Utilizing a Process Engineering Tool to Manage Workplace Safety, Health, Environmental and Ergonomic Risk in Commercial Airplane Production

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787 SHEA Representative
Boeing 787 Airplane Program
Safety Health and Environmental Affairs
6/6/07

Building the Dream
Setting New Levels of Leadership

- Less fuel used
- Lower emissions
- Quieter for communities, crews, and passengers
- Fewer hazardous materials
- Less waste in production
Composites Serve as Primary Structural Material

Carbon laminate: 50%
Carbon sandwich: 15%
Other composites: 10%
Aluminum: 20%
Titanium: 5%

Titanium/steel/aluminum: 5%
Dreamlifter Route Structure

- Section 41: Wichita, KS to Everett, WA
- Joined Section 47-48: Charleston, SC to Everett, WA
- Section 44: Grottaglie, Italy to Charleston, SC
- Section 46: Grottaglie, Italy to Charleston, SC
- Section 43: Nagoya, Japan to Charleston, SC
- Section 11/45: Nagoya, Japan to Charleston, SC
- Horizontal Stabilizer: Foggia, Italy to Charleston, SC
- Wing: Nagoya, Japan to Charleston, SC
Dreamlifter
Dreamlifter and DBL
Separated at Birth?
Everett, WA factory is certified with ISO 14001
ACSP  
Airplane Confined Space Permits

HECP  
Hazardous Energy Control Plans

FPWP  
Fall Protection Work Plans

HCIS  
Hazard Communication Information Sheets
<table>
<thead>
<tr>
<th>Data Source</th>
<th>Level</th>
<th>Ease</th>
</tr>
</thead>
<tbody>
<tr>
<td>DELMIA Process Engineer  &quot;SHEA Work Instruction Library Item&quot; used to populate Installation Plan&quot; (IP), pushed to Velocity-based &quot;Shop Order Instance&quot; (SOI)</td>
<td>3D</td>
<td>ME-Push</td>
</tr>
<tr>
<td>Excel-Workbook based &quot;Operations Library&quot; SHEA Note used to populate Installation Plan&quot; (IP), pushed to Velocity-based &quot;Shop Order Instance&quot; (SOI)</td>
<td>2D</td>
<td>ME-Push</td>
</tr>
<tr>
<td>Data Delivery</td>
<td>Level</td>
<td>Ease</td>
</tr>
<tr>
<td>Velocity-based &quot;Shop Order Instance&quot; (SOI)</td>
<td>3D or 2D</td>
<td>ME-Push</td>
</tr>
<tr>
<td>Data Source</td>
<td>Level</td>
<td>Ease</td>
</tr>
<tr>
<td>Web-Based access to full listing of 787SHEA documentation.</td>
<td>1D</td>
<td>MT-Pull</td>
</tr>
</tbody>
</table>
Standard Work: SHEA Work Instructions and Documents

HCIS (24) Hazard Communication Information Sheets

FPWP (60) Fall Protection Work Plans

HECP (114) Hazardous Energy Control Plans

ACSP (13) Airplane Confined Space Permits

IP Installation Plan

MT Manufacturing Technician (ultimately must implement these work instructions)
Who Uses the SHEA Wizard and Why?

- The SHEA Wizard is designed to assist Manufacturing Engineers (MEs) *in the performance of two required functions*:
  
  - Adding SHEA library Work Instructions (and associated Resource Objects) to a 787 Installation Plan (IP).
  
  - Creating a SHEA verification report for each 787 IP as a means of compliance with Program requirement to ensure a safe build process.
### Wizard Demo

For 787 Everett Commercial Use Only

<table>
<thead>
<tr>
<th>Wizard General Description</th>
<th>Output View: Key Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fall Protection Work Plan</strong></td>
<td></td>
</tr>
<tr>
<td>Will work be performed at heights of greater than 4 feet above the next lower level?</td>
<td></td>
</tr>
<tr>
<td><strong>Hazardous Material Control</strong></td>
<td></td>
</tr>
<tr>
<td>Will work be performed involving the use of, or exposure to hazardous materials (such as solvents, paints, adhesives, sealant, dusts, or other chemicals)?</td>
<td></td>
</tr>
<tr>
<td><strong>Aircraft Confined Space</strong></td>
<td></td>
</tr>
<tr>
<td>Will work be performed which requires partial or complete bodily entry into a confined space (such as a Stub, Wing, Keel Beam, 48 Section, or Vertical Fin)?</td>
<td></td>
</tr>
<tr>
<td><strong>Hazardous Energy</strong></td>
<td></td>
</tr>
<tr>
<td>Will work be performed which may cause employees to be exposed to uncontrolled hazardous energy (electrical, hydraulic, pneumatic, gravity, etc)?</td>
<td></td>
</tr>
</tbody>
</table>

[Go] [Clear]
### Current Checklist

**6 Ergo Risk Categories**
- Lifting
- Hand/Arm
- Overhead
- Push/Pull
- Bending
- Kneeling

#### 1) LIFTING

<table>
<thead>
<tr>
<th>ZONES</th>
<th>WEIGHT (in pounds)</th>
<th>COUNT</th>
<th>DAILY</th>
<th>TOTAL SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRIMARY</td>
<td>45</td>
<td>31</td>
<td>1.24</td>
<td>0.24</td>
</tr>
<tr>
<td>MODIFIED/PRIMARY</td>
<td>20</td>
<td>53</td>
<td>0.05</td>
<td>0.05</td>
</tr>
</tbody>
</table>

**TOTAL SCORE:** 0.34

#### 2) HAND/ARM

<table>
<thead>
<tr>
<th>ZONES</th>
<th>FORCE (in pounds)</th>
<th>COUNT</th>
<th>DAILY</th>
<th>TOTAL SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAND GRIP</td>
<td>15</td>
<td>600</td>
<td>0.15</td>
<td>0.15</td>
</tr>
<tr>
<td>PINCH GRIP</td>
<td>8</td>
<td>200</td>
<td>0.45</td>
<td>0.45</td>
</tr>
<tr>
<td>FINGER PRESS</td>
<td>8</td>
<td>100</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>THUMB PRESS</td>
<td>12</td>
<td>400</td>
<td>0.48</td>
<td>0.48</td>
</tr>
</tbody>
</table>

**TOTAL SCORE:** 1.17

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All total against a standard limit as defined by requirements incorporated in DELMIA

Cumulative
**Assignable SOIs**

<table>
<thead>
<tr>
<th>Title</th>
<th>Pre-Assigned</th>
<th>Elapsed Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Install Dorsal Fin</td>
<td>Y</td>
<td>15 Min</td>
</tr>
<tr>
<td>Initial Torque RH Tension</td>
<td>Y</td>
<td>15 Min</td>
</tr>
<tr>
<td>Final Torque RH Tension</td>
<td>N</td>
<td>------------</td>
</tr>
</tbody>
</table>

Production schedulers will make informed decisions to help reduce ergonomics risk exposure to production personnel. The “black” dot here indicates that this person will exceed a recommended exposure level should the assignment be made.

**SOI: Load & Lock L/H Blade Seals**

**MTs required: 2**

<table>
<thead>
<tr>
<th>Qualified MT's</th>
<th>ETA</th>
<th>Assign</th>
<th>Medical Restrictions</th>
<th>Ergo</th>
<th>Hrs Today</th>
<th>OT Hrs</th>
<th>Pay Hrs In Pay Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Tieks, Susan</td>
<td>5 Min</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>A Anthony, Kyle</td>
<td></td>
<td>Available</td>
<td></td>
<td></td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>A Mar, John</td>
<td>13 Min</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>A Hale, Mark</td>
<td>54 Min</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>A Norlin, Rob</td>
<td>1.62 H</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>A Yee, Sonny</td>
<td>2.42 H</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>A Sellers, Donny</td>
<td></td>
<td>Available</td>
<td></td>
<td></td>
<td>2</td>
<td>4.5</td>
<td></td>
</tr>
<tr>
<td>A Clemins, Jackie</td>
<td></td>
<td>Available</td>
<td></td>
<td></td>
<td>1</td>
<td>0.75</td>
<td></td>
</tr>
<tr>
<td>A Sawyer, Thomas</td>
<td></td>
<td>13 Min</td>
<td></td>
<td></td>
<td>3</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>A Newton, Paula</td>
<td>FAD01PAP0300</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>U Scotts, Darrell</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>U Tawson, Henry</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>U Wilson, Caleb</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>C Daniels, Tyler</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>W Kenyon, Farris</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>V Diers, Paul</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>V Fisher, Karri</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>
SHEA Input to Standard Work Operations and Resources
## EMERGENT WORK

**Ease Data Delivery**

<table>
<thead>
<tr>
<th>Data Delivery</th>
<th>Ease</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intercim</strong> Velocity-based, SHEA-type</td>
<td>MT-Push</td>
</tr>
<tr>
<td>“Emergent Event” is submitted</td>
<td></td>
</tr>
</tbody>
</table>

**Response**

<table>
<thead>
<tr>
<th>Response</th>
<th>Ease</th>
</tr>
</thead>
<tbody>
<tr>
<td>787 SHEA Representative responds.</td>
<td>SHEA - Pull</td>
</tr>
</tbody>
</table>
### Emergent Event

**Where in Boeing**

- SST 1 FINAL ASSEMBLY
- SHEA

**On Airplane / Not on Airplane**

- On-Airplane
- CAN NOT CONTINUE WORKING

**Emergent Event User Group**

- SHEAR

**Line Number**

- 1

**Model**

- 787

**Position**

- WORK AREA

**Work Center ID**

- 1

**Coordinate System**

- X, Y, Z

**Initiator Name**

- Magida, Steven J

**Phone #**

- 456-238-2843

**E-mail**

- steven.j.magida@boeing.com

**DateTime**

- 2007/06/20

### SHEA

**Is this an emergency that requires immediate Fire or Emergency Medical Response?**

- No

**Is this a SHEA issue which needs to be addressed immediately to avoid injury or environmental degradation, or disruption to flow?**

- Yes

**SHEA Discrepancy**

- CONFINED SPACE
- HAZARDOUS ENERGY
- OTHER
- CHEMICAL EXPOSURE/SPILL
- FALL HAZARD
- ERGONOMICS RISK
- OTHER SAFETY ISSUES
<table>
<thead>
<tr>
<th>Task ID</th>
<th>Description of Discrepancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1460-01-A-EE VALIDATION-1</td>
<td>Alisse states that Tooling Assist is needed to obtain cross supports (2X4s) for floorboards. Manager Bob Wharton provided details:</td>
</tr>
</tbody>
</table>

Manager: Bob Wharton
Date: Friday, May 11, 2007 11:06 AM
Notes: Applicable reference is FFWT-787-100: “Pre-Integration: Floor holes in Body Section.”
Progressing on Schedule

- **Airplane Announcement**: 2002
- **Authority to Offer**: 2003
- **Program Launch**: 2004
- **Firm Configuration**: 2005
- **Start of Major Assembly**: 2006
- **787-8 First Flight**: 2007
- **787-8 Enters Service**: 2008
- **787-3 Enters Service**: 2009
- **787-9 Enters Service**: 2010
Key Concepts

- You customer will undoubtedly tell you “Safety is my number one priority”.

  That’s great.
  But just for good measure, **find out what your customer’s number 2, 3, 4 and 5 priorities are**; see if your safety program facilitates them reaching those goals too...

- **Focus on your end user**, and make sure that he/she has ready access to your program information, can understand it, and can let *you* (the Safety Professional) know when you’ve screwed up.

- **Utilize your customer’s core systems** as much as possible,
  …while retaining as much independent control of content as possible.

- **Don’t confuse the “model” with “reality”**.

  All this stuff is really cool, but it will not help your customer to reduce injury and illness if the instructions are not implemented.
Boeing principles for Safety, Health and the Environment have been incorporated early in the 787 design phase. The integration of safety, environmental and ergonomics professionals in the product design process will have lasting benefits throughout the 787 life cycle, resulting in:

**An Airplane that is Better for People**

- Integrated philosophy for worker safety and the environment through design
- Focus on leading indicators and proactive intervention
- Ergonomics and Safety considerations incorporated in Tooling and Facility Designs
- Engineering tools and processes adopted/used by SHEA professionals
- >75 SHEA design requirements and objectives in six key areas of risk
- Ergonomics evaluations of 2000+ Installation Plans (IPs)
- Safe Work Instructions included by process in Installation Plans (IPs)
- Incorporated into Everett Site ISO14001 certification
- 787 2007 LWDCR Target = 1.0
Questions ?

Building the Dream

787 DREAMLINER®