GM 14-37

CIVIL AVIATION AUTHORITY OF BANGLADESH

Guidance Manual

Human Factor Principle in Aviation

Version 2.0
11 August 2024

AERODROME STANDARD DIVISION

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Guidance Manual
on
Human Factor Principle in Aviation

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Record of Amendments

Amend. No	Chapter Changed	Pages Replaced	Signature	Date

Revision History

Edition No	Date	Chapter/ Section	Details
01	20 December 2009	All	**AC(AD) No-08** Advisory Circular On Human Factor Principle in Aviation
02	15 July 2024	All	**GM 14-37** Guidance Manual On Human Factor Principle in Aviation

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Fordward

In exercise of the powers conferred by the Section 14 of Civil Aviation Act 2017, the Chairman, Civil Aviation authority of Bangladesh has promulgated ANO-14 Vol-I by transposing the Provisions of ICAO Annex 14 Vol-1.as specific operating regulations for the Aerodrome Operators, operating in Bangladesh.

An Aerodrome Operator is expected to comply with the Regulations of the ANO-14 Vol-I. There may be circumstances where compliance of requirements by the Aerodrome Operator becomes difficult because of constraints of trained manpower, training facilities and/or other administrative formalities. These situations require CAAB to establish subject specific guidance manuals.

Chapter 9 & 10 of ANO-14 Vol-I require that Aerodrome Operator observe Human Factor Principle in making plan to ensure optimum response by all existing agencies participating in emergency operations and in design & application of the maintenance programme as Human Factors principles apply to aeronautical design, certification, training, operations and maintenance and seek safe interface between the human and other system components by proper consideration to human performance.

This GM has been derived from the ANO-14, VOL-I & ICAO Doc 9683. It provides guidance to aerodrome operators on the people in their working and living environments. It is about their relationship with equipment, procedures and the environment. Just as importantly, it is about their relationships with other people. Human Factors involve the overall performance of human beings within the aviation system; it seeks to optimize people's performance through the systematic application of the human sciences, often integrated within the framework of system engineering. Its twin objectives can be seen as safety and efficiency.

It is expected that the concerned Aerodrome Operator will take this GM as a reference/guidance manual on their work place in evaluating the requirements of human factor/ Safety of the Existing Operation at the Aerodrome.

This GM is issued under the authority of the Director, Aerodrome Standard, CAAB and will become effective on the date mentioned in the document and will supersede the Aerodrome Advisory Circular (AC (AD) No-8) issued on 20 December 2009 on the same subject.

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List of Acronyms and Abbreviations

ARFF	Airport Rescue and Firefighting
AGA	Aerodrome & Ground Aids
CNS/ATM	Communications, Navigation and Surveillance Systems for Air Traffic Management
CAAB	Civil Aviation Authority of Bangladesh
CAR	Civil Aviation Rules
Doc	Document
ICAO	International Civil Aviation Organization
NID	Noise Induced Deafness
PPE	Personal Protective Equipment
ARFFS	Airport Rescue and Firefighting Services
SCBA	Self-Containing Breathing Apparatus
SHEL	Software, Hardware, Environment, Liveware
USOAP	Universal Safety Oversight Audit Programme

1. Purpose

Human Factors principles apply to aeronautical design, certification, training, operations and maintenance and seek safe interface between the human and other system components by proper consideration to human performance.

The purpose of this Guidance Manual is to provide guidance to aerodrome operators in observing Human Factor Principle in making plan to ensure optimum response by all existing agencies participating in emergency operations and in design & application of the maintenance programme.

2. Introduction

2.1 The subject of human factors is about people. It is about people in their working and living environments. It is about their relationship with equipment, procedures and the environment. Just as importantly, it is about their relationships with other people. Human Factors involve the overall performance of human beings within the aviation system; it seeks to optimize people's performance through the systematic application of the human sciences, often integrated within the framework of system engineering. Its twin objectives can be seen as safety and efficiency.

2.2 Human Factors is essentially a multidisciplinary field, including but not limited to; psychology; engineering; physiology; sociology; and anthropology. Indeed, it is this multidisciplinary nature and the overlapping of the constituent disciplines that make a comprehensive definition of Human Factors difficult.

2.3 Since the beginning of aviation, human error has been recognized as a major factor in accidents and incidents. Indeed, one of aviation’s biggest challenges has been and will continue to be human error avoidance and control. Traditionally, human error in aviation has been closely related to operational personnel, such as pilots, controllers, mechanics, dispatchers, etc. Contemporary safety views argue for a broadened perspective which focuses on safety deficiencies in the system rather than in individual performance. Evidence provided by analysis from this perspective has allowed the identification of managerial deficiencies at the design and operating stages of the aviation system as important contributing factors to accidents and incidents.

2.4 Statistics can be misleading in understanding the nature of accidents and devising prevention measures. Statistics reflect accidents as a series of cause and effect relationships grouped into discrete categories (flight crew, maintenance, weather, ATC, ARFF, etc.). Errors are not registered as such but some of their effects are: controlled flight into terrain, aborted take-off overrun, etc. Statistics then provide the answers when it is too late. They fail to reveal accidents as *processes*, with multiple interacting chains, which often go back over considerable periods of time and involve many different components of the over-all system.

2.5 The investigation of major catastrophes in large-scale, high-technology systems has revealed these accidents to have been caused by a combination of many factors, whose origins could be found in the lack of Human Factors considerations during the design and operating stages of the system rather than in operational personnel error. Large-scale, high-technology systems like

nuclear power generation and aviation have been called *sociotechnical systems*, in reference to the complex interactions between their human and technological components. *Management factors* and *organizational accidents* are key concepts in sociotechnical systems' safety. The terms *system accident* and *organizational accident* reflect the fact that certain inherent characteristics of sociotechnical systems, such as their complexity and the unexpected interaction of multiple failures, will inevitably produce an accident. In sociotechnical systems, remedial action based on safety findings goes beyond those who had the last opportunity to prevent the accident, i.e. the operational personnel, to include the influence of the designers and managers, as well as the structure or architecture of the system.

3. Definition of Human Factors:

Human Factors is about people: it is about people in their working and living environments and it is about their relationship with equipment, procedures and the environment. Just as importantly, it is about their relationships with other people. Human Factors involves the overall performance of human beings within the aviation system; it seeks to optimize people's performance through the systematic application of the human sciences, often integrated within the framework of system engineering. Its twin objectives can be seen as safety and efficiency. ICAO, HF Training Manual, Doc 9683 Part 2 .

4. Application of Human factors principles:

Principles which apply to:

i) Aeronautical design,
ii) Certification
iii) Training
iv) Operations and maintenance
iv) ARFF

These seek safe interface between the human and other system component to human performance.

5. Factors Affecting Human Performance

Basic concepts in human factors provided a conceptual framework for understanding how humans interface with various elements of their work environment. This Guidance Manual includes a brief discussion of some of the more common factors affecting human performance. Such factors create the operating context in which normal, healthy, qualified, experienced and well-motivated personnel commit errors (and sometimes, violations).
2. These factors are roughly grouped as follows: those essentially deriving from the individual, those affecting the individual's interactions with others, and those relating to the workplace, any of which can affect human performance in an aviation context.

6. Individual characteristics and performance

People are not equal in capability and performance. There are enormous differences in individual performance under similar operating conditions. These differences may be seen both

by comparing the individual's performance with others and by comparing the performance of individuals at different times. Some examples are given below.

6.1 Anthropometry

Physical characteristics such as height and weight ,reach and strength, and visual and hearing acuity may limit performance. Fortunately, these remain relatively static overtime and individuals learn to cope with the physical makeup with which they are endowed. Furthermore, there are internationally accepted norms and standards which can be applied in work station design, in personnel selection and during regular physical examinations.

6.2 Health and performance

6.2.1Certain pathological conditions, such as gastrointestinal disorders and heart attacks, have caused sudden Air Traffic Controller/ Operations and maintenance personnel /pilot incapacitation and in rare cases have contributed to accidents, and certain mild pathological conditions may go undetected, even by the person affected.

6.2.2 Physical fitness may have a direct relationship to mental performance and health. Improved fitness reduces tension and anxiety and increases self-esteem. It has favorable effects on emotions, which affect motivation, and is believed to increase resistance to fatigue. Factors that can affect fitness include diet, exercise, stress levels and the use of tobacco, alcohol or drugs.

6.3 Habituation

Much of human behavior is automatic. We don't think about it because we have learned specific responses to particular situations. Some of these responses are culturally driven, for example, driving on the right or the left side of the road. Other responses are the product of habituation whereby we adapt to particular situations and after a while ,are not even aware of them, such as wearing a wedding
ring. Habituation is a useful mechanism for efficiently dealing with repetitive, day-to-day situations. However, under stress we may revert to a formerly correct behavior pattern creating a potential for error. Habituation can also cause us to ignore potentially dangerous indicators.

6.4 Detection and Perception

Investigation has demonstrated that there are quantifiable thresholds for detecting particular stimuli with our five senses and how many distinct levels of a particular stimulus normal human beings can consistently discriminate. Even though our eyes or ears are technically capable of detecting a particular stimulus, our brains may not process the information and register perception in our mind .Several factors may diminish our ability to perceive a stimulus, such as distractions or noise, fatigue or boredom ,or workload or other stress. This difference between detection and perception is critical in tasks requiring high vigilance.

6.5 Vigilance

. Increasingly, tasks in the aviation industry require a high degree of vigilance. For instance, the careful monitoring of evolving situations often involve computerized equipment. Vigilance is required by all operational personnel. It often involves monitoring activities, using either sight or

hearing, for a particular event that is expected to occur only rarely. Unfortunately, boredom is a natural by-product of vigilance. Indeed research has consistently demonstrated marked reductions in the ability of humans to detect unwanted events, even after relatively short periods of intense monitoring.

6.6 Stress

6.6.1 Stress affects human performance, sometimes positively and sometimes negatively. Although ubiquitous, stress is difficult to quantify. The concern here is with decreases in human performance caused by anything that affects the way we live and work. These things are called "stressors". They include such things as fatigue, time pressures, workload, personality conflicts, family problems and substance abuse.

6.6.2 . The aviation environment is particularly rich in potential stressors. In the early days of aviation, the stressors of concern to flight crews were created by the environment (noise, vibration, temperature, humidity and acceleration forces) and were mainly physiological in nature. Today, they include such things as irregular working and resting patterns and disturbed circadian rhythms associated with long-range, irregular or night-time flying.

6.6.3 Individuals differ widely in their responses to stress. For example, flight in a thunderstorm area may be challenging for one individual but quite stressful for another. In some ways, the effect of a particular stressor can be predicted. Training and experience may help individuals in overcoming a particular work-related stress or such as performing a complex task under adverse conditions. Other stressors may be reduced or eliminated through life style modification. Body rhythm disturbance

6.6.4 The most commonly recognized of the body's rhythms is the circadian, or 24-hour rhythm, which is related to the earth's rotation cycle. Body rhythm is maintained by several agents, the most powerful being light and darkness, but meals and physical and social activities also have an influence. Air traffic controllers and maintenance technicians with frequently changing shift schedules can suffer from reduced performance produced by circadian dysrhythmia.

6.7 Sleep

6.7.1. Adults usually sleep in one long period each day and when this pattern has been established it becomes a natural rhythm of the brain, even when prolonged wakefulness is imposed. Wide differences have been found among individuals in their ability to sleep out of phase with their biological rhythms. Tolerance to sleep disturbance varies from one person to another and is mainly related to body chemistry but can also be related to emotional stress factors.

6.7.2 Insomnia defines a condition where a person has difficulty sleeping or when the quality of sleep is poor. When occurring under normal conditions and in phase with the body rhythms, it is called primary insomnia. On the other hand, insomnia may result when biological rhythms are disturbed. Both types of insomnia are of concern.

6.7.3 For operational personnel, the use of drugs such as hypnotics, sedatives (including antihistamines with a sedative effect) and tranquillizers to induce sleep is usually inappropriate, as they have an adverse effect on performance when taken in therapeutic doses for up to 36 hours after

administration. Alcohol acts as a depressant on the nervous system. It has a soporific effect, but it disturbs normal sleep patterns and causes poor quality of sleep. Caffeine in coffee, tea and various soft drinks increases alertness and normally reduces reaction times, but it is also likely to disturb sleep. Sleep fulfills a restorative function and is essential for sound mental performance.

6.7.4 Solutions for problems arising from sleep disturbance or sleep deprivation may include:

• modifying diet and recognizing the importance of regular meals;
• adopting measures in relation to light/darkness ,rest/activity schedules and social interaction;
• recognizing the adverse, long-term effects of drugs(including caffeine and alcohol);
• optimizing the sleeping environment; and
• learning coping strategies and relaxation techniques

6.8 Fatigue

6.8.1 Fatigue may be considered to be a condition reflecting inadequate rest. It may arise from sleep disturbances or sleep deprivation, disturbed biological rhythms, Personal stress, etc. Acute fatigue is induced by long duty periods or by a series of particularly demanding tasks performed in a short period. Chronic fatigue is induced by the cumulative effects of fatigue over the longer term. Mental fatigue may result from emotional stress, even with sufficient physical rest. Like the disturbance of body rhythms, fatigue may lead to potentially unsafe situations and a deterioration in efficiency and well-being. Hypoxia and noise may also contribute to fatigue.

6.8.2 At present, there is no way to directly measure fatigue (such as a blood test) but the effects of fatigue can be measured. When errors committed are measured per unit of time, the error rate increases with fatigue. Regardless of the source of fatigue, it tends to delay reaction and decision making, induce loss of or inaccurate memory of recent events, cause errors in computation and create a tendency to accept lower standards of operational performance.

6.9 Motivation

6.9.1 .Motivation reflects the difference between what a person can do and actually will do, and is what drives or induces a person to behave in a particular fashion. Clearly, different people are driven by different motivational forces. Even when selection, training and checking ensure capability to perform, it is motivation that determines whether a person will perform to the best of their ability in a given situation.

6.9.2 There is a relationship between expectation of reward and motivation since the level of effort that will be applied to obtain the reward will be determined by its perceived value and probability of attainment. This effort must not, however, exceed capability. It is important for high performers to feel that they are in a better position than poor performers to be rewarded otherwise motivation may decline. Those workers who enjoy a sense of job satisfaction tend to be better motivated than those that do not.

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6.10 Personality and attitudes

6.10 .1 Personality traits and attitudes influence the way we conduct ourselves at home and at work. Personality traits are innate or acquired at early stages of life. They are deep-rooted characteristics that define a person, and are both stable and resistant to change. Traits such as

aggression, ambition and dominance may be reflections of personality.

6.10.2 Accidents have been caused by inadequate performance by people who had the capacity to perform effectively and yet failed to do so. Reports from several confidential aviation reporting programmes support the view that attitudes and behavior play a significant role inflight safety. Certain unsafe behavior relates to deep rooted personality factors.

6.10.3 The difference between personality and attitudes is relevant, because it is unrealistic to expect a change impersonality through training. The time to address personality issues is during the initial screening and selection process. On the other hand, attitudes are more susceptible to change through training.

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6.11 Interpersonal factors

So much of human endeavor fails not necessarily because of the performance of the individuals but because of weaknesses in the interface between them. How effective and efficient people are as they interact is a function of many factors, some of which are described below.

6.12 Information processing

Before a person can react to information, it must first be sensed. There is a potential for error here, because the sensory systems function only within narrow ranges. Once information is sensed, it makes its way to the brain, where it is processed, and a conclusion is drawn about the nature and meaning of the information. This interpretative activity is called perception and is a breeding ground for errors. Expectation, experience, attitude, motivation and arousal all have a definite influence on perception and are possible sources of errors. After conclusions have been formed about the meaning of the information, decision
making begins. Many factors may lead to erroneous decisions: training or past experience; emotional or commercial considerations; fatigue, medication, motivation and physical or psychological disorders. Action (or inaction)follows decision, and further potential for error ensues. Once action has been taken, a feedback mechanism starts to work. Deficiencies in this mechanism may also generate errors (e.g. an ATC clearance read-back error).

6.13 Communication

6.13 .1 Effective communication, which includes all transfer of information, is essential for the safe operation of flight. Information may be transferred by speech, written word, symbols and displays or by non-verbal means such as gestures and body language. The quality and

effectiveness of communications determined by its intelligibility or the degree to which the intended message is understood by the receiver.

6.13 .2 The quality of communications can be adversely affected by:

- failures during transmission (e.g. unclear or Ambiguous messages);
- Difficulties caused by the medium of transmission(e.g. background noises or distortion);
- Failures during reception (e.g. another message expected, or message misinterpreted or disregarded);
- Conflict between the rational and emotional levels of communication (e.g. arguments);

• Physical problems related to hearing or speaking(e.g. impaired hearing or use of an oxygen mask);and
• use of English between native and non-native English speakers.

6.13.3 . Communication errors can be minimized through an appreciation of common communication problems and by reinforcing the standard of language to ensure error-free transmission and correct interpretation of messages.
.are for more information about each aircraft and reduced separation between aircraft requiring reduced delays in dealing with aircraft. This will lead to controllers having **5.14 Leadership**

A leader is a person whose ideas and actions influence the thought and the behaviour of others. Through the use of example and persuasion, and an understanding of the goals and desires of the group, the leader becomes a means of influence and change.. The optimal situation is when leadership and authority are
effectively combined. Leadership involves teamwork, and the quality of the leadership depends on the leader's relationship with the team.
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6.14 Workplace factors

30 The performance of all people working in aviation is strongly influenced by a set factors largely beyond their control, that is, the working conditions created by the environment and the employer. Some of these factors are outlined below.

6.15 Workload

Workload has to do with the amount of work expected from an individual. In aviation, workload generally implies mental effort as opposed to physical effort. If the workload generated by a task or set of tasks exceeds a person's mental capacity, performance will suffer. Generally speaking, training and experience equip us to effectively deal with increasing workloads. When overloaded, people may try to cope by skipping steps in their safe work routines, perhaps even ignoring obvious cues of unsafe conditions.

6.16 Training and evaluation

6.16.1Education and training are presented here as two different aspects of the learning process. Education encompasses a broad base of knowledge, values, attitudes and basic skills upon which

more specific abilities can be built later. Training is a process aimed at developing specific skills, knowledge or attitudes for a job or a task. Proper and effective training cannot take place unless the Foundations for the development of those skills, knowledge or attitudes have been laid by previous education. Skills, knowledge or attitudes gained in one Situation can often be used in another.

6.16.2 Learning is an internal process and training is the control of this process. The success or failure of training must be determined by the changes in performance or
Behavior that the learning produces. Since learning is accomplished by the student and not by the teacher, the student must be an active rather than a passive participant. Memory is relevant to learning. Short-term memory (STM)refers to the storage of information that will be stored temporarily and soon forgotten, while long-term memory (LTM) refers to the storage of

information for extended periods of time. STM is limited to a few items of information during a few seconds. Through repetition, information is transferred into LTM. While there is a very large capacity in LTM and fewer storage problems, there are certainly retrieval problems, as exemplified by the problems of witness recollections of past events.

6.16.3 A number of factors can interfere with the success of a training programme. Obvious ones include sickness, fatigue or discomfort as well as others, such as anxiety, low motivation, poor quality of instruction, an unsuitable instructor, inadequate learning techniques or inadequate communication.

6.16.4 To be cost-effective, training is developed using a systems approach. Training needs are determined, possibly through job task analyses, leading to clear job descriptions. Training objectives can then be formulated, and criteria can be established for the selection of the trainees. Only then is course content and the method of course delivery determined.

6.17 Documentation

Inadequacies in aviation documentation can negatively impact safety by adversely affecting information processing. Documentation in this context includes the textual communications in both hard copy and electronic formats. Effective documentation will take into account the environment and operation in and for which the document will be used.

6.18 Workstation design

For design purposes, Terminal Building , Operation Building. Fire station &Other installations should be considered as a complete or integrated system, as opposed to a collection of separate subsystems. Expertise should be applied towards matching the characteristics of this system to human dimensions and characteristics with due consideration to the job to be performed.

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6.19 Visual performance and collision avoidance

A full understanding of how the visual system works helps in the determination of the optimum working environment. The characteristics and measurement of light, the perception of color and the physiology of the are relevant in this area. Also important are factors involved in the ability to detect aircraft at a distance, both in daytime and at night, and to identify objects in the presence of rain or other contamination on the windscreen.

6.20 Conclusion:

This wide range of factors has the potential to adversely affect human performance. Although many of the examples cited relate to the work of flight crews, no one is immune to human limitations. They pose implications for almost everyone working in aviation, including aircraft maintenance technicians, air traffic controllers, and flight dispatchers. For those working closest to flight operations, the risk that limitations on human performance may cause an accident are higher.

7. Cultural Factors in Aviation

7.1 Introduction:

The ICAO universal safety oversight audit programme seeks improvement in aviation safety on a global scale. Improving safety involves reducing or eliminating risks But judging what constitutes risk is a subjective process reflecting cultural perspectives. What is safe and what constitutes reflect unacceptable risk are in the eye of the beholder. To be effective, efforts to improve safety on a global scale must recognize the importance of cultural factors in shaping human performance. This may go against the grain of conventional wisdom where there remains a residual belief in some quarters that aviation should be “culture free”.

7.2 Culture At Three Levels

7.2.1 Three levels of culture have been differentiated for the purposes of:

7.2.1.1 national culture which differentiates the national characteristics and values system of particular nations;

7.2.1.2 professional culture which differentiates the behavior and characteristics of particular professional groups (e.g. the typical behavior of pilots vis-à-vis that of air traffic controllers or maintenance engineers); and

7.2.1.3 organizational culture which differentiates the behavior and values of particular organizations.

7.2.2 All three cultural sets are important to safe flight operations. They determine how juniors will relate to their seniors, how information is shared, how personnel will react under stress, how particular technologies will be embraced and used, how authority will be acted upon, how organizations react to human errors (e.g. by blaming and sanctioning offenders or learning from experience). Culture will be a factor in how automation is applied in flight operations, how procedures (SOPs) are developed and implemented, how documentation is prepared, presented, and received, how training is developed and delivered, how crew assignments are made, relationships between airline pilots, operations and ATC, relationships with unions, etc. In other words, culture impacts on virtually every type of interpersonal transaction. In addition, cultural considerations creep into the design of technological tools. Technology may appear to be culture-neutral, but it reflects the biases of the manufacturer. Yet, there is no right and no wrong culture; they are what they are and they each possess a blend of strengths and weaknesses.

7.2.3 Our challenge is to understand how culture affects both individuals and aviation organizations and how that relationship can put safety at risk or serve to enhance it. To start this understanding, each of the three basic cultural sets is examined below.

7.3 National culture

National culture represents the shared components of national heritage (i.e. norms, attitudes and values). As discussed above, some aspects of national culture have a particular influence on the management of flight operations. Individualists focus on themselves and their personal benefits while collectivists are more attuned to the needs of their groups. Collectivisms often associated with a willing acceptance of unequal status and deference to leaders. In such high power-distance relationships, there may be an unwillingness to question the decisions or actions of leaders, even when it may be appropriate to do so. Similarly, those uncomfortable with uncertainty will be reluctant to break the rules, even when the situation might warrant such action. They feel that written procedures are required for all situations. Those more comfortable with uncertainty may be more prone to violating SOPs, but may also be more effective in developing ways to cope with novel situations. Such dimensions are all a reflection of national culture.

7.4 Professional culture

Though personnel selection, education and training, and on-job experience professionals tend to adopt the value system of, and develop behavior patterns consistent with, their peers. They have to "walk and talk" like the others, so to speak. As with national culture, the probability of changing professional culture in the interests of safety is slim. Professional associations can develop a climate in which their members will be inclined to oppose or accept changes. Some notable safety measures in which professional associations have played on important role during safety and emergency operations**.**

7.5 Organizational culture

7.5.1 Organizations must transcend national and professional cultures. Indeed, organizations are increasingly becoming multicultural. Individuals from different nations may be paired in the cockpit which can create the potential for misunderstandings and errors because of, for example ,the ever-present language barrier. Pilots may have different professional backgrounds and experience, such as military as opposed to civilian, or commuter operations as opposed to international air transport operations. They may also come from different organizational cultures due to corporate mergers or lay-offs.

7.5.2 Generally, airlines are like "families" in which aviation personnel enjoy a sense of belonging. They commit a large proportion of their life to their work. In so doing, their behavior is influenced by the values of their organization. Issues such as whether the organization recognizes merit, promotes individual initiative, encourages risk taking, tolerates breeches of SOPs and promotes open, two-way communications signify the organization's culture is a major determinant of employee behavior. Unfortunately, too many major accident reports demonstrate that companies were clearly unaware of the powerful position held with respect to setting an organizational tone conducive to the safety of flight operations. Indeed, some anecdotal evidence would almost suggest blatant defiance of the basic tenets of safety. Nevertheless, it is at the organizational level that there is the greatest potential for creating and nourishing a safety culture .

8. Human Factors Issues in ARFF Services

A competent and professional ARFF service must rely on a comprehensive and relevant set of training modules, coupled with an internal audit framework to regularly check the effectiveness and efficacy of these programmes. However, in the process of promulgating the training framework, one must not be overly fixated with the 'hard' skills component of the training outcomes. Thought must be given to the 'soft' human factor components during the promulgation and execution of the training programmes. Similarly, any assessment of the operational effectiveness of ARFF personnel must take into account human factor principles such as team coordination.

Human factors principles are not only confined to the development of ARFF training programmes. Consideration must also be given to the formulation of drawer plans such as the aerodrome emergency plan and the unit tactical plans of the ARFF service.

The application of human factor principles to ARFF services can therefore be classified into two broad pillars as follows:

a) Operational effectiveness and standards; and

b) Safety and well-being of ARFF personnel

9. Situational awareness

9.1Maintaining the mental picture is so important to controllers that a few more words about situational awareness from the perspective of the controller are warranted. Situational awareness may be considered from three levels of cognition: perceiving the situation, comprehending the significance of the situation and finally, projecting the situation into the future to make effective plans for dealing

with the situation. Some of the factors that the controller must continuously integrate to maintain a valid mental picture include:

- air traffic;
- current and forecast weather, including local effects;
- terrain, including obstacles and altitude restrictions;
- performance capabilities of different aircraft types;
- operating characteristics of particular operators;
- availability and limitations of navigation aids;
- aerodrome conditions;
- airport services available;
- ATC equipment capabilities;
- current operating procedures, restrictions, and accepted practices; and
- current capabilities of immediate colleagues and adjacent sectors.

9.1.1 Many of the changes under development or implementation in ATC with respect to automation have the potential for affecting how controllers develop and maintain their situational awareness.

10. Working (Short-Term) Memory:

This is the memory that we use, for example, when some one gives us a phone number to call or gives us directions on how to find an office in a building

last longer by "repeating" the information to yourself "in your head"
Working memory can hold about 5 to 9 "chunks" of information. For example, you will remember the name "Steven" as one "chunk" of information, not as six separate letters.

10.1 Long-Term Memory:

Some of the information that we receive in working memory also gets stored in long-term (permanent) memory, especially if…
The same information is repeated to us several times or
If we "practice" the information (saying it over and over to ourselves)

11. Fatigue

Fatigue-A feeling of lack of energy, weariness or tiredness. Also called tiredness, weariness, exhaustion, or lethargy. Fatigue is a normal response to physical exertion, emotional stress, and lack of sleep.
Alertness-Vigilantly attentive and watchful; mentally responsive and perceptive.

11.1Types of Fatigue:

Acute fatigue
Intense
Short duration
Cured by a good night's sleep
Chronic fatigue
Frequently fatigued
Long duration of the fatigue
Slow recovery
Often a physical sickness or mental stress that causes chronic fatigue
Not cured by one good night's sleep

12. Phobias:

Phobia = A persistent, abnormal, and irrational fear that compels avoidance, despite the understanding by the phobic person and reassurance by others that there is no danger.
Claustrophobia = Fear of enclosed spaces. A more accurate description is a fear of not having an easy escape route.
Acrophobia = Fear of heights or high levels

If a person is truly claustrophobic, they will not be able to work in an enclosed space.
If a person is truly acrophobic, they will not be able to work on top of a aircraft body or wing.
You cannot "talk" a person out of their phobia. However, phobias can be cured somewhat

easily.
While true phobias are somewhat rare, some people have a rational fear of enclosed spaces or of heights. Managers need to know this when assigning tasks to airman.

13. Fitness and Health

Ill health (sickness) and poor fitness can have a negative impact on performance (work)
- Work may be of poor quality
- Errors are more likely

The purpose of awareness training is to get airman to realize when they are feeling ill or exhausted from work, and to do something about it
- Stay home if really sick
- Ask to be put on a simple task
- Ask a friend to check your work
- Take their medications

Alcohol, medication, and drugs can all have an effect on performance
Three main effects
- **Central nervous system depressant** (e.g., alcohol, pain killers, and sleeping pills) slows down your reflexes and thinking ability
- **Central nervous system stimulant** (e.g., amphetamines and caffeine) speeds up your reflexes and thinking, but too much can have a negative effect
- **Hallucinogens** (e.g., marijuana and LSD) affects your understanding of reality

Purpose of training is to get mechanics to realize that using drugs of any kind can have an affect on their performance.
- If they are on prescription or over-the-counter drugs, they need to know the side effects (e.g., drowsiness or decreased mental capacity) so that they are aware of the drug's effect on their performance and can do something about it

14.Complacency

Complacency = Self-satisfaction accompanied by unawareness of actual dangers or deficiencies
Mechanics can become complacent when they have done a task over and over again without making an error
Inspectors can become complacent when they have done an inspection many times before without finding a problem
We must fight complacency!

15. Motivation:

Motivation = Desire × Belief

Motivation = A process within a person that causes the person to move toward a goal.

Motivation is determined both by…
The desire to succeed, and
The belief that effort will result in success

Example: Someone who does not believe they can win a race will not try hard no matter how badly they want the prize.

16. Performance

Performance = Skill × Motivation

Performance is determined by both: Skill & Motivation

17. Increasing Desire to Succeed

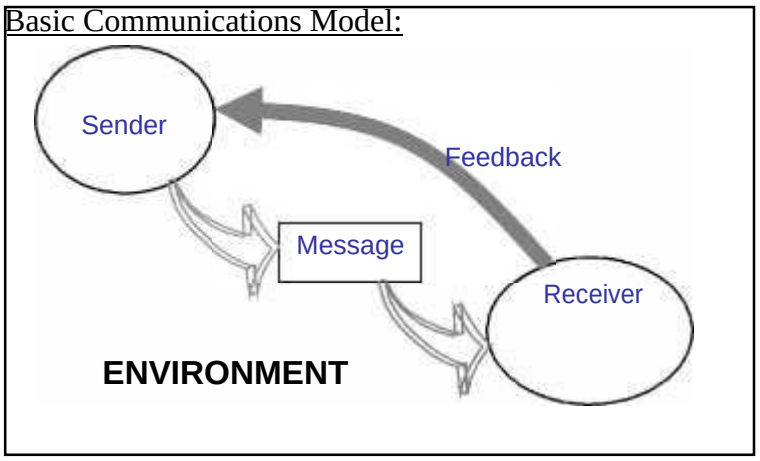
Desire to succeed at your job is not increased by:
Salary
Doing the same routine work day after day
Desire to succeed is increased by:
Fringe benefits
Incentive pay
Task complexity
Degree of job flexibility
It is a manager's job to increase an employee's desire to succeed (motivate) at their job

18. Effective Team Behaviors:

Communication
Assertiveness
Situation Awareness
Leadership

18.1 Communication - The ability to clearly and accurately send and acknowledge information and to provide useful feedback.

Basic Communications Model:



18.1.1 Barriers to Effective Communication:

Passive listening
- No feedback
- Poor feedback

Not using the right words
Inappropriate method
Vague or late information

18.1.2 Overcoming Barriers to Communication:

Use active listening
Request feedback
Use appropriate emphasis (loudness)
Use common words

18.1.3 Written Communication:

Written communication can be hard
- No visual feedback to tell you if the reader understands
- The reader cannot ask questions

Make sure that your writing is:
- Correct
- Complete
- Clear

Use computer spell checker 17

18.1.4 Shift/Task Handover:

Best shift/task handover would include…
- A written handover logbook entry about the task, including
  - What was completed
  - Exactly where in the task the handover occurred/where the task is to be started
  - Needed tools/parts/material to continue the work
  - Any special requirements (e.g., waiting for an inspection)
  - Any work done that was outside the task card (e.g., loosened a clamp)
- A verbal handover with the mechanic taking over the task
- A task card that was completely filled out (all "worked by" and "checked by" signatures completed) up to where the mechanic quit working on the task

18.1.5 Cultural Differences in Communication:

Some of these beliefs deal with communication issues
- Do not admit to mistakes
- Indirect (not straightforward) communications

Pilots will not talk to maintenance staff, etc.
Discuss how the participants' national/ organizational cultures affect communication

18.2 Assertiveness:

Providing relevant information without being asked

Making suggestions
Asking questions as necessary
Confronting ambiguities
Willingness to make decisions
Maintaining position when challenged until convinced by the facts
Clearly stating positions on decisions and procedures
Refusing an unreasonable request

18.3 Situation Awareness:

Situation Awareness - The ability to maintain awareness of what is happening on the ramp or the hangar, as well as what is happening on the task.

Situation Awareness Is the Ability to:

See elements (e.g., people and equipment) in the work environment Where they are now
Whether they are moving or stationary
Understand the importance of what you see, especially with regard to hazards/problems
Project the status of the elements for the near future (i.e., determine future implications) in order to detect situations requiring action

18.4 Barriers to Situation Awareness:

Insufficient communication
Fatigue/stress
Task overload/under load
"Groupthink" mindset
Degraded operating conditions

18.5 Overcoming Barriers to Situation

Awareness: Actively question/evaluate
Use assertive behavior when necessary
Analyze/monitor situation continuously

19. Leadership:

Leadership - The ability to direct and coordinate the activities of crew members and to stimulate them to work together as a team.

Direct and coordinate crew activities
Delegate tasks to crew members
Ensure crew understands expectations
Focus attention on critical aspects of situations
Keep crew informed of task/shift information
Ask crew members for relevant task/shift information Provide feedback to crew on their performance Create and maintain a professional atmosphere

18.6 Barriers to Effective Leadership:

Micro-management - failure to delegate
Poor interpersonal skills
Inexperience
Pressure
New situations
Rigidity

18.7 Effective Leadership:

Make suggestions; do not dictate
Encourage crew to participate
Lead by inspiration
Provide feedback to the crew

20. Human Factors Principles In Aerodrome Emergency Planning:

20.1 Aerodrome emergency planning is the process of preparing an aerodrome to cope with an emergency occurring at the aerodrome or in the vicinity. The objective of aerodrome emergency planning is to minimize the effects of an emergency, particularly in respect of saving lives and maintaining aircraft operations. The aerodrome emergency plan sets forth the procedures for coordinating the response of different aerodrome agencies and of those agencies in the surrounding community that could be assist in responding to the emergency. The Emergency plan shall observe Human Factors principles as per this Advisory Circular to ensure optimum response by all existing agencies like Airport Rescue & Fire Fighting (ARFF) personnel , ATC. Airport security . Engineers. Aircraft operators, Aerodrome Operator & other external organization participating in emergency operations.

20.2 Types of Airport Emergency Exercise & Consideration of Human Factor:

20.2.1 There are 3(Three) methods of testing the airport emergency plan:
20.2.1.1 Full scale exercises;

20.2.1.2 Partial exercises; and

20.2.1.3 Tabletop exercises.

20.2.2 These test shall be conducted on the following schedule: Full Scale: At least once every Two years;
Partial: At least once each year that a full scale exercise is not held or As required to maintain proficiency;
Tabletop: At least once each Six months, except during that six month period When a full scale exercise is held.

20.2.3 Precautions must be taken, where necessary, human factors concepts to mitigate weather-induced physical and other problems such as hypothermia and dehydration. Such considerations apply to emergency personnel as well as to victims of the accident.

20.3 Safety and Well-Being of ARFF Personnel

20.3.1 In the aftermath of an aircraft accident, it is often necessary to provide CARE (Caring Action in Response to Emergency) treatment for the survivors. However, aerodrome operators and ARFF services must also not neglect the mental and psychological well- being of emergency responders such as ARFF personnel who may suffer from post- traumatic stress disorders. It will therefore be essential to provide CARE treatment for ARFF personnel after a major crisis (Liveware vs. Liveware) both from a welfare perspective and also from a business continuity standpoint. Such treatment and counselling can be provided by other ARFF or airport personnel who had undergone the proper training or more likely to be provided by external medical institutions. Arrangements for the latter should then be formalised in the form of mutual aid agreements or can be incorporated into the aerodrome emergency plan (Liveware vs. Software).

20.3.2 The job nature of ARFF personnel poses numerous potential hazards (Liveware vs. Environment). The risk of inhalation of carbon or smoke particles when extinguishing a fire, either during an incident or during training, is very high. Therefore, ARFF services must provide all fire fighters with the appropriate personal protective equipment (PPE) such as self-containing breathing apparatus (SCBA), helmets, boots, protective clothing etc. In relation to day-to-day operations, the uniform worn by ARFF personnel should also be of a suitable material depending on the local climate and conditions.

20.3.3 To ensure that ARFF personnel are able to perform their roles effectively, thought needs to be put into designing an appropriate physical fitness programme to condition them for the physical rigours of the job (Liveware vs. Environment). In the process of designing any physical fitness programmes, due considerations must be given to individual human limitations. ARFF management must also accept that not all personnel can perform at the same level of physical fitness standard. The key is to establish the minimum physical fitness requirements of a fire fighter

and design a programme that can best replicate these demands.

20.3.4 Noise is an important human factor (Liveware vs. Environment) that is omnipresent in an airport environment and cannot be ignored. Most fire stations are located within close proximity of the runway and aircraft movement areas, thus exposing ARFF personnel to constant loud noises. Besides posing as disruptive interferences during the transmission of messages, long term and regular exposure to noise can have serious implications on one's health (e.g. temporary, partial or permanent hearing loss). To address this issue, ARFF services should issue and mandate the use of suitable hearing protection devices. In addition, personnel who are subjected to constant exposure to noise should be sent for regular noise induced deafness (NID) hearing tests.
20.3.5 Fatigue is one important factor that directly affects human performance and is greatly influenced by the shift system of ARFF services (Liveware vs. Software). Besides the need to conform to local labour rules and regulations of individual States, there must be considerations to ensure that ARFF personnel can have sufficient rest despite the need to be on 24-hour operational readiness at most airports.

20.3.6 A leader is an individual whose ideas and actions influence the thought and behaviour of others (Liveware vs. Liveware). Through the use of motivation and persuasion, and an understanding of the goals and desires of the team, the leader becomes an agent of change and influence. Skilled leadership may be needed to understand and handle various operational, training and administrative situations. For instance, personality clashes within a team complicate the task of a leader and can affect both safety and efficiency.

21. Adherence to Human factor principal:

Assessment is very much a part of aviation industry practice and provides one means of meeting standards and determining competency. Decisions as to suitable and productive means of operational personnel assessment will be an important influence in human performance in working place on the other hand, skill acquisition in aviation has traditionally been achieved on the job or in the course of high-fidelity simulation. Skill assessment and associated operational techniques have traditionally been conducted in the same environment .However, notwithstanding the influence of current practice, the desire for formal assessment of Human Factors skills must always be counterbalanced by full consideration of any negative learning consequences which may arise from that very assessment.

22. Human Factors Checklist:

To determine the relevant areas warranting Human Factors assessment/ investigation / analysis, the importance of each factor by indicating the appropriate weighting value mentioned below will be given beside each item:

0=Not contributory
1=Possibly contributory
2=Probably contributory
3=Evidence of hazard.

1. Name of the employee:
2. Designation:
3. Working position:
4. Name of organization :
5. Name(s) of the Inspector:
6. Date & time of assessment:

BEHAVIOURAL FACTORS	Mark
A Personal problems(family, professional financial)	
B. Overconfidence, excessive motivation	
C. Lack of confidence	
D. Apprehension / panic	
E. Error in judgment	
F. Delay	
G. Complacency, lack of motivation	
H. Interpersonal tension	
I. Drug abuse	
J. Alcohol / hangover	
K. Personality, moods, character	
L. Memory mindset	
M. Habit patterns	
N. Perceptions or illusions	

MEDICAL FACTORS

A. Physical attributes conditioning & general health
B. Sensory acuity(vision, hearing, smell, etc.)
C. Fatigue
D. Sleep deprivation
E. Nutritional factors
F. Drug / alcohol ingestion

OPERATIONAL FACTORS Mark

A. Lack of currency / proficiency
B. Command & control in ARFF Vehicles
C. Command &control, supervision
D. Ability to carryout instructions
E. Working environment (noice,fatiguevisibility,etc.)
F. Selection and training
G. ARFF Crew capability
H. Inadequate knowledge of procedures
I. Limited experience
J. Workload saturation
K. Situational awareness

EQUIPMENT DESIGN FACTORS

A. Design/location of instruments, controls
B. Lighting
C. Workspace incompatibility
D. Visual restrictions due to structure
E. Aerodrome design and layout
F. Effects of automation
G. Confusion of controls, switches, etc

ENVIRONMENTAL FACTORS.

A. Weather
B. Visibility restriction
C. Noise
D. Hot/ cold
E. Windblast
F. Smoke, fumes
G. Oxygen contamination
H. CO poisoning 0or other toxic chemicals
I. Radiation
J. Electrical shock

INFORMATION TRANSFER FACTORS

A. Adequacy of written materials
B. Misinterpretation of oral communication
C. Language barrier
D. Noise interference
E. Disrupted oral communication
F. Crew /AT S communication
G. Airport signals, marking and lighting
H. Ground signals