Using Human Performance Data to Evaluate Barrier Effectiveness and Identify Areas for Improvements

A.W. Armstrong
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A.W. Armstrong, Kestrel Management
What Is the Common Theme?

- Each event was caused, in part, by human error
- What percentage of all accidents, including premature equipment failures, are caused by human error?
- Regardless of the percentage, employees and contractors represent a significant source of risk to operations
How Do Companies Manage These Risks?

• A variety of controls, including:
  – Culture, leadership, and policies
  – Risk identification and assessment
  – Planning and budgeting
  – Procedures and practices
  – Personnel selection, training, and supervision
  – Monitoring, auditing, and verification

Organized into a management system
Why Do Accidents Still Occur?

- Accidents, both personal and process safety, occur when there is a failure in one or more of these controls.
- The desire is to focus resources on only those controls contributing to accidents.
- However, management systems are complex — 2,500 procedures at one facility.
- How do you know where to focus your resources? — Use human factor data to evaluate risk controls and identify areas needing improvement.
Swiss Cheese & Accident Causation Theory

[Diagram showing the Swiss cheese model with layers representing different levels of protection (i.e., controls) with holes indicating system weaknesses or failures leading to an accident.]
Human Factors Analysis and Classification System (HFACS)

- Provides detail to Reason’s Swiss Cheese Model
- Describes the categories of barriers
  - Unsafe acts
  - Preconditions
  - Supervisory factors
  - Organizational influences
- Identifies the system weakness or failures
  - The holes in the cheese
- Results in a large amount of data
- The challenge is how to deploy at the site level
## HFACS Hierarchy

<table>
<thead>
<tr>
<th><strong>Organizational Factors</strong></th>
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<tbody>
<tr>
<td>Resource Management</td>
<td>Infrastructure and Facilities</td>
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<tr>
<td></td>
<td>Organizational Climate</td>
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<tr>
<td></td>
<td>Organizational Process</td>
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<td>Labor</td>
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<td>Crew/Employee Interactions</td>
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<td>Work Instructions/Job Aids</td>
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Human Performance Reliability (HPR)

What is HPR?

• A investigation process based on HFACS
• HPR links human factor data to company-specific controls (i.e., policy, procedures, work instructions)
• Helps you systematically identify active failures and contributing factors
• HPR outputs help organizations identify patterns, trends, and gaps in existing barriers
• Linked with HFIT™ for data management, analysis and reporting
Why Use HPR?

• Current methods of incident investigation and cause analysis do not go broad enough in the examination of failures and do not specifically explore the characteristics and contributing factors to human error

• HPR enhances the connection between human factor details and operational controls and other system elements

• Opportunities are identified to strengthen safeguards and defenses for reducing risk, preventing incidents, and improving overall system reliability
Preparing for HPR Review Process

**Step 1**

- Designate a site-level HPR Implementation Team
  - Operations manager, HSE manager, PSM and operations representatives
- Conduct orientation training for HPR team and others at the site
- Designate a site-level HPR Review Team
  - May be same as Implementation Team
- Time and level of effort
  - 2 training sessions approximately 4 weeks apart
  - Each training session is approximately 4 hours
- Corporate resources are available for support
Preparing for HPR Review Process (continued)

Step 1a – Completed during Orientation Training

• HPR Team determines which incidents will receive HPR review
  – Not all are appropriate for review
  – Set review threshold and adjust over time

• Establish the HPR Profile
  – A standard set of data that will be used to conduct the HPR review
  – Initial incident reports, interviews, management reviews, etc.

• The HPR Profile is the set of materials used for the HPR review
Preparing for HPR Review Process (continued)

Step 2
- Identify HFIT™ Lead from the HPR Team
- Set up HFIT™ for site-level access
- Compile inventory of site-specific controls (i.e., work instructions, SOPs, work instructions, check lists)
- Load list of controls into HFIT™
- Train the HFIT™ Lead
- Time and level of effort depends on the accessibility of the controls inventory and the experience of the HFIT™ Lead
  - Expect 2 to 4 hours of training (1 hour per week)
Conducting the HPR Review

• HPR Review Team meets in person, often with outside facilitator
• One member provides an overview of the incident to be reviewed using the HPR Profile
• Using HFIT™, the Review Team collectively answers the HPR questions to assess the incident
  – There are approximately 170 HPR questions
  – Not all questions applicable to incident
  – HFIT™ hides non-applicable question based on answers to previous questions
• HFIT™ Lead loads answers into HFIT™ during the review - link responses to specific controls
Conducting the HPR Review (continued)

Level of effort:

- Time to complete a review will decrease as the HPR Review Team becomes more experienced
- Initially, one review may take 6 to 8 hours
- An experienced team should be able to complete a review in 1 to 4 hours, depending on the complexity of the incident
## Recall – HFACS Hierarchy

### Organizational Factors
- Resource Management
- Infrastructure and Facilities
- Organizational Climate
- Organizational Process
- Labor

### Supervisory Factors
- Inadequate Supervision
- Failure to Initiate Corrective Actions
- Supervisory Violations
- Supervisor Qualifications/Skill Set

### Preconditions
- Conditions/Ability of the Employee
- Crew/Employee Interactions
- Location Factors
- Work Instructions/Job Aids

### Unsafe Acts
- Errors
- Rule Violations
Level 1 – Unsafe Acts

Unsafe Acts

Errors
- Decision Error
  - Poor Choice/Problem Solving
  - Procedural Error
- Skill-Based Error
- Perceptual Error

Rule Violation
- Intentional
- Unintentional

Intentional
- Unintentional

Attention Failure
- Memory Failure
- Technique Error
Outputs

- Behavioral and contributing factors
- Existing and/or non-existing controls
- Determination of significance (random chance or systemic factor)
- Prioritized list by likelihood of systemic factor
Progression of HPR Review Data

• Individual incident review and summary reports provide information for making immediate local improvements
• Multiple reviews enable data for general assumptions
• Aggregated reviews provide data to analyze for patterns and trends
  – Provides a “snapshot” of an entire Business Unit
  – Review a single facility over time
• Application of inferential statistics determines significance and provides prioritization
Recommendations

• Review team must be independent of the incident
• Avoid fault-finding
• Separate analysis “review” from “solution finding”
• Establish terms and nomenclature early in the process
• Keep the review process moving forward
Case Study – Implementation at a Global Petrochemical Company
Background

• Company initiated a plan in 2013 to deploy HPR at select sites to help reduce human error
• A Pilot Plant was identified
• Objective was to deploy HPR at Pilot in 2013
• Timeline
  – Orientation training at Corporate, November 15, 2013
  – Second training conducted on December 9, 2013
  – HPR reviews began at Pilot on December 16, 2013
• Additional training and setup was required
  – Completed the training February 2014
Pilot HPR Review Team

- Plant Manager
- Operations Manager
- EHS Manager
- PSM Coordinator
- Corporate Support
Pilot Threshold and Profile

• Pilot Plant threshold for HPR Review includes the following:
  – All OSHA recordable cases
  – All PSM incidents
  – All Level B environmental releases, and
  – At the request of the Plant Manager

• Pilot Profile data
  – Plant Manager review
  – Incident investigation result
Progress to Date

• Eleven (21) reviews have been completed
• Time to complete reviews has decreased from 6 to 1 hours
  – Review decreases as experience of review team increases
  – Aligning systems and tools (e.g., investigation procedures) with HPR requirements also improves time
Early Indicators

• HPR process is helping management to make data-driven decisions about which procedures are contributing to incidents
  – Helps remove the “gut feel” of where to focus resources
• Incident investigation procedure should be modified to support HPR review (this finding affects everyone)
• Incident investigation procedure does not seem to include elements that allow Supervisory contributing factors to be identified.
• Too early to draw conclusions about specific human factors contributing to incidents
Early Indicators - Procedures

• HPR process is helping management to make data-driven decisions about which procedures are contributing to incidents
  – Helps remove the “gut feel” of where to focus resources
  – Incident investigation procedure should be modified to support HPR review (this finding affects everyone)
  – Loading and uploading procedures are becoming a focus area
Early Indicators – Human Factors

Unsafe Acts
- 42%
- 23%
- 19%
- 16%

Preconditions
- 55%
- 45%

Did the employee incorrectly assess the situation?
Did the employee fail to follow prescribed procedure?
Did the employee fail to adhere to the work instructions?
Was the employee distracted by conditions?

Was the employee complacent?
Was the employee unfamiliar or inexperienced with this situation?
Early Indicators – Human Factors (continued)

Supervisory
- 18% Was there failure to recognize unsafe conditions or practices?
- 18% Was there failure to enforce rules and regulations?
- 23% Was there failure to provide oversight?
- 41% Was there failure to provide training?

Organizational Influences
- 15% Were policies/standards not monitored adequately for compliance?
- 19% Was there failure to identify and manage risks?
- 22% Was there insufficient reinforcement of standards/policies?
- 22% Was there failure to carry out activities consistent with values and expectations?
- 22% Was there failure to identify change and adequately plan?
Questions and Discussion