Was It Really a Miracle on the Hudson? Aviation Systems Engineering Meets Health Care Safety

Capt. Jeff Skiles
First Officer on US Airways Flt 1594
&
Rollin “Terry” Fairbanks, MD MS
MedStar Health / Georgetown University

Was it Really a Miracle on the Hudson?

Jeff Skiles
Air Transport Pilot, US Airways
Vice President of Chapters and Youth Education, EAA

www.JeffSkiles.com
Primary Cause of Accidents Worldwide

Boeing Data
Psychology of the Pilot

- Technically oriented
- Perfectionists
- Training emphasizes individualism
- Not natural communicators
- Not natural managers
- No training in leadership or teamwork

Individually Based Safety Management System

- Flight Safety limited to Captain’s education
  - No attempt to foster ongoing or recurrent education
  - A pilot was viewed as a technician not a manager
- Fight Safety limited to Captain’s experiences
  - Lessons learned only shared informally
  - No attempt to share knowledge
Organizationally Based Safety Management System

- Flight Safety reflects the education of the group
- Flight Safety reflects the experiences of the group

What We Had Going For Us

- Extreme standardization of aircraft
- Standardization of processes
  - Checklists
  - Manuals
Crew Resource Management Training

- Peer to peer training
- Change a corporate and industry culture
- Ingrained thinking is a powerful impediment to progress
- Expanded to entire flight crew
- All classes and ranks present during training
Crew Briefing

- Establishes expectations
- Fosters an immediate connection as a crew
- Allows the entire crew to view each other as individuals
Standard Operating Procedures

• Why we need to develop and use SOPs:
  • Instill quality into the cockpit
  • Develop an understanding of expected behavior among all crewmembers
  • Allow crewmembers to communicate and act as a team

Checklist Theory

• The longer the checklist is, the less likely it will be accomplished completely and correctly
• The concept of FLOWS was introduced
• Checklists transitioned from Read-and-Do to a “check” of items already accomplished
Quick Reference Handbook

- Placed in a specific location outside of the pilots chart case.
- Allowed for increased and more appropriate information exchange.
Error Tracking Theory

- It is vastly more important to identify the hazards and threats to safety, than to identify and punish an individual for a mistake.
- We exchange the ability to reprimand an individual for the ability to gain greater knowledge.
Error Tracking Methods

• Self Reporting Mechanisms
  - De-identified report

• Direct Datalink Tracking
  - De-identified report

• Observation – Line Oriented Safety Audit
  - De-identified report

Non-Reprisal Policy

US Airways will not initiate disciplinary proceedings against any employee who discloses an incident or occurrence involving flight safety. This policy shall not apply to information provided to the company by a source other than the employee.

This policy excludes events known or suspected to involve criminal activity, substance abuse, controlled substances, extortion or intentional falsification.
Data Gathering

- Data is gathered and analyzed to develop an understanding of the threats experienced by the group.
- Procedures and training are evaluated to combat those threats or errors and trap them before they lead to an adverse outcome.
Procedural Solutions

• An error by one person is a mistake, an error by five people is an operational hazard requiring an organizational solution.
• In aviation we accept that errors can happen for human factors related reasons.
• We find procedural solutions to combat those errors for which data collection shows the group is at risk.

Procedural Solutions, Cont’d.

• Errors identified in the group are addressed by procedural solutions.
• The group learns from the experiences of the group.
• The group itself becomes the safety organization.
Training Program

- Annual training programs are developed to highlight threats identified by data collection and train new procedural solutions.

- Testing is not based on skill evaluation, but rather on following SOPs and crew concepts.

- A crew passes or fails as a crew, not as individuals.
Barrier to Error Management

- Utilizing all these tools is called Barrier to Error Management.
- Threats are identified by data collection.
- Compensatory procedures or alterations of company policy are developed to combat threats.
- New procedures, checklists, policies are made a part of the next training event.
Proactive not Reactive

• Traditionally aviation safety has been reactive
• Now aviation safety is proactive
  - We have created a resilient safety system
  - We have created a learning safety system

New Psychology in the Cockpit

• Traditionally a pilots authority was based on rank.
• Now a pilots authority is based on respect for the role in the crew.
• And all crewmembers respect and understand the role of other crewmembers.
Organizational Approach to Safety Management

• An organizational approach to safety management employs all facets of the organization to combat threats as they are identified.
• Organizational Safety Systems embrace constant change within the organization.

Passenger Safety Rate
The Value of an Organizational Approach to Safety Management

• The last fatal crash of an American major airline was November 12th, 2001.
• 13 years without a US major airline fatality.
RESPONSE:
Can Healthcare Benefit from Aviation?

Rollin J. (Terry) Fairbanks, MD, MS, FACEP
Attending Emergency Physician, MedStar Washington Hospital Center
Associate Professor of Emergency Medicine, Georgetown University

Director, National Center for Human Factors in Healthcare
Director, Simulation Training & Education Lab (MedStar SiTEL)
MedStar Health

www.MedicalHumanFactors.net
Twitter @TerryFairbanks

Chart Credit: Modified from L. Leape

Dangerous ($>1/1,000$)
Ultra Safe ($<1/100K$)

Total lives lost per year

Number of encounters for each fatality

Healthcare (1 of 616)
Healthcare: The Past 15 years

IOM Report in 2000

• Govt: 50% less error in 5 years
• Funding, Regs, High Focus

14 Years later....

ESSENTIALLY NO CHANGE

Adverse Event Rates

<table>
<thead>
<tr>
<th>Year</th>
<th>Rate</th>
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<tbody>
<tr>
<td>1991</td>
<td>3.7%</td>
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<tr>
<td>2000</td>
<td>2.9%</td>
</tr>
<tr>
<td>2010</td>
<td>5.7%</td>
</tr>
<tr>
<td>2010</td>
<td>13.1%</td>
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</tbody>
</table>

Disclaimer: Studies have different methodology and sample size and cannot be directly compared

Wrong Direction!

2011 33.2 %
Can we learn?

- Healthcare is not Aviation
- But MANY Parallels
  “We’re different”
  - Safety Science
  - Training & Discipline
  - Resilience
  - System Safety Engineering

System Safety Engineering

- The goal is NOT to “Eliminate Error”
- It is about Reducing HARM
  - Human error cannot be eliminated
  - Human error is mostly not from lack of accountability
Example: Defibrillator Case

![Graph showing chance of success reduced by 7-10% each minute.]

Survival from Sudden Cardiac Arrest.

Defibrillator Case

- VF cardiac arrest
- nurse with patient
- charges unit...
- clears patient...
- **presses “on” button**
- Machine powers down
  - 2-3 minute delay in shock
Defibrillator Case

• Trend found in EMS Reporting system

• Simulation study (Denmark)
  - 72 physicians
  - 5 of 192 defib attempts – Turned it off
    • Measurable delay in shock
  - Device turned off even if charged and ready

<table>
<thead>
<tr>
<th>Knowledge-Based</th>
<th>Conscious</th>
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</thead>
<tbody>
<tr>
<td>Improvisation in unfamiliar</td>
<td>Trial &amp; Error</td>
</tr>
<tr>
<td>environments</td>
<td></td>
</tr>
<tr>
<td>No routines or rules available</td>
<td>1. Misapply Good rule</td>
</tr>
<tr>
<td></td>
<td>2. Not apply good rule</td>
</tr>
<tr>
<td></td>
<td>3. Apply bad rule</td>
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<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Rule-Based</td>
<td>Slips &amp; lapses</td>
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<tr>
<td>Protocolized behavior</td>
<td>Automatic</td>
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<tr>
<td>Process, Procedure</td>
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<tr>
<td></td>
<td></td>
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<tr>
<td>Skill-Based</td>
<td></td>
</tr>
<tr>
<td>Automated Routines</td>
<td></td>
</tr>
<tr>
<td>Require little conscious attention</td>
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</table>

Figure adapted from: Embrey D. Understanding Human Behaviour and Error, Human Reliability Associates

Based on Posner et al’s SRM Model of cognitive control, adapted to explain error by Reason (1990, 2008)
Slips and Lapses: Common
Policies, inservices, discipline, training, vigilance
Commercial Aviation is Ultra-Safe

- 809 million passengers/year
- 30,000 flights/day
- **ATC-Pilot:** 2 errors/hour
Aviation’s 25 Year Transition

Safety Culture

Multidisciplinary Teams
**Error Event** Hazard Reporting

- Develop Teams
- Standardize Procedure
- Develop Procedure
- Train New Procedure

**Organizationally Based Safety Management System**

**Hazard Reporting**

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**Accident Causation Pyramid**

*Tip of the Iceberg*

- 1 serious or major injury
- 10 minor injuries
- 30 property damage injuries
- 600 incidents with no visible damage or injury

*Bird, 1969*

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Based on 1,753,498 accidents from 297 companies, 21 different industries

*Slide acknowledgment: Robert Panzer, M.*
“Restock errors had been reported hundreds of times”

US Airways Non-Reprisal Policy

US Airways will not initiate disciplinary proceedings against any employee who discloses an incident or occurrence involving flight safety...
Allow Non-Jeopardy Reporting
Make It Easy & Fast
Learn From Unsafe Conditions
Use System Safety Solutions

Optimize Process & Support Work

Develop Teams
Train New Procedure S
Organizationaly Based Safety Management System
Develop Procedure S
Track Errors
Standardize Procedure S
<table>
<thead>
<tr>
<th>Time</th>
<th>Description</th>
<th>Vital Signs</th>
<th>Location</th>
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<tr>
<td>00</td>
<td>Fever</td>
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<tr>
<td>00</td>
<td>Abdominal Pain</td>
<td></td>
<td></td>
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<tr>
<td>00</td>
<td>Chest Pain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>00</td>
<td>Shortness of Breath</td>
<td></td>
<td></td>
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<tr>
<td>00</td>
<td>ELEVATED B/P</td>
<td></td>
<td></td>
</tr>
<tr>
<td>00</td>
<td>Abnormal Mental Status</td>
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<td></td>
</tr>
<tr>
<td>00</td>
<td>Eye pain</td>
<td></td>
<td></td>
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<tr>
<td>00</td>
<td>HEART TROUBLE</td>
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<tr>
<td>00</td>
<td>Abdominal Pain</td>
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<td></td>
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<tr>
<td>00</td>
<td>RIGID ABD PAIN</td>
<td></td>
<td></td>
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<tr>
<td>00</td>
<td>Abdominal pain/constipation</td>
<td></td>
<td></td>
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<tr>
<td>00</td>
<td>Nausea and Vomiting</td>
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<tr>
<td>00</td>
<td>Shortness of Breath</td>
<td></td>
<td></td>
</tr>
<tr>
<td>00</td>
<td>Cach</td>
<td></td>
<td></td>
</tr>
<tr>
<td>00</td>
<td>Abdominal Pain</td>
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</tr>
<tr>
<td>00</td>
<td>Weakness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>00</td>
<td>Rash/itch back pain</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Design for Human Use
Consider Context
Support Cognitive Work
Effective & Sustainable Solutions

Complex Adaptive Systems:  
work as done -vs- work as imagined

“Work as Imagined”  
How managers believe work is being done  
(rules)

GAP

“Work as Performed”  
Every-day work: How work IS being done

Adapted from: Ivan Pupełydy
Aviation’s 25 Year Transition

Safety Culture
Safety Approaches

• Training & Discipline
• Resilience
• System Safety Engineering

“Fallibility is part of the human condition;
We cannot change the human condition;
We can change the conditions under which people work.”

To Err is Human

James Reason, PhD
Discussion

Jeff Skiles, ATP
Air Transport Pilot, US Airways
Vice President of Chapters and Youth Education, EAA
www.JeffSkiles.com

Rollin J. (Terry) Fairbanks, MD MS
Attending Emergency Physician, MedStar Washington Hospital Center
Associate Professor of Emergency Medicine, Georgetown University
Director, National Center for Human Factors in Healthcare
MedStar Institute for Innovation, MedStar Health
Terry.Fairbanks@MedicalHFE.org
www.MedicalHumanFactors.net
Twitter @TerryFairbanks