THE EVOLUTION OF AIR TRAFFIC CONTROLLER TRAINING IN THE UNITED STATES

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Abstract

Training for air traffic controllers has undergone changes over the years resulting in a loss of capability relative to university programs. New Federal Aviation Administration (FAA) initiatives currently underway offer some new paradigms that may represent improved training processes. The FAA's Aviation Rulemaking Advisory Committee is investigating outsourcing alternatives. A Center of Excellence in Technical Training and Human Performance was established by the FAA in 2016 to modernize and update air traffic controller training, and research has begun in key areas to support the transformation of training of air traffic personnel using distributed and adaptive learning technologies, modeling and simulation, and part-task training.

Introduction

In 1989 the Federal Aviation Administration (FAA) entered into a partnership with several U.S. colleges to provide training for students desirous of becoming air traffic controllers. This program was known as the Collegiate Training Initiative (CTI) and involved five colleges/universities. The FAA expanded the program to include academic programs at 36 colleges/universities. Graduates who had scored well on the qualifying exams were accepted for training at the FAA ATC Training Center. Various proposals were presented to Congress to allow colleges/universities the opportunity to fully train an air traffic controller thereby saving the government millions of dollars. Typical of these proposals was one by a university president in which he described how several millions of dollars could be saved by sending college graduates with air traffic controller training directly into the On-the-Job-Training (OJT) workforce" (*The Status of the Air Traffic Controller Workforce*, 2004, p. 35). Such requests as these went unheeded until recently.

The National Airspace System is undergoing an unprecedented redesign through the NextGen program. As NextGen continues to be implemented, the specialized skills required by those who will use and manage the systems must be upgraded in equal measure. That upgrade will be realized through enhanced training – moving away from the decades-old model of instructor-led training in a classroom in favor of a modern, national training approach using part-task trainers, modeling, immersive human-in-the-loop simulation, and adaptive learning technologies that are found in other technical workforces. The FAA recognizes that its databases must be centralized and linked to provide the analytics necessary for an effective, efficient system. To

accomplish this, the FAA created a new Center of Excellence in Technical Training and Human Performance.

Purpose

The purpose of this paper is to trace the evolution of air traffic controller training in the U.S., including the latest technology and pedagogical research efforts being conducted to transform training for the FAA's Air Traffic Organization (ATO) workforce. This purpose is achieved through the background discussion of: the current air traffic controller training system, which includes a description of the FAA's Collegiate Training Initiative (CTI), and through various efforts external to the FAA to change the training paradigm. Next, the narrative transitions to the FAA's current initiatives to address training pedagogy and technology; this is accomplished by examining recent efforts of the FAA Aviation Rulemaking Advisory Committee (ARAC) and the FAA's creation of a Center of Excellence to conduct research into new methodologies for training air traffic controllers. Several research databases and various government documents were used to develop this explication.

The FAA's Collegiate Training Initiative

In 1989 the Federal Aviation Administration (FAA) entered into a partnership with several U.S. colleges to provide training for students desirous of becoming air traffic controllers. This program was known as the Collegiate Training Initiative (CTI) and involved five colleges/universities. Over time the FAA expanded the program to include academic programs at 36 colleges/universities (Coyne, 2014). Upon completion of university programs, the graduates who had scored well on the qualifying exams were accepted for training at the FAA ATC Training Center in Oklahoma City. This training was from 11 to 15 weeks (Celio, Jarvis, & Poore, 2005). The cost to the government for this training averaged approximately $128K per student (Brady & McGuirk, 2014c).

The CTI partnership between the CTI universities moved along at a reasonable rate with CTI graduates enjoying what was believed to be preferential hiring. This changed dramatically in 2014 when the FAA abruptly changed the manner in which it recruited and hired new air traffic controller candidates. This prompted one university to report (Brady & McGuirk, 2014a, p. 1):

> After more than two decades of working with the FAA to supply highly educated candidates for the position of air traffic controller, the FAA, appears to have abandoned this partnership leaving 3,000 to 3,500 AT-CTI graduates and current air traffic control students without portfolio. Many AT-CTI graduates and current students have amassed upwards of $100,000 each in student loan debt in pursuit of air traffic degrees. In place of this program, the FAA opted to employ a general public announcement seeking to recruit U.S. citizens without regard to air traffic control background or education to fulfill future personnel requirements at air traffic control facilities. AT-CTI graduates who currently have a valid AT-SAT (Air Traffic Selection and Training) score were forced to re-compete through a Biographical Questionnaire for the "opportunity" to take or retake the AT-SAT. The latest

> Biographical Questionnaire tested roughly 28,000 applicants to yield about 2,200 individuals who were eligible to move on to take or retake the AT-SAT aptitude test.

The result of this action by the FAA was that enrollment in air traffic education programs in all CTI schools plummeted. For example, the largest university program enrollment dropped from more than 600 students to less than 300. Students enrolled in the CTI programs felt that the FAA had abandoned them. Many of those students banded together and brought a class-action lawsuit against the FAA. In responding to a letter sent to the White House, the FAA's Assistant Administrator for Human Resource Management stated, "I want to assure you that the FAA's goal in implementing the interim hiring process was to ensure the agency selects applicants with the highest probability of completing our rigorous air traffic controller training program…" (Bostick, 2014 as cited by Brady & McGuirk, 2014b, p. 1). The FAA achieved just the opposite; it closed the door on hundreds of highly qualified college-educated applicants.

External Efforts to Change the Training Paradigm

Various proposals were made to Congress to allow colleges/universities the opportunity to fully train an air traffic controller thereby saving the government millions of dollars; instead, students paid tuition to the universities for air traffic training. Typical of these proposals was one by a university president in which he said, "If [our] graduates were allowed direct entry into the OJT workforce, those savings to the FAA alone could approach as much as $18 million annually…" (*The Status of the Air Traffic Controller Workforce*, 2004, p. 35).

FAA's Current Initiatives

To investigate options for training air traffic controllers the FAA has undertaken several new initiatives. Most prominent among those are the efforts of the FAA's Aviation Rulemaking Advisory Committee (ARAC) and the creation of the Center of Excellence for Technical Training and Human Performance (TTHP).

Aviation Rulemaking Advisory Committee's Working Group

In September 2016 the FAA's ARAC (FAA Order 1110.119R, 2016) created a working group entitled Air Traffic Controller Basic Qualification Training Working Group. The group, composed of 12 representatives of industry, education, labor union, and the FAA was charged with providing to ARAC, "an analysis on options for external training provider solutions that restructure the FAA air traffic controller candidate pipeline" (ATCWG, 2017, p. 3). Two models were described:

> Model 1 • Candidates that apply for training at the ETPs [External Training Providers] would be self-funded • ETPs would provide the training track(s) (i.e., Initial Tower Cab Training/ Initial En Route Training) with the ultimate decision resting with the candidate • Upon completion of training, students would receive an examination from an FAA Examiner • Students would apply to FAA vacancy

> announcements • FAA would conduct Aptitude and Behavior testing • FAA would issue successful students a Tentative Offer Letter pending completion of medical and security requirements • FAA would issue Firm Offer Letter to students for direct hire to their designated facility.
>
> Model 2 • Candidates for the training would be self-funded • Candidates would apply to FAA vacancy announcement; the vacancy announcement would identify the track (i.e., Initial Tower Cab/ Initial En Route) • FAA would conduct Aptitude/Behavior testing and Medical/Security clearance • FAA would issue a Tentative Offer Letter • Candidates would select an Approved ETP • Students would complete training and successful examination from an FAA Examiner • Pending successful completion of training at a certified ETP, students would be issued a Firm Offer Letter and assignment to his/her designated ATC facility (ATCWG, 2017, p. 10).

The committee indicated a preference for Model 2. Both models assumed that the cost of training would be provided by the student as is the case now in CTI schools. Adopting either model would result in a savings to the FAA of approximately $119 million over a 10-year period. This would occur without a reduction of the quality of training that a candidate receives from the present program.

Accepting either model represents the culmination of an initiative begun by a university president in 2004 (*The Status of the Air Traffic Controller Workforce,* 2004).

Center of Excellence

The creation of Centers of Excellence (COEs) is a widely used strategy to address a host of issues faced by an industry or even a nation. For example, the National Operations Center of Excellence was begun in 2015 to serve as a single point-of-contact between the various stakeholders, to provide access to knowledge, to promote best practices, to support capacity building, and to provide a forum for exchange of ideas (Lockwood & Noble, 2014). Similar in concept, University Transportation Centers support vigorous research, and ongoing education through conference, webcasts, newsletters, and reports ("UMTRI-led effort," 2006). These and many other Centers of Excellence perform fundamentally like purposes.

The Federal Aviation Administration's (FAA) Air Transportation Center of Excellence program was begun in 1990 pursuant to Public Law 101-508 to address aviation challenges for the public good. The COEs are awarded to university teams to provide for multi-year, multi-million dollar grants, typically in the form of 10-year cooperative agreements, to research areas that are critical to the FAA and the flying public. COEs have been established in areas such as aircraft structures, general aviation, operations research, airworthiness assurance, aircraft noise and aviation emissions mitigation, advanced materials, airliner cabin environmental research, airport technology, and commercial space transportation (FAA Centers of Excellence Facts, 2017).

Between 2012 and 2021, it is estimated that over 12,000 air traffic controllers will retire, resign, be promoted, or lost to attrition. As the FAA hires new personnel who grew up in a digital world with a preference to digital technologies, the traditional means of training using static methods will become increasingly outdated (Hadar, 2015). Training for these new professionals entering the workforce will need to leverage multimedia and interactive devices, training and simulation with augmented reality, and other strategies to fully engage the learner.

To meet this challenge, the FAA announced on December 21, 2015, that it intended to form a new Center of Excellence in Technical Training and Human Performance (TTHP) (FAA Center of Excellence in Technical Training and Human Performance Solicitation, 2015). The FAA considered numerous applications and announced its decision on August 12, 2016, to award the COE to a combined team led by Embry-Riddle Aeronautical University and the University of Oklahoma. In announcing the award, FAA Administrator Michael Huerta stated, "This world-class, public-private partnership will help us focus on the challenges and opportunities of this cutting-edge field of research. We expect this team will help us educate and train aviation professionals well into the future" ("The FAA Announces," 2016, para. 2).

Core members of the team include: Auburn, Drexel, Embry-Riddle, Inter-American University, Oklahoma State, The Ohio State, Purdue, Tennessee State, Tulsa Community College, The University of Akron, University of Akron – Omaha, University of North Dakota, University Oklahoma, University of Wisconsin-Madison, Western Michigan, and Wichita State. In addition, 9 affiliate universities and 36 industry partners are members of the COE (COE SOAR, 2017).

Current research. Collaborative research projects are currently underway in the COE to address the technological and educational transformation needs of the FAA's Air Traffic Organization. This research is occurring in six broad categories as detailed in Table 1 (COE SOAR, 2017). These funded projects offer a clear indication of the type of research the FAA believes will solve the technological, pedagogical, and management shortcomings of the current approach to air traffic controller training. These projects are consistent with the FAA's desire to take advantage of "advancements in teaching, such as part-task training, modeling, immersive human-in-the-loop simulation, and adaptive learning technologies that are standard in other technical workforces (FAA Centers of Excellence, 2016)." The agency also noted:

> The COE will examine human factors issues such as changes in learner expectations and academic best practices for training a new generation of learners. The center also will research innovative training methods for this new generation. This includes new technologies such as mobile learning as well as new ways of collecting and managing training data. (FAA Centers of Excellence, 2016)

Table 1

Current COE for TTHP Research Projects

1. Curriculum Architecture	
Project Title	**Purpose (brief)**
Field Training Standardization	to assist the FAA with overcoming inconsistencies in technician and controller field training
Standardization of Training for Training Administrators	research and compare the training needs of multiple facilities to recommend a standardized training program that would "train the trainers" and enhance their knowledge base along with their performance level
Curriculum Architecture Gap Analysis	use Artificial Intelligence (AI) methods to identify and measure the gap or redundancy in training curriculum by automatically analyzing information in curriculum materials using a data-driven approach ….
Enhanced AT-CPC Training	research and develop recurrent and skill enhancement training to Certified Professional Controllers through a variety of methods
Modular Curriculum Design	research curriculum architecture design leading to modular curriculum to develop targeted performance competencies in Air Traffic Management and Technical Operations Training
2. Content Management and Delivery	
Virtual Training Delivery	a virtual training delivery methodology, associated maintenance processes, infrastructure requirements will be proposed and recommended
Course Development	examine current course development strategies used by the FAA and then create a course development structure for the FAA eLMS that assures standardization among contact developers
Development of Learning Taxonomy	exploratory and pilot study identifying common language, vocabulary, and understanding of interactions between items related to learning to develop a learning taxonomy and possible strategies for implementation of proposed taxonomy
Research Alternative ISD Model	exploratory qualitative study of best practices within U.S. aviation industry and government for centralized development of occupation education and technical training

3. Simulation and Part Task Training	
Optimize Simulation	investigate the use of simulation in FAA training and will report on the benefits, limitations, risks and challenges
Explore use of Gamification for Training	model the application and impact of gamification, serious game design [game-based learning (GBL)], and simulation/virtual working environments (VR) to provide state-of-the-art training solutions to aviation safety training
Analysis of Technical Training Courses for Specific Part-Task Training Implementation and Enhancement …	identify specific "chunks or part-tasks" of technical training of an FAA chosen course curriculum and follow the evaluation of the training to successful completion of tasks in a full simulation environment
4. Human Factors	
Universal Design for Learning and Multi-Modal Training	benchmark, adapt, and introduce new approaches in UDL design-based learning and multi-modal training for air traffic controllers through classifying current pedagogical practices, benchmarking existing and new state-of-the-art learning technologies, recommending adapted and new learning pedagogies, and developing protocols for assessing student learning outcomes
Applied Game Theory to Enhance ATC Training	explores the use of decision analysis techniques, game theory in particular, to enhance ATC training for addressing uncertain operating conditions
Characterization and Application of ATC Visual Search Patterns and Control Strategies…	characterize and classify the visual scanning patterns and control strategies of expert air traffic control operators (ATCOs) in order to support the efficient and effective training of air traffic control candidates
Human Factors and Scenario Based Training w/Advanced Weather … Using Probabilistic Hazard Information Displays	advance weather-simulation capabilities and behavioral-modeling techniques to improve weather-related flight skills among pilots and controllers
5. Analytics	
Learner Data Management	apply text analytics, knowledge extraction, and machine learning techniques to integrate data from existing FAA databases and transform it into useable information for efficient and effective management of Aviation Safety Training

Analysis of Technical Operations Job Tasks	research current job tasks for Technical Operations personnel and to develop a proposed model for integration of this job task analysis into existing courses that have outdated or no task alignment
Technical Training Knowledge Architecture	explore the industry best practice and latest research advancement on building effective knowledge search engine, through literature review, consulting with industry partners and, if possible some test runs of those methods
AJI-2 Customer Satisfaction Process	developing a recommendation for the implementation of a process to collect, analyze, respond to customer satisfaction data, and maximizing customer satisfaction with AJI-2 technical training products and services
6. Safety	
International Harmonization and Standardization	focus on: a global level investigation of the stakeholders to inform alignment within the instruction, curricula, and infrastructure for the technical training of air traffic controllers, aviation safety inspectors, engineers, pilots and technicians …

Summary

Training for air traffic controllers has undergone changes over the years resulting in a loss of capability relative to university programs. New FAA initiatives currently under way offer some new paradigms that may represent improved training processes. The FAA's Aviation Rulemaking Advisory Committee is investigating opportunities for outsourcing controller training. Further, the FAA has identified that the training it provides its air traffic control workforce has become outdated and inefficient, and it has established a Center of Excellence to conduct research to modernize this training with the infusion of technology, to develop training paradigms that workers who grew up in a digital world can more readily embrace, and to develop integrated systems that track and manage training data. Promising research has already begun in many of these areas.

References

ATCWG (Aviation Rulemaking Advisory Committee Air Traffic Controller Basic Qualification Training Working Group) (2017), *Phase I training interim report., March 16, 2017,* Washington DC: FAA.

Brady, T., & McGuirk, G. (2014a). *CTI white paper.* Paper on CTI changes provided to members of the House Aviation Subcommittee April 2014, Washington, DC.

Brady, T., & McGuirk, G. (2014b). *FAA Letter in Response to White House Letter Regarding FAA Changes to Air Traffic Control Specialist Hiring Process.* Retrieved from http://commons.erau.edu/publication/419

Brady, T., and McGuirk, G. (2014c). *White paper on tuition-based, ab initio, training programs for air traffic controllers.* Paper provided to members of the House Aviation Subcommittee, March 2014, Washington, DC.

Celio, J. C., Jarvis, K., & Poore, D. S. (2005). *Review and analysis of Air Traffic Controller education and training, Revised*. (MTR 04W0000098R01). Washington D.C.: MITRE Corporation.

COE SOAR. (2017). *Research projects.* Retrieved from http://coetthp.org/research-projects/

Coyne, W. (2014, August 4). A review of the history of the Air Traffic-Collegiate Training Initiative program. *International Journal of Aviation Aeronautics, and Aerospace 1*(3). Retrieved from http:/ / commons.erau.edu/ijaaa/voll / iss3/4

FAA Center of Excellence for Technical Training and Human Performance. (2015). *Final solicitation.* December 21, 2015, Washington D.C.: FAA.

FAA Centers of Excellence Facts. (2017). *Grant awards.* Retrieved from https://www.faa.gov/about/office_org/headquarters_offices/ang/offices/management/coe/grant_awards/

FAA Centers of Excellence. (August 12, 2016). *About FAA*. Retrieved from https://www.faa.gov/about/office_org/headquarters_offices/ang/offices/management/coe/

FAA Order 1110.119R. (2016). *Aviation Rulemaking Advisory Committee*. Retrieved from https://www.faa.gov/regulations_policies/rulemaking/committees/documents/media/ARAC-Charter-1110.119R.pdf

Hadar, G. (2015). What's next for air traffic control training in the FAA. *The Journal of Air Traffic Control, 57*(4). 48-54.

Lockwood, S., & Noble, D. (2014). Establishment of the National Operations Center of Excellence. *ITE Journal, 84*(12), 8-10. Retrieved from http://library.ite.org/resources/library/index.cfm?event=getSimpleSearch&mode=simpleSearch

The FAA announces a new Center of Excellence. (2016, August 12). *News & Updates*. Retrieved from https://www.faa.gov/news/updates/?newsId=86186

The status of the Air Traffic Controller workforce: Hearings before the Subcommittee on Aviation of the Committee on Transportation and Infrastructure, House of Representatives, 108th Cong. 2 (2004).

UMTRI-led effort wins university transportation center. (2006). *The UMTRI Research Review, 37*(4), 1-2. Retrieved from http://www.umtri.umich.edu/content/rr37_4.pdf

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