

Best Practices – Human Error Management Product Overview

May 4, 2017

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Acknowledgments

This document has been produced as a collaborative effort of the Mission Assurance Improvement Workshop. The forum was organized to enhance mission assurance processes and supporting disciplines through collaboration between industry and government across the U.S. Space Program community utilizing an issue-based approach. The process is to engage the appropriate subject matter experts to share best practices across the community in order to produce valuable mission assurance guidance documentation.

The document was created by multiple authors throughout the government and the aerospace industry. For their content contributions, the following contributing authors are acknowledged for making this collaborative effort possible:

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Iwona A. Palusinski	The Aerospace Corporation
Bonnie Valant-Spaight	The Aerospace Corporation
Laurie Stupak	Ball Aerospace and Technologies Corporation

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Roland Duphily	The Aerospace Corporation
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Eli Minson	Ball Aerospace and Technologies Corporation
Brian Reilly	DCMA



Best Practices – Human Error Management

Product Overview

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May 4, 2017

Agenda

- Motivation for product
- Product scope
- Product overview
 - *Best Practices*
 - *Examples*
- Team introductions



Human Error—"It" Happens

C-band reflectors removed and reinstalled on wrong sides at launch base

Bolts were torqued from memory

Manager walked into antenna while inspecting spacecraft

evacuation
exploded
gashed
dropped
stretched
dumped
fell
undocumented
hit
inadequate
left
heating
wrong
collided
scratched
damaged
incorrect
collapsed
inside
failure
cracked
memory

Tools left inside spacecraft and found during spacecraft rotation

Scissor lift collided with reflector

Vibe unit exploded due to undocumented procedure step

The wrong units were used (lbs vs. Kgs)

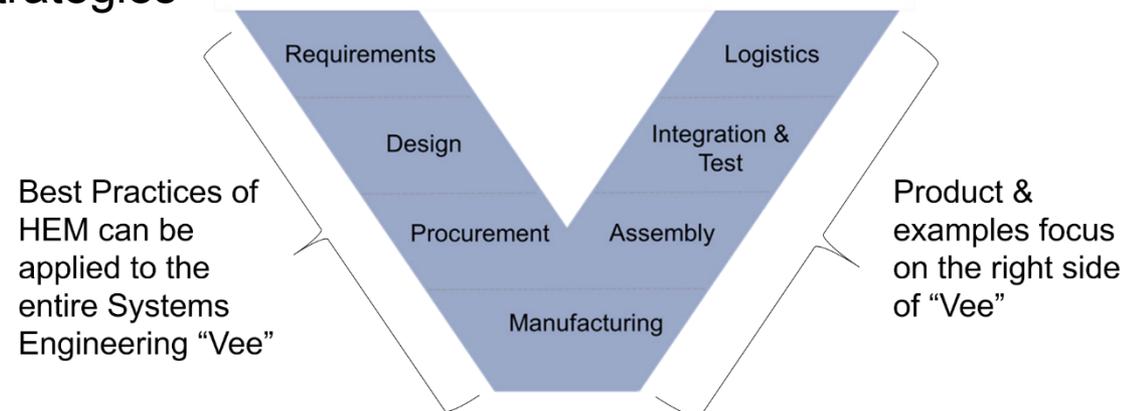
Why Human Error Management (HEM) Is Important

- Human contribution can be considered the most chaotic part of our processes
- Human error...“it” happens—and is accountable for over **50 percent** of errors in the aerospace industry
 - *These errors cost money, impact schedule, destroy hardware, and cost lives*
 - *These errors happen regardless of the measures in place to design them out, write the perfect procedure, or train all employees on how to do their tasks*
- Think about the last time you sat at your desk and wrote an email
- Think about the last time your company had an incident or failure due to human error
- Goals of the HEM Best Practices Product:
 - *Emphasize a **PROACTIVE** rather than reactive approach to managing human errors*
 - *Emphasize a **CULTURE** that is supported from the top down and which is based on more than just training*
 - *Define a uniform guideline with the objective of **REDUCED** human errors across the industry*



Product Scope

- Outlines Best Practices of human error management as a guideline to be considered for implementation at aerospace and subcontractor companies
 - *Product focuses on empowering the employees to MANAGE human error*
 - Human error will happen even with attempts to design it out
 - *Provides tools, models, and ideas to manage human error opportunities*
- Provides examples that focus on the right side of the Systems Engineering “Vee”
 - *Human errors and Best Practices apply through entire lifecycle*
- Presents a guide for companies to develop, improve, and/or strengthen their human error management strategies



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How Best Practices Were Developed

Human Error Vs Work Place Management: Areas to consider - Soumen Ganguly, 2011
Process Improvement Institute - "Human Factors and Their Optimization" - William G. Bridges, 2012
Office of Aviation Medicine - The Human Factors Analysis and Classification System- Scott A. Shappell and Douglas A. Wiegmann, 2000
Lifetime reliability solutions - Human rate error tables, Mike Sondalini, 2017
Normal Accident at Three Mile Island - Charles Perrow, 1981
The Field Guide to Human Error Investigations - Sidney Dekkar, June 2006
Evaluating Accident Models from Recent Aerospace Accidents - Nancy Leveson
SMS For Aviation - A Practical Guide: Human Factors - 2012 Civil Aviation Safety Authority
Human Error: Models and Management - James Reason, 2000
Skills, Rules, and Knowledge: Signals, Signs and Symbols, and Other Distinctions in Human Performance Models - Jens Ramussen, May 1983
Contextual Control Modes During and Airline Rescheduling Task - Karen Feigh, Amy Pritchett, Tina Denq, Julie Jacke - 2007
Toward a Theory of Situation Awareness in Dynamic Systems - Mica R. Endsley, 1995

~ Ball Aerospace
~ The Boeing Company
~ Harris Corporation
~ Lockheed Martin Corporation
~ Northrop Grumman Corporation
~ Raytheon Company
~ SSL

Models:
Input from
Literature

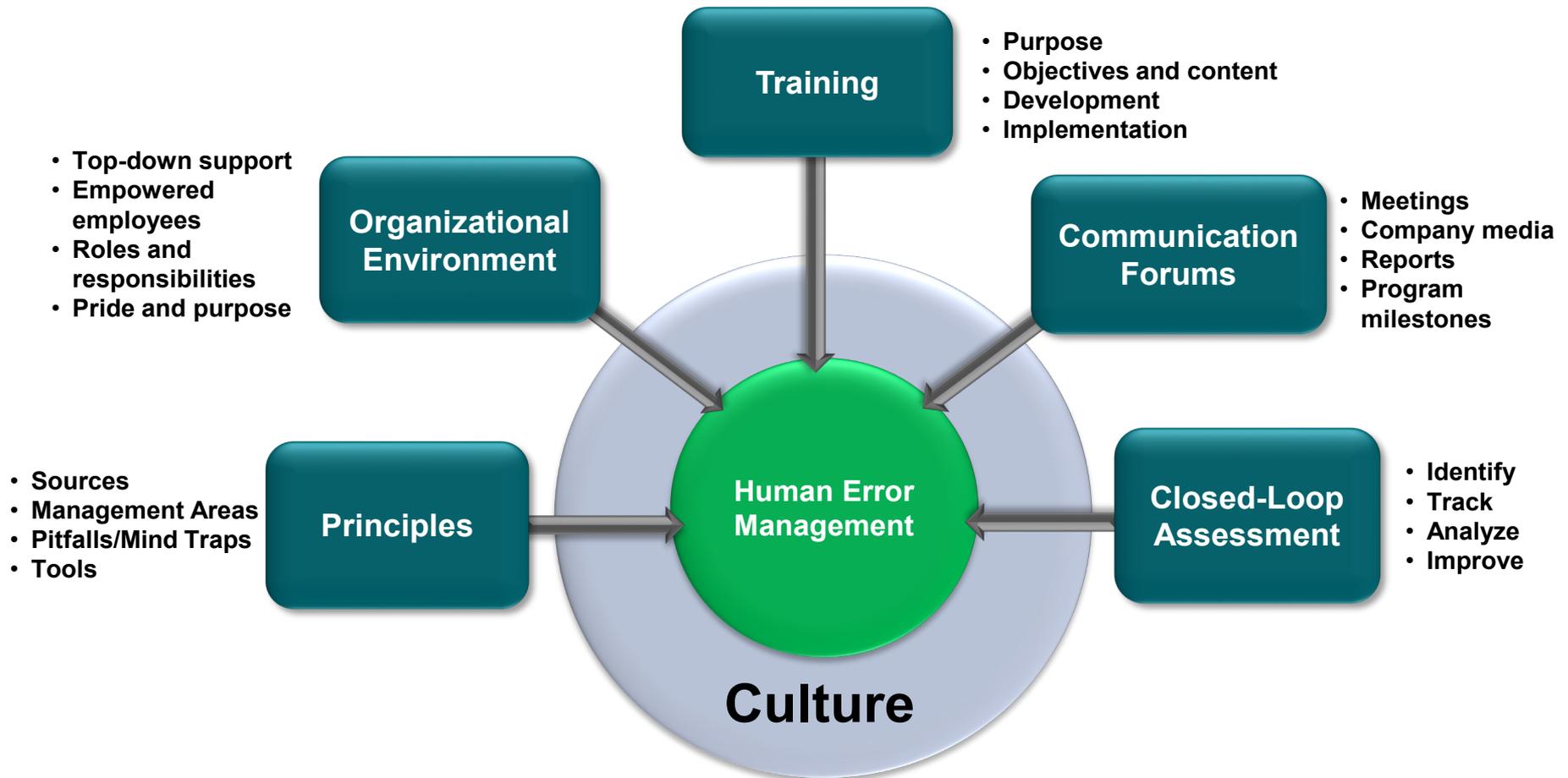
Implementation:
Current Company
Programs and Practices

Lessons
Learned:
Company
Experiences
and Culture

Best Practices – Human Error Management



5 Best-Practice Elements of Successful HEM Programs



Best Practices: Principles

Sources

Environmental
physical,
organizational,
process

Personnel
selection of
individual
training,
experience

Stress
personal,
circumstantial

Management Areas

Situational
awareness
management

Workload
management

Attitude
management

Group
dynamics
management

Risk
management

Communication
management

Pitfalls and Mind Traps

- Task saturation
- Distractions
- Repetitive tasks
- Communication breakdown
- Accommodation of risk
- Group think
- Hidden agenda
- Co-worker syndrome
- Excessive professional courtesy
- Hero/cowboy syndrome
- Alpha-dog syndrome
- Perceived pressure
- Risky attitudes
- Emotional stress
- Physical stress
- New situation/out of order
- Low workload (bored)
- High workload

Tools

[I'M SAFE]

[Gut feel]

[Time out]

[TEBS®]

[Asking: What could go wrong?]

[Checklists]
[AESOP™]

[Assertive statement]

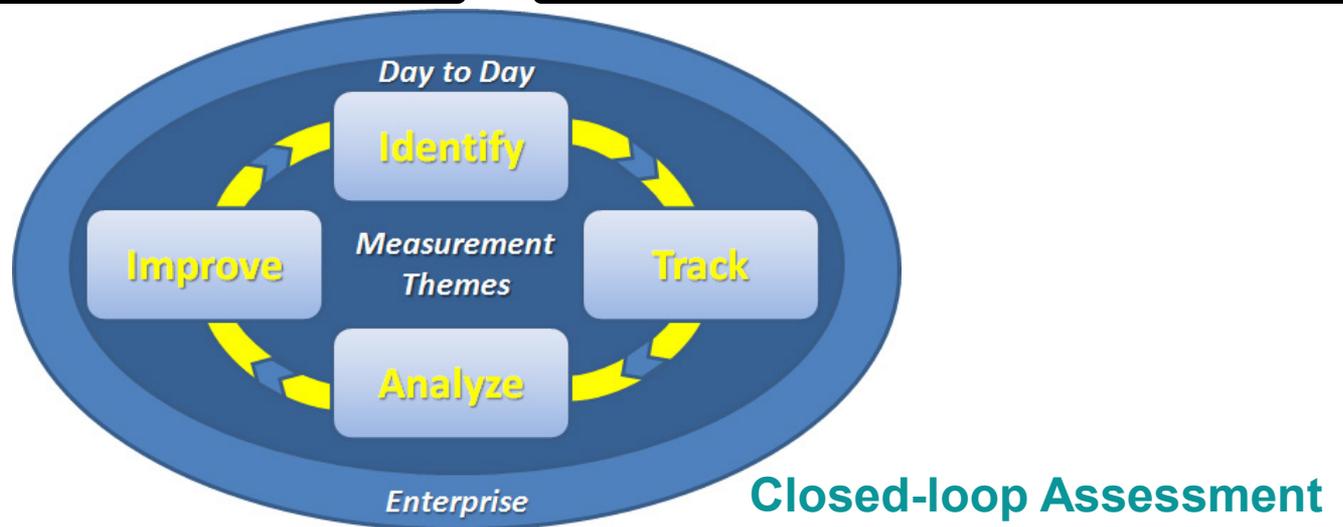
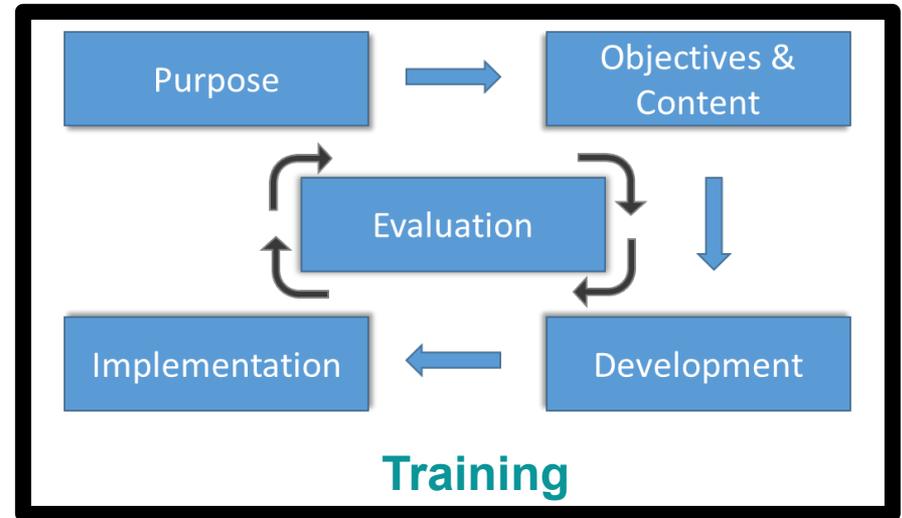
[Signs of loss of situational awareness]

[Slow down to speed up]

[ASK questions]

[Questioning attitude]

Best Practices Highlights



Human Error in the News

Incident: The wrong Best Picture winner was announced at the 89th Academy Awards® by Faye Dunaway and Warren Beatty. “La La Land” was announced when in fact “Moonlight” was the winner

Backstory:

Beatty was handed the envelope with the **WRONG** winner

- Received the duplicate card from the previous award
- The outside envelope actually had the previous award name
- PwC employee responsible for envelopes had just tweeted picture of the previous winner, Emma Stone, minutes before

Upon opening the envelope, Beatty hesitates to announce the winner.

"And the Academy Award..."

"...for best picture..."

Assuming Beatty is teasing the crowd, Dunaway jokingly pressures him.

"Come on,"

Still confused, Beatty shows the card to Dunaway who then **ANNOUNCES** the supposed winner.

“La La Land”

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Repetitive tasks?

Low workload —bored?

Distractions?

Upon opening the envelope, Beatty hesitates to announce the winner.

"And the Academy Award..."

Gut feel

"...for best picture..."

Assuming Beatty is teasing the crowd, Dunaway jokingly pressures him.

"Come on,"

Perceived pressure?

Still confused, Beatty shows the card to Dunaway who then **ANNOUNCES** the supposed winner.

"La La Land"

Hero syndrome?

Successful Best Practices Story

- **Situation:**

- *Large, wide, and heavy piece of critical ground support equipment (GSE) was delivered on a truck bed that was too long to back into facility loading dock (vendor error)*
- *Vendor insisted on attempting to maneuver truck to get into the building*
- *After many two-point turn attempts to situate the truck perpendicular to the loading bay, not only did many trees need to be cut down, but the truck became stuck in the facility landscaping*
- *Due to weight of GSE, the truck could not be moved until GSE was removed*

- **What now?**

- *Vendor did not have equipment to remove GSE off of truck bed*
- *Prime contractor had crane “inside” the building prepared to remove GSE once truck was inside*

- **New and unplanned task:**

- *Critical GSE needs to be safely removed from the truck without damage to the hardware or building or risking the safety of personnel*



Courtesy of Ball Aerospace and Technologies Corporation

Successful Best Practices Story

Training

Employees on program team had been proactively trained in the principles of HEM

Culture

- Proactive training
- Openly discussed
- Successes and activities openly communicated to customer

Principles

Workload Management

New situation, excessive/high workload, emotional stress (frustrating situation), physical stress (long day, manual labor)

“Shout out to Bob and Sally for encouraging a stop-and-think approach when it came to next steps and human safety.”

Attitude Management

Hero syndrome, perceived pressure, risky attitudes, pressure/get-it done, anti-authority, hero/show-off syndrome

“Even I got told to stop what I was doing.”
~ Responsible Engineer (RE)

Group Dynamics

Group think, excessive professional courtesy, strength of an idea, hesitant to critique others
“TEBS® was used as a tool to manage life and safety,” per RE who made a special effort to share how well the team did

Situational Awareness

Distractions due to numerous observers, sudden loss of judgment, communication breakdown
Early on, RE requested barriers be put up and that only those needed remain

Risk Management

Continuous critical thinking about what can go wrong, and appreciation of outcome

“Lots of ideas; we were careful to not take risks despite everyone involved”
~ Safety Engineer

Communication

Communication barriers between prime and vendor, excessive professional courtesy
Pre-meeting for lift defining remove and replace was held per system safety engineer

Best Practices

Management Areas
(Principles)

Tools
(Principles)

Pitfalls/Mind Traps
(Principles)



Human Error Management Product Summary

- Outlines Best Practices of HEM
- Facilitates the learning of HEM Best Practices through use of examples
- Provides a guide for HEM evaluation and implementation
- Human error management is not simply about taking a training class or about the card we all wear on our employee badges, it IS also about culture:
 - *A culture that empowers, communicates, and supports all employees around HEM*
 - *A culture where employees recognize their fallibility, and supervisors and managers do not point fingers*
 - *A culture that incorporates all Best Practices into the company's processes and way of thinking*



Core Team Members

Company	Participant
The Aerospace Corporation	Iwona A. Palusinski Bonnie Valant-Spaight
Ball Aerospace and Technologies Corporation	Eli Minson Laurie Stupak
The Boeing Company	Alfredo Nunez Thomas Pham James Poirier
Harris Corporation	Tony Fernandez Dave Hook
Lockheed Martin Corporation	Regina Palmer
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Northrop Grumman Mission Systems	Alisa Joseph
Raytheon Space and Airborne Systems	William Burk
SSL	Mark Seay
Missile Defense Agency	Ramin Chowdhury
DCMA	Brian Reilly

Co-leads
Steering Committee Champions



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Team Members - SMEs

Company	Participant
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The Aerospace Corporation	Kenneth Benner Matthew Binondo Suzanne Dawes Roland Dunphily Alan Kruger
Lockheed Martin Corporation	Tim Priser



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