ΑΛΕΞΑΝΔΡΕΙΟ ΤΕΧΝΟΛΟΓΙΚΟ ΕΚΠΑΙΔΕΥΤΙΚΟ ΙΔΡΥΜΑ ΘΕΣΣΑΛΟΝΙΚΗΣ

ΣΧΟΛΗ:
Διοίκηση και Οικονομίας
ΤΜΗΜΑ:
Διοίκηση Τουριστικών Επιχειρήσεων και Επιχειρήσεων Φιλοξενίας

ΜΑΘΗΜΑ:
Πτυχιακή Εργασία

ΘΕΜΑ:
Αεροπορική ψυχολογία και Ανθρώπινοι παράγοντες.

ΕΠΙΒΛΕΠΩΝ ΚΑΘΗΓΗΤΗΣ :
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ΠΡΟΛΟΓΟΣ

Η παρούσα πτυχιακή εργασία αποτελεί μια ομαδική προσπάθεια από την συνάδελφο μου Μαριάντα Νάση Σταυρου και εμένα, Τερτίπη Θεοδώρα Μαρία ώστε να προσεγγίσουμε και να κατανοήσουμε όσο το δυνατόν καλύτερα γίνεται την αεροπορική Ψυχολογία και τις ανθρώπινες ενέργειες που επηρεάζουν αυτή. Στην προσπάθεια αυτή είχαμε την αμέριστη συμπαράσταση και βοήθεια του επιβλέπων καθηγητή μας κ. Κασσιανίδη Παναγιώτη τον οποίο και ευχαριστούμε από τα βάθη της καρδιάς μας. Επιπρόσθετα θα θέλαμε να ευχαριστήσουμε και τις οικογένειες που πάντοτε μας υποστηρίζουν και μας ενθαρρύνουν να συνεχίσουμε την προσπάθεια μας να γινόμαστε όλο και καλύτερες και να εξελισσόμαστε στον τομέα που έχουμε επιλέξει.

ΠΕΡΙΕΧΟΜΕΝΑ

ΠΕΡΙΛΗΨΗ

Η παρούσα πτυχιακή εργασία αναφέρεται στην αεροπορική ψυχολογία και στην ανθρώπινη συμπεριφορά πάνω στον τομέα αυτό. Αρχικά, γίνεται λόγος για το τι είναι η αεροπορική ψυχολογία, για τα επιτεύγματα της και για τα μοντέλα που υπάρχουν πάνω στο κομμάτι αυτό. Στην συνέχεια της προσέγγισης αυτής, γίνεται λόγος για τους ανθρώπινους παράγοντες στην αεροπορική ψυχολογία. Αναλύοντας τα ανθρώπινα χαρακτηριστικά αλλά και τις θεμελιώδους αρχές και τις αρχές πληροφόρησης. Καθώς, έχουμε μεταβεί στο τρίτο κεφάλαιο της εργασίας αυτής, θα συναντήσουμε αναφορές λίγο πιο επιμέρους για το Stress. Πως δηλαδή επηρεάζει τις ενέργειές του ανθρώπου τόσο σε επαγγελματικό όσο και σε προσωπικό επίπεδο αλλά και τις μεμονωμένες διαφορές που έχει το Stress καθώς και τις συνέπειες του. Ένα επιπλέον θέμα το οποίο προσεγγίζουμε στην πτυχιακή εργασία αυτή είναι η κουλτούρα και πόσο επιδρά στις σχέσεις εργασίας, σε εθνικό επίπεδό αλλά και στην ασφάλεια. Τέλος, δεν θα μπορούσαμε να μην αναφερθούμε στην θέση της γυναίκας στο κομμάτι της αεροπορίας και στη συμπεριφορά απέναντι στις γυναίκες.

ABSTRACT

Aviation Psychology and Human Factors

This thesis deals with aviation psychology and human factors. First of all, the subject that we want to present is what is aviation psychology, the achievements that happened in aviation psychology , and the models that exist. Following in this thesis, we talk about human factors in aviation psychology. We Analyzing human characteristics, as well as fundamental principles and principles of information. As we go to the third chapter of this subject, we will come across reports that are a bit more specific about Stress.

How does it affect the actions of man on both professional and personal level, but also the individual differences that Stress has and its consequences. Another issue that we approach in this dissertation is culture and how it affects labor relations at national level and also in security. Finally, we can not fail to mention women's position on aviation and behavior towards women.

Εισαγωγή

Η παρούσα πτυχιακή εργασία έχει ως στόχο την εύρεση και παράθεση πληροφοριών σχετικά με την αεροπορική ψυχολογία, τους ανθρώπινους παράγοντες αλλά και πως αυτοί επηρεάζουν. Η ψυχολογία λοιπόν, είναι μια επιστήμη η οποία ασχολείται με τον τρόπο σκέψης και συμπεριφοράς κατά κύριο λόγο των ανθρώπων. Έχει ως στόχο την ανάλυση και κατανόηση των ανθρώπινων συμπεριφορών τόσο σε ατομικό όσο και σε ομαδικό επίπεδο και πως αυτές επηρεάζουν την κοινωνία αλλά και πως μπορεί να την ωφελήσουν. Υπάρχουν διάφοροι κλάδοι της ψυχολογίας, ένας από αυτούς είναι η αεροπορική ψυχολογία και πως ενεργούν οι άνθρωποι που σχετίζονται επαγγελματικά με την αεροπορία. Ένας παράγοντας για παράδειγμα που είναι πολύ σοβαρός είναι το άγχος ή αλλιώς το στρες. Το στρες διαχωρίζεται σε δύο κατηγορίες. Το καλό άγχος που προκαλεί την ανησυχία για το καλύτερο και την όρεξη για εργασία και βελτίωση των συνθηκών αλλά από την άλλη υπάρχει και το αρνικό άγχος που προκαλεί συναισθήματα φόβου, θυμού και κατάθλιψης και λειτουργεί αρνητικά στις αποφάσεις των ανθρώπων. Βέβαια, είναι ένα συναίσθημα που ο άνθρωπος έχει καθημερινά. Ένας επιπλέον και πολύ βασικό είναι το σρόλος της ανθρώπινης συμπεριφοράς είναι οι καταβολές τις οποίες έχει ο καθένας μας από το περιβάλλον το οποίο έχει μεγαλώσει και τις καταβολές που έχει δεχτεί. Για παράδειγμα είναι πολύ διαφορετικός ο τρόπος σκέψης ενός ανθρώπου που έχει μεγαλώσει στον λεγόμενο «δυτικό κόσμο» και πολύ διαφορετικός ο τρόπος κάποιου που έχει μεγαλώσει στην μέση ανατολή. Τέλος, αναπτύσσεται και το ρόλο της γυναίκας στον τομέα αυτό και πως αντιμετωπίζεται από του αντίθετο φύλλο.

Chapter 1

What is aviation Psychology?

1.Introduction

Because the primary target of this book is the student of aviation, rather than the student of psychology, it seems prudent to begin with a few defnitions. This will set some bounds for our discussions and for the reader's expectations. The title of the book includes two key terms: "aviation psychology" and "human factors." We included both these terms because they are often used interchangeably, although that is a disservice to both disciplines. Although we will touch on some of the traditional areas of human factors in the chapter on the design of aviation systems, our primary focus is on aviation psychology. Therefore, we will dwell at some length on what we mean by that particular term.

Psychology* is commonly defned as the science of behavior and mental processes of humans, although the behavior of animals is also frequently studied—usuallyas a means to understand human behavior better. Within this broad area, there are numerous specialties. The American Psychological Association (APA), the largest professional organization of psychologists, lists over 50 divisions, each representing a separate aspect of psychology. These include several divisions concerned with various aspects of clinical psychology along with divisions concerned with such diverse issues as consumer behavior, school psychology, rehabilitation, the military, and addiction. All of these are concerned with understanding how human behavior and mental processes influence or are influenced by the issues of their particular domain.

Clearly, psychology covers a very broad area: Literally, any behavior or thought is potential grist for the psychologist's mill. To understand exactly what this book will cover, let us consider what we mean by aviation psychology. Undoubtedly, students of aviation will know what the frst part of the term means, but what is included under psychology, and why do we feel justifed, even compelled, to distinguish between aviation psychology and the rest of the psychological world?

First, let us immediately dismiss the popular image of psychology. We do not include in our considerations of aviation psychology reclining on a couch recounting our childhood and the vicissitudes of our emotional development. That popular image of psychology belongs more to the area of clinical psychology, or perhaps even psychoanalysis. Although clinical psychology is a major component of the larger feld of psychology, it has little relevance to aviation psychology. That is not to say that pilots and others involved in aviation are not subject to the same mental foibles and afflictions that beset the rest of humanity. Neither would we suggest that aspects of the human psyche usually addressed in a clinical setting could have no influence on human performance in an aviation setting. Quite the opposite, we assert that all aspects of the mental functioning of pilots, maintenance personnel, air traffc controllers, and the supporting cadre inescapably influence behavior for better or worse.

Rather, we wish to dissociate aviation psychology from the psychotherapeutic focus of traditional clinical psychology. Aviation psychology may concern itself with the degree of maladaptive behavior evidenced by excessive drinking or with the confused ideation associated with personality disorders. However, it does so for the purpose of understanding and predicting the effects of those disorders and behaviors on aviation-related activities, rather than for the purpose of effecting a cure.

Ours is a much more basic approach. We are concerned not only with the behavior (what people do) and ideation (what people think) of those with various mental disturbances, but also with how people in general behave. Psychology at its most inclusive level is the study of the behavior of all people. Psychology asks why, under certain conditions, people behave in a certain way, and under different conditions they behave in a different way. How do prior events, internal cognitive structures, skills, knowledge, abilities, preferences, attitudes, perceptions, and a host of other psychological constructs (see the later discussion of constructs and models) influence behavior? Psychology asks these questions, and psychological science provides the mechanism for fnding answers. This allows us to understand and to predict human behavior.

We may defne aviation psychology as the study of individuals engaged in aviation-related activities. The goal of aviation psychology, then, is to understand and to predict the behavior of individuals in an aviation environment. Being able, even imperfectly, to predict behavior has substantial benefts. Predicting accurately how a pilot will react (behave) to an instrument reading will allow us to reduce pilot error by designing instruments that are more readily interpretable and that do not lead to incorrect reactions. Predicting how a maintenance technician will behave when given a new set of instructions can lead to increased productivity through reduction of the time required to perform a maintenance action. Predicting how the length of rest breaks will affect an air traffc controller faced with a traffc conflict can lead to improved safety. Finally, predicting the result of a corporate restructuring on the safety culture of an organization can identify areas in which conflict is likely to occur and areas in which safety is likely to suffer.

From this general goal of understanding and predicting the behavior of individuals in the aviation environment, we can identify three more specifc goals: frst, to reduce error by humans in aviation settings; second, to increase the productivity; and third, to increase the comfort of both the workers and their passengers. To achieve these goals requires the coordinated activities of many groups of people. These include pilots, maintenance personnel, air traffc control operators, the managers of aviation organizations, baggage handlers, fuel truck drivers, caterers, meteorologists, dispatchers, and cabin attendants. All of these groups, plus many more, have a role in achieving the three goals of safety, effciency, and comfort. However, because covering all these groups is clearly beyond the scope of a single book, we have chosen to focus on the pilot, with only a few diversions into the activities of the other groups. Another reason for choosing pilots is that the majority of research has been conducted on pilots. This is slowly changing, and more research is being conducted

using air traffc controllers, crew members, and other occupational groups involved in aviation.

In this, we enlist contributions from several subdisciplines within the overallfeld of psychology. These include engineering psychology and its closely related discipline of human factors, personnel psychology, cognitive psychology, and organizational psychology. This listing also matches to a fair degree, the order in which we develop our picture of aviation psychology - moving from fairly basic considerations of how the operator interacts with his or her aircraft (the domain of engineering psychology and human factors) through considerations of how best to select individuals to be trained as pilots (the domain of personnel and training psychology). Cognitive psychology also contributes to our understanding of how individuals learn new tasks, along with providing us information on how best to structure jobs and training so that they match the cognitive structure of the learner. Finally, from organizational psychology we learn how the structure and climate of an organization can contribute to issues such as safety through the expectations for behavior fostered among members of the organizations, as well as by the reporting and management structure that the corporate executives put in place.

Although aviation psychology draws heavily upon the other disciplines of psychology, those other disciplines are also heavily indebted to aviation psychology for many of their advances, particularly in the area of applied psychology. This is due primarily to the historic ties of aviation psychology to military aviation. For a number of reasons to be discussed in detail later, aviation—and pilots in particular— have always been a matter of very high concern to the military. Training of military pilots is an expensive and lengthy process, so considerable attention has been given since World War I to improving the selection of these individuals so as to reduce failures in training—the provenance of personnel and training psychology.

Similarly, the great cost of aircraft and their loss due to accidents contributed to the development of engineering psychology and human factors. Human interaction with automated systems, now a great concern in the computer age, has been an issue of study for decades in aviation, beginning from the introduction of flight director systems and in recent years the advanced glass cockpits. Much of the research developed in an aviation setting for these advanced systems is equally germane to the advanced displays and controls that will soon appear in automobiles and trucks.

In addition, studies of the interaction of crew members on airliner flight decks and the problems that ensue when one of the other crew members does not clearly assert his or her understanding of the potentially hazardous situation has led to the development of a class of training interventions termed crew resource management (CRM).

After a series of catastrophic accidents, the concept and techniques of CRM were developed by the National Aeronautics and Space Administration (NASA) and the airline industry to ensure that a crew operates effectively as a team. Building upon this research base from aviation psychology, CRM has been adapted for other settings, such as air traffc control centers, medical operating rooms, and military

command and control teams. This is a topic we will cover in much more detail in a later chap.

1.2 Goals of Psychology

Describe. Specify the characteristics and parameters of psychological phenomena more accurately and completely. For example, studies have been conducted of human short-term memory that very accurately describe the retention of information as a function of the amount of information to be retained.

Predict. Predicting what people will do in the future, based on knowledge of their past and current psychological characteristics, is a vital part of many aviation psychology activities. For example, accurately predicting who will complete pilot training based on knowledge of their psychological test scores is important to the organization performing the training. Likewise, predicting who is more likely to be in an aircraft accident based on psychological test scores could also be valuable information for the person involved.

Understand. This means being able to specify the relationships among variables—in plain language, knowing the "how" and "why" drives psychologists and nonpsychologists alike. Once we understand, we are in a position to predict and to influence.

Influence. Once we have learned why a person fails in training or has an accident, we may be able to take steps to change the outcome. From our earlier example, if we know that increasing the amount of sleep that trainees receive improves their likelihood of succeeding in training, then we almost certainly will wish to change the training schedule to ensure that everyone gets the required amount of sleep every night.

Psychology can also be broken down into several different general approaches. These approaches reflect the subject matter under consideration and, to a large degree, the methods and materials used.

These approaches include:

- A *behaviorist* approach looks at how the environment affects behavior.
- A *cognitive* approach studies mental processes and is concerned with understanding how people think, remember, and reason.
- A *biological* approach is concerned with the internal physiological processes and how they influence behavior.
- A *social* approach examines how we interact with other people and emphasizes the individual factors that are involved in social behavior, along with social beliefs and attitudes.

- A *developmental* approach is primarily interested in emotional development, social development, and cognitive development, including the interactions among these three components.
- A *humanistic* approach focuses on individual experiences, rather than on people in general.

The delineation of these six approaches may suggest more homogeneity than actually exists. Although some psychologists remain exclusively within one of these approaches (physiological psychologists are perhaps the best example), for the most part psychologists take a more eclectic view—borrowing concepts, methods, and theories from among the six approaches as it suits their purpose. Certainly, it would be very diffcult to classify aviation psychologists into one of these six approaches.

1.3 Models and Psychological constructs

The rules of science are met in other disciplines (e.g., chemistry, physics, or mathematics) through the precise delineation of predecessors, actions, conditions, and outcomes. In chemistry, for example, this is embodied in the familiar chemical equation depicting the reaction between two or more elements or compounds. The chemical equation for the generation of water from hydrogen and oxygen is unambiguous:

$$2H + O = H2O.$$

That is, two hydrogen atoms will combine with one oxygen atom to form one molecule of water.

This is a simple, but powerful model that lets chemists understand and predict what will happen when these two elements are united. It also provides a very precise defnition of the model, which allows other scientists to test its validity. For example, a scientist might ask: Are there any instances in which H3O is produced? Clearly, the production of a model such as this is a very desirable state and represents the achievement of the goals, in the chemical domain, that were listed for psychology earlier. Although psychology cannot claim to have achieved the same levels of specifcity as the physical sciences, great progress has nevertheless been made in specifying the relationships among psychological variables, often at a quantitative level. However, the level of specifcity at present generally is inversely related to the complexity of the psychological phenomenon under investigation.

Some of the earliest work in psychology dealt with psychophysics—generally including issues such as measurement of "just noticeable differences" (JNDs) in the tones of auditory signals or the weights of objects. In Leipzig, Germany, Ernst Weber

(1795–1878) discovered a method for measuring internal mental events and quantifying the JND. His observations are formulated into an equation known as *Weber's law,* which states that the just noticeable difference is a constant fraction of the stimulus intensity already present (Corsini, Craighead, and Nemeroff 2001).

More recent efforts have led to the development of several equations describingpsychological phenomena in very precise models. These include Fitts's law (Fitts 1954), which specifes that the movement time (e.g., of a hand to a switch) is a logarithmic function of distance when target size is held constant, and that movement time is also a logarithmic function of target size when distance is held constant. Mathematically, Fitts's law is stated as follows:

$$MT = a + b \log2(2A/W)$$

where

MT = time to complete the movement
a, b = parameters, which vary with the situation
A = distance of movement from start to target center
W = width of the target along the axis of movement

Another such example is Hick's law, which describes the time it takes a person to make a decision as a function of the possible number of choices (Hick 1952). This law states that, given n equally probable choices, the average reaction time (T) to choose among them is

$$T = blog2(n + 1)$$

This law can be demonstrated experimentally by having a number of buttons with corresponding light bulbs. When one light bulb is lit randomly, the person must press the corresponding button as quickly as possible. By recording the reaction time, we can demonstrate that the average time to respond varies as the log of the number of light bulbs. Although a seemingly trivial statement of relationships, Hick's and **8** Aviation Psychology and Human Factors Fitts's laws are considered in the design of menus and submenus used in a variety of aviation and nonaviation settings (Landauer and Nachbar 1985).

1.4 What is a Model?

A model is a simplified representation of reality. It can be a physical,

mathematical, or logical representation of a system, entity, phenomenon, or process. When we talk about a psychological model, we are usually referring to a statement, or a series of statements, about how psychological constructs are related or about how psychological constructs influence behavior. These models can be very simple and just state that some things seem to be related. For an example, see the description of the SHEL model.

On the other hand, the model could be quite complex and make specific quantitative statements about the relationships among the constructs. For an example of this type of model, see the weather modeling study in which a mathematical modeling technique is used to specify how pilots combine weather information. Other models, such as those of human information processing or aeronautical decision making, make statements about how information is processed by humans or how they make decisions. A good model allows us to make predictions about how changes in one part of the model will affect other parts.

Clearly, from some psychological research, very precise models may be constructed of human sensory responses to simple stimuli. Similarly, early work onhuman memory established with a fairly high degree of specifcity the relationship between the position of an item in a list of things to be remembered and the likelihood of its being remembered (Ebbinghaus, 1885, as reprinted in Wozniak 1999).

In addition to highly specifc, quantitative models, psychologists have also developed models that specify qualitative or functional relationships among variables. Some models are primarily descriptive and make no specifc predictions about relationships among variables other than to suggest that a construct exists and that, in some unspecifed way, it influences another construct or behavior. Some models propose a particular organization of constructs or a particular flow of information or events. The predicted relationships and processes of those models may be subject to empirical tests to assess their validity—a very worthwhile characteristic of models.

Of particular interest* to the feld of aviation psychology are models that deal with

- general human performance;
  • skill acquisition and expertise development;

  * These are but a sampling of the many models currently available. For more information, consult Foyl Introduction **9**

  • human information processing;
  • accident etiology; and
  • decision making (specifcally, aeronautical decision making)
- Aviation Psychology,
- Human Factors, and

- the Design of Aviation Systems

This, indeed, is the historical imperative of human factors—understanding why people do what they do so we can tweak, change the world in which they work and shape their assessments and actions accordingly.

Chapter 2

Human factors in Aviation

2. Introduction

As noted in the introduction in Chapter 1, aviation psychology is closely related to the feld known as human factors. In recent years the distinction among aviation psychology, human factors, and the more hardware-oriented discipline of engineering

psychology has become very blurred, with practitioners claiming allegiance to the disciplines performing very similar research and applying their knowledge in very similar ways. Traditionally, engineering psychology might be thought of as focusing more on humans and human factors might focus somewhat more on hardware and its interface with the human operator. For all practical purposes, however, the distinction between the two disciplines is irrelevant. It is mentioned here only to alert the reader to the terminology because much of what we would label as aviation psychology is published in books and journals labeled as human factors.

Setting aside the differences in terminology, aviation psychology (or human factors) has a great deal to say about how aviation systems should be designed. To meet the goals of reducing errors, improving performance, and enhancing comfort, a system must accommodate the physical, sensory, cognitive, and psychological characteristics of the operator. A system must not demand that the operator lift excessive weights or press a control with an impossible amount of force. A system must not require that the operator read information written in a tiny font or make fne distinctions of sound when operating in a noisy environment. A system must not demand complex mental arithmetic or the memorization and perfect recall of long lists of control settings, dial readings, and procedures. A system must not demand that the

operator remain immune to the social stresses placed on him or her by co-workers or to the demands of management to cut corners to accomplish the job.

Knowledge of human capabilities, strengths, and limitations informs the system design process because this knowledge sets the bounds for the demands the system may make of the operator. An extensive body of research has addressed these bounds. Researchers have studied how much weight humans can lift to specified heights, the numbers of errors that occur when identical controls are placed side by side, how many numbers can be recalled from short-term memory, the font size of displays, legibility of displays under varying degrees of illumination, and the effects of an organization's climate on the safety-related behavior of workers, to list but a few examples.The overall aim of this chapter is to demonstrate how psychological knowledge may be used when designing aviation systems, what principles should be applied, and common errors and problems that occur when humans interact with complex systems and equipment.

2.1 Types of human error

Arguably, the present status of aviation psychology and human factors owes much to the efforts of researchers during World War II. The sheer magnitude of the war effort led researchers on both sides of the conflict to conduct extensive studies with the aim of improving personnel performance and reducing losses due to accidents and combat. Perhaps the most frequently cited study in the area of aviation

psychology and human factors produced by that era was the work by Fitts and Jones (1947a) on the causes of errors among pilots.

Fitts and Jones (1947a, 1961a) surveyed a large number of U.S. Army Air Force pilots regarding instances in which they committed or observed an error in the operation of a cockpit control (flight control, engine control, toggle switch, bselector switch, etc.).

They found that all errors could be classifed into one of six categories:

•substitution errors—confusing one control with another or failing to identify a control when it was needed;
• adjustment errors—operating a control too slowly or too rapidly, moving av switch to the wrong position, or following the wrong sequence when operating several controls;

• forgetting errors—failing to check, unlock, or use a control at the proper time;
• reversal errors—moving a control in the direction opposite to that necessary to achieve the desired result;
• unintentional activation—operating a control inadvertently without being aware of it; and
• unable to reach a control—inability physically to reach a needed control or being required to divert attention from an external scan to such a point that an accident or near-accident occurred.

Substitution errors accounted for 50% of all the error descriptions reported; the most common types of errors were confusion of throttle quadrant controls (19%), confusion of flap and wheel controls (16%), and selection of the wrong engine control or propeller feathering button (8%). The conditions that gave rise to such results are illustrated in Table 3.1, using data provided by Fitts and Jones (1961a, p. 339) on the throttle quadrant confgurations on three common aircraft of that era. Similar Aviation Psychology, Human Factors, and the Design of Aviation Systems. diffculties were encountered with the controls for the flaps and landing gear, which at that time were often located close to one another and used the same knob shape.

Fortunately for today's pilots, many of the recommendations of Fitts and Jones and other researchers of that period have been implemented. The confguration of the six principal instruments, the order of controls on the throttle quadrant for propeller-driven aircraft, and the shapes of the controls themselves are all now fairly standardized. The shape of the knob for the landing gear resembles a wheel, the shape of the flaps knob resembles an airfoil, and the two controls are located as far apart as possible while still remaining easily accessible to the pilot.

Although these sorts of errors have been largely, though not entirely, eliminated, others remain. "Forgetting" errors, which in the Fitts and Jones study accounted for 18% of the total errors, remain a problem in today's aircraft. The shape of the landing gear control may have largely prevented its confusion with the flaps; however, the

pilot must still remember to lower the gear prior to landing. Memory devices, paper checklists, and, in the case of more advanced aircraft, computer watchdogs all serve to prevent the pilot from making the all-too-human error of forgetting. Interestingly, one of the recommendations of Fitts and Jones (1961a, p. 333) was to make it "impossible to start the takeoff run until all vital steps are completed." Clearly, this is a goal that still eludes us: Pilots still attempt takeoffs without frst extending the leadingedge slats and flaps, and they make landings without prior arming of the spoilers—typically, after defeating the warning systems put in place to prevent such events.

2.2 Human characteristics and design

At a more general level than the work by Fitts and Jones, Sinaiko and Buckley (1957; 1961)list the following general characteristics of humans as a system component:

- physical dimensions;
- capability for data sensing;
- capability for data processing;
- capability for motor activity;
- capability for learning;
- physical and psychological needs;
- sensitivities to physical environment;
- sensitivities to social environment;
- coordinated action; and
- differences among individuals.

All of these characteristics must be taken into account in the design of aviation systems. Some of the system requirements driven by these characteristics are reasonably well understood and have been addressed in system design for many years. For example, certainly since the work of Fitts and Jones following World War II, designers have been aware of the need to mark and separate controls properly and to arrange displays in a consistent way. However, the implications of some of the characteristics are still being explored. The work over the past 20 years on crew resource management (see Helmreich, Merritt, and Wilhelm, 1999, for an overview) is evidence of our growing understanding of the sensitivities of humans to their social environment and capabilities for coordinated action. Even more recently, researchers have begun to explore the influences of the organizational climate and culture on the performance of aircrew (Ciavarelli et al. 2001).

Of particular relevance to aviation psychology is the notion of differences among

individuals. Although Sinaiko and Buckley (1957) list it as a separate characteristic,it is really inherent in all the other characteristics they list. Humans vary, often considerably, on every characteristic by which they may be measured. The measurement of these individual differences and determination of how they contribute to other characteristics of interest—such as success in training, likelihood of an accident, skill at making instrument landings, or probability of being a good team member—are at the heart of aviation psychology.

In addition to examining the errors associated with controls, Fitts and Jones (1947b, 1961b) also examined errors in reading and interpreting aircraft instruments. As in their study of control errors, they classifed errors in reading or interpreting instruments into nine major categories. Errors in reading multirevolution instrument indications accounted for the largest proportion of errors (18%). Misreading the altimeter by 1,000 feet was the most common of these errors, accounting for 13% of the total errors. Additional errors included reversal errors (17%), signal interpretation errors (14%), legibility errors (14%), substitution errors (13%), and using inoperative instruments (9%).

Among their several conclusions, Fitts and Jones (1961b, p. 360) noted that "the nature of instrument-reading errors is such that it should be possible to eliminate most of the errors by proper design of instruments." Arguably, 60 years after the frst publication of their work, current researchers could still arrive at the same conclusion. If most of the issues associated with the shape of controls have been resolved, problems with displays remain. However, they are not necessarily the same problems identifed by Fitts and Jones. Multirevolution instruments (most notably the altimeter) have been replaced with instruments that depict information differently—typically, along a vertical scale in the case of altitude. Yet, pilots still fly into the ground on occasion because, even after reading the instrument correctly, they have misprogrammed the system that controls the vertical flight profle of their aircraft. Likewise, radio navigation beacons required pilots to identify the Morse signal transmitted by the beacon aurally and gave rise to signal interpretation errors; these have given way to GPS navigation, with its own set of display problems and corresponding errors.

Each new generation of technology offers some solutions to the problems that existed in the older generation, while creating a whole new set of problems. This situation is succinctly described by Dekker (2002, p. 8), who notes that "aerospace has seen the introduction of more technology as illusory antidote to the plague of human error. Instead of reducing human error, technology changed it, aggravated the consequences and delayed opportunities for error detection and recovery."

2.3 Principles of display design

One way to break this chain of technology and error is to step outside the specifc technologies and look at overarching principles that should be applied to all new

technology development. Thus, instead of looking for the best shape for the landing gear control, we might look for the general principles by which such controls should be designed. As an example, let us consider the design of aircraft displays. Wickens (2003), one of the preeminent researchers in the area of aviation displays, has enumerated seven critical principles of display design, which are described next.

2.3.1 Principle of information need

How much information does a pilot need? The short answer is "just enough." Too little information (e.g., the absence of weather radar on days when thunderstorms are present) leaves the pilot flying, and making decisions, blind. Most pilots would agree that having more information is good, but the converse is also true. Having too much information can be as damaging as having too little. Too much information can lead to a cluttered flight deck (typifed by the L-1011 and DC-10 era aircraft) with hundreds of dials and indicators. Searching for the needed information among all the extraneous information can lead to poor performance on critical, time-sensitive tasks. Current-generation aircraft, in contrast, have combined many of the formerly separate information sources into combined displays that integrate information, such as engine health, into a single, easily interpretable instrument. When that information is needed, it is easily obtained.

To determine how much information is enough, we turn to a family of techniques subsumed under the title "task analysis"* (cf. Kirwan and Ainsworth 1992; Meister 1985; Seamster, Redding, and Kaempf 1997; Shepherd 2001; Annett and Stanton 2000). Although several varieties of this technique exist and sometimes are used for different purposes (e.g., for training development or for personnel selection, as mentioned in other chapters of this book), they share a general approach to the orderly specifcation of the tasks that a person must accomplish, the actions (both physical and cognitive) that the person must complete, and the information required to permit the person to complete the actions. For example, we might specify the information required to complete a precision instrument approach or the information required to identify which of several engines has failed. If the pilot is expected to complete these tasks (making the instrument approach and dealing with the failed engine), then he or she must have the required information. In addition, that information should not be hidden by or among other bits of information.

Chapter 3

Stress, Human Reactions, and Performance

3. Introduction

An important part of psychology is the study of variations in how we think, feel, and react. Although it is important to be aware of such variations, there are a number of commonly shared patterns in terms of reactions—for example, to dramatic events. Hence, this chapter discusses both individual differences and common traits in reactions to everyday stress and more signifcant incidents. Also, this chapter investigates common psychological reactions in passengers.

3.1 Personality

Personality is a sweeping construct. It may be defned broadly as every internal

factor that contributes to consistent behavior in different situations or, narrowly, as encompassing only emotions and motivation. A broader definition of personality may include intelligence; traditionally, however, personality has been considered separate from intelligence and skills. This distinction is evident in psychological tests, which are usually divided into ability tests and personality tests. Ability tests often include time constraints, and the objective is to get as many correct answers as possible, whereas personality tests seek to measure typical response patterns—that is, how an individual usually reacts to a given situation.

For a long time, the psychology community has been engaged in discussion on how many personality traits or dimensions are necessary to describe someone. Imagine describing a long-time friend. Which adjectives and examples should be used? Perhaps the words "great," "friendly," "humorous," or "reliable" spring to mind. If one were to describe a person of whom one was less fond, perhaps words such as "aggressive," "cynical," "egotistical," or "prejudicial" would be used. If such descriptions are collected and systematized using factor analysis (see Chapter 2), fve general categories emerge. These fve factors are normally referred to as "the big fve": extroversion, agreeableness, conscientiousness, neuroticism, and openness to experience (Costa and McCrae 1997). Some measures use emotional stability instead of neuroticism. In other words, the positive end of the scale is applied. Refer to Table 6.1 for examples of characteristics that lead to high or low scores for the different dimensions.

Most techniques for personality characteristic measurements use statements combined with a point scale ranging from one to fve (or, in some cases, one to seven) to which subjects note their level of agreement. Combinations of positively and negatively phrased statements are often used for the different dimensions. For example, "I am often anxious" may be used instead of "I am never anxious."

Factor analysis of adjectives (e.g., "kind," "friendly," "frm," and "anxious") and longer statements has been the starting point for the fve-factor model. It is also possible to break the fve main factors into subfacets if a more detailed description of the person is required. Studies have shown that this fve-factor solution may be replicated across language and cultural barriers, and a satisfactory correspondence between the subjects' description of themselves and how others perceive them has been established, particularly when described by persons who know them well (see, for example, Digman 1990).

However, not all researchers agree that the fve-factor model represents a comprehensive description of personality. Some think it contains too few (or too many) traits. Others fnd the model simplistic or that it fails to explain "how we have developed into being who we are" (refer to Block, 1995, for a critical analysis). Despite these criticisms, the model has been widely used in research involving personality and appears to be accepted widely as a good starting point for personality assessments (see, for example, Digman 1990; Goldberg 1993). Studies have demonstrated a considerable inheritable component in personality characteristics and that personality traits develop until the age of 30, after which they remain relatively stable (Terracciano, Costa, and McCrae 2006).

In the 1980s a series of personality inventories were developed to map the big fve traits. Costa and McCrae's NEO personality inventory (NEO-PI) (1985) is particularly well known. The fve traits are presumed to be relatively independent of abilities; however, one exception is "openness to experience," which, to a certain extent, correlates with intelligence (Costa and McCrae 1985). These approaches share the advantage of a generally high reliability level. In terms of predictive validity, several of the dimensions have proven to be associated with work achievements, although the correlations are described as small or moderate. A meta-analysis of the relation between the personality traits and accidents revealed conscientious Ness and agreeableness to be associated systematically with accident involvement: People with low conscientiousness and agreeableness scores had experienced a greater number of accidents than those with higher scores (Clarke and Robertson 2005).

Although these measurement techniques were designed to measure aspects of an individual's established personality, other methods or diagnostics systems are used to document problems, such as high levels of anxiety and depression, or to establish whether someone is suffering from mental illness.

In addition to the fve-factor model and its associated empirical systems, specific traits are often used to describe personalities or aspects thereof that may be of importance in some situations. These traits are typically tied to certain theories or are particularly suited to explain reactions (or predict behavior) in certain situations. The following are examples of such traits: type A behavior, locus of control (LOC), psychological resilience, and social intelligence. Type A behavior and LOC are discussed in detail in Section 6.6 on individual differences and stress.

Psychological resilience has been studied in particular in relation to people who thrive despite challenges and misfortune. Important factors here are personal attributes such as social skills and leading a structured life; however, external support from family and friends is also important (Friborg et al. 2005). Social intelligence usually refers to social skills and the ability to understand one's own and others' reactions (Silvera, Martinussen, and Dahl 2001). These traits are more or less related to the personality traits contained in the fve-factor model. For example, LOC correlates with neuroticism, such that those with internal LOC are considered more emotionally stable. In addition to traits mentioned in scientifc literature, a number of poorly documented theories on personality can be found in popular science magazines and the like, often accompanied by different tests that reportedly measure these theories' accompanying traits. However, documentation to support the reliability and validity of such tests is usually scant.

3.2 What is stress?

We are continually bombarded with influences, expectations, and demands placed on us by our surroundings. Work commitments or the lack of time and resources to complete tasks are typical examples. Both paid work and unpaid work

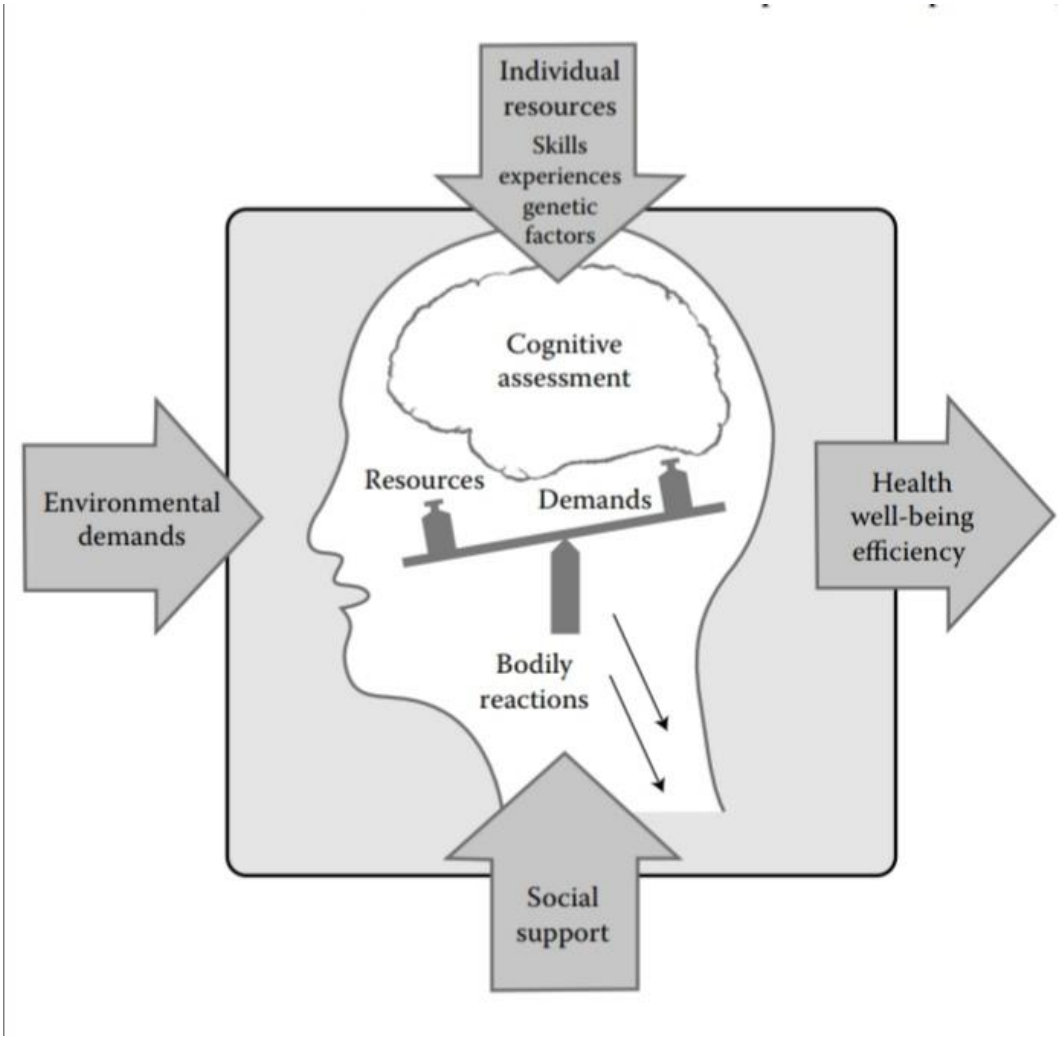
(e.g., caring for family members) are applicable factors in this regard. To meet social demands or solve work-related tasks, the individual relies on different sets of resources, including knowledge, experience, and personal attributes. Some theories describe stress as the result of factors or elements that have a negative impact on the individual—for example, distracting noise or pressure at work (stimulus-based theories). Other theories are concerned with the consequences of stress, such as various emotional and physical reactions (response-based theories). The latter tradition is exemplifed by Selye (1978). He describes a general stress response that is valid for everyone and consists of three phases: the alarm phase, the resistance phase, and the exhaustion phase.

A more modern understanding requires stress to be regarded as the interaction between demands and the resources available to the individual. When demands placed on an individual exceed his or her resources, stress develops. In these interaction models, an important point is that the person must evaluate the demands and consider whether these demands exceed his or her resources. Due to this cognitive evaluation, what one individual considers a stressor is not necessarily considered a stressor by someone else (noted in, for example, Lazarus and Folkman 1984). Balance between external demands and personal attributes is perceived as challenging and satisfying to the individual (Frankenhaeuser 1991), whereas imbalance is a precursor to emotional, physical, and behavioral consequences.

Frankenhaeuser's (1991) bio-psychosocial model (depicted in Figure 6.1) delineates the relationship between stress and health. In this model, the person is subjected to various demands, such as intense workloads, time constraints, shift work, problems, or conflicts. The person relates this to his or her resources, including experience, physical and mental health, personal abilities, and, potentially, external support. If demand surpasses the person's resources, stress ensues, accompanied by both psychological and physiological reactions. Immediately, various stress hormones are released into the body (adrenaline, noradrenaline, and cortisol). These hormones produce a number of advantageous effects in precarious situations; however, problems may arise if the individual is exposed to these effects for an extended period of time. If a person is continually stressed or if there is not enough time to rest, the body is unable to normalize the physiological reactions in time for the next work session. Stress is also an unpleasant experience, with short-term and long-term consequences for the affected person's productivity. We will discuss this more in a later section.

Other models describe work-related stress, such as Karasek's demand-control model (Karasek 1979; Karasek and Theorell 1990), which describes how stress relates to various consequences such as health risks and behavior within the organization. In this model, work-related demands are described as "high" or "low"; similarly, the individual's ability to affect or control the situation is deemed "high" or "low." Combining high demands with low levels of control increases the risk of psychological impacts and physical illness, such as cardiovascular diseases (Yoshimasu 2001). On the other hand, combining high demands and a high level of control encourages learning and has a motivational effect. Later expansions on this

model have pointed out that social support, such as assistance and encouragement by colleagues, may reduce stress and minimize risks associated with negative consequences of stress. There are several forms of social support, such as care and empathy, as well as assistance of a more practical nature such as being applauded for doing a good job.



3.3 conflicts between work and private life

Today, many of us choose to combine work and private life. This means that many people must be adept at several roles (parent, partner, employee, and so forth). The total workload is substantial and may lead to insuffcient time for recreation and rest. Thus, conflicts may arise from the interaction between work and private life. At the same time, having multiple roles can have positive aspects, such as increased self-confdence and greater fnancial freedom. There are several approaches to workto-home conflicts. One is that time management becomes diffcult, and it seems like "there are not enough hours in the day." Another is that work causes stress and exhaustion, leading to the inability to engage in quality family time as much as one would like.

Several studies have described a connection between work–home conflicts and burnout (Martinussen and Richardsen 2006; Martinussen, Richardsen, and Burke 2007) and between work–home conflicts and reduced satisfaction with one's partnership, as well as reduced job satisfaction (Allen et al. 2000). Some studies have pointed to a so-called "crossover effect" between partners: Stress and tension experienced at work by one person are transferred to his or her partner, who subsequently has to deal with the stress by serving as a buffer (Westman and Etzion 1995). This transfer probably occurs because the person empathizes with his or her partner; however, a more direct effect is plausible because exhausted and frustrated persons have "less to give" when they come home from work. A study of couples with young children revealed that men were more likely to become passive and withdrawn upon returning home after a diffcult day at work, and women were more likely to become aggressive (Schultz et al. 2004). In short, the study indicated that having a diffcult day at work might have consequences for one's partner and that there are gender-related differences in how one reacts to such situations. These fndings have since been supported by a survey of male flight controllers that revealed that they often reacted with withdrawal after a stressful day at work. The study also revealed that satisfaction was greater when their partner accepted such behavior.

Although fewer studies have investigated how family or private matters negatively affect job performance, we can safely assume that such effects would be undesirable. Some examples of demanding tasks at home include dealing with disease, partnership breakdowns, and caring for many young children. However, negative emotions are not the only emotions transferable between home and work. Positive experiences at work may transfer to family life as one arrives home contented and uplifted; conversely, positive events at home may lead to a better day at work. Arguably, people with family commitments may fnd it easier to set boundaries for their work commitments, which, in the absence of a family, might have absorbed a greater part of the day. Thus, family commitments become a legitimate excuse to the employer and, not least, to oneself. In particular, young, single professionals presumably experience greater pressure to perform and are more likely to work longer hours, indicating that individuals with family commitments are not the only ones struggling to fnd the balance between work and leisure. Further, modern communications (such as e-mail and cell phones) may enable a person to continue

working even after offcial work hours. Several studies have indicated the continuation of traditional labor-sharing practices in households in which women account for cooking, cleaning, and caring for children and men are mainly responsible for tasks such as maintenance and car repairs (Lundberg and Frankenhaeuser 1999; Lundberg, Mårdberg, and Franken hauser 1994; Østlyngen et al. 2003). A Norwegian study involving parents with young children (0–6 years) demonstrated that females did about 70% of the domestic work; however, this study included a relatively high percentage of mothers who worked part-time (Kitterød 2005). Nonetheless, the study indicates a larger total workload for women in comparison to men, leaving them with a reduced amount of time (after fnishing the day's paid and domestic work) available for relaxation and recreation.

A study of junior managers employed at the car manufacturer Volvo in Sweden revealed that stress hormone levels were equal in female and male managers during work hours, but a difference was noticeable after work hours. Rising levels were recorded in females between 6:00 and 8:00 p.m., but in males the corresponding values decreased during the same period (Frankenhaeuser 1991). The physiological data were consistent with self-reporting of weariness. Thus, male junior managers started relaxing immediately after work. This was not the case for females until much later in the evening. Therefore, females had a shorter time available for relaxation than did males, possibly incurring negative health consequences in the long term (Lundberg 2005).

3.4 Burnout and engagement

Burnout can be regarded as a stress reaction occurring after long-term, work-related demands and pressure. Maslach and Jackson (1981, 1986) have defned burnout as a three-dimensional psychological syndrome consisting of emotional exhaustion (acondition including overwhelming emotional and physical exhaustion), depersonalization (characterized by negative emotions and cynical attitudes toward the recipients of one's service or care), and reduced personal accomplishment (a tendency to evaluate one's own work negatively). Initial studies of burnout were based on workers in care professions such as nursing. Then, burnout was considered to be triggered by high interpersonal demands. More recently, however, burnout has been found in professions that do not necessarily involve caring for patients, clients, or pupils. The three dimensions have subsequently been generalized into the dimensions of exhaustion, cynicism, and professional effcacy (Richardsen and Martinussen 2006).

A number of work environment factors have proven to be associated with burnout. Leiter and Maslach (2005) have described six categories of such factors. One of these is workload: too much to do (or not enough time available to do it) or insuffcient resources to solve given tasks. Insuffcient control or autonomy in the workplace is also associated with burnout. If a person feels powerless to control

resources required to complete tasks or unable to influence how the job is done, reduced personal accomplishment may result.

Some work-related factors have a preventive effect on burnout or serve as a "buffer." These factors include social support or assistance provided by management or colleagues. Being rewarded, acknowledged, and feeling fairly treated (in terms of promotions, etc.) are positive resources. Sometimes an employee may fnd that the organization has values different from his or hers—for example, being told to withhold information or deceive someone. At present, however, what happens when values held by employees differ from those of employers has been insuffciently researched.

Although early research into burnout was directed at particular jobs (such as the previously mentioned nurses), not only those in demanding care professions are at risk. Few studies have been aimed at burnout in aviation professions, and most workrelated stress studies focus on short-term effects, such as measuring blood pressure changes in flight controllers when exposed to elevated air traffc density levels.

A study of Norwegian air traffc controllers concluded that the burnout rate was not signifcantly higher for them than for other professions included in the study. Both the levels of conflict experienced and work–home-related conflicts were associated with exhaustion in this group (Martinussen and Richardsen 2006). Most people would consider flight control to be a highly stressful profession; thus, it is surprising that this group did not have elevated burnout rates. On the other hand, flight controllers go through a process of strict selection, education, and training to enable them to perform extremely demanding tasks. Hence, there appears to be a balance between the tasks to be solved and the skills and abilities of the employees. This does not mean that the individuals are immune to the demands and requirements of the organization or that access to resources would not have a positive effect. Similar results have been found for the police profession, which considers organizational issues to be more frustrating and demanding than the job itself (Martinussen et al. 2007).

Traditionally, studies into work environments and burnout have focused greatly on negative aspects and attempted to establish the illness-inducing sides of the work environment (Maslach, Schaufeli, and Leiter 2001). Recently, however, researchers have turned their eyes on studying the opposite of burnout—that is, engagement— to fnd out what causes this outcome. Schaufeli and Bakker (2004) present a model that describes how resources and workplace demands relate to both engagement and burnout (Figure 6.2). This model tells us that burnout is, frst and foremost

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associated with demands and, second, with a lack of resources; engagement is predominantly associated with access to resources such as rewards, recognition, and support. Burnout and engagement have consequences for the organization. Burnout

implies negative consequences, whereas engagement has a positive impact. Examples of organizational consequences are intention to quit, work satisfaction, work performance, and feeling commitment to the organization. Burnout also has negative consequences for the affected individual's health and quality of life.

3.5 Individual differences and stress

There is little doubt that some working environments or factors are generally considered stressful. Yet, people with certain personality characteristics experience stress more often and more intensely than others. It is therefore of interest to study these differences in detail. Studies have shown that neuroticism is associated with burnout. Although some of the other big-fve personality characteristics also have been found to be associated with burnout, fndings vary greatly between studies. Working with individuals suffering from cardiovascular disease, two physicians (Rosenman and Friedman 1974) claimed to have observed certain recurring traits intheir patients. They labeled some of their patients' behavior type A—characterizedby irritability, time constraints, competitive mentality, aggression, hostility, and ambition. Patients who did not display these properties were labeled type B. Several methods of measuring and mapping type A personalities have since been developed, of which the most well known and widely used is the Jenkins activity survey. This method condenses the mentioned characteristics into two dimensions: impatience– irritability and achievement strivings. The latter represents a positive side—namely, that the person sets goals and works hard to achieve them. The former dimension represents the less positive side and is characterized by impatience and aggression. Impatience–irritability is related to health issues, while achievement strivings are associated with enhanced work achievements and better student grades.

Researchers have established the existence of a signifcant inheritable component in type A behavior; type A has also been found to be a risk factor in the development of cardiovascular diseases (see, for example, Yoshimasu 2001). The link is thought to occur because type A—in particular due to the impatience–irritability aspect—is associated with greater physiological activation including elevated blood pressure levels and heart rate. However, lifestyle choices, such as alcohol and smoking, may also contribute to this pattern.

What are the consequences of type A behavior in the workforce? In fact, many organizations are likely to reward type A personalities, at least those aspects relating to striving for achievement; however, irritability may cause problems for the individual and his or her surroundings. Perhaps type A behavior directly influences work-related satisfaction and the experience of stress and burnout. The combination of aspects of the work environment and, for example, impatience–irritability may cause particularly unfortunate outcomes for certain individuals. Type A personalities may even intuitively choose professions that are more challenging or involve a greater pace and workload. It may be the case that type A personalities affect their work

environment in certain ways and therefore contribute to creating a more stressed environment.

Another personal attribute under investigation is locus of control—the extent to which the person feels that he or she can influence or control events and situations. Internal LOC has been shown to be associated with several work-related variables, including improved motivation and commitment (Ng, Sorensen, and Eby 2006). People with active coping techniques (i.e., who act strategically to handle diffcult situations) generally score lower on burnout than people who use more emotionfocused coping techniques (e.g., the person attempts to deal with emotions by seeking comfort in other people).

People also differ according to gender, age, and other circumstantial factors. Generally, low correlations exist between burnout and factors such as age and gender. Sometimes, younger professionals have been found to be more exposed to burnout, but in other studies (e.g., flight controllers and the police), the "age effect" is reversed (Martinussen and Richardsen 2006; Martinussen et al. 2007). However, such correlations are found to be weak. This also applies to differences due to gender: Some studies fnd that females report a greater degree of exhaustion than men and that men have higher cynicism scores; others fnd no gender differences.

3.6 Consequences of stress

Stress has both short-term and long-term consequences. The following discusses emergency situations and how this affects an individual in relation to job performance. A critical stress situation may arise when something unusual takes place during a flight. Examples of stress situations include indications of technical difficulties or a rapid deterioration of weather conditions. It is important to know typical reactions in such situations, be aware of how the crew responds to stress, and understand how it affects decisions made during the flight.

It is diffcult to measure how stress affects various cognitive functions. Ethical considerations are involved in exposing subjects to stressful situations in experiments to study how they react. A possible solution to this problem is to use a simulator to study how people handle various abnormal situations. This provides a controlled environment in which emergency situations can be manufactured, workloads and time constraints increased, and reactions recorded. Although many simulators are highly realistic, they will never be identical to real-world experiences; thus, the possibility that fndings cannot be transferred to real-world situations must not be ignored.

A second option is to study incidents that have already taken place, reconstruct the decisions made, and observe how stress contributed to the event. The drawback of this method is that it is based on human recollection and perception of the event andwhat happened. Another issue is that situations may appear quite differently in hindsight compared to how the situation actually occurred and was experienced by the people involved. No matter which design is chosen, there are challenges and

shortcomings; however, some fndings on the immediate effect of stress on cognitive functions and decision-making capacity are consistent.

According to a review provided by Orasanu (1997), stress may have the following effects:

- People make more errors.
- Attention is reduced, causing tunnel vision or selective hearing.
- Scanning (vision) becomes more chaotic.
- Short-term memory is reduced.
- Change of strategy: speed gains preference to accuracy. People act as though time limits apply. Strategies are simplifed.

Thus, cognitive functions are subject to a number of stress-related consequences in terms of how we perceive our surroundings, process information, and make decisions. An important aspect regarding aviation is the need to take in and monitor information constantly. In a high-stress situation, the capacity to do so diminishes, reducing the ability to understand what is being said over the radio or what anotherperson says. Similarly, the information that is supplied to someone stressed may be poorly understood or not understood at all.

By short-term memory, we refer to the processes or structures that contribute to the temporary storage and processing of information. It enables us to read a couple of sentences while storing and processing information about, say, the last word in each sentence and to repeat those words in the correct order. Some argue that there are clear limitations to short-term memory, and early studies revealed a short-term memory capacity in adults of seven numbers (±2). However, later studies have pointed out more of a complexity in this matter. For instance, grouping a set of numbers and remembering them as one (e.g., “2,” “4,” and “5” as “245”) makes it possible to recall even more numbers. On the other hand, more complex elements (e.g., words) are more diffcult to remember, reducing the number of retainable elements to less than seven. In stressful situations, this capacity will be further reduced, with consequences for the ability to perform basic mental arithmetic, such as calculating the remaining flight time when the fuel tank is half full.

In connection with incidents and accidents, much focus has been put on decision making: How was the situation perceived, and what was the chosen course of action? Klein (1995) has studied decision making in real-life situations, in aviation and in general, for many years, and he developed a model called recognition-primed decision (RPD). His model involves experts using their knowledge to recognize or identify the problem and choosing a solution that has been proven successful in previous, similar situations. If the solution to the current situation is suitable, it is applied, and only one solution is considered at a time.

This model has since been expanded by Judith Orasanu (1997), who describes a

model that can be used even in unfamiliar situations. The frst thing the person does is to evaluate the situation: What is the problem? Are the warning signs clear and unambiguous or are they changing? Often, experts in such situations also consider how much time is available to take the necessary steps and they evaluate the level of risk involved. Then, the person must evaluate whether any existing procedure is available to remedy the situation. Perhaps there is more than one solution? One possibility is, of course, that there are no known solutions, which triggers the need to create a new and untested course of action.

In general, cognitive processes that involve retrieval of information from longterm memory are resilient to stress, while processes that require the use of short-term memory are more vulnerable. In other words, if the warning signs are well known and clear and a standard solution is applicable, the situation will not be significantly prone to stress. On the other hand, if the signs are obscure or keep changing and multiple courses of action must be considered, the situation is prone to stress. Perhaps it is not surprising that experienced pilots do not make as many mistakes under pressure as less experienced pilots: They have a greater number of experiences stored in their long-term memory and are more likely to use a rule-based approach rather than having to consider several options or even improvise new solutions.

It is therefore important to have knowledge of stress and how we are affected by acute stress; for example, a common mistake is to assume that time is more precious than it is. Another consequence of stress is the simplifcation of strategies, such as preferring speed over accuracy. It is important to be trained in managing stressful situations to familiarize oneself with critical situations and learn how they can be resolved. It is also important to be aware of strategies to reduce workloads in stressful situations—for example, how to distribute tasks between members of the crew in the best possible way

3.7 Extreme stress

Persons affected by accidents in aviation, both directly and indirectly (e.g., close colleagues perishing in a plane crash), are exposed to stress that is different from everyday stress. Extreme stress reactions vary from a strong feeling of surrealist immediately after the event to an apparent absence of a reaction. However, the long-term effects must also be considered; although an individual may seem to handle the situation well initially, it may take time for a reaction to manifest itself.

Persons exposed to trauma are at risk of developing posttraumatic stress disorder (PTSD), characterized by discomforting thoughts or dreams in which the trauma is relived. Affected individuals feel numb and avoid situations that remind them of the accident. Restlessness, nervousness, and sleep problems are also common. Posttraumatic stress disorder can lead to a reduction in the affected individual's ability to perform duties to the same level as before the accident. In some cases, the

condition is characterized by fear, helplessness, aggression, and/or a hostile attitude. Why the condition is characterized by negative emotions has not yet been made clear; however, a possible explanation is that people who have been exposed to a traumatic event have a reduced threshold for perceiving a situation as threatening. This leads to anxiety and avoidance,but also to aggression and more easily fnding oneself in an attack position.

The link between the severity of PTSD symptoms and aggression is stronger in individuals traumatized by acts of war than in individuals experiencing other traumatic events (Orth and Wieland 2006). In most cases, these symptoms will subside in the weeks and months following the experience, although a few individuals develop a chronic condition associated with depression, substance abuse, anxiety, and inability to work. Even though most people regain their ability to work after a traumatic incident, it is important to be able to identify individuals who are at risk of developing PTSD. It is safe to assume that social interventions, such as care and support from colleagues and management, will be of use to many of those affected. Population studies from the United States have shown that 50–60% of the population has experienced a traumatic event at least once in their lifetime, but only a small proportion (5–10%) developed PTSD (Ozer et al. 2003). Therefore, it is of interest to explore the factors or conditions that help us understand why some people develop PTSD and others do not.

A meta-analysis of a number of studies examining these factors found that individual factors, such as a record of previous mental health problems and prior exposure to trauma, were associated with more severe PTSD symptoms. Other factors, such as previous involvement in life-threatening situations, social support networks, and which emotions were experienced during the event itself were also associated with PTSD symptoms (Ozer et al. 2003).

With regard to vulnerability factors, those who were directly involved in the accident are considered more vulnerable than those not directly exposed to the event. Persons not appropriately trained—for example, in relation to the necessary rescue efforts—are more likely to have stronger and longer lasting reactions. In addition, the severity of the situation (e.g., as measured by the number of dead and injured or intense and overwhelming sensory impressions) is likely to increase the probability of developing PTSD.

All organizations should have routines for how to deal with accidents and how to care for those involved after the accident. The most common approach is to review the event with those involved within 48–72 hours after the event. This requires getting together in groups under the leadership of someone trained in such exercises. Typically, this entails restating exactly what has happened as well as sharing thoughts and emotions. Those involved are informed about common reactions to accidents or dramatic events. These measures are intended to minimize acute symptoms and make those involved more capable of dealing with their reactions in the time to come.

Another beneft of conducting such group interventions is the identifcation of people in need of extra counseling and care. For those who need more support, there are a number of different types of individual therapy, such as cognitive–behavioral

therapy, which contains an exposure part and provides a structured framework to deal with thoughts and emotions. Other cognitive–behavioral methods emphasize assisting the person in dealing with anxiety. A different form of therapy consists of what is called “eye movement desensitization,” which consists of having the patient visualizing the traumatic event while watching a moving stimulus.

Meta-analyses have found that therapy represents an effcient treatment of PTSD and that up to 67% of those who complete the treatment no longer satisfy the criteria to be rediagnosed with PTSD (Bradley et al. 2005). It is important to encourage affected individuals to keep working and maintain frequent exposure to the situation—for example, by returning to aviation. Studies have revealed that those who return to work are better off in the long term than those who choose to change professions, even for individuals who initially had similar symptom.

Chapter 4

Culture, Organizations, and Leadership

4. Introduction

This chapter discusses organizational and cultural factors and how these factors influence people working in aviation. The aviation industry is an international business in which individuals with different cultural backgrounds must work together to make sure that aircraft arrive at their destination in a safe and timely manner. Communication problems can lead to irritation and disagreement and may even have serious safety repercussions. Communication and coordination are always demanding, especially when people have different cultural backgrounds, genders, and languages. Toward the end of this chapter, we discuss organizational changes and leadership and how these influence employees and the jobs that need to be done.

4.1 What is culture?

The term "culture" has been associated with organizations since the early 1980s. There are about as many defnitions of culture as there are publications about it. By "organizational culture," one normally means, somewhat inaccurately, "the way things are done around here." A more formal defnition can be found in the book on organizational culture by Henning Bang (1995, p. 23): "Organizational culture is the set of commonly shared norms, values, and perceived realities which evolve in an organization as its members interact with each other and their surroundings." Schein (1996, p. 236) defnes the term as the "set of shared, taken for granted implicit assumptions that a group holds, and that determines how it perceives, thinks about, and reacts to various environments." These defnitions differ in the sense that the former describes how the culture takes shape (i.e., through interaction), whereas the latter describes its effect on the members of the group.

There are also a number of other, related terms, such as climate. Many articles and empirical studies use these terms interchangeably—that is, without clarifying their differences. Thus, scientists studying these phenomena are mapping approximately the same thing, although they appear to use different constructs for what these things are (Mearns and Flin, 1999, provide a summary).

Schein (1990) considers climate to be a manifestation and measurable aspect of culture. Thus, culture is a deeper phenomenon that is not easily charted or categorized. Others say that although culture is what is shared, or common, for members, climate is a kind of "average" of the group members' experience—

preferably the interpersonal relationships within the organization. The last word has hardly been spoken on this matter. In part, it is likely that the constructs have different histories and associated measurement techniques; however, the subjects of these studies are presumably overlapping phenomena. Climate is usually measured using standardized scales—an approach critics label as insuffcient to get hold of the culture (see, for example, Schein 1990). Methodologies, including interviews and observation, are, then, the preferred alternatives. Most empirical studies of culture, however, have used questionnaires to measure the construct.

As it relates to defnitions of culture, the term "organization" applies to both businesses (e.g., airlines) and groups composed in different ways, such as pilots (a profession) or subgroups within a business (e.g., women or technicians). It is common to study national cultures—that is, the extent to which differences exist between nations. In aviation, therefore, we may assume that individuals are affected by several cultures: national, professional, and company (the airline for which the person works) cultures. Cultures may develop in many different social systems as people interact over time. According to Schein (1990), the conditions necessary for cultural development include that the individuals must have worked together for a long enough time to have experienced and shared important problems. They must have had the opportunity to solve these problems and observe the effect of implemented solutions. Last, but not least, the group or organization must have taken in new members who have been socialized into the way the group thinks, feels, and solves problems. The advantage of having a culture is that it makes events more predictable and gives things meaning, which may reduce anxiety in group members (Schein 1990).

Subcultures, which may be in conflict or support each other, can also form within an organization. They may be based on profession, workplace (sea versus land), gender, or age. In the wake of corporate mergers, subcultures can form based on the formerly separate companies. In conflicts between subgroups, each side will typically view the other from a polarized, black-and-white perspective: "They are bad. We are good—we have the correct values." One explanation for the rise of such conflicts may be that groups have a need to preserve their social identity and will defend themselves against those who want to destroy or threaten their culture (Bang 1995). However, when such conflicts are allowed to thrive, they can sometimes be devastating for an organization, with harmful consequences for the well-being and health of individuals in the worst-case scenario. Subcultures arise in most organizations, and it is probably naïve to think that conflicts will never arise between them. Presumably, how the organization and its leadership manage such conflicts would bemore important than preventing their rise.

4.2 National culture

Aviation is, in almost every respect, an international industry. This forces

companies and individuals to interact with people from other cultures, who often have a language other than English as their frst language. National culture affects the way people communicate and act. The most popular model and method for studying these national differences are based on Geert Hofstede's questionnaire for work-related values (Hofstede 1980, 2001). Hofstede developed the measurement instrument in connection with an extensive study of IBM employees in 66 countries conducted from 1967 to 1973. Participants noted the importance or signifcance of given values—that is, the extent to which they agreed or disagreed with the statements. The questions were placed in four scales (power-distance—PD; uncertainty-avoidance—UAV; individualismcollectivism—IND; and masculinity-femininity—MAS). Descriptions of these with corresponding sample statements are given in Table 7.1.

Other scientists have used this measurement instrument in corresponding crosscultural studies, and a reasonable amount of support for these four dimensions has been established. However, the instrument has been criticized, notably for its low internal consistency as to the different scales (Spector and Cooper 2002; Hofstede 2002). Hofstede's study is nonetheless both impressive and important because of the great number of countries and individuals that participated and because it facilitates comparisons between his data and other fndings.

A study by Merrit (2000) that included almost 10,000 pilots from 19 countries revealed that two of the four dimensions (IND and PD) were replicable, whereas there were issues with some of the original questions for masculinity and UAV. However, a clear correspondence was present between Hofstede's ranking of countries according to cultural dimensions and the scores of pilots from the various countries. In addition, there were some differences between pilots as a group and the IBM employees used as a reference by Hofstede. For example, pilots had higher PD than Hofstede's group, underlining aspects of the piloting profession in which a clear-cut hierarchy (i.e., between captains and co-pilots) exists and is generally accepted.

A study by Sherman, Helmreich, and Merrit (1997) found differences between countries in terms of how pilots regard rules and procedures, the usefulness of automation, and the extent to which they accepted a defnitive hierarchy (chain of command) between captains and co-pilots.

table 4.2.1
Hofstede's scales for Measuring national culture

	What does It Measure?
Power-distance (PD) :	Denotes the degree to which power is unequally distributed between managers and subordinates and the extent to which

this is accepted. Low PD values have been recorded in Austria, Israel, and the Scandinavian countries; high PD levels have been found in the Philippines and Mexico.

Uncertaintyavoidance (UAV): Denotes the extent to which members of a culture feel threatened or anxious due to uncertainty and unpredictable situations. Countries including Greece, Portugal, and several Latin American countries report high levels of UAV; the United States, Singapore, Sweden, and Denmark report low UAVs.

Individualismcollectivism (IND): The extent to which focus is on the individual (i.e., the individual's rights and responsibilities versus the group's). High levels of individualism are found in Western nations such as the United States; several countries in Asia have low scores.

Masculinityfemininity (MAS): Measures the extent to which the culture emphasizes effciency and competition versus more social (feminine) values. Countries with high femininity scores include the Scandinavian countries; Japan and some nations in Southern Europe and Latin America have low scores.

In another study of military pilots from 14 NATO countries, the values on Hofstede's scales were compared to accident statistics for those countries (Soeters and Boer 2000). Data were collected over a 5-year period (1988–1992), and the number of lost planes per 10,000 flight hours was used to describe the accident ratio. This number was then correlated with the national values for the four cultural dimensions. Three out of the four dimensions were signifcantly correlated with results for IND (r = –.55), PD (r = .48), and UAV (r = .54) (Soeters and Boer 2000). There was no signifcant correlation between the masculinity index and accident ratio. Correlations

increased when accidents due to mechanical failure were removed. The numbers thus indicate greater accident rates in countries that have low individualism scores and high power-distance and uncertainty-avoidance scores.

The results are interesting; however, it is important to keep in mind that the number of countries involved was only $N = 14$ because the nations (not the pilots) were the subjects of the study. In other words, the correlations are based on a fairly small sample. In addition, a correlation is not the same as causality. Many other factors vary among countries, and these factors may cause the observed variations in the number of accidents. In addition, culture was not measured in the military pilots, but the results from Hofstede's study were used. Therefore, it is possible that figures are slightly different from what they would have been if culture had been measured in military pilots for the same time frame in which the accident statistics were collected. However, the study indicates that cultural factors and how they relate to accidents may be worth further investigation.

A third study (Li, Harris, and Chen 2007) compared accident statistics and accident causes from India, Taiwan, and the United States. A total of 523 accidents, including a combined 1,762 cases of human error, were investigated. The study summarized results from former accident surveys that used the HFACS system (Wiegmann and Shappell 2003) to classify errors. This system is based on Reasons model, which is discussed in greater detail in Chapter 8. The study found signifcant differences among countries in what were reported as causes. Organizational causes were reported more frequently in Taiwan and India (countries with high powerdistance and low individualism scores) than in the United States. This suggests a hierarchy in which employees expect to be told what to do (to a greater extent than in Western nations) and collective decisions are preferred to individual decisions.

The authors see this aspect as a possible explanation for more frequent reporting of organizational errors. There is less spontaneous feedback in the system by the means of open discussion, and subordinates have less authority and autonomy in decision making and, perhaps, in correcting errors and flaws.

4.2.2 Problems relating to study of cultural Differences

Studying national differences in culture or, for that matter, other aspects is a complicated job. Completing the study or survey in approximately the same way in vastly different countries represents one of the challenges. For example, is it possible to sample participants in a similar way, and is the same procedure used in all the countries included in the study? The nature of the matter is that the more different the countries are, the more diffcult it becomes to complete such a task. There may be different regulations as to the available registries of the target group and whether permission will be granted to extract information from these groups. For example, comparing nurses from The Netherlands to Malaysian pilots would hardly make a good basis for attributing potential fndings to cultural differences alone. Ideally,

thegroups in question should be as similar as possible, even though researchers typically have to admit that, in practice, it is impossible to complete a survey is exactly the same way in all countries. Greater similarity between groups (in terms of other variables) generates a greater degree of certainty to conclusions that differences are due to cultural factors.

Another issue is represented by the challenge of translating questionnaires between different languages. Even though a substantial amount of effort is put into translations, a statement may convey a different meaning in another language, or certain words and expressions may not exist in the target language or correspond to the original one. Often, a translation is made from the original language to the target language (e.g., English to Norwegian). Then, someone else who is also proficient in both languages translates the text back into the original language (in this case, English). Finally, the two English versions are compared, and at this point ambiguities in the translators' efforts and what needs to be adjusted become clear. The most important point here is that a perfect, word-for-word translation is not necessarily desirable; the important thing is to preserve meaning. Finally, issues may arise in cross-cultural studies because people from different cultures have different response styles. This means that some cultures may have a greater tendency to agree to a specifc statement; in other cultures, opinion is expressed more freely and the extreme ends of the scale are used to a greater extent.

4.3 Professional culture

Many occupations or professions have strong cultural identities. This applies to psychologists, air traffc controllers, and pilots, to mention but a few examples. Often, there is ferce competition to be selected and successfully complete the required (and often extensive) education. Upon completion of training, many people within the profession join powerful unions, which act to preserve the rights and interests of members. Some unions offer members sponsored education to maintain or build additional skills; they also typically provide guidelines for ethical behavior within the profession. Thus, unions help to socialize new members into the group (profession) by exercising control over the members to some extent. Professionals, including pilots, psychologists, and physicians, are often highly enthusiastic and proud workers. They will make every effort to be successful, and few people quit the profession after having entered the work force. On the other hand, a strong professional culturecan give individuals a false sense of invulnerability and disregard for their own limitations, according to Helmreich and Merrit (1998). Some people may be aware of various human limitations in general, but unaware of this applying to them (a forum of unrealistic optimism).

A study by Helmreich and Merrit (1998, p. 35) revealed that a large proportion of pilots and physicians strongly believed that they were able to do their job just as well in below-average conditions—that is, that equally sound judgments were made in

an emergency compared to under normal conditions or that personal issues were put on hold while working. There were also some differences between the groups; 60% of doctors declared they still worked effciently when tired, compared to only 30% of pilots. Together, the doctors' perceptions were somewhat less realistic than the pilots'. What caused this distinction is not yet clear. However, the long-term focus on human factors in aviation may have made its impact. For example, pilots must complete mandatory CRM courses, whereas this is relatively new to medical professions.

Within a profession, there may be subgroups with which an individual feels more or less associated. Subgroups may be based on specialization, workplace, and/or gender. Examples include military versus civilian pilots or clinical psychologists versus psychology professors.

One study examined cultural changes in a major Norwegian airline, with a sample of 190 pilots (Mjøs 2002). Signifcant differences were found between the scores for this group and national norms based on Hofstede's fgures. The greatest difference was found for the masculinity index, where pilots scored much higher than expected.

An international study of flight controllers from Singapore, New Zealand, and Canada investigated how they perceived their work environment (Shouksmith and Taylor 1997). The idea was that there would be greater differences between flight controllers from an Eastern culture compared to the two Western countries. The flight controllers were asked about what they considered stressful in their work environment, and many similarities were found. For example, flight controllers from all three countries mentioned technical limitations, periods of high traffc, and fear of causing accidents among the top fve most important sources of stress. On the other hand, Singaporean flight controllers also mentioned problems withlocal management in the top fve, whereas the two remaining groups mentioned the general working environment as a top fve stressor. The authors attribute this difference partly to cultural factors such as higher power-distance in Asia compared to Western nations, causing more severe implications when disagreements arise between subordinates and management. Even external environmental factors may explain some of the differences; for example, more frequently occurring bad weather in Canada could have led flight controllers to mention this factor as one of the most signifcant work-related stressors.

4.4 Organizational culture

As in national and professional cultures, there may be cultural variations between airlines operating in a country. In a Norwegian study including three airlines (Mjøs 2004), signifcant differences were found in three of the four Hofstede dimensions (PD, MAS, and UAV). The participating pilots (N = 440) were also asked to report any errors made during the past year as part of the survey. A total of 10 indicators, such as forgetting important checklist points or choosing the wrong taxi

runway, were included. For each pilot, a total error score was calculated and correlated with the stated cultural dimensions (PD, UAV, IND, and MAS). A strong association (r = .54) was found between PD and the number of operational errors (i.e.,the occurrence of errors increased with perceived PD). As mentioned earlier, correlations are not necessarily evidence of cause and effect; however, the result is interesting. We may only speculate as to mechanisms behind such correlations. Kjell Mjøs (2004) suggests a model where cultural variables have consequences for the social environment in a cockpit, which has consequences for communication between pilots that, in turn, can lead to operational errors.

Ten years after the frst data were collected, a follow-up survey was conducted with a smaller selection of pilots from the largest airline from the previous study (Mjøs 2002). The purpose of this study was to investigate potential changes in the airline's culture over time. Mjøs found a signifcant change in the scores for dimensions PD, IND, and UAV. The social climate had also improved in this period. Some pilots were evaluated while performing an exercise in a simulator. A lower number of operational errors were recorded in the follow-up study compared to 10 years earlier. One of the study's weaknesses was that it did not survey exactly the same persons both times; however, this would obviously be diffcult to accomplish due to the gap in time between the two surveys. Additionally, because the surveys were anonymous, it would have been impossible to record individual scores over time. It isalso important to be aware that the study explains neither the cause of the cultural changes nor whether the recorded performance improvements can be attributed to these changes.

4.5 Safety culture

Safety culture is a term that has been widely used in aviation and also, to some extent, in other industries where consequences of error are signifcant—for example, in high-tech factories and nuclear power plants, in surgery rooms, and in variousmodes of transport. Such systems often involve close interaction between technology and human operators, and errors may have disastrous consequences. There are a number of defnitions of safety culture (for a summary, see Wiegmann et al. 2004). A relatively simple defnition is that safety culture refers to the fundamental values, norms, presumptions, and expectations that a group shares concerning risk and safety (based on Mearns and Flin 1999).

Like organizational culture and organizational climate, boundaries between what is meant by safety culture and safety climate are unclear. Some people are of the opinion that they are different but related terms. That is, safety climate is measured using a questionnaire and provides a snapshot of how the employees perceive safety (often in relation to a specifc issue), whereas safety culture refers to more lasting and fundamental values and norms that partially overlap the national culture of which the organization is a part (Mearns and Flin 1999). In practice, however, the notions are

used interchangeably, and quantitative questionnaires often overlap in terms of content. Wiegmann and colleagues (2004) have described a number of traits or presumptions that are shared in the different defnitions of safety culture. These commonalities are that safety culture is something a group of people have in common, it is stable over time, and it is reflected in the organization's will to learn from mistakes, events, and accidents. Safety culture influences group members' behavior, either directly or through affecting the employees' attitudes and motivation to behave in a way that enhances safety.

4.5.1 What characterizes a sound safety culture?

An important aspect in a sound safety culture is management commitment and involvement in the promotion of safety. To achieve this, it is crucial that the highest levels of management make the necessary resources available and support the work involved. It must be reflected in all aspects of the organization, and routine evaluation and system improvements must take place. However, not only the higher levels of management but also lower level administrators, who should participate in activities related to improving safety, are important. Little is gained by sending employees to safety classes if those who are monitoring the implementation of routines do not participate.

Another indicator of safety culture is that those who are performing the specifc jobs are given the responsibility and authority to be the last resort in case of errors.

In other words, they feel enabled, and they regard their role as an important part in securing safety. This involves playing an active role and being heard in the work to improve safety. The organization's reward system is another aspect. Are reward systems in place to promote safety, or are employees punished or neglected when taking on an issue? A fnal concern is the extent to which the organization is willing to learn from previous mistakes and that employees are given feedback through the reporting system. Encouraging employees to report errors and mistakes but doing nothing to correct them would be very demotivating for those who do so.

4.5.2 Psychological contracts

When seen as isolated or separate incidents, the reactions that managers and employees display in the previously described situations may seem strange, irrational, and even surprising. However, reactions become more predictable when viewed as reactions to intense stress. Both sides have been through a very diffcult process that included losing one or more colleagues and, perhaps, friends. Moreover, they have been forced to change their perception of having worked in a fnancially solid company.

Downsizing may be regarded as a serious breach of the psychological contract that exists between employees and employers. Psychological contracts are individual expectations shaped by the organization about how exchanges should take place between the employee and the organization (see, for example, Rousseau 1995). Contracts are expectations about the future that are based on trust, acceptance, and reciprocity; they make it easier for people to plan and anticipate future events. Often these contracts contain the contributions expected of the employee as well as the compensation offered by the organization in return. For example, the employee promises to work hard, be loyal, and contribute to fulflling the company's mission statement. The employer, on the other hand, promises ongoing employment, payment, and opportunities for personal development and career advancement. Such contracts are not necessarily synonymous with written contracts, and there may be certain disagreements about what the contract involves.

Psychological contracts are formed in many ways—for instance, through verbal expression, written documents, observation of how others are treated within the organization, and company policy or culture. They may be expressed in writing or by stories and myths about how things have been done before. Because contracts are formed by the person perceiving and integrating information, there is an obvious chance that misinterpretations can occur. Breach of contract arises when an employee feels that the organization has not fulflled its duties. However, the organization or local management may have a different view.

Studies of people starting out in a new job show that contracts are often breached. One study revealed that 54% experienced a breach of contract during the frst 2 years (Robinson and Rousseau 1994). Thus, breaches of psychological contracts are not unusual in an organization. The severity of the breach will affect the severity of reactions and consequences. Breaches may occur knowingly and intentionally or because the business does not have the necessary resources to meet contractual requirements. Often, severe breaches of contract can be devastating and lead to negative reactions in employees, such as mistrust, anger, and wanting to quit the job. Generally, repeated offenses may degrade the relationship between the employee and the organization (Robinson and Rousseau 1994).

A number of factors influence the severity and nature of the consequences of breach of contract. One aspect is whether the breach occurred on purpose and whether similar breaches have occurred previously (a "string" of breaches). If an employer is unable to keep his or her promise to provide sponsored education because of a budget defcit, the employee may fnd it more acceptable than if the manager simply thinks such training is a bad investment. Events in the aftermath of a contractual breach may help to repair the relationship or, conversely, enforce its negative consequences.

4.6 Women and Aviation

Figures from the United States reveal that about 90% of today's pilots are white males, which means that both females and other ethnic groups are underrepresented in the cockpit. There is reason to believe that this could change in the future job market, but the rate at which it would happen is uncertain. Naturally, it is diffcult to predict how the industry will change over time and what the need for various professions will be in the years to come. Several Norwegian companies have expressed concern about a future shortage of pilots, and numbers from the United States reveal an expected increase of almost 27% in the demand for commercial pilots in the period to 2010 compared to the number employed in 2000 (U.S. Department of Labor, Bureau of Labor Statistics, quoted in Turney and Maxant 2004). Thus, it is reasonable to believe that airlines will recruit pilots and personnel outside national borders and in other groups than those who have chosen the piloting profession traditionally. It is diffcult to know exactly what motivates young people in their choice of profession. Probably, a number of factors are involved, such as subjective considerations of abilities and interests as well as external factors such as available opportunities, fnancial situation, and what they are familiar with through family and friends. Sometimes, even personal experiences may play a part in staking out a career path, as was the case with one of the frst Norwegian female aviators, Gidsken Jacobsen (Gynnild 2008): A day in June 1928, a big, three-engine seaplane roared trough Ofotfjorden and landed outside Narvik. Somewhere in the sea of spectators was Gidsken Jakobsen. The visit from above became a turning point in her life. "From the day I saw Nilsson's [flying] machine at the docks, there was nothing I'd rather do than fly," she said years later. "Imagine flying around in the air like Nilsson and his crew, from place to place, to get to know the country from the air and awaking the interest in thousands of people for what they loved more than anything else: To fly!"

Gidsken Jakobsen was raised in Narvik in the 1920s. She was not quite like other girls; she learned how to drive cars and motorbikes at an early age. At the age of 21, she left for Stockholm to take her pilot's license at the Aero-Materiell flight school. Subsequently, she learned to fly seaplanes and, with the help of her father,bought a seaplane that was given the name *Måsen* (*The Seagull*) (Gynnild 2008). There is no doubt that Gidsken Jakobsen lived an untraditional and exciting life, with great frmness of action and lust for life. Other examples of female pioneers can be found in Norway and in other countries, such as Dagny Berger and Elise Deroche, who got their pilot's licenses in 1927 and 1910, respectively. Harriet Quimby crossed the English Channel in 1912 and Amelia Earhart crossed the Atlantic in 1932 (Wilson 2004). Despite the fact that women were at the center of early aviation and that there were many female pioneers, the piloting profession of today is distinctly male dominated. Although it is difficult to predict with accuracy the global rate of female participation in this profession, it has been estimated at between 3 and 4% in Western countries (Mitchell et al. 2005).

It is difficult to say why more women are not fascinated by the act of flying. Probably, there are individual reasons and reasons based on the nature of aviation. Perhaps the profession is seen as particularly masculine because history is full of heroic achievements performed by men—"the right stuff." Thus, young females

would rather choose other education paths and career opportunities. Perhaps the thought of entering a trade where one risks being isolated and perhaps lives with negative and sexist comments from colleagues and others is less than appealing. Has the aviation industry been interested in allowing women into the cockpit, and with which attitudes are female pilots met? How can a female applicant to this profession expect to be received, and how do gender issues affect interactions in the cockpit, which, traditionally, is occupied by two males? Research into interactions between pilots has long been concerned with communication and cultural differences and theirimpact on aviation safety. Still, research into gender issues in aviation, both in terms of attitudes toward female pilots and consequences for interactions betweenpilots, is insuffcient.

4.6.1 Attitudes toward female pilots

To provide information about attitudes toward female pilots, a study was initiated in South Africa, the United States, Australia, and Norway; female and male pilotswere asked about how they regarded female pilots (Kristovics et al. 2006). The subjects were asked to express their opinions on a number of statements about female pilots. In addition, the survey presented an open question to which participants could express in their own words what they thought about the issues raised by the survey and the survey itself. The survey contained four sections of questions (examples are presented in Table 7.3). The participants responded by expressing their agreement or disagreement on a five-point scale. Results were then summarized for each dimension so that a high score represented a positive attitude and a low score indicated a negative attitude. Some of the questions thus needed to be reversed to combine the scores into a unifed index.

A total of 2,009 pilots (312 females and 1,697 males) with an average age of 36 participated in the survey. There were different proportions of participants from the four different countries, with 53% from Australia, 28% from South Africa, 9% from the United States, and 10% from Norway. Results revealed gender-related differences for all four dimensions; that is, male pilots regarded female pilots in a more negative light than female pilots did. Differences were greatest for the statements in the categories “decision/leadership” and “affrmative action.”

There were also differences between countries, as presented in Figure 7.2. The following results are based on male pilots only because the numbers of female pilots were very low in some participating countries. For three of the four dimensions, the Norwegian pilots were more positive than pilots from other countries, whereas for the dimension labeled “hazardous behavior” the situation was reversed. Statements in the latter category were of the type: “Male pilots tend to take greater risks than female pilots,” and Norwegian pilots, to a lesser extent, agreed with these statements. This

probably reflects the equality-mindedness of Norwegians, in which female pilots would not be viewed as being more careful or apprehensive than male colleagues. In summary, the results of the survey revealed that male Norwegian pilots were more positive about female pilots than their U.S., Australian, and South African counterparts. Perhaps this expresses stronger ideals of equality in Norway compared to the other countries involved in the investigation, which is in line with Hofstede's (1980) findings for Scandinavian countries.

Συμπεράσματα

Μέσα από τη μελέτη και στη συνέχεια της συγγραφής της εργασίας αυτής αποκομίσαμε αρκετές νέες γνώσης για το αντικείμενο της αεροπορικής ψυχολογίας και πόσο σημαντικός είναι ο ρόλος του ανθρώπου και όχι μόνο των μηχανημάτων που σαφώς κατέχουν εξίσου σημαντικό ρόλο. Έτσι λοιπόν, θα παραθέσουμε και τα συμπεράσματα τα οποία κατά τη γνώμη μας βγήκαν από την πτυχιακή εργασία. Αρχικά, το συμπεράσματα που βγάλαμε είναι ποιος είναι ο ρόλος της αεροπορικής ψυχολογίας και πως μέσα από διαφορετικά μοντέλα και εργασίες και τεστ εξάγονται συμπεράσματα στο τομέα αυτό. Στη συνέχεια, το επόμενο που κατανοήσαμε από την εργασία αυτή είναι πως οι ανθρώπινες ενέργειες επηρεάζουν την αεροπορία. Πως δηλαδή, τα σφάλματα που τυχαίνει να κάνει κάποιος που εργάζεται στην αεροπορία είτε πιλότος, είτε πλήρωμα έχουν αντίκτυπο στην πτήση αλλά και στην ίδια την ψυχολογία που ανθρώπου και πως μπορεί μέσα από τη σωστή πληροφόρηση να αποφευχθούν.

Επιπρόσθετα, ένας παράγοντας που αναλύσαμε αρκετά καθώς είναι και ένας από τους βασικότερους είναι το στρες. Το στρες είναι ένας αρνητικός αλλά και θετικός παράγοντας για τον άνθρωπο. Ο άνθρωπος, έχει τη δυνατότητα να αξιοποιήσει το στρες σε βελτίωση της δουλειάς του, το λεγόμενο παραγωγικό στρες αλλά και σε αρνητικό βαθμό και να βλάψει την εργασία του όταν το στρες γίνεται φόβος, είτε άγχος και μας παρακινεί σε βιαστικές αποφάσεις. Ακόμα, το επόμενο συμπέρασμα που βγάλαμε από την πτυχιακή αυτή είναι ο διαχωρισμός που οφείλει να κάνει κάθε άνθρωπος σχετικά με την εργασία του αλλά και την προσωπική του ζωή. Και πως μέσα από την προσωπική ζωή ο άνθρωπος στρεσάρετε και έχει ως αποτέλεσμα λανθασμένες αποφάσεις στον επαγγελματικό του χώρο.

Τέλος, μέσα από την μελέτη κατανοήσαμε ότι πολύ σημαντικό ρόλο παίζει ο ρόλος της κουλτούρας και πως μέσα από αυτή ο κάθε άνθρωπος ενεργεί διαφορετικά αλλά και πως ο ρόλος της γυναίκας έχει αρχίσει να κυριαρχεί στον χώρο αυτό. Γεγονός που επιβεβαιώνεται από την αύξηση του αριθμού πιλότων γυναικών.

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