Aeronautic Decision-Making (ADM)
U.S. Aviation Fatalities

The chart shows the number of fatalities in U.S. aviation from 2001 to 2011, categorized by General Aviation and Air Carrier and Air Taxi. The General Aviation category experienced a peak in 2006, while the Air Carrier and Air Taxi category remained relatively stable.
Phases of Flight and Accident %

Figure 2-1. The percentage of aviation accidents as they relate to the different phases of flight. Note that the greatest percentage of accidents take place during a minor percentage of the total flight.
80% of accidents have contributing factor of human error
Table of Contents

• Flightdeck: A Human-Machine “System”
• Procedures
• Aeronautical Decision-making
  – Risk Management
  – IMSAFE
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Flightdeck System
Airliner “Command-and-Control System”

1. Completed 4-D Trajectory for filed flightplan
2. Manage expected, unplanned mission surprises
3. Manage unexpected mission surprises (i.e. operational hazards)

- Filed flightplan (i.e. desired 4-D trajectory)
- Procedures for expected, unplanned mission surprises
- Environment (traffic, weather, ...)

Wind, storms, ceiling & visibility, traffic (ATC), airspace restrictions (ATC), ...
“Airliner “Command-and-Control System”

1. Completed 4-D trajectory for filed flightplan
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- Wind, storms, ceiling & visibility, traffic (ATC), airspace restrictions (ATC), ...

Captain + Automation + First Officer

Commands
Categories of Flightdeck Tasks

1. Progress on the filed flight plan (i.e. expected and planned)
   - Coordinate with ATC
   - Manage fuel and other vehicle resources

2. Manage expected, but unplanned events (Holding pattern for traffic, Go Around for unstable approach, traffic, ...etc)
   - Coordinate with ATC
   - Coordinate with other external factors (traffic, atmospherics, ...)
   - Vehicle expected system failures (checklist, electronic warnings, ...)

3. Manage unexpected events
   - Vehicle system failures
     Operational Hazards (10-9):
     - Aerodynamic Stability
     - Propulsion System Stability
     - Speed Envelope
     - Terrain
     - Traffic
# Flightcrew/Automation Responsibilities

<table>
<thead>
<tr>
<th>Category of Task</th>
<th>Function</th>
<th>Coordinate with Outside World</th>
<th>Flightplan (Lateral and Vertical Waypoints) ((10^{-5}))</th>
<th>Guidance (Targets and Modes) ((10^{-5}))</th>
<th>Control (Pitch/Roll/Thrust Commands) ((10^{-5}))</th>
<th>Stability Augmentation ((10^{-9}))</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Filed Flightplan</strong></td>
<td>Flightcrew: clearance from ATC</td>
<td>Automation optimizes trajectory to meet waypoints</td>
<td>Automation selects Modes and Targets</td>
<td>Automation generates commands</td>
<td>Autonomous Automation</td>
<td></td>
</tr>
<tr>
<td><strong>Expected, unplanned mission surprises</strong></td>
<td>Flightcrew: monitoring for expected, unplanned events</td>
<td>Flightcrew determine flightplan adjustments</td>
<td>Flightcrew determine guidance targets and modes</td>
<td>Automation generates commands from Flightcrew targets/modes</td>
<td>Autonomous Automation</td>
<td></td>
</tr>
<tr>
<td><strong>Unexpected mission surprises</strong> (i.e. (10^{-9}) Operational Hazards)</td>
<td>Flightcrew monitoring for unexpected unplanned events (i.e. op hazards)</td>
<td>Flightcrew determine flightplan adjustments</td>
<td>Flightcrew determine guidance targets and modes</td>
<td>Automation generates commands from Flightcrew targets/modes</td>
<td>Autonomous Automation</td>
<td></td>
</tr>
</tbody>
</table>

Flightcrew: monitor for expected, unplanned events: determine flightplan adjustments, determine guidance targets and modes, generate commands (Stick and Throttle).
## Categories of Operations

<table>
<thead>
<tr>
<th>Function</th>
<th>Category of Task</th>
<th>Coordinate with Outside World</th>
<th>Flightplan (Lateral and Vertical Waypoints) (10^{-5})</th>
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<td>Normal Operations</td>
</tr>
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<td>Flightcrew determine flightplan adjustments</td>
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</tr>
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<td>Flightcrew determine guidance targets and modes</td>
<td>Automation generates commands from Flightcrew targets/modes</td>
<td>Autonomous Automation</td>
<td>Abnormal/Emergency Operations</td>
</tr>
</tbody>
</table>

### Normal Operations
- Flightcrew: clearance from ATC
- Automation optimizes trajectory to meet waypoints
- Automation selects Modes and Targets
- Automation generates commands
- Autonomous Automation

### Abnormal/Emergency Operations
- Flightcrew: monitoring for expected, unplanned events
- Automation generates commands from Flightcrew targets/modes
- Autonomous Automation
- Flightcrew monitoring for unexpected unplanned events (i.e. op hazards)
- Automation generates commands from Flightcrew targets/modes
- Autonomous Automation
- Flightcrew determine flightplan adjustments
- Flightcrew determine guidance targets and modes
- Autonomous Automation
- Flightcrew determine flightplan adjustments
- Flightcrew determine guidance targets and modes
- Autonomous Automation
- Flightcrew generate commands (Stick and Throttle)
- Autonomous Automation
Airliner “Command-and-Control System”

1. Completed 4-D Trajectory for filed flightplan
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- Environment (traffic, weather, ...)

Operational Hazards (10-9):
- Aerodynamic instability
- Propulsion System instability
- Speed Envelope violation/Low energy
- Terrain
- Traffic
- Airspace

Wind, storms, ceiling & visibility, traffic (ATC), airspace restrictions (ATC), ...
Procedures
Airline flight deck operations are governed by airline Standard Operating Procedures (SOPs). SOPs identify the flight crew sequence of actions in response to all plausible situations that might emerge in the execution of a revenue-service airline flight.

- Continuously growing list

**Flight Operations Procedures Manual**

**Volume**: 1
**Originated by**: DIRECTOR
**Subject**: Operational Safety Procedures
**Date**: 5/16/94
**Review**: December

1.01 **PURPOSE**: To establish a flight safety procedure for use by Southwest Virtual Airlines.

1.02 **GENERAL**:

I. Southwest Virtual Airlines believes that the safety of our passengers and crew is paramount. Aviation has detailed regulations affecting all aspects of flight. The goal of these regulations and our virtual airline is to ensure that flights will be operated in the safest way possible.

II. Southwest Virtual pilots (simulators) encounters with mechanical problems or system failures on their flights. These simulations will enhance your piloting skills and decision-making. In addition, pilots may encounter weather problems during their flights that may result in flight deviations and missed approaches. These too are common in aviation, and can be safely resolved by following established procedures.

III. The Pilot in Command has the ultimate responsibility and authority when it comes to safeguarding the passengers and aircraft. However, in dire emergencies should the pilot invoke air traffic control procedures and instructions.

IV. Safe flight procedures should be followed. These include, but are not limited to maintaining separation distances, maintaining adequate ground clearances, following approach procedures, executing missed approaches when necessary and obeying all ATC instructions.

V. Pilots should perform preflight planning before each flight. This will ensure a smoother flight and alleviate multiple tasks at critical junctures in flight. This planning should include:
   1. Review of departure airport, route and destination weather
   2. Route selection and review
   3. Chart review
   4. Fuel planning

VI. Pilots should review the 2004 Airmen’s Information Manual, at http://www.aeroplane.com
Standard Operating Procedures (SOPs) specify [3] [4]:

1. what task to perform
2. when to perform the task (timing and sequence)
3. what actions are required to perform the task
4. who conducts the task (i.e. pilot-flying (PF) or pilot-monitoring (PM)), and
5. what feedback to provide (i.e., call-outs)

Standard Operating Procedures define:
1. what task to perform
2. when to perform the task (timing and sequence)
3. what actions are required to perform the task
4. who conducts the task
   • pilot-flying (PF) or pilot-monitoring (PM)
5. what feedback to provide (i.e., call-outs)
By standardizing procedures, the airline can:

- (1) ensure safe and efficient operations that are in adherence to its overall operational philosophy and policies [1], [2],

- (2) enable crew members to be paired with other crew members with whom they may have never flown before [1], and

- (3) provide the basis for objective flight crew proficiency evaluation.
Takeoff
https://www.youtube.com/watch?v=gStkrQGK5wQ

Engine out Procedure
https://www.youtube.com/watch?v=rEf35NtlBLg
TAKEOFF PROCEDURE

Not Drawn to Scale

Runway XXXX 123

Runway 16, cleared for Takeoff

ATC

Altitude

XXXX 123

Engage AP NAV 1

Flaps 18

Climb Nor/Max Set

V -ONE

Roll

Rotate

Climb-out

Flaps 24 to 18

Obstacle

V flapRetract

Not to Exceed Limit

Current Speed and Trend Vector

Gear Up

Flaps Zero

350' AGL

1,500' AGL
1. ATC gives clearance to Takeoff: “XXX123, RNW16, cleared for takeoff”
2. PF reads back clearance “Cleared for takeoff, XXX123”
3. PM announces “TAKE-OFF”
4. PM announces “YOUR CONTROLS” simultaneously holds ailerons into wind
5. PF puts right hand on the nose wheel steering control and simultaneously keeps left hand on lap, and simultaneously confirms “MY CONTROLS”
6. PM advances throttle levers
7. PM checks that all 4 engines accelerate symmetrically beyond 50% N1
8. PM activates auto throttles by means of TOGA buttons
9. PM checks FMA auto-throttle engagement: A/T green arc and FADEC trim arrow extinguished (if applicable)
10. PF simultaneously checks FMA auto-throttle engagement: A/T green arc and FADEC trim arrow extinguished (if applicable)
11. PM: before reaching 80 kts. Checks that take-off thrust is set
12. Needs time/aircraft dynamics awareness
13. PM: reports “TAKE-OFF THRUST SET”
14. PF verifies that takeoff thrust is set
15. PF confirms “CHECKED”
16. PM checks engine parameters throughout the take-off toll to be within limits
17. Aircraft Reaches 80 kts
18. PM sees 80 kts (or past)
19. PM calls “80 KTS”
20. PF compares speed indication on his/her side of the PFD
21. PF releases NWS
22. PF takes over control column with both hands
23. PF simultaneously confirms “MY COLUMN”
24. PM simultaneously keeps his right hand on the thrust levers throughout the take-off roll until V1
25. AC reaches V1=115kts (average) speed
26. PM sees V1 (e.g. 115 kts) on the PFD
27. PF calls “V1”
28. PM takes his/her hand away from the thrust lever after passing V1 = 115kts.
29. AC reaches VR
30. PM sees VR
31. PM calls “ROTATE”
32. PF starts a smooth rotation with about 3 °/sec. to simultaneously follow the FD pitch command. If FD is not usable, pilot needs to know climb with max V2+10 (initially 12°-15° ANU)
33. PF sees clear of ground
34. PF sees positive rate of climb (simultaneously since previous step is in the field of vision)
35. PF orders “GEAR UP”
36. PM silently checks positive rate of climb
37. PM selects gear up
38. PM monitors gear retraction
39. PF checks above 350 ft. RA (Do not engage the autopilot in the TO mode below 350 ft AGL. Do not deselect the TO mode until obstacle clearance is assured.)
40. PF orders “ENGAGE AUTOPilot NAV1” (or NAV2)
41. PM pushes AP engage button on the MCP
42. PM pushes NAV1 button on the MCP
43. PM checks annunciation on FMA (...)
44. PM confirms “AP NAV1”
45. PF checks FMA AP green
46. PF confirms “CHECKED”
47. PF sees thrust reduction altitude (1,500ft AAL.)
48. PF sets (retards) thrust to climb thrust
49. PF calls “CLIMB NORM/MAX SET”
50. PM checks thrust on PFD
51. PM reports “CHECKED”
52. PF after thrust reduction and passing acceleration altitude accelerates (Acceleration altitude 1500 ft. AAL of 3000 ft. AAL if not otherwise stated in OM-C)
53. PF sees acceleration altitude 1,500 ft. AAL (check previous step) sets speed (VF18+20. E.g. 146kts)
54. PF calls “SPEED 146 SET”
55. PM sees 146 kts on the MCP
56. PM reports “CHECKED”
TAKEOFF PROCEDURE 4/4

57. **SPEED ACHIEVES VF18 (e.g. 126 knots)**
58. PF sees VF18 (e.g. 126kts) on PFD
59. *PF orders “FLAPS 18”*
60. PM silently checks VF18 (e.g. 126 kts) on the PFD
61. PM selects flaps lever to 18°
62. PM monitors flaps transition on flaps position indicator
63. PM confirms “FLAPS 18”
64. PF checks flaps position 18° on flaps position indicator
65. PF confirms “CHECKED”
66. PF checks altitude on the PFD
67. PF sets appropriate speed VFT0+20 (e.g. 155kts)
68. PF states “SPEED 155”
69. PM sees 155 kts on the MCP
70. PM report “CHECKED”
71. **SPEED ACHIEVES VF0 (e.g. 135 knots)**
72. PF sees VF0 (e.g. 135 kts) on the PFD ~ flap retraction from 18 to 0
73. *PF orders “FLAPS 0”*
74. PM silently checks VF0 on the PFD
75. PM selects flaps lever t 0°
76. PM monitors flap retraction on flap position indicator ~ end
77. PM confirms after clean-up “FLAPS AT 0”
78. PF checks flaps position 0°
79. PF confirms “CHECKED”

Flaps must be retracted before aircraft reaches flap Retract Speed

**Allowable Operational Time Window (AOTW)**

= time in which Operator Actions must be performed

**Time-on-Procedure (ToP)** = time taken to perform sequence of Operator Actions
• AOTW is a Random Variable (depends on weather, weight, traffic, etc)
• ToP is Random Variable (depends on human performance)
• Procedure Buffer Time (PBT) is the difference between AOTW and ToP
• PBT < 0 → Hazardous Event
EXAMPLE TOP FOR TAKEOFF SEGMENTS

(a) 80 to v1 (Roll)

(b) V1 to VR (Rotate)

(c) VR to VF18 (Climb out)

(d) VF18 to VF0 (Retract Flaps from 24° to 18°)

One mode, but long tail

Multiple Modes (lots of variability)
\[ \mu_{\text{ToP}} = \mu_{OA1} + \mu_{OA2} + \mu_{OA3} + \mu_{OA4} + \mu_{OA5} \ldots \]

\[ \text{PBT} = \text{AOTW}(i) - \text{ToP}(i) \]

Well designed Procedure has appropriate positive Procedure Buffer Time (PBT) Probability of Failure to Complete > 0.01
CALCULATING TOP, PBT, PFTC

\[ \mu_{\text{ToP}} = \mu_{OA1} + \mu_{OA2} + \mu_{OA3} + \mu_{OA4} + \mu_{OA5} \ldots \]

\[ \text{PBT} = \text{AOTW}(i) - \text{ToP}(i) \]

Poorly designed Procedure has negative Procedure Buffer Time (PBT) and Probability of Failure to Complete > Threshold (e.g. 0.01)
WHAT CAUSES PFTC > THRESHOLD

PBT < 0 (i.e. ToP exceeds AOTW) because pilot takes too long

Distribution of AOTW

Barrier = Risk Management

Checklist
Pilot, Aircraft, enVironment, External (Operational) Pressures (PAVE)

Personal Risk
Illness, Medication, (Emotional) Stress, Alcohol, Fatigue, Emotion (IMSAFE)

Personality Risk
Anti-authority, Impulsivity, Invulnerability, Macho, Resignation
• **Procedure = sequence of Operator Actions**
• **Operator Action = Condition \( \rightarrow \) Action**

• **What else can go wrong with Procedure?**
  1. **Condition does not occur (in reasonable time)**
     - Aircraft Reaches 80 kts
     - PM sees 80 kts (or past)
     - PM calls “80 KTS”
  2. **Required condition does not exist**
     - PF compares speed indication on his/her side of the PFD
WHAT ELSE CAN GO WRONG?

Take too long to perform Operator Action $\rightarrow$ PBT < 0
(i.e. (1) pilot just takes too long, (2) conditions for OA do not occur (in reasonable time))

Skip a critical Operator Action or Make Wrong Action/Decision
PBT < 0 (i.e. ToP exceeds AOTW)

This step was skipped, in effect ToP is infinite
Pilot must abort existing procedure and switch to new procedure
1. What “procedures” were involved in the accident scenario?

2. What type of issue occurred with the procedure
   1. Poor procedure design (i.e. ToP > AOTW)
   2. Condition for OA does occur, but pilot takes too long to perform ToP
   3. Conditions for next OA do not occur and pilot does not abort/switch to new procedure
   4. Required safe condition no longer exists and pilot does not abort/switch to new procedure
Aeronautical Decision-Making
Definition

• Aeronautical Decision-Making (ADM) is a systematic approach to:
  – risk assessment
  – stress management
• How personal attitudes influence decision-making
  – How attitudes can be modified to enhance safety
• What factors cause humans to make decisions
  – How it works
  – How it can be improved
Steps for good decision-making are

1. Identifying personal attitudes hazardous to safe flight
2. Learning behavior modification techniques
3. Learning how to recognize and cope with stress
4. Developing risk assessment skills
5. Using all resources
6. Evaluating the effectiveness of one’s ADM skills
RISK MANAGEMENT

• The goal of risk management is to proactively identify safety-related hazards and mitigate the associated risks.

• Risk management is an important component of ADM.

• When a pilot follows good decision-making practices, the inherent risk in a flight is reduced or even eliminated.
RISK MANAGEMENT

• The ability to make good decisions is based upon:
  – direct experience
  – indirect experience
  – education
Risk Management Process

Figure 2-3. Risk management decision-making process.
Four fundamental principles of risk management

1. **Accept no unnecessary risk.** Flying is not possible without risk, but unnecessary risk comes without a corresponding return.
   – If you are flying a new airplane for the first time, you might determine that the risk of making that flight in low visibility conditions is unnecessary.

2. **Make risk decisions at the appropriate level.** Risk decisions should be made by the person who can develop and implement risk controls.
   – Remember that you are pilot-in-command, so never let anyone else—not ATC and not your passengers—make risk decisions for you.

3. **Accept risk when benefits outweigh dangers (costs).** In any flying activity, it is necessary to accept some degree of risk.
   – A day with good weather, for example, is a much better time to fly an unfamiliar airplane for the first time than a day with low IFR conditions.

4. **Integrate risk management into planning at all levels.** Because risk is an unavoidable part of every flight, safety requires the use of appropriate and effective risk management not just in the preflight planning stage, but in all stages of the flight.
Risk Management Process

1. Identify hazards
2. Assess risks

Hazards
• real or perceived condition, event, or circumstance that a pilot encounters.
• When faced with a hazard, the pilot makes assessment of hazard based upon various factors
• Pilot assigns a value to the potential impact of the hazard, which qualifies the pilot’s assessment of the hazard - $\rightarrow$ RISK

RISK
• Risk is an assessment of the single or cumulative hazards facing a pilot
• Risk = likelihood * severity
Example Hazards

• the pilot arrives to preflight and discovers a small, blunt type nick in the leading edge at the middle of the aircraft’s prop

• Beechcraft King Air equipped with deicing and anti-icing. The pilot deliberately flew into moderate to severe icing conditions while ducking under cloud cover

• Human Factors
Example Hazards = Human Factors

<table>
<thead>
<tr>
<th>The Five Hazardous Attitudes</th>
<th>Antidote</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Anti-authority: “Don’t tell me.”</strong></td>
<td>Follow the rules. They are usually right.</td>
</tr>
<tr>
<td>This attitude is found in people who do not like anyone telling them what to do. In a sense, they are saying, “No one can tell me what to do.” They may be resentful of having someone tell them what to do or may regard rules, regulations, and procedures as silly or unnecessary. However, it is always your prerogative to question authority if you feel it is in error.</td>
<td></td>
</tr>
<tr>
<td><strong>Impulsivity: “Do it quickly.”</strong></td>
<td>Not so fast. Think first.</td>
</tr>
<tr>
<td>This is the attitude of people who frequently feel the need to do something, anything, immediately. They do not stop to think about what they are about to do, they do not select the best alternative, and they do the first thing that comes to mind.</td>
<td></td>
</tr>
<tr>
<td><strong>Invulnerability: “It won’t happen to me.”</strong></td>
<td>It could happen to me.</td>
</tr>
<tr>
<td>Many people falsely believe that accidents happen to others, but never to them. They know accidents can happen, and they know that anyone can be affected. However, they never really feel or believe that they will be personally involved. Pilots who think this way are more likely to take chances and increase risk.</td>
<td></td>
</tr>
<tr>
<td><strong>Macho: “I can do it.”</strong></td>
<td>Taking chances is foolish.</td>
</tr>
<tr>
<td>Pilots who are always trying to prove that they are better than anyone else think, “I can do it—I’ll show them.” Pilots with this type of attitude will try to prove themselves by taking risks in order to impress others. While this pattern is thought to be a male characteristic, women are equally susceptible.</td>
<td></td>
</tr>
<tr>
<td><strong>Resignation: “What’s the use?”</strong></td>
<td>I’m not helpless. I can make a difference.</td>
</tr>
<tr>
<td>Pilots who think, “What’s the use?” do not see themselves as being able to make a great deal of difference in what happens to them. When things go well, the pilot is apt to think that it is good luck. When things go badly, the pilot may feel that someone is cut to get them or attribute it to bad luck. The pilot will leave the action to others, for better or worse. Sometimes, such pilots will even go along with unreasonable requests just to be a “nice guy.”</td>
<td></td>
</tr>
</tbody>
</table>

*Figure 2-4. The five hazardous attitudes identified through past and contemporary study.*
Risk

**Likelihood**
- Probable—an event will occur several times
- Occasional—an event will probably occur sometime
- Remote—an event is unlikely to occur, but is possible
- Improbable—an event is highly unlikely to occur

**Severity**
- Catastrophic—results in fatalities, total loss
- Critical—severe injury, major damage
- Marginal—minor injury, minor damage
- Negligible—less than minor injury, less than minor system damage
Risk

- Risk = Likelihood * Severity

**Figure 2-5.** This risk matrix can be used for almost any operation by assigning likelihood and consequence. In the case presented, the pilot assigned a likelihood of occasional and the severity as catastrophic. As one can see, this falls in the high risk area.
# Risk Assessment

## Pilot’s Name

<table>
<thead>
<tr>
<th>SLEEP</th>
<th>HOW IS THE DAY GOING?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Did not sleep well or less than 8 hours</td>
<td>1. Seems like one thing after another (late, making errors, out of step)</td>
</tr>
<tr>
<td>2. Slept well</td>
<td>2. Great day</td>
</tr>
</tbody>
</table>

## How Do You Feel?

<table>
<thead>
<tr>
<th>WEATHER AT TERMINATION</th>
<th>PLANNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Greater than 5 miles visibility and 3,000 feet ceilings</td>
<td>1. Rush to get off ground</td>
</tr>
<tr>
<td>2. At least 3 miles visibility and 1,000 feet ceilings, but less than 3,000 feet ceilings and 5 miles visibility</td>
<td>2. No hurry</td>
</tr>
<tr>
<td>3. IMC conditions</td>
<td>3. Used charts and computer to assist</td>
</tr>
</tbody>
</table>

## Weather at Termination

- Greater than 5 miles visibility and 3,000 feet ceilings
- At least 3 miles visibility and 1,000 feet ceilings, but less than 3,000 feet ceilings and 5 miles visibility
- IMC conditions

## Planning

- Rush to get off ground
- No hurry
- Used charts and computer to assist
- Used computer program for all planning
- Did you verify weight and balance?
- Did you evaluate performance?
- Do you brief your passengers on the ground and in flight?

## Column Total

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Total Score
Mitigating Risk

• Wait for the weather to improve to good visual flight rules (VFR) conditions
• Take an instrument-rated pilot.
• Delay the flight.
• Cancel the flight.
• Drive.
Mitigating Personal Risk = IMSAFE

1. Illness—Am I sick? Illness is an obvious pilot risk.
2. Medication—Am I taking any medicines that might affect my judgment or make me drowsy?
3. Stress—Am I under psychological pressure from the job? Do I have money, health, or family problems? Stress causes concentration and performance problems. While the regulations list medical conditions that require grounding, stress is not among them. The pilot should consider the effects of stress on performance.
4. Alcohol—Have I been drinking within 8 hours? Within 24 hours? As little as one ounce of liquor, one bottle of beer, or four ounces of wine can impair flying skills. Alcohol also renders a pilot more susceptible to disorientation and hypoxia.
5. Fatigue—Am I tired and not adequately rested? Fatigue continues to be one of the most insidious hazards to flight safety, as it may not be apparent to a pilot until serious errors are made.
6. Emotion—Am I emotionally upset?
Mitigating Risk = P A V E Checklist

<table>
<thead>
<tr>
<th>Pilot</th>
<th>Aircraft</th>
</tr>
</thead>
<tbody>
<tr>
<td>A pilot must continually make decisions about competency, condition of health, mental and emotional state, level of fatigue, and many other variables. For example, a pilot may be called early in the morning to make a long flight. If a pilot has had only a few hours of sleep and is concerned that the congestion being experienced could be the onset of a cold, it would be prudent to consider if the flight could be accomplished safely.</td>
<td>A pilot will frequently base decisions on the evaluations of the aircraft, such as performance, equipment, or airworthiness. During a preflight, a pilot noticed a small amount of oil dripping from the bottom of the cowling. Although the quantity of oil seemed insignificant at the time, the pilot decided to delay the takeoff and have a mechanic check the source of the oil. The pilot’s good judgment was confirmed when the mechanic found that one of the oil cooler hose fittings was loose.</td>
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<thead>
<tr>
<th>Environment</th>
<th>External pressures</th>
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<tbody>
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<td>This encompasses many elements not pilot or airplane related. It can include such factors as weather, air traffic control, navigational aids (NAVAIDS), terrain, takeoff and landing areas, and surrounding obstacles. Weather is one element that can change drastically over time and distance.</td>
<td>The interaction between the pilot, airplane, and the environment is greatly influenced by the purpose of each flight operation. The pilot must evaluate the three previous areas to decide on the desirability of undertaking or continuing the flight as planned. It is worth asking why the flight is being made, how critical is it to maintain the schedule, and is the trip worth the risks? On a ferry flight to deliver an airplane from the factory, in marginal weather conditions, the pilot calculated the groundspeed and determined that the airplane would arrive at the destination with only 10 minutes of fuel remaining. The pilot was determined to keep on schedule by trying to “stretch” the fuel supply instead of landing to refuel. After landing with low fuel state, the pilot realized that this could have easily resulted in an emergency landing in deteriorating weather conditions. This was a chance that was not worth taking to keep the planned schedule.</td>
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Figure 2-7. The PAVE checklist.
Traits of Pilots with Accident Records

1. Have disdain toward rules
2. Have very high correlation between accidents on their flying records and safety violations on their driving records
3. Frequently fall into the “thrill and adventure seeking” personality category
4. Are impulsive rather than methodical and disciplined, both in their information gathering and in the speed and selection of actions to be taken
5. Have a disregard for or tend to under utilize outside sources of information, including copilots, flight attendants, flight service personnel, flight instructors, and ATC
Rasmussen’s three levels of human behaviour: skill-, rule-, and knowledge-based behaviour
Activity

• Describe a situation in which you use:
  – Skill-based behavior
  – Rule-based behavior
  – Knowledge-based behavior