Review of Controller Training Requirements for Advanced ATC Environments

Colin Dow, Jonathan Histon
Humans in Complex Systems Lab (HCOM)
Systems Design Engineering
University of Waterloo
Contact: cdow@uwaterloo.ca
Introduction

• ATC system updates will increase automation and complexity
• Need for re-evaluation of:
  – knowledge, skills and abilities required of controllers
  – training best practices
• ATC training programs need to adapt by using new instructional techniques and concepts
• What are the key challenges that must be addressed?
Increasing Air Traffic

Upgraded ATM System

• A global ATM system upgrade is currently underway
• Airspace over Europe and the U.S. represent some of the biggest challenges
• Eurocontrol and the FAA have developed a plan for an improved system; shift to implementation

(FAA 2013) (Eurocontrol)
Changing Environment

• New operational tools being introduced include:
  - ADS-B
  - CPDLC
  - SWIM
  - CDM
  - Decision support tools (DSTs)

• New tools will have a significant impact on the operational environment

(FAA 2009)
Outline

- Approach & 3 Key Challenges
- Areas for Future Research
- Conclusion
Approach

• **Goal**: Gain better understanding of challenges and identify potential for research opportunities

• **Gathered** the relevant literature
• ** Analyzed** for recurrent themes
• **Identified** potential areas for further research

(SavePottstown)
Model for the process of ATC training program redesign

**CURRENT**

- Operational Tools
  - Redesign
- Research & Development
  - Deployment

**FUTURE**

- New Operational Tools
  - Operations
- Development of Training Requirements
  - New Training Requirements
  - Development of Training Program
    - **Key Challenges**
      - Simulation-Based Training
      - Training for Automation
      - Training Complex Skills
  - Deployment
- New Training Program

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3 Key Challenges

• Simulation-Based Training
• Training for Automation
• Instructional Design for Training Complex Skills
Simulation-Based Training

• Level of Fidelity
  – Not how much you have but how you use it (Salas et al. 1998)
  – High-fidelity simulation does not mean good training
  – Simulation-based training needs to be informed by research in instructional design and learning concepts

(AG-One)
Simulation-Based Training

• Lower-fidelity simulation can be just as valuable
  – High-fidelity simulation is one component of learning process

• Need to set:
  – Learning goals
  – Performance measurements

• Why continuing heavy reliance on high-fidelity?
Simulation-Based Training

• Characterization of Simulation Scenarios
  – Improved ability to create scenarios
  – Automatic Scenario Generation
  – How to characterize ATC simulation scenarios?

• Advanced Training Technologies
  – Intelligent Tutoring Systems
  – Voice Recognition & Synthesis
  – How to incorporate in training programs?
3 Key Challenges

• Simulation-Based Training
• Training for Automation
• Instructional Design for Training Complex Skills
Training for Automation

- Automation can have significant impact on:
  - Mental workload
  - Situation awareness
  - Complacency
  - Skill degradation

- What impact will new ATM tools have on performance?

(Tom Cheney)
Training for Automation

• Impacts of automation in advanced ATC environments have been extensively studied
• Less focus on how automation will affect training
• Recent studies have focused on the order in which ATC skills are trained (Manual control vs. Support tools)
  – There is a significant impact on performance depending on the order (Rorie et al., 2011; Billinghurst et al., 2011)
  – Reliance on DSTs in training can also affect performance (Vu et al. 2012)
• How else will training need to adapt?
3 Key Challenges

• Simulation-Based Training
• Training for Automation
• Instructional Design for Training Complex Skills
Instructional Design for Training Complex Skills

- Complex cognitive skills are essential for controllers
- There are learning concepts and theories to inform the design of training for these skills
  - Holistic approach vs. Atomistic approach
- Recent work supports the holistic approach (van Merrienboer & Kirschner, 2013)
  - Ex.: 4-Component Instructional Design Model
    - Learning tasks
    - Supportive information
    - Procedural information
    - Part-task Practice
Instructional Design for Training Complex Skills

• Dynamic Problem Selection
• Critical Thinking Instruction
• How do these learning strategies compare with current ATC training program design?
Outline

• Approach & 3 Key Challenges
• Areas for Future Research
• Conclusion
Importance of Training Program Redesign

**CURRENT**

- Operational Tools
  - Redesign
  - Research & Development
    - Deployment
    - New Operational Tools
      - Operations
      - Trains Controllers For
      - New Training Program
      - Redesign
      - Development of Training Requirements
        - New Training Requirements
          - Development of Training Program
            - Key Challenges
              - Simulation-Based Training
              - Training for Automation
              - Training Complex Skills

**FUTURE**

- New Operational Tools
  - Operations
  - Trains Controllers For
  - New Training Process
  - New Training Program
  - Deployment
Areas for Future Research

• Simulation-Based Training
  – Simulator fidelity for specific training outcomes
  – Use of complexity metrics for characterization of simulation scenarios

• Training for Automation
  – Training for automation failure
  – Controller skill degradation due to automation

• Instructional Design for Training Complex Skills
  – Adapting learning theories to ATC training programs
Outline

• Approach & 3 Key Challenges
• Areas for Future Research
• Conclusion
Conclusion

• Focus has been on design of new tools, what about the training to use these tools?
• Developed preliminary model for training design process
  – Further work needed to identify relationships between new tools and training needs
Conclusion

• Recent work has identified several key challenges that will affect the success of training programs
  – Choice of simulator fidelity
  – Need for contingency training
  – Approach to skill development
• Addressing these challenges is an important step in developing effective training programs that will support the introduction of new operational concepts
References

• ICAO. (2007). *Outlook for Air Transport to the Year 2025*. Montreal, QC: ICAO
References


Thank you.