F-16 Limited-Field-of-View Simulator Training Effectiveness Evaluation

Executive Summary

JULY 1987

Written by: Linda Wiekhorst, Captain, USAF
Chief, Training Research Branch
Directorate of Training, Tactical Air Command

Reviewed by: Cecil O. Davenport, Colonel, USAF
Director of Training
Tactical Air Command

Approved by: MARCUS A. ANDERSON, Major General, USAF
Deputy Chief of Staff, Operations
Tactical Air Command

This report has been cleared for unlimited distribution.

F-16 LIMITED FIELD OF VIEW TRAINING EFFECTIVENESS EVALUATION

INTRODUCTION

Singer-Link Flight Simulation Division submitted an unsolicited proposal to TAC for the loan of a limited Field of View (LFOV) visual system, at no cost, for six months. Singer offered to install and maintain the visual system on the F-16C Operational Flight Trainer (OFT) at Luke AFB, AZ. The purpose of this loan was to demonstrate that a visual system is useful in the training environment. This would provide TAC an opportunity to determine if a limited FOV system can support RTU training, and also validate an F-16 simulator training task analysis. In addition, an assessment could be made of off-the-shelf limited FOV visual systems to support tactical flying training. Several training system task analysis studies have indicated a potentially high training effectiveness payback for simulators with a visual system. This study looked specifically at possible enhancements to air-to-air and air-to-surface simulator missions using the proposed visual system. Included in these missions were several conversion, safety-of-flight, and emergency procedures tasks.

The IMAGE IIIT is a day/dusk/night color visual system, which meets FAA advanced simulation requirements. It is a three-channel, three-window, wide-angle display with 126 degree (+/- 63 degrees) horizontal FOV and 36 degree (+29, -15 degrees) vertical FOV. The IMAGE IIIT produces a real-time, color scene in response to operational flight trainer data. Singer-Link provided data bases for the Luke AFB area, air-to-air and air-to-surface ranges, low level navigation route, Phoenix area, and a Nap-of-the-Earth valley. Characteristics of these data bases included weather effects, weapons scoring, color, and moving targets.

METHODOLOGY

This study consisted of three phases: (1) training task analysis and preliminary visual system evaluation, (2) student evaluation of the visual system, and (3) instructor pilot (IP) assessment of training benefits.

Phase I. Det 1, 4444 Operations Squadron performed a task analysis to determine the best areas of instruction for a visual system. Based on this analysis two simulator sorties (1 air-to-air, 1 air-to-surface) were added to the F16COCXOAL syllabi. IPs were checked out in the simulator prior to student instruction. During their training they assessed the adequacy of the simulator visual system to support training. Based on their assessments some changes to the visual system data base were required.

Phase II. All F-16CX and TX students from Aug 86 to Feb 87 participated in this portion of the evaluation. TX students were asked to fill out general questionaires for a preliminary evaluation of the visual system data base and characteristics. CX students were debriefed after each simulator sortie using a detailed questionaire in a one-on-one interview to assess benefits and deficiencies of the visual system.

Phase III. At the conclusion of the test period, IPs were again questioned (1) as to any perceived training benifit of using the visual simulator, (2) for any change in skill level of students prior to the first flying sortie for air-to-air and air-to-surface, and (3) to recommend any additional tasks that could be incorporated into the syllabi for simulator sorties.

RESULTS

Results of this evaluation indicate a limited FOV visual system can substantially enhance simulator training. Over 80 percent of the pilots responded that the visual system enhanced training in one or more areas. IPs indicated students were better prepared to fly and that the visual system enhanced the quality of simulator training. Additional tasks were identified by IPs for future incorporation into the simulator sorties using a visual system. The visual system was very reliable throughout the evaluation period (97% availability).

During the evaluation, deficiencies were found in the visual system data base. This was reflected in an initial low acceptance rating by student pilots. Major modifications were then made to the visual data base, and student acceptance increased. These deficiencies highlighted the need for an accurate, easy to update and functional visual database. Enhancements outside the scope of this effort were recommended for future visual data bases.

Conversion tasks were rated as the training area most enhanced by the visual system, followed by air-to-surface, and air-to-air tasks. Over 90% of the pilots indicated training was enhanced in the conversion task area. Tasks with the highest perceived training benefit were instrument approaches and landings. This was particularly true when transitioning from instruments to visual cues in weather. The adverse weather effects available in the visual system provided critical spatial misorientation and safety-of-flight training.

Air-to-Surface training was also rated as being substantially enhanced with the use of the visual system. Over 80% of the pilots indicated training was enhanced in air-to-air tasks. IPs rated the visual system higher than students, probably due to the high experience level of the IPs. The limited FOV seemed to provide the experienced pilot adequate visual cues, but not the novice who may be more unsure of their position. Without a visual system, air-to-surface tasks could only be practiced heads down, providing little feedback of performance.

Air-to-Air training tasks were of average benifit. Sixty to eighty percent of the pilots indicated training was enhanced in air-to-air tasks. Tasks which could only be done with some type of visual system, BFM for example, could now be done in a limited fashion. This provided the student with a familiarization of several tasks prior to actual aircraft flights. Use of the LFOV visual system did allow the visual conclusion to several beyond-visual-range tasks (e.g. intercepts, BFM, weapons employment), providing performance feedback to the student.

Overall pilot acceptance of the visual simulator was very high. End of course critiques from several students recommended that more simulator sorties be added to the course. Many students indicated the visual system was the best they had seen. An average of two walk-ins a day also demonstrated an increased acceptance. IPs indicated students were better prepared in instruments, emergency procedures, situational awareness, local area procedures, and weapons employment than previous students.

CONCLUSION

Pilot acceptance of a limited FOV visual system was very high, which will increase the training benefit of simulators. The visual system allowed students to realistically practice cockpit management tasks, especially the time allocation of heads in/out of the cockpit. Students tended to fly the simulator more like they would the aircraft. Many tasks that previously could not be accomplished in a simulator were now trainable with the addition of this visual system. Examples include transition from instruments to visual cues during approaches and landings, VFR navigation, local area orientation, limited air-to-surface weapons employment, limited BFM, visual identification, air-to-air refueling, and limited threat reaction. In summary, the perceived benefit of using a limited visual system in simulator training was very high. The highest payoff was in the conversion task area followed by air-to-surface and air-to-air, respectively.

As a result of high pilot acceptance and training effectiveness found during this evaluation period, the USAF has leased an IMAGE IIIT visual system. This has also led to a competitive acquisition of several limited FOV visual systems. With increasingly complex aircraft, threats, and missions; training devices with LFOV visual systems should prepare pilots more adequately for airborne training.

DISTRIBUTION LIST

HQ USAF
WASH DC 20330
- XOO 1
- RDP 1
- RDQ 1
- LEY 1

HQ AAC/DOO 1
ELMENDORF AFB AK 99506

HQ AFSC
ANDREWS AFB MD 20334
- DLS 1
- SDT 1

HQ TAC
LANGLEY AFB VA 23665
- DOO 1
- DOT 1
- DRF 1
- XPP 1

HQ PACAF/DOO 1
HICKAM AFB HI 86853

HQ USAFE/DOO 1
APO NEW YORK 09012-5430

5 AF/DOT 1
APO SAN FRANCISCO CA 96328

9 AF
SHAW AFB SC 29152
- DOO 1
- DOT 1

57 FWW
NELLIS AFB NV 89191
- DO 1
- DT 1

12 AF
BERGSTROM AFB TX 78743
- DOO 1
- DOT 1

17 AF
APO NEW YORK 09130
- DOO 1
- DOT 1

ASD
WRIGHT PATTERSON AFB OH 45433
- TACSO-A 1
- TAF 1
- YW 1
- YWE 1

USAFTAWC
EGLIN AFB FL 32542
- DO 1
- HO 1
- OA 1
- TN 1

USAFTFWC/DOT 2
NELLIS AFB NV 89191

OO-ALC/MMI 1
HILL AFB UT 84056

HQ AFISC
NORTON AFB CA 92409
- SEL 1
- LGM 1

HQ AFOTEC
KIRTLAND AFB NM 87115
- TE 1
- TEL 1
- OAY 1
- HOA 1

DET 2 AFOTEC 2
EGLIN AFB FL 32542

1 TFW/DO 1
LANGLEY AFB VA 23665

18 TFW/DO 1
APO SAN FRANCISCO CA 96239

21 TFW/DO 1
ELMENDORF AFB AK 99506

23 TFW/DO 1
ENGLAND AFB LA 71301

33 TFW/DO 1
EGLIN AFB FL 32542

DISTRIBUTION LIST--CONTINUED

36 TFW/DO 1
APO NEW YORK 09132

49 TFW/DO 1
HOLLOMAN AFB NM 88330

354 TFW/DO 1
MYRTLE BEACH AFB SC 29577

363 TFW/DO 1
SHAW AFB SC 29152

388 TFW/DO 1
HILL AFB UT 84056

474 TFW/DO 1
NELLIS AFB NV 89191

56 TTW/DO 1
MACDILL AFB FL 33608

58 TTW/DO 1
LUKE AFB AZ 85309

355 TTW/DO 1
DAVIS-MONTHAN AFB AZ 85707

405 TTW
LUKE AFB AZ 85309
DO 1
TD 1

AFHRL
BROOKS AFB TX 78235
CC 1
XR 1

AFHRL/OT 2
WILLIAMS AFB AZ 85224

DEFENSE TECHNICAL INFORMATION CENTER 2
CAMERON STATION
ALEXANDRIA VA 22314

AD/DLOD 2
EGLIN AFB FL 32542

SINGER LINK 4
2224 BAY AREA BLVD
HOUSTON TX 77058

SINGER LINK 3
MAIL STOP 249
BINGHAMTON NY 13902-1237

GENERAL ELECTRIC 2
P.O. BOX 2500
DAYTONA BEACH FL 32015