

SHELL model

Software (checklist, manuals, ops., rules)

Hardware (the aircraft)



Liveware (human-like taking up ATC, mechanics, ...)

Environment (meteo, uncomfortable environment, ...)

SARPs: standard and recommended practices (published by ICAO)

Swiss model

The gaps (holes) are created by:
active failures: made by human-system interface
latent conditions: arising from the failure of designers, builders, managers to anticipate all possible scenarios.

Safety culture consists of:

- Informal culture: safety related data collected and analyzed & info spread (for safety)
- reporting culture: environment where people are confident enough to report
- learning culture: organization is able to learn from mistakes.
- just culture: unintentional acts not punished, intentional punished
- flexible culture: flexible to adapt to new changes
- open culture: team work (general aviation)

Safety Management System (SMS):

(yearly) SMS: → Safety policy → safety risk management → safety assurance
Threat and error management (TEM): environmental threat/organizational

Detect errors and respond to reduce consequence (latent threat)

threats something out of control or beyond the pilots

Error is the action or inaction

Undesired outcome

Gas laws:

Boyle's law = Barotrauma (gas) . pressure increase volume decrease

Charles's law: (calculus T/Volume) temperature increase volume increase

Dalton's law: (death/hypoxia)

Ficks law: (gas) gas will go from high concentration to low concentration

General gas law: Boyle + Charles'

Bernoulli law: (flow) Decompression sickness: nitrogen bubbles will form and expand

Radiation

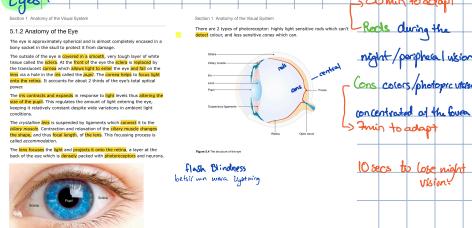
galactic radiation: fairly steady

Solar radiation: occurs during sun storms / high solar activity

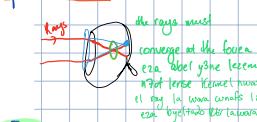
we are protected by the magnetic field and atmosphere (less effective)
amount of radiation 4 Mrad flight at 35000 ft = chest x-ray

Eyes:

Section 5.2 Anatomy of the Visual System



parallax illusion: head movements cause illusion to see distant objects moving



Ears:

Range between 20 Hz to 20000 Hz

ossicles: made of malleus, incus, stapes (3 bones, middle ear)

cochlea: inner ear is a narrowed filled fluid tube

ear drums junction b/w outer and middle ear

eustachian tube equalizing the pressure: middle to the outer ear

presbycusis: hearing loss due to age

noise induced hearing loss (NIHL): depends on frequency duration and sound energy.

conductive hearing loss: failure of the sound conducting element of middle

Breathing

lung capacity: (approx. 5 liters) vital capacity: difference b/w max inhale and max exhale total lung capacity: residual capacity + volume of the remaining tidal volume (at rest): 0.5 liters

red blood cells: oxygen blood plasma: CO₂

carbon monoxide binds with hemoglobin 200 times more efficient than O₂

arteries: oxygen blood from heart to tissues

pulmonary artery: CO₂ from heart to lungs

veins: CO₂ blood from tissues to the heart

pulmonary veins: oxygen from the lung to the heart

BP: 92 BPM pumping 5 L/min Stroke volume x heart rate daSt: (10/80)

anemia: low hemoglobin (Hb)

hypoxia: lack of oxygen (Satur. blood - oxygen)

oxygen pressure: 10.8000 psi 14.7000 vs 30000 psi

Reaction threshold (7000 ft) Disturbance threshold (10,000 ft)

affected: color vision + night vision impaired judgement, memory, + more BP to give more oxygen (light)

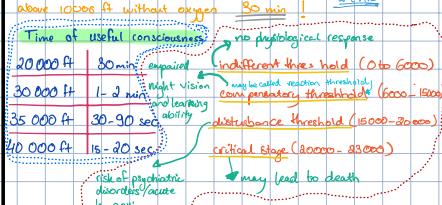
at 10000 ft: dizziness, euphoria, fatigue

at 12000 ft: dizziness, euphoria, fatigue

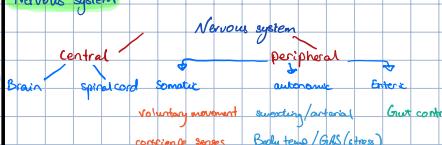
Critical threshold (20000 ft)

high confusion, total loss of consciousness, complete incapacitation/death above 33700 ft should supply 100% oxygen after blood clamping

above 10000 ft without oxygen 30 min !



Nervous system



Illusions

autokinetic illusion: where stationary lights tend to appear moving

black hole effect: features (no visual cues) think we are accelerating

somatospatial illusions: pitch sensed as acceleration

the lenses (somatospatial illusion): bus not sensed 3rd turn currenta nifura wings level run less ero 3am nroid zydeco

saccade: hige lama netek3 3a shi w n8ayer nazarna

bi anal kam milli tonya me netishout shi los n8ayer nazarna

empty field synapsi los 1 ben traker 3m machi fa bettawke

3a the water wo 2.

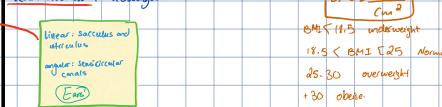
at night (a mirake 3a shi lezen netek3 3le 10°-15° (scan)

coriolis effect: lame manikun rama bi abet turn

Coronary

angina: mt1 dabta y3ne meaker jeezayyan

heart attack: kouligan



Anaemic hypoxia

lack of oxygen carrying capacity may be caused by blood loss

Histotoxic hypoxia:

occurs at a cellular level (the cell is unable to use oxygen)

Decompression sicknesses (Henry's law)

Symptoms: air bubbles of nitrogen form gives us the symptoms

- Bands: pain in the joints
- Creeps: itching skin
- Paralysis: paralysis of limbs
- Choke: (chest) coughing

after a rapid decompression go to the doctor even if there are no symptoms

Effects of accelerations:

- Linear acceleration
- Radial acceleration: turns
- Angular acceleration: change rate of rotation.

positive G's (Gx)

lack of blood in head (blood to the feet) ⇒ "graying out" (loss of vision, ultimately "blackout" and unconsciousness)

Negative G's (-Gx)

tall people more susceptible than short, blood to the head ⇒ more facial pain ⇒ "red out" of vision

countermeasures:

- planning countermeasures: managing anticipated and unexpected threats
- Execution countermeasures: error detection and error response
- Review countermeasures: managing the changing conditions of a flight.

Diseases:

Malaria: by female anopheline mosquito hepatitis: inflammation of liver tissue

Dengue fever: by Aedes aegypti hep A: by eating food with human

polio: from person to person hep B: sexually transmitted

typhoid: bacteria from food hep C: exposure to infected persons blood cholera: drinking dirty water type 1 diabetes: artificially produced; trouble from

thiamine: through wounds type 2 diabetes: type 2 diabetes

anesthesia: X-ray 12h local 48h general

Sleep

circadian rhythm: is about 25 hrs / but slowed down to 8 hrs

sleep credits: while sleeping: metabolic rate ↓ blood press. ↓ pulse ↑ 1 hr of sleep = 1 credit the awake = 1 credit

Stages of sleep:

orthodox sleep: physical recovery and deep sleep (from stage 1-4)

paradoxical sleep (REM) the brain have the same activity as you're awake

last from 90 to 120 min. refreshes the brain and memory. prolonged night frequent interruption are harmful. 4 to 5 REM cycle/night

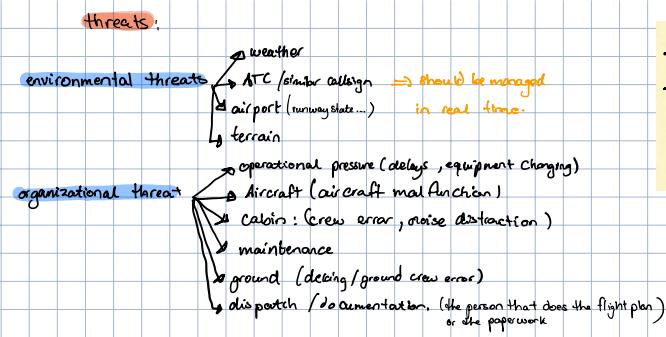
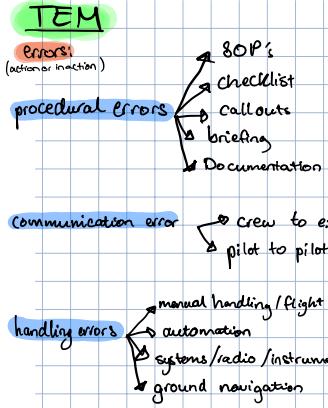
8 hrs sleep ⇒ 4-5 cycles 8 hrs = 5 cycles cycle = 8 stages 30min cycle

NAP: 20 min is the best

jet lag: circadian system is out of synchronization going EAT is worst when going west: going against the sun is always wrong

recovery westbound: 1 day per 1.5 hrs change / eastbound: 1 day per this change

stop over less than 24 hrs: keep home time travel kit is standard as usual



(hard system-based) (soft system-based)
 hard resources = system design (tech, skills)
 process re-position (proc)
 soft resources: based on actions/attitudes of the crew

Countermeasures:

planning countermeasures
 essential for managing anticipated and unexpected threats

- SOP's briefing
- plans stated
- work load assignment
- contingency management

after snorkeling: no limit
 after scuba-diving: 24 hrs
 after alcohol: 8 hrs.

Execution countermeasures
 essential for error detection and error response

- monitor and crosscheck
- workload management
- automation management

Lapses: pilot is distracted and doesn't complete a task while doing it.
 slips: when the intended appropriate action is carried out incorrectly
 (pilot did not do what he intended to do)

Review Countermeasures
 essential for managing and changing the flight condition

- evaluation and modification of plans
- inquiry
- assertiveness

Blinded concentration: focusing on one specific thing only and assuming that every other thing is working or maintained as planned. (situational awareness lost)

systemic - countermeasures

- ACAS/TCAS
- ground proximity warning sys (GPWS)
- SOP's
- TEM training / CRM training.
- Briefing / checklist

info processing system

- under-arousal = hypovigilance: if we are fatigued
- over-arousal = hypervigilance take a nap at 30 min
- cocktail-party effect: γ one fatty low fi ktr Take wedge
has masalan γ Baytaura 3rd frequency de8re mnenetekh
divided: multiple attention processing
- Attention: selective: one source at a time / after: γ distance

Coping with many tasks

- the primary task even we can manage it easily we will have more brain capacity for the 2nd task
- ex at primary task masalan maintain altit and heading.

Perception:

- awareness / understanding sensory info / resistant to correction
- as incorrect perception is highly persuasive
- 70% from the info comes from the eyes
- the brain gonna use previous knowledge to interpret info received by the senses
- what we perceive may or may not correspond with reality.

Bottomup / top-down processing

Bottom up: sensory info (first input)

- Top down: will implement experience and expectation mental model will be influenced by what we expect to hear/see

Memory, learning, Skills

- chunking: breaking down big info to small info to remember it. info is lost from working memory if we perform any other task
- Rehearsal: repeating the same during many times.

Long term memory: it is affected by expectations/suggestions.

- contains the skills (motor programmers)
- it has unlimited info (but the hard part is remembering to bring it back)
- episodic: events / experiences / suggestions (emotional)
- Semantic: words / nbs / language (general knowledge)
- procedural / motor skills: routine practice repetition (comes out without thinking)

Learning by imitation: installed L'instructor

- Impaired learning happens: lack of motivation, lack of dedication, overthinking
- Motivation level is higher for diff task and lower for an easy task.

Arousal \downarrow for \uparrow diff task Experience & arousal

Skills are learned in 3 stages

- cognitive
- Associative
- Autonomous Comes with repetition (7th min bishal mazra fixa)

Skill-based: motor programs

Rule-based: shared rules

Knowledge-based: using experience to solve new problem

peer pressure \uparrow influence to perform group norms (things individual don't do)

synergy: diff individuals will cooperate for common outcome

group think: too much cohesion gone kek | group bl wldl 3afekha waynakhan
 \hookrightarrow it happen if individuals are too influenced

Risky shift: n3mel estha setra ka group

Errors

slips: when actions don't always go as planned

mistakes: when the plan itself is faulty

lapses: when you forget something

violations: Ban used

errors can happen on skill based / rule based and knowledge based behaviours

latent error: errors that are hidden because they're not visible until certain conditions

Active error: errors where there consequences by bugs defr mat over-rotation bt3me tail strike.

Murphy's law: anything that can go wrong will go wrong



Internal errors

sensing error: error that is there but we can't sense it

perceptual error: interpretation of stimuli that is faulty (not!

upslope runway

Action slips: thinking of doing something bias b3al

Balat masalan wrong false

false-hypothesis: info that contradicts the \downarrow are rejected

External error

ergonomics: how the cockpit is built

economic: maybe pressure by ops on crew for money

social environment: el

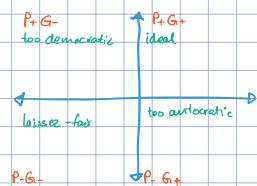
no fit bi jaser 3al errors

non synergistic cockpit

- Autocratic (authoritative) will lame 1 captain impose point dhu captain bnm overloaded
- laissez-faire: lame 1 captain for instance ykloun retya
- self-centered: crew act as individuals.

metacommunication: non verbal come wth gestures, tones (75% of com)

inter-personal conflict: btw crew members
intra-personal conflicts: with thyself.



Personalities

Self concept: what you think you are | ideal self: what you want to be
the smaller the gap between both the best we are

Aggression is often used to compensate underconfidence

Anti-authoritarianism: anti hal klasses which

impulsive:

Sense of invulnerability: "it will never happen to me" tends to reduce awareness

Excessive self-esteem "MACHO" takes unnecessary risks

Resignation: underestimate own capability (low self esteem)

Complacency: confidence + contentment / lead to reduced risk-awareness

when we are stressed: body and mind have 3 phases:

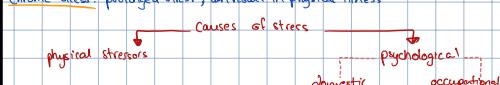
Alarm phase: fight or flight (general adaptation syndrome) body will: \uparrow arousal

Fight or flight + regeneration \uparrow glucose usage + stress resistance.

Resistance: help the body to recover but \uparrow hormones + \uparrow glucose usage we use cortisol and fats \rightarrow sugars.

Exhaustion: body resources are used and sugar levels drop dramatically

Chronic stress: prolonged stress, can result in physical illness



Environmental stress: stress like heat, noise, vibration ...

Stress is cumulative:

Coping with stress:

action coping: take positive action

cognitive coping: reduce psychological stress

symptom-directed coping: involves treating the symptom rather than the cause