
Barbara G. Kanki, Ph.D.  
NASA Ames Research Center  
Human Factors and Ergonomics Society 55th Annual Meeting  
Las Vegas, NV – September 23, 2011
Agenda

• Introduction

• Changes in Roles and Responsibilities
  – Focus on Collaborative Work
  – Focus on New Technologies
  – Focus on Roles and Responsibilities

• Collaborative Systems Assessment (CSA)
  – Developing a Baseline Interaction Matrix
  – Developing a Framework for CSA
  – Future Directions
Introduction

Program: NextGen Flight Deck Human Factors
- Division: Human Interaction with NextGen Technologies
- Topic Area: Automation/Roles & Responsibilities
- Project Focus: Pilot/ATC/Flight Operations Center Communication & Coordination

Research Team – NASA Ames Research Center
- Barbara G. Kanki, Ph.D., NASA
- Thomas L. Seamster, Ph.D., Cognitive & Human Factors
- Eric Chevalley, Ph.D., San Jose State Univ. Fndn
- Subject Matter Experts: pilots/air traffic controllers/dispatchers
Changing Roles and Responsibilities

Changes in the roles and responsibilities of pilot, ATC, FOC and automation are anticipated in future NextGen collaborative systems

– In order to implement the most effective distribution of roles and responsibilities there needs to be a way to assess various collaborative arrangements that:
  • takes into account Human Factors considerations,
  • identifies benefits and risks at a general level,
  • addresses performance tradeoffs at a procedural level.
Focus on Collaborative Work

AIR TRAFFIC CONTROL

Tower Team
- Flight data
- Tower supervisor
- Ground control
- Cab coordinator
- Local control

TRACON Team
- Arrival/Departure data
- Arrival Control
- Departure Control
- Satellite Control
- Traffic Management Unit

EN ROUTE
SECTOR TEAM
- Radar flight data
- Radar coordination
- Radar associate
- Traffic Management Unit

TRAFFIC MANAGEMENT

FLIGHTDECK
- Captain - First Officer
- Pilot Flying – Pilot Monitoring

FLIGHT OPERATIONS CENTER (FOC)
- Dispatchers who plan and release flights
- Dispatches who coordinate with ATC
Focus on New Technologies

AGD  ADS-B Guidance Display

Class 3 EFB (Electronic Flight Bag)

CDTI Cockpit Display of Traffic information

Class 2 Electronic Flight Bag with Airport Moving Map
Focus on Roles and Responsibilities

• **In the current system:**
  • Are responsibilities shared within/across teams?
  • Who does what and with what level of authority?
  • How are responsibilities governed?
  • How do roles communicate and coordinate; by what means?

• **When roles change:**
  • Will responsibilities shift or be shared across teams?
  • Will there be changes in workload, where will they occur?
  • What are the information requirements; will there be changes in situational awareness?
  • What are the overall benefits and risks?
Collaborative Systems Assessment (CSA)

Assumptions for developing a CSA framework:
1. Framework for assessment is generic (e.g., technology and procedure neutral).
2. Framework incorporates basic operational concepts (e.g., phase of flight, nominal vs. off-nominal conditions, time-sensitive vs. time-critical).
3. Currently, there is substantial interaction between groups but little “collaboration”.
4. Current interactions involve limited automation but as advanced automation is implemented, “automation” is considered the 4th “collaborator.”
Developing a Baseline Interaction Matrix

1. Detail current roles and responsibilities of pilots, controllers and dispatchers by phase of flight
   – on the basis of task analyses for each role,
   – using operator manuals, FAA guidance documents,
   – interviews and surveys with subject matter experts.

2. Identify generic points of interaction for normal and key off-normal operations (pilot-ATC, pilot-FOC, ATC-FOC)
   – describing the current function of the interaction,
   – providing the current means of interaction or communication.
Keeping a systems perspective...

... focusing on collaborative functions
Developing a Framework for CSA: 
5 Key Elements

1. Collaborators: Flightdeck, ATC, FOC, Automation
2. Collaborator Responsibilities for each
3. Functions and Procedures
   – Function Allocation
   – Collaborative Procedures
   – Tasks
4. Human Factors Considerations
   – Scenarios including Nominal and Off-nominal Operations
   – Measures and Metrics
5. Required Technologies
   – System requirements and technologies
Developing a Framework for CSA Inputs

CSA Input Elements for pilot/ATC/FOC/Automation

• When only General inputs are available
  – Phase of Flight of interest
  – Time Criticality: (e.g., critical, sensitive, planning)
  – Collaborator Responsibilities (e.g., collaborative trajectory mgmt)
  – Collaborator Functions (e.g., merging, spacing, separation mgmt)
  – Level of Automation (e.g., none, partial, full)

• When Detailed Procedural inputs are available
  – Assumed Systems/Technologies (e.g., ADS-B, Data Comm, RNAV, RNP, ERAM available, System Wide Information Management (SWIM), NextGen Network Enabled Weather (NNEW) is available, CDTI, Collaborative Trajectory Planning)
Developing a Framework for CSA Output

**CSA Output**

- When only General inputs are available,
  - General Benefits, e.g. efficiency, flexibility, enhanced situational awareness, decreased workload,
  - General Risks, e.g., work overload, not maintaining shared situational awareness, level of automation required not available.

- When Detailed Procedural inputs can be assumed, trade studies may be performed for particular collaborations
  - Metrics for each collaborator (e.g., Flightdeck, ATC, Automation) may include: Communication frequency, efficiency, flexibility, shared situational awareness, workload.
Future Directions

• The CSA framework (currently in the form of checklists) allows the user to assess collaborative systems at a General and/or Detailed, procedural level.

• The framework can be further developed into a stand-alone tool, supported by links to research literature as well as operational and guidance documents.

• Intended users are ConOps developers and other NextGen researchers.