Levels of Automation
Advantages & Disadvantages

June 2nd, 2015
AGENDA

Automation Dependency (Complacency, Addiction etc...)

Advantages & Disadvantages

Levels of Automation – Tier Module

Going Forward
Aviation Authority Warns of 'Overreliance' on Autopilots
CAA says pilots need more training to keep their manual flying skills sharp

November 29, 2014 – International Business Times

"It's also vital that pilots do not become over reliant on automated systems and are able to retain the high level of flying skills required to operate as a qualified commercial airline pilot." UKCAA

December 1, 2014 – Aviation Maintenance & Technology

“Operating highly automated jets during demanding situations still tends to significantly increase the pilots task complexity and workload”

February 2014 – Flight Safety Foundation Automation Vulnerabilities
Asiana Crash Hearing Draws Attention to Pilots’ Automation ‘Addiction’
Dec 11, 2013

GOLDEN RULE OF AVIATION

- AVIATE
- NAVIGATE
- COMMUNICATE
- AUTOMATE
AGENDA

Automation Dependency (Complacency, Addiction etc…)

Advantages & Disadvantages

Levels of Automation – Tier Module

Going Forward
## Automation Dependency

<table>
<thead>
<tr>
<th>Automation Advantages</th>
<th>Automation Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>➢ Precision, Safety &amp; Efficiency</td>
<td>➢ Automation -DM nil</td>
</tr>
<tr>
<td>➢ Never distracted</td>
<td>➢ Garbage in / Garbage out</td>
</tr>
<tr>
<td>➢ Immune to fatigue</td>
<td>➢ Complacency/Sense of Security</td>
</tr>
<tr>
<td>➢ Situational Awareness</td>
<td>➢ Situational Awareness</td>
</tr>
<tr>
<td>➢ Reduces direct operational involvement</td>
<td>➢ Over reliability/reliance</td>
</tr>
<tr>
<td>➢ Follows instruction without argument</td>
<td>➢ Inflexible</td>
</tr>
<tr>
<td>➢ Reduces workload ?</td>
<td>➢ Distraction</td>
</tr>
<tr>
<td></td>
<td>➢ Airmanship / Manual Flight Skills</td>
</tr>
<tr>
<td></td>
<td>➢ Silent failures (WOW)</td>
</tr>
<tr>
<td></td>
<td>➢ Does not respond to <strong>NOW</strong></td>
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</table>

**Aviation Knowledge – Human Factors & Automation**
# AUTOMATION DEPENDENCY

## IN SYNC - SYNCHRONIZE

<table>
<thead>
<tr>
<th>Automation (Pilot)</th>
<th>Human (Pilot)</th>
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<tbody>
<tr>
<td>Automation</td>
<td>Pilot</td>
</tr>
<tr>
<td>1-Perform routine and repetitive tasks</td>
<td>1-Detect visual and acoustic energy</td>
</tr>
<tr>
<td>2-Store, display and erase information</td>
<td>2-Percieve patterns of light/sound</td>
</tr>
<tr>
<td>3-Computability ability (quickly)</td>
<td>3-Improvise/ flexibility procedures</td>
</tr>
<tr>
<td>4-Handles complex operations</td>
<td>4-Inductive Reasoning (evaluates)</td>
</tr>
<tr>
<td>5-Multi task</td>
<td>5-Excersises Judgment</td>
</tr>
</tbody>
</table>

*Fitts, Billings 2007*
Butter Finger Syndrome

- Pushing the wrong button – right time
- Pushing the right button – wrong time
- Pushing the right buttons – wrong sequence
- Thinking that an automated function is off – WHEN ITS ON
- Thinking that an automated function is on – BUT ITS OFF
- Automation Bias – following the choice of the least cognitive effort (processing & interpretation of information)
AGENDA

Automation Dependency (Complacency, Addiction etc...)

Advantages & Disadvantages

Levels of Automation – Tier Module

Going Forward
Automation Tier Module 2.- Defined

1. Manual - upset flight, WS, GPWS, TCAS RA, VMC - nav/flight guidance - confusion, upset flight, WS, GPWS, TCAS RA, VMC

2. Tactical - ATC compliance in terminal area. Controlling aircraft thru Flight Director - coupled to basic modes (HDG/ALT/Speed)

3. Full-UP- All active guidance flown thru automation, (Flight Path, Energy). Extended period of navigation, cruise

AUTOMATION DEPENDENCY

Automation Tier Module: Cockpit


2. Flight Director active - HDG / ALT modes - using A/P at specific phases - Take-off.

3. Flight Director, autopilot, auto throttle, FMS Full use of vertical / lateral flight guidance – LNAV/VNAV / ADS-B, CPDLC, BEVS, HUD.

References:

AUTOMATION DEPENDENCY

Situational Awareness

Pilots separation from flight controls

Billings, Norman 1989
AUTOMATION DEPENDENCY

Going Forward

- Aviate (PFD), Navigate (MFD), Communicate (RTU) and Automate (FMS-A/T, FCP, CDU etc.)
- Head Up / Head Down. Defined and incorporated in SOP’s. Critical SA
- Navigation/Automation Mode Accuracy
- Correct level of Automation
AUTOMATION DEPENDENCY

Going Forward (2)

- III - Informed, Involved, Initiate
  - Informed – Monitor, Cross check, STAY in – the – loop, STAY informed
  - Involved – Active role in automation, normal/abnormal failure modes. SA!
  - Initiate- TURN IT OFF! Choose appropriate level of automation to maintain safety of flight. Revert to manual flight. MAKE the choice clearly apparent to the crew.

- Training – Re-evaluate Standards DOC 24 (Skill Test) and DOC 29 (CRM).
  - Recognise, detect and deal with situations in non-normal automation degradation. Intervention Point …..
  - Less “how it works” to “how to respond to failures”.
  - Better defined checklists for abnormal malfunctions
AUTOMATION DEPENDENCY

Going Forward (3)

- Automation Interface – NOT a common language
  - 60% of ALL accidents has identified as a leading factor
    Manual Handling Error

  - Incorrect Upset handling Recovery Technique
  - Inappropriate control inputs
  - Lack of manual handling after Autopilot/Auto thrust disconnect or combination of ……
  - Lack of recognition of any disconnection of Autopilot/Auto thrust or combination of resulting in poor monitoring of energy and speeds
  - Re-active ---- Watching things happen vs.
    Pro-active---- Making things happen
AUTOMATION DEPENDENCY

We remain Pilots – not Automation Managers

- We must be able to choose our level of automation based on flight conditions. Moving from Tier 1 thru 3 during all phases of flight.

- When descending thru MDA on A/P, it a natural instinct to push “ALT”? Or should we disconnect A/P and immediately return MDA.

- Tactile connected to aircraft below 10,000 – even with A/P.

- Recognize human factor issues such as – absorption (single task focused), fixation (locked on), complacency (over relying).

- Famous last words: “what’s it doing?” (would rather hear) “why did it do that?”
The first rule of any technology used in a business is that automation applied to an efficient operation will magnify the efficiency. The second is that automation applied to an inefficient operation will magnify the inefficiency.

(Bill Gates)
AUTOMATION DEPENDENCY

Reference Material:

- C.E. Lauber Billings, Aviation Safety – AMES Research Centre( 1976)
- P.Fitts – Human Engineering for an Effective Air Navigation and ATC system (2000)
Q&A