THE EXISTING TRAINING ON HUMAN LIMITATIONS IN AVIATION – IS IT USEFUL ENOUGH?

Dr. Elena Cataman

Moldavian Society of Aviation Medicine

Discussion on

- Training for the aviation personnel related to human performance (requirements)
- Current situation of pilot's training in the aspects of aviation medicine, related to flight safety
- What effectiveness of this training is, its output with regards to flight safety

History

- The recognition of human's deficiencies was tragically emphasized by the investigation of a number of accidents
- Pilot error was reconsidered in the cause of accident and research on human factor was established
- End of 70s – the development of aviation CRM courses and training began.

Training as requirement
ICAO

- Since the inclusion of Amendment 159 of Annex 1 to the Chicago Convention, which came into force on 16 th Nov, 1989, ICAO has made the study of Human Factors mandatory part of obtaining a professional pilot's licence,
- for flight and cabin crew members' training programmes – Annex 6 (1995) &
- in process of accident investigation – Annex 13 (1994)

Training as requirement

ICAO

For

— *Flight crew of all types of commercial and private pilot licence,*

— *flight navigator;*

— *flight engineer;*

— *cabin crew members.*

Other personnel

— *aircraft maintenance (technician/engineer/ mechanic);*

— *air traffic controller;*

— *flight operations officer/flight dispatcher;*

— *aeronautical station operator.*

ICAO Annex 1 Ch. 2-4

Annex 6, P. I, Ch. 12

Training as requirement
ICAO

ON human performance* including principles of threat and error management;

Note.— Guidance material to design training programmes on human performance, including threat and error management, can be found in the Human Factors Training Manual *(Doc 9683).*

** relevant to each type of licence*

ICAO Annex I Ch. 2-4

Training as requirement
JAA

Course on Human Performance & Limitations for obtaining:

PPL	*at discretion of the Authority*
CPL	*15 hours*
ATPL	*50 hours*

JAR FCL 1

Training as requirement

JAA

Human Factors in aviation

Becoming a competent pilot

Accident statistics

Flight safety concepts

Safety culture

Basics of flight physiology

Respiratory and circulatory systems

Hypertension and Hypotension

Coronary artery disease

Hypoxia, Hyperventilation

Decompression Sickness/Illness

Acceleration

Carbon Monoxide

High altitude environment

Ozone, Radiation, Humidity, Extreme Temperatures

Man and Environment: the sensory system

Central, peripheral and autonomic nervous systems

Vision

Functional anatomy

Visual foveal and peripheral vision

Binocular and monocular vision

Defective vision

Hearing

Descriptive and functional anatomy

Hearing loss

Equilibrium

Functional Anatomy

Motion sickness

Integration of sensory inputs

Training as requirement

JAA

Health and hygiene

Personal hygiene

Body rythm and sleep

Problem areas for pilots

Common Minor Ailments

Entrapped gases and barotrauma

Gastro-intestinal upsets

Obesity

Back Pain

Food Hygiene

Tropical climates

Infectious diseases

Intoxication

Tobacco

Caffeine, Alcohol, Drugs and self-medication

Toxic materials

Incapacitation in flight

BASIC AVIATION PSYCHOLOGY

Human information processing

Attention and vigilance

Perception

Memory

Response selection

Learning principles and techniques

Motivation

Human error and reliability

Reliability of human behaviour

Mental models and situation awareness

Theory and model of human error

Error generation

Decision making

Decision-making concepts

Training as requirement

JAA

Avoiding and managing errors: cockpit management

Safety awareness

Co-ordination (multi-crew concepts)

Co-operation

Communication

Human behaviour

Personality, attitude and behaviour

Individual differences in personality and motivation

Self-concept

Self-discipline

Identification of hazardous attitudes (error proneness)

Human overload and underload

Arousal

Stress

Fatigue and stress management

Advanced cockpit automation

Advantages and disadvantages

Automation complacency

Working concepts

Abstracts from syllabus

Respiratory and circulatory systems

List the main components of the respiratory system and their function

Identify the different volumes of air in the lungs and state the normal respiratory rate

State how oxygen and carbon dioxide are transported throughout the body

Explain the process by which oxygen is transferred to the tissues and carbon dioxide is eliminated from the body and the oxygen requirement of tissues

Explain the role of carbon dioxide in the control and regulation of respiration

Describe the basic processes of external respiration and internal respiration

List the factors determining pulse rate

Name the major components of the circulatory system and describe their function

State the values for a normal pulse rate and the average cardiac output (heart rate x stroke volume) of an adult at rest

Name the four chambers of the heart and state the function of the individual chambers

Differentiate between arteries, veins, and capillaries in their structure and function

State the functions of the coronary arteries and veins

Define 'systolic' and 'diastolic' blood pressure

State the normal blood pressure ranges and units of measurement

State that in an average pilot blood pressure will rise slightly with age as the arteries lose their elasticity

List the main constituents of the blood and describe their functions

Stress the function of haemoglobin in the circulatory system

Define 'anaemia' and state its common causesIndicate the effect of increasing altitude on haemoglobin oxygen saturation

Coronary artery disease

Differentiate between 'angina' and 'heart attack'

Explain the major risk factors for coronary disease.

State the role played by physical exercise in reducing the chances of developing coronary disease

Abstracts from syllabus

Body rythm and sleep

Name some internal body rhythms and their relevance to sleep

Explain the term 'circadian rhythm'.

State the approximate duration of a 'free-running' rhythm

Explain the significance '*the internal clock*' in regulating the normal circadian rhythm

State the effect of the circadian rhythm of body temperature on an individual's performance standard and the effect on an individual's sleep patterns

List and describe the stages of a sleep cycle

Differentiate between REM and non-REM sleep

Explain the function of sleep and describe the effects of insufficient sleep on performance

Explain the simple calculations for the sleep/wake credit/debit situation

Explain how sleep debt can become cumulative

State the time formula for the adjustment of body rhythms to the new local time scale after crossing time zones

State the problems caused by circadian disrhythmia (jet-lag) on an individual's performance and sleep

Differentiate between the effects of westbound and eastbound travel

Explain the interactive effects of circadian rhythm and vigilance on a pilot's performance during flight as the duty-day elapses

Describe the main effects of lack of sleep on an individual's performance

List possible coping strategies for jet-lag

Abstracts from syllabus

Problem areas for pilots

Common Minor Ailments

State the role of the Eustachian tube in equalizing pressure between the middle ear and the environment

State that the in-flight environment may increase the severity of symptoms which may be minor while on the ground

List the negative effects of suffering from colds or flu on flight operations especially with regard to the middle ear, the sinuses, and the teeth

Indicate the effects of colds or flu on the ability to equalize pressure between the middle ear and the environment

State when a pilot should seek medical advice from an AME, and when the Aeromedical Section of an authority should be informed.

Describe the measures to prevent and/or clear problems due to pressure changes during flight

Flight safety concepts

…

Explain how the interaction between individual crew members can affect flight safety

Identify and explain the interaction between flight crew and management as a factor in flight safety

- How the training improves the flight safety?
- What may prevent aviation personnel from using these knowledge?

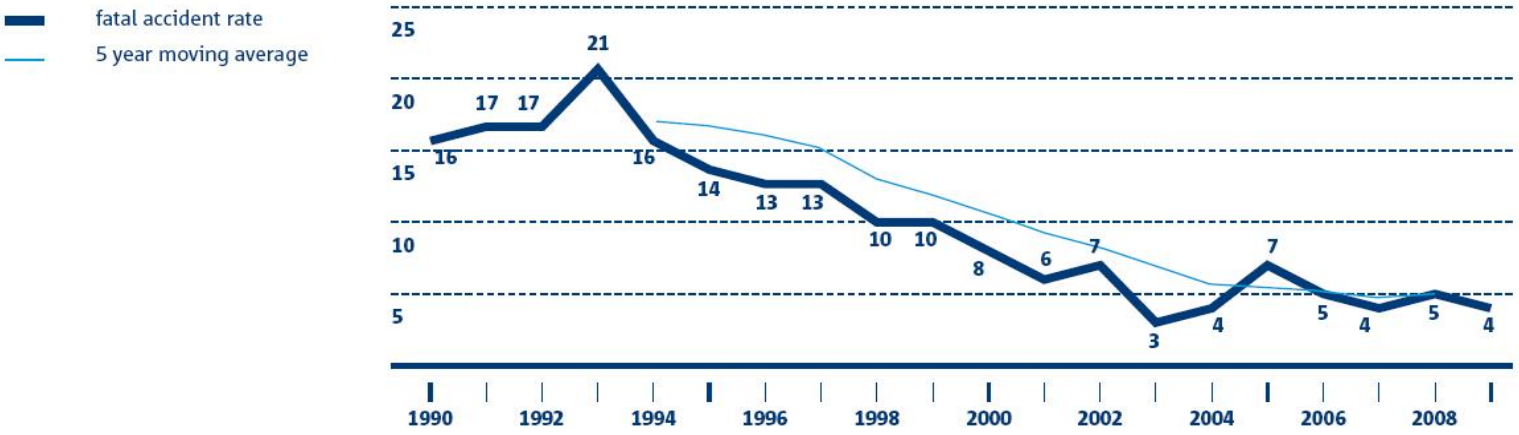
Guideline for analysis

- Statistical data of accidents where human factors are involved
- The confidential reporting system from pilots – that is not in worldwide practice (Australia – CAIR, Canada – SECURITAS, UK – CHIRP, United States – ASRS Office)

EASA Annual Safety Report 2009

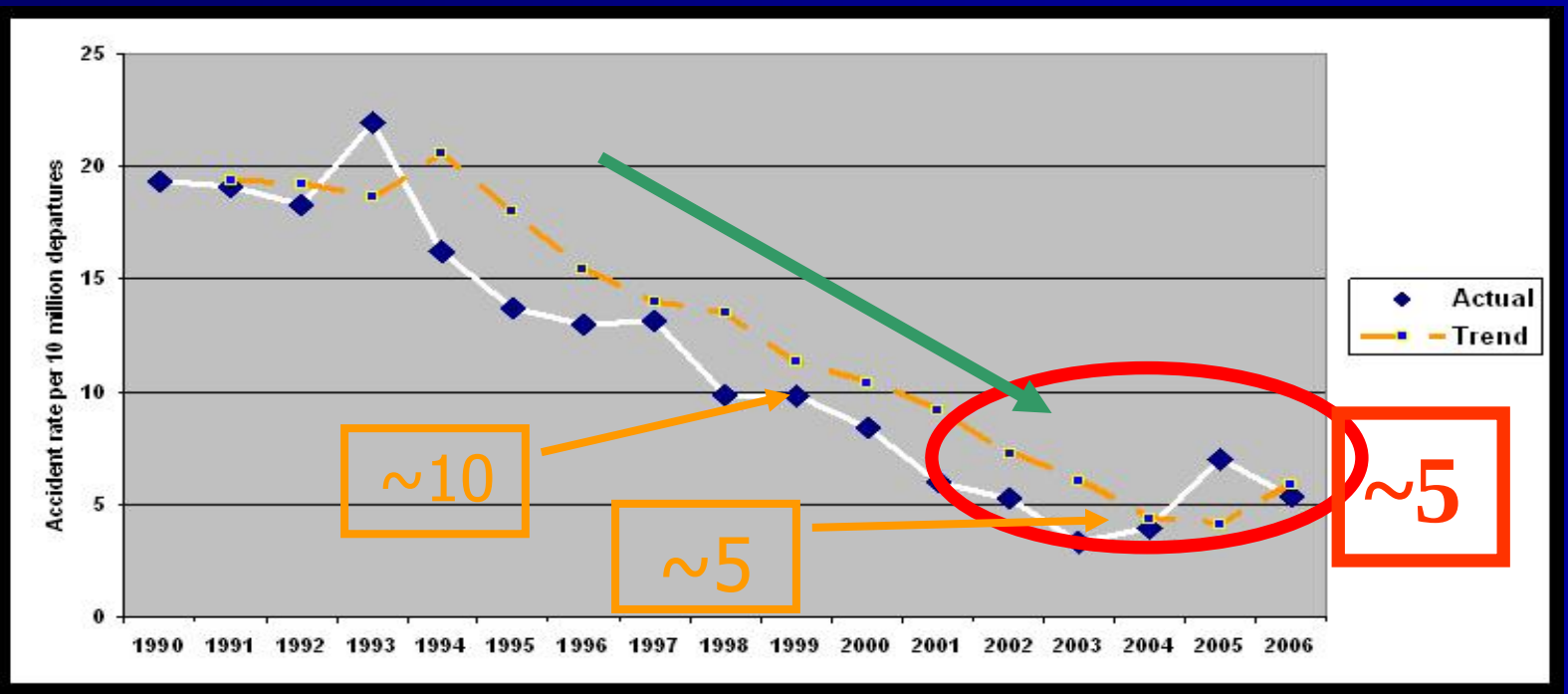
FIGURE 2-2

GLOBAL RATE OF ACCIDENTS INVOLVING PASSENGER FATALITIES PER 10 MILLION FLIGHTS, SCHEDULED COMMERCIAL AIR TRANSPORT OPERATIONS, EXCLUDING ACTS OF UNLAWFUL INTERFERENCE



Note: [2]This number was revised from the initial estimate of 4 to 5 based on the drop in traffic in 2008.

ICAO Accident/Incident Data Reporting system



Accident categories acronyms

EASA Annual Safety Report

		Human factor's related probability
ARC	Abnormal runway contact	√
AMAN	Abrupt manoeuvre	√
ADRM	Aerodrome	
ATM/CNS	Air Traffic Management / Communication Navigation Surveillance	√
BIRD	Collision / near Collision with bird(s)	
CABIN	Cabin safety events	√
CFIT	Controlled flight into or toward terrain	√
EVAC	Evacuation	√
F-NI	Fire / smoke (non-impact)	√
F-POST	Fire / smoke (post-impact)	
FUEL	Fuel related	√
GCOL	Ground collision	√
RAMP	Ground handling	√
ICE	Icing	√

Accident categories acronyms

EASA Annual Safety Report

LOC-G	Loss of control — Ground	√
LOC-I	Loss of control — In-flight	√
LALT	Low altitude operations	√
MAC	Airprox / TCAS alert / loss of separation / near midair collisions / midair collision	√
OTHR	Other	
RE	Runway excursion	√
RI-A	Runway incursion — Animal	√
RI-VAP	Runway incursion — Vehicle, aircraft or person	√
SEC	Security related	√
SCF-NP	System / component failure or malfunction (non-powerplant)	√
SCF-PP	System / component failure or malfunction (powerplant)	√
TURB	Turbulence encounter	
USOS	Undershoot / overshoot	√
UNK	Unknown or undetermined	
WSTRW	Windshear or thunderstorm	√

Human Factor Terminology

- Absence of a standard vocabulary for Human Factors in aviation accidents or a standard taxonomy for human error causation
- No single set of key words to find common Human Factor causes across all data bases

ICAO Doc 9683-AN/950

Statistical analysis

- ≈ 79% of the listed accident categories might be correlated with Human Factors causes
- Human Factor makes 60-80% of all the causes for fatal accidents (different authors)
- Each investigation report contains the details on all the factors that contributed to the accident

Fatigue

- "Fatigue (sleepiness, tiredness) is the largest identifiable and preventable cause of accidents in transport operations (between 15 and 20% of all accidents), surpassing that of alcohol or drug related incidents in all modes of transportation. Official statistics often underestimate this contribution".

Dr T. Åkerstedt, Stockholm

Case 1

Cargo An 32 of «KATA Air Transport Co. Ltd», Sudan, collided with metallic construction of beacon VOR DME in Chisinau airport 11 Apr. 2008 as a consequence of several errors of the flight crew.

The last contributing factor listed in the report – **possible fatigue and stress** due to several delays of flight (hours waiting in the airport without adequate conditions for rest) and the transponder failure that obliged crew to return to the airport of departure.

8 fatalities

Fatigue

- Fatigue mitigation in aviation is a joint responsibility between the operator and the pilot,
- Contemporary pilot has even scientific knowledge of fatigue and how it results in impaired standards of operation with increased likeliness of error
- **What do operator (managers) and regulator know about fatigue???**

FTL

- Convention 47 (**Forty-Hour Week Convention**, 1935, coming into force 1957).
- "- Considering that it is desirable that workers should as far as practicable be enabled to share in the benefits of the rapid technical progress which is a characteristic of modern industry; and

  - Considering that in pursuance of the Resolutions adopted by the Eighteenth and Nineteenth Sessions of the International Labour Conference it is necessary that a continuous effort should be made to reduce hours of work in all forms of employment to such extent as is possible"
- Legislation on FTL is not base on the From July 2008 Having regard to Council Regulation (EEC) No 3922/91 on the harmonisation of technical requirements and administrative procedures in the field of civil aviation European Commission has adopted EU OPS where in SUBPART Q – FTL and rest requirements were officially established the **60 hour duty period for a week**

Case 2

- 12 February, 2009 Bombardier DHC-8-400, "Colgan Air" crashed while on approach to the Buffalo/Niagara International Airport.
- 49+1 fatalities
- NTSB: probable cause of this accident was the captain's inappropriate response to the activation of the stick shaker, which led to an aerodynamic stall from which the airplane did not recover.
- Series of flight crew errors

  "…significant breakdown in their (both pilots) monitoring responsibilities and workload management."

Case 2 (cont.)

- "…actions were inconsistent with … procedures and training"
- "… performance …was not consistent with the crew resource management (CRM) training…"
- "The pilots' **performance was likely impaired because of fatigue**, but the extent of their impairment and the degree to which it contributed to the **performance deficiencies** that occurred during the flight **cannot be conclusively determined.**"
- "The first officer's **illness symptoms did not likely affect** her **performance** directly during the flight."

Case 2 (cont.)

"Operators have a responsibility to identify risks associated with commuting, implement strategies to mitigate these (fatigue, illness) risks, and ensure that their commuting pilots are fit for duty."

Fatigue and/or minor illness

- In investigation reports fatigue usually is mentioned as a contributing factor after all other reasons

- Do regulators and managers fully understand that fatigue and illness lead to
  - Reduction of alertness,
  - Lack of concentration,
  - Increased reaction time,
  - Impaired memory and other unsafe conditions

Predisposed to errors conditions

Safety culture

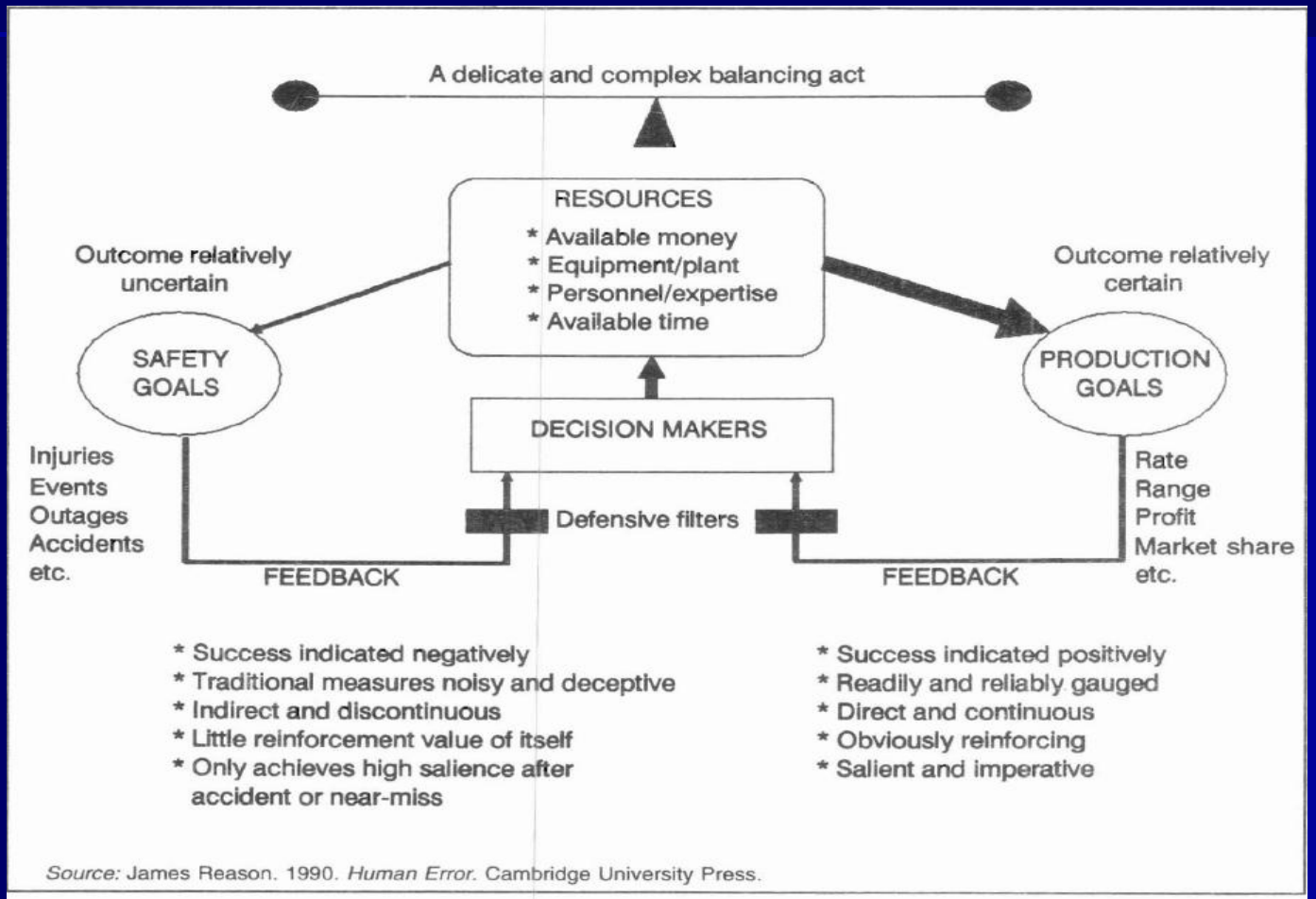


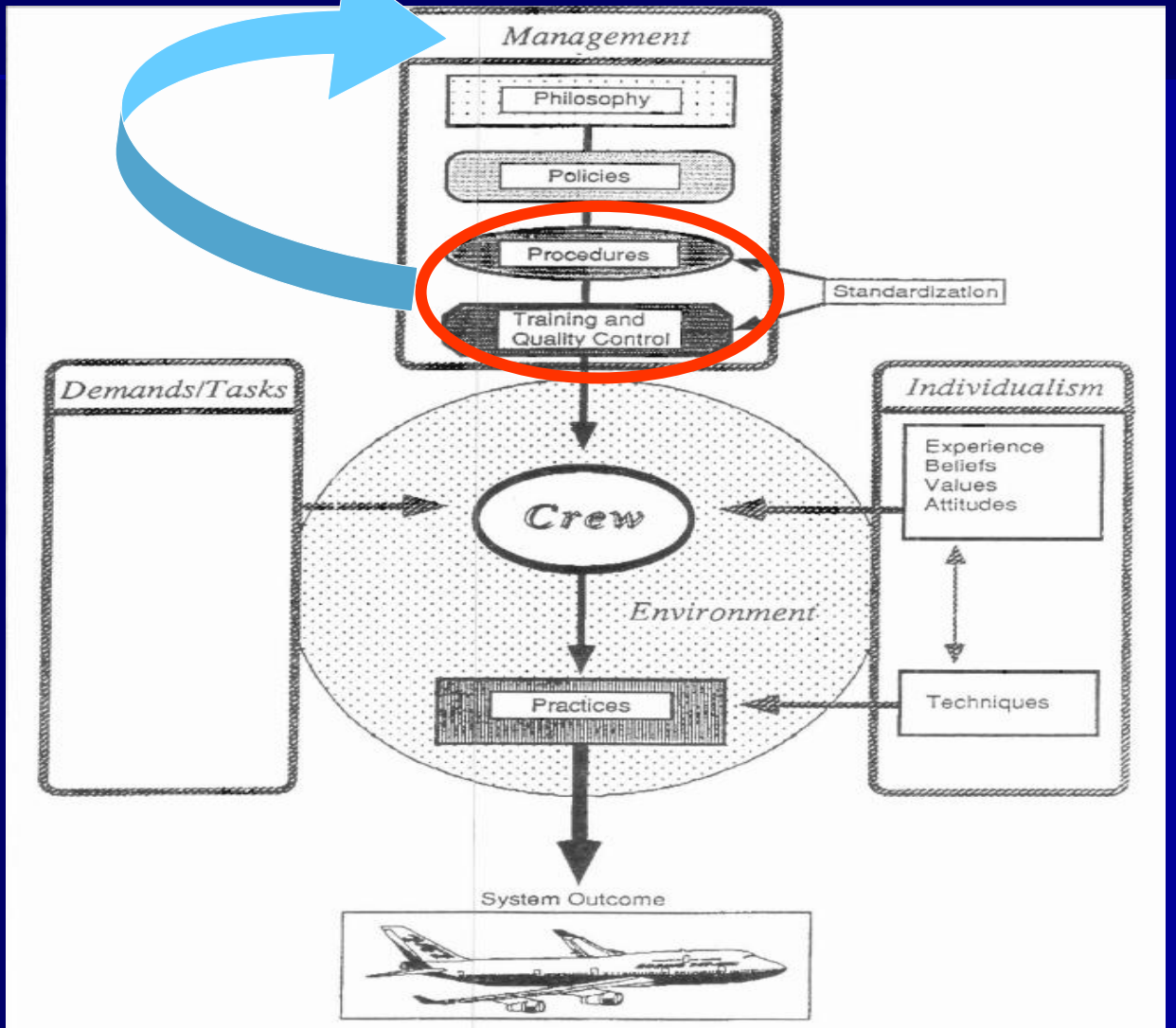
Figure 2-1. A summary of some of the factors that contribute to fallible, high-level decision-making

ICAO Human Factors Manual Doc 9683-AN/950

Safety culture

- Safety could be reached if the balance between safety and production goals is achieved.
- It is possible when the corporate management receive the adequate knowledge on Human factors that will allow to make a safety decision even if no Standard Operational Procedures related to human performance are foreseen

Safety culture



Source: A. Degani and E. Wiener. 1991. "Philosophy, Policies, Procedures and Practices: The Four P's of Flight Deck Operations". Proceedings of the Sixth International Symposium on Aviation Psychology, Columbus, Ohio, USA.

ICAO Human Factors Manual Doc 9683-AN/950

Pilots independency to follow the knowledge of training

- Refuse to accomplish duties due to “minor” health problems
- To interrupt the flight operation if Duty or Flight time exceed the limits and such decision results in extra expenses for the company (mostly difficult in small Operators)
- The absence in many companies of scheduling the “stand-by” crews to replace crew members in cases including health problems

Conclusion

- Big achievements have been made in studying of Human performance and limitations in aviation
- application of this studies in practice by giving knowledge to operational personnel in aviation definitely improves flight safety

Conclusion

- All levels in aviation management should be well aware of the health issues and risks caused by fatigue in order to secure the flight safety
- That could lead to mutual understanding of the human limitations by those who create the rules, manage and operate in aviation.
- This also will ensure the appropriate conditions for the effective use of knowledge in human factor.
- The standard terminology for human related causation of incidents and accidents can significantly help for further improvement of the training.

Thank you for attention!