Fundamentals for Human Performance Improvement

Sam McKenzie
Purpose of HPI

To minimize the frequency and severity of events
Course Objectives

- Why HPI events occur
- Error-likely Situations & error precursors
- HPI Models
- Jobsite tools
- Leadership practices
- Behavior reinforcement
- Mental framework
- Leadership roles
- Strengths, obstacles, key learnings, & actions
Human Performance

Target No.1

Target No.2
Significant Events
Annual Industry Averages

(Data Source: U.S. Nuclear Regulatory Commission
(Core Damage Potential)
# Nuclear Industry Event Causes due to human performance

<table>
<thead>
<tr>
<th>Cause</th>
<th>Number of Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change Management</td>
<td>215</td>
</tr>
<tr>
<td>Environmental Conditions</td>
<td>26</td>
</tr>
<tr>
<td>Human-machine Interface</td>
<td>39</td>
</tr>
<tr>
<td>Supervisory Methods</td>
<td>88</td>
</tr>
<tr>
<td>Work Organization/Planning</td>
<td>192</td>
</tr>
<tr>
<td>Written Procedure</td>
<td>654</td>
</tr>
<tr>
<td>Resource Management</td>
<td>806</td>
</tr>
<tr>
<td>Work Schedule</td>
<td>160</td>
</tr>
<tr>
<td>Training/Qualification</td>
<td>82</td>
</tr>
<tr>
<td>Verbal Communications</td>
<td>73</td>
</tr>
<tr>
<td>Work Practices</td>
<td>18</td>
</tr>
<tr>
<td>Managerial Methods</td>
<td>Other/Unknown</td>
</tr>
</tbody>
</table>

1,676 = Organizational Behavior (68%)

806 = Individual Behavior (32%)

Is 99.9% Good Enough?

1 hour of unsafe drinking water per month

2 unsafe landings per day in Atlanta, GA.

50 dropped babies per day

116,000 lost pieces of mail per hour

20,000 incorrect drug prescriptions per year

22,000 checks deposited in wrong accounts per hour
Two Kinds of Error

Active Error

Latent Error

(leading to latent conditions)
Principles of Human Performance Management

- Humans are fallible...
- Error is predictable...
- Organization influences behavior.
- Behaviors are reinforced.
- Events are avoidable.

Anatomy of an Event

Event

Vision, Beliefs, & Values

Initiating Action

Latent Organizational Weaknesses

Vision, Beliefs, & Values

Error Precursors

Flawed Defenses
Strategic Approach

1. Anticipate and prevent active error at the job-site.
2. Identify and eliminate latent organizational weaknesses.
Essential Elements for Achieving Reliable Human Performance

- Organizational Attributes
- Process Contributors
- Individual Values and Behaviors
The Jobsite and The Individual
Traps of Human Nature

- Stress
- Avoidance of mental strain
- Inaccurate mental models
- Limited working memory
- Limited attention resources
- Mind set
- Difficulty seeing own errors
- Limited perspective
- Susceptible to emotion
- Focus on goal
- Fatigue
Phrase Recall Exercise
Phrase Recall Exercise (Cont.)

PARIS
IN THE
THE SPRING

ONCE
IN A
A LIFETIME

BIRD
IN THE
THE HAND
Error Precursors

- Task Demands
- Work Environment
- Individual Capabilities
- Human Nature
Count the F’s

Finished Files are the Result of Years of Scientific Study Combined with the Experience of Many Years.
Error-likely Situation

Task Demands precursors

Human Nature precursors

Work Environment precursors

Individual Capabilities precursors

An error about to happen due to error precursors
## Error Precursors

### short list

<table>
<thead>
<tr>
<th>Task Demands</th>
<th>Individual Capabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time pressure (in a hurry)</td>
<td>Unfamiliarity w/ task / First time</td>
</tr>
<tr>
<td>High Workload (memory requirements)</td>
<td>Lack of knowledge (mental model)</td>
</tr>
<tr>
<td>Simultaneous, multiple tasks</td>
<td>New technique not used before</td>
</tr>
<tr>
<td>Repetitive actions, monotonous</td>
<td>Imprecise communication habits</td>
</tr>
<tr>
<td>Irrecoverable acts</td>
<td>Lack of proficiency / Inexperience</td>
</tr>
<tr>
<td>Interpretation requirements</td>
<td>Indistinct problem-solving skills</td>
</tr>
<tr>
<td>Unclear goals, roles, &amp; responsibilities</td>
<td>“Unsafe” attitude for critical task</td>
</tr>
<tr>
<td>Lack of or unclear standards</td>
<td>Illness / Fatigue</td>
</tr>
<tr>
<td><strong>Work Environment</strong></td>
<td><strong>Human Nature</strong></td>
</tr>
<tr>
<td>Distractions / Interruptions</td>
<td>Stress (limits attention)</td>
</tr>
<tr>
<td>Changes / Departures from routine</td>
<td>Habit patterns</td>
</tr>
<tr>
<td>Confusing displays or controls</td>
<td>Assumptions (inaccurate mental picture)</td>
</tr>
<tr>
<td>Workarounds / OOS instruments</td>
<td>Complacency / Overconfidence</td>
</tr>
<tr>
<td>Hidden system response</td>
<td>Mindset (“tuned” to see)</td>
</tr>
<tr>
<td>Unexpected equipment conditions</td>
<td>Inaccurate risk perception (Pollyanna)</td>
</tr>
<tr>
<td>Lack of alternative indication</td>
<td>Mental shortcuts (biases)</td>
</tr>
<tr>
<td>Personality conflicts</td>
<td>Limited short-term memory</td>
</tr>
</tbody>
</table>
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>
</tr>
<tr>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>

- **KB Patterns**
- **RB If-Then**
- **SB Auto**
- **Inaccurate Mental Picture**
- **Misinterpretation**
- **Inattention**

Error-reduction Techniques @ jobsite

- Conservative decision-making
- Change management
- Three-way communication
- Concurrent verification
- Independent verification
- Meetings
- Peer-checking

- Placekeeping
- Prejob Briefing
- Problem-solving
- Procedure use & adherence
- Questioning attitude
- Self-checking
- Stop & collaborate
- Two minute walkdown
Questioning Attitude Meter

Healthy Uneasiness/Wariness/Alertness

Uncertain/Unsure

Too Certain/Too Sure
Team Errors

- Social Loafing
- Halo Effect
- Pilot / Co-pilot
- Free Riding
- Groupthink
- Risky Shift
Organization
Breaking The Human Performance Paradigm

Minimum **frequency** and **severity** of plant events, with high safety margins and reliability and no fuel-damaging events.

\[ \text{Re} + \text{Md} \rightarrow \emptyset \}

[reducing error \textbf{AND} managing defenses \textbf{leads to} zero events]

[Aka: \textit{Individual} + \textit{Organization & Processes} \textbf{>>>>> Performance Improvement}]
The Performance Model

- Job-Site Conditions
- Organizational Processes & Values
- Worker Behavior
- Plant Results
WHEN GOOD PETS GO BAD
Dual Purposes

To consistently **search** for and **eliminate** conditions that provoke human error while reinforcing defenses.

Safety

To facilitate the accomplishment of the organization’s **mission** in accordance with its norms, values, and strategies.
Competing Resources

Defenses

Flawed defenses *allow* active errors or their consequences to occur.

**Functions:**
- Create Awareness
- Detect and Warn
- Protect
- Recover
- Contain
- Enable Escape

<table>
<thead>
<tr>
<th>Functions</th>
<th>Physical</th>
<th>Administrative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create Awareness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Detect and Warn</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protect</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recover</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enable Escape</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Defense -in- Depth

Challenges To the Plant

- MANAGERIAL METHODS
- WRITTEN COMMUNICATIONS
- TRAINING
- WORK ORGANIZATION OR SUPERVISORY METHODS
- ENVIRONMENTAL FACTORS
- VERBAL COMMUNICATIONS
- DESIGN
- WORK PRACTICES
- WORK SCHEDULE
- CHANGE IMPLEMENTATION

EVENTS
Latent Organizational Weaknesses (sources)

Processes (structure)
- Work control
- Training
- Accountability policy
- Reviews & approvals
- Equipment design
- Procedure development
- Human resources

Values (relationships)
- Priorities
- Measures & controls
- Critical incidents
- Coaching & teamwork
- Rewards & sanctions
- Reinforcement
- Promotions & terminations
Finding Latent Organizational Weaknesses

- Self-Assessments
- Benchmarking
- Post-job Critiques
- Trending
- Surveys and Questionnaires
- Observations
- Root Cause Analysis
Air Ontario Flight 363 Fokker F28 Dryden, Canada
Leadership
Leadership Practices

1. Facilitate open communication
2. Promote teamwork
3. Reinforce desired behaviors
4. Eliminate latent organizational weaknesses
5. Value prevention of errors
Reinforcement

Consequences that Increase Behavior

1. GET SOMETHING YOU WANT
2. AVOID SOMETHING YOU DON’T WANT

Consequences that Decrease Behavior

1. GET SOMETHING YOU DON’T WANT
2. LOSE SOMETHING THAT YOU HAVE

Source: Daniels, Bringing Out the Best in People, 1989.
SAFER Dialogue
S – Summarize critical steps
A – Anticipate error traps
F – Foresee consequences
E – Evaluate defenses
R – Review operating experience
## Guidance for Level of Pre-job Briefing

<table>
<thead>
<tr>
<th>Simple or Repetitive</th>
<th>Low-Risk</th>
<th>Complex or Infrequent</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAFER Dialogue</td>
<td></td>
<td>Generic Prejob Briefing Checklist Plus SAFER</td>
</tr>
<tr>
<td>Preplanned Prejob Briefing Forms Plus SAFER</td>
<td>Infrequently Performed Test or Evolution Plus SAFER</td>
<td></td>
</tr>
</tbody>
</table>

- **Low-Risk**
  - SAFER Dialogue
- **High-Risk**
  - Preplanned Prejob Briefing Forms
  - Plus SAFER
Post-Job Critique

1. Purpose: Organizational improvement (OE)
2. Quick and easy
3. Production and Prevention
4. Management acknowledgement
5. Follow-through
Blame Cycle

Human Error

More flawed defenses & error precursors

Latent organizational weaknesses persist

Management less aware of jobsite conditions

Individual counseled and/or disciplined

Reduced trust

Less communication

Source: Reason, Managing the Risks of Organizational Accidents, pp.127-129.
Culpability Evaluation Flowchart

- **Were actions as intended?**
  - Yes: Intentional Act (not an error)
  - No: Were expectations reasonable, available, workable, intelligible, and correct?
    - Yes: Possible reckless violation
    - No: Deficiencies in training, selection, assignment, or experience?
      - Yes: System induced error
      - No: Possible negligent error

- **Pass substitution test?**
  - Yes: Corrective training or other intervention may be warranted
    - Yes: Blameless error
    - No: History of human performance problems?
      - Yes: Self reported?
        - Yes: Blameless error
        - No: Diminishing culpability
      - No: Deficiencies in training, selection, assignment, or experience?
        - Yes: System induced error
        - No: Possible negligent error

- **Evaluate Organizational Processes & Management / Supervisory Methods**
“The longest distance to travel in HPI is from the head to the heart.”
-Tom Herrall, Mcguire plant manager

- Purposefulness
- Control
- Competence
- Progress
Error Precursors

Root Cause
Changes
Time Pressure
New Technique
Hidden System Response

Root Cause
Habit Patterns
Simultaneous
Hazardous Attitude

Root Cause
Unclear Goals
Complacency

Root Cause
Assumptions
Interpretation
Stress
Workarounds
Repetitive Actions

Error Precursors

Organizational Weaknesses
Implementing a “Program”

1. Senior Management Commitment
2. Steering Committee
3. Self-assessment
4. Strategy
5. Communicate and Empower
6. Implement
7. Evaluate
8. Maintain