A Human Factors Approach to Bridging Systems and Introducing New Technologies

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CASI AERO 11 – 1st Human Factors Symposium
April 26, 2011 – Montreal, Quebec

Agenda

- Human Factors to Human Systems
- Application of Human Factors to System-level Changes
  - NextGen Changes in the Airspace System
  - Focus on Collaborative Work
  - New Technologies
- Approach to Bridging Systems
  - Focus on Roles and Responsibilities
  - Identifying Points of Collaboration
  - Developing an Assessment Tool

Human Factors to Human Systems

Traditional Human Factors

- INDIVIDUAL: perception, cognition, knowledge and skills
- TEAM/ORGANIZATIONAL: leadership, communication, coordination, skill sets
- OPERATIONAL: off-nominal conditions, weather, traffic
- TECHNOLOGIES: Increased automation, changes in displays, information systems

Human Systems (Multiple Organizations)

- ROLES and RESPONSIBILITIES: Pilots, Air Traffic Control (ATC), Flight Operations Center (FOC)

Application of Human Factors to System-level Changes

FAA's goal for the NextGen Flight Deck Human Factors program is to reduce risks associated with human performance while ensuring system safety and supporting NextGen efficie ncy and capacity goals

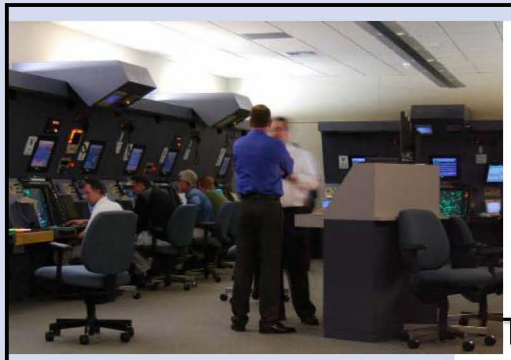
- Research on specific NextGen applications and procedures (e.g., trajectory based operations (TBO), collaborative air traffic management)
- Research on specific NextGen technologies (e.g., automatic dependent surveillance-broadcast (ADS-B), DataComm, Network enabled weather
- Research on human interaction with NexGen applications and technologies (e.g., communication, **automation/roles & responsibilities**, risk & error management, decision making

Pilot/ATC/FOC Communication & Coordination Task

- Research Team
  - Barbara G. Kanki, Ph.D., NASA ARC
  - Thomas L. Seamster, Ph.D., Cognitive & Human Factors
  - Eric Chevalley, Ph.D., San Jose State Univ. Fndn.
- Subject Matter Experts
  - Operators: Pilots, Dispatchers,
  - FAA: Air Traffic Controllers, Air Traffic Management
  - NextGen Stakeholders
- Other NextGen Researchers
  - E.g., FAA HF Area 5: Roles and Responsibilities
  - Automation, TBO Working Groups

NextGen Changes in the Airspace System: Focus on Collaborative Work

TOWER TEAM
Flight data
Tower supervisor
Clearance delivery
Ground control
Cab coordinator
Local control



TRACON TEAM
Arrival/Departure data
Arrival Control
Departure Control
Handoff Control
Satellite Control
Traffic Management Unit

EN ROUTE SECTOR TEAM
Radar flight data
Radar coordination and handoff
Radar associate
Radar

Information Sources
Training materials, observations, SMEs
Guidance documents: JO 7110.65T, ICAO, Eurocontrol guidance
Initiatives: Airspace redesign, traffic mgmt, time-based metering, ground delay program
Technologies: En Route automation, satellite-based surveillance

NextGen Changes in the Airspace System: Focus on Collaborative Work

Electronic Flight Bag Example

- Distraction Management
  - EFB usage by the non-flying pilot during critical phases (e.g., Taxi, Climb, Descent)
- Workload Management
  - Use of SEND and SYNC functions to promote crew coordination and efficiency
  - Coordination and sequence of FMS and EFB usage by crewmembers

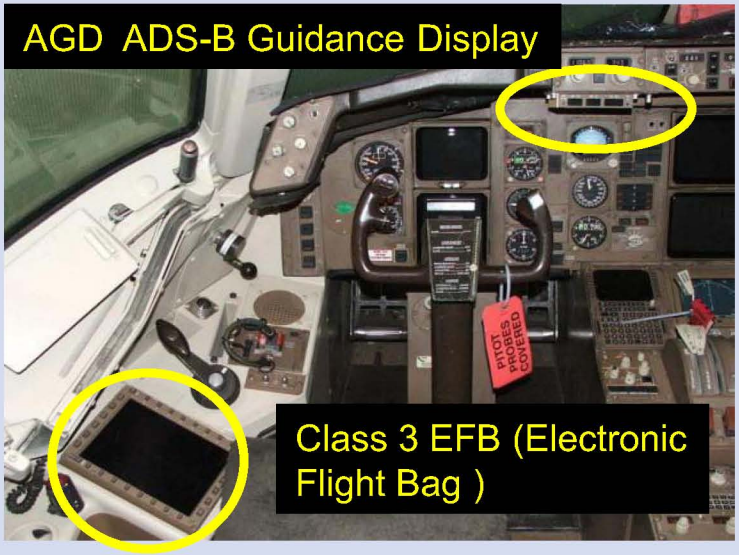
Information Sources

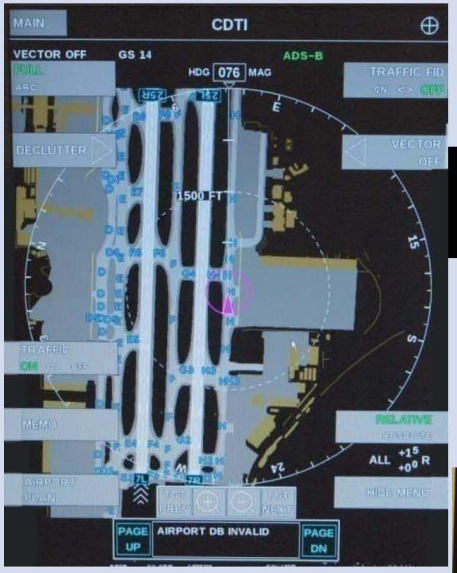
Guidance documents Part 61, 91, 121, 135, Advisory Circulars (e.g., CRM), Aeronautical Information Manual

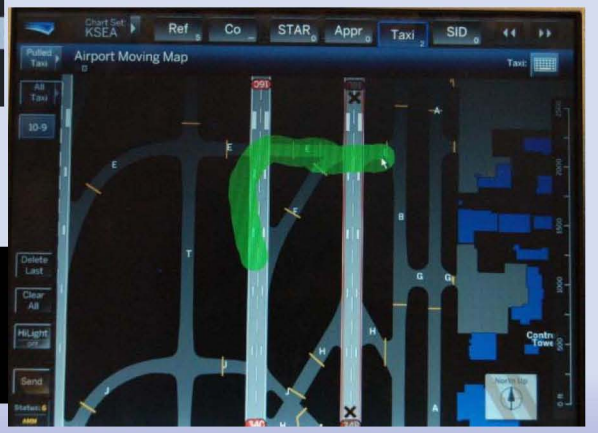
Company policy/procedures, operating documents, AQP task analysis, etc

Current technologies: ADS-B, CDTI, EFB, Data Link

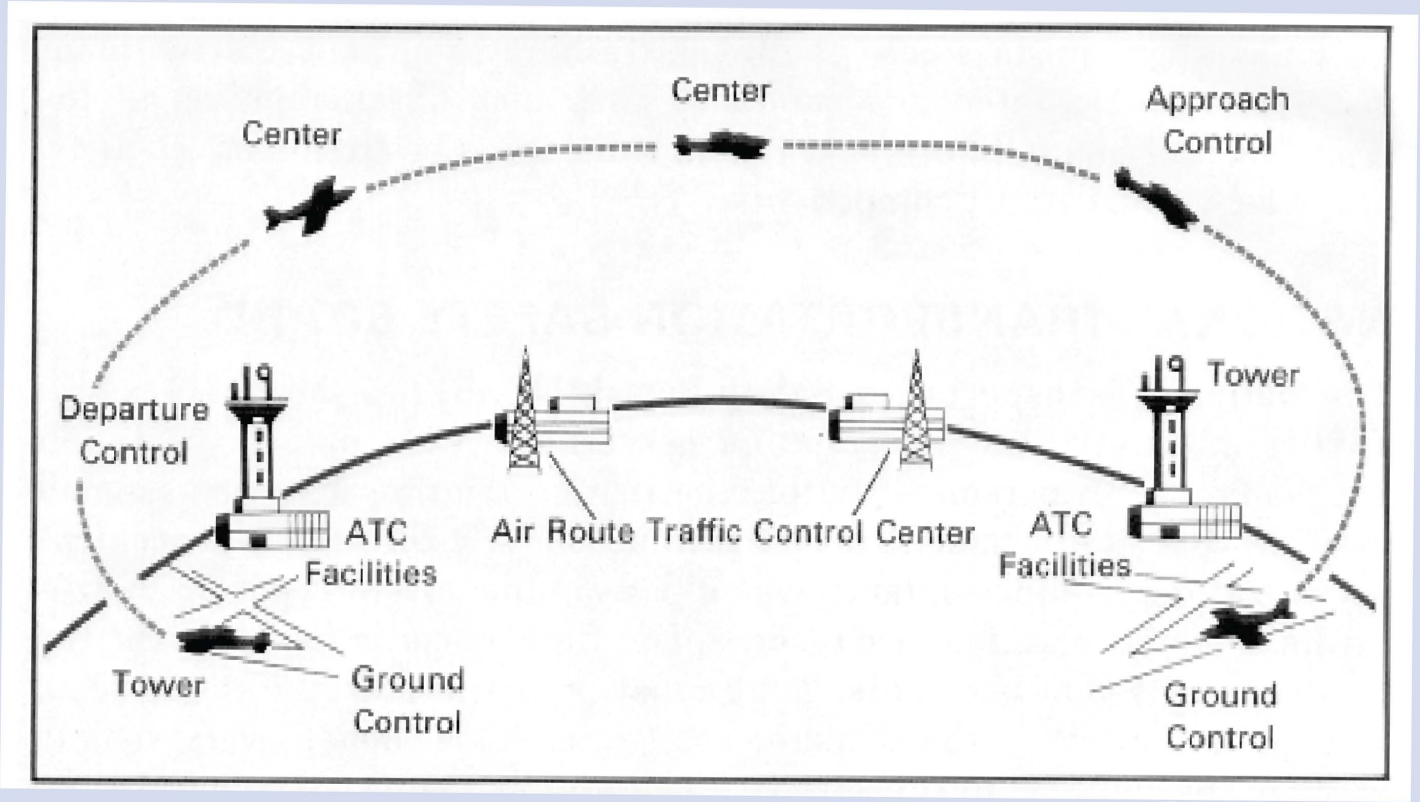
NextGen Changes in the Airspace System: New Technologies







Keeping the System Perspective



. . . focusing on collaborative functions

Focus on Roles and Responsibilities

- In the current system:
  - Who does what and with what level of authority?
  - How are responsibilities governed?
  - How do roles coordinate; by what means?
  - Are responsibilities shared within/across teams?
- When roles change:
  - What are the implications to safety/risk?
  - What are the information requirements?
  - What are the implications for training and metrics?
  - How can cost/benefits be assessed?

Approach to Bridging Systems

1. Identify potential NextGen transition points for roles and responsibilities of pilots, ATC, FOC and automated systems:
   - Comprehensively map *current* pilot/ATC/FOC tasks and collaboration points
   - Support this activity through Literature and State-of-the-Practice Reviews, Subject Matter Experts, etc.
2. On the basis of current operations, develop a **Collaboration Matrix** to identify and describe pilot/ATC/FOC coordination tasks and procedures that anticipate NextGen changes.

Identifying Points of Collaboration

3. Identify generic points of collaboration for normal and key off-normal operations (pilot-ATC, pilot-FOC, ATC-FOC) by Phase of Flight
   - Include key variables such as: From/to, function, information transferred, media
   - On the basis of task analyses for each role (as per operator manuals and FAA guidance documents)

Based on FAA documents, operator documents, AQP task analyses, 100 hours of interviews with ATC SMEs, FOC site visits, frequency/criticality ratings

Collaboration Matrix Sample

Phase of Flight	Time	System	FROM	TO	CREW Position	ATC Facility	ATC Position	Action	Information
Pre-flight	-4.00	COMP	AOC	COMP				Input	Initial Routing
Pre-flight	-2.00	COMP	AOC	COMP				Input	MEL and other constraints
Pre-flight	-2.00	COMP	AOC	ATC		Tower	Clearance Delivery	Send	Requested Routing
Pre-flight	0.00	COMP	AOC	COMP				Monitor	Flight Plan updates by ATC, weather, airport status (ATIS)
Pre-flight	-1.00	COMP	AOC	CREW				Print	Flight Plan, fuel, alternates, take-off & landing weights, dispatch name+phone, Wx, Mx history, NOTAMS, crew, security info
Pre-flight	-0.55	In Person	CREW		CAPT & FO			Review	Flight Plan, route, weather, fuel, maintenance, NOTAMS etc.
Conditional Pre-flight	-0.45	COMP	CREW	AOC	CAPT			Request	Flight Plan changes *(If change required)*
Pre-flight	-0.40	COMP	AOC	ATC		Tower	Clearance Delivery	Send	Flight Plan update
Pre-flight	-0.40	PAPER (or COMP)	CREW	AOC	CAPT			Signs	Flight Plan concurrence
Conditional Pre-flight	-0.35	COMP	CREW	Datalink				Initialize	Datalink initialization *(If required equipage)*
Pre-flight	-0.30	ACARS	AOC	CREW				Send	ACARS flight data (Flight Plan + weight + ATIS code + rwy perf, release verif, maintenance release)

Developing an Assessment Tool

Collaborative Systems Assessment Template (**CSAT)** a hierarchical structure starting with:

- Collaborative Functions in the airspace system
  - Collaborative Procedures (e.g., TBO)
    - Responsibilities: Flightdeck, ATC, FOC
    - Relevant Technologies: Flightdeck, ATC, FOC
    - Human Factors Considerations and Measures: Workload, SA, number of ATC communications, interventions
    - Evaluation Scenarios: based on current baselines, existing research, critical off-nominal conditions

Current Status and Final Thoughts

- Application in work: Trajectory-based operations (e.g., Flight Deck-based Merging and Spacing)

- Transition issues to keep in mind
  - Implementation of multiple changes in a continuous and overlapping timeline
  - Existence of hybrid systems (some old, some new) that may only be implemented in some locations, under some conditions: A/C differences, airport/ATC capability differences

Thank You!