The Essential Elements for Safety (\& Productivity)

Improvements in an Aviation Environment

Denver Lopp, Purdue University
Christy Brazee, UW-SP
Industry Trends & Safety

- Passenger Growth
  - Corporate Aviation
- Cargo Growth
  - New Business Jets
- Financial Situation
- New Realities
  - Outsourcing
  - International Impact
Example of New Aviation Model

Complexity via Maintenance Out-Sourcing

- Increased technical requirements
- 5 different air carriers
- 12 different aircraft
- 7 different FAA PMIs
- PMI for each air carrier
- PMI for 145 operator
- Different procedures for same aircraft
Operational Goals in Common

- Reduced “turn backs”
- Fewer write-ups
- Reduction of lost-time injuries
- Decrease in ground damage
- No accidents

Requires “Best Practices” for the Organizational System
Driven by Assumptions...

- One best way
- Policies/Procedures for all contingencies
- Manage people through process

Therefore, believe that...

Aviation Operations are Linear

Not True!
Much More Complex...

• Too many factors to manage fully
• Highly interdependent
• Constantly needing to adjust to changing environment (people, work, & physical)
• Multiple causations possible

Therefore...

Can’t reliably predict & can’t fully prepare
Complexity Model of Accident

Air Florida, Flight 90
# Points of Complexity

<table>
<thead>
<tr>
<th>Complexity Web Analysis</th>
<th>NTSB Recommendations</th>
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<tbody>
<tr>
<td>1. Ice on Plane</td>
<td>1. + + + + + +</td>
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<td>3. Time</td>
<td>3. +</td>
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<td>5. Deicing Crew</td>
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<td>7. Soft Field Takeoff</td>
<td>7.</td>
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</tbody>
</table>
Adopt Complexity Perspective...

- Behavior not predictable, but can adapt
- Simple rules create complex behavior
- Manage process, not people
- Foster view of system as dynamic

ORDER  CHAOS
Throughout our studies...

A central theme

- Ten years plus of aviation industry research
  - Airlines, MROs, Corporate Ops, Airports
  - FAA, NTSB, & other regulators
  - Domestic & International operations

- Safety = Major Concern

- Safety & Productivity = Tradeoff

*Need safety & productivity aligned!*
Competing Messages...

• “Safety is Number One Priority”
  – Staff meetings & reports focus on cycle times, on-time departures, aircraft readiness
  – Safety index for the week? Common answer is “huh?”
  – Large signs designating “Safety as #1” Becomes Wallpaper
4-Essential Elements of Safety

- Drive...
- Education
  - Effectiveness
  - Efficiency
  - Adaptability
- Infrastructure
- Work Process
- Measurement
Infrastructure

Organization’s Safety Support System
Organizations

Top Management

Middle Management

1st-Level Managers & Supervisors

Safety Team

Employees
Top Executive Team

• Determine success or failure by having the understanding and desire for allocating resources for:
  – Infrastructure
  – Establishing standard processes
  – Measurement
  – Education
Middle Management

• Caught in the middle
  – Make top management’s ideas happen
  – Change frontline workers’ behaviors

• Often divest their safety responsibility
  – Dedicate manpower to safety team
  – Seen as disconnected & less safety focused
1st-Line Management & Supervisors

• Safety Roles
  – Set working expectations
  – Responsible for enforcement
  – Establish importance of safety in culture

• Typically set up for failure...
  – Great technical skills
  – Poor organizational and people skills
  – Hired based 90% on technical skills
  – Fired based 10% on people skills

Determines safety success or failure
Organizations

1st-Level Managers & Supervisors

Middle Management

Top Management

Employees (The Focus)

Safety Team
Top Executive Team

• “Lives and breathes” safety as a priority

• Stays the course furnishing leadership and management of key elements

• Becomes involved directly
Management Team

• Middle Managers
  – Provide necessary resources & support
  – Demonstrate involvement & importance

• 1st-Level Managers & Supervisors
  – Model appropriate safety behaviors
  – Enforce safety in policies & procedures
  – Reinforce good safety practices
### What do we know?

#### Types of Organizational Cultures

<table>
<thead>
<tr>
<th>Pathological</th>
<th>Bureaucratic</th>
<th>Generative</th>
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<tbody>
<tr>
<td>• Don’t want to know</td>
<td>• May not find out</td>
<td>• Actively seek it</td>
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<td>• Messengers (whistle-blowers) are ‘shot’</td>
<td>• Messengers are listened to if they arrive</td>
<td>• Messengers are trained and rewarded</td>
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<td>• Responsibility is shirked</td>
<td>• Responsibility is compartmentalized</td>
<td>• Responsibility is shared</td>
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<td>• Failure is punished or concealed</td>
<td>• Failures lead to local repairs</td>
<td>• Failures lead to far-reaching reforms</td>
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<tr>
<td>• New ideas are actively discouraged</td>
<td>• New ideas often present problems</td>
<td>• New ideas are welcomed</td>
</tr>
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*Reason, 1997, “Managing the risk of organizational accidents”*
### Types of Organizational Cultures

<table>
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<tr>
<th>Least Safe</th>
<th>Most Safe</th>
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- Reason, 1997, “Managing the risk of organizational accidents”
• At 1st-level management & supervisor levels, process goals and day-to-day operations adopt “norms” approach.
  – “Don’t mess with it if it’s not broke.”
  – “Works well enough.”

• “Get it done” attitude overtakes adhering to standard procedures.
  – “Worked out fine the last time.”
Often supervisors will respond with:

– I am too busy, and usually they are....

• Filling out paper work
• Answering e-mails
• Determining schedules and days off
New processes & improvement opportunities are often discarded due to limited “buy-in” by day-to-day operators.

– “Won’t last... never do.”
– “Can’t support it.”
– “Won’t work in my operation.”
– “They won’t check if we do or don’t.”
Influencing Employee Behavior

Purdue Research found...

– Peers reported to have most influence
– Supervisors as having least impact

**Problem:** Supervisors rely on authority of position rather than peer influence
Setting Tone of Work Environment

Most Influential - Lead (52%)
Most experienced technician (23%)
Older technicians (8%)
Technical peers (6%)
Team Coordinators (3%)

Least Influential - Manager (2%)
1. Focused, planned operational approach
   - Upper - middle - lower levels in organization

2. Safety roles & responsibilities defined at all levels

3. Organizational decisions & behaviors demonstrate safety commitment

4. Peer influence impacts behavior most so establish “champions”
Work Process

“Doing” Safety & “Doing” Safely
Often a disregard for the importance of policies & procedures and established work processes.
Survey:

Maintenance procedures NOT followed **25%** of the time.

20. In your experience, what percentage of the time do you feel company maintenance procedures are followed? **75%**

37. In your experience, what percentage of time do you feel company maintenance procedures are not followed? **26%**
Doing Work...

• Organizations have SOPs & Rules
• Normal Working Conditions...
  – May or may not follow procedures
  – Safety more likely taken for granted
• Unusual or Unexpected Conditions...
  – May rely more heavily on SOPs & Rules
  – May identify gaps in safety knowledge
General Finding...

Organizational tools designed to support and direct work processes are problematic in their application by technicians.

Policies / Procedures / Manuals
Policies and Procedures

- Procedures and policies driven by company’s organizational methodology
- Guided & designed per FAA regulations and oversight mechanisms
  - Written format – “Big Book”
  - Does not account for daily operation usage
- Written & verbal format for visually-driven technicians
Technicians indicate they believe:

26% of written procedures are incorrect

They occasionally/frequently encounter procedures which are unsafe
Procedural Manuals:

- Confusing and difficult to use
- Written in vague and general terms
- Difficult to change/update/correct
- Poorly organized for use
- Often duplicate procedures, sometimes with conflicting instructions
General Finding...

Lack of understanding in how different career fields & work processes interact

- AND -

the overall effects of these interactions on work safety and customer satisfaction
Organizational Silo’ing

• Career fields focus only on their “parts” of the work process
  – Lose track of the organization’s product

• Lose track of impact of own work on work of others
  – Within & across career fields
  – Time & operational pressures encourage narrow focus
Research Findings: Poor Working Relations

Work process is a major contributor to workplace conflicts

- Conflicting tasks
- Redundant tasks
- Misaligned tasks
- Operational constraints
Dynamic Work Environment

• Too many factors to ensure effectiveness of routine work processes over time

• Creates additional tensions with uncertainty of implications on goals

• How system get back on track?

Therefore, need process standards for technicians to target their efforts toward
Develop Standard Processes

• Beyond tasking to process integration
• Address changing environment via technician adaptability
• Encourages & expedites recovery

*Manage system rather than individuals*
Process Maps Strategy

A visual representation of the Entire Set of Work Steps that must be performed to meet operational goals & objectives.
Process Mapping Benefits

• Helps establish roles & responsibilities
• Defines process ownership & accountability
• Promotes better communication & coordination
• Foundation for continuous improvement
• Fosters more informed decision-making
• Generates more efficient resource utilization
Purdue Research...Examples

- Airline On-Time Performance
- Airline Positive Pax Bag Matching

- **Shift Turn-Over Process in a heavy maintenance operation**
Process Comparison Between Bays

1st Bay’s process map

2nd Bay’s process map

3rd Bay’s process map
Issues Noted During Assessment

- Information flow was ineffective:

  **Off-Going Shift**

  - Bay Manager
  - Lead
  - Technicians Doing the Task (4-8)

  **On-Coming Shift**

  - Bay Manager
  - Lead
  - Technicians Doing the Task (4-8)
Shift Turnover

Critical Information

• Critical details of the work in progress were lost during shift turnover

  – Bay Shift Manager  (18 items & unusual conditions)

  – Lead  (35 items)

  – Technician  (39 items & process information)
Structured/Tested new process

• Designed a new shift turnover process
• Selected a test bay
• Trained Leads and technicians in process
• Implemented the strategy
• Measured the effectiveness of the process
  – Pre-implementation aircraft & historical data
  – Two test aircraft
Direct Transfer of Shift Turnover Information Between Technicians

Benchmark: 7%
1st Aircraft: 58%
2nd Aircraft: 65%
Incidents of Task “Rework”

- Benchmark: 38
- 1st Aircraft: 22
- 2nd Aircraft: 11
Company officials estimated that the new process saved...

$140,000 to $160,000 per aircraft
Work Process Take-Aways...

1. Manuals more useful & user-friendly
2. Maps to provide “big picture” view
3. Align work process interactions & interdependencies
4. Revisit processes to improve & adapt on regular basis *(scheduled & as needed)*
Measurement

Direction & Displaying “Value”
Why Safety Programs Fail...

Found organizations **DO NOT**:

- Understand & consider **ALL** sources of safety errors
- Measure operational safety effectively
- Approach safety in a systematic way
- Roles & responsibilities not clearly defined
Problem with Measuring Safety

Traditionally, safety is measured reactively...

✓ after an accident, incident, or injury occurs
✓ investigations stop after identifying “who” made the error
✓ interventions focus on proximate conditions not the actual “root cause” of the event
✓ prevention strategies generally do not change unsafe behaviors
Reactive Measures...

• Lead to “catch-up mode”
  – Data 24 hours behind... at best!

• No plan for determining the operational factors to measure

• No plan for identifying the influence of and impact on the system

• Years of established measurements that get filed, but not used  *(Hubble Effect)*
• When asked what the level of safety is at their operation, most managers can only report...

“We haven’t had an (accident, aircraft damage, injury) for (1,2,6…weeks, months)”

Fails to provide direction toward effective preventative safety approaches
Proactive Safety Measurement system

We need to:

✓ Build comprehensive safety information database

✓ Identify the “root causes” of errors

✓ Track changes in worker behaviors

✓ Address organizational conditions that promote errors

✓ Develop a method for continually monitoring and improving operational safety
Real-Time Safety Measurement

To truly *prevent* future errors, we must...

- Accurately assess current levels of safety
- Identify emerging error potentials
- Adapt and adjust error management strategies to meet changing needs
Goal – Design a Safety Metric which will:

✓ Measure the level of unsafe acts (real-time)
✓ Identify the most common sources of errors
✓ Target “top three” at-risk behaviors for each career group for intervention strategies
✓ Monitor & report changes in error potentials
✓ Trend safety level over time to show progress
## Safety Metric Checklist

<table>
<thead>
<tr>
<th>Aircraft Arrivals</th>
<th>Termina</th>
<th>Hangar</th>
<th>AJC Mov</th>
<th>Personal Accountability</th>
<th>Not Following Procedure</th>
<th>Communication</th>
<th>Incompatible Goals</th>
<th>Work Process Design</th>
<th>Training</th>
<th>Equipment</th>
<th>Interline Operations</th>
<th>Construction</th>
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<tbody>
<tr>
<td>1. No UAL approved hearing protection used</td>
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<td>2. AMT not on gate/hanger for arrival</td>
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<td>3. PLB not in box</td>
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<td>4. Fire extinguishers obstructed/not in correct position</td>
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<td>5. FOD walk not performed</td>
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<td>6. Improper envelope parking observed</td>
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<td>7. Envelope parking not enforced</td>
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<td>8. Improper guideman signals position</td>
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<td>9. Inappropriate wands used</td>
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<td>10. Proper chocks not used immediately after blocked</td>
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<td>11. PLB warning light &amp; bell not used</td>
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<td>12. Arrival/FOA walk around not performed</td>
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<td>13. FOA damage not reported/investigated</td>
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<td>14. Bypass pin not installed before towbar connect</td>
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<td>15. Streamer not installed on bypass pin</td>
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<td>16. AMT crossed over AJC towbar</td>
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<td>Comments/Others (Facilities, Airport Ops, etc...)</td>
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</table>
Maint. Arrival Weekly Totals

Infractions per Day

- □ FOD walk not performed
- □ AMT not on gate/hanger for arrival
- □ Fire extinguishers obstructed/not in correct position

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<td>Root Cause Percentages</td>
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<tr>
<td>Personal Accountability</td>
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<td>0%</td>
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<td>0%</td>
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<tr>
<td>Construction</td>
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<tr>
<td>100%</td>
<td>0%</td>
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</table>

FOD walk not performed

Root Cause Percentages

- Personal Accountability: 0%
- Not Following Procedure: 0%
- Communication: 100%
- Incompatible Goals: 0%
- Work Process Design: 0%
- Training: 0%
- Equipment: 0%
- Interline Operations: 0%
- Construction: 0%
Purdue’s Safety Metric

Station’s 10-month safety history reviewed

– 20 events (incident/accident) occurred
– Causes were reviewed and compared to at-risk behavior reports for same time period
– Behavior captured by observation checklist was defined
– Behavior predicted by the metric was recorded
### Safety Metrics Success

<table>
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<th>Metric</th>
<th>Value</th>
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<tr>
<td>Total Mishaps</td>
<td>20</td>
</tr>
<tr>
<td>Items not captured by checklist</td>
<td>7</td>
</tr>
<tr>
<td>Items captured by checklist</td>
<td>13</td>
</tr>
<tr>
<td>Errors predicted during period</td>
<td>10</td>
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</table>
Measurement Take-Aways...

1. Develop & implement proactive safety behavior measurement systems
2. Identify at-risk behaviors/conditions and track effectiveness of safety strategies
3. Regularly discuss & address safety issues in station operations meetings
4. Share reports & proposed strategies with technicians (encourage participation)
Education

Safety Learning & Application
Need for Focus on Education

- Promotion to management positions based on technical skills & tenure
  - Training focuses on paperwork & legal regulations
- Management training conducted when a crisis has occurred
- Additional promotion based on survivor mode
- Limited support amongst management peers
Where does Education occur?

What does Education include?
Education more than Training

- Professional training
- Formal training sessions
- O-J-T
- Mentoring - formal & informal
- Individual interpretation & sensemaking
- Management instruction
- Management feedback (& lack thereof)
Limitations to Traditional Training

I. Learning part of daily work experience

II. Piecemeal approaches to learning

III. Removed from work environment

IV. Too narrowly focused on particular events, incidents, and behaviors
Part of Daily Work Experience

- Watching others in work environment
- Model after management’s behaviors in work environment
- Observing management’s reactions to other workers’ behaviors
- Feedback or instruction from peers
Piecemeal Approaches to Learning

• Reduce complex subject to simple parts
  – **Not provide holistic view**
  – **Parts by training sessions, not natural breaks**

• Reactive training as deficits identified
  – **Not account for dynamic work/workplace**
  – **Create static training modules w/o updates**
• Difficulty applying in actual setting
  – Hands-on practice vs. “book” learning
  – Lack of correspondence to actual doing

• Work groups not trained together
  – Expected to maintain training vs. norms
  – Lack of confederates in work environment
  – Exaggerates difficulties of un-learning
Too Narrowly Focused

- Trainings designed to address specific topics or problems \textit{(reactive)}
- Unable to account for all contingencies
  - Little attention to methods for adaptation
  - May direct away from root cause analysis
- Not account for upstream & downstream factors in work flow
Management & Supervisors...

*Little focus on “People” Skills*

- Much promotion per seniority
- Great technician not mean great manager
- Little training in how to manage others
- Difficulty making transition from peer
Review of In-House Supervisor Education

- Over 75% of content & time spent on paperwork & technical skill development
- Specific safety training... Apart from ops
- “Soft” skills largely ignored
How do Technicians learn procedures?

42% Classroom training
35% Taught by OJT
9% Self-taught
8% Informally from other mechanics
4% Never informed at all
Management *demonstrates* Values

- Own behaviors in work environment
- Corrective feedback to technicians
- Reinforcing feedback to technicians
- Lack of feedback (“let it slide this time”)

*Training & education are part of management’s roles & responsibilities in daily activities*
Education Take-Aways...

1. Adopt “learning” approach & adapt to changing environment
2. Encourage (varied) learning application
3. Develop “big picture” understandings
4. Provide constant & consistent reinforcement via mini-lessons
Essential Elements of Safety

- Work Process
- Infrastructure
- Education
- Measurement
Because Safety is Complex...

• Account for nonlinear nature of safety

• Develop standards & clear expectations for effectiveness & efficiency

• Allow & encourage adaptation to SOPs

• Design integrated proactive & retrospective views of work behavior
As stated by one technician -

“Revamp the safety program to an on-going safety process with direct input and feedback from the floor.”

Anonymous Technician