COE TTHP

FAA Center of Excellence for Technical Training & Human Performance

Executive Summary

Year 2 August 15, 2018

Federal Aviation Administration

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LETTER FROM THE CO-EXECUTIVE DIRECTORS

We are excited to share with our public and private partners the Executive Summary for the DOT FAA Center of Excellence for Technical Training and Human Performance for 2018. This summary provides an overview of the initial two years of research highlights and project recommendations developed by a world-class consortium of 65 academic institutions and corporate organizations representing the work of leading faculty and industry experts in aviation.

This report includes the COE TTHP organizational structure, roles, and responsibilities for the lead institutions, core institutions, executive committee, and industry advisory board.

Our consortium is tasked with conducting front-line research designed to develop enhanced training and technology to increase the deployment of mission-ready employees for all aviation professions with an emphasis on the needs of the FAA's Air Traffic Organization, NextGen, Flight Program Operations, and Flight Standards. Leveraging the research and prototype findings from the initial 70+ projects will ensure the FAA will develop a highly trained technical workforce by examining human factors issues and incorporating training technologies to enhance performance.

As the COE TTHP moves into the third year, a priority for future research is to focus on increasing the safety of the National Airspace System by examining the impact of fatigue, weather, heavy traffic, as well as the integration of UAS and UAM on FAA employees and incorporating lessons learned into future training curriculum, mobile learning, and AR/VR simulation scenarios.

Thank you to our executive and project sponsors from the FAA. Thousands of voluntary manhours have contributed to our success. We especially want to thank Abigail Smith, Karen Callihan, Angelia Kinston-Thomas, Jonathan Gray, Pat Watts, and the support teams at the FAA COE TTHP and the FAA Center of Excellence Program Office.

Together we will enhance the training delivery and technology support of the next generation of aviation professionals.

Mark Friend, Ph.D.
Embry-Riddle Aeronautical University

Martha L. Banz, Ph.D.
University of Oklahoma

John Tomblin, Ph.D.
Wichita State University

PREFACE

The Federal Aviation Administration (FAA) Office of Safety and Technical Training (STT) is pleased to release this FAA Center of Excellence for Technical Training and Human Performance (COE TTHP) Year 2 Annual Report Executive Summary. The second-year continued with the University of Oklahoma and Embry-Riddle Aeronautical University providing technical leadership to the 16-core member and 11-affiliate member university partners. Wichita State University continued strong contributions as the administrative co-lead. These great universities complemented by affiliate and associate members, and augmented by numerous private organizations, industries, and research institutions are working on 76 actively funded tasks through cooperative agreements and grants.

Supporting the gifted principal investigators, researchers and students are a vital group of financial officers, contractors, business men and women, executives, administrators, controllers, technicians, and government researchers.

It is the effort of these individuals that makes the research possible, provides matching cash and in-kind contributions, posts the extensive technical and financial data for government-required reports, and fundamentally makes the overall system function efficiently through their individual actions.

The first year of operation focused on building the various types of relationships (e.g., research, administrative, financial, personal, etc.) among the many individuals at each of the 16 universities, industries, and government offices. Although the budget of the center may be relatively small, the complexity of the relationship network makes the smooth operation of this center more challenging than what may be encountered at other COEs with more universities and larger budgets.

Despite this complexity, the COE TTHP has successfully emerged from the initial "getting to know you" period as a fully functional, cohesive unit. During Year 2 of the organization, the emphasis is being placed on raising the COE TTHP profile with industry to better understand the needs of the evolving technical training marketplace and the participating actors.

The FAA project and executive sponsors like Abigail Smith, Karen Callihan, Angelia Kinston-Thomas, Jonathan Gray and the support team headed by Dr. Patricia Watts, National Program Director of the FAA COEs, are individuals without whose support the COE TTHP could not function. They are recognized as driving forces for the past successes of the COE TTHP and will be the source of any future accomplishments as well. The COE TTHP is very grateful for their encouragement and advocacy. Each of these individuals, representing the dozens of participating organizations and institutions, cannot be given enough words of thanks or acts of appreciation in recognition for their contributions of time, effort, and treasure. Thank you ALL.

For more information about the content of this report, please visit the COE TTHP web site at www.coetthp.org. Please address any questions or corrections to COE TTHP Program Manager, Ms. Karen Callihan Karen.Callihan@faa.gov. For more information about the tasks presented in this report, please visit the COE TTHP website at www.coetthp.org.

INTRODUCTION

This document accompanies a more detailed Year 2 Annual Report of the FAA Center of Excellence for Technical Training and Human Performance (COE TTHP) that began operation on August 12, 2016. The period of performance of the second year of the COE TTHP is August 12, 2017 – August 11, 2018. This initial award for the Center of Excellence (COE) extends through August 11, 2021.

This executive summary begins with overviews of the FAA Office of Safety and Technical Training (STT) (sponsoring organization), the FAA COE Program and the COE TTHP. Additional information in this summary includes:

- Brief introductions to each of the sixteen core institutions
- List of available research facilities and equipment
- Research area summaries and tasks
- Research charts outlining the tasks initiated, conducted and concluded during the second year of operation.
- A comprehensive list of research partners, students, publications and awards that contributed to the COE TTHP second year of operation.

The Executive Summary is accompanied by an additional comprehensive volume that provides a full description of the FAA COE TTHP including research, structure, member universities, funding, and research tasks. Where applicable research presentation charts, meeting notes and teleconference recordings links are provided.

These will be available at the COE TTHP website www.coetthp.org.

OVERVIEWS

FAA Office of Safety and Technical Training

The FAA Office of Safety and Technical Training (AJI) is responsible for the development of the Air Traffic Organization's Safety Management System and the integration of safety and training standards into the provision of air traffic services. They lead organizational efforts to manage risk, assure quality standards, instill an open culture of disclosure, educate employees, and promote continuous improvement. The FAA STT provides training programs that produce the highly skilled technical workforce needed as the FAA transitions to the Next Generation Air Transportation System.

FAA Center of Excellence Program

The FAA COE program was established by the Omnibus Budget Reconciliation Act of 1990, Public Law 101-508, Title IX, Aviation Safety and Capacity Expansion Act.

COEs are established through cooperative agreements with the nation's premier universities and their members and affiliates, who conduct focused research and development and related activities over a period of 10 years.

The COE program facilitates collaboration and coordination among government, academia, and industry to advance aviation technologies and expand FAA research capabilities through congressionally required matching contributions. COE members match FAA grant awards to establish; operate; and conduct research, dollar-for-dollar, with contributions from non-federal sources and may also provide additional contributions through cost-share contracts.

Over the life of the program the COE universities, with their non-federal affiliates, have provided more than **$312** million in matching contributions to augment FAA research efforts. Through these long-term, cost-sharing activities, the government and university-industry teams leverage resources to advance the technological future of the nation's aviation industry while educating and training the next generation of aviation scientists and professionals.

Currently, the FAA oversees the following active COEs:

Center of Excellence Title/Area	Lead Institutions	Established
Joint Center for Advanced Materials Research	Wichita State University and University of Washington	2004
Commercial Space Transportation	Florida Institute of Technology	2010
General Aviation Safety	Purdue University	2012
Alternative Jet Fuels and Environment	Massachusetts Institute of Technology and Washington State University	2014
Unmanned Aircraft Systems	Mississippi State University	2015
Technical Training and Human Performance	Embry-Riddle Aeronautical University and the University of Oklahoma	2016

The COE members have assisted in mission-critical research and technology areas that have focused on the following topics:

- Technical training and human performance
- Unmanned aircraft systems
- Alternative jet fuels and environment
- General aviation safety, accessibility, and sustainability
- Commercial space transportation
- Advanced materials
- Airliner cabin environment and intermodal transportation research
- Aircraft noise and aviation emissions mitigation
- Airworthiness assurance
- Operations research
- Airport technology
- Computational modeling of aircraft structures

FAA Center of Excellence for Technical Training & Human Performance

The FAA Center of Excellence for Technical Training and Human Performance (COE TTHP) unites over 65 organizations from the public sector, private sector, and academic institutions to perform basic and applied research, education, and training tasks through a variety of analyses, development, and prototyping activities. This world-class consortium is focused on research and development of technical training for air traffic controllers, aviation safety inspectors, engineers, technicians, and pilots. Embry-Riddle Aeronautical University and the University of Oklahoma were chosen by the FAA in August of 2016 to co-lead the COE TTHP.

The COE TTHP aligns its research projects to assist the FAA with meeting its strategic goals.

The goals of the COE TTHP's primary funder, the Air Traffic Organization, include:

- Safety Incidents and Equipment Readiness: Analyze data close to training
- Time to Certification: Measure how long it takes to certify
- Course Enhancements: Track percent of courses that transition to other channels of delivery or add simulation capability
- Speed of Course Delivery: Measure time from course development to launch
- Project Health: Track percent of projects meeting key milestones and targets
- Course Effectiveness: Survey learners and site directors on course timeliness, fit for need, and quality

In addition to the Air Traffic Organization, the Center also assists FAA's Flight Program Operations and Flight Standards with the following:

- Develop a fleet modernization plan for the FAA
- Determine the best model for training and proficiency of aviation safety inspectors
- Determine the feasibility of UAS-based flight inspection
- Recommend best practices for managing training content
- Recommend best practices for employee hiring and development

The COE TTHP is singularly unique among the COE's in that it collaborates with the FAA Labor Relations and bargaining units. Facilitating an effective relationship with labor means understanding their specific issues and endeavoring to align research project results with labor needs. This important relationship promises mutual benefits to all parties but especially to the flying public and tax payer.

COE TTHP YEAR 2 HIGHLIGHTS

The following are the foremost milestones for the COE TTHP during its second year:

- Seventy-two research projects open with four completed
- Executive Committee, consolidating the core institutional members into a single entity for governance and oversight activities working well
- Second year of operation for the Industrial Advisory Board
- Annual Administrative Meeting held at WSU, November 7-9, 2017
- Annual Technical Meeting held at Drexel, April 3-5, 2918
- Participation in COE outreach at the Air Traffic Control Association (ATCA) October 15-18, 2017
- Participation in COE outreach at National Air Traffic Controllers Association (NATCA) March 20-22, 2017
- Participation in I/ITSEC, November 27 – December 1, 2017
- Developed and implemented a comprehensive COE TTHP Program Management Plan including the establishment of Communications and Outreach Task Force, Research Strategy Task Force, and Fund Development and Partnerships Task Force
- Initiated production of COE TTHP video

COE TTHP Metrics	Year 1 (FY16)	Year 2 (FY17)
Active Projects	22	72
Completed Projects	0	4
Principal Investigators	50	50
Students	52	71
Publications	0	39
Affiliate Members	9	9
Industry Partners	40	40
Funding Profile	$5M	$1.5M
Administrative Overhead	54%	28.2%

COE TTHP CORE INSTITUTION MEMBERS

Sixteen COE TTHP core institution members are Auburn University, Drexel University, EmbryRiddle Aeronautical University, InterAmerican University, Oklahoma State University, The Ohio State University, Purdue University, Tennessee State University, Tulsa Community College, The University of Akron, University of Nebraska – Omaha, University of North Dakota, University of Oklahoma, University of Wisconsin – Madison, Western Michigan University, and Wichita State University.

These members provide a comprehensive geographical distribution, representing 14 states across the U.S. All facets of the air traffic system are represented by our core institutions. These include remote areas; heavily trafficked, en route corridors; hubs of regional airline activity; and dense urban airspace areas. Collectively, our members possess a penetrating element of multicultural diversity, cutting across demographics of age, race, culture, and socioeconomic status. Our team has a proud history of reaching learners from diverse socioeconomic and cultural backgrounds.

Many of our academic core and affiliate institution partners lead Aviation Accreditation Board International (AABI)-accredited aviation programs with state-of-the-art approaches to technical training, aviation, pilot, and management education. Various universities have FAA Collegiate Training Initiative (CTI) or air traffic management (ATM) programs, providing the FAA skilled air traffic control and technical operations candidates. Currently there are over 400 students enrolled in such programs within the COE TTHP institutions. The COE TTHP team combined fixed-wing and rotorcraft fleet is over 680 aircraft. Most of the universities are operating their own or are adjacent to airports. The COE TTHP is unique in its depth, breadth and uniqueness. To our knowledge there is not a comparable institution in the world.

Embry-Riddle Aeronautical University (ERAU) – Technical Co-Lead

ERAU is the world's largest, fully accredited university specializing in aviation and aerospace degree programs. These programs are all accredited by the national and international Aviation Accreditation Board International (AABI) and the national Accreditation Board for Engineering and Technology (ABET). With two residential campuses and a worldwide presence encompassing over 130 online and remote educational sites, ERAU is focused on STEM research and partnership with the aerospace industry, other universities, and government agencies. The institution's aerospace engineering graduate program has been ranked No. 1 nationally. ERAU has 94 instructional aircraft and 41 flight simulators. ERAU operates the FAA's NextGen Test Bed, an agile research and integration facility designed to allow government, industry, and academia to showcase their ideas and technologies in a NextGen National Airspace System environment. ERAU is currently a core institution partner of the FAA Center of Excellence for Unmanned Aircraft Systems and previously served as lead of the FAA Center of Excellence for General Aviation Research.

University of Oklahoma (OU) – Technical Co-Lead

Since 1947, the University of Oklahoma has offered top-tier aviation and engineering education. OU's Department of Aviation offers four-degree concentrations: Professional Pilot, Aviation Management (Flying and Non-Flying), and Air Traffic Management. These programs are all accredited by Aviation Accreditation Board International (AABI). OU's programs include an FAA-approved, Part 141 and Part 61 Flight School and FAA Air Traffic Collegiate Training Initiative. The Aviation program has strong partnerships with the National Weather Center, Tinker Air Force Base, Federal Aviation Administration, American Airlines, Envoy Air, Jet Blue, and FedEx. The institution also offers engineering undergraduate and graduate degrees in the following areas: aerospace and mechanical, computer science, data science and analytics, electrical and computer, industrial and systems. These programs are all accredited by the national Accreditation Board for Engineering and Technology (ABET). The institution has a 50year history of successfully managing technical training contracts and related research grants for the federal government. OU owns and operates the Max Westheimer Airport located on OU's north research campus.

Wichita State University (WSU) – Administrative Lead

Wichita State University has operated the National Institute for Aviation Research (NIAR) since 1985, the most capable university-based aviation research center in the U.S. WSU provides research, design, testing, certification and training to the aviation manufacturing industry, government agencies, educational entities and other clients. NIAR operates on a non-profit budget that has steadily increased to more than $46 million. Clients include Boeing, Bombardier Learjet, Cessna, Beechcraft and Spirit Aerosystems. The institution offers engineering undergraduate and graduate degrees in the following areas: aerospace, biomedical, electrical and computer, industrial, systems, and manufacturing and mechanical. These programs are all ABET accredited. NIAR is home to the FAA Center of Excellence for Composites and Advanced Materials (CECAM) and the National Center for Advanced Materials Performance (NCAMP), which is funded through the FAA and Air Force Research Laboratory. WSU is also a core institution partner of the FAA Center of Excellence for UAS Research.

Auburn University (AU)

Since 1941, Auburn University has been actively involved in aviation education and is considered a leader in aviation research. The Harbert College of Business offers two aviation related degree programs; Aviation Management and Professional Flight Management. These programs are all accredited by the national and international Aviation Accreditation Board International. Included in the Auburn Aviation Center is the FAA approved Part 141 and Part 61 Flight School that offers pilot training from Private Pilot through Flight Instructor. The institution also offers engineering undergraduate and graduate degrees in the following areas: aerospace, computer science and software, electrical and computer, industrial and systems, and mechanical. These programs are all accredited by the national Accreditation Board for Engineering and Technology. Auburn is an affiliate academic partner of the FAA Center of Excellence for UAS Research.

Drexel University (DU)

Since its founding in 1891, Drexel University has emphasized its strengths in engineering, science and technology undergraduate and graduate degree programs. These programs are all accredited by the national Accreditation Board for Engineering and Technology. Drexel offers extensive published research in human-computer interaction, modeling and simulation, and other safety and human factors topics. Among other initiatives, faculty have worked to characterize ATC judgment and decision making with respect to conflict detection. Through a $12.5 million grant from the Department of Defense, Drexel also established the Applied Communications and Information Network (ACIN) Center. Drexel was re-designated by the National Security Agency (NSA) as a Center of Academic Excellence in Information Assurance Education. The college's $35 million Bossone Research Enterprise Center is home to facilities in nanotechnology, information networking and smart infrastructures. Drexel is a core institution partner of the FAA Center of Excellence for UAS Research.

InterAmerican University (IAU)

The InterAmerican University of Puerto Rico School of Aeronautics offers two-degree programs: Aircraft Systems Management (Professional Pilot) and Aviation Management. A Commercial Pilot minor and an Air Traffic Control minor are available. These programs are accredited by Aviation Accreditation Board International. The programs include an FAA-approved Part 141 Flight School for Private Single Engine Airplane Pilot, Commercial Single Engine Pilot, and Instrument Airplane rating. Additionally, FAA-approved Part 61 certifications include MultiEngine Airplane, Instructor Airplane, Instrument Instructor Airplane, Multi-Engine Instructor, Flight Review for Single Engine, Flight for Completion of Wings Program, Maintaining Instrument Rating Flight Experience, Recent Flight Experience for Pilot in Command, Instrument Flight Proficiency Check, Airline Transition Training Experience and ATP Certificates Training.

Oklahoma State University (OKSU)

Oklahoma State University's School of Aeronautics offers five undergraduate degree options: Professional Pilot, Aviation Management, Technical Services Management, Aerospace Security, and Aerospace Logistics. Graduate degree options also include a Master of Science in Aviation and Space and a Doctor of Education in Aviation and Space. These programs are all accredited by Aviation Accreditation Board International. OSU's programs include both FAA-approved Part 141 and Part 61 flight training programs. The institution also offers engineering undergraduate and graduate degrees in the following areas: aerospace, computer, electrical, industrial and mechanical. These programs are all accredited by the Accreditation Board for Engineering and Technology. OSU is also home to the Oklahoma Aerospace Education Research Symposium and NASA Johnson Space Center Strategic Education Alliance Program.

The Ohio State University (OSU)

Since 1917, the Ohio State University has offered leading aviation and engineering degree programs. These programs are all accredited by the Aviation Accreditation Board International and the Accreditation Board for Engineering and Technology. The OSU Center of Aviation Studies incorporates engineering, business, and behavioral philosophies into a multidisciplinary approach to the many components of the aviation industry. It supports world-class, flight-education programs; academic degree programs; research initiatives; and outreach activities on local, regional, national, and international levels. OSU also owns and operates the Ohio State's Don Scott Field airport and associated FBO which first opened in 1942. OSU's FAR part 141 certified flight education program is supported by more than 20 training aircraft and flight simulators. The institution has partnered with several airline bridge programs to facilitate the matriculation of students into professional pilot positions and NetJets, Flight Safety International, and other industry players to support general aviation research and education. Aviation and aerospace research at OSU accounts for more than $7.5M in annual research expenditures. OSU is currently a core institution partner of the FAA Center of Excellence for General Aviation and the FAA Center of Excellence for Unmanned Aircraft Systems.

Purdue University (Purdue)

Purdue's School of Aviation and Transportation Technology, one of six departments and schools in the Purdue Polytechnic Institute, is recognized worldwide as a leader in aviation education. Since 1930, Purdue has offered world-class aviation and engineering educational programs: aeronautical engineering technology, aerospace financial analysis, airline management and operations, airport management and operations, aviation management, professional flight, and unmanned aerial systems. These programs are all accredited by the Aviation Accreditation Board International and the Accreditation Board for Engineering and Technology. Purdue also owns its local airport, Fixed Base Operator, and large fleet, including Cirrus, Piper, and Embraer aircraft. The institution also houses an Aviation Materials Lab, Dynamic Flight Lab, Engine Test Cells, and Hanger of the Future Lab. Purdue leads the FAA Center of Excellence for General Aviation and is a core institution partner of the FAA Joint Center of Excellence for Advanced Materials and the FAA Center of Excellence for Alternative Jet Fuels and Environment.

Tennessee State University (TSU)

Tennessee State University has offered engineering undergraduate and graduate degrees since 1967. TSU degree areas include: aeronautical and industrial, computer science, electrical and computer engineering, and mechanical and manufacturing. These programs are all accredited by the Accreditation Board for Engineering and Technology. The institution also operates an NSF-funded Interdisciplinary Graduate Engineering Research (TIGER) Institute, a graduate level research facility within the College of Engineering, Technology and Computer Science. TSU graduates the largest number of African-American engineers in the state of Tennessee. Defense organizations like Lockheed Martin, Boeing, and branches of the military often collaborate with TSU in conducting research and offering internship and employment opportunities to TSU students.

Tulsa Community College (TCC)

Since 1992, the Aviation Center at Tulsa Community College has offered degree programs in Air Traffic Control, Professional Pilot, Aviation Management and Aviation Logistics. These programs are all accredited by the Aviation Accreditation Board International. Included in the program is the FAA-approved Part 141 and Part 61 Flight School.

University of Akron (UA)

Since 1913, the University of Akron has offered undergraduate and graduate degree programs in engineering. Akron degree areas include aerospace systems, computer, electrical, and mechanical. These programs are all accredited by the Accreditation Board for Engineering and Technology. Akron is home to one of the oldest, traditional co-op programs in the country in which students gain valuable, practical work experience in between periods of rigorous academic coursework. The co-op program successfully maintains and establishes relationships in private industry and with government agencies all over Ohio and around the United States.

University of Nebraska-Omaha (UNO)

Since 1990, the University of Nebraska-Omaha's Aviation Institute has offered degree programs in Aviation Studies, Air Transport Administration, and Professional Flight. Graduate degree programs are also offered at the master's and doctoral level in Aviation Administration. These programs are all accredited by the Aviation Accreditation Board International. UNO's programs include both FAA-approved Part 141 and Part 61 flight training programs. The institution also offers engineering undergraduate and graduate degrees in the following areas: computer, software, electrical, and mechanical. These programs are all accredited by the Accreditation Board for Engineering and Technology. The institution also manages the NASA Nebraska Space Grant and NASA Experimental Program to Stimulate Competitive Research (EPSCoR) program.

University of North Dakota (UND)

Since 1968, the University of North Dakota has offered atmospheric research and aviation education programs. The John D. Odegard School of Aerospace Sciences is now the second largest of UND's degree-granting colleges and operates one of the largest fleets of civilian flight training in North America. This world-renowned center for aerospace learning is nationally acclaimed for its achievements in collegiate aviation education, atmospheric research, space studies, and earth system science and policy research. Degrees include airport management, aviation management, air traffic control, aviation technology management, commercial aviation (fixed-wing and helicopter), flight education, UAS operations, business aviation, and safety. These programs are all accredited by the Aviation Accreditation Board International. The Aerospace program has strong partnerships with Endeavor Air, Envoy Air, ExpressJet, JetBlue, and SkyWest. The institution also offers engineering undergraduate and graduate degrees in the following areas: computer science, electrical, and mechanical. These programs are all accredited by the Accreditation Board for Engineering and Technology. UND is currently a core institution partner of the FAA Center of Excellence for Unmanned Aircraft Systems.

University of Wisconsin-Madison (UWM)

The University of Wisconsin-Madison has offered undergraduate and graduate engineering degrees since the early 1900s. The program has grown to include computer engineering, electrical engineering, engineering mechanics, and industrial engineering. These programs are all accredited by the Accreditation Board for Engineering and Technology. UWM has a fleet of 36 aircraft and is home to the Flight Simulation Research Laboratory, a custom-built advanced aviation training device (AATD) with advanced weather simulation in support of full-mission and part-task, scenario-based training. The FAA's Human Factors Division has also funded projects through UW's Space Science and Engineering Center.

Western Michigan University (WMU)

Since 1942, Western Michigan University has offered aviation and engineering education. These programs are all accredited by the Aviation Accreditation Board International and the Accreditation Board for Engineering and Technology. The College of Aviation offers the only comprehensive aviation program at a public university in Michigan, and with nearly 900 undergraduate students, is one of the largest aviation programs in the nation. WMU has extensive research and publication history in the fields of aviation human factors, safety training, flight training, and electronic training and simulation applications. WMU is currently an affiliate academic partner of the FAA Center of Excellence for General Aviation.

COE TTHP LEADERSHIP TEAM

Mark Friend, Ed.D. (Embry-Riddle Aeronautical University, Technical Lead) serves as Co-Executive Director for the COE TTHP and is responsible for technical oversight and governance. He has over 45 years of higher education experience and serves as Professor in the School of Graduate Studies in the College of Aviation at Embry-Riddle University. Dr. Friend is also the former Dean of the Central Region for the Worldwide Campus and Chair of the Applied Aviation Sciences Department at ERAU. Prior to joining Embry-Riddle, he was Professor of Safety and Director of the Center for Applied Technology at East Carolina University. He has also served as Chair of the Department of Occupational Safety and Health at Murray State University after holding faculty positions at West Virginia University, Fairmont State College, and Waynesburg College. Dr. Friend served on the governing board of the Board of Certified Safety Professionals and is a professional member of the American Society of Safety Engineers. He has also served as a commissioner and team leader of site visits for the Accreditation Board for Engineering and Technology and site visitor for the Aviation Accreditation Board International.

Dr. Martha Banz, Ph.D. (University of Oklahoma, Technical Lead): Dr. Banz is interim dean of OU Extended Campus. During her career, she was founding director for several specialized academic programs, serving traditional and nontraditional student populations at multiple universities. As interim dean, Dr. Banz provides administrative oversight for all aspects of the college's work, both academic and operational including the School of Aviation Studies. She is the Executive Director of the FAA's Center of Excellence for Technical Training and Human Performance and provides oversight of all aviation grant and contract initiatives such as support of OU's participation in the FAA's Unmanned Aircraft System Integration Pilot Program with the Choctaw Nation. During Dr. Banz's time student enrollment in the college increased by almost 25 percent, several new academic programs have been approved, full-time faculty appointments in the college have grown, and the total faculty corps expanded to include more than 200 OU faculty and practice professionals from around the world. Dr. Banz holds membership in Psi Chi, Sigma Xi, Phi Delta Lambda, the American Psychological Association, the American Psychological Society, and the American Academy for the Advancement of Science.

John Tomblin, Ph.D. (Wichita State University, Administrative Lead) serves as Co-Executive Director for the COE TTHP and is responsible for administrative and reporting oversight. He is the Vice President for Research and Technology Transfer and the Executive Director of the National Institute for Aviation Research at Wichita State University. Dr. Tomblin has overall administrative responsibility for developing, coordinating and stimulating research and creative activity; for enhancing external funding; and for ensuring compliance with all applicable laws and regulations. He also serves as the director of NIAR's Composites and Advanced Materials Laboratory, Mechanical Test Laboratory, the FAA Center of Excellence for Composites and Advanced Materials, and National Center for Advance Materials Performance. In addition, Dr. Tomblin oversees eighteen laboratories and has directed a number of multidiscipline and multi-investigator projects with external funding exceeding $125 million. He has provided testimony to the U.S. Senate Department of Commerce Committee on Science, Space, and Technology on the future of the aerospace industry relative to the role of academia in partnership with government and industry.

Sid McGuirk, J.D. (Embry-Riddle Aeronautical University, Technical Advisor) serves as a Lead Technical Expert for the COE TTHP and is responsible for assisting and mentoring researchers with project designs, data collection, reporting, and prototyping. He currently serves as Chair of the Department of Applied Aviation Sciences at ERAU in Daytona Beach, Florida. Prior to ERAU, he served 35 years with the FAA in a variety of positions, including Air Traffic Controller, Air Traffic Supervisor, FAA Headquarters Assistant Division Manager for Air Traffic Technical Training, and FAA Headquarters Division Manager for Technical Operations Training. He holds a Master of Arts degree in Government, a Juris Doctor degree, and a Master of Laws degree in Taxation. Mr. McGuirk also serves as the chair of the FAA ARAC Air Traffic Controller Basic Qualification Training Working Group.

Stephanie Fussell, M.S. Aeronautics (Embry-Riddle Aeronautical University, Technical Co-Lead) serves as Lead Research Assistant for the COE TTHP and provides day-to-day operational support to include communications, data management, meeting and conference planning, and information dissemination. She currently is a Ph.D. residential student with research interests in aviation education, the effect of learning styles, and the process of learning. Ms. Fussell holds a private pilot instrument rating, B.S. and M.S. degree in Aeronautics from ERAU, and is a member of the Air Traffic Control Association. In 2016, she co-presented at the International Symposium on Aviation Psychology regarding an approach to teaching aviation studies on how to conduct situation awareness research.

April Millaway, M.Ed. Adult Education (University of Oklahoma, Technical Lead) serves as Program Manager for the COE TTHP and is responsible for day-to-day center operations as well as a liaison to the COE TTHP Industrial Advisory Board. She has 17 years of experience in business development, adult education and training, and executive coaching with the FAA, DoD, DOE, and DHHS. Currently, Ms. Millaway oversees OU's Office of Business Development for the College of Professional and Continuing Studies and is responsible for securing federal funds for military education, aviation training, and leadership and management development projects. She is certified in assessing and coaching professionals and individuals using the Emotional Intelligence (EQ-i) 2.0 and 360 leadership inventory and Assess report tools.

Tisha Merchant, B.S. in Business Administration and Management (University of Oklahoma, Technical Lead) serves as Program Coordinator for the COE TTHP and provides day-to-day operational support for the COE to include communication and data management support, meeting and conference planning, and information dissemination – e-newsletter, tech talks, and research events. In addition, Ms. Merchant supports OU's Office of Business Development for the College of Professional and Continuing Studies and is responsible for financial and operations support for several federally funded projects. Prior to her time at OU, she worked for over 12 years as a legal assistant and medical records clerk for over twenty attorneys. Her academic background is in business administration, management, and accounting.

Lisa L. Haggard M.S.J., Intellectual Property Law, Seton Hall Law, Newark, NJ, Program in Progress; M.B.A., Friends University, Wichita, KS 2012, B.A., Business Management, Friends University, Wichita, KS, 2009 (Wichita State University, Administrative Lead) Lisa Haggard is the Contract/Grant Manager for the Office of Research at Wichita State University (WSU) and the Administrative Lead for the FAA Center of Excellence (COE) for Technical Training and Human Performance (TTHP). In her role of a Contract/Grant Manager, Ms. Haggard negotiates contracts, awards, and grants for WSU's research centers, institutes, departments, and other sponsored programs. Ms. Haggard has worked with several federal, state, and private entities along with the FAA COEs for Joint Advanced Materials and Structures (JAMS) as well as Unmanned Aerial Systems (UAS). As the Administrative Lead for the FAA COE for TTHP, Ms. Haggard provides administrative oversight and guidance to the COE TTHP core members. She tracks various activities and oversees the submittal of quarterly, semiannual, and fully inclusive annual reports. In addition, Ms. Haggard works in collaboration with the FAA Program Management Office to support the grants.gov submission process. The COE TTHP reports contain accomplishments, sources of funds including matching contributions, fiscal expenditures, sub-awards made to the COE TTHP affiliates and others, hiring of students and placement of graduates, and other information as required by the FAA COE PMO.

COE TTHP CORE INSTITUTION REPRESENTATIVES

James Birdsong, Ph.D. (Auburn University) serves as a Core Institution Representative and an Executive Committee Member for the COE TTHP. Currently, he is an instructor in meteorology, air transport economics, and operations management courses and is faculty lead for the youth aviation summer enrichment program. Prior to his time at Auburn, Dr. Birdsong served as an Air Force officer, a command C-130 pilot, a headquarters staff officer, and a squadron operations officer. He has held various positions in finance, operations, safety, systems acquisition, and strategic planning, and has extensive international experience working in Asia, Europe, Africa, and South America.

Kurtulus Izzetoglu, Ph.D. (Drexel University) serves as a Core Institution Representative for the COE TTHP. Currently, he is a member of the functional optical imaging research team at Drexel, where he is a project engineer. Dr. Izzetoglu's current research projects focus on development of optical sensors, novel algorithms and techniques to deploy the optical brain imaging system, human performance assessment (cognitive workload and expertise development), and depth of anesthesia monitoring. Prior to his time at Drexel, he gained professional software development and medical imaging experience as a member of consulting companies in the United States and the Netherlands.

Caroline Ocasio, MBA (InterAmerican University) serves as a Core Institution Representative for the COE TTHP. She has over 20 years of experience in multiple roles in the aviation industry with experience in airlines such as Continental Airlines, Aerolíneas Argentinas, Ladeco Chilean Airlines, and aviation consulting. Currently, Ms. Ocasio is an instructor in the School of Aeronautics and oversees the Aviation Management and Air Transportation practicum programs. She is a member of the Editorial Board of INTEResante Magazine, a unique publication in Puerto Rico targeted at highlighting the research and academic efforts of the Bayamon Campus faculty and students. Under her leadership, Girls in Aviation, an educational program to promote aviation education among girls in Puerto Rico, was created with the sponsorship of the JetBlue Foundation.

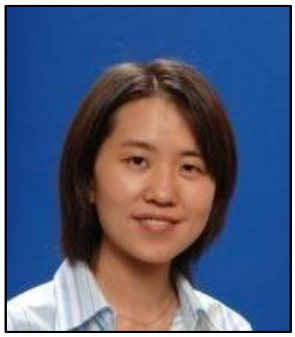
Jon Loffi, Ed.D. (Oklahoma State University) serves as a Core Institution Representative for the COE TTHP. Currently, he is an Assistant Professor in the Aviation and Space program at OSU. His research agenda is centered on homeland defense and security and small unmanned aviation systems (sUAS) where he works with the College of Mechanical and Aeronautical Engineering. Dr. Loffi also serves on a counter sUAS committee with the engineers in concert with the U.S. Department of Defense involving classified research in sUAS and UAS countermeasures. Additionally, he is researching sUAS and manned aircraft in proximity to one another for visibility in determining a pilot's visual efficacy to sense and avoid sUAS in the national airspace.

Seth Young, Ph.D. (The Ohio State University) serves as a Core Institution Representative and an Executive Committee Member for the COE TTHP. He has nearly 20 years of experience in academia and industry focusing on issues of site selection, infrastructure planning, capacity and delay estimation, airside and landside operations, security policies, engineering, and financing of civil use airports. Currently, Dr. Young is the Director of OSU's Center for Aviation Studies and is on the faculty of the OSU College of Engineering. He is an active participant in aviation research and professional committees with the American Association of Airport Executives, the Florida Airports Council, and the National Academies Transportation Research Board, where he serves as outgoing Chair of Committee AV020 – Aviation System Planning. Dr. Young is an Accredited Airport Executive with the American Association of Airport Executives and holds an instrument-rated commercial airplane and seaplane pilot's license and certified flight instructor certificate from the U.S. Federal Aviation Administration.

Steve Landry, Ph.D. (Purdue University) serves as a Core Institution Representative and an Executive Committee Member for the COE TTHP. Currently, he is an Associate Professor and Associate Head of the School of Industrial Engineering specializing in the areas of Human Factors and Air Transportation Systems Engineering. Previously, Dr. Landry worked as research engineer at NASA's Ames Research Center in Mountain View, California where he worked on the Multi-Center Traffic Management Advisor system, an air traffic management decision support tool which was successfully developed, tested, and evaluated in four FAA En Route control centers. Dr. Landry is a retired Air Force C141B pilot with over 2,500 heavy jet flight hours including extensive international flight experience and participation in Desert Shield/Storm and numerous other operations.

Keith Hargrove, Ph.D. (Tennessee State University) serves as a Core Institution Representative for the COE TTHP. Currently, he is the Dean of the College of Engineering and Director of the TIGER Research Institute at TSU. He has received research funding from the National
Science Foundation, and conducted research projects with Sikorsky Aircraft, Boeing, NASA, U.S. Navy, and the U.S. Army. Dr. Hargrove's research areas include systems engineering, design, virtual and augmented reality, advanced manufacturing, and minority engineering education. He has received several awards for teaching, research, mentoring, and is an Associate Member of the Society of Manufacturing Engineers, Institute of Industrial Engineers, ASEE, Tennessee Academy of Science, and the Tennessee Society of Professional Engineers.

Gary Wescott (Tulsa Community College) serves as a Core InstitutionRepresentative for the COE TTHP. Currently, he serves as an Assistant Professor and Coordinator of the TCC's Aviation Program. He worked with the FAA for almost 22 years before retiring in 2011. During his career, Mr. Wescott was certified as an Air Traffic Controller and also served as a Front-Line Manager at Riverside ATCT, a level 8 VFR tower, and Tulsa ATCT, a level 9 terminal facility. He also has experience working as a member of the Terminal Planning and Requirements Department in the Central Regional Office in Fort Worth, TX. In addition, Mr. Wescott served as a Cadre Instructor for the Operational Supervisors Workshop and an FAA Quality Assurance Training Specialist.



Chen Ling, Ph.D. (University of Akron) serves as a Core Institution Representative for the COE TTHP. Currently, she is an Associate Professor of Systems Engineering in the Mechanical Engineering Department at Akron. Dr. Ling's research interest is in cognitive systems engineering of complex systems to enhance system safety and efficiency. Her research has been funded by the FAA, NSF, DOT, and DOC. Dr. Ling is published in journals such as *Behavior and Information Technology, International Journal of Human Computer Studies, Ergonomics*, and *Theoretical Issues in Ergonomics*. She is a member of the Human Factors and Ergonomics Society and the Institute of Industrial Engineering.

Scott Tarry, Ph.D. (University of Nebraska-Omaha) serves as a Core Institution Representative and an Executive Committee Member for the COE TTHP. Currently, he is the Director of the Aviation Institute at UNO and serves as the Director of the NASA Nebraska Space Grant and NASA EPSCoR program. Dr. Tarry is responsible for establishing the strategic direction of a consortium of 11 universities and colleges across the state of Nebraska. As Chair of the national NASA EPSCoR Caucus, he is a liaison between the NASA EPSCoR Program Manager and the 26 NASA EPSCoR states and jurisdictions. Dr. Tarry is also Treasurer for the Board of Directors for the National Space Grant Alliance and has served as Secretary of the National Council of Space Grant Directors and Co-Chair of the Aeronautics Working Group. He has served as President of the Transportation Research Forum, a national transportation organization; and as Chair of the Section on Transportation Policy and Administration for the American Society for Public Administration. He was a Faculty Research Fellow at NASA Langley Research Center in 2000.

Elizabeth Bjerke, Ph.D. (University of North Dakota) serves as Core Institution Representative and an Executive Committee member for the COE TTHP. Currently, Dr. Bjerke is the Associate Dean for the Odegard School of Aerospace Sciences at the University of North Dakota and a Professor in Aviation. She has nearly twenty years of experience in collegiate aviation education starting at certified flight instructor and working her way up through the academic ranks. Her research focuses on pilot supply and sourcing, along with persistence within collegiate aviation programs. Dr. Bjerke is an active participant in the Aviation Accreditation Board International, having served on their Board of Trustees for nine years. She is also a member of the National Pilot Source Forum.

Douglas Wiegmann, Ph.D. (University of Wisconsin – Madison) serves as a Core Institution Representative for the COE TTHP. Currently, he is an Associate Professor in the Department of Industrial and Systems Engineering at UWM. Dr. Wiegmann is a nationally respected expert in the areas of aviation safety and accident investigation, receiving two U. S. Navy commendation medals for research on human factors safety issues during extended flight operations and for development of a technique for classifying and studying pilot error in aviation accidents. Prior to UWM, Dr. Wiegmann served as an aviation accident investigator for the National Transportation and Safety Board, where he led the team that was responsible for taking and interpreting testimony from eye-witnesses to the TWA Flight 800 crash. Dr. Wiegmann was also the official human factors consultant to the U.S. DOE during the investigation of the August 2003 blackout and consultant to the Columbia Accident Investigation Board during their analysis of the crash of the NASA space shuttle.

Raymond Thompson, Ph.D. (Western Michigan University) serves as a Core Institution Representative for the COE TTHP. He has 36 years of experience in aviation and aerospace education and currently is the Associate Dean of the College of Aviation at WMU. Dr. Thompson's research areas include aviation maintenance faculty development, using technology and multimedia in the classroom, applied advanced composite technology, and airline maintenance management. He serves as an Educator Board of Trustee member for Aviation Accreditation Board International with a focus on promoting the aviation maintenance profession and increasing AABI accreditation in aviation maintenance technology programs.

Jibo He, Ph.D. (Wichita State University) serves as a Core Institution Representative for the COE TTHP. Currently, he is an Associate Professor of Psychology and Director of the Human Automation Interaction Lab at WSU. Dr. He's research interests are in the areas of fatigue, eye movement, and human performance. He has received over $1M in funding from the NSF and invented eight patents registered in the U.S., China, and 27 European countries. Dr. He is the recipient of the Star of Tomorrow Award from Microsoft and Most Valuable Graduate from the University of Illinois. His work has been reported by Bloomberg News, Forbes, Kansas City Star, New York Public Radio, and APA Monitor.

COE TTHP RESEARCH AREAS

Human performance is enhanced through the technical training of air traffic controllers and technicians. This important research is investigated in the projects aligned to six focus areas: curriculum architecture, content management and delivery, simulation and part task training, human factors, analytics, and safety.

The FAA tasked the COE TTHP with examining the *curriculum architecture* of the FAA Academy and creating initiatives with industry partners to modernize training. The project teams are working with ATO Technical Training to standardize the field training of technicians and controllers, as well as training administrators, and improving the training of Certified Professional Controllers (CPCs). Principal investigators are measuring the gaps and redundancies in the current training curriculum and investigating the practices leading to modular curriculum.

As the training needs evolve, the content management and delivery of the courses are examined to support development and implementation of new content. Virtual training delivery methods are being explored for air traffic control students. It is expected that dedicated research for technical operators will follow. Researchers are working with FAA stakeholders to create a course development structure for the FAA electronic learning management system (eLMS), to develop a learning taxonomy aligned to ATO standards and learning outcomes, and to review Instructional Systems Design (ISD) methodologies that could facilitate course design for the Academy.

Implementation strategies of learning *analytics* (e.g., completion records, learner progress) will provide the FAA with recommendations for new training processes and systems. To transform useable information for efficient and effective training, researchers will explore existing FAA data, integrating job task analysis into existing courses that have become outdated or that have no task alignment. This task will build a more effective knowledge search engine for the Agency, thus maximizing customer satisfaction for ATO Technical Training constituents.

The COE TTHP members continue researching the capabilities and expanding the instruction delivery opportunities of the Academy through *Human Factors* research and how it is being applied to technical training. Project teams are applying game theory to enhance training and study decision making, benchmarking best practices for multi-modal training, and studying the eye movement of expert air traffic controllers. Scenario-based training is being studied to view pilots and air traffic controllers and how they can better integrate probabilistic hazard information to enhance safety.

To train learners, using new technology including optimizing simulation for the classroom, the simulation and part-task training offers the FAA new opportunities. Researchers are analyzing technical-training courses for enhancement with the new technologies and further exploring the use of gamification for aviation safety training.

A safety research team is assessing international harmonization and integration of educational best-practices for alignment with technical training. Incorporating *safety* into technical training will influence not only ATO Technical Training courses but will be incorporated by other groups within the ATO. The TTHP emphasizes efficiency and efficacy of training, through greater understanding of learning taxonomy and how the international community trains its air traffic controllers.

Safety of our national airspace system is of paramount importance as demonstrated at Ohio State University where an extensive amount of human factors research with respect to pilot performance, testing, and integration of advanced cockpit technologies (such as angle of attack indicators and in cockpit weather information systems), as well as gaining a greater understanding of system safety through safety management systems research has been done. All of OSU and Drexel University's expertise in these areas will have benefits and applications to future TTHP related work.

Curriculum Architecture

- Field Training Standardization
- Standardization of Training for Training Administrators
- Curriculum Architecture Gap Analysis
- Enhanced AT-CPC Training
- Modular Curriculum Design

Content Management and Delivery

- Best Practices and Methods for Virtual Training Delivery
- Development of Learning Taxonomy
- Research Alternative ISD Model
- Course Development

Simulation and Part-Task Training

- Optimize Simulation
- Explore Use of Gamification for Training
- Analysis of a Technical Training Course for Specific Part-Task Training Implementation

Human Factors

- Universal Design for Learning and Multi-modal Training
- Applied Game Theory to Enhance ATC Training
- Characterization and Application of Air Traffic Controllers Visual Search Patterns
- Scenario-Based Training with Advanced Weather

Analytics

- Learner Data Management
- Analysis of Technical Operations Job Tasks
- Technical Training Knowledge Architecture
- AJI-2 Customer Satisfaction Process

Safety & Program Management

- International Harmonization and Integration
- COE Strategic Framework

COE TTHP RESEARCH TASKS

TASK # CFA001-02-03. STRATEGIC FRAMEWORK

PROJECT AT-A-GLANCE

UNIVERSITIES: Embry-Riddle Aeronautical University, University of Nebraska-Omaha, and University of Oklahoma

PRINCIPAL INVESTIGATORS: Dr. Mark Friend (ERAU), Dr. Scott Tarry (UNO), and Dr. Martha Banz (OU)

INDUSTRY PARTNERS: Adacel, American Airlines, C2 Technologies, CNI Aviation, Computer System Designers, KeyBridge Technologies, Leidos, Robinson Aviation, Veracity Engineering, and Washington Consulting Group

RELEVANCE TO TECHNICAL TRAINING AND HUMAN PERFORMANCE

This project focuses on developing the COE TTHP roadmap, to incorporate future research goals and those goals of AJI-2, the FAA, and the NAS as a whole. The purpose of the research roadmap is to highlight priority research areas, subareas, and project ideas to demonstrate the strategic direction of research efforts.

STATEMENT OF WORK

- Organize and host workshops to identify key research areas
- Prioritize research tasks and align with FAA and other agency initiatives
- Develop and collect survey data from field employees across all aviation professions on current and future technical training needs
- Facilitate discussions with academia and industry to forecast short-term (by 2021) and long-term (by 2026) research topics
- Engage COE TTHP task forces in the development of a research roadmap
- Publish a research roadmap and distribute to internal and external constituents

Figure 1. Updated Research Themes and Subthemes (June 2018)

STATUS AND FUTURE WORK

- S1: Research areas have been identified
- S2: Short-term (by 2021) research topics have been prioritized
- S3: Field survey has been conducted and analyzed
- S4: Research roadmap initial summary draft has been completed
- F1: Long-term (by 2026) research topics will be identified and prioritized
- F2: Task forces will edit and publish a comprehensive research roadmap by end of project period (March 2019)
- F3: Roadmap will be distributed to internal and external constituents

2nd Annual Report 2018

TASK # CA001-02-09. FIELD TRAINING STANDARDIZATION

PROJECT AT-A-GLANCE

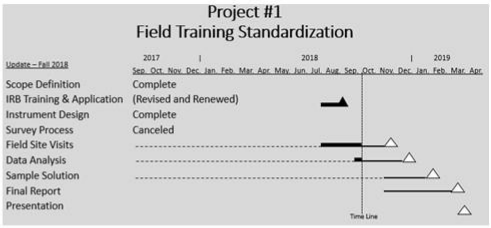
- UNIVERSITIES: University of Oklahoma, InterAmerican University, and Tulsa Community College
- AFFILIATE UNIVERSITY: Texas State Technical College
- PRINCIPAL INVESTIGATORS: Dr. Robert Dionne (OU) & Steve West (OU); Caroline Ocasio (IAU); Gary Wescott (TCC); Al Culp (TSTC)
- INDUSTRY PARTNERS: Leidos, Chickasaw Nation Industries, Computer System Designers, Robinson Aviation, and CI² Aviation

RELEVANCE TO TECHNICAL TRAINING AND HUMAN PERFORMANCE

- The purpose of this research project is to assist the FAA with the analysis of standardization within tech ops and air traffic controller field training. The goals are to 1) identify a fundamental baseline of training that is common across all facilities in the NAS and 2) determine the best delivery method to standardize fundamental knowledge.

STATEMENT OF WORK

- A cross-collaboration between academic and industry members with NAS, FAA, and/or Tech Ops or ATC professional and/or instructor experience will result in the following SOW tasks for the project:
  - Team will review current state of delivery for OJT and other types of field training in varied types and levels of FAA facilities.
  - Team will identify baseline commonalities that exist in OJT and other types of field training in varied types and levels of FAA facilities
  - Team will analyze whether current baseline commonalities in field training among varied types and levels of FAA facilities are sufficient from the perspective of training standardization across each organizational unit
  - Team will identify areas where additional standardization of field training in ATC and/or Tech Ops facilities would be beneficial
  - Team will develop suggestions for and/or a sample for increased standardized delivery of curriculum
  - Team will develop a final report of recommendations for the FAA



STATUS

- Literature review in final stages
- Documentation review in final stages
- Process mapping in final stages
- Interview process started in July 2018, process continues and near completion
- Updated and Renewed IRB Application, Received Approval

FUTURE WORK

- Complete Field Facility interview process.
- Complete analysis existing literature for report.
- Complete a sample of course or curriculum delivery.
- Complete recommendations and conclusion.
- Complete and submit final report.

TASK # CA007-08. Enhanced AT-CPC Training

PROJECT AT-A-GLANCE

- UNIVERSITY: Embry-Riddle Aeronautical University and University of North Dakota
- PRINCIPAL INVESTIGATOR(S): Marty Lauth (ERAU), Paul Drechsel (UND)
- STUDENT(S): Mattie Milner
- INDUSTRY PARTNER(S): TransLumen, UFA

RELEVANCE TO TECHNICAL TRAINING AND HUMAN PERFORMANCE

- Air Traffic Control is a multifaceted system made up of many elements. While the technologies used in modern air traffic control systems have improved, the accreditation process and training techniques for experienced Certified Professional Controllers have remained mostly unchanged. Even though the use of high fidelity simulation is being used extensively throughout the industry's initial training process there is a need for a variety of low fidelity, lower cost, part task training that can deliver the information to experienced controllers in a Just-in-Time (JIT) format yet still maintain the integrity of the full simulation experience.

STATEMENT OF WORK

- Identify requirements for enhance/advanced training and
- Examine current methods of advanced training
- Review existing research on ATCS advanced training
- Evaluate benefit for providing this training at the FAA Academy in Oklahoma City
- Identify several alternatives for implementing the advanced training concept model and identify associated risks and limitations for each alternative.

Advanced Air Traffic Controller Training

STATUS

- Project Closed

FUTURE WORK

- Review the FAA's Courses to determine if delivery could be more effective, efficient and interactive.
- Review the research concerning training methods and delivery completed through the FAA COE TTHP.
- Research to determine if part task training can be accomplished affordably and in mobile format, possibly through the cloud integrating voice recognition and response capabilities.
- Research and apply gaming concepts to create a more interactive experience.
- Research SubThreshold Extreme Gradual Change (STEGC) to increase controllers ability to retain and learn information.

TASK # CA003. Standardization of Training for Training Administrators

PROJECT AT-A-GLANCE

- UNIVERSITY: Embry-Riddle Aeronautical University
- PRINCIPAL INVESTIGATOR(S): Dr. John R. Griffin
- GRADUATE STUDENT: Ms. Alyssa Pavlik
- INDUSTRY PARTNER(S): Washington Consulting Group (WCG)

RELEVANCE TO TECHNICAL TRAINING AND HUMAN PERFORMANCE

- Training Administrators that are poorly trained and inadequately equipped to perform the duties of the position have an adverse effect on the entire training program of the FAA facility. When personnel are better prepared, they perform more competently and at a higher level. Facility benefits with better trained personnel and shorter training times.

STATEMENT OF WORK – Recommendations Provided to the FAA

- Determined an inadequacy existed in the FAA's current formal training and it's content. Recommended improvements to course structure, length, and content.
- Recommended newly assigned TA personnel should receive formal training with the first 3 to 6 months of assignment.
- Restructure the current FTA course to more nearly align itself with the type of facility where training is being conducted.
- Add practical scenarios, case studies, situational training, explain the difference in a good training program versus a bad one. Expand media to include embedded videos.
- Create a FTA refresher course. This would greatly aid personnel assigned to the TA position years after receiving formal training. This would provide current information to better equip the TAs.
- Develop a sharing network that would allow TAs to put questions and answers to other TAs in real time. Utilize applications like, Yammer, Slack, Hipchat, etc.
- Provide all TAs with a listing of current available resources to aid them in performing their duties. Mandate the creation of a "Desk Guide" for use by the incoming TAs. Provide training on how to develop an effective desk guide.
- Establish a Mentor Program. Provide a current contact list of peers.
- Establish a dedicated training administrator position for high level terminal facilities instead of having it as an additional duty.

Training in an ATC Lab

STATUS

- Research completed and final close-out briefing given to the FAA on September 20, 2018.

FUTURE WORK

- The FAA expressed interest in having me develop a "strawman" type of template to create a desk guide. This guide would be for departing TAs to use as a briefing tool and guidance for their incoming replacements. Still in the negotiation stage with FAA Training.

CA010-11: Modular Curriculum Architecture

PROJECT AT-A-GLANCE

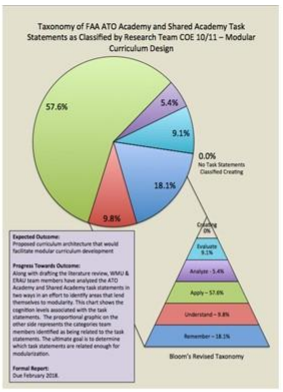
- UNIVERSITY: Embry-Riddle Aeronautical University / Western Michigan University
- PRINCIPAL INVESTIGATOR(S): Daryl Watkins (ERAU), Adam Manley (WMU)
- STUDENT(S): Sarah Lewis, Chelsea Hall (WMU)
- INDUSTRY PARTNER(S): ADDX Corp.

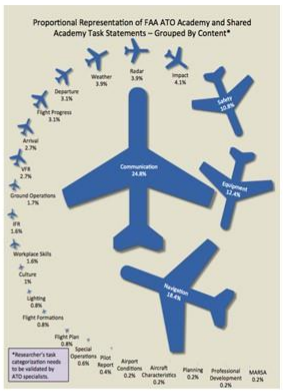
RELEVANCE TO TECHNICAL TRAINING AND HUMAN PERFORMANCE

- This research provided opportunities to:
  - reuse and redeploy training assets
  - identify waste in training and development
  - rapidly deploy consistent training modules
  - ensure quality and excellence through the implementation of best practices.
- . This research provided opportunities to:
  - reuse and redeploy training assets
  - identify waste in training and development
  - rapidly deploy consistent training modules
  - ensure quality and excellence through the implementation of best practices.

STATEMENT OF WORK

- Task 1 - Conduct Literature Review
- Task 2 - Collect FAA-ATO Artifacts
- Task 3 - Map Current Process
- Task 4 - Validate Understanding
- Task 5 - Map New Process
- Task 6 - Develop concept for enhanced curriculum architecture
- Task 7 - Develop list of recommendations





STATUS

- Project completed 6/15/18 and debriefed 8/23/18.

FUTURE WORK

- N/A

TASK CMD-1. Best Practices and Methods for Virtual Training Delivery

PROJECT AT-A-GLANCE

- UNIVERSITY: Embry-Riddle Aeronautical University
- PRINCIPAL INVESTIGATOR(S): Lulu Sun
- STUDENT(S): Haley Dennis
- INDUSTRY PARTNER(S): ATAC, JMA Solutions

RELEVANCE TO TECHNICAL TRAINING AND HUMAN PERFORMANCE

- FAA training delivery methods such as instructor led-courses, and PowerPoint with no accompanying assessment, have not kept pace with advances in **simulation** technologies
- Air traffic volume and complexity have steadily increased, along with the **innovative** technologies and methodologies
- **Millennials** have expertise in media, tools, and technology than the Boomers. FAA must change its traditional means of training since the new hires grew up in a digital world and prefer digital technologies to the more static teaching methods used to train their predecessors

STATEMENT OF WORK

- Study **training courses** offered by FAA academy, CTI schools, and other training area
- Conduct **surveys** and face-to-face **interviews** to examine the current controller's training experience and expectation
- Collaborate with **industry partners** to research potential training curriculum and delivery improvements and identify potential impacts
- **Best** practices and methods will be identified and presented to the FAA
- Research **findings** from training courses offered by the FAA academy, and CTI schools and in-field facilities will be presented
- Develop **recommendations** for changes to the FAA Training process
- Identify potential **impacts** on training for both current and future training delivery systems
- **Communicate** with FAA administrators and **collaborate** with course developers to improve training course delivery

STATUS

- Finished background research (complete)
- Synthesize information (complete)
- Disseminate results to conferences(in progress)
- Finish report to FAA (in progress)

FUTURE WORK

- Implement Air Traffic Control in A Blended Learning Environment Curriculum Design Pilot program:

Select
Low-impact training initiative

Apply
Interactive virtual training platform and technology

Implement
Active learning in face-to-face classes

Utilize
Robust assessment tools to evaluate training and retention

Project #CMD007 - Managing Training Content Including Adaptive Learning Capabilities Using 21st Century Technology

PROJECT AT-A-GLANCE

- UNIVERSITY: Embry-Riddle Aeronautical University, Interamerican University of Puerto Rico
- PRINCIPAL INVESTIGATOR(S): Michael Wiggins, Caroline Ocasio, Robert Thomas, Victoria Thorpe
- STUDENT(S):
- INDUSTRY PARTNER(S): C2 Technologies, Inc

RELEVANCE TO TECHNICAL TRAINING AND HUMAN PERFORMANCE

- The goal of this project is to use LMS/LCMS technology to allow for customization and adaptive learning for FAA Aviation Safety Inspectors. In the long-term, this will transition from a training environment to a cost-effective workforce development environment.

STATEMENT OF WORK

- 1. Create a report that highlights 21st Century Personalized/Adaptive Training best practices and methods, and includes a technology comparative study that discusses handling of modular content.
- 2. Compare LMS/LCMS software from different companies to determine one that would be compatible with the needs of the FAA. Determine if the existing LMS used by the FAA is capable of delivering the desired courses in a manner consistent with the intended use for future ASI training. If no existing LCMS is used or required, then make recommendations regarding which one(s) can meet the goals of the FAA.
- 3. Analyze current AFS-500 training requirements and procedures and develop a framework to assist in selecting which topics should be taught in a face-to-face setting (either in a traditional classroom setting or a virtual classroom), which topics can be best taught via online/mobile learning, and how to test for/determine topics that employees can bypass if they possess adequate knowledge of the topic.
- 4. Develop a prototype lesson representative of an ASI training topic that will demonstrate the use of modular and mobile adaptive learning with the ability for rapid updating.
- 5. Produce a final report outlining the process used and all information determined during the research project that provides recommendations and a roadmap towards a fully integrated system.

21st Century Personalized/Adaptive Training

STATUS

- Completed SOW 1 report
- Completed SOW 2 LMS comparison
- Currently gathering materials from the FAA AFB-500 to use to create a sample course that demonstrates using Personalized/Adaptive Training best practices and methods

FUTURE WORK

- Develop a prototype course that uses adaptive training methods
- Demonstrate the ability to rapidly update the training course
- Produce Final Report

TASK # CMD008. CREATING AN ADAPTIVE AND DISTRIBUTED COMPETENCY-BASED LEARNING ENVIRONMENT TO DEVELOP THE NEXT GENERATIONS OF AVIATION SAFETY INSPECTORS

PROJECT AT-A-GLANCE

- UNIVERSITY: University of Oklahoma
- PRINCIPAL INVESTIGATOR(S): Todd P. Hubbard
- RESEARCH ASSISTANT: April Millaway
- INDUSTRY PARTNER(S): Karen Yoshino, Blackboard

RELEVANCE TO TECHNICAL TRAINING AND HUMAN PERFORMANCE

- The recommendations from this project, if applied, will increase efficiency and productivity, improve safety, assure quality control, and will significantly reduce training costs

STATEMENT OF WORK

- Transform current training courses into competencies
- Translate training objectives to competencies for each course
- Group competencies into logical groups (places where specific competencies are needed)
- Create logical connections between competency and "most likely to occur" status by region (or FAA area designation)
- Establish training priorities

Augmented Reality for Technical Training

STATUS

- 10% of the courses have been transformed to competency-base education (CBE) format

FUTURE WORK

- Convert remaining courses
- Demonstrate how CBE can be used in Aviation Safety Inspector training
- Write scholarly paper on the process of conversion and integration of competencies within the FAA workforce

SPTT001 – Optimize Simulation

PROJECT AT-A-GLANCE

- UNIVERSITY: Embry-Riddle Aeronautical University
- PRINCIPAL INVESTIGATOR(S): Dr. Shafagh Jafer
- STUDENT(S): Bharvi Chhaya, Jessica Updegrove, Ashok Vardhan, Khushboo Dhala, Ahrash Aleshi
- INDUSTRY PARTNER(S): N/A

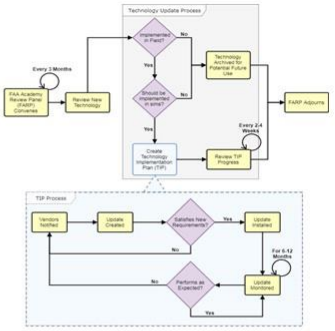
RELEVANCE TO TECHNICAL TRAINING AND HUMAN PERFORMANCE

- This project investigated the use of simulation in FAA ATC training and reported on the benefits, limitations, risks and challenges.

STATEMENT OF WORK

- Report literature survey on current simulation technologies used for FAA ATC training.
- Report research into the benefit and anticipated ROI of simulation vs. training on live equipment in a technical environment.
- Research and report how to determine whether simulation is the appropriate medium and how it is operationalized into the curriculum development process.
- Report how FAA can optimize the use of simulation and propose a process to ensure updates are made concurrent to equipment changes.
- Research and make recommendations on the actual courses that would benefit from use of simulation over actual equipment training.

Technology Update Process



STATUS

- Project Closed out March 29, 2018 and all deliverables were submitted on time.

FUTURE WORK

- Utilization of the project findings to enhance sim-based training at the academy ATC training program.
- A follow-on proposal was submitted in summer 2018 suggesting a process to keep training technologies in sync with real-world devices, as well as a process to update AMA-500 curriculum.

TASK # HF001: UNIVERSAL DESIGN FOR LEARNING (UDL) AND MULTI-MODAL TRAINING

PROJECT AT-A-GLANCE

- UNIVERSITY: University of Oklahoma
- PRINCIPAL INVESTIGATOR(S): Ziho Kang (Lead PI), Randa L. Shehab, Lei Ding, Han Yuan
- STUDENTS: Ricardo Fraga, Lauren Yeagle, Amin Alhashim, Mel Rosa Plata, Mattlyn Draggoo, Rashmi Reddi Annandi, Saptarshi Mandal, Kelvin Egwu, Josiah Rippetoe, Jamie Jazier
- INDUSTRY PARTNER(S): Adacel, ATSI, KeyBridge Technologies

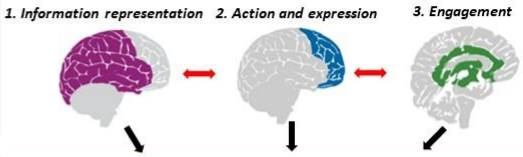
RELEVANCE TO TECHNICAL TRAINING AND HUMAN PERFORMANCE

This project aims to 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.

STATEMENT OF WORK

- ATC training content analysis: Map UDL principles to current teaching curriculum and develop classification system.
- Learning style evaluation: Investigate and classify preferred learning styles from ATC candidates.
- Benchmark best practices: Investigate UDL and multimodal training practices.
- Recommend approaches: Align the content analysis with the benchmarking study to recommend adapted and/or new ATC training methods.
- Develop protocols: Develop performance evaluation metrics and procedures to assess the learning outcomes.

UDL and Multi-Modal Training Principles



Accommodate diverse learning preferences to increase learning performance.

STATUS

All milestones complete.
Final technical report to be submitted by 31 Dec. 2018.

- Conducted classroom and lab observations at the FAA Academy and mapped the results with the UDL principles.
- Investigated the learning styles of ~ 500 FAA Academy trainees.
- Benchmarked best practices in other areas.
- Developed recommendations through providing implementation examples using actual FAA teaching materials.
- Conducted short-term experiment to evaluate the implemented examples.

FUTURE WORK

- Development of fully implemented training materials for each course.
- Evaluation of the fully implemented materials through experiments.
- Systematic training of instructors and trainees on how to maximize the usage of the UDL and multimodal training approaches.
- Implementing state-of-the-art technologies to support training.

TASK # HF002: APPLIED GAME THEORY TO ENHANCE AIR TRAFFIC CONTROL TRAINING

PROJECT AT-A-GLANCE

- UNIVERSITY: University of Oklahoma
- PRINCIPAL INVESTIGATOR(S): Kash Barker and Andrés González.

RELEVANCE TO TECHNICAL TRAINING AND HUMAN PERFORMANCE

- The project will result in a better understanding of how game theory can be used to model ATC decision making in nominal situations and deviations from those nominal situations with application of research findings to improve the theory supporting future ATC training scenarios.

STATEMENT OF WORK

1) Understand how effective ATC actions can be informed by game theory; 2) Understand normal and variations to normal ATC operations; 3) Document decision analysis and game theory approaches to support training; and 4) Explore the effectiveness of ATC learning through game theory driven platforms.

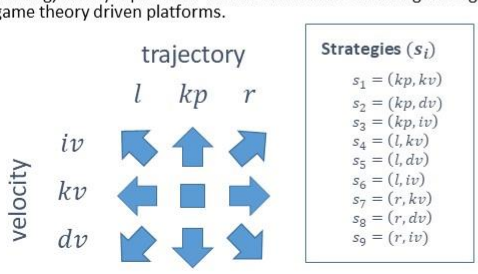


FIGURE 1. Nine possible strategies of aircraft to reduce conflict zones

STATUS

- Completed literature review on proposed approaches to deal with the problem of conflict detection and resolution in air traffic management
- Developed concept of the project and ideas on how to apply game theory to enhance ATC training in potential conflicts in the airspace
- Prepared the general structure of the algorithm and specifying the required formulation
- Designed the formulation requirement for different parts of the algorithms
- Designed the algorithm for conflict detection and resolution (e.g., Conflict zone detection sub-algorithm, Game model construction sub-algorithm, Conflict resolution sub-algorithm)
- Coded the algorithm with Python programming language
- Validated the coding and algorithm logically for different simple examples
- Coded the graphical modules to illustrate the generated results

FUTURE WORK

- Illustrate the application of the proposed algorithm for a segment of airspace as a case study
- Perform sensitivity analysis to calculate the cost of deviation from nominal for different minimum safety distances
- Perform sensitivity analysis to calculate the cost of deviation from nominal by adding more levels for path direction and velocity change
- Perform sensitivity analysis to calculate the cost of deviation from nominal under unexpected circumstances: 1) Increasing the number of airplanes in the airspace (having more airspace congestion), 2) Decreasing the number of available airports, 3) Potentially considering especial emergency situations (e.g. malevolent attack, natural disaster or operational failure)
- Finalize the project report

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TASK # HF003: CHARACTERIZATION AND APPLICATION OF AIR TRAFFIC CONTROLLERS VISUAL SEARCH PATTERNS AND CONTROL STRATEGIES FOR EFFICIENT AND EFFECTIVE TRAINING

PROJECT AT-A-GLANCE

- UNIVERSITY: University of Oklahoma
- PRINCIPAL INVESTIGATOR(S): Ziho Kang, John Dyer.

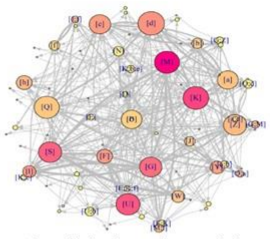
RELEVANCE TO TECHNICAL TRAINING AND HUMAN PERFORMANCE

- This proposed project aims to 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.
- We will collect eye movement data and aircraft control commands from multiple expert ATCOs, and develop designs to better provide the characterized and classified visual search and control strategies. The research focus is on enroute air traffic control.

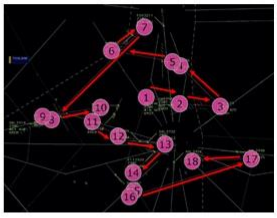
STATEMENT OF WORK

- Conduct requirement analysis for collecting ATCO's eye movements, retrospective verbal inputs, and mitigation commands.
- Perform experiments on retired expert ATCOs: Record eye movements and verbal commands. Analyze visual scanning patterns and conduct retrospective verbal protocol analysis..
- Characterize and classify expert ATCO's visual search patterns and control strategies.
- Develop designs to provide visualization and classification results.

Examples of visual scan characteristics



Overall visual scan characteristics



Example of spiral visual scan

STATUS

- Project completed in Q1 of 2018.
- Final briefing completed in Q2 of 2018.
- All milestones complete: Discovered different types of visual scans and conflict mitigation strategies using high fidelity scenarios.

FUTURE WORK

- Phase II (i.e. next phase) research is to start shorty: (1) implementing the results into a gamified software and (2) evaluating the learning effectiveness.
- Development of algorithms (e.g. machine learning) to automatically classify visual scans.
- Development of real-time eye tracking analysis algorithms.

Task HF006-007-008 HF and Scenario Based Training w/Advanced Weather & Training of Pilots and Air Traffic Controllers in Weather-related Decision Making Using Probabilistic Hazard Information Displays

PROJECT AT-A-GLANCE

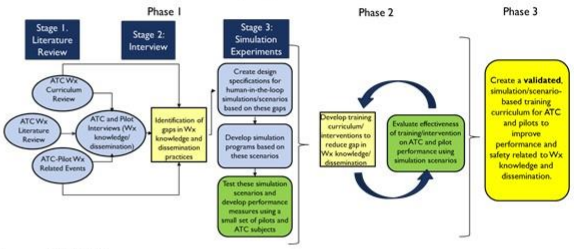
- UNIVERSITY: University of Akron, University of Wisconsin-Madison, Embry-Riddle Aeronautical University
- PRINCIPAL INVESTIGATOR(S): Dr. Chen Ling, Dr. Doug Wiegmann, Dr. Mike Wiggins
- STUDENT(S): David Toon, Ali Alshaqah, Emma Pierson, Harry Harrison
- INDUSTRY PARTNER(S): Dr. Christopher Johnson, Pilot Training System

RELEVANCE TO TECHNICAL TRAINING AND HUMAN PERFORMANCE

- The objective of this study is to discover if scenario-based training can enhance decision-making capabilities of air traffic controllers and pilots to enhance safety while reducing weather delays.
- **STATEMENT OF WORK**

1. Determine the extent to which gaps in weather-related training exist, and understand if the problem is institutional, regional, national and/or international. –literature review, interview SME
2. Determine if scenario-based simulation (integrated and non-integrated) with advanced weather modeling can bridge gaps in weather-related training. – literature review, interview SME
3. Prepare for weather scenarios for initial testing –computer programming to develop representative scenarios for use in ATC labs and computer aviation training devices.
4. Study pilots decision making when encountering severe weather situations –Human performance experiment- Simulations were conducted at the University of Akron on a ELITE flight simulator and Integrated weather display.
5. Study air traffic controller decision making when encountering severe weather situations –Human performance experiment- Simulations were conducted at the University of Akron Human Factors Engineering Lab with ATC weather simulation.

Project Overview



STATUS

- Phase 1 is complete.

FUTURE WORK

- Phase 2 will involve developing, testing, and validating training curriculum and/or interventions to reduce the gap in weather knowledge and dissemination using simulated scenarios.
- Phase 3 will create validated simulation/scenario-based training curriculum for ATC and pilots to improve performance and safety related to weather knowledge and dissemination

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HF009 AJW-3 Project #1 Fleet Assessment/Modernization Study

PROJECT AT-A-GLANCE

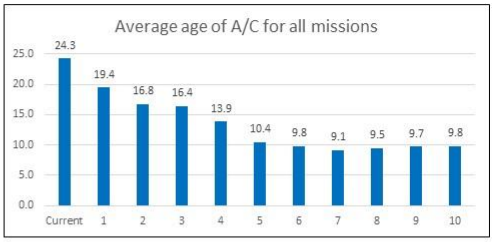
- UNIVERSITY: Embry – Riddle Aeronautical University
- PRINCIPAL INVESTIGATOR(S): Dr. Massoud Bazargan
- STUDENT(S): Ziyi Huang and Nidhi Tambadia
- INDUSTRY PARTNER(S): None

RELEVANCE TO TECHNICAL TRAINING AND HUMAN PERFORMANCE

- This project is focused at identifying best fleet mix for the FAA to support their missions.

STATEMENT OF WORK

- Review the current program mission, facilities, aircraft fleet and needs.
- Develop aircraft replacement strategies and establish models based on missions and requirements of the Flight Program Operations.
- Identify number and type of fleet of aircraft, determine strategies on buy, lease and time frame for which these aircraft are leased or sold based on the intended FAA's planning period;
- Recommend maintenance strategies and manpower planning for the proposed fleet.



STATUS

- The project is making good progress. Preliminary results have been submitted to the FAA incorporating their requirements and strategic goals.
- The project is set to finish at the end of Nov. 2018. We will submit the final results by then.

FUTURE WORK

- The project has been very successful and are looking forward to continue working on the follow-ups to this project including:

Manpower planning
Maintenance planning
Simulation modeling for site consolidations

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TASK # HF010: Feasibility Study of Flight Inspection Aided by UAS-Based Sensing and Calibration

PROJECT AT-A-GLANCE

- UNIVERSITY: **University of Oklahoma**
- PRINCIPAL INVESTIGATOR(S): **Yan (Rockee) Zhang, John Dyer**
- STUDENT(S): **Matthew Gilliam, Ramesh Nepal**
- INDUSTRY PARTNER(S): **Chickasaw National Industries**

RELEVANCE TO TECHNICAL TRAINING AND HUMAN PERFORMANCE

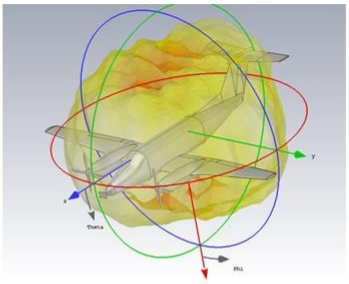
- Simulation data supported the improvements of the flight inspection mission software tool

of FAA, and provides guidance for flight tests and inspection procedures of the crew members.

STATEMENT OF WORK

- **Perform the initial modeling of BE-300PL and CL605 (with different configurations) aircrafts for EM evaluations**
- **Complete the EM simulation runs and radiation pattern generations for signal strength evaluations**
- **Deliver the EM simulation data to FAA team for integration into flight inspection/signal strength measurements software systems.**
- **Assessment of overall signal strength measurement quality based on new technology**
- **Final recommendations report**

3D EM Simulation of radiation pattern from Navigation aide Models



STATUS

- Delivered simulation datasets and plots to FAA team.
- Initial validations using previous flight test data
- Working together with FAA team on flight test validation and evaluations of the simulations

FUTURE WORK

- Further evaluation of the high-resolution signal strength data quality
- Support fully integration into the 4D normalization software of FAA
- Promote automatic flight inspection procedure through developing integrated VOR/LOC transceivers and using UAS platforms

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TASK #HF011 PART 141 PILOT SCHOOL FEASIBILITY STUDY

PROJECT AT-A-GLANCE

- UNIVERSITY: Embry-Riddle Aeronautical University
- PRINCIPAL INVESTIGATOR(S): Andrew R. Dattel and Margaret F. Klemm
- STUDENT(S): Saralee Pruksaritanon, Andrey K. Babin, and Rebecca L. Perini
- INDUSTRY PARTNER(S): n/a

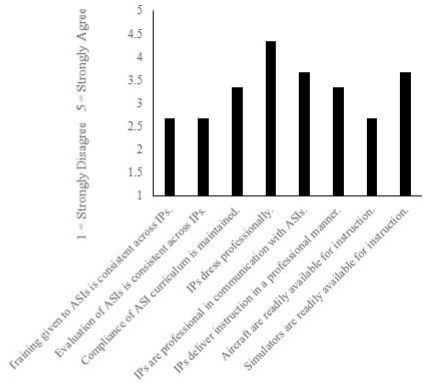
RELEVANCE TO TECHNICAL TRAINING AND HUMAN PERFORMANCE

- Improve currency program for Aviation Safety Inspectors (ASI)
- Explore a Part 141 model of training for Instructor Pilots (IP) who conduct the currency curriculum for ASIs

STATEMENT OF WORK

- Review current curriculum for the ASI currency curriculum.
- Review elements of IP's hiring and training
- Survey standardization pilots of AJW-32 where the currency training program of ASIs is conducted
- Analyze potential benefits of a Part 141 model for IPs who provide currency training to ASIs
- Deliver report of results and recommendations.

FAA Standardization Pilot Responses About IPs



STATUS

- All deliverables have been delivered and closeout is in process

FUTURE WORK

- Help with writing requirements for a Part 141-K program for IP training of ASIs
- Evaluate effectiveness of Part 141-K program for IP training for ASIs

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AN001. LEARNER DATA MANAGEMENT

PROJECT AT-A-GLANCE

- UNIVERSITY: University of Oklahoma
- PRINCIPAL INVESTIGATOR(S): Christan Grant And Dean Hougen
- STUDENT(S): Keerti Banweer, Sai Teja Kanneganti Santhosh Maddula, Chenguag Xu

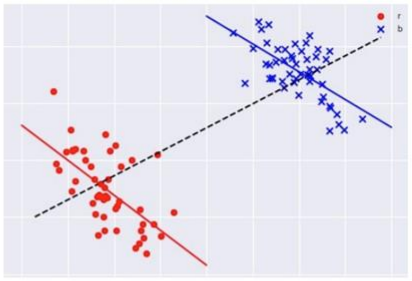
RELEVANCE TO TECHNICAL TRAINING AND HUMAN PERFORMANCE

- We generated algorithms and visualizations that analysts can use over Learner Management Data to help avoid bias during data analysis.

STATEMENT OF WORK

- Understand the needs for FAA learner data management.
- Explore the analytical pathways to provide a solution to improve the success rate for on-the-job training of air traffic controllers.
- Develop example implementations for use by analyst of learner data.

Techniques for Analyzing Learner Data



STATUS

- Data analysis algorithms for bias avoidance well developed.
- Beginning proof-of-concept exploration of data set relationships.

FUTURE WORK

- Investigate separately collated data sets for meaningful relationships related to NAS (for example, correlations between flight delays and accidents).

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TASKS AN002/AN003. ANALYSIS OF TECHNICAL OPERATIONS JOB TASKS

PROJECT AT-A-GLANCE

- UNIVERSITIES: Drexel University (AN002) and Purdue University (AN003)
- PRINCIPAL INVESTIGATORS: Ellen J. Bass (Drexel) and Steven J. Landry (Purdue)
- POSTDOCTORAL RESEARCHER: Andrew J. Abbate (Drexel)
- STUDENT RESEARCHER: Nguyen V.-P. Nguyen (Purdue)
- INDUSTRY PARTNER: Benjamin Bell (Eduworks)

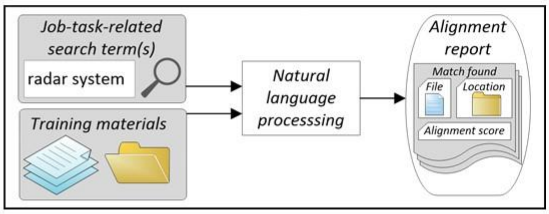
RELEVANCE TO TECHNICAL TRAINING AND HUMAN PERFORMANCE

- The training curriculum for technical operations and other mission-critical occupations includes thousands of learning objectives distributed across hundreds of courses. As the learning objectives in the curricula evolve, keeping the course materials aligned with the actual curriculum is challenging. To address this problem, this work developed an approach to evaluate alignment with respect to matching text in the curriculum files and job task analysis (JTA) task statements to help the FAA keep materials and objectives aligned.

STATEMENT OF WORK

- An analysis will be conducted to identify the state of training and training documentation for the tasks.
- The team will develop a formal definition of alignment between job tasks and training, including developing a method for determining alignment for the task and training materials of interest, using natural language processing techniques.
- The team will make recommendations for integration of current job task analysis into existing courses that have outdated or no task alignment.

TASK—TRAINING ALIGNMENT ANALYSIS APPROACH



STATUS

- AN002 is closed. AN003 has closed.

FUTURE WORK

- We recommend investigating the treatment of files that are not text-based documents, the treatment of text-based documents that are not aligned, and characterizing alignment with respect to the JTA hierarchy
- We recommended integrating this approach with a JTA database for all FAA roles.
- We recommend also conducting research in the adoption of a competency-based approach to processing and aligning instructional materials with job performance requirements, in accordance with FAA initiatives emphasizing competencies.

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TASK #AN006 AIR TRAFFIC AND TECH OPS JTA WORKBOOKS DATABASE

PROJECT AT-A-GLANCE

- UNIVERSITY: Drexel University
- PRINCIPAL INVESTIGATOR(S): Ellen J. Bass
- STUDENT(S): n/a
- INDUSTRY PARTNER(S): n/a

RELEVANCE TO TECHNICAL TRAINING AND HUMAN PERFORMANCE

- Improve training content by identifying job tasks that are critical to training and performance
- Lessen the difficulty and reduce the unproductive time involved in producing Job Task Analysis (JTA) Summary Reports by removing the current bottlenecks
- **STATEMENT OF WORK**
- Task 1: Concept of operations: Coordinate with FAA to determine the envisioned use of the data base system.
- Task 2: Requirements analysis: Develop and document requirements for the data base system
- Task 3: Design: Design the database, human-computer interface, and report
- Task 4: Implementation: Build the Microsoft Access database system and develop user documentation
- Test 5: Test and evaluation: Develop test cases and test the implemented system with FAA users
- Task 6: Deliver the Microsoft Access database system and user documentations

Database prototype search human-computer interface

STATUS

- All deliverable have been delivered and closeout is in process

FUTURE WORK

- Develop a web-based multi-user system
- Enhance search capabilities to include searches with wildcards and matching on word stems
- Add the JTA data and related functionality for roles beyond Tech Ops and ATC. This functionality should include data validation
- Integrate database system with system to analyzing the alignment of existing technical operations (Tech Ops) courses and job task analysis (JTA) data

AN007 - Benchmark Premier Technical Training Providers

PROJECT AT-A-GLANCE

- UNIVERSITY: Embry – Riddle Aeronautical University
- PRINCIPAL INVESTIGATOR(S): Dr. Massoud Bazargan
- STUDENT(S): Ziyi Huang and Nidhi Tambadia
- INDUSTRY PARTNER(S): None

RELEVANCE TO TECHNICAL TRAINING AND HUMAN PERFORMANCE

- This project is focused at identifying best training practices at other industries which are relevant to air traffic controllers.

STATEMENT OF WORK

- Identify industries that have similar technical/professional training requirements and goals to those for ATC and ATSS technical training.
- Document and review the training programs including tools and evaluation processes in the selected industries, and identify the best practices.
- Report key lessons learned and top success stories.
- Recommend actionable best practices, tools, and processes that would help FAA ATO Technical Training.

STATUS

- The project is set to end by the end of Sep, 2018. We are working on finalizing the report.
- We will submit the report to our FAA Project Manager and address any feedback to finalize the submission on OMIS.

FUTURE WORK

- We will submit the report to our FAA Project Manager and will address any feedback to finalize the submission of the final report on OMIS.

COE TTHP RESEARCH FACILITIES AND EQUIPMENT

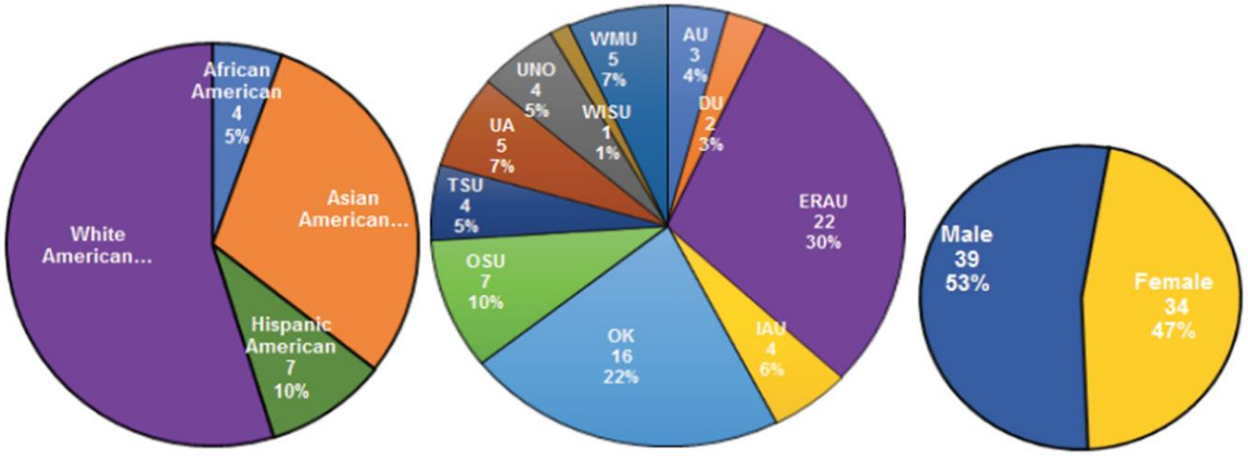
COE TTHP has a variety of unique and diverse research facilities. This list is representative and is not inclusive.

Core Institutions	Facilities and Equipment
Embry-Riddle Aeronautical University (Technical Co-Lead)	The Next-Generation ERAU Applied Research (NEAR) Lab, Advanced Flight Simulation Center, Florida NextGen Test Bed, Computer Security & Forensics Laboratory
University of Oklahoma (Technical Co-Lead)	OU National Weather Center and various radar labs, OU owned and operated Max Westheimer Airport with 23 aircraft, Jim Hamm ATC Simulation Center, two level 3 flight training devices, and a control tower
Wichita State University (Administrative Lead)	National Institute for Aviation Research, FAA COE for Composites and Advanced Materials, and National Center for Advanced Materials Performance
Auburn University	Aviation Center with 17 aircraft, Warrior Research Center, Exercise Psychophysiology Lab, and Rehabilitation Informatics Lab
Drexel University	Cognitive Neuroengineering and Quantitative Experimental Research (CONQUER) Collaborative; Human-System Evaluation and Analysis Laboratory (H-SEAL)
InterAmerican University	School of Aerospace Airways New Zealand's "Total Control Tower Simulator", ALSIM Flight Trainer model ALX, and access to nearby airport and aircrafts
Oklahoma State University	College of Aviation Lab with Redbird MCX simulator, MATRIX graphical flight simulator, and 17 aircrafts (Cessna-152, Cessna172, Cessna-182RG, and Piper PA-44 Seminoles)
The Ohio State University	Aerospace Research Center (ARC) featuring two subsonic wind tunnels and anechoic chamber; Ohio Supercomputer Center
Purdue University	Fluid Power Lab, Computer Lab, Composite Lab, a Flight Trainer Lab, and an Advanced Simulator lab
Tennessee State University	TSU Interdisciplinary Graduate Engineering Research Institute Facility with Computer Assisted Virtual Environment system from Mechdyne
Tulsa Community College	Aviation Center with an Adacel Maxsim ATC Simulator, RedBird 3-Axis Single and Twin-Engine Simulator, RedBird Cross-Wind Trainer, and 5 leased Cessna aircraft
University of Akron	Computational Mechanics Lab, Materials Testing Lab, and Robotics Lab
University of Nebraska Omaha	Aviation Institute's Flight Simulation Facility with 3 flight simulators
University of North Dakota	Road Weather Field Research Facility, Glacial Ridge Atmospheric Observatory; Adacel 225 and 360 Tower/RADAR Simulators
University of Wisconsin Madison	Flight Simulation Research Laboratory, Naturalistic Decision Making & Simulation Lab
Western Michigan University	Hangars to house 35 SE and ME aircraft; ATC tower laboratories; NEST Research Lab

Active research grants from the FAA and other government organizations to investigate air navigation modernization, atmospheric research, the use of unmanned technology, weather analysis and other topics related to aerospace and technology have demonstrated the ability of the universities to successfully work with government entities at a high level. **Core Institution members have over $4 billion** of aggregated, annual, research expenditures.

COE TTHP STUDENT RESEARCHERS

The following is a list and demographic information of the 47 COE TTHP students working on research tasks during second year of operation.



Student Name	Institution	Mentor
Joseph Fetch	Auburn University	JoEllen Sefton
Hayden Hickey	Auburn University	JoEllen Sefton
Rian Ory	Auburn University	JoEllen Sefton
Andrew Abbate	Drexel University	Ellen Bass
Ahana Sabu	Embry-Riddle Aeronautical University	Lulu Sun
Lusine Carlson	Embry-Riddle Aeronautical University	Steven Hampton
Matthew Pierce	Embry-Riddle Aeronautical University	Martin Lauth
Ziyi Huang	Embry-Riddle Aeronautical University	Massoud Bazargan
Andrey Babin	Embry-Riddle Aeronautical University	Andy Dattel
Khushboo Dhala	Embry-Riddle Aeronautical University	Shafagh Jafer
Saralee Pruksaritanon	Embry-Riddle Aeronautical University	Andy Dattel

Christopher Shannon	Embry-Riddle Aeronautical University	Shafagh Jafer
Nidhi Trambadia	Embry-Riddle Aeronautical University	Massoud Bazargan
Marissa Pecora	Embry-Riddle Aeronautical University	Massoud Bazargan
Gabrielle Powell	Embry-Riddle Aeronautical University	Mark Friend
Rolando Fernandez	Inter American University	Caroline Ocasio
David Perez	Inter American University	Caroline Ocasio
Jesus Plaza	Inter American University	Caroline Ocasio
Alexander Rivera	Inter American University	Caroline Ocasio
Wilson Flores	Ohio State University	David Delaine
Rohan Sheth	Ohio State University	David Delaine
Pearl Chen	Ohio State University	Rachel Kajfez
Brooke Stieber	Ohio State University	Rachel Kajfez
Katherine Tanner	Ohio State University	Rachel Kajfez
Andy Theiss	Ohio State University	Rachel Kajfez
Geoffrey Brown	Tennessee State University	Keith Hargrove
Dylan Dorman	Tennessee State University	Keith Hargrove
Nicholas Oliveira	Tennessee State University	Keith Hargrove
Paxtyn Wright	Tennessee State University	Keith Hargrove
Ali Alshaqah	University of Akron	Chen Ling
Kazi Rahman	University of Akron	Chen Ling
Harry Harris	University of Akron	Chen Ling
Emma Pierson	University of Akron	Chen Ling
Dylan Christiansen	University of Nebraska at Omaha	James Taylor
Benewende Sam	University of Nebraska at Omaha	James Taylor
Henry Schleu	University of Nebraska at Omaha	James Taylor
Nicholas Shawhan	University of Nebraska at Omaha	James Taylor
Saptarshi Mandal	University of Oklahoma	Ziho Kang
Lauren Yeagle	University of Oklahoma	Ziho Kang
Mattlyn Dragoo	University of Oklahoma	Ziho Kang
Josiah Rippetoe	University of Oklahoma	Ziho Kang
Chelsea Hall	Western Michigan University	Raymond Thompson
Sarah Lewis	Western Michigan University	Raymond Thompson
Li Cheng	Western Michigan University	Raymond Thompson
S M Pavithi Kavindie Srisannas Senanayake	Western Michigan University	Raymond Thompson
Lang Tong	Western Michigan University	Raymond Thompson
Lesheng Hua	Wichita State University	Jibo He

COE TTHP PUBLICATIONS, PRESENTATIONS, AND AWARDS

Publications

- Chenguang Xu, Sarah M. Brown, Christan Grant. Detecting Simpsons Paradox. The 31st International Florida Artificial Intelligence Research Society (FLAIRS) Conference. Melbourne, Florida. 2018.
- Updegrove, J. & Jafer, S. (2017). Recommendations for next generation air traffic control training. 1-6. 10.1109/DASC.2017.8102129.
- Updegrove, J.A. and Jafer, S., (2017). Optimization of Air Traffic Control Training at the Federal Aviation Administration Academy. Aerospace, 4(4), p.50.
- "Exploring the Best Practices of Virtual Training Delivery for the Prospective Air Traffic Controller" at 31st National Training Aircraft Symposium (NTAS) in Daytona Beach, Florida on August 13th, 2018
- Adaptive Learning Pedagogy in Universal Design for Learning and Multi-Modal Training, In proceedings of the 2017 National Training Aircraft Symposium, August 14 – August 17, 2017, Daytona Beach, FL. Presenter: Kang.
- Universal Design for Learning in the Framework of Neuroscience-based Education and Neuroimaging-based Assessment, In proceedings of the IEEE BioSmart 2017: 2nd International Conference on Bio-engineering for Smart Technologies, September 28 – October 1, 2017, Paris, France.
- Kang et. al (2017). Adaptive Learning Pedagogy in Universal Design for Learning and Multi-Modal Training, submitted August 1st to the joint publication of the Journal of Aviation/Aerospace Education & Research and International Journal of Aviation, Aeronautics, and Aerospace. Preparing a conference or journal paper for the learning styles assessment from the FAA Academy trainees. (assessment is currently underway).
- **Journal paper:** Kang, Z., Dragoo, M. R., Yeagle, L. N., Shehab, R. L., Yuan, H., Ding, L., and West, S.G. (2018). Adaptive learning pedagogy of Universal Design for Learning (UDL) for multimodal training. *Journal of Aviation/Aerospace Education and Research*, 27(1), 23-48.
- **Conference paper:** Yeagle, L. N. and Kang, Z. (2018). Universal design for learning (UDL) for STEM and higher education: Characterizations and applicability. In *Proceedings of the 2018 ISER International Conference on STEM*, Jun. 18-19, Seoul, South Korea.
- **Conference paper:** Kang, Z., Dragoo, M. Yeagle, L., Shehab, R. L., Yuan, H., Ding, L., and West, S. G. (2017). Adaptive learning pedagogy in Universal Design for Learning and multimodal training. In *Proceedings of the 2017 National Training Aircraft Symposium (NTAS)*, Aug. 13 - 17, Daytona Beach, FL., USA.
- **Conference paper:** Yuan, H., Rippetoe, J., Ding, L., Kang, Z., Shehab, R. L., and West. S. G. (2017).Universal Design for Learning in the framework of neuroscience-based education and neuroimaging-based assessment. In *Proceedings of the 2nd International Conference on Bio-engineering for Smart Technologies (BioSmart)*, Aug. 30 - Sep. 1, Paris, France.

- Kang, Z. Evaluation of the Universal Design for Learning (UDL) pedagogy through eye tracking analysis and memory tests. (under preparation)
- "Exploring the Best Practices of Virtual Training Delivery for the Prospective Air Traffic Controller" at 31st National Training Aircraft Symposium (NTAS) in Daytona Beach, Florida on August 13th, 2018
- Kang et. al (2017). Data visualization approaches in eye tracking to support the learning of air traffic control operations, In proceedings of the 2017 National Training Aircraft Symposium, Daytona Beach, FL.
- Kang (2017). Real time eye movement analysis framework: Objective-based systematic approach, In proceedings of the IEEE BioSmart 2017: 2nd International Conference on Bio-engineering for Smart Technologies, Paris, France.
- Kang et. al (2017). Data visualization approaches in eye tracking to support the learning of air traffic control operations, submitted August 1st to the joint publication of the Journal of Aviation/Aerospace Education & Research and International Journal of Aviation, Aeronautics, and Aerospace.

Presentations

- Chenguang Xu, Sarah M. Brown, Christan Grant. Detecting Simpsons Paradox. The 31st International Florida Artificial Intelligence Research Society (FLAIRS) Conference. Melbourne, Florida. 2018.
- Chenguang Xu, Sarah M. Brown, Christan Grant, Chris Weaver. Interactive Visual Analytics for Simpson's Paradox Detection. The 3rd Workshop on Human-In-the-Loop Data Analytics (HILDA). Houston, Texas. 2018.
- Presentations at the COE TTHP Y2M2 Technical meeting at Drexel University
- FAA SOAR Q2 presentation (Nov. 2016). Universal Design for Leaning and Multimodal Training Q1 progress presentation, November 30-December 1, 2016, Norman, OK. Presenter: Kang.
- FAA SOAR Q3 presentation (Mar. 2017). Universal Design for Leaning and Multimodal Training Q2 progress presentation, February 28-March 1, 2017, Daytona Beach, FL. Presenter: Kang.
- FAA SOAR Q4 poster session (Jun. 2017). Universal Design for Leaning and Multimodal Training poster presentation, June 1315, 2017, FAA Headquarters, Washington D.C.
- Kang, Z. (2017, August). Adaptive learning pedagogy in Universal Design for Learning and multimodal training. In Proceedings of the 2017 National Training Aircraft Symposium (NTAS), Aug. 13 - 17, Daytona Beach, FL., USA.
- Kang, Z., (2017, August).Universal Design for Learning in the framework of neuroscience-based education and neuroimaging-based assessment. In Proceedings of the 2nd International Conference on Bio-engineering for Smart Technologies (BioSmart), Aug. 30 - Sep. 1, Paris, France.
- Kang, Z. (2018, June): Human factors research roadmap (invited panel). Center of Excellence For Technical Training and Human Performance Workshop, Jun. 5-6, Norman, OK.

- Kang, Z. (2018, June). Universal design for learning (UDL) for STEM and higher education: Characterizations and applicability. In Proceedings of the 2018 ISER International Conference on STEM, Jun. 18-19, Seoul, South Korea.
- Kang, Z. (2018, June): Human factors research roadmap (invited panel). Center of Excellence For Technical Training and Human Performance Workshop, Jun. 5-6, Norman, OK.
- Data visualization approaches in eye tracking to support the learning of air traffic control operations, In proceedings of the 2017 National Training Aircraft Symposium, August 14 – August 17, 2017, Daytona Beach, FL. Presenter: Kang.
- Real time eye movement analysis framework: Objective-based systematic approach, In proceedings of the IEEE BioSmart 2017: 2nd International Conference on Bio-engineering for Smart Technologies, September 28 – October 1, 2017, Paris, France. Presenter: Kang.
- Kang will be a keynote speaker for the IEEE BioSmart 2017 conference.
- FAA SOAR Q2 presentation (Nov. 2016). Characterization of visual scanning patterns and aircraft control strategies for training Q1 progress presentation, November 30December 1, 2016, Norman, OK.
- FAA SOAR Q3 presentation (Mar. 2017). Characterization of visual scanning patterns and aircraft control strategies for training Q2 progress presentation, February 28March 1, 2017, Daytona Beach, FL.
- FAA SOAR Q4 presentation (Jun. 2017) . “Characterization of visual scanning patterns and aircraft control strategies for training Q3 progress presentation, June 13-15, 2017, FAA Headquaters, Washington D.C.
- FAA SOAR Q4 poster session (Jun. 2017). Universal Design for Leaning and Multimodal Training poster presentation, June 13-15, 2017, FAA Headquarters, Washington D.C.
- Kang will be a keynote speaker for the IEEE BioSmart 2017 conference.
- Lulu Sun - Exploring the Best Practices of Virtual Training Delivery for the Prospective Air Traffic Controller” at 31st National Training Aircraft Symposium (NTAS) in Daytona Beach, Florida on August 13th, 2018

Awards

- Kang received the Andrew P. Sage Best Transactions Paper Award in October, 2016.
- Mandal received the Best Student Paper Award (first place) from the Aerospace TG within the Human Factors and Ergonomics Society in October, 2016.
- Kang received the Andrew P. Sage Best Transactions Paper Award in October, 2016
- Kang was nominated for the Dr. Hamed K. Eldin Outstanding Early Career IE in Academia Award at the Instituted of Industrial and Systems Engineering in 2018.
- Kang was the Keynote Speaker at the IEEE BioSmart conference in 2017.
- Kang received the Best Presentation Award at the IEEE BioSmart conference in September in 2107.
- Kang received the Andrew P. Sage Best Transactions Paper Award in 2016.
- Lulu Sun - Second place award of student poster competition at FAA COE TTHP Year 2 Meeting 2 technical meeting in Philadelphia, PA on April 4th, 2018.

COE TTHP AFFILIATE PARTNERS

Subject matter experts (SMEs) from academia and industry support specific projects within the six core research areas.

Academic Affiliate Partners

- Central Washington University
- Louisiana Tech University
- OKC Metro Technology Center
- Polk State College
- Spartan College of Aeronautics and Technology
- Texas State Technical College
- University of Southern California
- University of South Florida
- Vaughn College of Aeronautics and Technology

Central Washington University (CWU)

Since 1975, Central Washington University has served as a leading professional aviation-education institution. The CWU aviation program is the only fully accredited, public university aviation program in the Pacific Northwest. The institution offers a Bachelor of Science degree with Aviation Management, Flight Officer, and/or Commercial Pilot specialization options. Students train at Bowers Field, north of the main CWU campus.

Louisiana Tech University (LTU)

Louisiana Tech University's Department of Professional Aviation was the first university FAR Part 141 aviation program to be recognized in the Southwest Region and the second in the nation. The program offers degrees in Professional Aviation or Aviation Management. These programs are all accredited by the Aviation Accreditation Board International (AABI). Louisiana Tech hosts an FAA approved Part 141 and Part 61 Flight School. FAA certificates and ratings are available to include Private, Instrument, Commercial, and/or Certified Flight Instructor and Certified Instrument Flight Instructor.

OKC Metro Technology Center (OKC Metro Tech)

OKC Metro Technology Centers' Aviation Career Campus was built in 1988 and is located at Will Rogers World Airport in Oklahoma City. The Aviation Maintenance Technician program prepares students to pass both the Airframe Mechanic and the Powerplant Mechanic exams administered by the FAA. The Aviation Maintenance Technician major is certified under Part 147 of the Federal Aviation Regulations with an FAA-approved and supervised curriculum.

Polk State College (Polk State)

Polk State College's Aerospace Program offers degrees in Professional Pilot Science, Aerospace Administration, and Aerospace Sciences. The program prepares students to earn the Federal Aviation Administration (FAA) Commercial Pilot Certificate, with Single and Multi-Engine Land class ratings, as well as an Instrument Rating. This program also prepares students for additional optional certificates qualifying them to become Certified Flight Instructors (Airplane), Certified Instrument Flight Instructors, and/or Certified Multi-Engine Flight Instructors. These programs are an FAA approved Part 141 and Part 61 Flight School.

Spartan College of Aeronautics and Technology (Spartan)

Spartan College of Aeronautics and Technology has been providing training to pilots and technicians since 1928. These programs include degrees in Aviation Flight, Aviation Maintenance Technology or Airframe/Powerplant Technology, Aviation Electronics Technology, Nondestructive Testing, and Quality Control. All programs are FAA Part 141, 61, and 147 approved. In addition to its degree programs, Spartan College is proud to provide flight and aviation maintenance training for the United States Air Force at the flight facility in Tulsa, Oklahoma located on the Richard L. Jones Airport. Spartan's flight instructors are highly recognized as some of the best in the industry leading to multiple contracts with the U.S. Government.

Texas State Technical College (TSTC)

Texas State Technical College has developed strong aviation programs since 1970. These programs include degrees and certificates in Aircraft Pilot Training (both fixed and rotary-wing), Air Traffic Control, Aircraft Dispatch, Aviation Maintenance (Airframe and Powerplant), and Avionics. All programs are FAA Part 141, 61, 145, and 147 approved programs.

University of Southern California (USC)

University of Southern California is ranked first in the nation among all universities in the size of its computer science research program and has the largest graduate program in engineering of all private research universities. The institution has a long history of partnering with outside organizations and producing scientific advances in areas relevant to air transportation. The Institute for Creative Technologies and School of Cinematic Arts have multiple institutes, laboratories, and resources that can be applied to computer and simulation-based training. The Mixed Reality Lab explores techniques and technologies to improve the fluency of human computer interactions and create visceral synthetic experiences. Research and prototypes focus on immersive systems for education and training simulations that incorporate both real and virtual elements.

University of South Florida (USF)

University of South Florida offers undergraduate and graduate programs in engineering. Specialization areas include computer science and engineering, industrial and management systems engineering, and mechanical engineering. These programs are all accredited by the Accreditation Board for Engineering and Technology. The institution has worked with FAA databases such as airport system performance metric, airline service quality performance, enhanced traffic management system, the operations network, and performance data analysis and reporting system. USF is currently an affiliate academic partner with the FAA Center of Excellence for Aviation Operations Research. Additionally, USF has worked on multiple projects for the FAA to help understand the correlation of human performance and efficiency and safety of national airspace system.

Vaughn College of Aeronautics and Technology

Vaughn College offers bachelor's and associate degree programs in engineering; engineering technology; management; and aviation, as well as a unique master's degree in airport management. Specialization areas include: electronic engineering, mechanical engineering, mechanical engineering technology, electronic engineering technology, general management, airline management, airport management, aviation maintenance management, aviation maintenance, aircraft operations, aeronautical sciences, aeronautical engineering technology, flight dispatch and air traffic control (non-degree program.) The institution also offers a mechatronic engineering program; one of only three ABET accredited mechatronic engineering programs in the U.S. In addition, Vaughn is home to an FAA Air Traffic Control Collegiate Training Initiative program.

COE TTHP Industrial Advisory Board

Adacel and the Washington Consulting Group, Inc. serve as co-leads of the COE TTHP Industrial Advisory Board (IAB). IAB members assist with reviewing and monitoring of all research grants to ensure research ideas translate into future prototypes and/or products of benefit to the FAA. Several subject matter experts also serve as members of research project investigation teams.

Industry Partners

- 1st American Systems and Service
- Adacel*
- Addx Corporation*
- Air Traffic Simulation, Inc.
- American Airlines*
- American Institutes for Research
- ATAC
- AVT Simulation
- C² Technologies*
- Chickasaw Nation Industries*
- Christiansen Aviation
- CI² Aviation
- Computer System Designers*
- CSSI
- Crew Training International
- Eduworks Corporation*
- Florida NextGen Test Bed
- Frasca International, Inc.
- General Dynamics IT
- Heartwood 3D
- Hucon Global
- Infina, Lt*
- Instructure, Inc. & Canvas Network
- JMA Solutions*
- KeyBridge Technologies
- Leidos*
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- Northrop Grumman*
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- Raydon Corporation
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- SkySoft ATM
- Skymantics LLC
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- Washington Consulting Group, Inc.*
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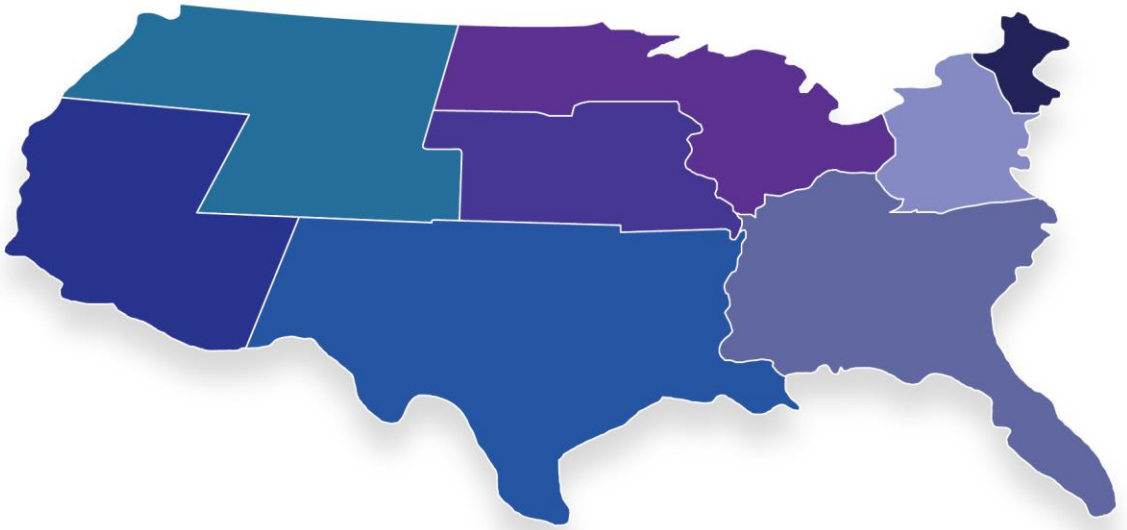
"" – Serve as voting members of the Industry Advisory Board*

Affiliate Partners

COE TTHP
Center of Excellence for Technical Training & Human Performance

INDUSTRY PARTNERS MAP



INDUSTRY PARTNERS

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ATAC (Santa Clara, CA)
TetraTech (Pasadena, CA)

ARIZONA
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American Institutes for Research (Washington DC)
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UTAH
Instructure, Inc. & Canvas Network (Salt Lake City, UT)

OREGON
Eduworks Corporation (Corvallis, OR)

TEXAS
American Airlines Dallas, TX

OKLAHOMA
Air traffic Simulations, Inc (Edmond, OK)
Chickasaw Nation Industries (Norman, OK)
Christiansen Aviation (Tulsa, OK)
Computer System Designers* (Oklahoma City, OK)
KeyBridge Technologies (Oklahoma City, OK)
Robinson Aviation (Oklahoma City, OK)

WISCONSIN
Pilot Training System (Madison, WI)

ILLINOIS
Frasca International, Inc. (Urbana, IL)
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Orion America Technologies (Columbus, OH)

FLORIDA
Adacel (Orlando, FL)
AVT Simulation (Orlando, FL)
CSSI (Coconut Creek, FL)
Florida NextGen Test Bed (Daytona Beach, FL)
Skymantics LLC (Melbourne, FL)

GEORGIA
CP Aviation (Dunwoody, GA)

TENNESSEE
Crew Training International (Memphis, TN)

MARYLAND
Washington Consulting Group, Inc.* (Bethesda, MD)

MASSACHUSETTS
UFA, Inc (Boston, MA)
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VIRGINIA
Addx Corporation (Alexandria, VA)
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Infina, Ltd. (McLean, VA)
Leidos (Reston, VA)
Northrop Grumman (Falls Church, VA)

VERMONT
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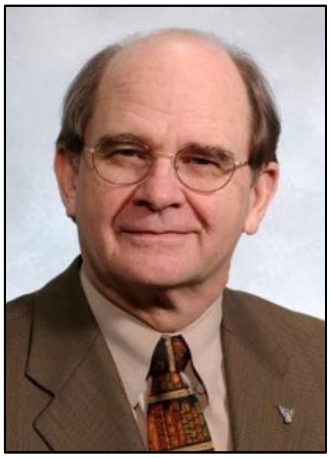
INTERNATIONAL PARTNERS

NORWAY
Hucon Global (Verdal, Norway)

SWITZERLAND
SkySoft ATM (Genève, Switzerland)
SkyGuide (Genève, Switzerland)
Weytech (Genève, Switzerland)

Jeff Tyrcha, M.S. Industrial Engineering serves as Co-Chair of the FAA COE TTHP Industrial Advisory Board. He has over 22 years of experience working in the Aerospace and Defense industry in executive, program management, and technical positions. Mr. Tyrcha's career experience spans all areas of the training and simulation industry and work with the FAA, DoD, NASA, and international aviation organizations. He has a Bachelor's Degree in Aeronautical and Aerospace Engineering from Purdue University and a Master of Science in Industrial Engineering from the University of Oklahoma. Mr. Tyrcha is also a graduate of the Defense Systems Management College at Fort Belvoir, Virginia and the BAE Systems Executive Institute at the University of New Hampshire. In 2013, he was honored as Purdue University Outstanding Aerospace Engineer. Mr. Tyrcha also served in the Air Force as Program Manager and Executive Officer for multiple organizations throughout the Air Force. He formerly served as Chairman of the AFA Junior Officer Advisory Council, and President of the Air Force Association Dallas Chapter. Mr. Tyrcha also served as a board member of the Association for Aerospace Education and is a strong advocate for expanding aviation education around the globe.



Ned Reese, Ed.D. serves as Co-Chair of the FAA COE TTHP Industrial Advisory Board. He has over 45 years of experience working with the FAA as an administrator, technical training contractor, and air traffic controller. In 1969, Dr. Reese joined the FAA as an air traffic controller and was assigned to the Memphis Air Route Traffic Control Center. Over the next 36 years he acquired extensive air traffic experience having served in a variety of roles including En Route air traffic controller, data systems specialist, headquarters staff specialist, field supervisor, traffic management officer, operations manager, facility management and division management roles. In addition to Memphis ARTCC, Dr. Reese has work in FAA Headquarters, Kansas City ARTCC, Denver ARTCC and the Mike Monroney Aeronautical Center. In 1990, he was selected as manager for the National Air Traffic Training Requirements Division (ATZ-100) in Washington Headquarters where he chaired the Air Traffic Training Workgroup and led a major redesign of the air traffic training program. In 1992, Dr. Reese was selected as manager of the Air Traffic Division of the FAA Academy at the Mike Monroney Aeronautical Center. Prior to his retirement from the FAA he served on the committee that developed the

Administrator's Air Traffic Controller Workforce Plan 2005-2014. Dr. Reese has an A.S. degree in Computer Science from State Technical Institute at Memphis, B.S. Degree in Organizational Leadership from Southern Nazarene University, and Master of Science Degree in Applied Science from Oklahoma State University. In 2000, he received a Doctor of Education Degree from Oklahoma State University.

1st American Systems & Services, LLC is a training solutions provider with deep expertise and capabilities in design, development, and deployment of custom eLearning, mobile learning edutainment games, 3D simulation, and virtual learning environments. The organization's system components provide ease of use, compatibility through multiple mediums, accessibility, and scalability to accommodate unlimited user growth.

Adacel is a leading developer of advanced simulation and control systems for aviation and defense. The company operates in the Global Aerospace Systems market including operational Air Traffic Management, Airport and Air Traffic Control Training, and Airborne Vehicle Systems. Within this market space, Adacel focuses on three converging knowledge domains, real time software, simulation and voice activated control technology.

Addx Corporation has extensive experience successfully enhancing federal systems from the individual to the enterprise level. From dynamic intelligence to legacy modernization to IT governance, the company offers a comprehensive set of IT and engineering services founded on expertise, strategy, and collaboration to improve business operations and reduce risk. Some of Addx Corporation's clients include the Federal Aviation Administration, U.S. Navy, and the U.S. Coast Guard.

Air Traffic Simulation, Inc. specializes in modeling & Monte-Carlo simulation, statistical analysis, data processing automation, and 3D visualization. The company is the creator of SMART, a multi-faceted Air Traffic Control high fidelity simulation system dedicated to the training of Air Traffic Controllers.

American Airlines serves as the world's largest airline when measured by fleet size, revenue, and scheduled passenger-kilometers flown and the second largest by number of destinations. The airline operates an extensive international and domestic network with an average of nearly 6,700 flights per day to nearly 350 destinations in more than 50 countries.

American Institutes for Research serves as a research organization to the FAA to analyze the performance of air traffic controllers, identify the NextGen technologies impacting airway transportation systems specialists, and conduct usability testing of the new NOTAM data entry tools.

ATAC is well known in the aviation industry for aviation modeling, simulation, and developing software to support FAA operations. The company also provides comprehensive operations design and data analysis, including airport and airspace planning, applicable for military and commercial operations.

AVT Simulation integrates the upgrades of older outdated training simulation devices; this service includes improving software, modernizing hardware, upgrading the visuals, and redesigning the models and databases. AVT's training solutions division consists of the Collective Aircrew Mission Task Trainer (CAMTT), offering a reconfigurable rotary wing "collective trainer."

C² Technologies, Inc. provides training, strategic human capital management, mission-critical support services, and information technology solutions to meet the specific needs of civilian, defense, and private-industry clients. The company provides a broad range of education and training services such as virtual task trainers, serious games, simulation and modeling,

IMI/WBT/CBT courseware, learning management systems, and performance support tools.

Chickasaw Nation Industries provides aviation-related professional services including engineering, technical support, and program management. CNI supports the FAA as a subcontractor on the Controller Training Contract and with second level engineering, development, configuration management, acquisition support, and prototyping efforts of the WAAS. CNI's FAA systems are located across the continental U.S., Alaska, Hawaii, Puerto Rico, Mexico, and Canada.

Christiansen Aviation offers flight training, aircraft rental, aircraft leasing, maintenance, sales of new and used Cessnas, pilot supplies, and a full service fixed-base operator.

CI² Aviation is a full-range aviation facility management, information technology, engineering, and administrative consulting organization, serving more than 25 federal ATC contract towers. The company's contract services specialize in airfield operations, systems engineering and integration, financial administration, and program management services.

Computer System Designers currently provides information technology, engineering, training, and eLearning support to Federal clients, including the FAA, the U.S. Department of Agriculture, the U.S. Air Force, the U.S. Army, and the Defense Information Systems Agency. CSD is the prime contractor for the Regulatory Standards Division Instructional Services Training Contract and provides extensive support to the FAA Academy in Oklahoma City.

CSSI, Inc. partners with clients to deliver solutions to complex, high-consequence challenges, pioneer innovative analytics and best practices, and enhance productivity and safety through superior engineering and technical solutions. These solutions support the FAA, U.S. Navy, NASA, and other partners in the commercial sector.

Crew Training International has developed advanced training solutions for government and commercial agencies to achieve the mission of optimizing performance through cutting-edge learning solutions. CTI's training professionals have developed programs and courseware solutions for the NASA, NATO, U.S. Air Force, and others.

Eduworks Corporation creates solutions using artificial intelligence and text mining to improve processes, increase speed and accuracy, and decrease overall cost. The firm also creates performance multipliers to advance training analyses and technologies, simulator training effectiveness, individual and team performance assessment, and the work-practice and activity-based simulation of socio-technical systems for the Air Traffic Organization.

Florida NextGen Test Bed, governed by the FAA and used by NextGen stakeholders within industry, academia, and government, provides an integrated NAS based platform for NextGen by leveraging NAS systems augmented by prototype functionality. The Test Bed can be used to evaluate concepts, operational research, capabilities, and technologies prior to these being funded, implemented, or fielded at a NAS facility. It provides an open platform to help evaluate and examine the feasibility of new technologies.

FRASCA International, Inc. focuses on designing and building the most accurate and reliable Flight Simulators. FRASCA's training devices meet the stringent requirements of both their customers and the leading regulatory agencies around the world, such as FTD's and FFS's utilizing the latest in avionics, visual systems, motion systems, control loading, and aircraft systems.

General Dynamics IT provides information technology, systems engineering, professional services and simulation and training to customers in the defense, federal civilian government, health, homeland security, intelligence, state and local government, and commercial sectors.

Heartwood 3D assists the operations and maintenance workforce learn complex procedures by allowing them to practice on equipment virtually. The company's 3D interactive applications enable users to learn on Web, PC, Mobile, AR, and/or VR applications.

Hucon Global offers risk-sensitive operation tools, skill assessments, and software development services to corporate and public-sector clients. The company is focused on increasing safety by reducing incident and accident rates.

Infina, Ltd. delivers impactful training products via state-of-the-art audiovisual material, progressive graphic art and eye-catching print material. Infina supports the FAA on all recurrent technical training and several other programs for air traffic controllers and technicians.

Instructure, Inc. and Canvas Network creates software and learning management systems with open, adaptable, reliable, native cloud technologies that empower learning in every context. In addition, the company offers assessment management systems tailored to individual student and participant needs.

JMA Solutions offers cutting-edge products and services that provide safe and efficient air travel on a global scale such as requirements development, systems engineering, human factors research and development, operational improvements, proof-of-concept demonstrations, training development and delivery, and safety risk management. The company's air traffic management expertise extends to System Wide Information Management, Decision Support Systems, Terminal and En Route environments, Unmanned Aircraft Systems, Safety Management, and Technical Training.

Key Bridge Technologies specializes in all aspects of instructional delivery, web-based courseware development, and information technology-based training support with a long history of supporting the FAA in various aviation-related endeavors. FAA Academy support includes course development, revision services of course material, integrating current operational and technical lessons, leading-edge technologies, and courseware development.

Leidos, includes formerly Lockheed Martin Aviation Division, is a trusted systems integrator serving Air Navigation Service Providers including the Federal Aviation Administration, the Transportation Security Administration, and airport operators. The organization's work in airport modernization helps stakeholders achieve stated objectives including increased operational efficiency and safety, a technology enhanced passenger experience, nonaeronautical revenue enablement, and state-of-the-art situational awareness and security.

Metacraft, the creator of SimSuite, is a comprehensive air traffic control training and simulation platform with components for ground, tower, terminal, and en route training. Customers can select a software-only package suitable for installation on commercial off-the-shelf hardware, or a high-fidelity system comprised of highly-realistic consoles and system hardware.

Northrup Grumman Technology Services provides innovative system, products, and solutions for unmanned systems, cyber, C4ISR, and logistics and modernization to customers around the world. Technology Services' three divisions focus on creating innovative, cost-effective solutions for defense, civil, and aviation customers.

Pilot Training System is a virtual training center where pilots have access to training modules, videos, and tutorials; discussion forums; an advanced weather simulation technology called ClimaDrive, which produces pre-flight and in-flight weather reports; flight planning technology; and other technology for the modern pilot and aviation student.

Raydon provides world class virtual reality-based training solutions with an extensive range of trainers including embedded trainers, tabletops trainers, appended trainers, and institutional trainers. The organization's innovative approach to virtual training design has yielded several defense market training firsts including the world's first Convoy Operations Trainer, Route Clearance Trainer, Mounted Machine Gun Trainers, and most recently Stryker Trainers.

Robinson Aviation, Inc is an aviation services company that specializes in air traffic control operations; communications engineering, installation, and maintenance; navigation and landing system engineering, installation, and maintenance; aviation safety and CNS/ATM studies; and transportation security studies and planning. RVA operates 97 air traffic control towers under the FCT program and employs 550 controllers, engineers, and technicians.

RTSync is a developer of advanced modeling and simulation (M&S) software environments, specializing in Discrete-Event Systems Specification technology; Ballistic Missile Defense System (BMDS) model architectures; and designing and developing M&S solutions and expertise and consultation for commercial, research and development, and governmental agencies.

SkySoft ATM designs innovative and customized ATM systems and mobile training solutions that depict real-life conditions and scenarios. The organization offers products such as ATC HTMI, ATC data processing engines, radar data recording solutions, ATC trainer, and radar training.

Skymantics provides aviation IT advisory services, specializing in large scale enterprise networks, information exchange methodologies, and wireless data link technologies.

Tetra Tech is a leading provider of consulting and engineering services specializing in infrastructure, aerospace, training, procedure development, information technology, safety management, and environmental management support. The organization offers navigation, airspace, and instrument procedure design support for the FAA with special emphasis on development activities supporting both air traffic and flight operations within some of the most complex airspace in the United States.

Textron Systems delivers command and control services across manned and unmanned systems, creating an unparalleled operational picture for decision makers, analysts, and dismounted teams. The organization also provides a comprehensive range of capabilities from high-powered exploitation and mapping for geospatial analysts to image analysis tools for tactical users.

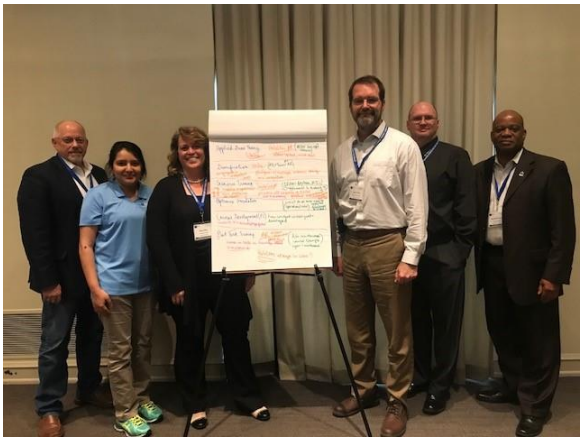
TransLumen Technologies provides advanced observational training and are pioneers in visualization technologies and mobile app development. The company has differentiated itself in the field through proprietary and patented algorithms to advance dashboard aggregation and navigation toward more actionable graphical user interfaces.

UFA, Inc. is a leading, privately-held software engineering firm providing Air Traffic Control Tower and Radar simulation technologies and services to civil aviation, military, and universities worldwide. UFA also provides voice technologies including voice recognition and response and voice communication simulation.

Veracity Engineering specializes in NextGen, systems engineering, ATC communications, aviation laboratories, airport surface surveillance, software engineering, program management, business case analysis, asset management, and safety management systems. The company is the prime contractor for several FAA initiatives such as Systems Engineering 2025 and Enterprise Programs, Infrastructure, and Communications Services.

Volpe Center partners with public and private organizations to assess the needs of the transportation community, evaluate research and development endeavors, assist in the deployment of state-of-the-art transportation technologies, and inform decision- and policymaking through comprehensive analyses.

Washington Consulting Group is a professional services firm offering a wide variety of technical training and consulting services of benefit to the worldwide air traffic system management and air traffic controller training. The organization offers services such as airport and airfield operations support, ATM security and crisis response, and airspace modeling and is a recognized ICAO distributive training center.



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