INSTRUCTOR OPERATOR SYSTEMS: EFFECTIVE DESIGN TO MAXIMIZE STUDENT LEARNING

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ABSTRACT

This paper describes a study conducted during the design phase of a weapons system trainer (WST) for the U.S. Air Force Special Operations Aircrew Training System. The purpose of the study was to identify key instructor requirements of the instructor operating station (IOS) for the WST. During the pre-design and early design phases, an analysis of existing IOS stations was conducted to determine their strengths and weaknesses. The analysis considered instructor tasking requirements, along with task saturation points in the mission training from the perspectives of both student crew members and instructors. The results indicated that many required human factors and instructional design features were not effectively built into many of the existing stations. Several factors also complicated the IOS for this system. The requirement for instructors to have both over-the-shoulder and IOS access to students, combined with the multiple crew positions involved, created complex design problems to solve. Following the analysis of existing systems, a study was developed to determine the critical elements of instructor interface both to the IOS and to the student during both crew station (individual) and weapons system (crew) training exercises. Mission scenarios were designed for use in this study which paralleled real-world situations. The segments of the missions most subject to task saturation for instructors and students were identified. The scenarios were then run under controlled, simulated conditions. The scenarios were videotaped for analysis and systematic debriefing sessions were held following each scenario. The data was analyzed by instructor and mission tasking requirements. Study results were used to define specific design requirements which would meet the instructional needs of the students and the tasking and operational requirements of the instructor. Refinements to the design of the instructor operating stations were made to maximize both the station's human factor capabilities and the instructor-student interactions. General design guidelines are provided for future research in this area.

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INTRODUCTION

The advance of technological enhancements and procedures maximizes the use of systems engineering, human factors, and training considerations in the design of training media. The use of systematic processes for the integrated design of training systems, to include simulators, has proven difficult both for the organizations completing the design and for the end users, who create evaluation mechanisms to measure the simulator's resemblance to the actual equipment.

In the past, training devices were often provided to the user with the main focus of design on the operation of the device, rather than on the usability of its components, such as the instructor operator station (IOS). In recent years, however, the capabilities of training devices such as weapons systems trainers (WSTs) has expanded dramatically, creating opportunities for crew members to train operations which are difficult to perform in the actual aircraft except in a conflict situation. The rising cost of aircraft use for training purposes has also refocused the attention on use of devices such as WSTs to meet the majority of training requirements. Simulation technology has advanced to the point of creating real-world exercises for crew members, along with the capability for networking trainers to provide further opportunities in full-mission, multiple-aircraft training.

Research and development efforts in IOS design, however, have not followed the pace set by simulation technology (Charles, 1982). While organizations have undertaken research in recent years to evaluate the effectiveness of IOS design features (Charles, 1988), the integration of these features with instructional design and instructor requirements requires further development.

The USAF *Special* Operations Aircrew Training System includes WSTs for the MC-130E and MC-130H aircraft. Design of these WSTs included several unique features. First, the system was designed to operate in a crew station trainer (CST) mode as a part task trainer for one or two crew positions, as well as in a WST mode for total crew member interaction. The number of crew members in training on the motion-based platform for the MC-130H aircraft totalled five (four crew positions), with a requirement for over-the-shoulder access by the four instructors during training. In addition, the nature of the mission performed by crew members presented unique situations for lighting, position, visual display requirements, and equipment use and availability.

This design, based on the requirements, created a first for industry in the number of personnel required on the platform. The platform designers had the requirements to:

1. Closely resemble the actual aircraft in position, equipment, and so forth.

2. Provide for multiple crew and instructors in a *non-interference basis.*

3. Provide for conditions in which mission operation can be conducted in a night vision goggle (NVG) environment.

4. Provide ease of access and information utilization for the instructor at the IOS.

These combined requirements created a complex set of considerations in designing both the platform arrangement and the information accessibility of the IOS.

As defined in a study conducted by Braby et al. (1988), IOS station features include the following general categories: training strategy, instructor location, trainer features, instructor features, managing features, and record keeping. The study attended to features in each of these categories. Loral's design of the IOS included consideration of the same general features. In working group sessions held with government and contractor personnel early in the design phase, the applicable features were defined in greater detail. Through this process, the requirements for the IOS station and its use in training were defined, and included the location of instructors (which moved from off-platform to on-platform to provide over-the-shoulder capability); the number of data screens required for instructor/student information; the information needed for the repeater screens located at the top of the IOS; and the means by which instructors would access information during training.

As the requirements and design specifications for the IOS station evolved, it was determined that a study was in order to more clearly define the requirements and to test the accessibility of information by the instructor, particularly during high tasking periods of a training mission scenario. The issues that were explored through the study were not so much about the format of information on the display screens, but rather the broader issues of the overall usability and operability of the system within the training situation. This included: the definitization of the instructor station locations on the platform; instructor accessibility to the IOS station during training; the speed of access to required IOS information during the training scenario; and the capability for multiple-instructor access to IOS information during the training session.

Purpose of the Study

The purpose of this study was to definitize and finalize the instructor operator requirements for the MC-130E and MC-130H WST and CST. The MC-130H simulator, for example, is unique in the number of crew positions and instructors (totalling 9) required on the motion platform (in the cockpit) of the simulator. This factor, along with the complexity of the missions performed and the conditions of mission employment, led to the conduct of this study.

DESCRIPTION OF THE STUDY

Goals and Objectives

The IOS for this program was required to service a large number of instructors in a relatively small area. The space available in the WST was limited by the footprint as well as the height. To address this problem, a team approach was pursued from the inception of the program. The training and engineering organizations, along with human factors specialists, worked closely to develop an IOS that would provide the most "power" for the space allocated.

The team worked together from the requirements analysis phase through preliminary design, holding meetings and discussions with the instructors and training subject matter experts (SMEs) to discuss training objectives and to determine the detailed requirements for the IOS. Early prototypes of the man-machine interfaces and display layouts were used to ensure that the proper technology and design were being pursued.

During the detailed design phase, it was determined that a formal, hands-on study should be conducted. Goals of the study were to familiarize all members of the team with the current design, to identify any deficiencies, and to gather suggestions for possible improvements/enhancements to the system. Up to this point, the hardware configuration had been defined and the majority of the layouts of the display screens had been prototyped. The actual functionality of each had not yet been finalized, but the instructors could view each and determine in a "real-life" situation the most critical elements.

Design of the Study

Throughout the development life cycle of the IOS, standard reviews were held (system walkthroughs, requirements walkthrough, detailed design walkthrough, preliminary design review [PDR]), along with supplemental reviews with the users of the IOS on an as-needed basis (e.g., to address the use of touchscreens versus toggle switch control panels). However, the development team identified the need to perform a more thorough and comprehensive analysis of the IOS and WST as a whole system. To this end, a formal study was organized and conducted.

A room in the IOS design lab was modified to closely resemble the layout of the WST. A mockup was set up to replicate the size and shape of the actual WST. Tracks were located on the floor to control the movements of the instructor seats like in the simulator. The IOS mockup included two screens, two repeater monitors and a work table which incorporated the trackball and other input devices. In addition, the instructors provided foamboard replicas of the cockpit and those were placed appropriately around the room. Video equipment was situated in strategic locations in the lab to tape all simulated mission exercises.

Procedures

A group meeting was held over a three-day period at the facility where the IOS was being developed and built. The meeting was attended by members of program management, the training organization, the engineering development team, WST instructors, and human factors experts. Presentations were made of the capabilities of the WST and the IOS along with hands-on, simulated simulator sessions.

The meeting was opened with a presentation of the layout of the designed simulator station. The group then moved to the mockup, where a brief description of the WST was provided. The IOS design engineers conducted a "walkthrough" of the current IOS screens, provided instruction on how to manipulate the screens, and described the capabilities of the trackball and touchscreens, and so forth.

The simulated WST mission scenarios were presented twice. The first presentation was conducted by the instructors performing the mission as crew members would conduct an actual mission in an aircraft. The instructors sat in crew member chairs, and flew the mission as it would be flown. Instructors used an actual scenario designed by courseware developers for use in the final curriculum. The purpose of this first exercise was twofold. First, it provided the observers with a sense of the entire mission itself, from the student or crew member's point of view. The exercise provided a basis for the instructor simulation which was to be conducted the following day (using the same mission scenario). It also provided the observers an opportunity to view the critical crew coordination and timing issues associated with flying a particular mission, as well as the high task periods during the mission.

Following this exercise, the entire group of observers and participants discussed their observations, problems, concerns, and so forth. The instructors then "flew" the mission a second time, this time in their role as instructors. This exercise demonstrated the ways in which they would use the IOS, determined critical tasking requirements for use of the IOS, and provided visibility to potential limitations.

Two CST mission scenarios were also simulated for the observers. The first scenario was designed for the pilot, copilot, and flight engineer; and the second was designed for the left navigator, right navigator team (as for the MC-130E CST design). These scenarios were actual training scenarios obtained from courseware developers for use in the final training program.

The scenarios were generally run in a real-time mode as they would in a normal training environment. However, interruptions were permitted as required to capture critical data. The instructors interjected comments and recommendations as the scenarios unfolded and the observers asked questions as required. This approach resulted in a good mix of realistic training time and question and answer periods throughout the scenarios.

Description of Scenarios. Three training lesson scenarios were instructed as a part of the study, one full WST and two CST scenarios. They were chosen as typical scenarios for the overall curriculum.

The WST scenario began with the ownship on the ground, the crew having just entered the aircraft. Each crew member was required to go through all checklists in preparation for takeoff. This included all calls and all switch settings. Once in the air, all crew members performed their after-takeoff checklists and activities. Throughout the various phases of the session, crew member checklists were constantly monitored. The scenario then called for a period of low-level flight. Throughout this period, threat detection and avoidance was verified. All crew members were active in the threat detection and avoidance phases. Malfunctions were introduced at this point to simulate the attack by the threats. The crew was monitored for their reactions to these attacks and for their continued efforts to avoid further damage from the threats. Once past the threat area, the scenario called for an airdrop to be performed. After following four more waypoints, the scenario ended with an infiltration/ exfiltration exercise. The crew was required to locate the landing zone (LZ), land there, perform the off/on load procedures and then depart.

The first CST session involved three students and two instructors. It reflected the actions of the pilot, copilot and flight engineer performing an infiltration/exfiltration mission with night vision goggles (NVGs) and was monitored by the instructor pilot and instructor flight engineer. The basic scenario was started from a position on final approach approximately 15 nautical miles (nm) from the landing area and continued through roll-out to a stop, simulated rapid off/on load, 180-degree taxi turn and takeoff, and ended with a clean aircraft at 1000 feet above mean sea level (msl) approximately 2 nm off departure end.

The second CST session involved two students and an instructor. It focused on the actions of two student navigators performing the basics of terrain following/terrain avoidance (TF/TA) flight and was monitored by the instructor navigator. The scenario included positioning the aircraft relative to the selected TF/TA targets, waypoints and radar update targets for the purpose of demonstrating TF/TA procedures and techniques, turn point procedures and techniques, and mission computer updating procedures and techniques, including observation of weather and altitude. Application of these procedures and techniques were monitored throughout the flight path.

Use/Advantages of Note Taking/Videotaping. Accurate recording of the activities, comments, and results of the scenarios was a critical aspect of the study. This was accomplished through note taking throughout the three days of activities as well as through videotaping of the scenarios. The note taking resulted in the compilation of data that was sufficient for publication. The videotapes were analyzed for instructor and student requirements, and archived for future reference in the detailed design process. The videotapes have proved to be invaluable during the continued detail design and production phases and have been used frequently by design and production engineers and training personnel.

During the study, individuals from each of the disciplines (engineering, training, and human factors) took notes. These notes were collected and condensed to create a comprehensive narrative of the activities as well as to obtain a thorough list of the observations and recommendations.

The scenario sessions were videotaped from the key viewpoint, concentrating on the IOS and the instructor pilot, who was the chief narrator of the scenarios. Though the actual information on the IOS displays was unreadable, it provided good insight into the number of times the instructors required access to the information on the displays, the number of times they needed to interact with the displays and their accessibility to the IOS in general. The audio portion of the videotape was also very important. It provided the actual communications among the instructors and crew members concerning performance of their tasks as well as comments on the current design; and comments of the observers who were present.

LESSONS LEARNED

Summary of Results

The presentation and discussion sessions, as well as the mission scenario sessions, provided valuable results. The discussions were lively in both sessions and a number of recommendations, suggestions, and design confirmations were generated.

Relative to the overall layout of the platform, it was determined through these exercises that the required number of instructor and student/crew personnel could be accommodated safely on the motion platform. Egress from the front seats of the cockpit was discussed, and a suggestion was made to install a folding seat for the flight engineer (FE) instructor, which enabled easier and safer egress from the front cockpit seats. The location of the FE instructor was also discussed in terms of access to the circuit breaker panels. It was concluded that the FE instructor could act on verbal command of the student(s) for any activity required at the panels obscured from the FE instructor. Another issue related to the station layout dealt with the NVG curtain (designed and located as in the aircraft). The results of the study concluded that the curtain need not be closed entirely at any point since the lighting at the IOS is all NVG-compatible. It was felt that the curtain would be used across the right-hand portion of the flight station to cut down on the glare from the lights at the navigation/electronic warfare operator (NAV/EWO) crew stations panel(s).

The next issue discussed concerned the instructor techniques when using the IOS. The issue of over-the-shoulder versus remote instruction was highlighted as a critical factor in the ultimate success of the IOS. The outcome of this exercise as to the need for both over-the-shoulder and IOS station access varied from instructor to instructor. The results indicated that the instructor viewpoints varied and were dependent upon past simulator experience. Those instructors who had little or no simulator experience were most comfortable with the over-the-shoulder technique that they were most familiar with; those instructors with prior simulator experience were able to provide more substantive comments concerning the appropriate utilization of the IOS station and the information provided. The participants familiar with instruction using simulators stressed that use of the IOS in its current configuration would be extremely beneficial in their training activities.

The results of the study relative to the CST mode of operation were discussed at length. The design of the CST mode provides for the training of multiple students at the two stations simultaneously. For example, while one student pilot and instructor are training on one scenario at one of the two stations, the electronic warfare student and instructor can train an independent scenario at the second station. The requirement for simultaneous training resulted from the expected student throughput for the training sessions in the schoolhouse. Much discussion centered around the results concerning the requirements for functionality and fidelity while in the CST mode of operation. It was determined that further analysis of the requirements was warranted to ensure that the engineering design met all training and throughput requirements, based on the curriculum design.

The Electronic Combat Environment (ECE) makeup was also discussed as it relates to the training environment. Initial requirements for the WST and CST were defined for use in mission rehearsal. It was determined that the requirements for ECE training were not as complex in either the WST or CST training, since the design is common across both the WST and Mission Rehearsal Devices (MRDs). Further discussion and study in this area was not warranted at the time.

The group next focused on the results found during the initialization process of the WST/CST. The training organization and instructors expressed the need to automate as much of the mission scenario exercises as feasible. It was determined that the planning software configuration must include ownship location, ownship flight path/plan, ownship configuration (fuel, oil, armaments, etc), as well as malfunctions, threat laydown and actions, and weather conditions. It was recommended that this information be organized into sets which would then be grouped logically as missions. It was also determined that it would be desirable to have the capability to use varying sets of information within a mission scenario in order to individualize training to meet the training needs of all students/crews. Selection of a pre-defined mission should be straightforward and should be viewed as the standard mode of operation for training exercises.

Results of the study were also discussed concerning the repeater displays, the information required, and their functionality. The existing design allowed the repeaters to display (repeat) the video simultaneously displayed at a selected student station. It was agreed through the discussions and study analysis that out-the-window views and video views available to the student crew would not be required, since this information is available in the over-the-shoulder view of all instructors.

These and additional issues identified during the WST scenario study can be summarized as follows:

1. The arrangement of instructors and student/crew on the platform was workable, with some modifications for the FE instructor.

2. The number of IOS screen utilization conflicts between instructors was less than anticipated. Results indicated that the instructors shared utilization effectively, even during the high tasking periods of the mission scenarios.

3. The FE instructor, in his position on the platform, was totally removed from participation in the scenario through his use of the IOS. He was unable to see or reach the IOS.

4. The remote hand-held device used by the FE instructor, as designed, was rarely used. It was determined, however, that a hand-held device with additional capability to access instructor information and input data would be used by the FE instructor and would make him a more active participant in the training scenario. It was determined that the ability to have a display

capability on his remote is essential to bring him into the training situation.

5. The display of a background chart (map) on the IOS instructor screens would be a great enhancement for navigator and EWO instructors.

6. Overall, the format and information arrangement on the display pages were found to be quite effective for use by the instructors. Some pages were reorganized for more efficient utilization, including the status, approach, departure, rendezvous, and communication pages.

The study also identified several additional potential design modification requirements. These included:

1. The content and arrangement of the status information screens required some revision. The instructors experienced some utilization conflicts in screen access of status information.

2. The FE instructor, as stated previously, was functionally left out of the scenario due to the lack of free access to the IOS due to his physical location on the platform. He was unable to clearly view the IOS screens from his position. It was determined that an enhanced hand-held remote would allow him to access information from the IOS.

3. It was determined that the ability to monitor the communications transmissions by the students is critical. Thus, it was recommended that the communications capabilities accessed through the IOS be modified.

4. Human factors personnel identified the following additional observations:

   a. The pilot instructor must twist his body backwards to use the IOS. It was determined that this was not a major problem.
   b. The trackball position on the IOS shelf did not permit access by all instructors at the station at the same time. Modifications to the location of the trackball were recommended.
   c. The ability of the instructors to move the seat positions quickly was hampered by the crowding on the platform. It was determined that this could not be completely assessed at the time of the study due to the lack of actual seat equipment used in the scenario.
   d. The EWO instructor had difficulty seeing the forward multi-function displays (MFDs) in the cockpit. Likewise, it was difficult for the pilot instructor to view the aft IOS screen. These items were determined to be of no major consequence, as the required information could be accessed by the instructors on a nearby IOS screen.

5. The instructors required an out-the-window view, although it was determined that this would be available to them from their position on the platform.

The following issues were identified specifically during the CST sessions:

1. The navigator instructor's manual control of the "dummy" aircraft to follow verbal heading changes was discussed and determined to be usable in its present design configuration.

2. It was determined that the pilot instructor should be able to insert radar updates into the IOS.

3. It was requested that engineering reconsider the ability to have a record/replay capability in the CST mode of operation.

Implications/Applications of Results to Current Design

The issues noted during the conduct of the study resulted in a series of general recommendations. The following represent key recommendations from the study and their disposition:

1. The ability to perform record/replay while in the CST mode is a requirement for training, and will be provided on one station at a time. For example, if the pilot/FE station is conducting record/replay, it will not be simultaneously available on the NAV/EWO station. It was determined by all to be sufficient for training requirements, and capable of easy integration into the device.

2. The current design of the hand-held device has some limitations which were identified by the study. As a result, its capabilities were reevaluated and a revised design was implemented

which meets the training requirements. This also solved the problem of the location of the FE instructor -- he was given additional capability on the hand-held device to meet his requirements.

3. The instructor EWO must move back from the student to the IOS to manipulate or modify the threat. This problem was addressed in the redesign of the hand-held device, giving him additional capability which permits him to stay in the over-the-shoulder position with the student.

4. The instructor is required to manually control the *dummy* aircraft during the CST mode of operation, to include radar updates. This change was incorporated into the final design of the IOS.

5. The need for additional screens and more windowing capability was identified. This was added to the final design considerations of the device.

6. The need for the instructor to determine actual aircraft position, mission computer position, and planned position at the IOS was identified and provided in the final detailed design.

7. The capability for the instructor to monitor the cumulative effect of battle damage to the aircraft was identified and provided in the final design. Note: The IOS also provides the capability for the instructor to set a cascading malfunction scenario, based on the probability of survival data maintained by the simulator.

8. The capability for a map background chart on the IOS was determined to be proposed as a future upgrade to the system.

Overall, results of the study indicated a user-friendly IOS station, with ease of information access and the capability for multiple status display information through windows and function keys. Instructor-student interaction was effective with both the over-the-shoulder capability and instructor use of the IOS. It was further determined that the design and utilization of space on the platform was excellent, providing ease of access for instructors along with aircraft design characteristics for student crews.

FUTURE DIRECTIONS

Analysis of Study

Positive Outcomes. The development team agreed unanimously that the study provided useful and concrete design feedback. Having the instructors and training personnel in a situation in which they worked side by side with the engineering development team provided insight to both organizations of what was required to meet the training requirements. All too often, the integration of these groups is not sufficient in the design of the devices, and this can lead to devices which fall short of expected or required capabilities. In an aircrew training system (ATS) program, it is critical that the engineering and training organizations work together closely to meet all requirements. The entire team must be involved to ensure that the student, instructor, and media come together with all requirements met in a way to maximize the training opportunity given a variety of training scenarios. The study proved useful for the engineering development of the system, the training/instructor development of the curriculum, and the human factors elements of the IOS.

In addition to providing instantaneous feedback for design considerations, the study also created a situation which opened communications between these organizations for the remainder of the program. Often in programs of this type, the communications between engineering, training, and end users is not as it should be for effective, efficient design and use of the device. This study forced these organizations to come together, test assumptions in a controlled environment, and analyze the results systematically, leading to increased understanding among all concerned.

Videotaping the study's mission scenario exercises also proved to be extremely useful. The actions and activities of the instructors were captured for ongoing analysis. The audio portion captured the dialogue throughout the exercises, and served as a permanent record for reference during final design. These tapes were put to immediate use following the conduct of the study by members of the development engineering team who were not present at the sessions. Follow-up reviews of these tapes yielded additional observations and viewpoints.

Pitfalls to Avoid in Future Studies. As is often the case in the design of devices, past experience on the part of the users and personal preference can influence the design outcome. Although this was also the case in this situation, personal preference was often overcome by the objective conduct and outcome of the scenario procedures. Thus, the study created opportunities for decisions to be made based on objective observations rather than impressions of instructors and training personnel. The analysis of the study also included the identified personal preference recommendations. These were then weighed against the results demonstrated through the taped sessions.

A second factor in this study was the size of the lab room. While it closely resembled the size and configuration of the WST, it limited the ease of observation by others and the flexibility to position the videotape equipment. It did, however, create a realistic environment in which to conduct the study. One solution could be to provide a larger space with the footprint of the device marked in the space as appropriate.

Guidelines for Future Studies. A number of guidelines can be generated from the conduct of this study which can be useful in future endeavors of this type.

1. The timing of such a study is critical. While it should be done early in the design cycle, it is also important to have the initial design parameters completed in order to make the session productive. Depending on the size and complexity of the device, it may also be useful to conduct such an event at several intervals during the design and development process. If multiple session are conducted, however, a core team of individuals should be involved at all stages to ensure consistency of design and history of development.

2. To minimize the personal preference inputs by users and designers, a well constructed set of scenarios, consistent with the training requirements, should be employed. Each resulting design consideration evolving from the study should be analyzed in an objective manner, and should be data based.

3. It is most effective to involve a team comprised of those with training expertise, engineering expertise, as well as the end users from both an instructor and student point of view throughout the study. Personnel experienced in the aircraft in addition to experienced instructor personnel can provide insight unequalled in creating a realistic test scenario.

4. Creating an environment which realistically depicts the eventual training situation provides for more believable results. Participants, if comfortable in the environment, can role play the simulated mission scenarios more effectively, and the results are much more credible. This provides more accurate representations on which to make design considerations.

5. Participants should accurately represent the anticipated users of the final product. If the skill and experience levels of the study participants reflect the end users, the data generated is a more accurate representation of training needs and requirements. Additionally, those who analyze the results should reflect all disciplines, (e.g., engineering, training, and human factors). All perspectives are required to make effective design decisions.

SUMMARY

The results of this study provided an objective basis upon which to make final design decisions for the MC-130E and MC-130H WSTs. The conduct of the study brought together all disciplines, working as a team, to ensure that the final training requirements were met. Although research has been conducted on an ongoing basis concerning the most effective, efficient operational features of IOS systems, the study described here provides two additional design considerations. First, the conduct of the study brought together engineering, training, and users to collectively define the design to meet the unique characteristics of this device. All viewpoints were considered prior to final decisions, and agreement was reached by all team members. In such a way, the considerations of all perspectives were made and decisions were data-based, and interpreted from all perspectives.

Additionally, design decisions were focused on the requirements of the end users (student crews and the instructors) rather than on ease of design from an engineering perspective or a human factors requirement only. Designers of media devices must, as technological capability increases, emphasize the requirements from the student and user perspective. Otherwise, designs can be driven by technology capabilities alone, creating circumstances in which a device is over-designed and unnecessarily costly from a training perspective.

REFERENCES

Braby, R., Charles, J., Sylla, C., Ramesh, R., Willis, R., & Hunter, D. (1988). Instructor considerations in the design of optimal training devices. (Report No. AD-A252 122). Orlando Field Unit, Orlando, FL: U.S. Army Research Institute.

Charles, J. P. (1982, August). Operational problems in instructor operator station designs. Paper presented at the Workshop on Instructional Features and Instructor Operator Station Design for Training Systems at the Naval Training Equipment Center, Orlando, FL.

Charles, J. P. (1988). Instructor/operator station (IOS) design guide. (Report No. AFHRL-TR-87-32, AD-A192 055). Brooks AFB, TX: Air Force Systems Command.