1998) coping refers to “the way in which individuals try to change, reinterpret or reduce the negative emotions, either directly or through modifying

the causes of these emotions, for example, through instrumental action and cognitive effort” (p.157).

### **2.4.1 Theoretical approaches to coping**

A few theoretical approaches to coping have been discussed in the literature and will be reviewed as background to the present study.

#### **2.4.1.1 Psychoanalytic approach to coping**

In this approach coping is defined in terms of realistic thoughts and actions which solve problems confronting the individual (Edwards, 1988). Dewe et al. (2010) reported that this approach viewed coping primarily in terms of a defense mechanism, where individuals used various techniques to adjust the meaning of the stressful event so as to be able to manage any distress it caused. According to this approach the use of mature defenses promote better health and wellbeing than might the use of immature defenses, which are presumed to be associated with pathology (Dewe et al., 2010).

#### **2.4.1.2 Coping as a personal trait or style**

Studies adopting this approach examine the impact of a particular personality trait or coping style, such as hardiness, locus of control, or type A behaviour pattern, on the relationship between stress and wellbeing, under the assumption that individuals with certain predispositions (for example, high hardiness, internal locus of control, type B behaviour pattern) are better able to cope with stress and therefore suffer fewer of its negative consequences (Edwards, 1988). Furnham (2005) reported that whether people suffer from stress or not is largely dependent on their coping style.

#### **2.4.1.3 Coping as a sequence of stages**

In coping with stressful situations this approach suggest that individuals go through a sequence of stages as proposed by Kubler-Ross (1969). Kubler-Ross (1969) reported that terminally ill patients pass through stages of denial, anger, bargaining, depression and acceptance. This approach according to Edwards (1988) is particularly common in research on reactions to life threatening illness and injury.

#### 2.4.1.4 Coping as specific methods or foci

This approach involves the development of a taxonomy which classifies coping efforts either according to the method used or according to the focus, or target, of coping efforts. Three methods of coping have been distinguished in the literature (Edwards, 1988): (1) active-cognitive, (2) active-behavioural, and (3) avoidance. Active-cognitive coping refers to the use of cognitive (re)appraisal strategies (for example, drawing on past experiences and positive self-talk) to help change the perceived stressfulness of a situation. Active-behavioural coping refers to the use of overt behaviours (for example, seeking advice or making action plans) to deal directly with a stressor. Avoidant coping refers to denying or repressing behaviours (for example, refusing to accept the truth or using alcohol and/or drugs to relieve tension) (Edwards, 1988). Similarly, there are two foci, or targets, of coping efforts identified in the literature, that is, (1) problem-focus coping, and (2) emotion-focus coping. Emotion-focused coping use strategies which attempt to deal only with the effects of the stressor, while attempting to alleviate stress by dealing directly with the stressor is known as problem-focused coping (Davey, Hampton, Farrell, & Davidson, 1992).

The resources that people use to cope with stress are discussed in the following paragraphs.

#### **2.4.2 Coping resources**

The construct coping resources was defined by Hammer (1988) as a theoretical framework that described coping resources as those psychological capacities inherent in individuals that enable them to handle stress effectively and limit the ill effects of stress upon exposure to stressors and recover faster from a stressful event. Resources are more than just the specific coping

mechanisms or coping strategies that an individual uses when exposed to stress, but are more powerful and enduring (Hammer, 1988). Coping strategies help a person to feel better at the time when experiencing stress and resources on the other hand are reserves that an individual can draw on. Coping resources are those efforts adopted to handle life problems (Jackson & Saunders, 2006). Coetzee and Esterhuizen (2010) noted that the presence of coping resources serves as both deterring and coping functions.

The psychological coping capacities referred to by the coping resource construct as defined by Hammer (1988) are the following:

- a. *Cognitive resources*: the extent to which individuals maintain a positive sense of self-worth, a positive outlook towards others, and optimism in general.
- b. *Social resources*: the degree to which individuals are embedded in a social network able to provide support in times of stress.
- c. *Emotional resources*: the degree to which individuals are able to accept and express a range of affect, aiding the amelioration of long term negative consequences.
- d. *Spiritual resources*: the degree to which actions of individuals are guided by stable and consistent values such as those derived from religious, familial or cultural traditions or personal philosophies.
- e. *Physical resources*: the degree to which individuals enact health-promoting behaviours thought to improve physical well-being (Hammer, 1988).

Coping resources in the context of occupational stress in air traffic control is regarded as closely related to proactive coping. According to Greenglass (2005) proactive coping consists of efforts to build up general resources that facilitate the achievement of challenging goals and promote personal growth. Proactive coping involves processes in which people anticipate potential stressors and act in advance to prevent them. For example, an ATCO expecting a high traffic

volume will plan ahead on how he or she will separate aircrafts and/or call a colleague to open another sector to deal with that high volume of air traffic. By being proactive and planning in advance an ATCO is able to prevent the encounter with stressful situation.

In contrast to traditional coping models that emphasize the reactive nature of coping and focus attention on how people cope with past or ongoing stressors, proactive coping deal with anticipated stressful events that have not occurred (Gan, Hu & Zhang, 2010). Aspinwall and Taylor (1997) noted that the skills such as planning, goal setting, organisation and mental simulation are associated with proactive coping behaviour. The aim of proactive coping according to Dewe et al. (2010) is to either prevent the stressor from occurring in the first place and/or to reduce its potential impact on the person. They further reported that this is achieved through the acquisition of resources and skills which will prepare the person to tackle stressors when they arise. Different people react to stressful situations in different ways and research studies have been conducted to understand how people deal with stress, and these different ways of how people deal with stress will be discussed in the following sections.

### **2.4.3 Individual differences in resistance to stress**

People exposed to stressful situations react differently to the stressors and as a result are not affected in the same way. Some people are better able to cope with stressful situations than others (Ivancevich & Matteson, 2002). Researchers have for many years investigated a wide range of individual characteristics that moderate the relationship between stressor–strain relationships (Beehr & Glazer, 2005; Cartwright & Whatmore, 2005; Ivancevich & Matteson, 2002; Landy & Conte, 2010; Schultz & Schultz, 2010). According to Landy and Conte (2010) a moderator is “a variable that affects the direction or strength of the association between the two other variables” (p. 467). Individual difference moderators being researched in the literature are hardiness, self-efficacy, locus of control, type A behaviour pattern, and emotional intelligence.

#### **2.4.3.1 Hardiness**

Kobasa (1979) reported that people who are characterised as being hardy have a sense of control over their lives, they are committed to their work and other activities significant in their lives, and they see change as a challenge rather than a threat. Hardy people experience fewer physical illnesses under very stressful situations than people who are not hardy (Schultz & Schultz, 2010). Landy and Conte (2010) noted that a key component of hardiness is transformational coping, which involves actively changing perceptions of a stressful event by viewing it as a challenge that can be overcome.

#### 2.4.3.2 Self-efficacy

Self-efficacy is the belief people have about their ability to successfully complete an activity (Schultz & Schultz, 2010). It is the cognitive evaluations people make of their abilities to perform a specific task (Beehr & Glazer, 2005). Ivancevich and Matteson (2002) reported that persons with high levels of self-efficacy feel confident in their abilities and they are more likely to perceive potential stressors as challenges and opportunities, rather than threats and problems. In contrast, people with low levels of self-efficacy are less confident in their abilities and in successful completion of tasks. Schultz and Schultz (2010) argued that people who are high on self-efficacy are less troubled by stress than people who are low in self-efficacy.

Fox and Spector (2006) noted that people who score high on self-efficacy tend to try harder to master the challenge of difficult situations, show more persistence when they encounter obstacles, respond to negative feedback with increased effort and motivation, set more challenging goals, and work harder and longer to achieve them.

#### 2.4.3.3 Locus of control

Locus of control (LOC) is the extent to which a person sees events as a result of his or her actions (internal locus of control) or from outside causes (external locus of control) (Landy & Conte, 2010). A body of research has demonstrated that people with internal locus of control are better able to handle work stress (Fox & Spector, 2006). In contrast, Cartwright and Whatmore (2005) noted that individuals with external locus of control reported higher levels of distress

emotions, made fewer attempts to exert control over their experiences, resorted to self-blame tactics and avoidance behaviour such as sleeping and watching television, and generally perceived life to be stressful.

The locus of control – stress relationship is a function of personal beliefs and environmental realities, that is, when a person's beliefs about where control resides are congruent with the actual locus of control in a given situation, there is less likelihood stress will result (Ivancevich & Matteson, 2002). Ivancevich and Matteson (2002) gave an example that internals are more likely to experience stress when they are unable to exercise the control they believe they should, while externals will be threatened (and subsequently, stressed) in situations where they can exercise some degree of control over what is happening.

#### 2.4.3.4 Type A behaviour pattern

Type A behaviour pattern (TABP) refers to a personality type that has been studied for many years as a potential moderator of the stress-strain relationship. The person with TABP has the following characteristics (Ivancevich & Matteson, 2002):

“ (a) Chronically struggles to get as many things done as possible in the shortest time period; (b) is aggressive, ambitious, competitive, and forceful; (c) speaks explosively, rushes others to finish what they are saying; (d) is impatient, hates to wait, considers waiting a waste of precious time; (e) is preoccupied with deadlines and is work oriented; (f) is always in a struggle with people, things and events” (p. 283).

Cartwright and Whatmore (2005) also reported that these behaviours manifest themselves in the work environment as a tendency to work long hours, cut short holidays, report excessive workloads, feel misunderstood, and to display frustration and irritability when dealing with work colleagues. The behaviours that are characteristic of individuals who are diagnosed as being Type A leave them at risk for negative stress reactions (Ross & Altmaier, 1994).

The type A behaviour pattern is linked to coronary heart disease and heart attacks, and it is also called coronary-prone personality (Landy & Conte, 2010). Rosch (2006) noted that Type A

behaviour has been shown to be as significant a risk factor for coronary heart disease as smoking, hypertension and cholesterol. In contrast, Type Bs are described as relaxed, patient, easy going, and as a result are much less prone to stress (Landy & Conte, 2010).

#### 2.4.3.5 Emotional intelligence

The notion of emotional intelligence (EI) was first introduced by Salovey and Mayer in 1990, and since then it has become very popular. Salovey and Mayer (1990) defined emotional intelligence as the subset of social intelligence that involves “the ability to monitor one’s own and others’ feelings and emotions, to discriminate among them and to use this information to guide one’s thinking and actions” (p.189). They noted that there is a set of conceptually related mental processes involving emotional information, which are, (a) appraising and expressing emotion in the self and others, (b) regulating emotion in the self and others, and (c) using emotions in adaptive ways. The components of EI are depicted in figure 2.3.

Zeidner (2005) reported that proponents of EI often see effective coping with stress as central to EI, and that the way people identify, understand, regulate and repair emotions (in self and others) helps determine coping behaviours and consequent adaptive outcomes. In evaluating the relationship between emotional intelligence and stress management, Ramesar et al. (2009) argued that stress management is a component of EI, while stress can be either an input or an outflow of emotional intelligence or the lack thereof. Ramesar et al. (2009) conducted a research in a financial institution on individuals who were considered for managerial positions to determine the relationship between emotional intelligence and stress management. Occupational Personality Questionnaire 32i (OPQ32i) and Emotional Quotient Inventory (EQ-i) were used to collect data, and the results showed significant correlations of the worrying, optimistic and socially confident scales with the emotional-intelligence scales. The results supported the researchers’ view that stress management, which is coping with stress by being ‘optimistic’ and ‘socially confident’, is a component of emotional intelligence, while ‘worry’ can be either an input or an outflow of emotional intelligence or a lack thereof.

Air traffic controlling is a team based occupation, that is, air traffic controllers work in collaboration with others such as, other air traffic controllers, air traffic service officers, air traffic flow specialists and aeronautical information management officers to ensure safety of aircrafts in the sky. It is therefore important that controllers are aware of theirs and others' emotions to facilitate good relationships and as a result will manage stress effectively. Mayer, Roberts and Barsade (2008) concurred when they noted that EI influences positive relationships and enhances psychological and physical wellbeing.

For most healthy individuals emotions convey knowledge about a person's relationship with the world (Mayer & Salovey, 1997). Mayer, Salovey and Caruso (2008) noted that just as higher EI predicts better social outcomes, lower EI predicts interpersonal conflict and maladjustment, and that people with high EI tend to be more socially competent, to have better quality relationships, and to be viewed as more interpersonally sensitive than those lower in EI.

Brink (2009) studied 64 South African air traffic controllers and found no correlation between the dimensions of stress and the dimensions of emotional intelligence (self). She however, found statistically significant relationships between the dimension of stress: operating procedures and the dimensions of emotional intelligence (manager): motivation ( $r = .246; n = 64; p = .050$ ), empathy ( $r = .295; n = 64; p = .018$ ) and social skills ( $r = .287; n = 64; p = .022$ ). Mayer et al. (2008) reported that high EI correlates with better relationships in business settings and that managers higher in EI are better able to encourage productive working relationships with others.

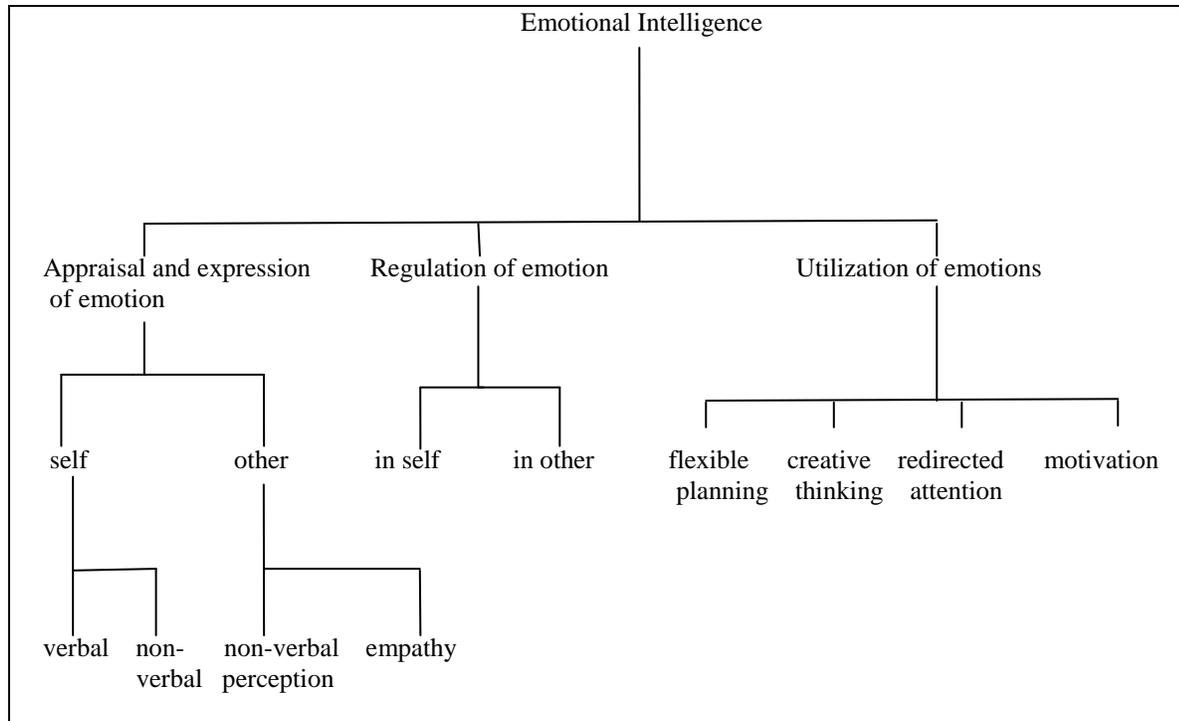


Figure 2.3. Conceptualisation of emotional intelligence (Adapted from Salovey & Mayer, 1990, p. 190)

## 2.5 SOURCES OF STRESS IN AIR TRAFFIC CONTROL

Sutherland and Cooper (1988) identified five categories of potential sources of psychosocial and occupational stress as factors intrinsic to the job, the role of the individual in the organisation, the relationships and interpersonal demands of the work environment, career development, and the organisational structure and climate. The likely sources of stress at work are many and various and differ between occupational groups and job status (Cartwright & Whatmore, 2005).

Air traffic controllers are considered one of the working groups having to deal with a very stressful and demanding job (Landy & Conte, 2010). The job entails a complex set of tasks requiring very high levels of knowledge and expertise, as well as the practical application of specific skills pertaining to cognitive domains (e.g. spatial perception, information processing, logic reasoning, decision making), communicative aspects and human relations (Costa, 1995). Schultz and Schultz (1998) mentioned that their work is hectic, difficult, and demanding, with

the additional burden of being responsible for hundreds of lives throughout each workday. To have an idea of its complexity, Costa (1995) cited a job analysis of en-route controllers carried out by group of American researchers, in which six main activities were identified as (1) situation monitoring, (2) resolving aircraft conflicts, (3) managing air traffic sequences, (4) routing or planning flights, (5) assessing weather impact, (6) managing sector/position resources, which include 46 sub-activities and 348 distinct tasks.

According to several surveys, the main sources of stress reported by air traffic controllers are connected both to operative aspects and to organisational structures (Costa, 1995). For the former, the most important are peaks of traffic load, time pressure, having to bend the rules, limitations of and the reliability of equipment (Costa, 1995). The latter are mainly concerned with shift schedules (night work in particular), role conflicts, unfavourable working conditions and the lack of control over work (Costa, 1995).

Working shifts also contribute to the amount of stress controllers experience during their working life. The adverse effects of shift working are well documented and they include biological disruption to physiological processes, including the sleep-wake cycle, the impairment of physical health and psychological wellbeing, problems with alertness, performance, safety, and interference with social and domestic life (Smith, Folkard, Tucker & Macdonald, 1998). Shiftwork causes sleep disruption (for example, insomnia at home and sleepiness at work) for most people, and this can negatively affect productivity and quality of life. Low productivity and quality of life lead to people experiencing stress both at work and at home.

## **2.6 THE ROLE OF AIR TRAFFIC CONTROLLERS**

Air traffic controllers provide a service to airlines and general aviation (for example, private pilots). Their main responsibility is to ensure safe, orderly and expeditious flow of air traffic. The primary task of an air traffic controller is to maintain aircraft separation in the national airspace (Corker, 2003; Pawlak, Brinton, Crouch & Lancaster, 1996).

Redding and Seamster (1994) noted that air traffic control occurs in a complex, time constrained, multi tasking, team work environment. They further noted that it involves a special form of expertise including not only domain knowledge but also efficient problem solving and workload management strategies that must be implemented within the time critical demands of the task.

### **2.6.1 The nature of ATC work**

According to the International Civil Aviation Organization [ICAO] (2002) air traffic control requires a lot of cognitive processing in the synthesis and analysis of significant amounts of information, the mastery of often complex procedures, real time problem solving, and the listening and speaking skills necessary for effective information transfer. The cognitive skills required to control air traffic include the following as outlined by ICAO (2002):

- **Perception** for sensing and reacting to visual and aural information. For example, detecting and resolving deviations from planned flight paths.
- **Attention (or vigilance)** sometimes for prolonged periods of intense activity, and sometimes for prolonged periods of relative inactivity.
- **Learning** to master the procedures, practices and peculiarities of the position as well as from day to day operational experience.
- **Memory** to interpret the evolving situation correctly and quickly, both short term for dealing with a situation in real time as well as long term for integrating knowledge and procedures.
- **Information processing** to synthesize many diverse pieces of changing data about traffic, weather, aerodrome conditions, and navigation aids into a coherent picture and to manage that picture in accordance with existing plans and procedures.

- ***Situational awareness*** to successfully integrate all the relevant information into a coherent and current picture. This includes knowledge of the present, past and pending situation, system functioning, human roles and tasks, and the ATCO roles, procedures and objectives. Losing this “picture” is the worst nightmare for an ATCO.
- ***Planning*** to integrate the time element by extrapolating from the controller’s picture to develop expected aircraft sequencing and spacing in accordance with established procedures and objectives.
- ***Communicating*** for both the reception and correct interpretation of information as well as for sending information and instructions, often through the barriers of language and radio noise. Effective communication also requires a feedback mechanism to confirm understanding. For example, pilots have to readback the instructions given by controllers and controllers must listen to the readback.
- ***Problem solving*** to resolve deviations from plans and cope with unforeseen circumstances such as system outages or aircraft emergencies.
- ***Decision making*** for not only the timely selection of the best alternative course of action for a particular situation, but also to appreciate how that decision will affect subsequent traffic. Not only must the traffic flow safely and expeditiously, it must continue to be orderly.
- ***Motivation*** to adhere to high standards.

The complexity, workload, automation and human factors in air traffic control and how they contribute to stressful situations will be discussed in the following paragraphs.

## **2.6.2 Complexity in air traffic control**

Air traffic control takes place in a complex environment and many studies have been conducted to determine the activities involved in controlling air traffic and its complexity (Koros, Della Rocco, Panjwani, Ingurgio & D'Arcy, 2003; Pawlak et al. 1996). Pawlak et al. (1996) noted that many of these studies have based their measure of air traffic control complexity on physical workload experienced by controllers and discounted the importance of cognitive activities of the controller.

ATCOs' job involves cognitive demanding processes, such as constantly processing changing information, keeping the mental picture of the air traffic situation, dividing attention among different situations, solving conflicts, planning ahead, working under time pressure and constantly adapting to changing circumstances (Schuver-van Blanken, Huisman & Roerdink, 2010). These activities happen at the same time when the controller is on position and requires that the controller pay attention, and is alert all the time to ensure safe operation of air traffic. Ensuring safe separation of aircrafts in the sky in a complex system is not an easy task and requires constant use of cognitive processes.

In order to understand and address the issues of cognitive complexity of air traffic control, Schuver-van Blanken et al. (2010) developed a model called ATC Cognitive Process & Operational Situation model (ACoPOS). As shown in figure 2.4, the model was developed by combining the insights of the complexity factors in the operational situation as well as cognitive processes involved in air traffic control and the practical operational experiences. The elements of the model as developed are discussed in the following section.

#### 2.6.2.1 Cognitive processes in air traffic control

After an extensive literature review three main categories of cognitive processes were included in the model: situation assessment, problem solving & decision making and attention management & workload management (Schuver-van Blanken et al., 2010). Certain actions are executed as outcomes of these cognitive processes.

*a. Situation assessment*

The process of situation assessment results in situation awareness (SA), or the mental representation of the situation, and it involves three levels of SA (Schuver-van Blanken et al., 2010). The higher level depends on the success of the lower levels: 1) Perception: basic perception of information, such as aircraft, requests, clearances and weather conditions; 2) interpretation: creating an understanding of these elements in a complete picture, for example, conformance to clearances, timing issues and the impact of occurrences (e.g. weather conditions); 3) Anticipation: projecting the future state of the elements and the operational situation, involving aspects such as projection of aircraft routes, detection of conflicts and separation. Schuver-van Blanken et al. (2010) noted that gaining and maintaining SA can be cognitively demanding, as a result of the dynamic and interactive nature of the elements in the operational situation and the interaction with the other cognitive processes.

*b. Problem solving & decision making*

ATCOs are decision makers in a dynamic environment involving many factors, such as constantly updating relevant information and resolving conflicting goals, and often make difficult decisions with incomplete information, under time pressure, and with high workload (Koros et al., 2003). In making decisions ATCOs search for patterns and relevant cues of problems or difficulties which are commonly encountered and establish a particular course of action, and in those situations in which no appropriate solution is available they use problem-solving techniques to develop a new solution (Schuver-van Blanken et al., 2010).

*c. Attention management & workload management*

Paying attention to the evolving air traffic situation helps in maintaining situational awareness and keeping the mental picture of the traffic in the airspace. According to Schuver-van Blanken et al. (2010) it involves continuously directing attention to information sources to determine whether the actual situation is consistent with the expected situation. They further noted that by

managing their workload, ATCOs are able to avoid working reactively and eventually losing situational awareness.

#### *d. Actions*

Schuver-van Blanken et al. (2010) reported that the outcome of the cognitive processes results in actions executed by the air traffic controller to interact with the operational environment and implement plans and solutions. Radio telephony (R/T), coordination, teamwork and the use of operational systems are some of the actions that are executed by the controllers to interact with the operational environment (Schuver-van Blanken et al., 2010).

#### 2.6.2.2 Operational ATC situation

Some elements in the operational situation result in cognitive complexity (Schuver-van Blanken et al., 2010). Based on studies conducted on complexity factors, Schuver-van Blanken et al. (2010) distinguished between categories of elements in the operational situation as follows:

##### *a. Safety, Efficiency and Environment*

The operational situation is characterised by the requirements in terms of safety, efficiency and environment that have to be met and continuously balanced in ATC (Schuver-van Blanken et al., 2010). Vogt and Leonhardt (2005) reported that the core business of air traffic control is safety. According to Schuver-van Blanken et al. (2010) while safety is kept at first priority, efficiency is increased as more aircraft have to be handled in less time and with more punctuality. Schuver-van Blanken et al. (2010) further noted that continuously balancing and meeting safety, efficiency and environmental demands is at the heart of the ATC task.

##### *b. Strategic traffic situation*

The complexity of the air traffic is influenced by the pattern of the strategic traffic situation. The physical framework within which air traffic has to be handled is set by the strategic traffic

situation (Schuver-van Blanken et al., 2010). The strategic situation can (either permanently or temporarily) vary in: airspace structure and sectors; airport layout and runways used; traffic volume and density; and flight planning and flow management. High traffic volume and frequency congestion represent the leading factors influencing complexity (Koros et al., 2003).

#### *c. Tactical traffic situation*

The tactical traffic situation comprises the actual traffic situation, the aircraft positions and clearances given, the mix in traffic and aircraft performances, the traffic flows and routings, the actual weather situation and emergencies and exceptional situations (Schuver-van Blanken et al., 2010). It is characterised by the dynamic nature of the situation, with continuous changes in the information and situation and factors interacting with each other. These often result in unexpected situations that can be cognitively demanding. Koros et al. (2003) reported that much of the complexity is characterized by unplanned demands and having to dynamically re-plan in response to weather, traffic management initiatives, airport construction, maintenance activities, and other events. Unplanned tasks make it difficult for controllers because they cannot prepare for them and may increase controller workload.

#### *d. Teamwork*

Air traffic controllers work in various team situations and these teams consist of ATCOs, in the own sector, including supervisors and assistants, as well as colleagues from adjacent sectors and centers, and also pilots. Schuver-van Blanken et al. (2010) noted that due to changes in the strategic traffic situation, working positions can be combined or separated, resulting in changes in team configuration and operating procedures. These changes increase the complexity of controlling air traffic.

#### *e. Procedures*

According to Schuver-van Blanken et al. (2010) the procedures describe the formal operating procedures within which air traffic has to be handled, and comprises standard operating

procedures and rules for providing air traffic control as well as working methods. Cognitive complexity is influenced by the number of procedures used, the complexity of procedures, diversity in working methods and the increase of legal liability issues. Pawlak et al. (1996) noted that some of the procedures that are established for the control of air traffic require multiple or lengthy instructions to be communicated to every aircraft.

*f. Technical Systems*

ATCOs use several systems in performing their tasks, and they include communication systems, planning systems and navigation and surveillance systems (Schuver-van Blanken et al., 2010). For example, the decision support tools such as the radar system assist the ATCO in performing complex tasks, by providing information, alerts or filtering information. Schuver-van Blanken et al. (2010) noted that the design of these systems can heavily impact complexity: a mismatch between system characteristics and human information processing can increase cognitive complexity, for example, because the cognitive process cannot be performed intuitively. System software designs are often less optimal because of the complexity of the information that must be transmitted, the numerous ways it can be done, and the distinct skill levels of the various users (Proctor & Van Zandt, 1994). A user friendly system designed to what is required by the air traffic controller is therefore important.

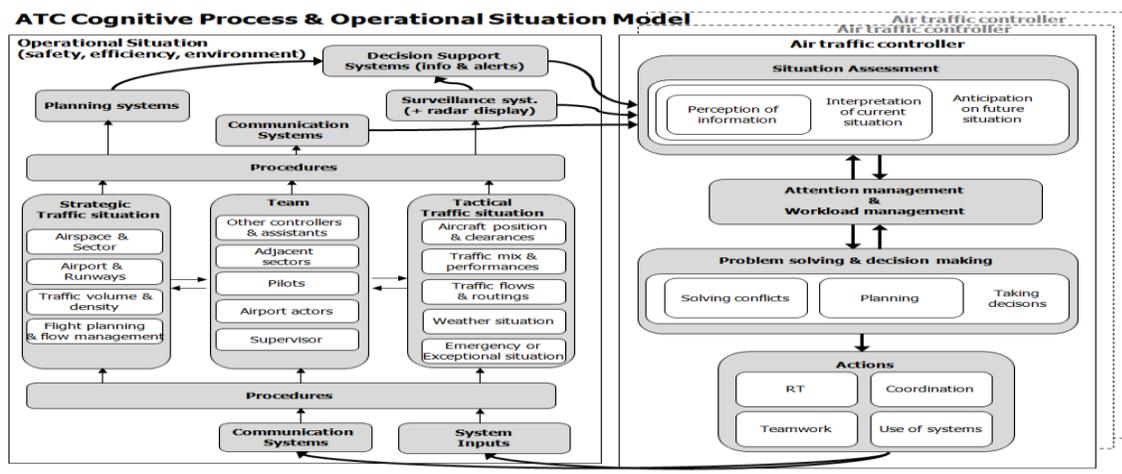


Figure 2.4. The ATC Cognitive Process & Operational Situation model (ACoPOS model) (Adapted from Schuver-van Blanken et al., 2010, p. 84)

### **2.6.3 Air traffic control workload**

The rapid and continued growth in air traffic globally is outpacing and putting strain on air traffic control systems to handle the traffic volume and its inherent complexity (ICAO, 2002). Because of this rapid growth the workload of controllers also increases. The concept of workload in air traffic control have been studied for many years and according to Gaillard (cited in Collet, Averty, Delhomme, Dittmar & Vernet-Maury, n.d.), mental load and stress are related concepts that originate from different theoretical frameworks. When an individual experiences high mental workload he or she becomes stressed if the workload is not handled properly.

Air traffic controllers operate in high pressured situations every day when on position because of the responsibility bestowed on them to ensure safety in the sky. The pressure and complexity of their job is compounded by workload (Galster, Duley, Masalonis & Parasuraman, 2001). Researchers believe that stress is a product of workload (Bourne & Yaroush, 2003; Corker, 2003; Franco, 2008; Vogt & Leonhardt, 2005). Stress is experienced during both high workload operating phase and low workload operating phase. Strauch (2004) noted that workload affects an operator's ability to attend to and interpret necessary cues, and thus affects situational awareness. In a complex system such as air traffic control if the operator loses the picture of the traffic (situational awareness), it becomes a stressful situation as the workload increases while the controller attempts to regain the picture of the traffic.

Many of the studies regarding workload in air traffic control were conducted in the laboratory and according to Bourne and Yaroush (2003) laboratory studies generally focus on relatively weak acute stress. Villena, Acevedo, Cruz and Le Gal (2008) also concur when they noted that experiments regarding workload in air navigation have been performed under very simplified simulated conditions, often far from the reality. During the experiments controllers are exposed to simulated stressful events that might not necessarily be the true reflection of the actual events. For example, Galster et al. (2001) examined the effects of conflict detection and self-separating aircraft resolution on the mental workload and performance of en-route air traffic controllers. An air traffic control simulator was used to manipulate traffic loads and traffic complexity. In

determining the effect of light and heavy workload on air traffic tactical operations, Kuk, Arnold and Ritter (1999) also used simulation of two en-route ATC sectors.

Workload can either be caused by physical or mental task loadings. Villena et al. (2008) noted that it is not possible even if they are frequently compared to realize equivalences, neither theoretical nor methodological, between physical and mental workload. Due to the nature of the job compared to other professions that are considered to be very stressful, such as police and nursing, one can assume that air traffic controllers experience mostly mental workload as opposed to both physical and mental workload. Air traffic controllers experience mental demand as a source of workload. According to Kissing, Zierke, Hoermann and Eißfeldt (2010) mental demand is a concept which is connoted to the general cognitive operations of thinking, deciding, mental arithmetic, remembering, and searching.

Both overload and underload have been found to have the same effect of stress in air traffic control (Galster et al., 2001; Kuk et al., 1999). Being stressed as an air traffic controller has serious safety implications, and Vogt and Leonhardt (2005) reported that not only overload, but also underload and boredom can lead to safety problems. Controlling air traffic requires air traffic controllers to be vigilant throughout when on position, and workload affects vigilance and situational awareness. Strauch (2004) noted that in high workload conditions operators' cognitive capacity to attend to multiple cues become limited due to work intensity, and that in low workload operators may reduce their vigilance to the point that they attend to cues ineffectively, or fail to seek out the cues necessary for situational awareness.

Studies have indicated that the number of aircraft under control and potential conflicts between them are the main workload factors in air traffic control (Vogt & Leonhardt, 2005). They further noted that the number of aircraft under control is the only well-established indicator of ATCO workload. As the number of aircraft under control increase, mental workload also increases as conflict resolution and detection of traffic also increase. In contrast, Collet et al. (n.d.) confirmed the hypothesis that observation of a controller managing a number of aircraft in a given ATC sector tends to show that number of aircraft under control is not a perfect index, especially as aircraft configurations (the way these are spread over space and time) heavily influence it.

Instead they suggested that emotional activity, that is, workload subjective aspects, should be taken into account in the evaluation of workload.

Automation has generally been seen to reduce workload of the operator (Strauch, 2004). The role of automation in air traffic control will be discussed next.

#### **2.6.4 Automation in air traffic control**

The rapid growth of air travel around the world put huge pressure on air traffic systems and how air traffic controllers do their job (ICAO, 1998). It is envisaged that in future the way air traffic is controlled will change from active controlling to monitoring by controllers. The shared decision making responsibilities between controllers and pilots will necessitate that controllers be supported by automated decision making aids (Metzger & Parasuraman, 2005). Automation is often introduced to reduce human mental workload in human-machine interaction and it is intended to allow human operators to cope with growing task demands and task complexity and thus to increase overall system capacity, safety, and reliability (Kolrep, Oehme & Mohs, 2010).

Automating tasks or system functions by replacing the human's sensing, planning, decision making, or manual activities with computer based technology requires making decisions of which functions to be allocated to human and which to be delegated to automatic controls (Sharit, 2006). If tasks are not distributed efficiently and there is an imbalance in the distribution to either human or automation functions or tasks, humans might experience stress due to the frustrations encountered with the system (Eschen-Léguedé, Gasche & Eißfeldt, 2010).

Proposals have been made for changes in ATC procedures and one of them is to give users (for example, pilots) the freedom to choose their routing to their destination (Metzger & Parasuraman, 2001). Under "free flight" (FF) pilots will have more freedom to choose their heading, altitude, and speed in real time and primary responsibility for maintaining separation from other aircraft (Metzger & Parasuraman, 2005). For these changes to be implemented successfully, some of the procedures and tasks will have to be automated. Eschen-Léguedé et al. (2010) noted that in fact, working procedures in aviation have become more and more

automated, however humans will remain the core of operations. Working procedures in an automated environment have to be performed by a human and an automated system in close interaction, and such collaboration can be understood as teamwork between human and machine, that is, a "hybrid team" is formed (Eschen-Léguedé et al., 2010). There are benefits and shortcomings of automation and these will be discussed in the following paragraphs.

#### 2.6.4.1 Benefits of automation

There is no doubt that automation in the complex system such as in air traffic control has brought benefits (Strauch, 2004). Many of the direct benefits of automation are accompanied by indirect benefits in the form of error reduction (Sharit, 2006). Strauch (2004) noted that automated systems performs many cognitively demanding tasks faster and more accurately than humans could, and that assigning cognitively demanding tasks to machines reduces mental workload. For example, the eurocat system (system used by controllers to separate traffic) reduces the workload of controllers in that the system calculates the distance between aircraft and can highlight conflict between aircraft, and this allows the controllers to concentrate more on high priority tasks. Controllers' situational awareness and their ability to recognize and respond to a potentially dangerous situation are enhanced by the system.

Air traffic controllers' main responsibility is to ensure safety in the airspace, and safety is enhanced by accurate information from the system that increases the controllers' abilities to effectively respond to conflicts (Metzger & Parasuraman, 2005). According to Keinrath, Vašek and Dorneich (2010) human-automation systems perform complex tasks in complex and dynamic environments better than automation-alone or human-alone systems. This "hybrid team" makes it possible for safety to be realised in the complex air traffic control system (Eschen-Léguedé et al., 2010).

New generation equipment provides more accurate, reliable and up to date data about the position of each aircraft, its plans and intentions, its flight level and speed, and its flight progress (ICAO, 2002). With this kind of information readily available the controller is able to make quick and accurate decision and experiences less stress. Although there are benefits brought by

automation in air traffic control, there are also challenges and shortcomings and will be discussed next.

#### 2.6.4.2 Shortcomings of automation

Keinrath et al. (2010) noted that it is also a fact that there can be a considerable penalty in human attention and effort when interacting with automated systems. They gave an example that the difficulty in trying to understand what automation is doing, or locating relevant information, or even commanding the automation to perform its functions can degrade the efficient and safe performance of the intended underlying functions.

With every human machine interaction (HMI) there is always a challenge for humans to use the system according to its specifications at all times. Strauch (2004) reported that the operators' self confidence in their ability to operate the system effectively depend on their experiences with the system. If their experience with the system is not pleasant, they are more likely to dislike using the system and commit more errors.

The purpose of automation is to reduce workload of the operators; however in some instances the opposite is achieved. It is reported that automation reduces workload during already low workload phase and increase workload during already high workload phase, and create a phenomenon referred to as *clumsy automation* (Metzger & Parasuraman, 2001; Strauch, 2004). Keinrath et al. (2010) also noted that some well-known human-automation interaction problems are uneven distribution of workload, inappropriately aligned trust in automation, breakdown in mode and automation awareness, delays in finding, interpreting and integrating information, and human input errors.

Research has shown that increasing automation and decreasing operator involvement in system control reduces operator ability to maintain awareness of the system and its operating states (Strauch, 2004). Strauch (2004) further noted that operators may find unexpected system events to be stressful, such as displays with information that cannot be interpreted, unexpected aural warnings, and controls that appear to be ineffective.

### **2.6.5 Human factors in air traffic control**

Modern aviation has become a more complex system characterised by congested airports and airspace, new technologies in air traffic management and airports, high traffic volume, and high production pressure (ICAO, 2002). Because of all these pressures stress is created and mechanisms are needed to understand and mitigate the adverse effects of stressful situations. ICAO (2002) noted that stress affects human performance particularly so in aviation environment which is rich in potential stressors. Human factors is the study of those variables that influence the efficiency with which the human performer can interact with the inorganic components of a system to accomplish the system goal (Proctor & Van Zandt, 1994). The human in the system is in the centre and if a human fails to perform in the system, the whole system collapses. It is for this reason that human capabilities and shortcomings are studied to understand the role of human in the human-machine interaction. Human Factors is studied to understand humans at work, to improve quality and efficiency in organisations (Eurocontrol, 1997).

The human element in the interaction between man and machine is the most adaptable, flexible and important part of the aviation system and at the same time it is also the most susceptible to influences which can adversely affect its performance (Civil Aviation Authority [CAA], 2002). Research has shown that 70 percent of the accidents in aviation are attributed to less than optimum human performance (CAA, 2002; Cebola & Kilner, 2009; Strauch, 2004). ICAO (2002) noted that understanding the predictable aspects of human performance and limitations and applying this understanding in the operational environments are the primary concerns of human factors.

Studying human factors as science draws from different disciplines and use the information from these disciplines to understand a human being better in order to enhance human performance. According to ICAO (2002) at the level of the individual, information is drawn from psychology to understand how people process information and make decisions. From psychology and physiology comes an understanding of sensory processes as a means of detecting and transmitting information on the world about humans. Anthropometry and biomechanics are

called upon to understand the measures and movements of the body, which is essential in optimizing the design and layout of controls, and other workplace characteristics. Biology and its subdiscipline, chronobiology, help to understand the nature of body rhythms and sleep, and their effects during shift work, working at night, and time zone changes. Human factors in aviation safety is essentially concerned with solving practical problems in the real world based on scientific findings evolving from the research community (ICAO, 2002).

ICAO (1998) reported that in addition to safety, orderliness and expedition, the air traffic control system has several less known objectives, such as, fuel conservation; noise abatement; minimum environmental disturbance; cost effectiveness; impartiality towards all users within the rules and regulations; and the granting of users' requests whenever possible. The knowledge and understanding of human factors is important in that when they encounter these challenges air traffic controllers will be in a better position to react in an appropriate manner and avoid being stressed. Air traffic controllers in their daily interaction with machines, the environment and other human beings are required to understand how each of these elements affects how they do their job (Edwards, 1972).

To better understand the different parts in the whole system in aviation and how they interact with one another, Edwards (1972) designed a model called SHELL model and this model will be discussed in the following paragraphs.

#### 2.6.5.1 A conceptual model of human factors

The SHELL model was created by Edwards (1972) in order to understand the interrelations of socio-technical system components in the safety critical system in aviation. The components of the model as depicted in figure 2.5 stands for:

**S = Software.** This category includes written items such as regulations, maps, charts, standard operating procedures, checklists, letdown procedures, standing instructions, and manuals.

**H = Hardware.** This refers to all physical aspects of the equipments such as loading aids, seats, instruments, radios, and navigation equipment.

**E= Environment.** Characteristics of the workplace or operating environment such as wind, temperature, ambient light, terrain, company culture, and facilities and structures.

**L= Liveware.** The human as component. This entails qualities of the operator in terms of abilities, training, experience, knowledge, attitudes, stress level, and so on. The operator is the centerpiece of the model, interacting with other components, and reflecting the importance of the human factor in accident investigations.

In the centre of the SHEL model is a human, the most flexible and important component in the system to which other components of the system must be carefully matched if stress and things going wrong in the system are to be avoided (ICAO, 2002). In air traffic control careful matching of these components is particularly important because of the nature of the job. As mentioned previously controlling air traffic is one of the most stressful jobs, hence it is important to understand how a human as a central component interact with other components in the system. The examples as given by ICAO (1998) on the SHEL interfaces for ATC are discussed in the following paragraphs.

*Liveware-software:* Existing differences in altimeter setting procedures (inches vs. hectoPascals; height of transition altitudes and/or levels) may lead to errors by crews who operate in foreign or unfamiliar airspace. National or local ATC procedures manuals are not up-to date with applied operational procedures. The consequence of this misalignment may lead to ATCOs experiencing stress.

*Liveware-hardware:* Adjustable chairs with wheels are often more comfortable than rigid chairs with traditional legs. Enough serviceable headsets are provided to ATCOs to use when on position controlling traffic.

*Liveware-environment:* Provision of temperature-control and/or air conditioning in the operations rooms. In towers - slanted windows, tinted glass, etcetera. Positioning of the tower to avoid looking into the sun most of the day.

*Liveware-liveware:* Every aspect of co-ordination and communication between controllers themselves or other humans in the system (for example, pilots).

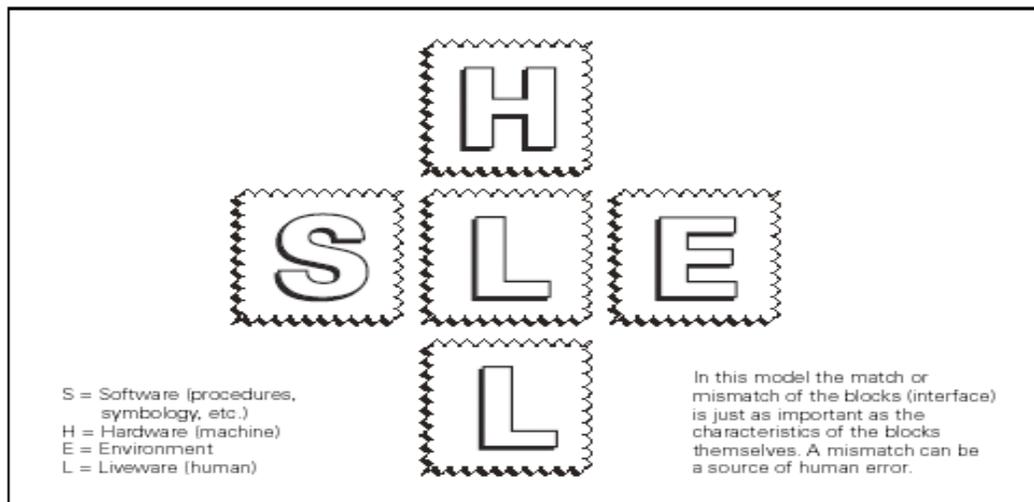


Figure 2.5. SHEL model as modified by Hawkins (Adapted from CAA, 2002, p. 3)

The various blocks of the SHEL model are depicted with irregular surfaces (ICAO, 2002). This irregularity highlights the fact that the relationship or interaction between human and other components of the system is not smooth. For example, in air traffic control the positioning of the equipments on the console might be difficult to reach by controllers and as a result that situation in itself creates stress, and negatively affects the controller's performance. It is for this reason that whenever there are changes in any component of the system, it must be considered how those changes will affect other components in the system. To mitigate the negative effects of stress, organisations have designed programmes to assist employees to deal with stress better, and one of these programmes in air traffic control will be discussed.

## 2.7 STRESS MANAGEMENT

Stress affects many people in organisations and has negative consequences to the productivity of the business, hence some organisations have taken an initiative and designed stress management programmes to assist employees who are experiencing stress (Cartwright & Cooper, 2005). However, despite widespread recognition that stress is an important issue and its upsetting consequences to people's lives and performance at work, not all organisations have given this issue the attention it deserves. Dewe et al. (2010) noted that the level of attention given by organisations to addressing stress-related issues is still relatively small when compared with their investments in other areas such as financial budgeting, marketing and technological development.

Organisations that have introduced the stress management programmes, many of them have adopted the broad brush, companywide wellness programmes and policies to promote healthier lifestyles and create awareness to detect early symptoms of stress (Dewe et al., 2010). Cartwright and Cooper (2005) noted that the impact of such health promoting activities have received mixed support evidence for their effectiveness as the means of combating stress. In support to these initiatives, Quick et al. (2006) reported that the benefits of health programmes such as improved diet, increase exercise, weight loss, smoking cessation, and the acquisition of stress reduction techniques have been demonstrated to improve general health of the employees.

Ross and Altmaier (1994) reported that intervention strategies in most stress management programmes fall short because they are curative in nature. They are aimed at curing problems after workers have already experienced the negative effects of stress. Williams and Cooper (2002) argued that proactive stress management combined and supplemented by behaviour changes that build the ability to cope with pressure is effective in preventing and managing stress. They noted however, that in practice a lot of stress management in the organisations does neither of these and focuses instead on repairing the casualties of workplace stress through counseling and advice.

It can be argued that treating symptoms and the damage caused by stress is not necessarily a bad thing, however, that approach is not effective in the long run. Prevention of stress is much more cost effective and has lasting positive effect on employees' wellbeing and the productivity of the organisation (Quick et al, 2006). Treating the casualties is one form of intervention but is at the wrong end of the prevention spectrum, and best practice dictates that prevention is better than cure (Williams & Cooper, 2002).

One of the ways in which organisations consider interventions is to reflect on the level of intervention (Cooper, Dewe & O'Driscoll, 2001). The conceptual framework for managing stress in the organisations is discussed in the following paragraphs.

### **2.7.1 Conceptual framework for stress management interventions**

Organisations have designed strategies to combat the debilitating effects of stress and in some instances these interventions are not based on any research framework (Dewe et al., 2010). By not basing their interventions on researched and validated stress frameworks, organisations are unable to track and measure the effectiveness of those interventions. A conceptual framework for stress management interventions which has frequently been cited in the literature has three different levels of intervention, that is, primary, secondary and tertiary interventions (Dewe et al., 2010).

Primary interventions as Dewe et al. (2010) put it, build up on an assumption that the most important way to reduce stress in the workplace is to remove or at least reduce the sources of stress, that is, the stressors themselves. Williams and Cooper (2002) noted that these interventions seek to remove or moderate the effect of stress by removing or moderating the source of the problem. For example, in air traffic control instead of opening one sector when it is busy, two sectors are opened to reduce the workload of an air traffic controller. Workload as a stressor is reduced and the controller experiences less stress because of that intervention. The primary intervention is more preventative and proactive in dealing with stress. Dewe et al. (2010) noted that the preventative and proactive models of dealing with stress derive from the more

general person-environment fit perspective, where the focus is on modifying the environment to meet the workers' needs.

Secondary interventions seek to moderate or remove the impact of stress on the employees by enhancing their capacity to cope, and leave the source of the problem unaddressed (Williams & Cooper, 2002). Dewe et al. (2010) noted that secondary interventions do not aim to deal directly with stressors but rather to modify the reactions of people to those stressors. They further mentioned that one of the prominent approaches used is stress management training (SMT), and it involves assisting individuals to enhance their coping skills or modify their appraisals of stressors. According to Cartwright and Cooper (2005) stress management training is an umbrella term used to describe a wide range of activities designed to improve stress resilience in individuals. For example, some SMT programmes focus on a single technique, that is, relaxation training or time management, while other programmes are multimodular combining educational activities with a range of different cognitive and behavioural methods. While primary interventions are by description proactive, secondary interventions may be either proactive or reactive (Dewe et al., 2010).

Tertiary interventions deal with the treatment of a person who is already experiencing or suffering from stress (William & Cooper, 2002). According to Dewe et al. (2010) this level of intervention largely reflects a rehabilitation approach to stress management. They reported that the most well known example is the employee assistance program (EAP), which normally involves some type of counseling for workers who report strain or other difficulties. EAPs are used by employees and their families, and are offered either internally or externally by a service provider. The purpose of tertiary intervention is to heal a person suffering from stress and to increase a person's capacity to deal and cope better with stress, rather than prevent it (William & Cooper, 2002). Because tertiary intervention does not proactively put strategies in place to either eliminate or reduce the effect of stress, it can be considered to be reactive rather than preventative.

Air traffic controllers experience critical incident stress, that is, unusual strong emotional reactions to a stressful situation and normal stress management programmes are not sufficient to

deal with such a situation (Eurocontrol, 1997). As a result the concept of critical incident stress management (CISM) has been adopted in air traffic control to deal with stress experienced by air traffic controllers, and is discussed in the following sections.

## **2.8 CRITICAL INCIDENT STRESS MANAGEMENT**

Incidents and accidents in air traffic control often have serious impact psychologically on the person witnessing such an event (Eurocontrol, 1997). Stress reactions of air traffic controllers after critical incident elicit strong emotions that if not attended to might have long term undesirable effects. A critical incident is any situation that causes a person to experience unusually strong stress reactions that the person perceives as disturbing or disabling (Eurocontrol, 2008).

Stress reaction to a critical incident is more severe than day-to-day stress and requires different approach in dealing with the situation (Eurocontrol, 1997). Critical incidents impair work performance and affect tasks such as decision making, concentration, identifying known persons or objects (aircraft), memory, and decisiveness (Vogt & Leonhardt, 2005). Vogt and Leonhardt (2005) further noted that the stress reactions cause significant irritations to self-conception of an ATCO. Air traffic controllers are highly trained professionals and any feeling of self doubt will negatively affect them. Their profession requires that they always remain in control of the situation and exposure to a critical incident undermines the feeling of being in control. Critical incident stress reactions may occur at different degrees of intensity and type, and some have the potential to promote the development of a chronic stress disorder (Eurocontrol, 2008). CISM plays an important role in that it is the first step in reestablishing personal abilities and confidence, stabilizes, and gets the affected ATCO fit to go back to controlling traffic (Everly, 2000).

The following incidents may be regarded as critical incidents in air traffic control (Eurocontrol, 2008):

- disasters and occurrences which cause devastating damage,

- severe accidents,
- separation infringement,
- aircraft emergencies,
- events which result in casualties,
- casualties of children, relatives, colleagues,
- destruction of own personal environment,
- criminal offences, assaults or threats,
- personally experienced/witnessed violence,
- near incidents or accidents.

With every shocking event, feelings of intense fear and helplessness or horror are caused, and the event causes trauma to the person involved (Eurocontrol, 1997). The person experiences intense emotions and these emotions come with questions about the event and the individual's role in the event. According to Eurocontrol (1997) emotions experienced by the person involved in the incident can be recognised by symptoms of:

- Intrusion (like nightmares, acting or feeling as if the event were recurring, flashbacks),
- Avoidance (like avoidance of conditions related to the event, inability to recall important aspects of the event, loss of interest),
- Hyperarousal (like difficulty in concentrating, difficulty in falling or staying asleep, irritability).

### **2.8.1 What CISM is**

CISM is a comprehensive, integrative, multicomponent crisis intervention system (Everly, 2000). According to Eurocontrol (1997), CISM is the structured assistance for a normal reaction to an abnormal event. It is a program developed to help employees minimize the adverse impacts of stress and to assist those who are adversely affected by critical incidents recover more quickly from their normal reactions to abnormal events. CISM is considered comprehensive because it

consists of multiple crisis intervention components which span both the temporal and functional spectra of a crisis, and its interventions range from the pre-crisis phase, through the acute crisis phase, and into the post-crisis phase (Everly, 2000). Everly (2000) further noted that CISM consists of interventions which may be applied to individuals, small functional groups, large groups, families, organisations, and even entire communities.

Responses to stress may be immediate and incident specific, or they may be delayed for a period of time after an incident and can cause serious negative consequences if not mitigated (Eurocontrol, 2008). Immediate action oriented intervention such as CISM encourages a victim of incident stress to do something to try to understand what is going on instead of staying in a state of passiveness, shock and confusion (Eurocontrol, 1997).

CISM can be classified as a secondary intervention as it is both proactive and reactive. It is proactive in that people are educated about stress and stress management prior to their exposure to traumatic events. It is reactive in that CISM team members are activated during and after critical incidents in order to provide emotional support and professional referrals for those affected (Everly, 2000). Eurocontrol (2008) also reported that CISM methods are secondary preventive measures which consist of discussions about the incidents in the form of structured individual and group discussions and help the persons affected regain their ability to apply coping strategies.

The person involved in the incident has the discussions performed by a colleague who have been trained and qualified in Critical Incident Stress Debrief (CISD). Having colleagues performing CISD is effective in that they understand what the person is going through and the person is able to talk about his or her feelings openly. The people involved in the CISM discussion are at the same level and understand one another better. The environment being created allows and encourages the person involved in an incident to open up and the healing process happens quicker (Everly, 2000).

CISD consists of elements such as ensuring confidentiality, providing individuals with the opportunity to talk about their perspective on, thoughts about, and the emotional reactions to the

incident, assessing psychological and physical symptoms, and providing information about stress responses and coping strategies (Schat & Kelloway, 2005). CISD involves providing assistance immediately following critical incident or traumatic event in order to prevent serious and long term negative consequences from developing.

### **2.8.2 Objectives of CISM measures**

Objectives to be achieved by applying CISM measures (Eurocontrol, 2008):

- reduce critical incident stress reactions as quickly as possible,
- "normalise" the unusual experience and reaction,
- reactivate the cognitive functions and processes affected by the incident,
- regain the ability to work as soon as possible.

Research has shown that when CISM measures are implemented in the organisations, the person who has been affected find it easier to cope with the critical incident experience and recover quicker to commence tasks that he or she was busy with before the incident (Eurocontrol, 2008; Everly, 2000). Different techniques that are employed to combat the unpleasant consequences of exposure to critical incident stress are discussed next.

### **2.8.3 CISM techniques**

Prolonged exposure to stress may potentially trigger psychological disorder, and specific techniques to support people who experienced critical incident stress have been developed over the years (Eurocontrol, 1997). CISM techniques are not a therapy; they are a form of prevention and are designed for peers to help peers. A person does not need a professional background in human sciences to apply CISM techniques, but do need training and practical experience.

There are two complementary approaches of CISM techniques, that is, one-on-one counseling and group session (Eurocontrol, 2008). In one-on-one counseling the trained peer talks with the person who experienced critical incident and supports him/her in moderating the impact of the crisis. With the group session technique, various witnesses of the same critical incident gather and exchange their experiences. CISM intervention does not stop once defusing and debriefing of the critical incident stress has taken place, but a follow-up of the counseling sessions is also important to ensure that critical incident stress management does reach its objectives (Eurocontrol, 1997).

## **2.9 CHAPTER SUMMARY**

In this chapter, research and models pertaining to the concepts of stress and coping, and their relevance to air traffic control were discussed. The concept of stress was defined and explained as well as how stress affects air traffic controllers. Secondly, the concept of coping and coping resources were discussed. The role of air traffic controllers was discussed to understand how the work as an air traffic controller influences how people in this job experience stress. Lastly, stress management interventions and how stress is managed in the air traffic control environment were discussed.

## CHAPTER 3: RESEARCH ARTICLE

### OCCUPATIONAL STRESS AND COPING RESOURCES IN AIR TRAFFIC CONTROL

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#### ABSTRACT

**Orientation:** Stress presents a serious challenge in air traffic control and requires air traffic controllers to develop coping resources to effectively deal with work-related stress.

**Research purpose:** This study explored how air traffic controllers cope with work-related stress (as measured by the Coping Resources Inventory), and to also determine if there are statistically significant differences in the coping behaviour of air traffic control staff from different groups.

**Motivation for study:** Air travelling has increased and is expected to continue to increase as more people are now choosing to fly than using other modes of transport. With the increase in air traffic, air traffic controllers will experience more stress as there will be more airplanes in the sky to separate. Exposure to stressful situations for a long period of time can be harmful and there is a need to understand how air traffic controllers cope with work-related stress.

**Research design, approach and method:** A survey design and quantitative statistical procedures were used to achieve the research objective. Convenience sampling was used. 100 questionnaires were distributed and 82 questionnaires (80 usable responses) were returned (82% response rate).

**Main findings:** The hypothesised theoretical framework of coping resources was not supported by the empirical results. The results showed that air traffic controllers use emotional coping resources to cope with stressful work situations and make less use of cognitive coping resources. The results also showed that there are no statistically significant differences in the coping behaviour of air traffic control staff from different groups.

**Practical implications:** The insights derived from the findings can be used by air navigation service providers to devise stress management and coping programmes for controllers to more effectively deal with stress.

**Contribution/value-add:** The findings add value by highlighting coping resources used by air traffic controllers to deal with stress. Such information can be used to inform organisations of the type of programmes that can be introduced by air traffic management to help ATCOs cope with their stressful work environment.

## INTRODUCTION

### Key focus of the study

The need for stress research became necessary for sustaining and improving performance in a variety of demanding environments, yet advancement in this area had a variety of unique challenges to overcome (Morphew, 2001). Occupational stress has become one of the most critical organisational and health concerns in the world. Today there is overwhelming evidence that stress is one of the direct causes of the most common and most serious psychological and physiological diseases that affect people at work, including cardiovascular pathology, diabetes, asthma, cancer, hypertension, osteoporosis, anxiety, depression, insomnia, memory loss and premature aging (Dolan, 2007).

Air traffic controllers (ATCOs) are widely recognised as an occupational group that works in a highly stressful environment (Proctor & Van Zandt, 1994). Schultz and Schultz (2010) reported

that air traffic controllers' work is hectic, difficult, and demanding, and has the additional burden being responsible for thousands of lives daily. The knowledge that they are responsible for thousands of lives in itself creates stress. Everybody is exposed to stress in the workplace but some are more often and more intensely exposed than others (Cartwright & Whatmore, 2005). Costa (1995) argued that air traffic controllers are some of the individuals who are exposed most to stress in the workplace and that they intensely experience work-related stress.

Prolonged exposure to stressful situations may cause serious health problems to affected individuals (Wainwright & Calnan, 2002). Sulsky and Smith (2005) reported that it is important to identify occupationally specific stressors in order to target areas for change or intervention, and to protect those affected. It has been argued that although it is possible to identify potential sources of stress at work, there is still a need to evaluate the impact of these stressors, particularly those related to task demands (Tattersall & Farmer, 1995).

### **Background to the study**

Exposure to stressful situations and how individuals respond have been two subjects for debate for many decades with different views expressed by different writers (Zeidner, 2005). For some it was merely the presence of certain job characteristics, such as heavy demands, interpersonal strife, or lack of control that constituted stress, but others suggested that work stress was about the inability to cope with such factors, or the physical or psychological consequences of failing to cope (Wainwright & Calnan, 2002).

Research over many decades has shown that stress is associated with a wide range of negative outcomes, such as depression, anxiety, physical symptoms, disease, and even death in extreme cases (Folkman & Moskowitz, 2000). In recent years, however, there has been a growing interest in positive aspects of the stress process and individuals' strengths (Cameron, Dutton & Quinn, 2003; Folkman & Moskowitz, 2000).

Knowledge has been gained in Industrial Psychology on the effects of stress and how groups such as teachers, engineers, scientists, unemployed African graduates, police officers and

accounting professionals cope with stress (Coetzee & Esterhuizen, 2010; Coetzee, Jansen & Muller, 2009; Cope, 2003; Louw & Viviers, 2010). Despite a growing volume of studies on occupational stress, relatively few studies have addressed employees' efforts to cope with the stress of the workplace (Tetrick, Quick & Quick, 2005). However, little research in South Africa has been conducted on how air traffic controllers cope with stressful situations that they are constantly exposed to. Brink (2009) conducted research to determine the relationship between emotional intelligence, stress and coping strategies in the occupation of air traffic control in South Africa.

The effects of stress manifest themselves differently in individuals as not everyone responds to stress in the same way (Dolan, 2007). Landy and Conte (2007) noted that researchers have studied several individual characteristics as potential moderators of stressor–strain relationship, and that the characteristics that have received the most attention are locus of control, hardiness, self esteem, and the Type A behaviour pattern. In this study the focus was on the coping resources that air traffic controllers use to mitigate the effects of stress.

Coping resources are useful for wellbeing and health, and resources such as social support at work and job control are defined as factors in the job stress process that protect the individual from detrimental immediate psychological, physiological, and behavioural responses to job stressors (Grebner, Elfering & Semmer, 2010). Coetzee and Esterhuizen (2010) also reported that the presence of coping resources provides both deterring and coping functions, and that they reduce anguish and preserve people's psychological and social balance. This might explain why air traffic controllers are able to cope with the stressors they are constantly exposed to during the course of their working life. The following research questions were formulated:

- (1) What coping resources do air traffic controllers use to mitigate the effects of stress in the workplace.
- (2) Are there statistically significant differences in the coping behaviour of air traffic control staff from different groups?

## Trends from the research literature

### Stress

Stress has been studied for many decades and its effects on individuals are well documented (Costa, 1995; Dolan, 2007; Gebner et al., 2010; Tetrick et al., 2005). Cox and Griffiths (1995) noted that the definition of stress is not simply a question of semantics and that it is important that there should be a broad agreement on its nature. According to Gaillard (2001) the concept of stress has a variety of meanings:

- An *input* variable referring to either work demands (difficulty, time pressure), emotional threat (accident, potential violence or loss), or adverse environments (noise, sleep loss, drugs, et cetera.).
- An *output* variable referring to a pattern of behavioural, subjective, and physiological responses often labeled as strain.
- A *state* in which we feel strained and threatened on the basis of a subjective evaluation of the situation.
- A *process* that gradually results in a dysfunctional state, degrading the work capacity and the potential to recover from work.

In the context of this study, the definition by Robbins, Judge, Millett and Waters-Marsh (2008) was adopted. Robbins et al. (2008) defined stress as “a dynamic condition in which an individual is confronted with an opportunity, demand or resource related to what the individual desires and for which the outcome is perceived to be both uncertain and important” (p. 623). This definition is particularly relevant in air traffic control, in that ATCOs operate in a complex environment characterised by constant change that requires people to adjust all the time.

Air traffic control operations have been a focus of a great deal of research, and according to Tattersall and Farmer (1995) studies of air traffic controllers are equivocal in their findings with

respect to health changes as a consequence of the work. They noted that some reviews of stress in air traffic control suggest that controllers' health is not unduly affected by the job. Cobb and Rose (as cited in Tattersall & Farmer, 1995) alternatively reported that the incidence of hypertension, diabetes, and ulcers was significantly higher in a sample of more than 4000 American air traffic controllers than in a comparison group of more than 8000 other aviation workers.

## **Occupational stress**

Subsequent to the transactional model of stress, Beehr and Newman (as cited in Zeidner, 2005) view job stress as condition wherein job related factors (for example, workload, time pressures, degree of control) interact with the worker's personal resources (skills, expectations, coping skills, dispositions) to change (disrupt/enhance) the worker's physiological or psychological condition, so that the person consequently deviates from normal functioning. Occupational stress is seen as the entire process in which people perceive and interpret their work environment in relation to their capacity to cope with it (Dolan, 2007). Arnold et al. (2010) reported that most modern theories of work-related stress define it as a negative emotional state that can result from interaction between a person and their environment.

According to Cox and Griffiths (1995), it has been concluded in several different reviews of the relevant literature that there are essentially three different, but overlapping approaches to the definition and study of stress. The approaches are from: (1) engineering and ergonomics, (2) medicine and physiology, and (3) psychology. The engineering approach conceptualizes occupational stress as an aversive or harmful characteristic of the work environment and as an environmental cause of strain. This approach treats stress as a property of the work environment.

The physiological approach defines stress in terms of the common physiological effects of a wide range of aversive or harmful stimuli and as a response to a threatening or damaging environment (Cox & Griffiths, 1995). The psychological approach, on the other hand, as Cox and Griffiths (1995) put it, conceptualizes work stress in terms of the dynamic interaction between individuals and their work environment. The psychological approach is preferred by

many researchers and dominates contemporary stress theories because of its adequacy in explaining the interaction between stress and the environment (Cox & Griffiths, 1995; Dolan, 2007; Sulsky & Smith, 2005).

The effect of stress on individuals and organisations is well documented, however, the response from employers has often been ambivalent and equivocal (Wainwright & Calnan, 2002). Wainwright and Calnan (2002) further reported that the threats from the work stress phenomenon are taken seriously by employers, but at the same time they are reluctant to accept the work stress epidemic at face value. Dewe, O'Driscoll and Cooper (2010) noted that the level of attention given by organisations to addressing stress-related issues is still relatively small when compared with their investments in other areas such as financial budgeting, marketing and technological development. The organisations that have heeded a call to do something about the negative effects of stress in the workplace have come up with programmes to combat stress (Dewe et al., 2010). For example, through their employee wellness programmes organisations have counseling and stress management interventions (Dewe et al., 2010).

There has been an increased interest in knowing about and better understanding of the conditions which make the workplace more conducive and less harmful for workers, with inclusion of those factors or conditions that causes stress (Dolan, 2007). Dolan (2007) further noted that it is however, impossible to provide a complete list of stressors and their consequences, especially if we bear in mind that the stressor condition depends on the assessment each individual makes of a specific condition. In air traffic control, the main sources of stress reported by air traffic controllers are connected both to operative aspects and to organisational structures (Costa, 1995). For the former, the most important are peaks of traffic load, time pressure, having to bend the rules, limitations of and the reliability of equipment (Costa, 1995). The latter are mainly concerned with shift schedules (night work in particular), role conflicts, unfavourable working conditions and the lack of control over work (Costa, 1995).

Sulsky and Smith (2005) reported that a perceived lack of control is reported to be one of the most potent stressors for air traffic controllers. Research by Shouksmith and Burrough (as cited in Sulsky & Smith, 2005) compared occupational stressors reported by Canadian and New

Zealand air traffic controllers and found high agreement regarding the top job-related stressors: equipment limitations, peak traffic situations, general work environment, and fear of causing an accident. In South Africa, a study conducted by Brink (2009) found that the top five most stressful elements for the air traffic controllers were: number of air craft under control, extraneous traffic, unforeseen events, peak traffic hours, and limitations and reliability of equipment.

## **Coping**

How individuals cope with stress has been the focus of research over many decades (Arnold et al., 2010). The process of coping with occupational stress is complex, highly dynamic, and is directed toward moderating the impact of stressful events on an individual's physical, social and emotional functioning (Fielden & Cooper, 2002). Like stress, coping as a construct is multi-dimensional and contextual (Dickinson, 2007). Dickinson (2007) further noted that factors such as environmental demands, personal resources, appraised threat level, and meaning or emotional investment may have mediating or moderating effects on the coping process. Coping usually represents either an adjustment *to* the situation or an adjustment *of* the situation (Cox & Griffiths, 1995).

Historically psychologists have operated within a number of different paradigms, which has led to a number of different perspectives on the meaning of coping (Sulsky & Smith, 2005). Arnold et al. (2010) define coping as “the efforts people make, through their behaviour and thoughts, to alter their environment and/or manage their emotions” (p. 471). Coping is examined from a cognitive, rather than situational perspective, that is, one employs cognitive and behavioural efforts to cope (Wainwright & Calnan, 2002).

According to Piko (2001) various factors, such as demographic, personal, sociocultural, and environmental, have an influence on which coping strategies are mobilized under the specific circumstances. Coping has two widely recognized major functions, that is, regulating stressful emotions (emotion-focused coping) and altering the troubled person-environment relation causing the distress (problem-focused coping) (Bohnen, Nicolson, Sulon, & Jolles, 1991;

Folkman, Lazarus, Dunkel-Schetter, DeLongis, & Gruen, 1986). Previous research has found that problem-focused coping is more useful in more controllable situations and emotion-focused coping is more useful in less controllable situations (Gan, Liu, & Zhang, 2004). Air traffic controllers operate in an unpredictable and less controllable environment most of the time because of adverse weather conditions, emergencies and pilots who are not familiar with the airspace layout.

### **Coping resources**

In order to combat the various aspects of stressors, individuals develop a variety of coping resources (Dickinson, 2007). Coetzee, Jansen and Muller (2009) distinguished between coping strategies and coping resources, where coping strategies refer to behaviours occurring after the appearance of the stressor or in response to chronic stressors, and coping resources refer to those resources inherent in individuals that enable them to handle stressors more effectively, to experience fewer or less intense symptoms upon exposure to a stressor, or to recover faster after being exposed to stressors.

The coping resources construct as developed by Hammer (1988) is presented in this study. Hammer (1988) defined coping resources as those psychological capacities inherent in individuals that enable them to handle stress effectively and limit the ill effects of stress upon exposure to stressors and recover faster from a stressful event.

The psychological coping capacities referred to by the coping resource construct as defined by Hammer (1988) are the following:

- *Cognitive resources*: the extent to which individuals maintain a positive sense of self-worth, a positive outlook towards others, and optimism in general.
- *Social resources*: the degree to which individuals are embedded in a social network able to provide support in times of stress.

- *Emotional resources*: the degree to which individuals are able to accept and express a range of affect, aiding the amelioration of long term negative consequences.
- *Spiritual resources*: the degree to which actions of individuals are guided by stable and consistent values such as those derived from religious, familial or cultural traditions or personal philosophies.
- *Physical resources*: the degree to which individuals enact health-promoting behaviours thought to improve physical well-being (Hammer, 1988).

## **Research objectives**

In organisations one of the obstacles preventing people from operating to their maximum potential is stress (Landy & Conte, 2007). Stress in the workplace has negative impact on productivity and no organisation is spared from this phenomenon. Stress in the workplace becomes a health problem if not managed well (Schultz & Schultz, 2010). One of the ways in which to deal effectively with stress in the workplace is to understand how employees cope with stressful situations on a daily basis. This information will assist in the process of designing stress management programmes in the organisation. As highlighted previously, air traffic control is considered one of the most stressful jobs. The main objective of this study was to investigate how air traffic controllers cope with stress by using coping resources. The research was also aimed at exploring whether there are any significant differences in how different groups from air traffic control staff cope with stress.

The following research hypothesis was formulated:

There are statistically significant differences in the coping behaviour of Air Traffic Control staff from different groups.

Sub-hypotheses:

H<sub>1</sub>: There is a statistically significant difference in the coping styles preferred by male and female ATCOs.

H<sub>2</sub>: There is a statistically significant difference in the coping styles preferred by senior and junior ATCOs

H<sub>3</sub>: There is a statistically significant difference in the coping styles preferred by older and younger ATCOs

H<sub>4</sub>: There is a statistically significant difference in the coping styles preferred by different race groups of ATCOs

### **Potential value-add of the study**

Any organisation that seeks to establish and maintain the best state of physical, mental, and social wellbeing of its employees needs to have policies and procedures that comprehensively address health and safety of workers (Cooper & Cartwright, 2001). This article will assist organisations operating in air traffic management to understand how air traffic controllers cope with stress, and possibly use that information when formulating and designing their stress management programmes. Studies have been conducted to investigate sources of stress in air traffic control, however, few have been conducted to understand how ATCOs deal with stressful situations - especially in the South African context.

The following sections describe the research design, the findings, and the discussion that includes conclusions and implications for practice and future research.

## **RESEARCH DESIGN**

The aim of the research design is to enhance validity and reliability and also to align the pursuit

of a research goal with the practical considerations and limitations of the project (Mouton & Marais, 1990).

## **Research approach**

A quantitative survey research approach was followed to achieve the research objectives. This research approach was chosen because survey research in general offers advantages in terms of the amount of data that can be collected, economy, and the chance to sample the whole population (Babbie, 2007). Primary data was collected and no previously existing data was used.

## **Research method**

### Participants

The participants were a convenience sample of 82 (80 usable responses) air traffic controllers from the 100 questionnaires that were distributed to the different air traffic service units around the country (82% response rate). One participant was not an ATCO and one questionnaire had incomplete information and had to be discarded. Detailed breakdown of the participants is shown in Table 1.

In this study younger ATCOs were considered to be between the ages of 18-35 years and older ATCOs between the ages of 36-60 years. As presented in Table 1, 58 were younger (72.5%) and 22 were older (27.5%). In terms of race as depicted in Table 1, 26 were African (32.5%), 4 were coloured (5%), 6 were Indian (7.5%), and 44 were white (55%).

In this study, ATCOs with experience of up to 5 years were considered to be junior and those with experience from 6 years and above were considered to be senior. As presented in Table 1, 39 were junior (48.75%) and 41 were senior (51.25%). As indicated in Table 1, 58 were males (72.5%) and 22 were females (27.5%).

**Table 1**  
**Descriptive statistics: Age, Race, Seniority, and Gender**

Age	Number of ATCOs	Percentage of ATCOs
18-35	58	72.5%
36-60	22	27.5%
Total	80	100%
<b>Race</b>		
African	26	32.5%
Coloured	4	5%
Indian	6	7.5%
White	44	55%
Total	80	100%
<b>Seniority</b>		
5years and below	39	48.75%
6 years and above	41	51.25%
Total	80	100%
<b>Gender</b>		
Female	22	27.5%
Male	58	72.5%
Total	80	100%

## Measuring instrument

The 60-item Coping Resources Inventory (CRI) was used to determine what type of resources ATCOs use to cope with stress (Hammer, 1988). CRI is designed to identify the personal coping resources available to individuals for managing stress at a particular point in time (Pollard & Baker, 2000). It is an instrument with demonstrated reliability and validity in addition to being gender normed (Pollard & Baker, 2000). The obtained scores are transformed into T-scores with a mean of 50 and a standard deviation of 10. Scores below or equal to 30 are interpreted as below average and scores above or equal to 70 are interpreted as above average.

It is reported that the CRI appears to be a reliable measure to use in the South African context with Cronbach's alpha = .93 (Jooste & Foxcroft, 2005). Cronbach's alpha coefficients varying from .84 (emotional), .80 (spiritual/ philosophical), .79 (social), .77 (cognitive), and .71

(physical) were reported by Hammer (1988). A study conducted by Coetzee, Jansen and Muller (2009) , yielded Cronbach's alpha coefficients for the CRI varying from .68 (cognitive), .71 (spiritual/philosophical), .73 (physical) to .81 (social) and .83 (emotional) for South African sample. Also in a study conducted by Coetzee and Esterhuizen (2010), the internal consistency coefficients for each scale were as follows: .59 (physical); .70 (cognitive); .72 (social); .66 (spiritual/philosophical) and .75 (emotional).

In the present study the Cronbach's alpha was reported as .92, and the scale reliability tests yielded Cronbach's alpha coefficients of .79 (cognitive), .83 (social), .81 (emotional), .79 (spiritual/philosophical), and .78 (physical). As reported, the scale reliability was considered acceptable.

For each item in the inventory individuals have to indicate how representative the statement is of them in the last 6 months with N=never or rarely, S=sometimes, O=often and A=always or almost always. The responses are then grouped and profiled according to one of five domains: Cognitive, Social, Emotional, Spiritual/Philosophical and Physical.

## **Research procedure**

Permission to conduct the survey was obtained from the chief executive officer of the organisation and the executive in the office of the CEO. A cover letter with each questionnaire explained the purpose of the research and that the results will only be used for the purpose of this research. Once the purpose of the research was explained in the letter, anonymity and confidentiality were also guaranteed. Participants were requested to complete the questionnaires and give them back to the unit representative who gave them the questionnaire, and the unit representative sent the completed questionnaires and the consent forms to the researcher.

Questionnaires were sent to the managers, secretaries and supervisors of the units around the country to give to air traffic controllers who were willing to participate in the study. Only air traffic controllers (ATCOs) that control civilian aircraft were sampled, and ATCOs from the South African Air Force were not included in the study. ATCOs from the South African Air

Force work in a different environment from ATCOs that control civilian aircraft and might be experiencing different level of stress and use different coping style, and their inclusion in the study could impact the overall results of the study. ATCOs in the civilian sector experience higher work demand in terms of the amount of traffic they control.

The ethical considerations applied to this research project included the following:

- The participants completed the questionnaire voluntarily and were not coerced into taking part in the study.
- Informed consent was obtained from the research participants.
- Confidentiality was ensured by an undertaking to report on the results without identifying individuals.
- The research aims and the process to be followed in conducting the research were explained to participants.
- The data was kept in a safe place throughout the project.

### **Statistical analysis**

Statistical analyses were computed using SPSS Statistics, Version 19 (Argyrous, 2000). Analysis of variance was used to investigate the differences between race groups. T-test was used to investigate the differences between gender, age and seniority groups. Descriptive statistics (mean and standard deviations) were used to provide descriptive data of the total sample as well as the different groups.

## **RESULTS**

The main objective of this study was to investigate how air traffic controllers cope with stress using different coping resources, and also whether there are any significant differences in how different groups from air traffic control staff cope with stress.

## Descriptive statistics

In answering the question of how air traffic controllers cope with stress it appears that air traffic controllers in this study prefer emotional coping resource (mean of 47.50) to cope with stressful situations as depicted in Table 2. Following the emotional coping resource was the social coping resource with the mean score of 40.98. The cognitive coping resources variable obtained the lowest mean score ( $M = 30.20$ ). This means that when experiencing stress, the participants did not maintain a positive sense of self-worth, a positive outlook toward others, and optimism about life in general (Hammer, 1988). According to Pollard and Baker (2000) scores below or equal to 30 are interpreted as below average.

**Table 2**  
**Descriptive Statistics: mean, min, max and standard deviation**

Coping resources	Mean	Minimum	Maximum	Std. deviation
Cognitive	30.20	14.00	36.00	3.73
Social	40.98	29.00	52.00	5.26
Emotional	47.50	33.00	63.00	6.09
Spiritual/ Philosophical	33.11	20.00	44.00	5.19
Physical	31.06	19.00	43.00	5.09

Table 3 also provides the descriptives (mean, minimum, maximum and standard deviation) of the different groups that were compared. Female participants obtained the highest mean score on emotional coping resources ( $M = 48.68$ ) while male participants obtained the mean score of  $M = 47.05$ . Male participants obtained higher scores than female participants on cognitive, social and physical coping resources. Senior participants obtained higher scores than junior participants on cognitive and emotional coping resources, while junior participants obtained higher scores on social, spiritual/philosophical and physical coping resources.

Younger participants obtained higher mean scores than older participants on all the coping resources, that is, cognitive, social, emotional, spiritual/philosophical and physical. In terms of race, Indian participants obtained higher mean scores than other racial groups on cognitive ( $M =$

31.66), social ( $M = 43.16$ ), emotional ( $M = 50.83$ ) and spiritual/philosophical ( $M = 36.00$ ) coping resources while white participants obtained the highest score more than the other race groups on physical coping resources with the mean score of  $M = 31.61$ .

**Table 3**

**Descriptive Statistics: mean, min, max and standard deviation (different groups)**

	<b>Gender</b>	Mean	Min	Max	Std. deviation
Cognitive	Male	30.50	20.00	36.00	3.25
	Female	29.41	14.00	36.00	4.79
Social	Male	41.22	29.00	52.00	5.37
	Female	40.31	32.00	52.00	5.04
Emotional	Male	47.05	33.00	63.00	6.04
	Female	48.68	37.00	62.00	6.19
Spiritual_Philosophical	Male	33.08	20.00	44.00	4.88
	Female	33.18	23.00	42.00	6.03
Physical	Male	31.34	19.00	43.00	5.28
	Female	30.31	23.00	40.00	4.57
<b>Experience</b>					
Cognitive	Junior	28.80	14.00	36.00	3.51
	Senior	30.25	24.00	36.00	2.87
Social	Junior	40.45	32.00	52.00	4.13
	Senior	40.42	29.00	52.00	5.44
Emotional	Junior	44.72	37.00	59.00	4.92
	Senior	46.28	33.00	63.00	5.08
Spiritual_Philosophical	Junior	32.45	23.00	44.00	4.34
	Senior	30.00	20.00	42.00	3.82
Physical	Junior	30.18	19.00	41.00	4.60
	Senior	29.85	21.00	43.00	5.98
<b>Age Groups</b>					
Cognitive	Younger	30.36	14.00	36.00	4.08
	Older	29.77	27.00	35.00	2.67
Social	Younger	41.27	30.00	52.00	5.36
	Older	40.18	29.00	51.00	5.03
Emotional	Younger	47.53	33.00	63.00	6.69
	Older	47.40	41.00	56.00	4.22
Spiritual_Philosophical	Younger	33.22	20.00	44.00	5.43
	Older	32.81	24.00	42.00	4.58
Physical	Younger	31.10	19.00	43.00	5.17
	Older	30.95	22.00	40.00	4.98
<b>Race</b>					
Cognitive	White	30.11	14.00	36.00	4.04
	African	30.15	20.00	36.00	3.52
	Coloured	25.00	26.00	32.00	2.50
	Indian	31.66	27.00	36.00	3.32
Social	White	41.63	29.00	52.00	5.15
	African	39.96	32.00	51.00	4.91
	Coloured	37.00	30.00	43.00	6.05
	Indian	43.16	36.00	52.00	6.30
Emotional	White	48.15	37.00	60.00	5.28
	African	46.23	33.00	62.00	6.63
	Coloured	43.50	37.00	52.00	6.55
	Indian	50.83	40.00	63.00	7.85
Spiritual_Philosophical	White	32.88	23.00	42.00	5.01
	African	33.19	20.00	44.00	5.89
	Coloured	30.75	29.00	32.00	1.25
	Indian	36.00	30.00	42.00	4.42
Physical	White	31.61	21.00	43.00	5.28

African	30.96	19.00	41.00	5.02
Coloured	28.75	23.00	34.00	4.78
Indian	29.00	24.00	36.00	4.14

## Hypothesis testing

In addition to the main objective of the study to investigate how air traffic controllers cope with stress, the research also explored whether there are any significant differences in how different groups from air traffic control staff cope with stress. The research hypothesis with sub-hypotheses was formulated. The main hypothesis was formulated as follows: There are statistically significant differences in the coping behaviour of air traffic control staff from different groups. The null hypothesis was not rejected by the data collected for the study. The results show that there are no statistically significant differences in the coping behaviour of air traffic control staff from different groups.

The first three hypotheses were analysed by conducting t-test analyses and the fourth hypothesis was analysed by conducting analysis of variance (ANOVA).  $H_1$  proposed that there is a statistically significant difference in the coping style preferred by male and female ATCOs. However, as reported in Table 4 no statistical significance was obtained in any of the coping resources. For example, cognitive ( $t=1.16$ ,  $df=78$  and  $sig.=.24$ ), social ( $t=.68$ ,  $df=78$  and  $sig.=.49$ ), emotional ( $t=-1.07$ ,  $df=78$  and  $sig.=.28$ ), spiritual/philosophical ( $t=-.07$ ,  $df=78$  and  $sig.=.94$ ), and physical ( $t=.80$ ,  $df=78$  and  $sig.=.42$ ).

**TABLE 4**  
**T-test: Gender mean differences**

		t-test for Equality of Means					
		T	Df	Sig. (2-tailed)	Mean difference	95% Confidence interval of the difference	
						Lower	Upper
Cognitive	Equal variances assumed	1.16	78.00	0.24	1.09	-0.76	2.95
	Equal variances not assumed	0.98	28.63	0.33	1.09	-1.17	3.35
Social	Equal variances assumed	0.68	78.00	0.49	0.90	-1.72	3.54
	Equal variances not assumed	0.70	40.21	0.48	0.90	-1.69	3.50
Emotional	Equal variances assumed	-1.07	78.00	0.28	-1.63	-4.66	1.40
	Equal variances not assumed	-1.05	37.09	0.29	-1.63	-4.75	1.49
Spiritual_Philosophical	Equal variances assumed	-0.07	78.00	0.94	-0.09	-2.69	2.50
	Equal variances not assumed	-0.06	32.02	0.94	-0.09	-3.02	2.83
Physical	Equal variances assumed	0.80	78.00	0.42	1.02	-1.51	3.57
	Equal variances not assumed	0.85	43.58	0.39	1.02	-1.38	3.43

H<sub>2</sub> proposed that there is a statistically significant difference in the coping style preferred by senior and junior ATCOs. Also as depicted in Table 5 no statistical significance was obtained in any of the coping resources, cognitive ( $t=-.92$ ,  $df=16$  and  $sig.=.37$ ), social ( $t=.01$ ,  $df=16$  and  $sig.=.99$ ), emotional ( $t=-.64$ ,  $df=16$  and  $sig.=.52$ ), spiritual/philosophical ( $t=1.22$ ,  $df=16$  and  $sig.=.24$ ), and physical ( $t=.13$ ,  $df=16$  and  $sig.=.89$ ).

**TABLE 5**  
**T-test: Seniority mean differences**

		t-test for Equality of Means					
		T	Df	Sig. (2-tailed)	Mean difference	95% Confidence interval of the difference	
						Lower	Upper
Cognitive	Equal variances assumed	-0.92	16.00	0.37	-1.46	-4.83	1.90
	Equal variances not assumed	-0.96	14.82	0.34	-1.46	-4.70	1.76
Social	Equal variances assumed	0.01	16.00	0.99	0.02	-4.75	4.80
	Equal variances not assumed	0.01	10.37	0.99	0.02	-5.30	5.35
Emotional	Equal variances assumed	-0.64	16.00	0.52	-1.55	-6.66	3.55
	Equal variances not assumed	-0.64	12.58	0.53	-1.55	-6.82	3.70
Spiritual_Philosophical	Equal variances assumed	1.22	16.00	0.24	2.45	-1.80	6.71
	Equal variances not assumed	1.25	14.15	0.22	2.45	-1.72	6.63
Physical	Equal variances assumed	0.13	16.00	0.89	0.32	-4.96	5.61
	Equal variances not assumed	0.12	10.47	0.90	0.32	-5.55	6.20

H<sub>3</sub> proposed that there is a statistically significant difference in the coping style preferred by older and younger ATCOs. As shown in Table 6 no statistical significance was obtained in any of the coping resources, cognitive ( $t=.62$ ,  $df=78$  and  $sig.=.53$ ), social ( $t=.82$ ,  $df=78$  and  $sig.=.41$ ), emotional ( $t=.08$ ,  $df=78$  and  $sig.=.93$ ), spiritual/philosophical ( $t=.31$ ,  $df=78$  and physical ( $t=.11$ ,  $df=78$  and  $sig.=.90$ ).

**TABLE 6**  
**T-test: Age group mean differences**

		t-test for Equality of Means					
		T	Df	Sig. (2-tailed)	Mean difference	95% Confidence interval of the difference	
						Lower	Upper
Cognitive	Equal variances assumed	0.62	78.00	0.53	0.58	-1.28	2.46
	Equal variances not assumed	0.75	57.91	0.45	0.58	-0.97	2.15
Social	Equal variances assumed	0.82	78.00	0.40	1.09	-1.53	3.72
	Equal variances not assumed	0.85	40.21	0.40	1.09	-1.50	3.69
Emotional	Equal variances assumed	0.08	78.00	0.93	0.12	-2.92	3.18
	Equal variances not assumed	0.10	59.96	0.92	0.12	-2.39	2.64
Spiritual_Philosophical	Equal variances assumed	0.31	78.00	0.75	0.40	-2.19	3.00
	Equal variances not assumed	0.33	44.69	0.73	0.40	-2.03	2.84
Physical	Equal variances assumed	0.11	78.00	0.90	0.14	-2.40	2.70
	Equal variances not assumed	0.11	39.30	0.90	0.14	-2.40	2.69

H<sub>4</sub> proposed that there is a statistically significant difference in the coping style preferred by different race groups of ATCOs. As shown in Table 7 no statistical significance was obtained in any of the coping resources among the races, cognitive ( $f=.39$  and  $sig.=.75$ ), social ( $f=1.70$  and  $sig.=.17$ ), emotional ( $f=1.77$  and  $sig.=.15$ ), spiritual/philosophical ( $f=.92$  and  $sig.=.43$ ), and physical ( $f=0.77$  and  $sig.=.51$ ).

**TABLE 7**  
**Anova: Mean difference among race groups**

		Sum of Squares	df	Mean Square	F	Sig.
Cognitive	Between Groups	16.90	3.00	5.63	0.39	0.75
	Within Groups	1087.90	76.00	14.31		
Social	Total	1104.80	79.00		1.70	0.17
	Between Groups	137.97	3.00	45.99		
	Within Groups	2055.97	76.00	27.05		
Emotional	Total	2193.95	79.00		1.77	0.15
	Between Groups	191.66	3.00	63.88		
	Within Groups	2738.33	76.00	36.03		
Spiritual_Philosophical	Total	2930.00	79.00		0.92	0.43
	Between Groups	74.76	3.00	24.92		
	Within Groups	2053.22	76.00	27.01		
Physical	Total	2127.98	79.00		0.77	0.51
	Between Groups	60.54	3.00	20.18		
	Within Groups	1988.14	76.00	26.16		
Total		2048.68	79.00			

## DISCUSSION

The main objective of conducting this study was to investigate how air traffic controllers cope with stress using coping resources, and also to explore whether there are any significant differences in how different groups from air traffic control staff cope with stress. As air traffic control is considered one of the most stressful occupations, this study shared light on how controllers cope with stress. This information may be used in the design of stress management programmes tailored specifically for ATCOs in assisting them to effectively deal with stressful events.

The results show that ATCOs prefer emotional coping resource to cope with stressful situations followed by social coping resources. The least used coping resource by the participants of this study was cognitive coping resources. No previous research was found that investigated how ATCOs cope with stressful situations using coping resources. Typical way in which people deal with stressful situations is by regulating stressful emotions (emotion-focused coping) and/or by altering the troubled person-environment relation causing the distress (problem-focused coping) (Bohnen et al., 1991; Folkman et al., 1986).

The null hypothesis that there are no statistically significant differences in the coping behaviour of air traffic control staff from different groups was not rejected. All the sub-hypotheses that there are statistically significant differences in the coping style preferred by male and female ATCOs, senior and junior ATCOs, older and younger ATCOs, and by different race groups of ATCOs were not accepted.

It is interesting to observe that ATCOs prefer emotional coping resources to combat the effects of stress. This means that when faced with stressful situations participants are able to accept and express a range of affect, based on the premise that a range of emotional response aids in ameliorating long-term negative consequences of stress. According to Narayanan, Menon and Spector (1999) work control is a critical facet of the psychosocial work environment and could be an important variable which differs as a function of job type. For example, it is possible for coping to be more emotion focused in the occupations where there is less control of the situation, and the emphasis will be on controlling the emotional response rather than the situation (Narayanan et al., 1999). Gan et al. (2004) also reported that previous research has found that emotion-focused coping is more useful in less controllable situations. Air traffic controllers at times have little control over some of the situations they encounter, such as the emergencies, adverse weather conditions and unexpected extraneous traffic.

Lepore, Fernandez-Berrocal, Ragan and Ramos (2004) reported that by expressing one's emotions, one can potentially change the content of stress-related thoughts and memories and individuals may be able to interpret stressors in personally meaningful terms, integrate threatening or confusing aspects of the experience into a coherent and non-threatening conceptual framework, and reach a state of emotional acceptance.

Gender roles are acquired through socialization, males and females are taught different roles at the very young age (Piko, 2001). Because of this it was expected that male and female participants in this study will use different coping resources in dealing with stress. One of the most well documented gender differences in adult human behaviour is a strong tendency for women to affiliate with others when coping with stress (Nelson, Burke & Michie, 2002). This was however not the case in this study as no statistically significant difference between the

gender groups was obtained. Greenglass (2002) reported that research has shown that when education, occupation, and position are controlled, few gender differences are found in how individuals cope with stress, and that the type of coping employed to deal with stress is often related to the status, resources, and power associated with one's position. Air traffic controllers go through the same selection process and training, and this may explain why gender difference in dealing with stress is not found.

No statistically significant differences were found on how younger and older (age), and junior and senior (tenure) groups cope with stress. Narayanan et al (1999) in their research examining stress-related incidents experienced in day-to-day work across three occupations (clerical workers, university professors and sales associates) also found no significant effects for coping with stress or emotional reactions as a function of age or tenure. They further reported that it may be important to note that age and tenure are confounded.

In this study it was also expected that there would be a statistically significant difference in the coping style preferred by different race groups of ATCOs, however, the findings did not support this expectation. People from different backgrounds are exposed and socialised differently, hence the expectation that they will use different coping resources when exposed to stress. In their research to determine race differences of patients who had cancer in how they used coping resources to cope with stress, Ell and Nishimoto (1989) found statistically significant difference in the coping styles preferred by different race groups. It may again be argued that the training that air traffic controllers go through play a role in diminishing the difference in how people from different race groups cope with stress. Also through the selection process certain types of people are selected into this profession. For example, the ability to relax easily and also that a person is generally calm is one of the competencies being assessed during the selection process to become an air traffic controller.

### **Limitations of the study**

Limitations inherent in the self-report approach may call into question some of the preceding findings. Self-reporting may have caused participants to give socially desirable or acceptable

answers. Folkman et al. (1986) reported that the problem is not that self-report is inherently more frail than other methods of inquiry - in fact for certain kinds of psychological processes it may be the only way to obtain certain information - but rather that it requires verification by other methods such as observation of direct behaviour and physiological assessment. Sample size further limited the research results in such a way that results could not be generally applied to all ATCOs in South Africa. The size and the composition of the participants may not be representative of the whole population of air traffic controllers in South Africa.

This study only explored how air traffic controllers cope with stress without establishing the type of stressors they are dealing with, and how stressed they really are. The research relied on previous studies on what causes stress in air traffic control without empirically verifying that information in this study.

## **Recommendations**

Since this was an exploratory study, the need exists for a future replication with a larger sample of air traffic controllers, to ensure better representation and to allow for generalisation of empirical findings. To corroborate and to get better understanding of why participants prefer certain coping style it is recommended that in addition to employing quantitative research method, mixed method should be used. By using qualitative methods in addition to quantitative method to collect data we will have a better and more in-depth understanding of the phenomenon being investigated. Haslam and McGarty (2003) reported that qualitative rather than just quantitative method does a better job of understanding a phenomenon as it is experienced by, and have meaning for, the people involved and as it occurs naturally in the real world.

It is also recommended that this type of research should be replicated and in addition a stress instrument should be used to determine the level and type of stressors controllers are experiencing. This will give a comprehensive picture and some correlations may be drawn between the type of stressors controllers experience and their preferred coping resources.

## Conclusions

The results in this study shed light on how air traffic controllers cope with stress using coping resources. The findings of the study expand the coping literature, particularly literature on research on the coping capacities of air traffic controllers. For example, this research revealed that air traffic controllers use emotional coping resources when faced with stressful situations, and also that there are no statistically significant differences in the coping behaviour of air traffic control staff from different groups.

The research was exploratory in nature and attempted to gain a broader understanding of the aspects that contribute to the ATCOs' capacity to deal with stress. While acknowledging the limitation in the sample size and representation of the sample which could have influenced the results obtained by the study, this study attempted to gain a better understanding of how people who are constantly exposed to stressful situations manage to survive the negative effects of stress.

In practice this information can be used by employers when designing stress prevention and coping programmes, policies, and procedures to deal effectively with the effects of stress in air traffic management.

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## **CHAPTER 4**

### **CONCLUSIONS, LIMITATIONS AND RECOMMENDATIONS**

The aim of this study was to investigate how air traffic controllers cope with stress and also to determine whether there were statistically significant differences in the coping behaviour of air traffic control staff from different groups. In this chapter, the conclusion in relation to the findings of the study will be discussed in the context of the literature review and empirical study. The limitations of this study will be highlighted and recommendations made for a possible future research.

#### **4.1 CONCLUSIONS**

The conclusions arrived at for both the literature review and the empirical study are discussed below.

##### **4.1.1 Literature review conclusions**

The aim of this study was to investigate how air traffic controllers cope with stress. A literature review was conducted on both the concepts of stress and coping.

A literature review was provided which incorporated a definition and models of stress. The discussion indicated that there is little agreement as to how stress should be defined, and that stress is a multifaceted concept derived from different disciplines (Buunk et al., 1998; Fletcher, 1988; Le Blanc et al., 2008). Le Blanc et al. (2008) noted that as much as there is lack of consensus on the definition, nonetheless, most researchers in the field of stress do agree that three different meanings of the term stress can be distinguished: stress as a stimulus, stress as a response, and stress as meditational process between stressor (stimulus) and reaction (response).

Occupational stress as the stress that is experienced at work was also discussed and it was reported that occupational stress is a complex, multilayered phenomenon that requires a systematic or ecological analysis using multiple perspectives (Kenny & McIntyre, 2005). Stress in the workplace not only is damaging to individual employees, but also organisations suffer in the process through manifestation of behaviours such as turnover, absenteeism and accidents (Rosen et al., 2010; Schultz & Schultz, 2010).

Various models have been developed focusing specifically on understanding occupational stress and such models as the Social Environment Model, the Person-Environment Fit Model, the Demand-Control-Support Model, and the Vitamin Model were discussed. It was established that prolonged exposure to stress has negative consequences on individuals' wellbeing and that the effect of stress is at times devastating and can be divided into three categories: psychological, behavioural and physiological (Landy & Conte, 2010; Ross & Altmaier, 1994).

According to Brandes and Das (2006), coping has remained a key feature of the stress literature and studies have shown that it can reduce the intensity of stress being experienced. Different theoretical approaches to coping were discussed and reviewed, such as psychoanalytic approach to coping, coping as a personal trait or style, coping as a sequence of stages, and coping as specific methods or foci.

Coping resources was the focus of this study and it was distinguished from coping strategies by Coetzee et al. (2009) as those resources inherent in individuals that enable them to handle stressors more effectively, to experience fewer or less intense symptoms upon exposure to a stressor, or to recover faster after being exposed to stressors, while on the other hand coping strategies referred to behaviours occurring after the appearance of the stressor or in response to chronic stressors. Coping resources in the context of occupational stress in air traffic control was regarded as closely related to proactive coping, which according to Greenglass (2005) consists of efforts to build up general resources that facilitate the achievement of challenging goals and promote personal growth. The construct coping resources was defined by Hammer (1988) as a theoretical framework that described coping resources as those psychological capacities inherent

in individuals that enable them to handle stress effectively and limit the ill effects of stress upon exposure to stressors and recover faster from a stressful event.

#### **4.1.2 Empirical study conclusions**

In answering the question of how air traffic controllers cope with stress, the results showed that air traffic controllers in this study use emotional coping resource to cope with stressful situations with cognitive coping resource being the least used resource by the participants in this study. In addition to the main objective of the study to investigate how air traffic controllers cope with stress, the research also explored whether there are any significant differences in how different groups from air traffic control staff cope with stress. Based on the results of this study, it can be concluded that there are no statistically significant differences in the coping behaviour of air traffic control staff from different groups.

The null hypothesis was not rejected by the data collected for the study. All the sub-hypotheses that there are statistically significant differences in the coping style preferred by male and female ATCOs, senior and junior ATCOs, older and younger ATCOs, and by different race groups of ATCOs were not accepted.

#### **4.2 LIMITATIONS**

The research limitations are addressed in the following section.

##### **4.2.1 Limitations of the literature review**

- Literature on stress among air traffic controllers within the South African context is limited.
- Literature on coping, especially coping resources in air traffic control is also lacking.

## **4.2.2 Limitations of the empirical research**

- Limitations inherent in the self-report approach may call into question some of the preceding findings. Self-reporting may have caused participants to give socially desirable or acceptable answers.
- Sample size further limited the research results in such a way that results could not be generally applied to all ATCOs in South Africa. The size and the composition of the participants may not be representative of the whole population of air traffic controllers.
- This study only explored how air traffic controllers cope with stress without establishing the type of stressors they are dealing with, and how stressed they really are. The research relied on previous studies on what causes stress in air traffic control without empirically verifying that information in this study.
- Coloured and Indian participants in this study accounted for 5% and 7.5% respectively, and this percentage is very low to have meaningfully contributed to the overall results.

## **4.3 RECOMMENDATIONS**

### **4.3.1 Recommendations for future studies**

- Since this was an exploratory study, the need exists for a future replication with larger and broader samples that are more representative of the air traffic control population in South Africa.
- These findings need to be replicated applying different research methodologies, such as qualitative and longitudinal approaches in order to gain a better understanding of why air traffic controllers use a certain coping resource over the other.

- Similar studies should be conducted in future with participants from air traffic controllers working in the military.

#### **4.4 CHAPTER SUMMARY**

In this chapter conclusions and limitations of the research were discussed and recommendations for future similar studies were made to practitioners of industrial and organisational psychology.

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