HUMAN FACTORS IN RESCUE & FIREFIGHTING

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General Manager AFRS

28 February 2024 | Monday | 1030 IST

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KUL


BKI


MLE


HQ


MATC

INTERNATIONAL AIRPORT PROFESSIONAL

Global ACI-ICAO Airport Management Professional Accreditation Programme (AMPAP)

UPM UNIVERSITI PUTRA MALAYSIA BERILMU BERBAKTI

Master
Emergency Response & Planning

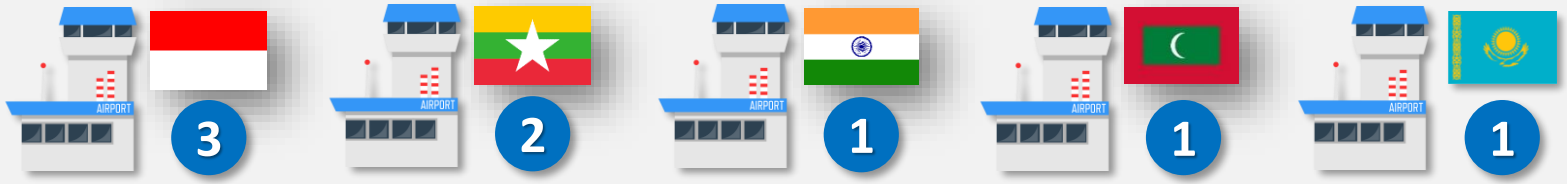
UNIVERSITI KEBANGSAAN MALAYSIA
National University of Malaysia

Degree
Information Technology

AKADEMI BOMBA

Diploma
Fire Science

ACI APEX AIRPORT EXCELLENCE IN SAFETY™



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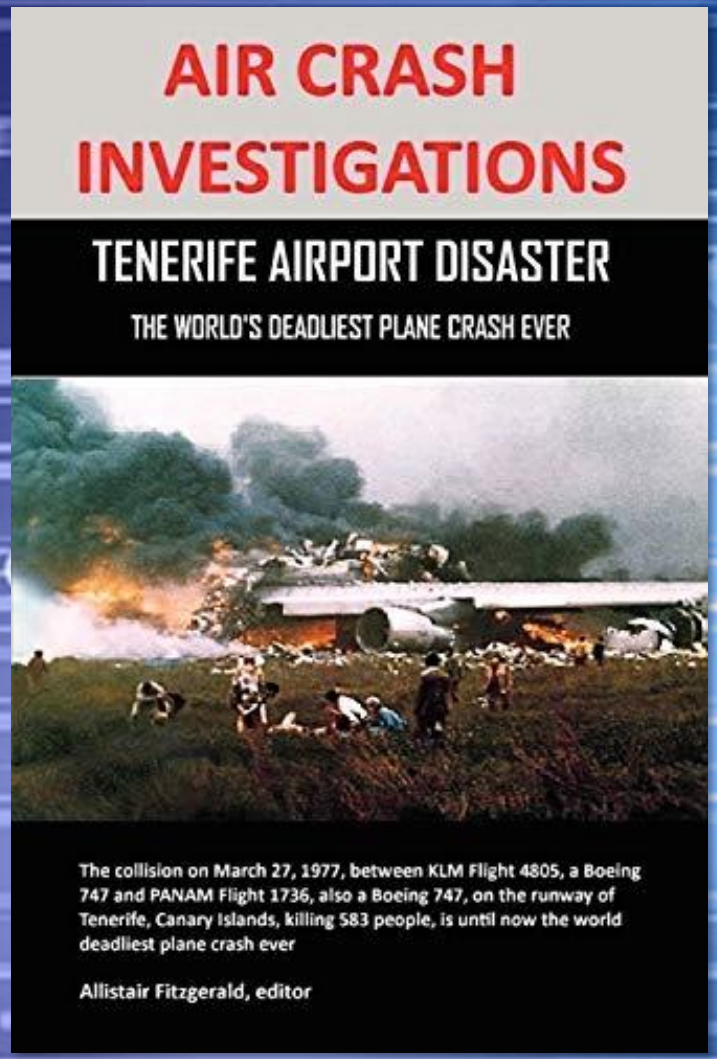
THE HUMAN ELEMENTS

HUMAN FACTORS IN AVIATION



- Flight deck cooperation

Cockpit Resource Management

- Influences on all staff on ground and in the air

Human Factors Management

1940 — **1980** — **Today**

Crew Resource Management

- Cooperation of all flight related staff

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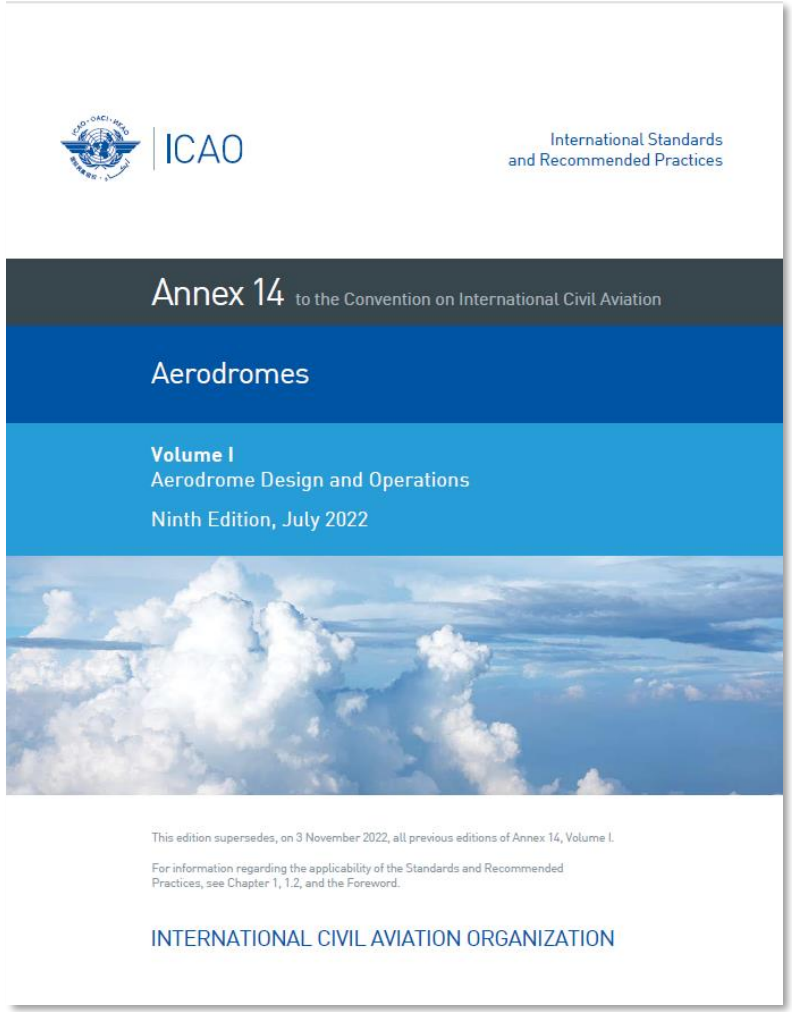
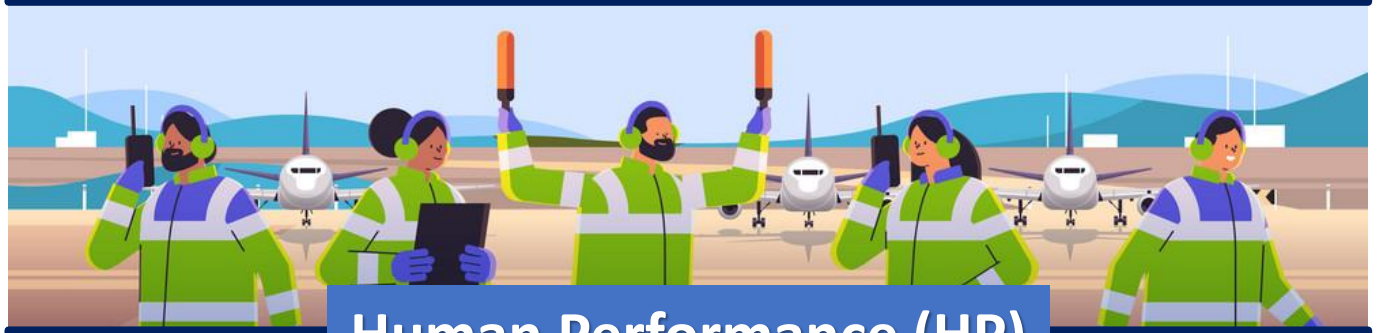
HUMAN FACTORS IN ANNEX 14 VOL I



Human Factors (HF)

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



Human Performance (HP)

Human capabilities and limitations which have an impact on the safety and efficiency of aeronautical operations.

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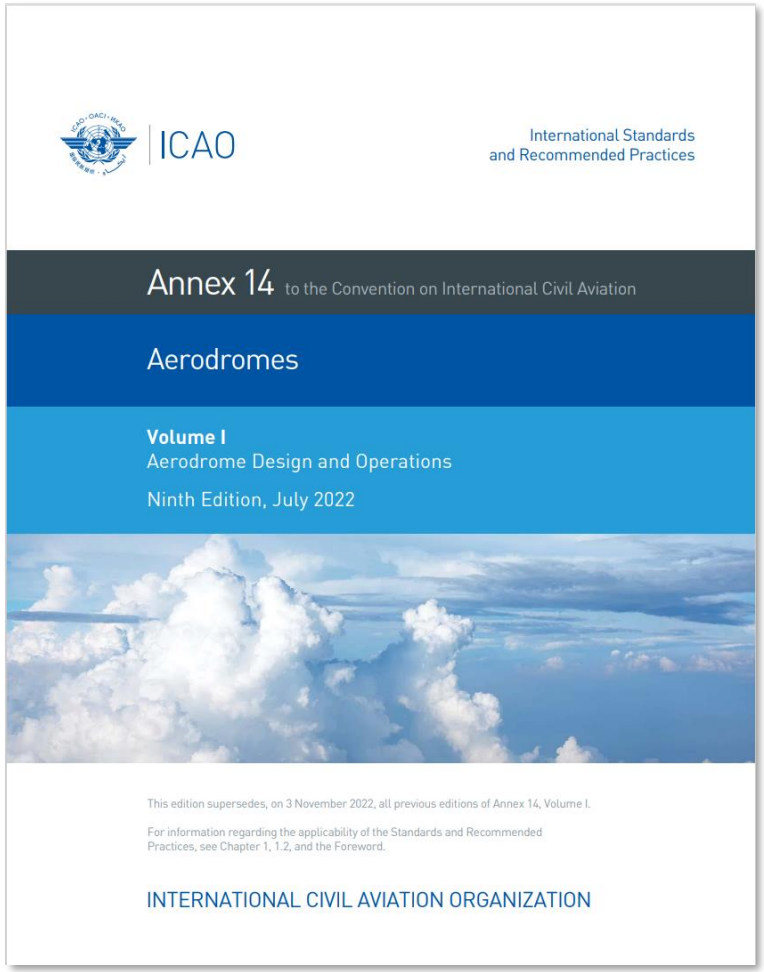

AERODROME EMERGENCY PLANNING

9.1.6 The plan shall observe human factors principles to ensure optimum response by all existing agencies participating in emergency operations.

Note 1.— Guidance material on human factors principles can be found in the Human Factors Training Manual *(Doc 9683).*

Note 2.— General principles and procedures on the training of aerodrome personnel, including training programmes and competence checks, are specified in the PANS-Aerodromes (Doc 9981).

RESCUE & FIREFIGHTING

9.2.42 The rescue and firefighting personnel training programme shall include training in human performance, including team coordination.

Note.— Guidance material to design training programmes on human performance and team coordination can be found in the Human Factors Training Manual *(Doc 9683).*

AERODROME MAINTENANCE

10.1.2 **Recommendation.—** *The design and application of the maintenance programme should observe human factors principles.*

Note 1.— Guidance material on human factors principles can be found in the Human Factors Training Manual *(Doc 9683) and in the* Airport Services Manual *(Doc 9137), Part 8.*

Note 2.— General principles and procedures on the training of aerodrome personnel, including training programmes and competence checks, are specified in the PANS-Aerodromes (Doc 9981).

DOC 9683 HUMAN FACTORS TRAINING MANUAL

Doc 9683-AN/950

HUMAN FACTORS TRAINING MANUAL

FIRST EDITION — 1998

Approved by the Secretary General and published under his authority

INTERNATIONAL CIVIL AVIATION ORGANIZATION

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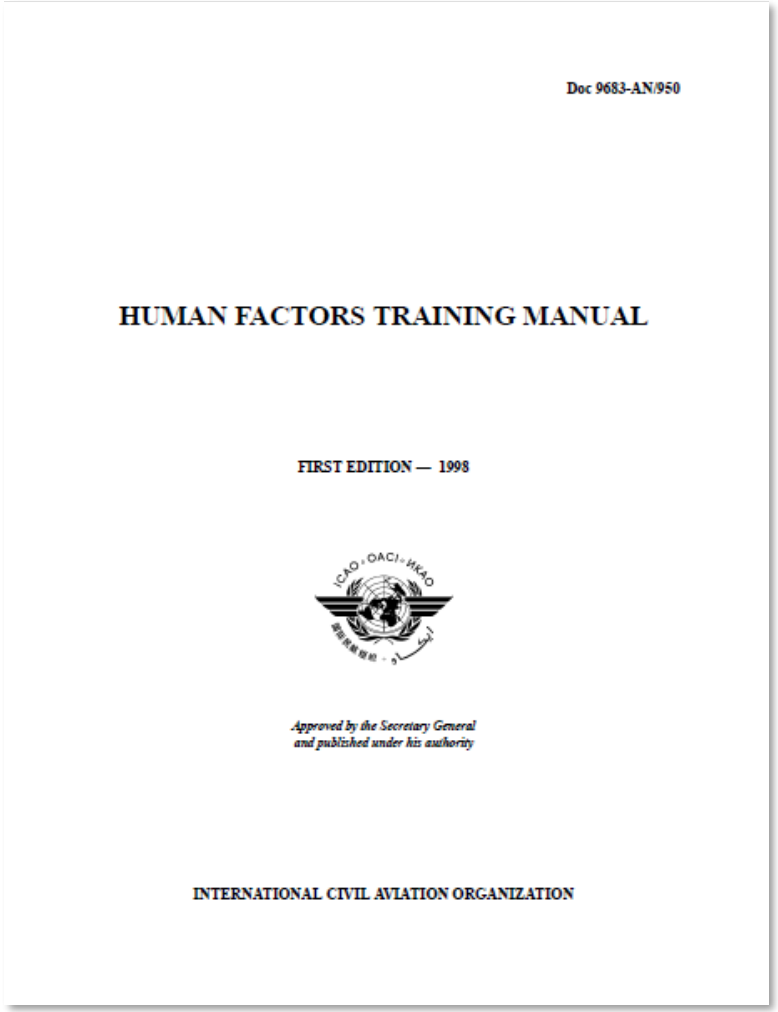

Doc 9683-AN/950

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FIRST EDITION — 1998

Approved by the Secretary General and published under his authority

INTERNATIONAL CIVIL AVIATION ORGANIZATION

Target Audience

Pilot

ATCO

Technician

Investigator

Duration

20 hours to 35 hours

Skill Requirement

Liveware-Liveware (L-L)
Liveware-Hardware (L-H)
Liveware-Environment (L-E)
Liveware-Software (L-S)

Module	Title	Time	
1	Introduction to Human Factors in aviation	1.75 hours	5%
2	The Human Element (Aviation physiology)	3.5 hours	10%
3	The Human Element (Aviation psychology)	3.5 hours	10%
4	Liveware-Hardware: Pilot-equipment relationship	4.75 hours	15%
5	Liveware-Software: Pilot-software relationship	3.5 hours	10%
6	Liveware-Liveware: Interpersonal relations	7.0 hours	20%
7	Liveware-Environment: The organizational environment	10.5 hours	30%
		35 hours	**100%**

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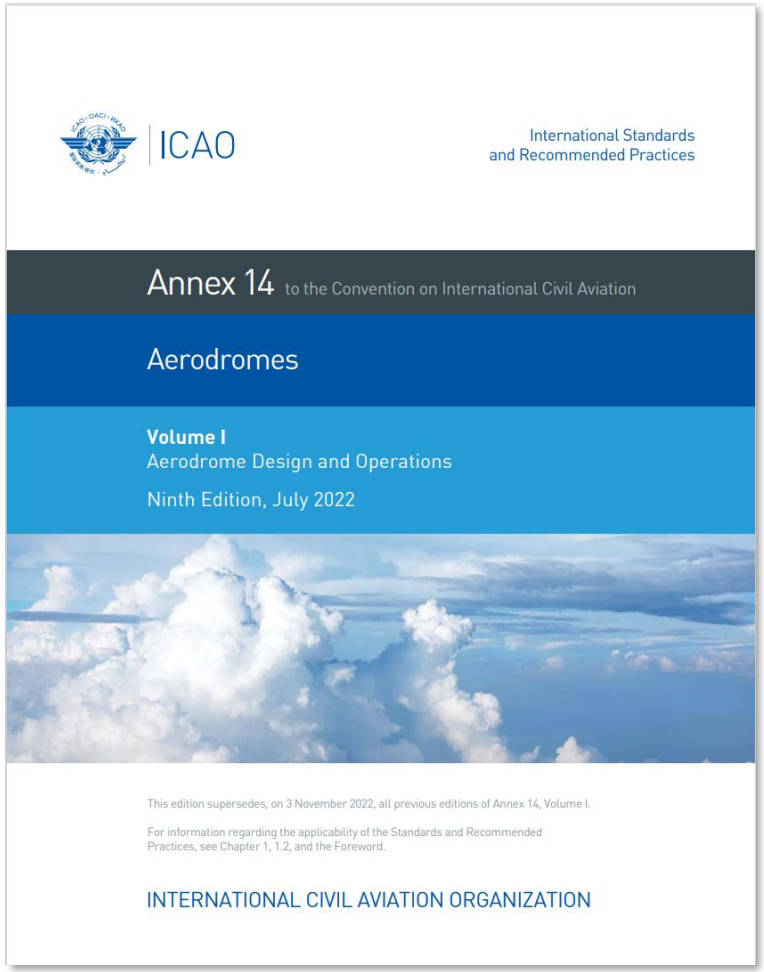

AERODROME EMERGENCY PLANNING

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9.2.42 The rescue and firefighting personnel training programme shall include training in human performance, including team coordination.

Note.— Guidance material to design training programmes on human performance and team coordination can be found in the Human Factors Training Manual *(Doc 9683).*

AERODROME MAINTENANCE

10.1.2 **Recommendation.—** *The design and application of the maintenance programme should observe human factors principles.*

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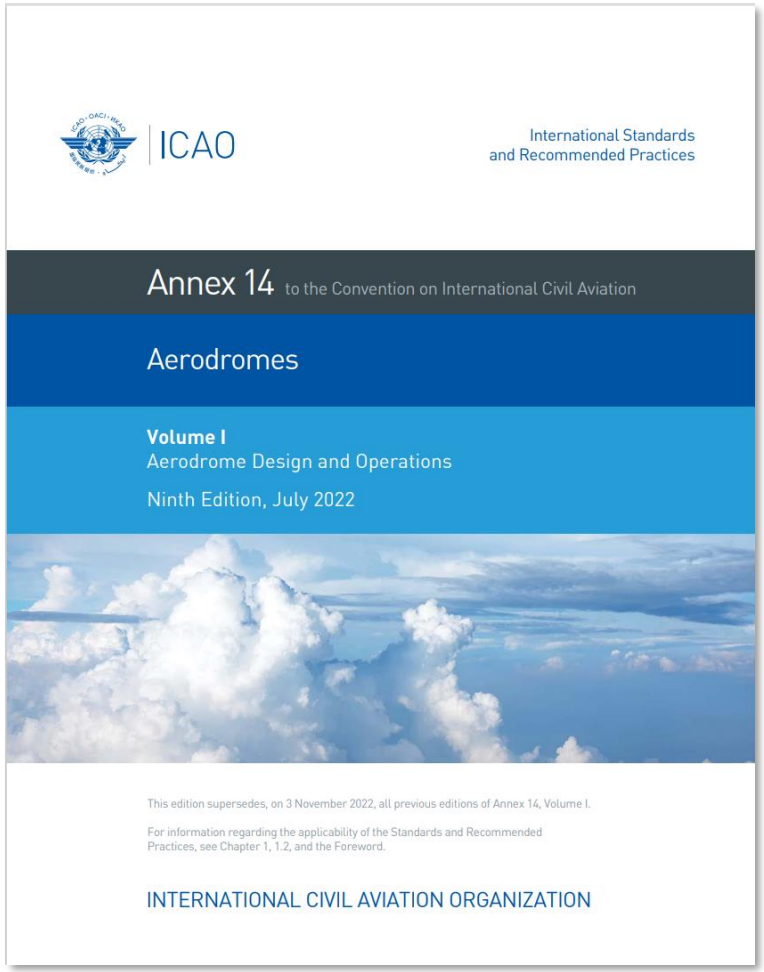

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RESCUE & FIREFIGHTING

9.2.6 If, after selecting the category appropriate to the longest aeroplane's overall length, that aeroplane's fuselage width is greater than the maximum width in Table 9-1, column 3, for that category, then the category for that aeroplane shall actually be one category higher.

Note 1.— See guidance in the Airport Services Manual *(Doc 9137), Part 1, for categorizing aerodromes, including those for all-cargo aircraft operations, for rescue and firefighting purposes.*

Note 2.— Principles and procedures on training, including training programmes and competence checks, are specified in the PANS-Aerodromes (Doc 9981). Further guidance on the training of personnel, rescue equipment for difficult environments, and other facilities and services for rescue and firefighting is given in Attachment A, Section 17, and in the Airport Services Manual *(Doc 9137), Part 1.*

9.2.42 The rescue and firefighting personnel training programme shall include training in human performance, including team coordination.

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HUMAN FACTORS IN DOC 9981 PANS AERODROME

ICAO

Doc 9981

PROCEDURES FOR AIR NAVIGATION SERVICES

Aerodromes

Third Edition, 2020

This edition supersedes, on 5 November 2020, all previous editions of Doc 9981.

INTERNATIONAL CIVIL AVIATION ORGANIZATION

PART II — AERODROME OPERATIONAL MANAGEMENT

Chapter 1

TRAINING

1.1 GENERAL

1.1.1 The activities conducted by an aerodrome operator require the competence and appropriate training of personnel in order to carry out their assigned tasks.

1.1.2 This training is generally conducted by the individual's employer, but may also be conducted by the aerodrome operator or third parties.

1.1.3 This chapter provides the general obligations related to training programmes and competence checks for all personnel carrying out the procedures detailed in each of the following chapters of this document.

Note.— Training for other activities, not contained in Part II of this document, may be carried out depending on the needs identified by the aerodrome operator.

1.1.4 Additional material related to training procedures, including more detailed programmes or requirements, can be found in a number of chapters in Part II of this document.

Note.— The additional material has been provided to add information related to activity-specific training.

1.2 OBJECTIVES

1.2.1 Aerodrome operators shall ensure that training programmes are developed and implemented for all personnel involved in aerodrome operations.

1.2.2 The training programmes shall include procedures for the verification of personnel knowledge and for the practical application thereof, at adequate intervals.

1.3 OPERATIONAL PRACTICES

1.3.1 Aerodrome operators shall be responsible for ensuring that their staff and all personnel involved in aerodrome operations at the aerodrome are competent for each task they are required to carry out. The details of the training will vary depending on the person's experience and background and the complexity of the required task.

1.3.2 Training objectives shall be identified to ensure that competence is achieved and maintained. Based on these objectives, the training programme should include content and frequency for each technical subject, as well as a method to track the progress of the required training and the maintenance of training records.

1.3.3 A training programme should include:

a) theoretical training;

b) practical or on-the-job training;

c) testing of understanding; and

d) demonstrating competence or recurrent theoretical and/or practical training.

Note 1.— Provisions on demonstrating competence are included in the Appendix to this chapter.

Note 2.— Demonstration of continued competence is an alternative to recurrent training.

Note 3.— The attachment to this chapter provides guidance on the structure of a training programme.

1.3.4 Refresher training should be provided following an accident, incident or serious occurrence, if training-related issues have been identified as a contributing factor, or after a long-term absence to ensure that personnel are kept abreast of the most recent material, developments and practices.

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HUMAN FACTORS IN DOC 9137 ASM PART 1

ICAO

Doc 9137-AN/898

Airport Services Manual

Part 1 — Rescue and Firefighting
Fourth Edition, 2015

Approved by and published under the authority of the Secretary General

INTERNATIONAL CIVIL AVIATION ORGANIZATION

Chapter 18

HUMAN FACTORS PRINCIPLES

18.1 GENERAL

18.1.1 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.

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

18.2 THE SOFTWARE, HARDWARE, ENVIRONMENT AND LIVEWARE (SHEL) MODEL

18.2.1 Human factors specific to RFF services encompass a wide spectrum of activities, ranging from training and operations to station routine and audits. The study of human factors principles can be described as both an art and a science and must be associated with the entire range of RFF activities in order to achieve a higher level of professionalism, a higher state of operational effectiveness and a higher standard for safety.

18.2.2 The SHEL model (see Figure 18-1) provides a conceptual framework to help understand Human Factors. It illustrates the various constituents and the interfaces — or points of interaction — which comprise the subject. Human Factors elements can be divided into four basic conceptual categories:

a) *Software*: plans, procedures, documentation, etc.;

b) *Hardware*: machine, equipment, etc.;

c) *Environment*: internal (e.g. workplace), external (e.g. surroundings), etc.;

d) *Liveware*: the human factor.

18.2.3 Interactions between people and the other elements of the SHEL model are at the heart of Human Factors, which involve the interfaces between:

a) People and machines — "Liveware vs. Hardware";

b) People and procedures — "Liveware vs. Software";

c) People and colleagues — "Liveware vs. Liveware";

d) People and workplace — "Liveware vs. Environment";

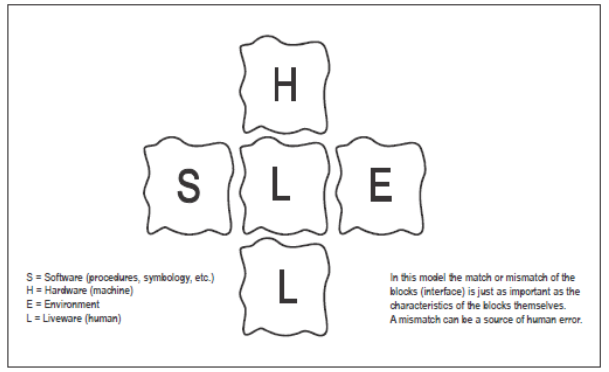

Figure 18-1. The SHEL model as modified by Hawkins

18.3 HUMAN FACTORS ISSUES IN RFF SERVICES

18.3.1 A competent and professional RFF 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 RFF personnel must take into account human factor principles such as team coordination.

18.3.2 Human factors principles are not only confined to the development of RFF 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 RFF service.

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

a) operational effectiveness and standards; and

b) safety and well-being of RFF personnel.

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MASLOW'S HIERARCHY OF NEEDS

A Job Well Done

Self-actualization
desire to become the most that one can be

Respect of Others

Esteem
respect, self-esteem, status, recognition, strength, freedom

Team Member

Love and belonging
friendship, intimacy, family, sense of connection

Job Safety & Security

Safety needs
personal security, employment, resources, health, property

Pay

Physiological needs
air, water, food, shelter, sleep, clothing, reproduction

BELIEF VS ATTITUDE VS BEHAVIOUR

BELIEF

an acceptance that something exists or is true

ATTITUDE

a feeling or opinion about something or someone

BEHAVIOUR

the way that someone behaves

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FACTORS THAT INFLUENCE HUMAN BEHAVIOURS

P — Personal Life

- Marital problems
- Financial worries
- Bereavement
- Alcohol or Drug abuse
- Loner

E — Environment

- Heat / Cold Dry / Wet
- Room facilities
- Culture
- Uniform / PPE
- Equipment condition

M — Management

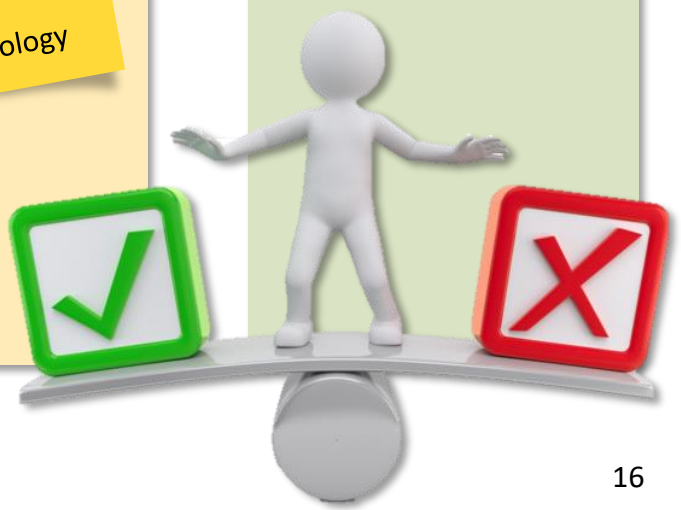
- Respect or No Respect
- No blame culture
- Listen or Dictate
- MBO or MBWA

E — Ergonomics

- Anatomy
  - Anthropometrics
  - Biomechanics
- Physiology
- Psychology

C — Circadian Rhythm

- Shift work
- Adequate breaks



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HUMAN FACTORS ISSUES “THE DIRTY DOZEN”

1. Lack of Communications
2. Distraction
3. Lack of Resources
4. Stress
5. Lack of Teamwork
6. Complacency
7. Time Pressure
8. Lack of Awareness
9. Lack of Knowledge
10. Fatigue
11. Lack of Assertiveness
12. Routine

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FUNDAMENTAL OF HUMAN FACTORS

01 Enhance Safety

02 Manage Errors

03 Enhance Comfort

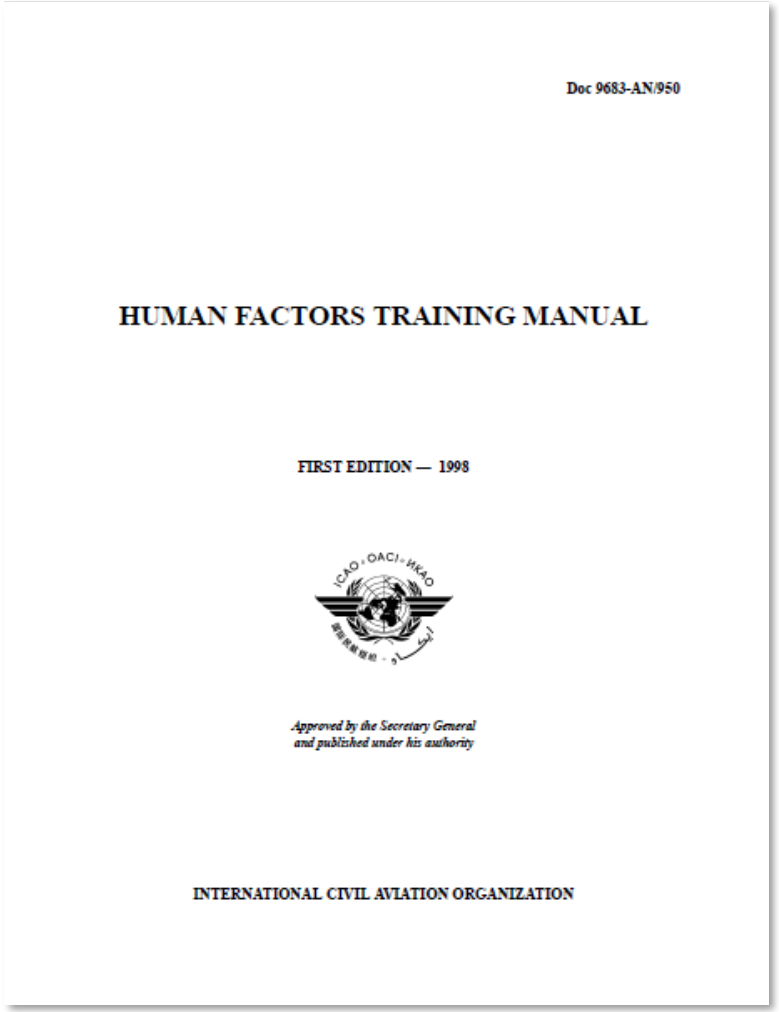
04 Increase Efficiency

Define SOP

Enhance Design

Improve Selection, Training & Performance Management

HUMAN FACTORS TRAINING MANUAL (DOC 9683)



Doc 9683-AN/950

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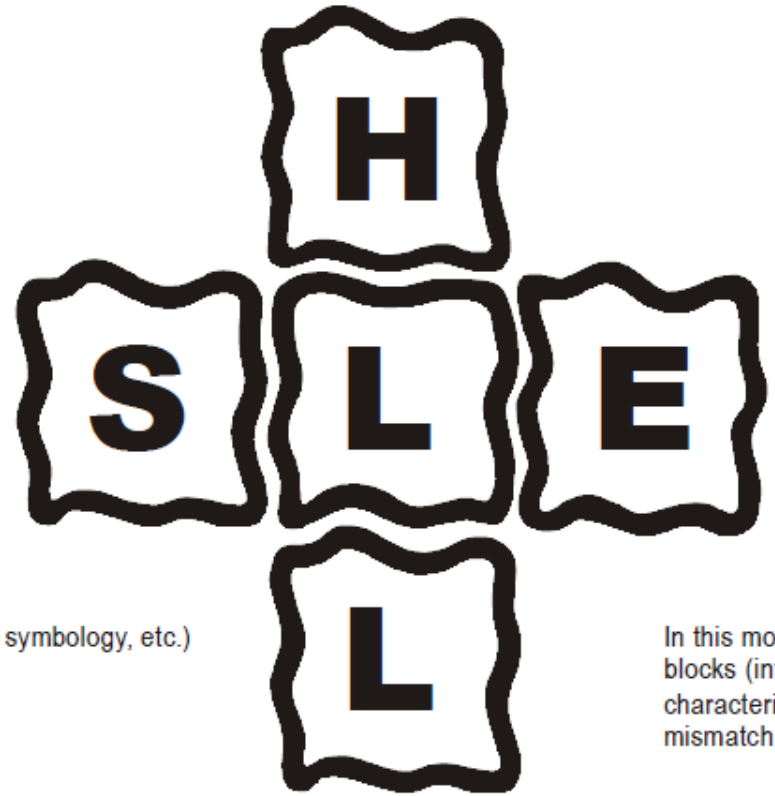
INTERNATIONAL CIVIL AVIATION ORGANIZATION

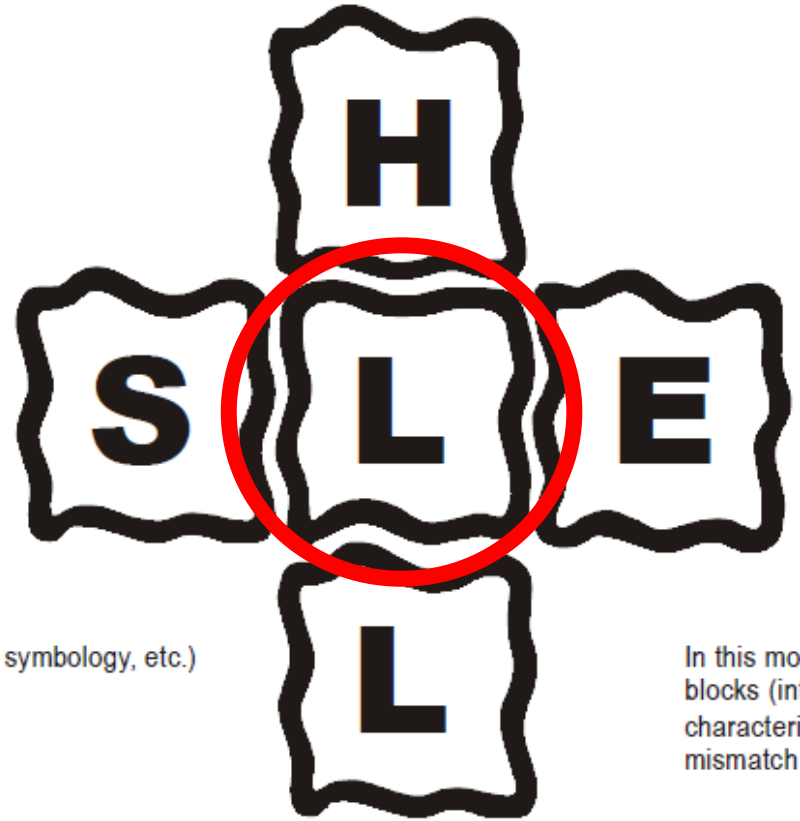


S = Software (procedures, symbology, etc.)
H = Hardware (machine)
E = Environment
L = Liveware (human)

In this model the match or mismatch of the blocks (interface) is just as important as the characteristics of the blocks themselves. A mismatch can be a source of human error.

The SHEL model as modified by Hawkins

CONCEPTUAL MODEL OF HUMAN FACTORS



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In this model the match or mismatch of the blocks (interface) is just as important as the characteristics of the blocks themselves. A mismatch can be a source of human error.

The SHEL model as modified by Hawkins

Liveware - Hardware

Liveware - Software

Liveware - Environment

Liveware - Liveware

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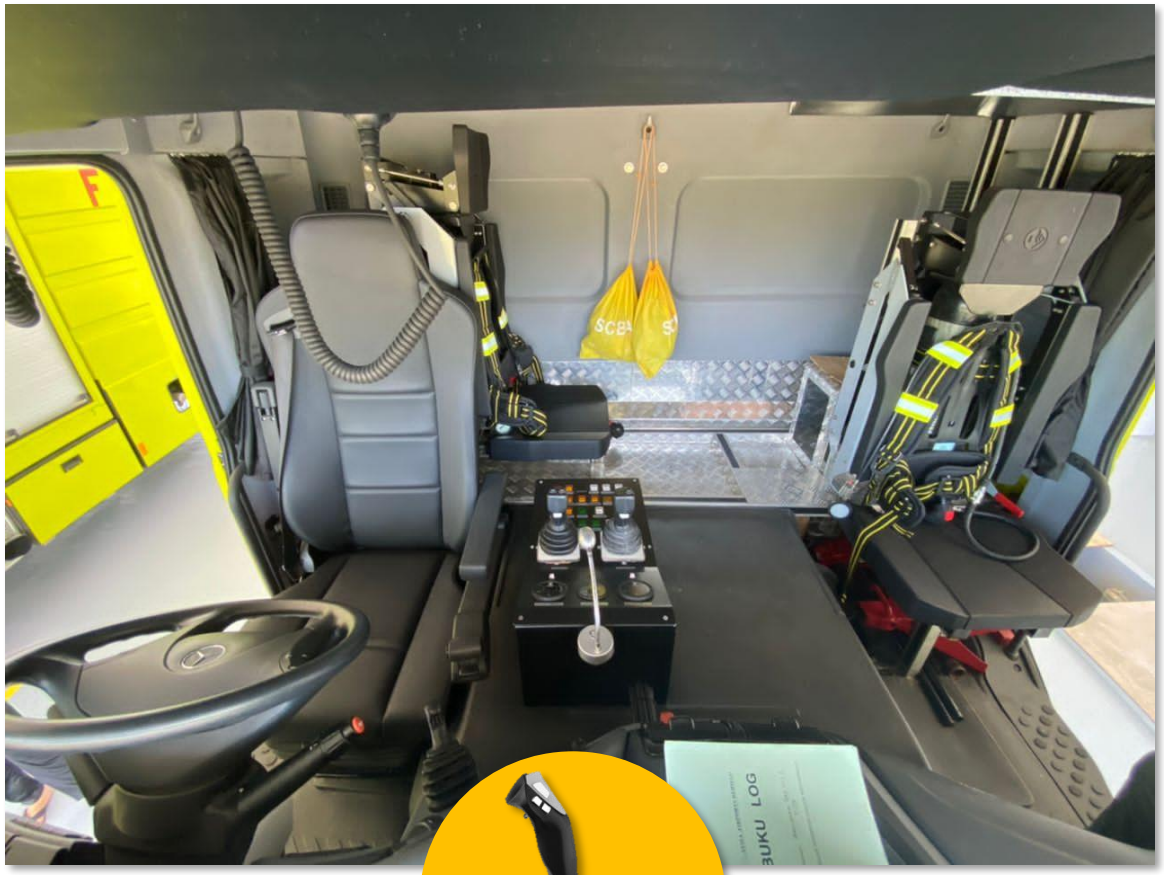
LIVEWARE-HARDWARE: MASTERING THE MACHINE

FIRE VEHICLE - DESIGN



Steering Location

Seating Layout

Joystick Position

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MALAYSIA AIRPORTS (SEPANG) SDN. BHD.
3rd & 4th FLOOR,
AIRPORT MANAGEMENT CENTRE,
KL INTERNATIONAL AIRPORT 64000 KLIA,
SELANGOR DARUL EHSAN
EMERGENCY
START

FIRE VEHICLE

Fire vehicle overturned at runway during routine trial run
Tirupati International Airport @ 19th July 2020

Fire vehicle hit a car at public road
Darwin International Airport @ 7th August 2011

TRAINING! TRAINING! TRAINING!

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RESCUE EQUIPMENT

Specification

Quantity & Storage

Maintenance

Training

LIVEWARE-SOFTWARE:
UNDERSTANDING OF RFF DOCUMENTATIONS

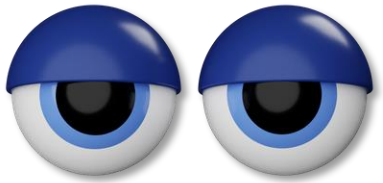
THE REGULATIONS

INTERNATIONAL

NATIONAL

DOCUMENTATIONS

Know the Documents



Read the Documents

Understand the Documents

Utilize the Documents

DOCUMENTATIONS

EASY TO UNDERSTAND

PERIODICAL REVISION

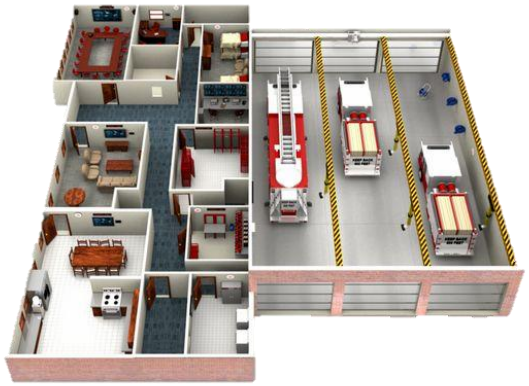
CONTINUOUS LEARNING

MALAYSIA AIRPORTS Hosting Joyful Connections


AIRPORT
FIRE RESCUE
2

LIVEWARE-ENVIRONMENT: WORKING AMBIENCE

DESIGN OF FIRE STATION



SPACES TYPE & LAYOUT

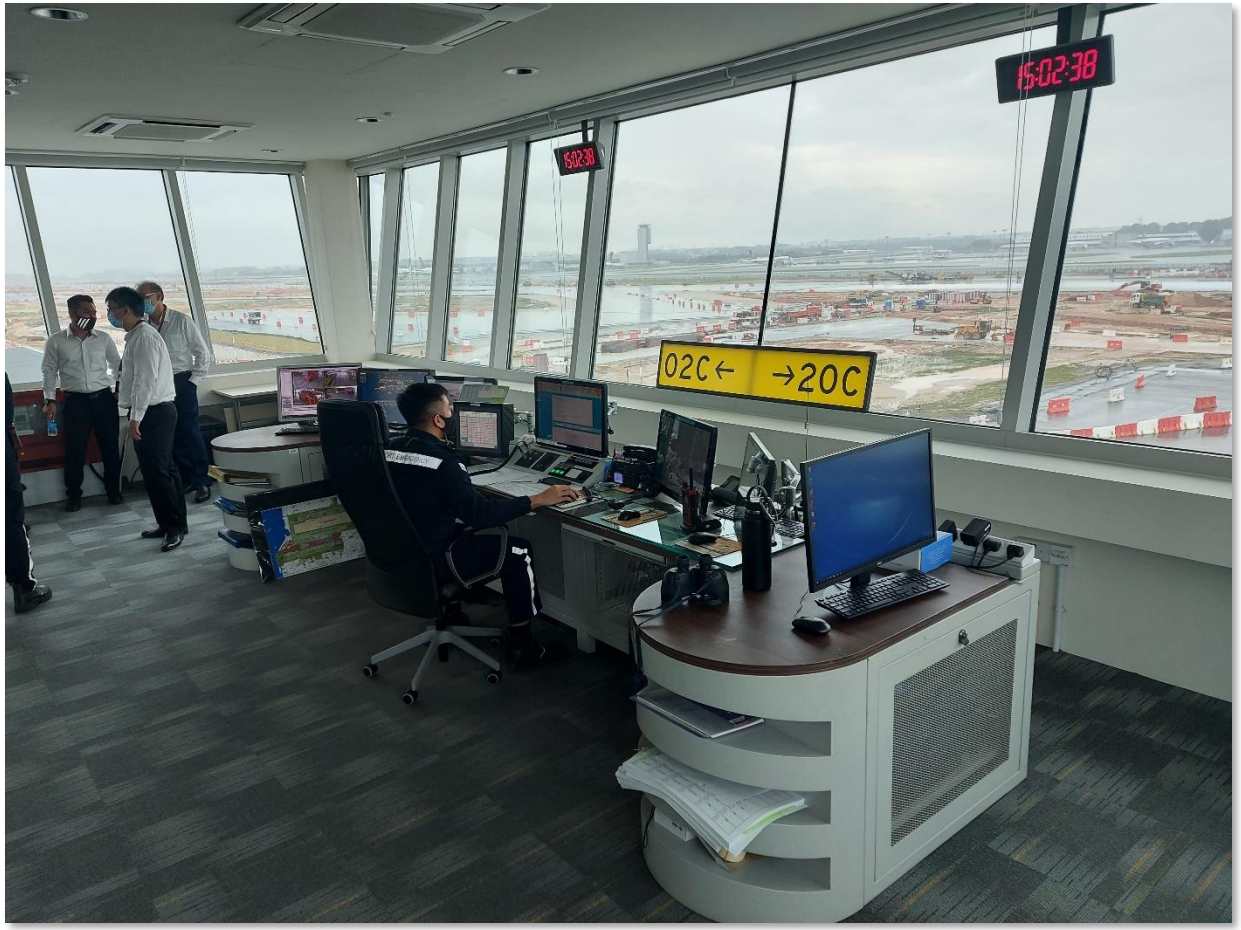
- Fire Vehicle(s) Bay
- Administrative Areas
- Training Areas
- Residential Areas

DESIGN CONSIDERATIONS

- Response Time
- Quality of Life
- Safety, Health & Environment
- Flexibility

DESIGN OF FIRE STATION

Airport Fire & Rescue Service, KL International Airport



Airport Emergency Service, Changi International Airport

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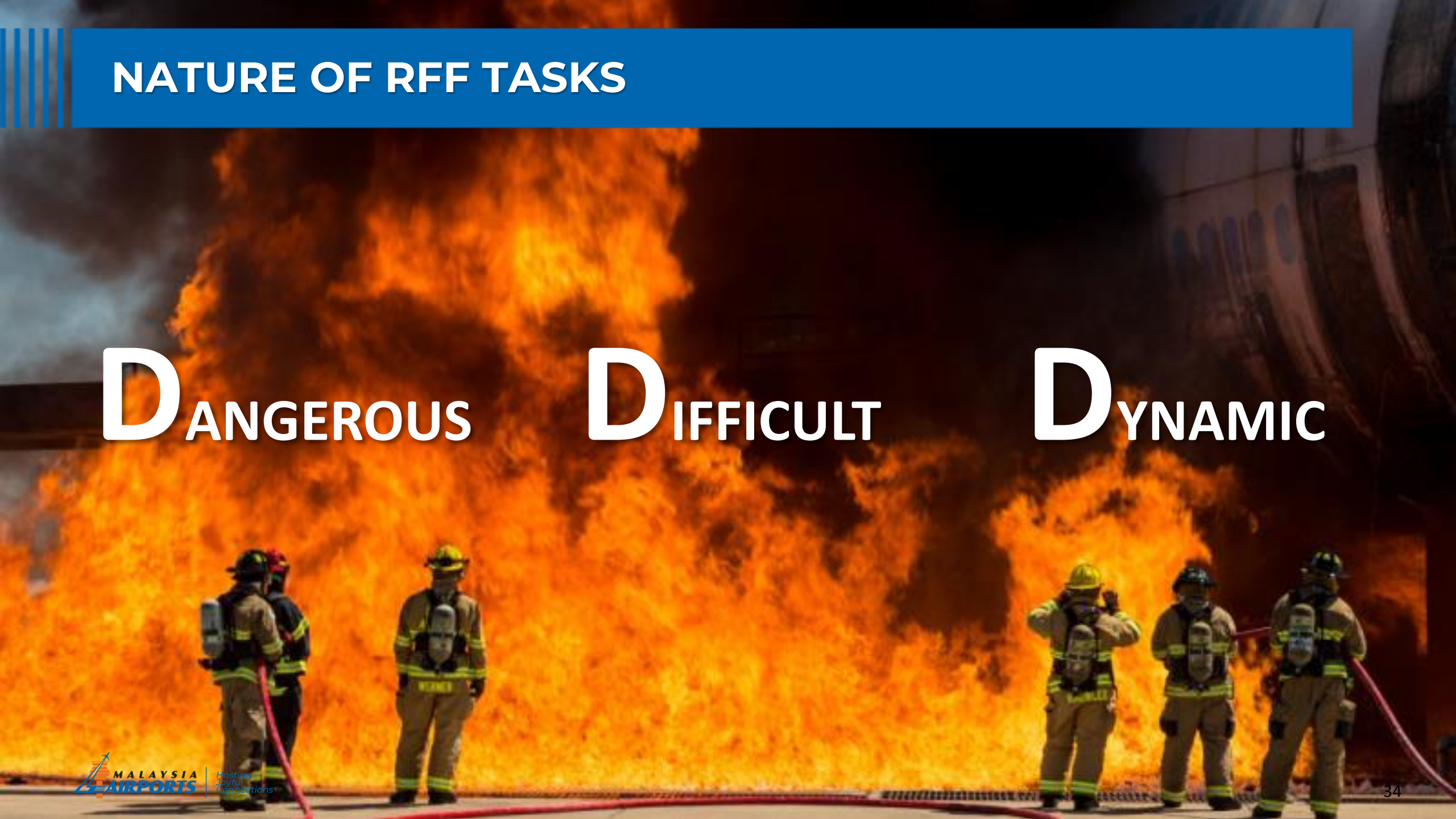
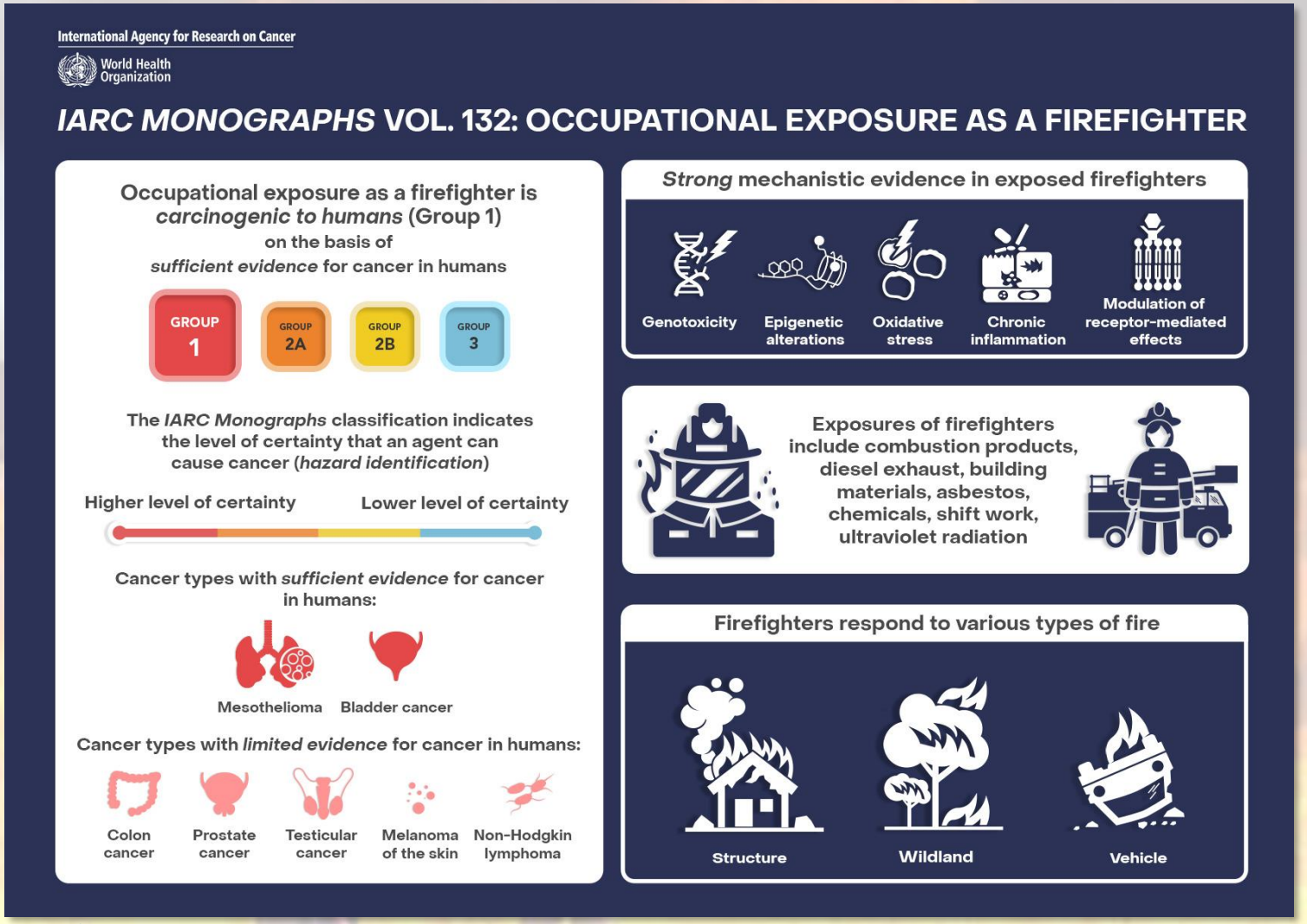
NATURE OF RFF TASKS



PERSONAL PROTECTIVE EQUIPMENT



Specification **Issuance & Maintenance**

Donning & Doffing **Training**

PHYSICAL & MEDICAL FITNESS PROGRAMMES

AEROBIC FITNESS

The ability to continue to exercise for prolonged periods of time at low to moderate or high intensity.

ANAEROBIC FITNESS

An activity that requires high levels of energy & is done for only a few seconds or minutes at a high level of intensity.

FLEXIBILITY

The ability to move the limbs & joints into specific positions at the end of their normal range of movement.

MEDICAL FITNESS

To identify any underlying medical conditions, which may pose a risk to the individual firefighter during physically demanding activities.

PHYSICAL FITNESS ASSESSMENT

- Cater all three (3) components.
- Conducted at least once a year.
- Pre-employment entry as a firefighter.
- Ongoing test for existing RFF staffs.

MEDICAL FITNESS ASSESSMENT

- Specific components to be developed.
- Frequency to be determined.
- Pre-employment entry as a firefighter.
- Ongoing check for existing RFF staffs.

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REALISTIC VS VIRTUAL REALITY TRAINING

REALISTIC FIREFIGHTING TRAINING METHOD

Financial Costs

Environmental Costs

Human Costs

VIRTUAL REALITY FIREFIGHTING TRAINING METHOD

Reduced Time

Variety of Scenarios

Accessibility

Maintain Safety

Reduced Costs

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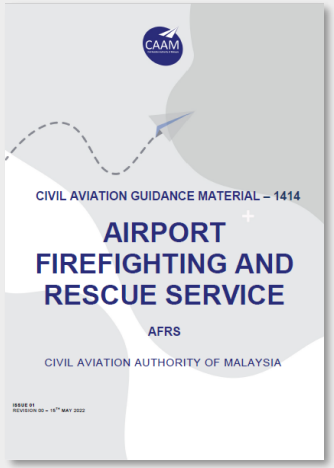
LIVEWARE-LIVEWARE: INTERPERSONAL RELATIONS

LEADERSHIP



14.8 Leadership performance

14.8.1 The leadership qualities exhibited by an RFF team commander often determines the outcome in an emergencyresponse. The commander leads and motivates the staff in achieving peak performance under a challenging operating environment. In this regard, a robust leadership training programme should be instituted to better prepare RFF leaders inassuming command during crises.

Point No 1

- Leadership qualities determines the outcome in an emergency response.

Point No 2

- Commander leads & motivates the staff in achieving peak performance under challenging operating environment.

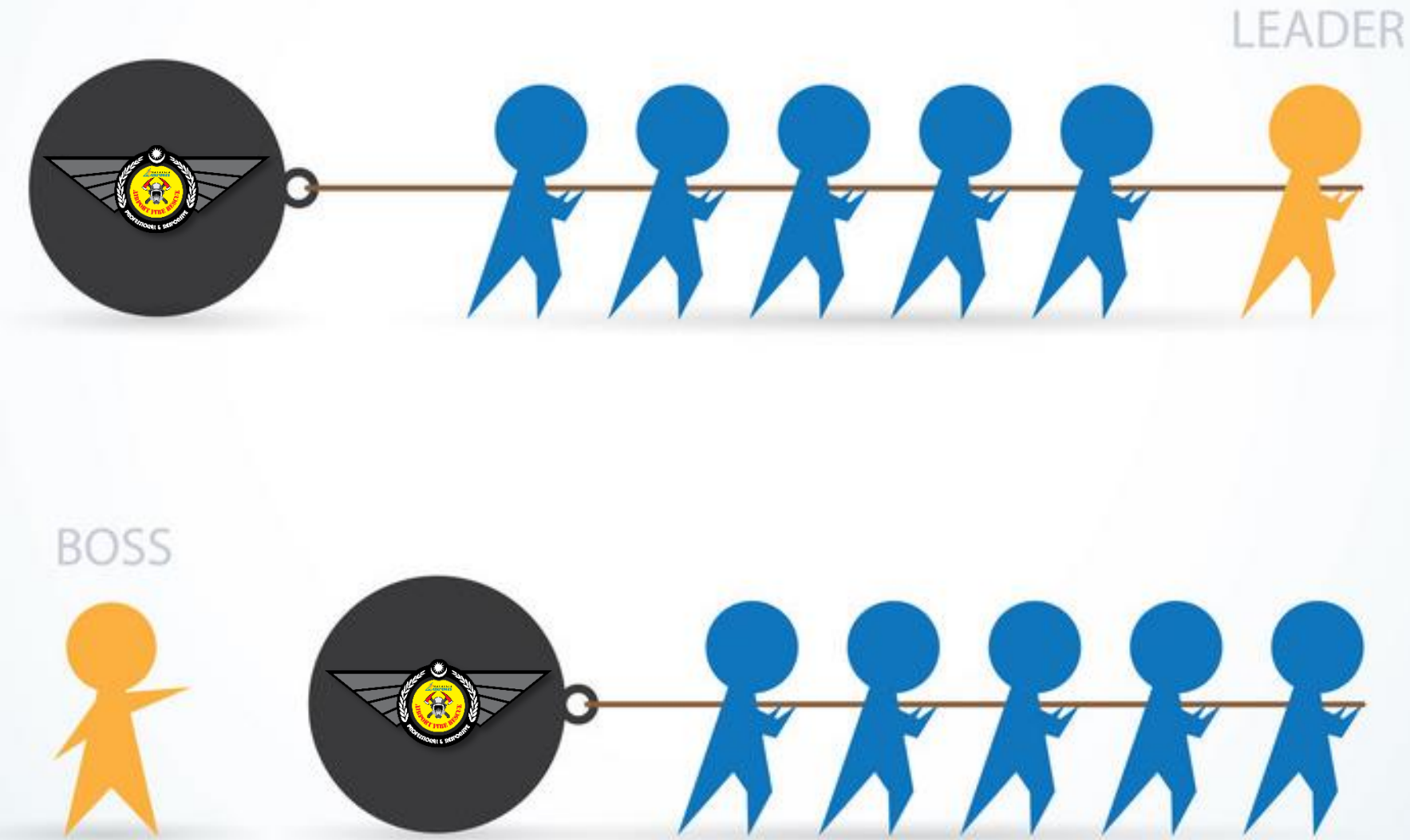
Point No 3

- Robust leadership training programme should be instituted to better prepare RFF leaders.

Point No 4

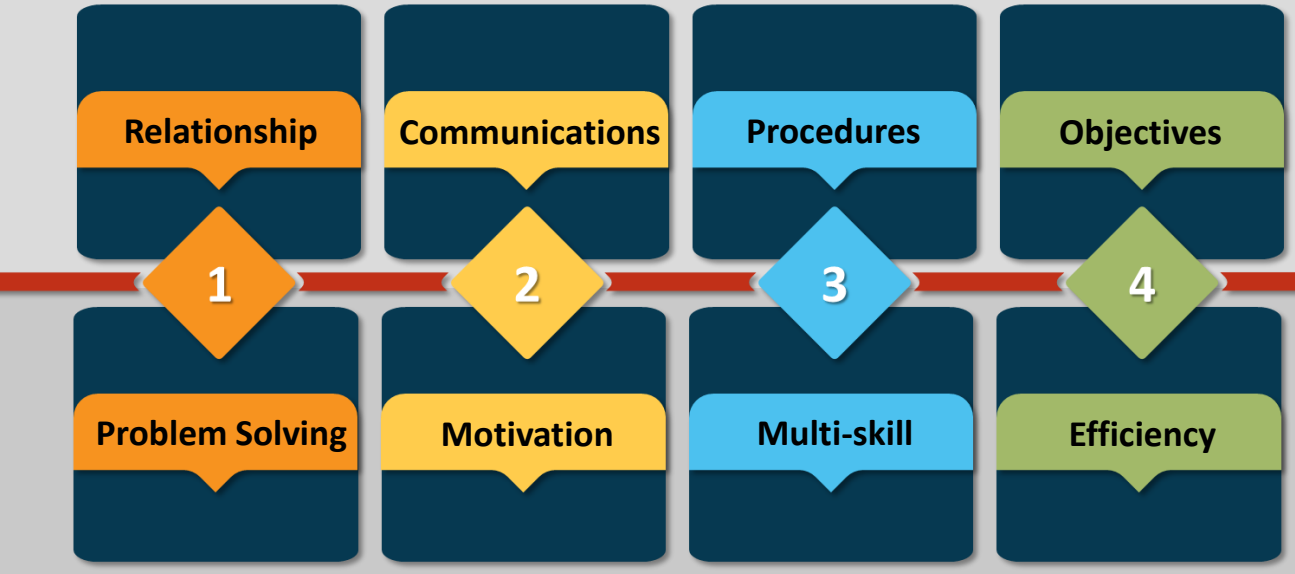
- Human performance training based on SHEL Model

LEADERSHIP



TEAM COORDINATION

THE FUNDAMENTALS OF TEAMWORK



THE BENEFITS OF TEAMWORK

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PSYCHOLOGICAL WELL BEING

01

Disaster Victims

02

Next of Kins

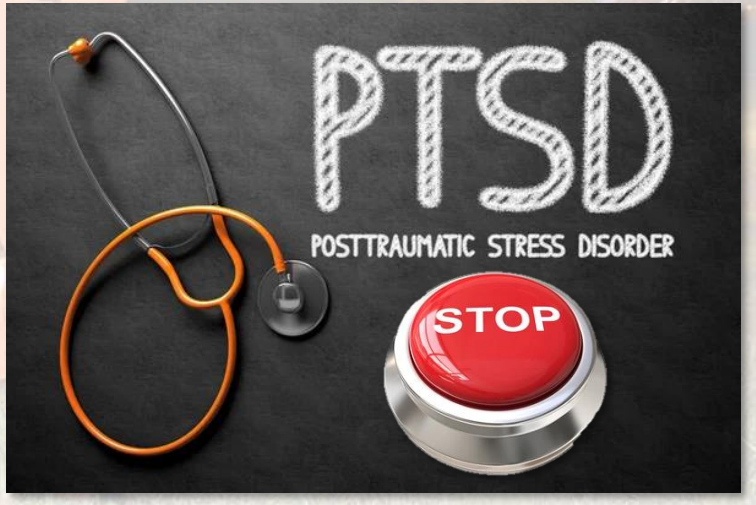
03

Emergency Responders

Psychological First Aid (PFA) is an evidence based modular approach to assist community in the immediate aftermath of disaster or crisis events.

Welfare

Business Continuity



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CONCLUSION

"In flying I have learned that carelessness & overconfidence are usually far more dangerous than deliberately accepted risks" - *Wilbur Wright*

SOFTWARE **HARDWARE** **ENVIRONMENT** **LIVEWARE**


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