The “Good” Pilot

Barbara Holder

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Ethnography of Flight Operations

Data collected at airlines across Europe, Asia, Oceania, North and South America

Flight segments observed in 777, 737, 767, A320 airplanes

Training observations in full-motion flight simulators and Interviews

Manage Complexity of the Operation

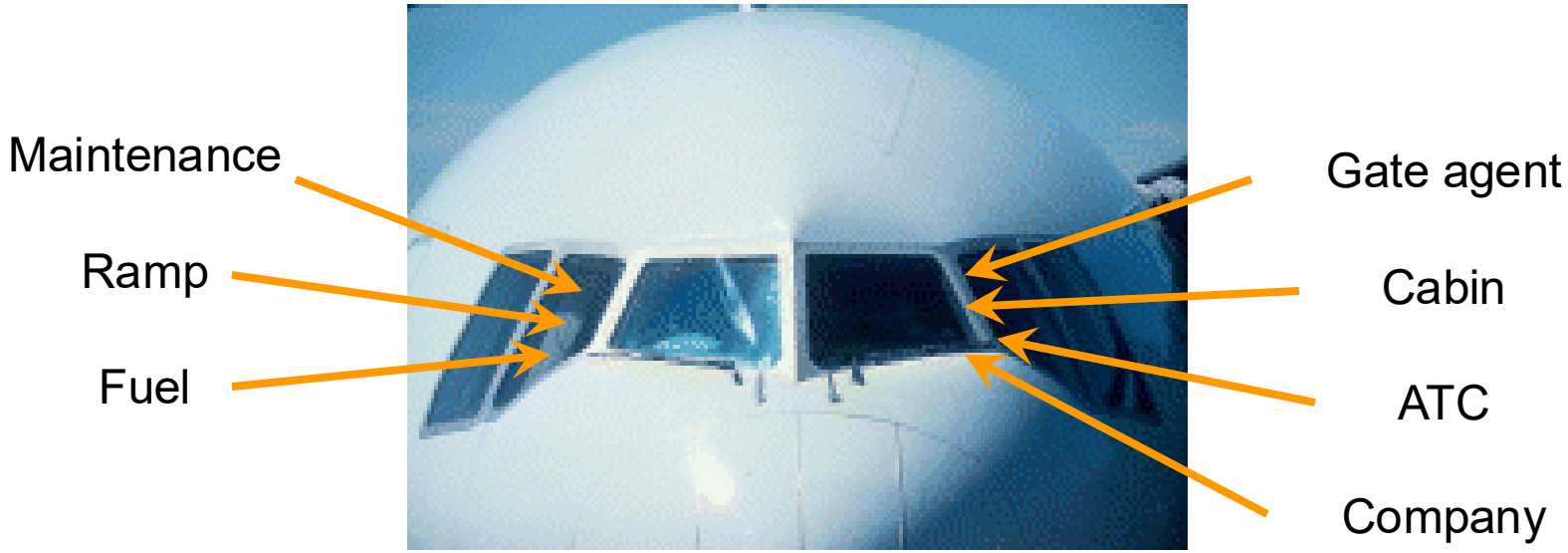
- The pilot's central task function is to manage the complexity of the operation
- Pilots are central coordination interfaces, managing dependencies and facilitating workflow and information flow
- Flights have varying levels of complexity that influence flight crew performance
- Strategies to manage differing levels of complexity are primarily ***nontechnical***

At the Airplane

- Important calculations, information loaded into flight computer and checked
- Pilots must divide attention between tasks and deploy strategies to manage their attention
  - Reminders, task switching, focus attention, pause and resume tasks, etc.
- The operational timeline impacts:
  - Time allocated to a task
  - Communication/coordination requirements
  - Delivery of task information to the crew

Managing Distractions

Information comes from variety of outside functional groups



- Data may be transmitted in person or digitally
- Information exchange often requires outside functional personnel to enter the flight deck, which interrupts and distracts
- Information comes when information or sender is ready, not when flight crew needs it or is ready to receive

Task Management Strategies

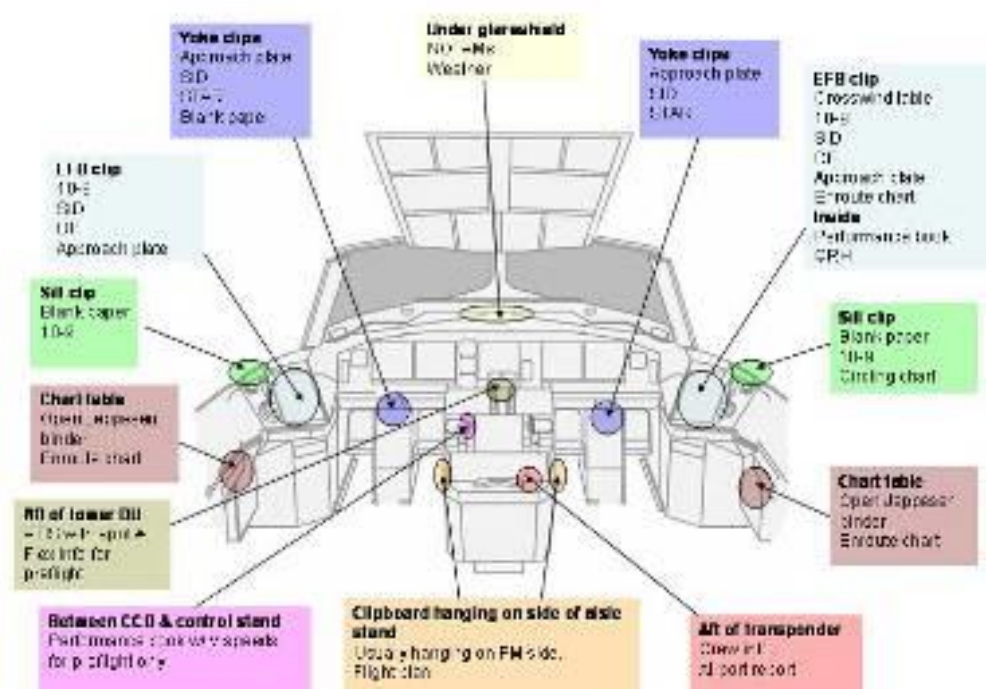
Strategic

- Anticipate how the flight will progress
- Establish task priorities for the upcoming phase of flight in the briefing
- Anticipate "*threats*" and have a plan for mitigation
- Schedule and complete tasks during low workload to "*buy yourself some time*"
- Stay organized with information to not be distracted with managing them
- Anticipate and plan for tasks needing focused attention

Tactical

- When surprised, and/or disrupted, immediately check and control Flight Path
- Preserve the current task by placing interrupting task/person on hold
- Verify last step completed after interruption
- Suspend a task, switch to another task, and then resume primary task
- Reprioritize tasks due to a change
- "*Create time*" request an extended vector, or hold, slow the aircraft or stop it on ground
- Ask for help/delegate a task
- Focus attention to only one task

Pilots Manage Information Access and Flow



Current flight deck practices manage information and allocation of attention

- Pilots organize their workspace to <u>manage access to information</u>
- Pilots organize paper to <u>regulate information flow</u> so needed information is available at the proper time

Standard Operating Procedures

- SOPs and checklists provide generic task models with idealized workflows
- Real-world task execution does not follow linear flows, pilots manage workflow to fit the operation and pace
- Procedural “noncompliance” often reflects crew professionalism in optimizing procedures to support a safe/efficient outcome

Taxi

- Attention to ground path and aircraft movement
- Operation may impose concurrent tasks:
  - Route changes
  - Unassigned runway
  - Runway changes
  - Checklist use
  - Late arrival of information
- Distract attention from flight path management
- Risk of incursions

Takeoff

Attentional focus

Real-time contingency planning

- Engine loss
- Bird strike
- Conflict vehicles/aircraft/animals
- Anticipate VMC vectors

No flight is routine, nor flown exactly as planned

Climb

Flight Path Management

Manage auto flight systems

Comply with departure constraints

Watch for traffic, terrain, weather

Manage turbulence

Aircraft configuration (speeds, flaps, slats, gear)

Manage flight path, navigate, communicate, etc.

Descent/Approach

- Complex airspace procedures
- Assess airspace procedure compliance, decide
- Automation decisions
  - Full vs. partial automation
  - Doing what's expected
  - When/how to intervene
- Manage aircraft energy
  - Slow down, go down
  - Held high
- Assure airplane is performing as desired
- High workload, time compression

Manage Unexpected Situations

"*The pilot is a decision maker, can I go to the destination, or do I need to go to an alternate*"

"*SOPs are important but they are not enough. We operate in a complex environment, so you need to have CRM skills to manage it correctly. Pilots are more managers of the situation than just machine operators*."

Flight crew expertise is critical:

- Generate solutions
- Evaluate circumstances
- Trade risks
- Decide what to do, when, how, who
- Manage nonnormal situations/events
- Adapt procedures…

Decision to Land vs. Go-around

Landing Decision Factors from Narratives	
Aircraft	Aircraft systems issue or system failure, Low fuel, Equipage limitations, Aircraft energy state, Aircraft trending to stable
Pilot	Comfort with go-around, Fatigue, Manual flying proficiency, Reluctance to fly manually, Confidence in co-pilot, Mindset to land, Comfort/confidence in “making it work”
Context	Wind shear, Thunderstorms, Deteriorating weather, Airport traffic, Length of runway, ILS out, Runway condition, ATC communication challenges, Time, Schedule pressure, Workload, Multiple go-arounds

The Turn

Turn Task/Time Management

17:23 – 17:44, 21 minutes

Captain entered the new departure airport, destination airport and company route while the F/O completed the paperwork.

Both pilots organized the new set of charts for departure and arrival.

The F/O filled out the new TOL card.

The F/O then copied the clearance.

The final load sheet, new weather and new dispatch data were brought in by the gate agent at 17:35 local.

Both pilots reviewed the landing information

The Captain briefed the TO data at 17:38 local.

In-Airplane Briefing for Next Segment

“Be as efficient as possible. There are a lot of numbers to calculate in the flight deck at each turn…

Daily operational decisions are more on economics, we make strategic decisions for the benefit of the company, fuel, services.”

Do it all again...

Training Research

Flight Path Management the New “Aviate” Task

Flight Path Management (per AC 120-123):

The planning, execution, and assurance of the guidance and control of aircraft trajectory and energy, in flight or on the ground.

- Flightpath means trajectory (lateral, longitudinal, and vertical) and energy state of the aircraft.
- Includes “ground path” if the aircraft is in motion on the ground.

Reported FPM Training Needs

Auto flight Systems Knowledge and Use

- Intervention strategies
- Interdependencies
- Engagement/disengagement

Manual Flying Proficiency and Confidence

- Ways to incorporate into training and line flying
- Ways to manage unexpected AP disengagement

Task Prioritization / Distraction Management

- Keeping the main thing the main thing
- Appropriate allocation of attention

Crew Resource Management

- CRM incorporates “difficult but critical” nontechnical skills
- Nontechnical skills remain difficult to describe and there is little agreement on which skills are essential
- Most CRM assessment tools use behavioral markers/observable behaviors to evaluate pilots.
- These assessment metrics have proven to be subjective and are very difficult to standardize

Reported CRM Issues

- Airlines expect pilots come equipped with the needed nontechnical skills
- No standard definitions for CRM skills (not always what pilots do)
- Difficult to assess or teach effectively
  - “Situational Awareness, Decision Making, Teamwork” eliminated
  - Reported to be “impossible” to train, assess, remediate
- Challenges with recognition of deteriorating situations and appropriate response
- CRM skills are undervalued
- Redefine CRM as fundamental for technical performance and safety
- Instructors are not always equipped with clear methods or criteria to evaluate CRM/non-tech skills.

Discussion 1/2

- The data we collect and analyze influences our understanding of pilot performance
  - *Are there common patterns in the details of pilot behavior that underlie superior/inferior pilot performance?*
  - *We lack the quantitative measures required to answer these basic questions*
- Most data and analyses focus on errors, exceedances, etc.
- Airline data are often protected/proprietary
- Data access and sharing across industry is needed to inform research and design

Discussion 2/2

- Flying skills are fundamental, but nontechnical skills are critical for managing the operation and its complexity
- CRM training is ineffective at nontechnical skill development/assessment
- The integration of technical and nontechnical performance, requires redefining what is CRM
- Develop and maintain worker expertise
- Tools that support management of complexity