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Mental Engineering - A Significant Contribution to Resilience Engineering in Aviation

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Mental Engineering—
A Significant Contribution to Resilience Engineering in Aviation

Dr. Reiner Kemmler/Capt. Max Scheck
OVERVIEW

- Introduction
- (New) Challenges on Modern Flight Decks
- Stress Resilience Management
- Action Regulation
- ME Training Concept
INTRODUCTION

United Airlines 232 - 1989 © NTSB 2009

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Colgan Air 3407 – 2009

Air France 447 – 2009
http://a.abcnews.com/images/International/gty_air_france_crash_tail_ll_120605_me.jpg

Air Asia 8501 – 2014
http://a.abcnews.com/images/International/AP_airasia_plane_1_it_150111_12x5_1600.jpg

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(NEW) CHALLENGES ON MODERN FLIGHT DECKS

- **Increasing Complexity**
  - Increased automation
  - Overall more systems
    - Higher complexity of systems
    - Increased integration and connection of systems
    - More integration of processes and procedures

- **Increasing economic pressure in initial-, recurrent- and further training**
  - New training concepts (e.g. MPL) with less “real” flight experience
  - Increased utilization of synthetic training devices and “virtual” training media
(NEW) CHALLENGES ON MODERN FLIGHT DECKS

- On workload on ground

- On senses:
  - visual – acoustic

- On cognitive functions:
  - Knowledge – Planning – Monitoring – Anticipating – Problem-Solving

- On dealing with potential for complacency

- On Inflight- Workload:
  - Lift-Off – Climb – Cruise – Descent – Final Approach – Go-Around – other special manoeuvres (e.g. GPWS, Windshear)

- On tactile feedback
(NEW) CHALLENGES ON MODERN FLIGHT DECKS

- Loss of manual flying skills
- Pilots overwhelmed in “high-stress” situations

How do we deal with this?
MENTAL ENGINEERING (ME)

ME is a psychological training method focusing on the professional management of high-workload and emergency situations

- The goal of ME is to help the pilot perform in high-stress situations – both
  - “known high-stress situations” (i.e. events that are unexpected, yet have happened before and thus have a clear sequence of response actions)
  - “unknown high-stress situations” (i.e. events that are unexpected and “unknown” and thus have only “generic” response actions)

ME combines **Stress Resilience Management (SRM)** and **Action Regulation through Knowledge Management and Mental Training (MT)**

- Two evidence-based methods that have been widely-used with great success in areas such as sports-science, business and economy
MENTAL ENGINEERING (ME)

ME does not replace actual flight-training, but is rather an effective and efficient tool to significantly augment and improve pilot training, as well as daily flight operations.
STRESS RESILIENCE MANAGEMENT (SRM)

Goal:
Conscious regulation of one’s arousal level

- Breathing techniques

- Relaxation techniques/circulatory cardiac training
  - Progressive muscle relaxation (Jacobson)
  - Autogenic training (Schultz)
  - Yoga
ACTION REGULATION

Goal:

Premeditated, coordinated and controlled performance of action sequences

- Action Regulation encompasses Knowledge Management and Mental Training (MT) by foresighted trial actions

- MT is the intense imagination of an action-sequence without actually performing the action(s) (Kemmler)

- MT is the planned, repeated, systemic, conscious and controlled optimization of imagining ones’ *Eigenstate*, ones’ actions and/or ones’ path, without simultaneous practical execution (Eberspächer)
MENTAL TRAINING - PROCEDURE

1. Establish action(-sequence) and describe

2. Structure action(-sequence)

3. Train before “the inner eye”
   - Internalize
   - Sub-vocalize
   - Imagine the action
   - Sensory experience: see – hear – feel (kinesthetic)

4. Define and mark nodal-points
   - Identify actions (-moments) with the lowest degree of freedom
   - Compare with checklists, QRH, Procedures, AOM, etc.
ME TRAINING CONCEPT

- Ideally, ME is incorporated into all phases/stages of pilot training (initial-, recurrent-, further training)

- ME requires very little “training equipment” per se

- ME does require well-trained instructors
  - Psychologists with an aviation-background
  - Experienced flight-instructors with some training in psychology

- ME does require an “open mind” on part of the students
ME TRAINING CONCEPT

ME Training Timeline

1. Diagnostics
   - Basic Assessment

2. + 3. SRM
   - Basic Exercises

4. SRM
   - Exercises

5. Identification of Personal Trigger

6. Basic MT

7. Advanced MT
   - Nodal Points

8. + 9. Integrated ME
   - Combined SRM & MT

10. Customize Fine tune ME

Weeks
ME is a psychological training method focusing on the professional management of high-workload and emergency situations.

ME combines Stress Resilience Management (SRM) and Action Regulation.

ME is a two-step process:

- Step 1 - Pilots utilize SRM-techniques to regulate their state of body and mind (by self-regulation, relaxation-training and/or circulatory-/cardiac-training), thus bringing themselves into a state in which they are able to move to.

- Step 2 - Action-Regulation – regulating the actions (by Knowledge-Management and Mental Training).
- ME should become an integral of all commercial pilot training

- For the existing pilot-corps, training modules should be offered to familiarize them with the concept

- One such training module has been developed by Dr. Kemmler and the Qualification and Training Committee of the German Airline Pilots’ Association

- After several beta-test runs, the three-day training module will be offered for the first time this fall