Center, We Have A Problem.  
Emergency and Abnormal Situations in Aviation

Barbara K. Burian  
San Jose State University Foundation at the NASA Ames Research Center

Immanuel Barshi and Key Dismukes  
NASA Ames Research Center

The Emergency and Abnormal Situations project is funded through the NASA Aviation Safety and Security Program.
EAS Project Team – Past and Present

Immanuel Barshi, Ph.D.*
Sean Belcher, M.A.**
Ben Berman, A.B.**
Barbara Burian, Ph.D.*
Key Dismukes, Ph.D.*
Will Dismukes **
Richard Fariello, B.S.**
Richard Geven, M.A.**
Todd Kowalski, B.S.*
Jon Holbrook, Ph.D.
Jessica Lang Nowinski, Ph.D.
Sharon Pickering, M.A.
Chris Reed, B.S.**
Mark Staal, Ph.D.

* Certificated Pilot
^ Part 121/135
The Challenge

Emergency and abnormal situations:
- are often time critical, complex, and/or ambiguous
- are high stress, high workload, and a great deal is at stake
- require exceptionally high levels of coordination inside and outside of the airplane

Emergency and abnormal procedures:
- are generally focused on aircraft systems rather than on the situation as a whole
- are practiced seldom (twice a year or less) and used rarely
- are often highly dependent on fragile cognitive processes
- when needed, are crucial and must be performed correctly
### Emergency and Abnormal Situations Project

**Industry Consultants and Collaborators**

<table>
<thead>
<tr>
<th>Manufacturers:</th>
<th>Boeing, Bombardier, Airbus Industries, BAe Systems,</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulatory and Governmental Agencies:</td>
<td>FAA, CAA (UK), JAA, ICAO, Eurocontrol, NavCanada</td>
</tr>
<tr>
<td>Unions and Trade Groups:</td>
<td>ALPA, IFALPA, APA, SWAPA, ASPA, ATA, IATA, AFA, ASSA, ADF</td>
</tr>
<tr>
<td>Accident Investigation Bodies:</td>
<td>NTSB, TSB of Canada, ISASI</td>
</tr>
<tr>
<td>Airlines:</td>
<td>Airborne Express, Air Canada, Alaska, Aloha, American, Atlantic Southeast, Cathay Pacific, Continental, Delta, FedEx, Frontier, Hawaiian, Horizon, JetBlue, Southwest, United, UPS, US Airways, TWA (prior to merger)</td>
</tr>
</tbody>
</table>

---

**NASA**

**Human Factors research and technology**
Emergency and Abnormal Situations Project
Taxonomy of the Domain

Issues Related to Checklists and Procedures
- Design and Content, Use, Modality (paper, electronic, etc.)

Issues Related to Humans
- Performance under Stress, Communication and Coordination, Roles of All

Issues Related to the Aircraft
- Warning Systems, Flight Envelope Protection, Automation

Issues Related to Training
- Content and Approach, Retention of Seldom Practiced Procedures

Selected Emergency Equipment and Evacuation Issues
- Initiation and Coordination of Evacuation, Equipment used during Response

Broad, Over-arching Issues
- Philosophies and Policies, Regulatory and Economic Concerns
Emergency and Abnormal Situations Project
Taxonomy of the Domain

Issues Related to Checklists and Procedures
- Design and Content, Use, Modality (paper, electronic, etc.)

Issues Related to Humans
- Performance under Stress, Communication and Coordination, Roles of All

Issues Related to the Aircraft
- Warning Systems, Flight Envelope Protection, Automation

Issues Related to Training
- Content and Approach, Retention of Seldom Practiced Procedures

Selected Emergency Equipment and Evacuation Issues
- Initiation and Coordination of Evacuation, Equipment used during Response

Broad, Over-arching Issues
- Philosophies and Policies, Regulatory and Economic Concerns
SAS 751 - MD-81 Dual Engine Failure – Gottroa, Sweden – December 27, 1991

On takeoff, ice was ingested into the engines which damaged the fan stages and caused the engines to surge – all power was lost 77 seconds later.

During the event engine power was increased automatically by the Automatic Thrust Restoration (ATR) feature, which increased the intensity of the surging and contributed to the failure of the engines.

Neither the crew nor the company knew that the ATR feature existed on the airplane.
Emergency and Abnormal Situations Project
Taxonomy of the Domain

Issues Related to Checklists and Procedures
- Design and Content, Use, Modality (paper, electronic, etc.)

Issues Related to Humans
- Performance under Stress, Communication and Coordination, Roles of All

Issues Related to the Aircraft
- Warning Systems, Flight Envelope Protection, Automation

Issues Related to Training
- Content and Approach, Retention of Seldom Practiced Procedures

Selected Emergency Equipment and Evacuation Issues
- Initiation and Coordination of Evacuation, Equipment used during Response

Broad, Over-arching Issues
- Philosophies and Policies, Regulatory and Economic Concerns
While on final approach the forward flight attendant noticed a burning smell and discovered that the handset to call the cockpit was not working.

After landing she pounded on the cockpit door and yelled to get the flight crew’s attention.

The flight crew never heard the flight attendant pounding or yelling.
Emergency and Abnormal Situations Project
Taxonomy of the Domain

Issues Related to Checklists and Procedures
- Design and Content, Use, Modality (paper, electronic, etc.)

Issues Related to Humans
- Performance under Stress, Communication and Coordination, Roles of All

Issues Related to the Aircraft
- Warning Systems, Flight Envelope Protection, Automation

Issues Related to Training
- Content and Approach, Retention of Seldom Practiced Procedures

Selected Emergency Equipment and Evacuation Issues
- Initiation and Coordination of Evacuation, Equipment used during Response

Broad, Over-arching Issues
- Philosophies and Policies, Regulatory and Economic Concerns
Dispatch: ...uh current San Francisco weather one eight zero at six, nine miles, few at fifteen hundred, broken twenty eight hundred, overcast thirty four hundred...uh, if uh you want to land at LA of course for safety reasons we will do that, uh, we'll uh tell you though that if we land in LA uh, we'll be looking at probably an hour to an hour and a half, we have a major flow program going right now...uh, that's for ATC back in San Francisco.

Captain: Well, uh, yu, you eh, huh...boy you put me in a spot here, um...I really didn’t want to hear about the flow being the reason you’re calling us ‘cause I’m concerned about overflying suitable airports.
Develop guidance for procedure development and certification, training, crew coordination, and situation management based on knowledge of the operational environment, human performance limitations, and cognitive vulnerabilities in real-world situations.