AUTOMATION ADDICTION

"IS INNOVATIVE ENGINEERING GETTING TOO FAR AHEAD OF PILOT TRAINING?"

20 November 2012

6th European Flight Safety Workshop

Media Headlines

TIME

'Automation Addiction': Is Technology Weakening Pilots' Skills?

Time.com – Wed,

*Although fatal airline accidents have decreased dramatically over the past 10 years, the International Air Transport Association (IATA) reports that **some 51 "loss-of-control" accidents - in which planes stalled or got into unusual situations from which that pilots were not able to recover** - have occurred over the past five years, making it the most common type of airline accident*

*The Associated Press report adds that a draft FAA study - which examined 46 accidents and major incidents, 734 voluntary reports by pilots as well as data from more than 9,000 flights in which a safety official rides in the cockpit to observe pilots - **found that pilots sometimes "abdicate too much responsibility to automated systems**."*

Are Pilots Forgetting to Fly?

What Are We Going To Discuss?

- Does the phenomenon of *'Automation Addiction'* actually exist?
- Instigators of this phenomenon?
- "Research Results" - Benefits of automation
- Problem Definition
- Risks from over-reliance on automation
- Case Study of *'Automation Addiction'* accidents
- Engineer vs Pilot Philosophy
- FAA Investigation Findings
- Airbus SOPs
- *'Automation Addiction'* the way forward?

Phenomenon of Addiction

DRUG REINFORCEMENT (SALIENCE ATTRIBUTION)

Reward Circuits (VTA, Nac)

Reward Circuits

Memory (hippocampus)

Anterior Cingulate Prefrontal Cortex

Conditioned Res (amygdala)

ADDICTION

WITHDRAWAL

CRAVING (DRUG EXPECTATION)

Cingulate Gyru

'Aeronautical Automation Addiction', is the complete submission, reliance, capitulation and belief in technology to automatically and accurately control flight.
(Des Barker)

"Addiction is a primary, chronic disease of brain reward, motivation, memory and related circuitry. This is reflected in the individual pursuing reward and/or relief by substance use and other behaviors. The addiction is characterized by impairm_____abstain, and *diminish*_____*rs*. Without treatmen_____ive and can result in_____

Automation -
the technique, method, or system of operating or controlling a process by highly automatic means, as by electronic devices, reducing human intervention to a minimum.

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Aerospace Automation

Instigators?

Fighters

Transport

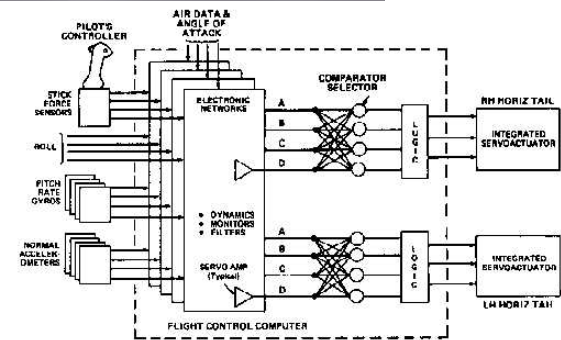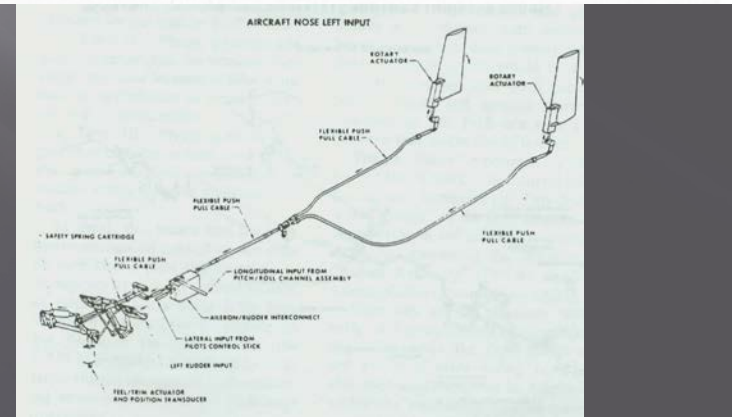# Analogue to Digital Cockpit Displays

Digital Flight Control Systems

Auto-Throttle
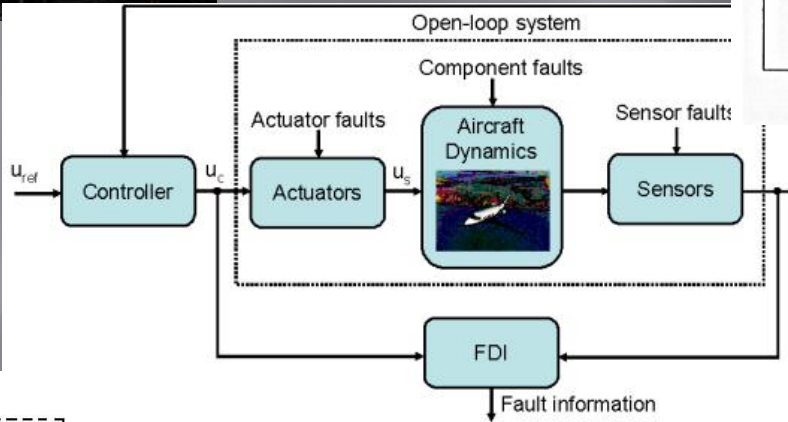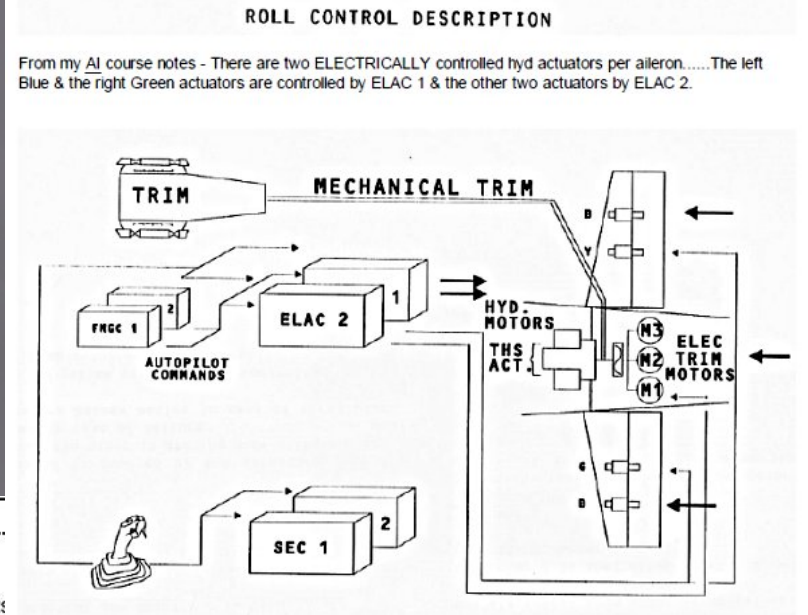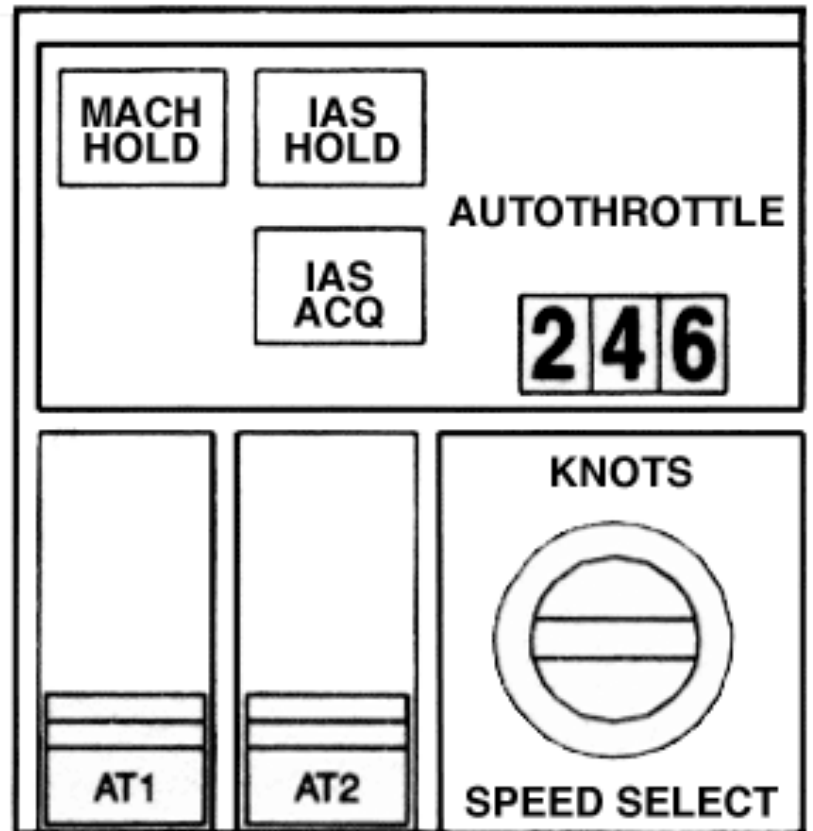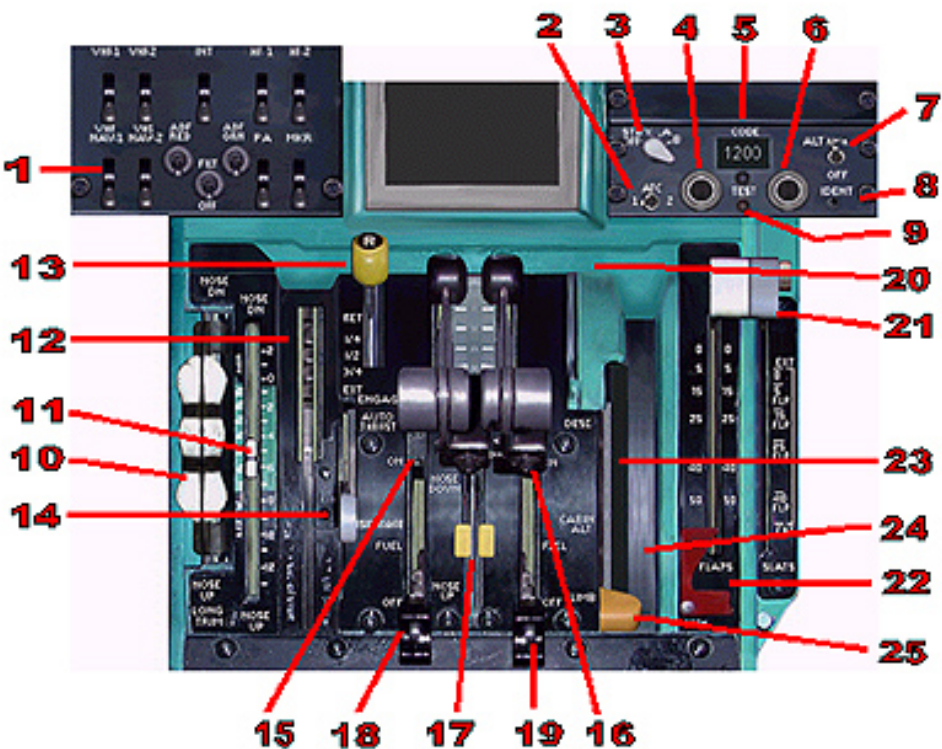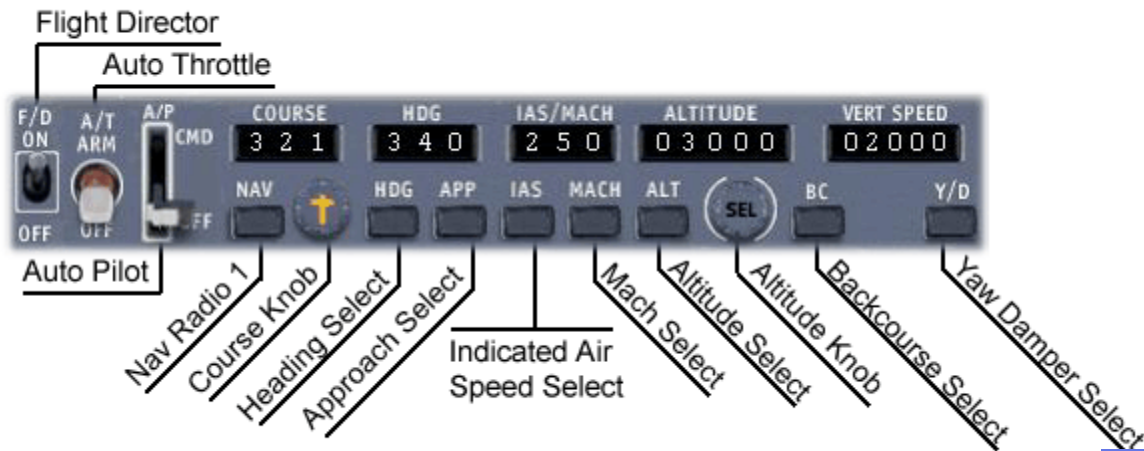
Head-Up & Helmet Mounted Displays

Coupled Systems!!!

Fully Automated Cockpits

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Institutionalized New Culture?

Cessna 210 Cockpit Layout

Contributor: Confusing Peripheral Cues

Where Will It All End?

groenbrothers.com

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Do We Have a Problem?
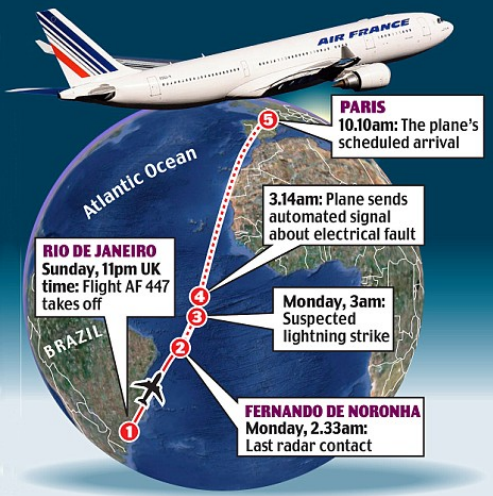
Elardus Park
Primary School
Science Week
2012

Grade 7 School Research Project

Question 1: *Do you think that automation has improved aviation safety?*

96% of the pilots indicated that flight safety had improved.

Research Questionnaire to 80 pilots:
1. **South African Airways.**
2. **British Airways Comair,**
3. **SA Express.**
4. **Emirates.**

Question 2*: Do you think automation has reduced pilot handling skills?*

The majority (89%) agreed that automation had decreased their handling skills.
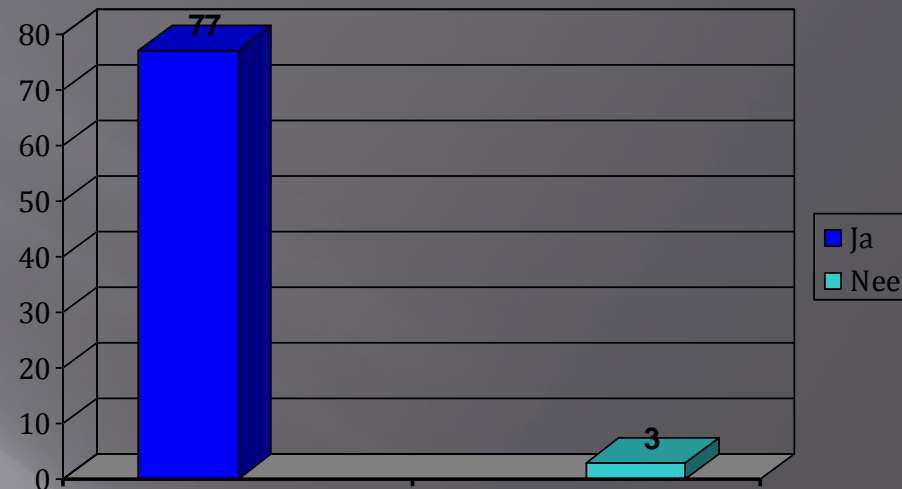
Grade 7 School Research Project
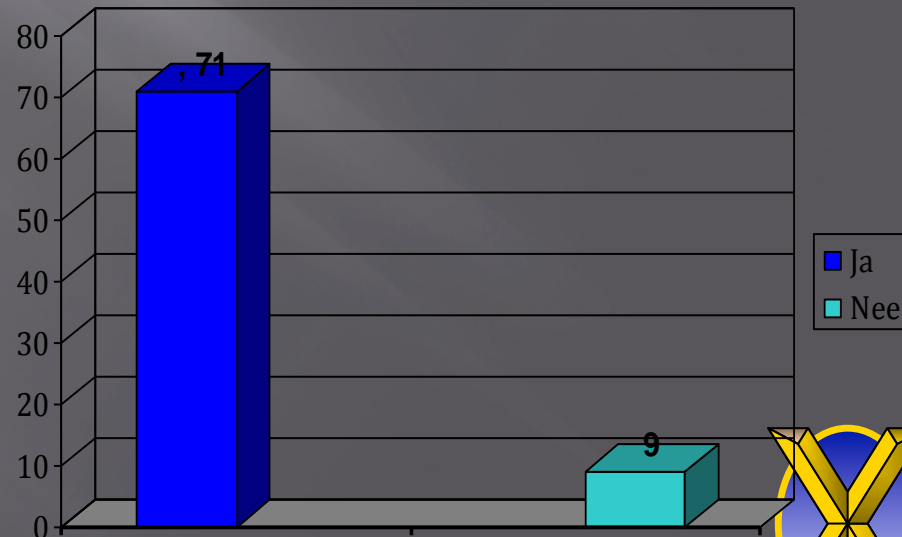
Question 3: *Do you think that pilot training has kept pace with the demands that automation places on pilots?*

41% of the pilots thought that training has maintained pace with technological innovations of automation, but of concern was that 59% did not think so.
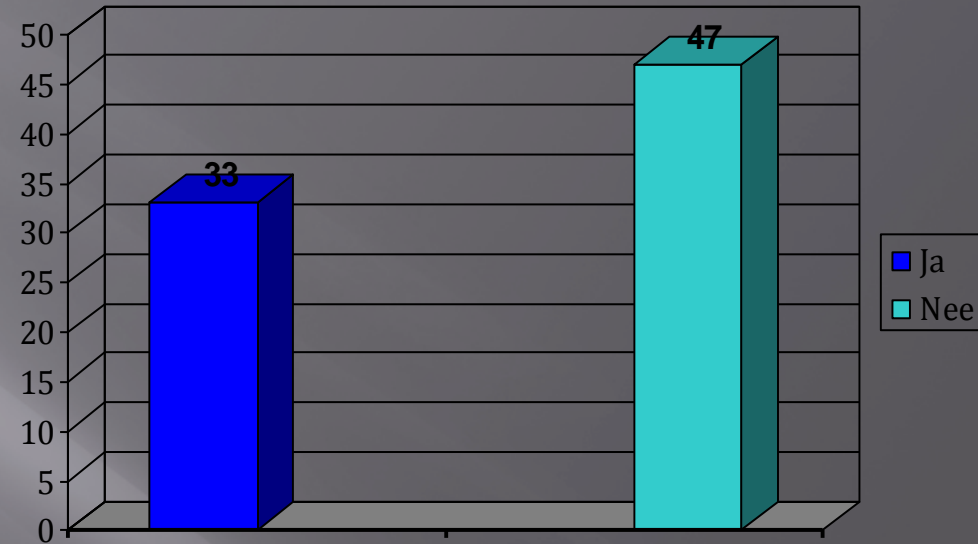
Question 4: *Do you think aerobatic training can improve handling skills?*

85% of the pilots were of the opinion that regular aerobatic training would be beneficial in improving handling skills.

When Things Go Wrong?

SAAB JAS-39 Gripen
Stockholm
08 August 1993
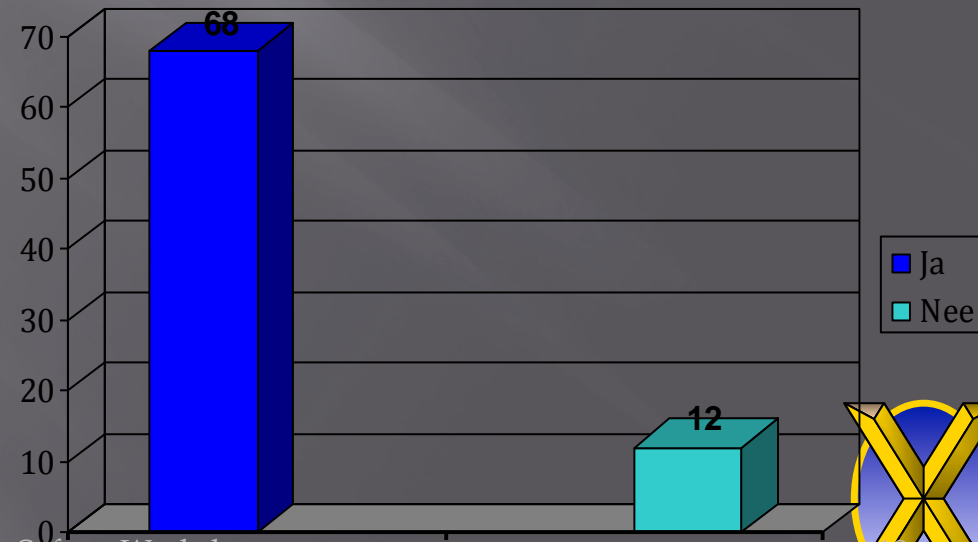
Airbus A320
Mulhouse Habsheim,
26 June 1988

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23.12.12

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Aero Engineers Argument

- Engineering Disclaimer; general impressions NOT necessarily substantiated by any defendable evidence:

- "Engineers have been working hard <u>at reducing pilot workload</u> in the name of safety.

- Current DESIGN PARADIGM = "The less you give the pilot to do, the safer the system will be"; led to large amounts of automation in cockpit.

- "There's too much automation in modern cockpits" isn't a useful design input.   Identification of what in particular about automation is causing problems, why there are problems and how they can be overcome".

- "Perhaps the role of the pilot needs to be re-examined"?

- "Has automation in the cockpit decreased the safety of flying? What evidence substantiates this"?

- "Have incidents involving pilot error and automated systems been correctly identified"?

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Problem Definition?

1. Pilot vs Engineering philosophy: Design human error out of the cockpit!
   a. Pilot Interpretation: "Automation to back up pilots"
   b. Engineer Interpretation: "Pilots to back up automation"!
2. Human psyche: slave to automation!
3. Loss of situational awareness!
4. The 'element of surprise' – "What's it doing now?"
5. Reliance on technology to ameliorate emergencies!
6. Psychomotor skills degradation!
7. Training regimens - inadequate consideration for technology failures; focus on mechanical failures!
8. Regulatory authorities not intervening to ensure matching training between HUMAN and TECHNOLOGIES!

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Benefits of Complex Automation?

- More accurate than human beings (RVSM)
- Repeatable performance –EVERY TIME (ALMOST)
- Verifiable standards
- Pilot workload reduction
- Complex tasks accomplished with reduced fatigue
- Reduction in fatal commercial accident rates worldwide to 1:49 million flights (2010) vs 1:1.7 million (1989) = 96% decrease in risk.
- SO WHY DO THESE AIRCRAFT STILL CRASH??

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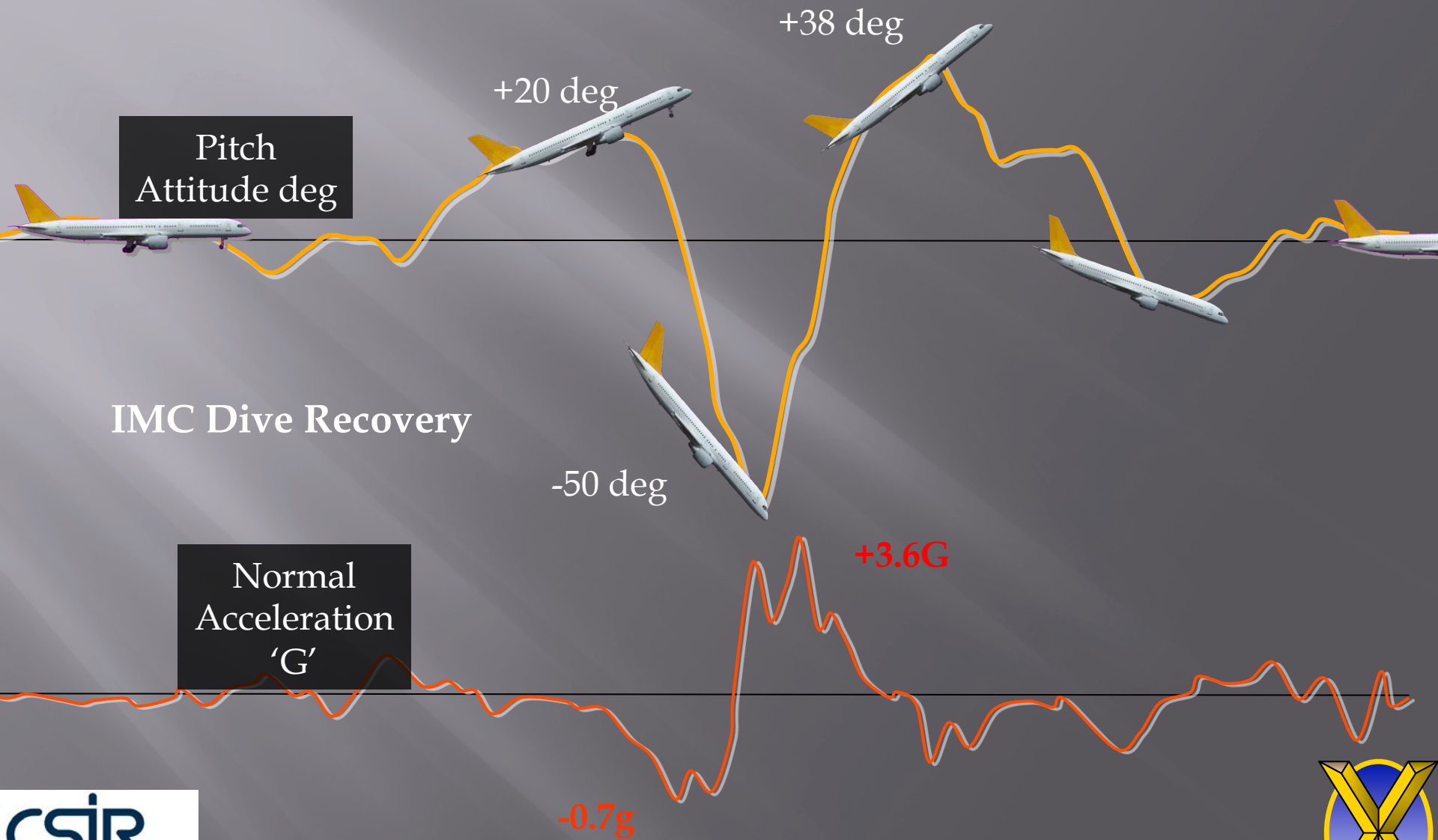
What Other Things Have We Learned Since The Introduction of Complex Automation?

- Flight Safety Foundation – Approach and Landing Accident Reduction (ALAR)
  - 78% of the ALAR accidents were preventable by a timely go-around
  - 17% of ALAR aircraft did go around but even some of these crashed!
- WHY ?
- Pilots of automated aircraft have made some tragically unexplainable errors

B757 Oslo, Go-Around from point other then the FMS pre-programmed location results in IMC dive recovery

+38 deg

+20 deg

Pitch Attitude deg

IMC Dive Recovery

-50 deg

+3.6G

Normal Acceleration 'G'

-0.7g

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GO-Around Incident Analysis

- Findings by AIB
  - Pilot was automation dependent
  - A "single cue scanner"
  - Very poor instrument scan
  - Pilot inputs significantly delayed and out of phase
  - Very abrupt and large scale control inputs
  - Poor crew coordination
  - Classic symptoms of "Automation Addiction"
  - Classic case of pilot induced perturbations

# Automation Addiction Changes in pilot behaviours and skill sets

- Effects of automation dependency are a continuous subtle degradation of Basic Attitude Instrument skills combined with
  - False sense of security;
  - Emphasis shift: Increased confidence as flight time provides familiarity and apparent mastery of the automated environment.

- Pilots must be prepared to intervene if required by operational conditions!!!!!

Automation Addiction
Changes in pilot behaviours and skill sets

- FSF ALAR study revealed similar lapses in Flight crew coordination during De-automated flight
  - NEW demands on crew coordination
    - The PF must verbalize commands for the PNF to set in FCU
    - PNF must react
    - PF must judge if reaction of PNF has satisfied his request
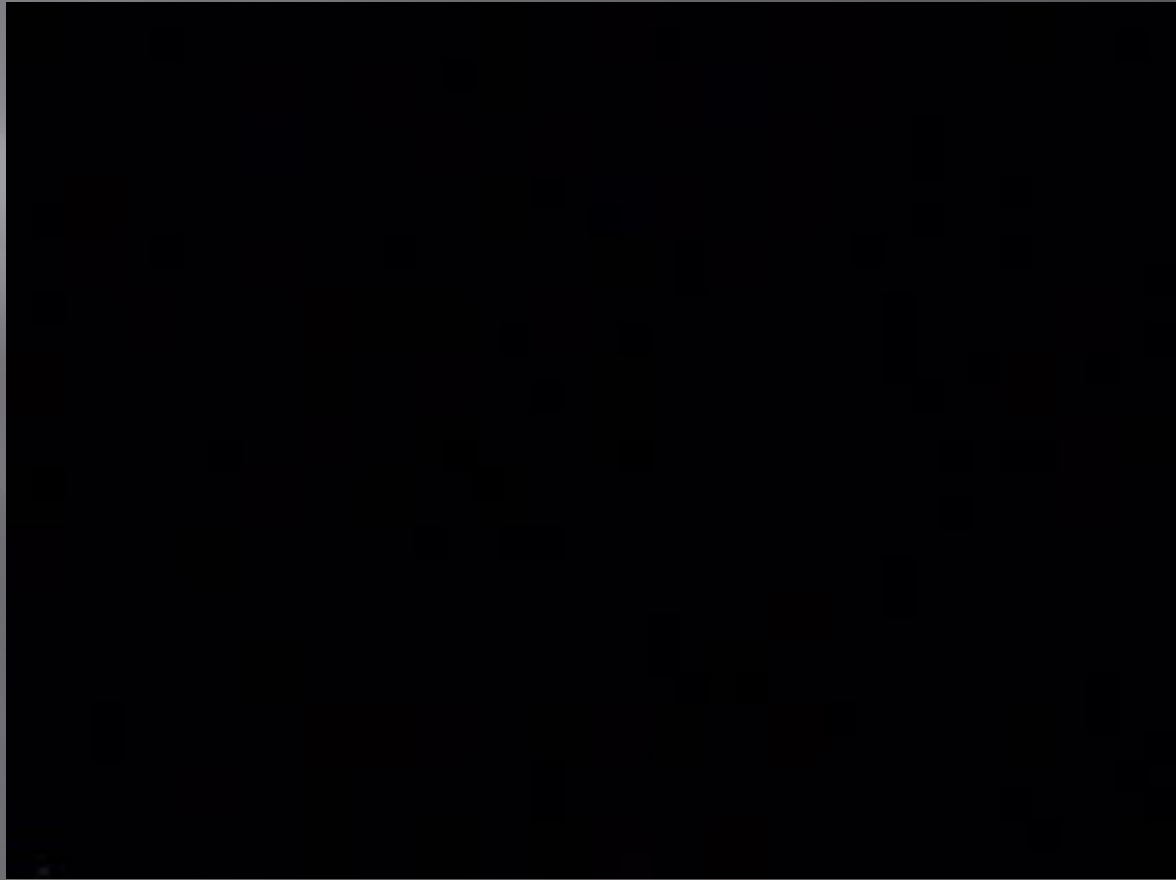
FAA Findings on Automation

1. FAA study found serious flaws in pilot training for handling automation. Conclusion:

   a. flight crew not properly trained for operating highly automated aircraft,

   b. for many problems there are no checklists, leaving the pilots to manage using ingenuity and airmanship.

3. Inadequate crew knowledge of automated systems a factor in 40% accidents + 30% of serious incidents between 2001 and 2009.

4. FAA human factors specialist, Dr Kathy Abbott evidence of disharmony between crews and highly automated aircraft. Recurring handling problems pilots demonstrated, included:

   a. lack of recognition of autopilot/auto-throttle disconnect;

   b. lack of monitoring and failure to maintain energy/speed;

   c. incorrect upset recovery and inappropriate control inputs.

5. Abbot delivered the judgement: *"Failure __assessment is__ difficult, failure __recovery is__ difficult, and the failure modes were not anticipated by the designers."*

AIRBUS Flight Operations Briefing Notes S.O.P. –Optimum use of Automation

"The correct level of automation often is the one the pilot feels comfortable with, for the task or the prevailing conditions, depending on his/her own knowledge and experience of the aircraft and systems."

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AIRBUS Flight Operations Briefing Notes
S.O.P. –Optimum use of Automation

- At any time if the aircraft does not follow the desired flight path and/or airspeed,
  - Do not hesitate to revert to a more direct level of automation, i.e.:
    - Revert from FMS-Managed Modes To Selected Modes
    - Disconnect the AP and follow FD guidance (if correct)
    - Disengage the FD and hand fly the aircraft, using raw data or visually (if in VMC)
    - Disengage the A/THR and control the Thrust manually
- "Reversion to hand flying and Manual thrust controls actually may be the correct level of automation, depending on the prevailing conditions."

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Question: So, How Real Is The Threat?

1. Is the threat of *'automation addiction'* real?

2. Is engineering is getting ahead of, and out of synch with the pilot's cognitive abilities?

3. Are test pilots fulfilling the interface role between engineers and pilots?

4. Are airline training regimens adequately adapted to cater for the insidious automation failures?

5. Does CAA regulatory oversight adequately address automation training?

6. Could the advanced technologies instituted to ameliorate human shortcomings turn out to be a bigger threat to safety than the human factor designed to be overcome?

7. We have entered a new era in aircraft handling and control requirements.

Conclusions: Back to Basics?

1. Airline pilots are not necessarily engineers nor test pilots.
2. Pilot 'disconnect' from aircraft – automated response rate out of synch with pilot expectations viz logic, gain scheduling, phase, frequency.
3. Loss of spatial and situational awareness.
4. Pilots have been seduced by innovative engineering without full understanding of cognitive saturation and motor skills degradation.
5. Focus on automated systems at expense of pilot judgement under duress – OODA loop theory to be revisited?
6. Theoretical training comprehensive technically, but what about focus?
7. Disciplined CRM/crew workload sharing more essential than ever!
8. Question. Is there really a workload reduction during emergencies?
9. Realistic training scenarios required – Regulator and Airline.
10. Flight test certification of 'canned' scenarios; out of touch with permutation of variable failure cases of line operations.
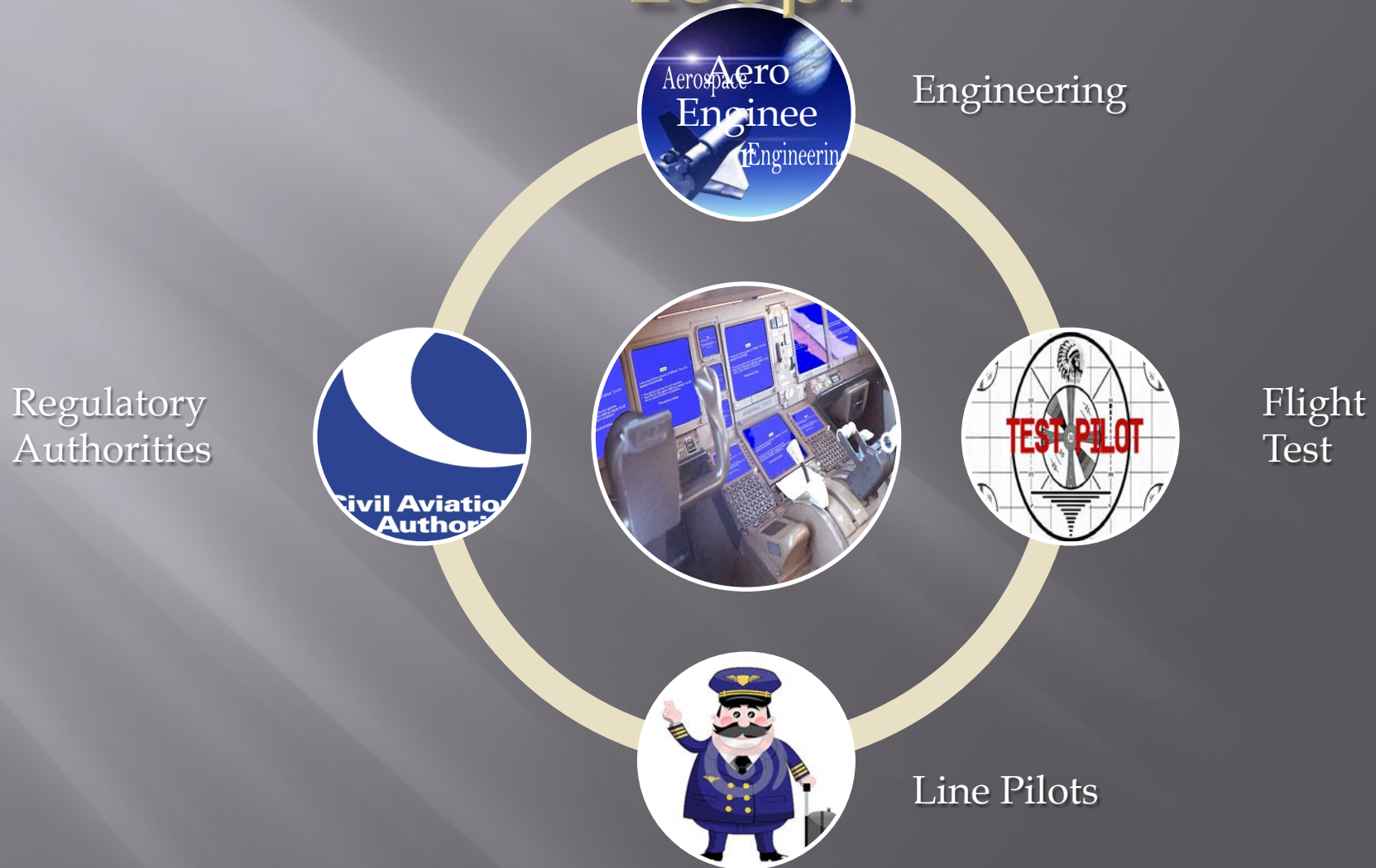
Conclusion: Training Gap Analysis
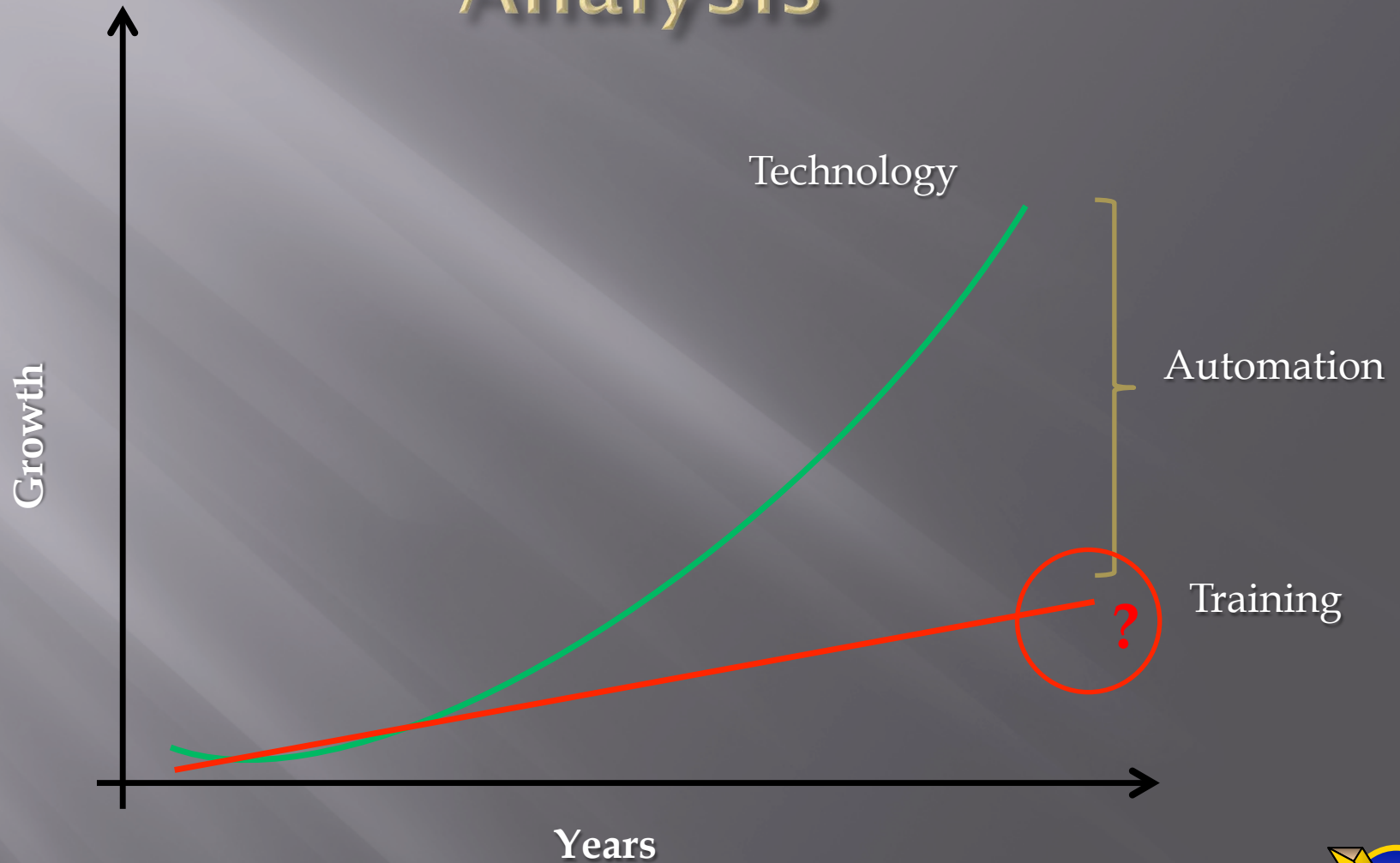
Recommendation: Collaboration Loop?

Engineering

Flight Test

Line Pilots

Regulatory Authorities

Thank You!!!!!

We cannot afford pilots and the technology failing together! "If we only look at the pilots - the human factor - then we are ignoring other important factors, we have to look at how they work together."
(US Airways Capt. Chesley "Sully" Sullenberger