Hong Kong

Occupational Safety and Health Seminar on “Construction Safety and Human Reliability”

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Occupational Safety and Health Seminar on “Construction Safety and Human Reliability”

- Human Reliability Analysis Techniques
- Sandia Report – Aviation Safety Human Reliability Analysis Method (ASHRAM)
- Human Error
- Cognitive Model Diagram
- Best Practices on Site Safety
- Wall-mounted Working Platform
Human Reliability Analysis (HRA)

HRA Techniques

- Techniques for Human Error Rate Prediction (THERP)
- Success Likelihood Index Methodology-Multi-Attribute Utility Decomposition (SLIM-MAUD)
- Human Cognitive Reliability (HCR)
- Operator Action Tree (OAT)
Human Reliability Analysis (HRA)

- Human Error Assessment and Reduction Technique (HEART)
- Operator Reliability and Characterization (ORCA)
Human Reliability Analysis (HRA)

- Cause-Based Decision Tree (CBDT)
- Connectionism Assessment of Human Reliability (CAHR)
- Cognition Simulation Model (COSIMO)
- Human Error Reliability Methods for Event Sequences (HERMES)
- Cognitive Reliability and Error Analysis Method (CREAM)
Human Reliability Analysis (HRA)

- European Association on Reliability Technique for Humans (EARTH)
U.S Nuclear Regulatory Commission

Human reliability analysis (HRA)

(A Technique for Human Event Analysis ATHEANA)

The underlying premise is that significant human errors occur as a result of a combination of plant conditions and certain human factors that trigger cognitive error mechanisms in personnel.
The error mechanisms can lead to the execution of unsafe acts, such as bypassing engineered safety features.

Due to the usefulness of the approach, and the Clinton administration’s initiative to improve commercial airline safety, Sandia funded the initial development of ASHRAM.
The result is a method that allows aviation researchers to analyze aviation accidents and incidents that involve human errors in ways that account for the operational context, crew expectations, training, airframe-related human-system interfaces, and crew resource management.
Purpose and Scope

- More completely understand the human-system interactions that contribute to aviation accidents, incidents, and hypothetical scenarios.
- Identify potentially unsafe human actions and accident scenarios that have, as of yet, not been documented.
Identify elements of error-forcing contexts that contribute to known unsafe actions

Analyze and model situations where pilots may perform actions not required for emergency response, or intentionally disable safety systems, in the course of attempting to solve or reduce problems

Model and document families of related undesirable aviation events
It provides a step-by-step method to:

- document accidents retrospectively in a format amendable to assessing cognitive errors
- consider crew errors of commission that make dangerous situations even worse
- analyze accidents in terms of the contexts that lead pilots to take unsafe actions
take advantage of the synergy from involving subject-matter experts representing a variety of contributing fields of study and experience

identify salient, potential accident scenarios, based upon event initiators

enumerate numerous variations of the potential unsafe actions and accident scenarios

develop novel scenarios for simulator training
The controlled flight into terrain (CFIT) accident near Cali, Columbia, 1995

Three-Mile Island accident, operators inappropriately terminated high-pressure injection, resulting in reactor core undercooling, and eventual fuel damage. In a subsequent report, an engineered safety system was inappropriately bypass.

The pilot in command (PIC) & the First Officer (FO) misidentified which engine was malfunctioning and jointly decided to shut it down for safety reason. It was a good, safe, strategy, given that the correct engine was identified.
‘Human Error’

- “Any member of a set of actions that exceeds some limit of acceptability”
- Something has been done which was not intended by the actor; was not desired by a set of rules or an external observer; or that led the task or system outside its acceptable limits.
- Manifested as failure to perform a required action; or its performance in an incorrect manner, out of sequence, or at an incorrect time.
- These types of errors are typically referred to as (respectively), errors of omission, errors of commission, sequence errors, and timing errors.
“Human Error”

- The main conclusion is that few human errors represent random events, instead, most can be explained on the basis of the ways in which people process information and make responses in complex and demanding situations. Thus, it is important to understand the basic cognitive processes associated with monitoring, decision-making, and control, and how these can lead to human error.
“Human Error”

- Human error is a term intentionally avoid. First, it does not contribute to the discussion in any constructive way. Secondly, the implied aspect of assigning blame detracts from the discussion by making people respond defensively.
Cognitive Model Diagram

Figure 1. ASHRAM Cognitive Model Diagram
Cognitive Model Diagram

- The three segments of the cognitive model are necessarily interactive and non-sequential. That is, all environmental perception (EP) does not occur prior to reasoning and decision-making, and all reasoning and decision-making (R/D/M) does not occur prior to initiation of action. There is overlap and non-linearity. There are implied feedback and feed-forward loops among the stages.
The model is not intended to describe how people think and behave, but it is more a structure from which intelligent discussions of human information processing and human reliability can evolve.
Environmental Perception (EP) includes perceptual processes, attention, detection, recognition, monitoring, interpretation of environmental cues, and overall understanding of the state of the aircraft/environment system.
Cognitive Model Diagram

- **Reasoning and Decision-making (R/D/M)** includes cognitive or thinking processes, such as awareness and deduction of unsafe or dangerous conditions, remembering situation-specific training, deciding to follow recommended procedures, planning flight navigation, diagnosis of trouble symptoms, deciding how to respond to situations, problem solving, and novel or creative use of existing tools or systems.
Action (A) includes control inputs to airframe, operating control hardware in the cockpit, communications to crew and passengers, and any other overt physical behaviors.
Cognitive Model Diagram

Performance-shaping factors (PSF)

- Any factor that influences human performance
- Internal factor such as stress, fatigue, knowledge, personality, bodily structure, skills, experiences, attitudes, and intelligence
- External factor such as human-system interface (HIS) design, organizational structure and rewards, training programs, and written procedures
Cognitive Model Diagram

- Internal factors – improving operator factors (OFs), or making them less susceptible to error might include additional simulator training, longer rest periods between flights, more frequent eye examination, etc.
Cognitive Model Diagram

- External factors – features of the man-made environment that may affect performance, such as navigational display design, safety procedures, approach chart nomenclature, etc.
Cognitive Model Diagram

Operator Factors
- Fatigue level
- Stress level
- Knowledge
- Skills and talents
- Personality, leadership
- Experience
Cognitive Model Diagram

Design Factors
- Instrument set, layout
- Logic of FMS
- Airframe response
- Radio protocols
- Chart legibility
- CRM practices
Error mechanisms (EMs) are psychological mechanisms that can contribute to human errors if employed inappropriately, or out of context. That is, they are internal cognitive processes that have been cultivated over time to deal with environmental demands that may tax limited processing resources, such as attention or short-term memory. Inappropriately applied, they lead to confusion and can precipitate unsafe acts.
Unsafe actions (UAs) refer to those overt actions inappropriately taken by crew members, or those not taken when needed, that result in a degradation in safety. (e.g. The act of crossing the active runway without permission would be the unsafe action. The term does not mean to imply that the human was the cause of the problem. This distinction avoids any inference of blame and accommodates the assessment that people are often “set up” by circumstances to make actions that are unsafe. In these circumstances, the crew does not knowingly commit an error. They are performing the “correct” action as it seemed to them at the time.)
Contributory Actions (CAs) are actions taken (or omitted) that precipitate, or ultimately lead up to the UA. In and of themselves, CAs are not necessarily inappropriate or unsafe. However, in the context of the scenario, they set up, or set the stage for an unsafe act. In the runway-incursion scenario used as an example above, the assumption by the pilot that the active runway could be crossed was a CA.
Cognitive Model Diagram

- The error-forcing context (EFC) is the combined effect of aircraft conditions, operator and design-based PSFs, procedural factors, weather, and traffic conditions that create a situation where an unsafe act is likely. Pilots are assumed to be performing to their best ability to complete the mission at hand. Usually, the mission is to deliver passengers and crew safely and on-time to a destination, and happily, this is usually the outcome. However, occasionally pilots are confronted with trying or confusing situations that elicit inappropriate responses, and these situations are called EFC.
Observations

- Human actions can be initiating events. A misinterpreted communication, a misperceived instrument, or a false assumption about an approach plate can lead to humans taking actions that lead to problems.
Observations

- Pilot goes through his procedure/checklist, usually without questioning the steps, and may put flight in danger.
Understanding the Error-forcing Context (EFC) is important for gaining an appreciation for how to avoid recreating similar circumstances in the future and for redesigning aspects of the aviation system to avoid these EFCs altogether.
Conclusions

- It is to understand, enumerate, and document, the conditions and factors that did contribute to an EFC that precipitated an unsafe action.
- We can project into the future to appreciate as-yet inexperienced circumstances and conditions that could lead to unsafe actions.
Conclusions

- Any HRA technique cannot be all things to all people. Tradeoff need to be made.
- Often a sound and complete HRA analysis needs to combine several techniques to compile the entire picture.
- Other techniques have been developed that provides guidance for quantifying estimates of human error probabilities and these methods can be used in conjunction with ASHRAM.
Cognitive Model – Construction Industry
Rigid guardrails

Special design working platform for column steel fixing

Hoarding and protective net
Workers’ Canteen and Rest Area with air conditioning system

Subcontractor site office
Emergency Rescue Drill
Safety Training

- Pneumoconiosis
- Deafness Prevention
- Mosquito Prevention
Workshop

Use of Fire Resistance Blanket

Fire Ambassador Training
➢ PPE Promotion
Exhibition

Safety Lifting

Working at Height

Fire Prevention
Safety Promotion

Employees General Union

H.K. Construction Industry Professional Plant
- Operators and Mechanics Association
Lifting Gear Fitted with Metal Plate Showing S.W.L.
➢ Hand-Key Access Control System (Site Entrance)

- Provision of Hand-Key Access Control System
- Provision of Sufficient Safety Helmet Cages
Standard Safety & Environmental Notice Board

Mobile Safety & Environmental Notice Board

Standard Setup at Each Subcontractor Office
Provision of Fiber Board for Temporary Access

Provision of Concrete Access for Pedestrian

Main Access With Speed Limit Sign
Chemical Toilets

Toilet facilities

Improved Toilet
Façade & Table-form Flying Training
Temporary Drainage System
Material Storage & Stacking

Designated Material Storage Yard
Fire Fighting Facilities
Appointed Competent Persons
Wall-mounted Working Platform
Wall-mounted Working Platform
Wall-mounted Working Platform
Wall-mounted Working Platform

Double-deck Working Platform
Wall-mounted Working Platform
Wall-mounted Working Platform
Wall-mounted Working Platform
Wall-mounted Working Platform

Governed by PNRC 29

Temporary Wall-Supported Platforms inside Lift Shafts

Temporary wall-supported platforms are frequently erected inside lift shafts of buildings or structures under construction. They are provided either as working platforms for the erection of lift shafts or as catch platforms for falling building materials and debris.

2. Collapses resulting from the failure of such platforms have in the past claimed the lives of workers. There have also been other serious accidents when construction workers sustained multiple injuries from failure of such platforms.

3. The safety of these platforms is governed by the provisions of the Construction Sites (Safety) Regulations. In addition, every employer has the general duty to ensure that a safe place of work is provided and maintained under the Factories and Industrial Undertakings Ordinance, Cap 56. In view of the incidence of accidents, the Labour Department considers it necessary to implement forthwith stricter controls to safeguard workers operating on these platforms.

4. Where there are temporary wall-supported platforms inside lift shafts in building sites, the Labour Department would raise legal notice under section 7(d) of the Factories and Industrial Undertakings Ordinance to require building contractors to adopt the following special measures:

(a) Every temporary wall-supported platform inside a lift shaft on a building site should be properly designed by an authorized person (AP) or a registered structural engineer (RSE). The plan prepared by the AP or RSE must contain all the necessary details and specifications of the platform and should be available on site for inspection by a factory inspector;

(b) Every temporary wall-supported platform inside a lift shaft should be constructed in accordance with the plan prepared by the AP or RSE and under the supervision of a competent person appointed by the registered contractor of the building site in accordance with Construction Sites (Safety) Regulations. A record should be kept of the date of erection of each platform and the name of the person who supervised the work. This record should also be available on site for inspection by a factory inspector;
~ The End ~
Thank you