Human Performance

An Introduction
HUMAN FALLIBILITY & VULNERABILITY

- Machines are: _________, _________, and _________.

- Humans are: _________, _________, and _________.

• Machines are: Fast, Accurate, and Dumb.

• Humans are: Slow, Sloppy, and Brilliant.
Principles of Human Performance

- People are fallible, and even the best make mistakes
- Error-likely situations are predictable, manageable, and preventable
- Individual behavior is influenced by organizational processes and values
- People achieve high levels of performance based largely on the encouragement and reinforcement received by leaders, peers, and subordinates
- Events can be avoided by an understanding of the reasons mistakes occur and application of the lessons learned from past events
Human Performance

Target No.1

B + R = P

Target No.2
Two Kinds of Error

Active Error

Active errors are errors that change equipment, or system state triggering immediate undesired consequences. The key distinction that makes the error active is the immediate unfavorable result to system equipment or personnel.

Latent Error

Latent errors are errors resulting in undetected organization-related weaknesses or equipment flaws that lie dormant. Latent errors create veiled conditions commonly referred to as latent conditions.
Anatomy of an Event

Flawed Defenses

Latent Organizational Weaknesses

Goals Policies Procedures

ONE WAY

Error Precursors

Initiating Action

Event

ONE WAY
Anatomy of Events

Active Errors:
Weak Skills, Failed, or Nonexistent Barriers

Latent Errors:
Organizational Weaknesses; Poorly Written Procedures, Failed, or Nonexistent Programmatic Barriers, Ineffective Management

Human Fallibility

Programmatic Barriers

Organizational Barriers

Management Barriers

“Defense in Depth Model”
Dr. James Reason, Managing the Risks of Organizational Accidents, 1997.

Initiating Action
An error about to happen due to error precursors
# Common Error Precursors

## Task Demands
- **Time pressure** (in a hurry)
- **High workload** (memory requirements)
- Simultaneous, multiple tasks
- Repetitive actions / Monotony
- Irreversible actions
- Interpretation requirements
- Unclear goals, roles, or responsibilities
- Lack of or unclear standards

## Individual Capabilities
- Unfamiliarity with task / First time
- Lack of knowledge (mental model)
- New technique not used before
- Imprecise communication habits
- Lack of proficiency; Inexperience
- Indistinct problem-solving skills
- “Can do” attitude for crucial task
- Illness or fatigue; general health

## Work Environment
- Distractions / Interruptions
- Changes / Departure from routine
- Confusing displays / controls
- Work-arounds / OOS instrumentation
- Hidden system responses
- Unexpected equipment conditions
- Lack of alternative indication
- Personality conflicts

## Human Nature
- Stress
- Habit patterns
- Assumptions
- Complacency / Overconfidence
- Mind set (intentions)
- Inaccurate risk perception
- Mental shortcuts or biases
- Limited short-term memory
Performance Modes Overview

Information processing apparently operates in one or more of three modes—Skill-Based (SB), Rule-Based (RB), and Knowledge-Based (KB). Referred to as performance modes, they are based on the level of familiarity an individual has with a specific task and the level of attention (degree of information processing) a person applies to the activity.
Performance Modes

<table>
<thead>
<tr>
<th>Familiarity (w/ task)</th>
<th>Attention (to task)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Low</td>
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<tr>
<td>High</td>
<td>High</td>
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- **SB**
  - Auto
  - Chance for error - lower

- **RB**
  - If - Then
  - Chance for error - higher

- **KB**
  - Patterns
Skill Based Performance Mode
Skill Based Performance Mode

Routine actions in a familiar situation.

Highly practiced actions (routine activity) usually executed from memory without significant conscious thought in a familiar situation. Behavior governed by preprogrammed instructions developed by either training or experience. Actions guided by subconscious mind possess 10 times the capacity of conscious thought.
Skill Based Performance Mode
Errors

Error Mode
Inappropriate act due to lack of attention

Error Rate
1 in 10,000
Skill Based Performance Mode
Examples
Skill Based Performance Mode Tools

- Self Check
- Verbalize
- Situational Awareness
Skill Based Performance Mode Tools

Self Check

This SB technique is designed to enhance one’s attention before performing a specific action on system equipment. (STAR - Stop, Think, Act, and Review)
Skill Based Performance Mode Tools

Verbalize

State out loud your thoughts and intentions before acting to enhance one’s attention and understanding of a RB or SB task and to allow coworkers the opportunity to challenge. In some cases verbalizing is accompanied by pointing to the device.
Skill Based Performance Mode Tools

Situational Awareness

This ongoing effort of vigilance anticipates possible error-likely situations and flawed defenses (what if ...) as work is performed on the system. Helps keep second level of attention attuned to adverse conditions. Behaviors include:

- **Monitor** - regularly scanning task, environment, yourself and coworkers conditions to identify undesirable situations

- **Interpret** - anticipating error-likely situations and flawed defenses and deciding on changes to the work situation and/or contingency actions

- **Intervene** - executing necessary changes in work situation to prevent existence of error-likely situations and flawed defenses
Rule Based Performance Mode
Rule Based Performance Mode

Prepackaged action determined by recognition of familiar problem situations. Task performed by using existing rules from procedures, training, or experience.

Behavior based upon selection of stored rules derived from one’s recognition of the situation; follows IF (symptom X), THEN (situation Y) logic). The problem, although possibly familiar, is usually unanticipated. Problems discovered during a task usually require a different skill than planned to accomplish the task successfully.
Error Mode

Misinterpretation - not recognizing changes in task requirements, system response, or equipment conditions associated with task due to some preoccupation. Or, so intent on task that pertinent information is not detected, i.e., over attentive.

Error Rate

1 in 1,000
Rule Based Performance Mode
Examples
Rule Based Performance Mode Tools

- Procedure Use and Adherence
- If$^2$Then$^2$
- Peer Check
- Verbalize
Rule Based Performance Mode Tools

Procedure Use & Adherence

Procedures are written and used to consistently control the user’s behavior to perform a RB task safely and reliably and to high standards. The quality of procedure use is driven by the norms and values of the organization such as the following:

- All work is performed using approved procedures.
- Work cannot be altered by verbal directives from others despite rank.
- Procedures corrected and approved before use.
- Evaluated before using under system conditions other than those presumed by the procedure.
Rule Based Performance Mode
Tools

**If²Then²**

This **RB** technique is designed to **confirm** the authenticity of the need for action on system equipment (**If**), and to **validate** the appropriateness of the intended action to achieve the desired results (**Then**). Can be used when self checking. Establishes a questioning attitude.
Rule Based Performance Mode Tools

Peer Check

This collaborative technique involves asking others to observe or check the behavior of the worker performing a critical step or series of steps to verify correct performance. This RB technique takes advantage of a fresh set of eyes not trapped by the performer’s mindset and is similar to double verification.
Rule Based Performance Mode Tools

**Verbalize**

State out loud your thoughts and intentions before acting to enhance one’s attention and understanding of a RB or SB task and to allow coworkers the opportunity to challenge. In some cases verbalizing is accompanied by pointing to the device.
Knowledge Based Performance Mode
“Humans are notorious pattern matchers.”

Dr. James Reason
Mental Model

A mental model or picture is the structured organization or understanding of knowledge (facts or assumptions) a person has in their mind about how something (T&D systems or culture) works or operates. It is an internalized picture or map of a system or situation. It reflects a person’s understanding of the system’s present state in terms fundamental laws of nature, what the system contains, how it works, and why it works the way it does. Mental models are used in all performance modes. In fact, they are usually responsible for the ability humans have for detecting skill-based slips and lapses; they aid in detecting deviations between desired and undesired system states such as manually controlling oil level when refilling a transformer.
Mental Model Test
Phrase Recall Exercise

- Paris in the spring
- Once in a lifetime
- Bird in the hand
Mental Model Test

What did you see?
Phrase Recall Exercise

PARIS IN THE THE SPRING

ONCE IN A A LIFETIME

BIRD IN THE THE HAND
Knowledge Based Performance Mode

Unfamiliar situation exists requiring worker to apply analytical skills and judgment

Behavior in response to a *totally unfamiliar* situation (no skill or rule recognizable to the individual) relying on one’s *understanding* and recollection of *knowledge* of the system, system’s present state, and scientific principles and fundamental theory related to the system.
Knowledge Based Performance Mode

Error Mode

Diagnosis errors - flaws in problem-solving and decision-making based upon erroneous mental representation of the system/equipment status; typically based upon insufficient information about the true system or equipment status.

Error Rate

1 in 10
Knowledge Based Performance Mode
Knowledge Based Performance Mode Tools

Devil’s Advocate
C Your Way Out
Stop & Collaborate
Problem-Solving Technique
Devil’s Advocate

A role in a team or group effort designed to continuously monitor and challenge the actions and decisions of the team. This person provides a watchful eye out for possible danger, since the human brain can be sensitized to think in only one direction at a time. Most of the time people are focused on accomplishing the task, not on what to avoid. This person encourages the team to know what to avoid. Whether in the plant or in conference room, this person should point out what is inconsistent or contradictory, how some proposed course of action does not fit existing conditions, available resources, policy, ethics, values, strategy, and so on. This role challenges the group’s situational awareness by verifying the accuracy of individual perceptions, identifying assumptions, calling time outs as needed, and being on watch for error-likely situations.

A devil’s advocate is particularly useful for knowledge-based situations encountered whether in the plant or in the office. The role should be rotated among individuals. A point of caution: devil’s advocates should not be asked to “prove it’s unsafe.” Usually, such conclusive evidence is scarce; we’re dealing with likelihoods versus certainty.
Knowledge Based Performance Mode Tools

C Your Way Out

When an individual or team realizes that the work situation is unfamiliar, a knowledge-based situation, people must react with deliberate action to regain control of the situation. “C Your Way Out” is an easy-to-remember mental process to reduce the chance for error. When in doubt, individuals are encouraged to:

- **Consider the risk** – identifying likely and worst-case consequences if nothing is done about the present circumstances.
- **Communicate** – raise the flag to supervision or management to get appropriate resources focused on the issue.
- **Collaborate** – involve appropriate experts and knowledgeable people in a systematic problem-solving/decision-making process.
- **Consider the alternatives** – to identify as many as possible options to the situation before proceeding.
Problem-Solving Technique

Problem solving becomes the primary activity whenever an individual enters a knowledge-based work situation. Everyone eventually experiences situations where a given state does not match a desired goal state, and the path to achieve the desired goal is vague or unknown. Without guidance, human beings do not customarily execute approaches that rigorously, methodically, and painstakingly solve problems. Also, people may lack fundamental knowledge of the situation. Consequently, the chance for error increases dramatically in a knowledge-based work situation. Therefore, people need to work with others and apply a disciplined approach to problem solving. Without practice, people will default to what they are comfortable with, i.e., trial and error. A fundamental problem-solving technique could include the following elements:

- Define the **problem**, i.e., the gap between actual and desired conditions.
- State **goal(s)** clearly. Prioritize them if more than one.
- Establish an accurate **mental model** of the system. Gather as much information relevant to the problem as time permits. (Caution: vital data may be missed.)
- **Identify alternatives that could accomplish the goals.**
- **Decide** on course(s) of action that achieve goals considering risks, costs.
- **Plan.** Consider several solutions or courses of action. **Predict** potential outcomes and side effects (what if).
- **Execute** the plan.
- **Review** outcomes and adapt (any of previous steps).
This knowledge-based technique prompts an individual or team to pause and get help if plant or task conditions change such that they are not immediately recognizable.
Everyone has the responsibility to make sure the switch in the head is in the on position before we proceed!
C-RAT is a tolerance of risks or risk-taking that is created by the activities and experiences an individual is routinely assigned.

Individuals are conditioned over a period of time through repetition of similar activities to accept risks that others may immediately find intolerable. When we are unable to recognize the risks associated with the activities we are performing, it is an indicator that we are operating at a threshold of Risk Tolerance that might lead to a Human Performance Error or Event.

Conditioned Risk Acceptance Tolerance (C-RAT)
What is the Difference Between Safety & Human Performance?

- Safety protects me from the distribution system.
- Human Performance protects the distribution system and others from me.