Weather Technology in the Cockpit Program (WTIC) BSI Number: A12.c

REDAC / NAS Ops

Review of FY 2021 Proposed Portfolio

March 26, 2019

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WTIC Program
Budget line – A12.c

What are the benefits to the FAA

- Enhanced safety by resolving/reducing adverse-weather safety risks before they result in an accident/incident

- Enhanced NAS efficiency and increased capacity resulting from consistent and predictable pilot adverse weather decision making due to established cockpit minimum weather service(s)
  - Reduced emissions due to enhanced efficiency
  - Reduction in flight delays
  - Enhanced flight routing in and around adverse weather

- Enhanced safety resulting from the resolution of pilot MET-training shortfalls

WTIC Program
Budget line – A12.c

What determines program success

- Number of standards released incorporating WTIC MinWxSvc recommendations
- Number of transitions of WTIC MinWxSvc recommendations into commercial products or operations
- Number of transitions of WTIC training materials to use in courses, textbooks, guidance, Wings Credit Courses, FAA pilot exam questions, and commercial training products
- Number of MinWxSvc recommendations incorporated by pilots and other stakeholders into practice, guidance, or endorsements by representative groups such as Aircraft Owners and Pilots Assoc (AOPA), Air Line Pilots Association (ALPA), and National Assoc of Flight Instructors (NAFI)

WTIC Program / BLI Number: A12.c Overview Capabilities - Stakeholders

Government

- FAA
  - Flight Standards Service
    - Test questions AFS-630
    - NEXRAD Online Course AFS-850
    - ASRS report AFS-430
  - Aircraft Certification
  - Small Aircraft Directorate
  - Office of Aviation Safety
  - Human Factors Research & Engineering
  - William J. Hughes Technical Center(WJHTC)
  - Civil Aerospace Medical Institute (CAMI)
- NASA - Ames
- NTSB
- NCAR

International

- Eurocontrol, EASA

Airlines

- Delta
- United
- American

Academia

- Embry-Riddle Aeronautical University
- Florida Institute of Technology
- Georgia Institute of Technology
- Iowa State University
- Purdue University
- Texas A&M University
- The Ohio State University
- University of Oklahoma
- Western Michigan University
- Virginia Tech

Professional Societies

- AOPA
- GAMA
- RTCA
- ALPA
- Others (via GAJSC)
- Royal Aeronautical Society
- NAFI

Industry

- Lockheed Martin (via PEGASAS)
- Frasca (via PEGASAS)
- Mindstar Aviation (via PEGASAS)
- Fly8Ma (vis PEGASAS)
- WebManuals (via PEGASAS)
- Foreflight (via AOPA)

WTIC Accomplishments in FY19

Remote Oceanic Meteorological Information Operational (ROMIO): Benefits analysis on schedule for initial report in July 2019, and final report March 2020. Demo period extended to incorporate GOES West and plan to add Himawari-8 and Meteosat images for global oceanic coverage for more complete benefits assessment.

- Collected FlightAware flight data from 70 origin-destination (OD) pairs by participating airlines
- Performed statistical comparisons between surveyed flights and similar flights flying the same OD pairs and under similar weather patterns
- Developed computer code to estimate flight metrics associated with weather events and deviations

Nulling NEXRAD Latency: Method completed May 2018. Developing assessment plan, but effort paused to get inputs from Time to Contact project. MinWxSvc recommendations output to be based on results of final pilot assessment.

WTIC Accomplishments in FY19

VFR Not Recommended Study: Completed final report on VNR and submitted for publication. Developing next phase of research to develop thresholds and processes to make VNR issuance more consistent and objective, and compatible with automation. Next phase planned to be done as cognitive walk-through.

Pilot Reports (PIREP) Modernization: Completed analysis of "screens study" and found pilots selected 5 of 6 options as potentially increasing rate and accuracy of PIREP submittals. Completed comparison of PIREP dissemination flow charts to identify causes for reports not being disseminated. PEGASAS preparing a proposal for next phase to prototype and evaluate selected improvements from "screens study."

Time to Contact HITL: Developed draft plan for conduct of demonstration of providing a time indicator for encroachment on 20 miles of separation from severe convective activity.

WTIC Accomplishments in FY19

Augmented Reality: PEGASAS (Western Michigan University) signed a contract to write a book on aviation weather using augmented reality and a second contract to provide an augmented reality chapter for a book called Next Generation of Aviation Professionals and will include WeatherXplore examples and other WTIC references

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Book Publishing and Distribution Agreement

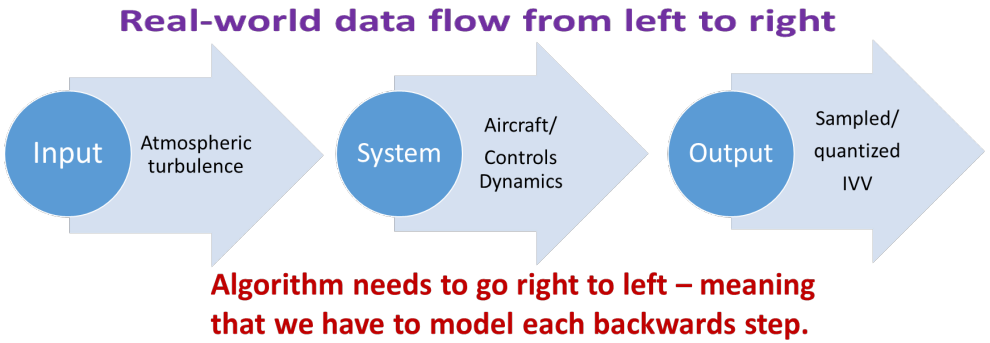
This Agreement for the publication and distribution of book(s) and related digital media, in connection with the publication titled *Aviation Weather with Augmented Reality*, is made as of the 31 st. day of January, 2019, by and between eAcademicBooks LLC ("eAcademicBooks")

The Contributor is writing a chapter or case entitled TITLE HERE of WORD COUNT words, including all references, figures and illustrations (the 'Contribution') for *Engaging the Next Generation of Aviation Professionals* (the 'Work') edited by Suzanne Kearns, Timothy Mavin and Steven Hodge ('the Editors').

WTIC Accomplishments in FY19

ADS-B Turbulence Study: Completed kickoff meeting and received research plan. Concurrence on approach, research questions, and objectives. Study to assess feasibility, potential applications, and a comparison of producing aircraft-dependent and aircraft-independent (EDR) turbulence information using ADS-B data.

- Trade study to compare potential applications and utility versus head-to-head comparison due to varying information from the two methods



WTIC Accomplishments in FY19

Wind Study: Completed assessment of wind lexicon used for winds

- Different terms sometimes used for same wind information (e.g. "Gridded Winds", "Model Winds")
- Identical terms used for different wind data in different application contexts (e.g. "Winds Aloft")
- "Slang terms" such as "ATC Winds" and "FAA Winds"

Term	Communicator	Lexicon Source	User Definition
FB Winds, FD Winds	NOAA	NOAA Newsletter, "The Front", Vol 4, Number 3, Nov. 2005	"the 'official' forecast of upper level winds and temperatures in the FAA view."
FB	Flight instructor	Prevost, S.E., "Understanding the Winds and Temperatures Aloft Forecast Product (FB)", 8/12/2007	"Planning for a cross-country flight includes an examination of the winds aloft"
Forecast Winds and Temperatures Aloft	Website	AvnWx.com	"Forecast Winds and Temperatures Aloft is a forecast of wind direction and speeds and of temperatures at different altitudes for specific locations"
Winds Aloft	AOC, Pilot, Pilot Instructor	Airline SOC, pilot interviews, pilot instructor	"It means, wind at an altitude over the ground. As a pilot, my concern before flying is not only the wind at the surface but also the wind aloft"
Winds Aloft	Website	N90 Strategic Planning Aid (SPA) tool	Vertical wind profiles through RAP model winds.
Winds Aloft	ATC	ITWS Terminal Wind Profiles	
Winds Aloft Forecast	NOAA	Product Description Document - Winds Aloft Forecast, NOAA, January 2016	"The National Centers for Environmental Prediction (NCEP) produces scheduled wind and temperature aloft forecasts four (4) times daily for specified locations in the Continental United States (CONUS), the Hawaiian Islands, Alaska and coastal waters, and the Pacific Ocean."
Winds and Temperatures Aloft Forecast	Website	Wikipedia entry for "Winds Aloft"	"Winds aloft, officially known as the winds and temperatures aloft forecast, (known as "FD" in the US and Canada, but becoming known as "FB", following the World Meteorological Organization [WMO] nomenclature), is a forecast of specific atmospheric conditions in terms of wind and temperature at certain altitudes, typically measured in feet (ft) above mean sea level (MSL)"
Wind and Temperature Aloft Forecast	NOAA AWC	NOAA AWC Advisory Circular 00-45G Change 1, Oct. 2014, NWS Instruction 10-812, Oct. 25, 2016	"Wind and Temperature Aloft Forecasts (FB) are computer prepared forecasts of wind direction, wind speed, and temperature at specified

WTIC Accomplishments in FY19

RTCA SC-206 Support

- Current Term of Reference two documents in works; Two modifications to DO-358 the Minimum Operational Performance Standards (MOPS) for flight Information Services Broadcast (FIS-B) data using Universal Access Transceiver (UAT) and Minimum Aviation System Performance Standards (MASPS) for Aeronautical Information / Meteorological Data Link Services
  - Modify DO-358 to DO-358A
    - Add six new FIS-B Products: Lightning, Turbulence, Icing, Cloud Tops, Center Weather Advisory, Graphical Airmen's Meteorology Advisory, and correct errors or deficiencies.
    - DO-358A deliver date: March 2019
  - Modify DO-358A to DO-358B
    - Add two new FIS-B Products: Temporary Restricted Area, Temporary Military Operating Area, and correct errors or deficiencies
    - DO-358B deliver date: March 2020
  - Update DO-364 to DO-364A
    - Expand minimum system requirements and recommendations to cover additional AIS and MET data link services as identified by SC-206, EUROCAE WG-76, and industry
    - No changes, except error corrections, will be made to the Near Real-Time Aircraft-Based Meteorological Observation Services System already defined in DO-364
    - Expand minimum system requirements and recommendations to include those for AIS and MET input information
      - Identify parameters for AIS and MET input information and their associated characteristics (e.g. latency, accuracy, resolution) that support the newly defined services
      - Identify AIS and MET input requirements for portable or installed avionics
    - Coordinate with the Collaborative Decision Making (CDM) Steering Group to document minimum information content requirements for cockpit participation in specific CDM initiatives
    - DO-364A deliver date: December 2020

Anticipated Research in FY19 & FY20

- Next phases of research on:
  - Making VNR more objective
  - Augmented reality applications for training
  - Resolving previously identified human factors gaps in cockpit renderings
  - Perform helicopter gap analyses and develop resolutions to selected gaps
  - Perform operational demonstration of crowd sourced visibility information using the hybrid system
  - Continue research using crowd sourcing for ceiling and wind information
  - PIREP enhancements
  - Follow-on to ADS-B turbulence study based on trade study results

Anticipated Research in FY19 & FY20

Anticipated New Starts (Pending approvals):

- 3-D display for icing via uplink of MRMS to Part 135 and potentially Part 91 aircraft
  - Feasibility study to determine if MRMS supports 3-D rendering
  - Modify EDR turbulence viewer to show icing
  - Evaluate pilot decision making and utility of 3-D rendering
- Industry perspective on WTIC MinWxSvc recommendations relative to new NextGen operations
  - ALPA interested in supporting study
- Feasibility of cockpit MET information to relax precipitous terrain restrictions

Emerging FY21 Focal Areas

New Areas in FY21 (Anticipate follow-on phases of FY19 and FY20 research

- Weather training for new entrant pilots (ie, UAV)
- Gap resolution of special operation GA (non-helicopter)
- Identification of MinWxSvc gaps/updates to support new entrants (supersonic, UAV, UAM, etc) and identification of requirements for remote sensors to meet cockpit information needs
- Criteria to assess autonomous vehicle adverse weather decision making to equivalent or better level of safety as piloted aircraft.
  - Assess need to replicate out-the-window to achieve equivalent level of safety
- MinWxSvc gaps resulting from reduced separation flight in the NAS

WTIC Part 121 & 135 MinWxSvc

Research Requirement

- Develop Part 121/135 MinWxSvc recommendations for cockpit weather information and technology.
- Sponsored by ANG-C6, ALPA, AFS, industry, airlines, NextGen
- POC: Gary Pokodner, ANG-C61, 202-267-2786

Outputs/Outcomes

- Identification of gaps in Part121 MinWxSvc recommendations to support new entrants such as supersonic flight.
- Demonstration results of aircraft downlinking forward looking radar photos, other cockpit instruments as selected, to build radar composites in remote areas such as Alaska
- Evaluation report of prototype 3D viewer demo and development of technical transfer package.
- RTCA standards as applicable
- Research plan to resolve selected gaps from the Industry Perspective study.

FY 2021 Planned Research

- Gap analyst to identify gaps in Part 121 MinWxSvc recommendations to support supersonic flight and other Part 121 new entrants.
- Crowd sourcing forward looking radar (photo PIREPs)
- Phase 3 of developing 3-D cockpit viewer of icing using MRMS
- RTCA SC-206 technical support
- Phase 1 research to resolve gaps identified in Industry Perspective research

Out Year Funding Requirements

FY18	FY19	FY20	FY21	FY22
$ M	$ M	-	-	-

WTIC Part 91MinWxSvc

Research Requirement

- Develop Part 91 MinWxSvc recommendations for cockpit weather information and technology.
- Sponsored by ANG-C6, AOPA, AFS, industry, NAFI, Alaska and other remote areas
- POC: Gary Pokodner, ANG-C61, 202-267-2786

Outputs/Outcomes

- PIREP enhancement MInWxSvc recommendations
- MinWxSvc recommendations to enhance initial capabilities of automated VNR (reduce scenarios requiring calls to Flight Service Stations)
- Identification of gaps in MinWxSvc recommendations to support new Part 91 entrants adverse Wx decision making and associated recommendations for sensor performance to fill information gaps.
- Preliminary development of some criteria to assess autonomous (ie, air mobility) vehicle adverse weather avoidance decision making

FY 2021 Planned Research

- Complete assessments of recommendations for PIREP improvements
- Research VNR thresholds for complex scenarios to update version 1 automation capabilities
- Gap analyses of MinWxSvc recommendations for new entrants in Part 91 and develop recommendations for sensor performance to fill identified gaps.
- Develop criteria to assess autonomous (ie, air mobility) vehicle adverse weather avoidance decision making

Out Year Funding Requirements

FY18	FY19	FY20	FY21	FY22
$ M	$ M	-	-	-

WTIC Training

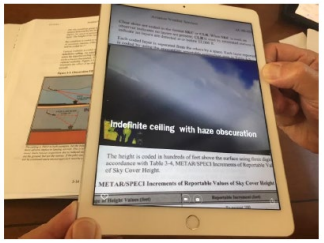
Research Requirement

- Develop enhanced pilot weather training including online courseware, instructor led training materials, augmented reality training materials, enhanced WeatherXplore capabilities, experiential training modules, and 3-D augmented reality for training on cockpit weather enhancements, new cockpit weather technology, and new entrant pilots.
- Sponsored by ANG-C6, NextGen, FAAST team, NAFI, ALPA, AOPA
- POC: Gary Pokodner, ANG-C61, 202-267-2786

Outputs/Outcomes

- Online training courseware to support new entrant pilots on Wx
- Augmented reality training materials that include 3-D (textbooks, guidance)
- Technical transfer package so industry can easily incorporate augmented reality into manuals and training
- Updates to WeatherXplore application based on feedback, new entrants, and cockpit Wx advancements.

Look for the WeatherXplore logo. Scan images with the demo app with your phone or tablet to see augmented reality made easy.



FY 2021 Planned Research

- Identify pilot Wx training for new entrant aircraft including UAVs.
- Update pilot training to resolve gaps based on new NextGen operations and evolving cockpit Wx information and technology.
- Continue expanding the uses of augmented reality and experiential learning.

Out Year Funding Requirements

FY18	FY19	FY20	FY21	FY22
$ M	$ M	-	-	-