At-Risk Safety Metric

A Proactive Safety Measurement Strategy

presented by

Dr. Gary Eiff

Purdue University Aviation Human Factors Research Team
Measuring the Level of Safety in Aviation Operations

There is an industry-wide struggle to accurately:

- Determine the level of safety of operations
- Identify the true causes of unsafe conditions
- Measure and trend operational safety
The 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 real “root cause” of the event
- prevention strategies generally do not change unsafe behaviors
How Safe Is Your Operation?

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)”

Such “bad outcomes” are rare enough that they provide little insight into how to effectively prevent errors!
Maintenance Human Error Iceberg

- Accident / Incidents
  - Reportable Events
    - Operationally Significant Events
    - IFSDs, ATBs, Delays, Cancellations
    - Unreported Errors

Numbers:
- 1
- 40
- 600
What’s the difference between…

Circumstances

Accidents  Incidents

Personal Injuries  Reportable Events

Unreported Errors
Results of Reactive Approach

Safety measurements based only on accidents & incidents

- Allow analysis only after a “bad outcome” has resulted
- Does not provide enough data to accurately trend error potentials
- Provides little insight into “root causes” of unsafe acts
- Does not accurately identify conditions

Like the “Gopher Game” at an arcade, prevention strategies based on such measurements are always trying to catch-up with errors
To Move Toward a

Proactive Safety Strategy

We need:

- A comprehensive safety information database
- To identify the “root causes” of errors
- Change worker behaviors
- Address organizational conditions which promote errors
- Develop a method for real-time monitoring and continual improvement of operational safety
Need More Information…

Need a more robust database of errors/causes…

- Accidents / incidents historic data
- Aircraft & ground equipment damage
- Personal injury
- “Near-miss” and safety concern reports
- Real-time assessment of “at-risk” worker behaviors and operational safety levels
…which leads to effective solutions

To be effective, safety measurements should:

- Accumulated records in a common database
- Provide a common classification scheme of “root causes”
- Periodically report “top” safety problems to promote targeted interventions
- Trend safety levels to show improvements and areas of opportunity
We need to look more closely at *Unreported Incidents*

... That is, the day-to-day activities and conditions which lead to bad outcomes...

...If we can change unsafe conditions and behaviors and reduce unreported errors, then accidents and incidents will also be reduced...
Assessing Safety in Real-Time!

Aviation work environments are in a constant state of change… to truly prevent future errors, we must…

- accurately assess current levels of safety
- identify emerging error potentials
- adjust error management strategies to meet changing needs

We must be able to measure safety in “real-time”!
The Missing Tool for a Proactive Approach to Safety

The key to unlocking a truly proactive approach to managing errors lies in being able to monitor:

✓ Workers’ at-risk behaviors
✓ the operation’s level of unsafe acts & errors

...day-to-day in the workplace.
Purdue’s Safety Metrics System

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 and report changes in error potentials
- Trend safety level over time to show progress
At-Risk Behavior Safety Audit

Safety in “real-time”  - A Beginning -

Previous Research - Actions of workers which most often lead to errors, incidents, accidents…

- Not following procedures
- Knowingly taking risks
- Loss of situational awareness
- Not adhering to accepted safety practices
To Be Measurable; at-risk behaviors must be

Observable – through
  • physical actions
  • records / reports
  • work related outcomes

(Can not measure things like)
  - intentions
  - thoughts

Clearly Identifiable

Unambiguous
Defining the “at-risk” behaviors to be measured…

Working with the industry partner team…

Identify common errors which lead to unsafe acts

✓ Review historic data to identify common errors
✓ Define work process and safe practices
✓ Evaluate policies & procedures

Determine which at-risk behaviors can be observed

Fully define observable indicators of at-risk behaviors

Develop observational checklist

✓
### Aircraft Arrivals

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<thead>
<tr>
<th>Behavior</th>
<th>Terminal</th>
<th>Hanger</th>
<th>A/C Move</th>
<th>Bag</th>
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### Comments/Others(Facilities,Airport Ops,etc…)

- No Co. approved hearing protection used
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- Fire extinguishers obstructed/not in correct position
- FOD walk not performed
- Improper envelope parking observed
- Envelope parking not enforced
- Improper guideman signals/position
- Inappropriate wands used
- Proper chocks not used immediately after blocked
- PLB warning light & bell not used
- Arrival/FOA walkaround not performed
- FOA damage not reported/investigated
- Bypass pin not installed before towbar connect
- Streamer not installed on bypass pin
- AMT crossed over A/C towbar

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**Sample Safety Observation Checklists**

**Selected At-Risk Behaviors**

- No Co. approved hearing protection used
- AMT not on gate/hanger for arrival
- Fire extinguishers obstructed/not in correct position
- FOD walk not performed
- Improper envelope parking observed
- Envelope parking not enforced
- Improper guideman signals/position
- Inappropriate wands used
- Proper chocks not used immediately after blocked
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- Arrival/FOA walkaround not performed
- FOA damage not reported/investigated
- Bypass pin not installed before towbar connect
- Streamer not installed on bypass pin
- AMT crossed over A/C towbar
- Comments/Others(Facilities,Airport Ops,etc…)

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**Sample Safety Observation Checklists**

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<tr>
<th>Aircraft Arrivals</th>
<th>Terminal</th>
<th>Hanger</th>
<th>A/C Move</th>
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**Company Defined Root Causes**

- No Co. approved hearing protection used
- Eq, not parked in designated area
- Eq. not positioned clear of the envelope
- Driving in front of aircraft during arrival
- Envelope incursion before chocked
- Warming light & bell not used
- No FOA check prior to Eq. moved into position
- FOA damage not reported appropriately
- Approach to A/C before engine shut down
- Improper positioning of eq. at aircraft
- Beltloader/Cargoloader bumper contacting A/C
- Unnecessary driving under aircraft profile
- Personal items observed on vehicles

Comments/Others(Facilities,Airport Ops,etc…)
Monitoring Unsafe Behaviors

Workplace safety observations

Each Day on Every Shift, members of the station’s safety team:

- Observed at least 2 complete operations per career field per shift
- Recorded the number of occurrences of each at-risk behavior
- Monitored and recorded unsafe conditions in the workplace
- Performed worker interviews to determine “root causes” of behavior
- Provided immediate feedback and safety mentoring to workers
Safety Metrics Program Structure

On the program disk

Safety Metrics Program Folder

Cabin Service
- Lav

Customer Service

Maintenance

Ramp

Cabin Service
- Lav Arrival
- Lav Depart
- Lav Serv

Customer Service

Maintenance Arrivals Data

Maintenance Departure...

Maintenance Serv Data

Ramp Arrivals Data

Ramp Departu...

Ramp Serv Data

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Opening a data entry sheet

1. Open Microsoft Excel or simply open the desired file by double clicking the sheet’s icon
### Entering Data

- Enter observation checklist data into the program’s spread sheet

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3. Record the number of observational checklists from which the data is being transferred

- The number of sheets entered is set to “1” by default
- BUT, if you combine more than one checklist together before transferring the data to the database, enter the total number of observation sheets represented by the data in this block
- Press “ENTER” button

(NOTE - if the button does not work, make sure that no cell is still active with a blinking cursor)
4. Compiling the data produces a graph of the top three safety infractions for each workgroup

- Enter the average number of flights per day
- Press the “COMPILE” button

Note - if the button does not work, make sure that no cell is still active with a blinking cursor
If any of root cause boxes contain “DIV/0” it is not an error. It simply means that there is no data for that root cause.
Early Results…

After three months of observational safety audits…

✓ Workers & management more focused on safety
✓ Safety mentoring producing measurable behavioral changes in workers
✓ Error management interventions more easily definable
✓ Aircraft & equipment damage reduced
✓ Personal injuries reduced
✓ Measurable productivity improvements
Safety Metric Program - The Future

Opportunities for improvement:

- Observation training modules for observers
- Data-entry training for industry partner teams
- Strategy for adapting to new workplace settings
- Movement toward ACCESS based program
  - More user friendly
  - Multiple source database (accident, near-miss, etc.)
  - Searchable “comments” section
  - Linkable / sortable by “root causes”
Thank You

Aviation Human Factors Research Team
Aviation Technology Department, Purdue University