

Human factor analysis based on real world examples: How can human factors be identified and analyzed?

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2 Steps in Accident Investigation

1. Event recording:

Objective, neutral description of facts

- **WHAT** happend?
- Under **WHICH** circumstances?

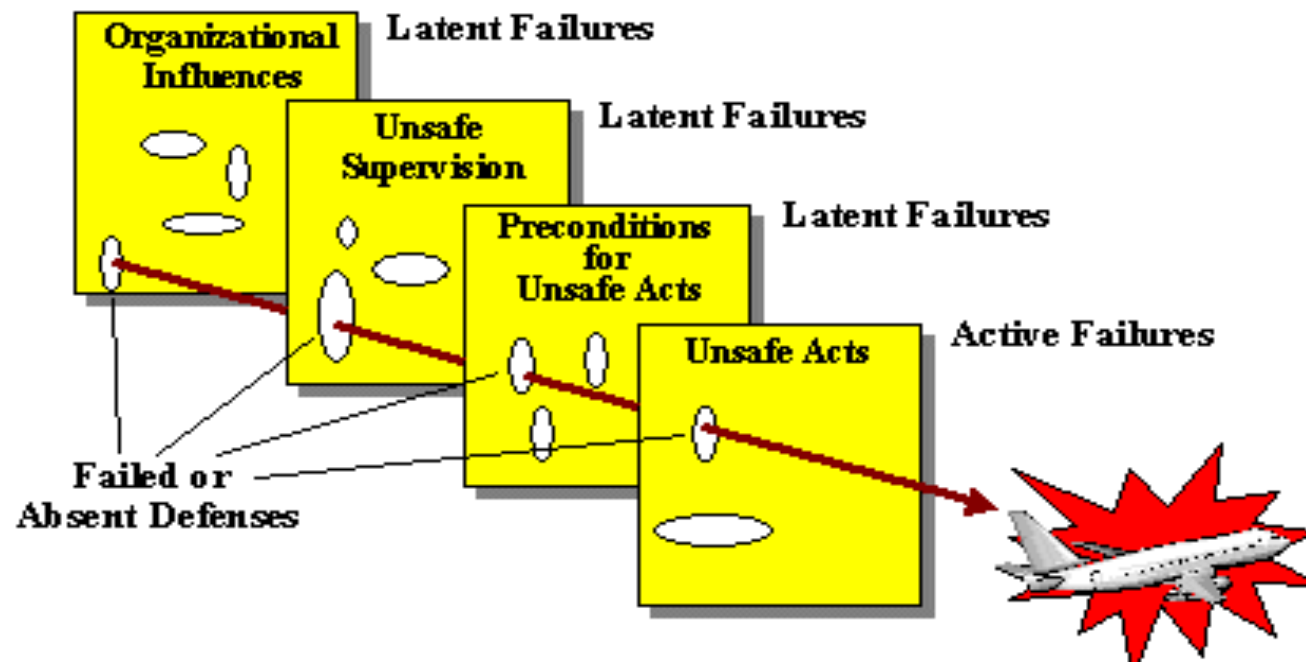


2. Root cause analysis:

Analysis and interpretaion of facts

- **WHY** did it happen?
- Search for **connections** and **interdependences** in the **system**
- Focus on actor according to „**local reality principle**“

The „Swiss Cheese Model“ (Reason, 1990)



Human Factors Analysis and Classification System (HFACS)

(Wiegemann & Shappell, 2003)

- Commonly used investigation methodology based on “Swiss cheese model”
- 4 subcategories
 - Organizational Factors
 - Unsafe Supervision
 - Preconditions for Unsafe Acts
 - Unsafe Acts by Operator

HFACS Category: Organizational Factors

- Resource management
 - Human Resources
 - Budget Resources
 - Equipment Resources
- Organizational process
 - Operations
 - Procedure
 - Oversight
- Organizational climate
 - Structure
 - Policies
 - Culture

HFACS category

Unsafe Supervision

- Inadequate supervision
- Planned inappropriate operations
- Failed to correct a known problem
- Supervisory violation

HFACS Category

Preconditions for Unsafe Acts

- Conditions of operators
 - Adverse mental states
 - Adverse physiological states
- Personnel factors
 - Crew resource management
 - Personal readiness
- Environmental factors
 - Physical environment
 - Technological environment
 - others

HFACS Category: Unsafe Acts by Operator

- Errors
 - Skill-based errors
 - Decision errors
 - Perceptual errors
- Violations
 - Routine
 - Exceptional

Case: Airprox SWR 1326 & SWR 202W in ZRH

On 15 March 2011 at 11:41:15 UTC, the Swiss International Airlines Airbus A320-214 aircraft, with the ATC callsign SWR 1326, received clearance to taxi to the take-off position on runway 16. While taxiing to the take-off position, the air traffic control officer (ATCO) of aerodrome control (ADC), cleared SWR 1326 for take-off at 11:42:19 UTC. The crew of SWR 1326 acknowledged this clearance and initiated their take-off roll at 11:43:12 UTC. At 11:43:05 UTC the Swiss International Airlines Airbus A320-214 aircraft, with the ATC callsign SWR 202W, which was waiting in the take-off position on runway 28, received clearance for take-off. The crew acknowledged this clearance and immediately initiated their take-off Roll. During the take-off roll, at 11:43:47 UTC, the crew of SWR 202W noticed SWR 1326, which was converging from the right on runway 16, and immediately initiated an aborted take-off. At approximately the same time, the ADC air traffic control officer gave the crew of SWR 202W the order to immediately abort their take-off. The speed of SWR 202W at this time was 135 kt. The aircraft came to a standstill in the safety area of runway 16 and then taxied to the assigned stand. The crew of SWR 1326 had not noticed the serious incident and continued their flight to their destination. (Final Report no. 2136 of the SAIB)

Excercise in Groups

- In your group, skim read through the SAIB accident report by focusing on the given subcategory:
 - 1) Organizational Factors
 - 2) Unsafe Supervision
 - 3) Precursors to unsafe acts
 - 4) Unsafe acts by the operator)
- Extract the relevant information to answer the questions within your subcategory and design your group's piece of the puzzle needed for the root cause analysis (RCA)
- Present your findings and discuss with the other groups to complete RCA

Take home message:

“Finding the *bad apple* does not prevent future accidents – understanding why the apple went bad does”



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HUMAN FACTORS ANALYSIS AND CLASSIFICATION SYSTEM (HFACS)

Organisationale Einflüsse:

RESCOURCEN MANAGEMENT
Human Resources
Selection
Staffing/manning
Training
Background checks
Monetary/Budget Resources
Excessive cost cutting
Lack of funding
Equipment/Facility Resources
Poor aircraft/cockpit design
Purchasing of unsuitable equipment
Failure to correct known design flaws
ORGANIZATIONAL CLIMATE
Sturcture
Chain-of-command
Communication
Accessibility/visibility of supervisor
Delegation of authority
Formal accountability for actions
Policies
Promotion
Hiring, firing, retention
Drugs and alcohol
Accident investigations
Culture
Norms and rules
Organizational customs
Values, beliefs, attitudes
ORGANIZATIONAL PROCESS
Operations
Operational tempo
Incentives
Quotas ¹
Time pressure
Schedules
Procedures
Performance standards
Clearly defined objectives
Procedures/instructions about procedures
Oversight
Established safety programs/risk management programs
Management's monitoring and checking of resources, climate, and processes to ensure a safe work environemnt

Unsichere Supervision:

Inadequate Supervision
Failed to provide proper training
Failed to provide professional guidance/oversight
Failed to provide current publications/adequate technical data and/or procedures
Failed to provide adequate rest period
Lack of accountability
Perceived lack of authority
Failed to track qualifications
Failed to track performance
Failed to provide operational doctrine
Over-task/untrained supervisor
Loss of supervisory situational awareness
Planned Inappropriate Operations
Poor crew pairing
Failed to provide adequate brief time/supervision
Risk outweighs benefit
Failed to provide adequate opportunity for crew rest
Excessive tasking/workload
Failed to Correct a Known Problem
Failed to correct inappropriate behavior/identify risky behavior
Failed to correct a safety hazard
Failed to initiate corrective action
Failed to report unsafe tendencies
Supervisory Violation
Authorized unqualified crew for flight
Failed to enforce rules and regulatios
Violates procedures
Autorized unnecessary hazard
Willful disregard for authority
Inadequate documentation
Fraudulent ² documentation

¹ Pensum

² betrügerisch

Vorbedingungen unsicheren Handelns:

CONDITION OF OPERATORS
Adverse Mental States
Loss of situation awareness
Complacency
Stress
Overconfidence
Poor flight vigilance
Task saturation
Alertness (drowsiness)
Get-home-itis
Mental fatigue
Circadian dysrhythmia
Channelized attention
Distraction
Adverse Physiological States
Medical illness
Hypoxia
Physical fatigue
Intoxication
Motion sickness
Effects of OTC ³ medications
Physical/Mental Limitation
Visual limitation
Insufficient reaction time
Information overload
Inadequate experience for complexity of situation
Incompatible physical capabilities
Lack of aptitude to fly
Lack of sensory input
PERSONNEL FACTORS
Crew Resource Management
Failed to conduct adequate brief
Lack of teamwork
Lack of assertiveness
Poor communication/coordination within & between aircraft, ATC, etc.
Misinterpretation of traffic calls
Failure of leadership
Personal readiness
Failure to adhere to crew rest
Inadequate training
Self-medicating
Overexertion while off duty
Poor dietary practices
Pattern of poor risk judgement
Personal attitude
ENVIRONMENTAL FACTORS
Physical Environment
Weather
Altitude
Terrain
Lighting
Vibration
Toxins in the cockpit
Technological Environment
Equipment/controls design
Checklist layout
Display/interface characteristics
Automation
andere

³ OTC: over the counter (rezeptfrei)

Unsichere Handlungen des Operators:

ERRORS
Skill-based Errors
Breakdown in visual scan
Inadvertent use of flight controls
Poor technique/airmanship
Over-controlled the aircraft
Omitted checklist item
Omitted step in procedure
Over-reliance on automation
Failed to prioritize attention
Task overload
Negative habit
Failure to see and avoid
Distraction
Decision Errors
Inappropriate maneuver/procedure
Inadequate knowledge of systems, procedures
Exceeded ability
Wrong response to emergency
Perceptual Errors
Due to visual illusion
Due to spatial disorientation/vertigo ⁴
Due to misjudged distance, altitude, airspeed, clearance
VIOLATIONS
Routine
Inadequate briefing for flight
Failed to use ATC radar advisories
Flew an unauthorized approach
Violated training rules
Filed VFR ⁵ in marginal weather conditions
Failed to comply with departmental manuals
Violation of orders, regulations, SOPs ⁶
Failed to inspect aircraft after inflight caution light
Exceptional
Performed unauthorized acrobatic maneuver
Improper takeoff technique
Failed to obtain valid weather brief
Exceeded limits of aircraft
Failed to complete performance computations for flight
Accepted unnecessary hazard
Not current/qualified for flight
Unauthorized low-altitude canyon running

Quelle:

Wiegmann, D. A., & Shappell, S. A. (2003). *A human error approach to aviation accident analysis*. Aldershot, UK: Ashgate.

⁴ Schwindel

⁵ Visual Flight Rule (Fliegen nach Sicht; im Gegensatz zu Instrumentenanflug)

⁶ Standard Operating Procedures (Vorschriften)