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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



US Air 1549 – 2008 © CC BY2.0



Quantas 32 – 2009 Public Domain



Colgan Air 3407 – 2009

<http://sportysnetwork.com/airfacts/wp-content/blogs.dir/13/files/2014/03/colgan-3407.jpg>



Air France 447 – 2009

http://a.abcnews.com/images/International/gty_air_france_crash_tail_1l_120605_me.jpg



Air Asia 8501 – 2014

http://a.abcnews.com/images/International/AP_airasia_plane_1_jt_150111_12x5_1600.jpg

(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

Rise in Demands

- On workload on ground
- On senses:
 - *visual – acoustic*
- On cognitive functions:
 - *Knowledge – Planning - Monitoring – Anticipating – Problem-Solving*
- On dealing with potential for complacency

Reduction in Demands

- 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

- 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

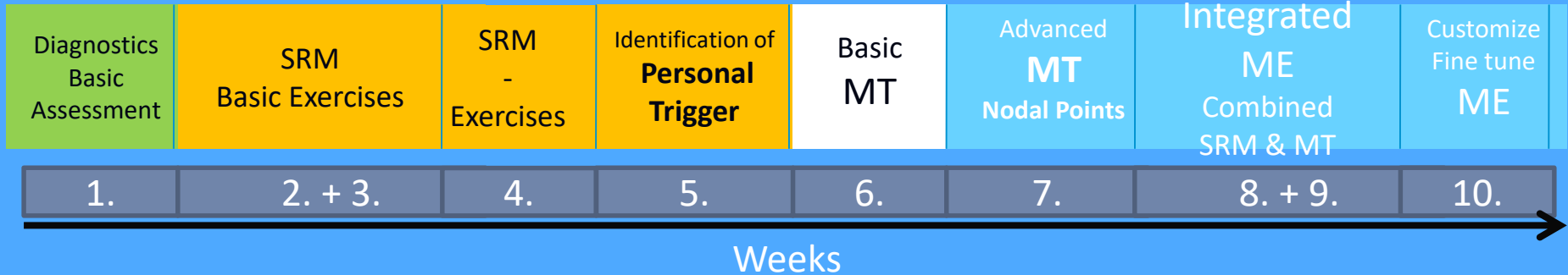
- 1. Establish action(-sequence) and describe**
- 2. Structure action(-sequence)**
- 3. Train before “the inner eye”**
 - Internalize**
 - Sub-vocalize**
 - Imagine the action**
 - Sensory experience: see – hear – feel (kinesthetic)**
- 4. Define and mark nodal-points**
 - Identify actions (-moments) 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



SUMMARY

- **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)**

OUTLOOK

- **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**