Managing the Grey

Resolving ambiguity in aviation
A CLOSE CALL

On July 7 at 11:56 p.m., an Air Canada plane almost landed on a taxiway with four planes lined up instead of the runway at SFO.
Importance

• Review of NTSB accident reports identified a common pattern of the crew’s decision to continue with their original plan in the face of ambiguous or dynamically changing conditions.¹

• Four factors identified as contributors to these decision errors:
  o Ambiguity of cues
  o Risk underestimated
  o Goals conflicted
  o Consequences not anticipated (possibly due bias)

¹Orasanu and Martin, 1998
Ambiguity

Description:
• Situations in which we are unclear about what the facts are or which facts are relevant

Causes:
• Incomplete information
• Contradictory information/cues
• Information overload
Shades of grey

• SA relies on perceiving cues in the environment and responding to them
• TEM relies on identifying threats and errors and managing them
• RM relies on identifying unknowns and managing the associated uncertainty
• These safety methodologies require clarity as to what is known and unknown
• But how do we make effective decisions when the situation and threats are not yet clear to us?
Premise

- We can ‘manage the grey’ by recognising the situation we are in (level of clarity) and applying the appropriate strategies to inform our decision-making.
### Concepts

#### Known
- Things we are aware of but don’t understand: **uncertain**
- Things we are aware of and understand: **certain**

#### Unknown
- Things we are neither aware of or nor understand: **unclear (ambiguous)**
- Things we understand but are not aware of: **unaware**

#### What we comprehend
- **Knowns**
- **Unknowns**

#### What there is to know
Concepts

What there is to know

Unknowns

Knowns

Known

Unknown

What we comprehend

uncertain

unclear (ambiguous)

unaware

certain

What there is to know
Indicators

- Vague/unclear statements
- Incomplete information
- Conflicting information/cues
- Can’t make sense of situation
- Non-standard (outside procedure)
- Probability of success unclear
- Context
- Signals/red flags
- Concern expressed
- Emotional response (e.g. unease)
## Response

<table>
<thead>
<tr>
<th>Category</th>
<th>Management strategies (recovery)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolve ambiguity</td>
<td>• Resource management&lt;br&gt;• Seek/share information&lt;br&gt;• Closed loop communication&lt;br&gt;• Shared mental models</td>
</tr>
<tr>
<td>• No unknowns</td>
<td></td>
</tr>
<tr>
<td>Reduce ambiguity</td>
<td>• As above, plus:&lt;br&gt;• Iterative and incremental processes</td>
</tr>
<tr>
<td>• Less unknowns; greater clarity</td>
<td></td>
</tr>
<tr>
<td>Achieve uncertainty</td>
<td>• As above, plus:&lt;br&gt;• Risk management</td>
</tr>
<tr>
<td>• Known unknowns</td>
<td></td>
</tr>
<tr>
<td>Accept ambiguity</td>
<td>• Awareness&lt;br&gt;• Test assumptions / trial and error&lt;br&gt;• Check progress against objectives&lt;br&gt;• Agility</td>
</tr>
<tr>
<td>• Opportunity and risk</td>
<td></td>
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<tr>
<td>Do not accept ambiguous situation</td>
<td>• Cease activity&lt;br&gt;• Choose conservative/known action</td>
</tr>
<tr>
<td>• No ambiguity tolerance</td>
<td></td>
</tr>
</tbody>
</table>
Assumptions

Low                  ←                  High

High                   ←                  Low

Safety critical

Innovation

Low                  ←                  consequence →                  High

Low                  ←                  opportunity →                  Low
Cognitive biases

- Ambiguity is a threat
- Ambiguity effect
- Decision paralysis (inaction)
- Plan continuation error
- Confirmation bias
- Expectation bias
- Attention tunnelling
System level - contributors

• Multiple participants
  o Conflicting goals / expectations
• Regulation
  o Performance based regulations
• Regulator ↔ Participant interactions
  o Different goals
  o Unclear expectations
  o Just culture
• Accident investigation
• Ambiguous threats
  o e.g. cyber security
System level – example 1

Volcanic ash
- Iceland 2010
- Chile 2011
  - Conflicting information regarding level of ‘tolerable’ ash
  - Forecasting vs actual
  - Operator risk assessment and controls quite different
  - Regulatory capability
System level – example 2

SMS – risk management

• Operator risk acceptance
  o Participant vs. participant
  o Regulator vs. participant

• Criteria may not be well defined

• Risk assessment

• Effect of controls
System level – example 3

Emergency response – bomb threat

• Individual response plans
  o Aerodrome operator
  o Airline
  o ATC
  o Police
  o Avsec
  o CAA

• Conflicting objectives/actions
System level - strategies

• **System:**
  - Information sharing
  - Coordinated decision making
  - International: compliance; recognition; harmonisation

• **Performance Based Regulation (PBR):**
  - Describe desired performance and what needs to be demonstrated
  - Industry and regulator common understanding

• **Regulator – participant interactions:**
  - Transparent
  - Acknowledge common/different goals
Just Culture

• CAA Vector Magazine – May/June 2016
Management level - contributors

• Business
  o Competing goals – safety vs profitability
  o Geographical distribution
  o Hierarchical structures

• Threats
  o Change (technological)
  o Safety data
  o Weak signals

• Decision-making
  o Incomplete information
  o Qualitative risk management
  o Groupthink (social/emotional factors)
Management level – contributors (cont’d)

• Leadership
  o Unclear policies, SOPs
  o Drift
  o Actions in response to unsafe behaviours

• People
  o Cultural and status differences
  o Labour unrest

• Crew member
  o Performance
    ▪ training vs line environment
    ▪ rater reliability
  o Pilot wellness
Management level - example

Non routine flight operations
- Acceptance & post-maintenance flights
  • Objective
  • Roles
  • Status of aircraft
  • Threats/risks
  • Airspace
  • Weather
  • Competency of crew
  • Procedures
  • Mindset / approach
Management level - strategies

• Culture
  o Management commitment
  o Reporting; communication
  o Learning; inquisitiveness
  o Foster constructive challenge

• Data
  o (caution)
  o Explore/amplify weak signals
  o Sharing; feedback

• Decision-making
  o Build effective teams
  o Collaborative problem id.
  o Collective ‘sense-making’
Management level – strategies (cont’d)

• Training
  o Evaluate effectiveness of CRM/HF programmes
  o Automation philosophy/policy
  o Realistic scenarios
    ▪ Ambiguous cues
    ▪ LOFT
  o Go-around decision-making
  o UPRT

• Mindset/approach
  o Navigate ambiguity
  o Vigilance
  o Resilient processes/people
  o Flexibility
Operational level - contributors

- Crew Member
  - Fitness to fly
  - Authority gradient
  - Cultural differences; language barriers
  - Differences in experience/training

- Pilot-ATC comms
  - Non-standard phraseology
  - Unusual clearances
    - Accounts for 11% of threats

- Technology
  - Autoflight mode
  - Information overload

- Operations
  - Runway condition reporting
  - Weather (e.g. turbulence)
Operational level – example 1

Pilot – Controller

Ambiguity inducing situations
- Weather avoidance/deviations
- Conditional clearances
- Declaring an emergency
- Go-arounds VMC
- Speed instructions
- Runway change
- Fuel state
- TCAS vs ATC commands

- Different interpretations
- Different expectations
- Failure of coordinated decision-making
Operational level – example 2

Pilot – cabin crew

• [occurrence report] “Taxiing for runway I heard what I thought was the cabin secure signal. I overturned the ‘Cabin Secure’ card, the Before Take-off Checklist was completed, and ATC clearance was received for an ‘immediate take-off’. Just prior to lining-up a single chime was heard in the flight deck which I answered. I thought the call was to confirm that we had heard the ‘double-ding’, whereas the CS was checking that we had heard the 3 chimes as there was an event taking place in the cabin. I realised that the cabin was not secure, but TO/GA had been pushed and take-off power was being set. The take-off was continued.”
Operational level - strategies

• Management
  o Operational control
  o Information management

• Crew
  o Resource management
  o Team SA; shared mental models
  o Briefings, regular updates
  o Advocacy, assertiveness, challenge
    ▪ Defined escalation procedure

• Pilot-ATC
  o Standard phraseology
  o Read-backs, hear-backs
  o Familiarisation (other roles)
Crew decision-making

Naturalistic Decision Making (NDM)

1. Intended outcome

2. Situation assessment
   - problem, risk, time

3. Course of action selected
   - Recognition primed; rule based; multiple options

If problem not well defined:
- Procedural management
  - (e.g. follow emerg. process steps)
- Diagnosis
- Creative problem solving
Summary

• Recognise indicators of ambiguity

• Different strategies to manage:
  o Ambiguity
  o Lack of situational awareness
  o Uncertainty

• Employ practical steps to ‘manage the grey’ at system, management and operational level to enhance decision-making and safety
Thank you