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Journal of Aviation/Aerospace Education & Research

Volume 15
Number 3 *JAAER Spring 2006*

Article 6

Spring 2006

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Mark Sherman

Deak Arch

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Scholarly Commons Citation

Sherman, M., & Arch, D. (2006). Transitioning to Glass Cockpit Primary Training Fleets: Implications. *Journal of Aviation/Aerospace Education & Research, 15*(3). Retrieved from https://commons.erau.edu/jaaer/vol15/iss3/6

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FORUM

TRANSITIONING TO GLASS COCKPIT PRIMARY TRAINING FLEETS: IMPLICATIONS

Mark Sherman and Deak Arch

In late July, 2004, Ohio University had the unique opportunity to become a front-runner in one of the most significant revolutions in Technically Advanced Aircraft (TAA) training by purchasing seven new Piper Warrior III aircraft equipped with Avidyne Entegra Integrated Flight Decks, a highly advanced avionics system. This technology combines computerized flight decks with multi-function displays, moving maps, and integrated flight instruments in basic trainers.

Prior to integration of the new aircraft, initial questions arose addressing concerns about student pilot flight training conducted in Technically Advanced Aircraft, instructors whom have little experience teaching Technically Advanced Aircraft, integrating new aircraft platforms into FAR 141 Training Course Outline (TCO) requirements, and use of these aircraft while fulfilling Practical Test Standards (PTS) requirements.

In late July, 2004, Ohio University decided to trade off the majority of its training fleet and replace these aircraft with new Technically Advanced Aircraft (TAA) available on the retail market. The newly obtained aircraft would replace aircraft reaching an age upwards to fifteen years with new TAA type aircraft. The few aircraft not replaced were planned to either be used for complex, high performance, or spin training.

REVIEW OF LITERATURE

A review of literature on primary training fleets using glass technology produced minimal results. In the fall of 2002, Middle Tennessee State University purchased twenty-five aircraft from Diamond Aircraft and The New Piper Aircraft Incorporated for 4.8 million dollars. These aircraft were all equipped with Avidyne FlightMax Entegra cockpits (Weiler, 2003). Dowling College located on Long Island, New York ordered two Warrior III equipped with Avidyne FlightMax Entegra Systems. The first aircraft arrived November 9, 2004 (Dowling College, 2004). Oklahoma University has ordered 13 Warrior III aircraft scheduled to be delivered first quarter 2005. Two will be equipped with Avidyne FlightMax Entegra Systems (New Piper, 2004).

TRAINING FLEETS

Prior to ordering the new Piper Warrior III aircraft, the training fleet consisted of; two Cessna C-152's, one Cessna C-172N, one Cessna C-172P, one Cessna C-172S, six Cessna C-172 R models, one Beechcraft F-33 Bonanza, one Beechcraft B-55 Baron, one Frasca 131 Flight Training Device (FTD), and one Frasca 142 FTD. All training aircraft used "round dial" analog instrumentation.

The first Warrior arrived March 3, 2005, with two more aircraft delivered on March 23rd. Subsequent deliveries are planned for late spring 2005 with a fleet dedication ceremony and media event to be held on April 30, 2005. Currently the temporary training fleet consists of two C-152's, one C-172P, one C-172N, one Piper Warrior I (leased from the Athens Flying Club), three Piper Warrior III models, two Piper Archers, one Beechcraft F-33 Bonanza, one Beechcraft B-55 Baron, one Frasca 131 FTD, and one Frasca 142 FTD. After all new training aircraft arrive, the fleet will consist of seven normally aspirated Piper Warrior III aircraft equipped with the Avidyne Entegra FlightMax Flight Deck systems fully integrated with dual Garmin 430's. Both Garmin 430's will be IFR certified and provide GPS database, radios, and a navigation "brain" driving the Entegra PFD (primary flight display) and MFD (multi function display). The remainder of the fleet will consist of two analog Cessna 152's, one analog Cessna 172N, one Piper Archer, one Beechcraft F-33 Bonanza, one Beechcraft B-55 Baron, one Frasca 131 FTD, and one Frasca 142 FTD.

Published by Scholarly Commons, 2006

The decision to replace the majority of the training fleet aircraft from conventional analog instrumentation to technically advanced glass cockpit configurations could be best stated by Jack Bantle, Vice President for Research, Dennis Irwin, Dean College of Engineering, and Juan Merkt, Department of Aviation Chair.

Other universities that have been using Piper aircraft for more than 15 years report no design or maintenance problems with these aircraft. Further, the AOPA Air Safety Foundation gives this type of aircraft an excellent safety rating. (Bantle, Ohio University, 2004)

These aircraft offer our students the opportunity to train with the latest technology and to become proficient with the same systems they will use during their careers, making them extremely valuable as training aircraft because this is the technology of the future, it makes sense, from both a teaching and economical standpoint, to acquire aircraft with this advanced avionics system. (Irwin, Ohio University, 2004)

This purchase makes Ohio University a front-runner in one of the most significant revolutions in aviation training. For the first time, computerized flight decks with multi-function displays, moving maps and integrated flight instruments is available in basic trainers. We will be among the first universities to provide all basic flight training in airplanes equipped with this state-of-the-art technology. (Merkt, Ohio University, 2004)

PIPER WARRIOR III COSTS

The Piper Warriors cost approximately $206,000 each, totaling $1,420,000 for the seven aircraft purchased. The university is receiving $420,000 for the old aircraft, with $110,000 satisfying old debt. The purchase will be funded by a loan -- first as a short-term internal loan from the university, then as a permanent 15-year loan. Student course fees for flight training must increase by 6-8 percent beginning Spring Quarter 2005. (Ohio University, 2004)

All instrumentation, with exception of the backup airspeed and altimeter, are electrically driven. The backup attitude indicator has a standby battery rated for forty-five minutes of reserve power. To alleviate some of these concerns, Ohio University investigated options to supplement the existing Piper Warrior electrical system.

The accepted solution to the electrical system problem was solved using an FAA Supplemental Type Certificate (STC). B&C Specialty Products Incorporated of Newton, Kansas, have secured an FAA STC/PMA (Parts Manufacture Approval) approval for installation of the BC 410 standby alternator and BC203-2D (28 volts) or BC 317-1A (14 volts) regulator on Piper models; Cherokee Six, Lance and Saratoga. Cost per aircraft includes $2,200 for alternator and regulator with the STC, $385 for instillation kit for a total of $2,585 and $500 maintenance labor costs ($50/hour at ten hours each airframe). Total cost to equip the seven Piper Warrior aircraft with a supplemental electrical backup system is $21,595. This STC/PMA has not been approved for Piper Warrior III aircraft and will require future field approval.

INITIAL GLASS TRAINING OF FLIGHT INSTRUCTORS

Currently all faculty and staff flight instructors (salaried baccalaureate holding individuals) will receive initial transition training in the Avidyne/Garmin systems. After initial training, course evaluation will occur determining what modifications are needed before training remaining flight instructors. Once the staff has been trained, hourly paid flight instructor (23 students working toward a baccalaureate) training will commence. The future goal is to conduct student training using Piper aircraft during the Spring 2005 Quarter.

The current training regiment consists of a two-hour PowerPoint presentation on the overview of the glass-cockpit system, two hours in the aircraft focusing on the Avidyne Primary Flight Display, the Avidyne Multi Function Display, and the Garmin GNS 430 Global Positioning System. After appropriate ground training has been accomplished, a one and a half hour familiarization flight will be conducted. Additional supplemental information will be provided to each participant to include; the Garmin GNS 530/430 sample training syllabus and flight lessons for use by flight schools and flying clubs, the GNS 430 quick reference guide, the GNS 430/430A pilot's guide and reference manual, the FlightMax EX500 Multi-Function Display Pilot's Guide, and the FlightMax Entegra Primary Flight Display Pilot's Guide. If desired, pilots being trained may also elect to watch the Garmin GNS 430 & 530 video, download the Garmin 430 personal computer simulator, or Avidyne FlightMax EX500 personal computer simulator. Both simulators can be obtained from the manufacturer's websites.

Standardization concerns were already raised concerning displayed information and configuration of the Garmin 430 GNS system GPS pages during student training activities. Initially, faculty and staff were concerned with information being presented on Avidyne displays as well as information being presented on Garmin displays. Presented information is customizable from user to user and may be different after each flight taking each instructor several minutes to configure displays to individual instructor's

liking. This area is identified as an area needing to be studied further until a solution is found.

Student training will be started in the Spring. 2005. Quarter where only new instrument students will be placed in technologically advanced aircraft. Other students using the aircraft, such as the private pilot candidates, will start training in Piper aircraft in Fall of 2005. Since these students are trained under a FAR 141 Training Curriculum Outline (TCO), all ground and flight training courses will need to be restructured with guidance from the Columbus, Ohio, Flight Standards District Office (FSDO) in designing FAR 141 courses that fulfill training requirements in Technically Advanced Aircraft. After students are instrument rated, they will revert to a standard analog configured aircraft for advanced cross country flight portion of training.

PRACTICAL TEST STANDARDS

In order for a student to become certificated, the student must meet the Practical Test Standards (PTS) for each certificate and/or rating sought. PTS requirements were originally written for analog aircraft cockpits, not technically advanced instrumentation displays. The latest edition of the instrument PTS (FAA-S-8081-4D), dated April, 2004, identifies precisely how student will be tested during partial panel segment of the instrument practical examination. Referencing the instrument PTS under the heading of *Aircraft and Equipment Required for the Practical Test*, the FAA states

> Modern technology has introduced into aviation a new method of displaying flight instruments, such as Electronic Flight Instrument Systems, Integrated Flight Deck displays, and others. For the purpose of the practical test standards, any flight instrument display that utilizes LCD or picture tube like displays will be referred to as "Electronic Flight Instrument Display". Aircraft equipped with this technology may or may not have separate backup flight instruments installed. Abnormal or emergency procedure for loss of electronic flight instrument display appropriate to the aircraft will be evaluated in the *Loss of Primary Instruments* TASK. The loss of the primary electronic flight instrument display must be tailored to failures that would normally be encountered in the aircraft. If the aircraft is capable, total failure of the electronic flight instrument display, or a supporting component, with access only to the standby flight instruments or backup display shall be evaluated. (Federal Aviation Administration, 2003, P. 7)

Several concerns were originally raised regarding fulfillment of these standards. One valid concern regards use of Garmin GNS 430 systems, which supplies navigation frequencies for the backup navigation instrumentation (i.e. standby OBS). It would be impractical for a Designated Pilot Examiner (DPE) to fail this system. If the DPE allows applicants to use the GNS system, students could possibly use the system to gain situational awareness advantage, normally not permissible. After referring to Designee Update Special Edition: Examiner, Designee, And Instructor Community, dated July 17, 2003, it is clear the DPE must conduct partial panel testing using standby navigation and standby flight instrumentation. While conducting partial panel testing, the examiner is required to test an applicant on a non-precision approach procedure. This circular infers the applicant will still be able to use the Garmin GNS 430 system during the partial panel segment of the instrument practical examination. However, it remains unclear which approaches will be allowed during this phase of flight. If the student has to be tested on the standby navigation equipment (i.e. standby OBS), then a non-precision GPS approach may not be allowed. This area of testing has not been clarified by local DPE examiners. Each DPE will need to check with the local FSDO to inquire how such testing should be conducted.

SUPPLEMENTAL STUDENT PILOT LEARNING

To supplement student learning in the Piper Warrior aircraft, Ohio University is considering different training aids. Students have access to the Garmin 430 simulator available from Garmin's Website, *GNS 430 & 530 Integrated Navigation* video, and *Flying The Avidyne FlightMax Entegra* DVD. Another idea to assist student training is to refurbish current training aids with new technically advanced software and/or hardware. Ohio University supplements flight training with two Frasca Flight Training Devices (FTD). Future plans include installing a Garmin GNS 430 in the Frasca 142 FTD.

Ohio University also has three personal computer-based aviation training devices (PCATDs) from Precision Flight Controls with both Microsoft Flight Simulator 2004, A Century of Flight, and ELITE software installed. While ELITE software does not have technically advanced cockpit representations, Microsoft Flight Simulator 2004 does have a few aircraft that have Electronic Flight Instrumentation System (EFIS) displays. The Beechcraft King Air 350 has combination analog and EFIS displays. Boeing 737, 747, and 777 are all EFIS based aircraft, as well as the Lear 45, however, these aircraft are EFIS based and do not readily mirror Avidine PFD and MFD systems. Utilizing aircraft

represented in PCATD's may be limited due to transfer of learning concerns.

Ohio University has also contacted hardware/software vendors to inquire about software that could be used to demonstrate the Avidyne Entegra/Garmin GNS 430 systems. Unfortunately, glass-cockpit simulation hardware/software are not yet widely available although a few vendors, such as Aerosim, will have these systems available in the near future.

The weakest area for Ohio University is availability of supplemental simulation of the Avidyne/Garmin GNS 430 system for students. It is hoped these limitations will be short lived as technically advanced training aircraft become more mainstream and software to represent these cockpits become more available as well.

ADVANTAGES

It should be noted the original reason that Piper Technically Advanced Aircraft was selected was to benefit students. Several concerns were raised with the future of aviation and what would best benefit today's student as well as future students. It was apparent to Ohio University that analog cockpits are slowly becoming obsolete. Most commuter entry jobs of the last ten years have transitioned from flying Saab and Jetstream type aircraft to Bombardier/Emberair Canadian Regional Jet (CRJ) type aircraft. The entry type aircraft of today and of the future will be designed using Cathode Ray Tube (CRT) type displays in the cockpit. It only made sense for Ohio University to purchase aircraft that would support its student and their chosen career field.

The other advantage is that it allows Ohio University to be on the front line of conducting advanced research to properly train initial student pilots through flight training completion using technically advanced cockpits to represent navigation, communication, engine instrumentation, and flight instrumentation. This will help Ohio University create and maintain research relationships with other university institutions.

REMAINING QUESTIONS

Many questions remain unanswered. Will initial primary glass trained student transition to round dial analog instruments be a smooth one? Will the student pilots become overly reliant upon moving map displays and loose basic pilotage skills? How will basic skills be taught in new aircraft? Will training times increase because students must ultimately learn two different aircraft environments? How will scanning techniques vary from aircraft to aircraft? What about the use of digitally represented instrumentation? Will different representations of instrumentation lead to a conductive learning experience? Several research studies will need to be conducted in order to come to a viable conclusion. ✈

Mark Sherman is an assistant professor and interim department chair at Central Missouri State University. He is a Doctoral Candidate from Oklahoma State University, and holds an Education specialist degree, Masters in Arts in History, Masters of Science in Aviation Safety, and a Bachelors of Science in Aviation Technology. He holds a CFI (Airplane Single Engine & Instrument Airplane), Ground Instructor (Advanced and Instrument), Commercial Pilot (Airplane Single Engine Land, Instrument Airplane, & Glider), A&P, and FCC license with radar endorsement. Teaching areas includes Airframe and Powerplant, Aviation History, Aircraft Systems & Components, Transport Aircraft Systems, Sport Aviation. His research and teaching interest are in the area of aviation history with an emphasis on Great War Aviation.

Deak Arch is an assistant professor in the Department of Aviation at Ohio University. Deak received his Master in Commercial Aviation degree in 2001. He currently holds his airline transport certificate with a Cessna Citation 500 type rating. He holds a gold seal flight instructor certificate and is qualified to instruct in both single and multiengine aircraft. He is also a certified airframe and powerplant mechanic. Deak is currently establishing himself within the aviation community through his focused research on technology and its impact within the aviation field.

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LIST OF ACRONYMS AND ABBREVIATIONS

CRJ	Canadian Regional Jet
CRT	Cathode Ray Tube
DPE	Designated Pilot Examiner
EFIS	Electronic Flight Instrumentation System
FAA	Federal Aviation Administration
FSDO	Flight Standards District Office
FTD	Flight Training Device
GNS	Global Navigation System
GPS	Global Positioning System
IFR	Instrument Flight Rules
LCD	Liquid Crystal Display
MFD	Multi Function Display
OBS	Omni Bearing Selector
PCATD	Personal Computer Aviation Training Device
PFD	Primary Flight Display
PMA	Parts Manufacture approval
PTS	Practical Test Standard
STC	Supplemental Type Certificate
TAA	Technically Advanced Aircraft
TCO	Training Course Outline