AIRCREW TRAINING
A FAMILY OF TRAINING DEVICES

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ABSTRACT

Recent statement of Air Force aircrew simulator policy reaffirmed that Aircrew Training Devices (ATDs) are an integral part of aircrew training programs. The Tactical Air Forces (TAF) have adopted a concept for a family of ATDs to support aircrew training needs. The family of ATDs includes: Cockpit Familiarization Trainers (CFTs), Egress Procedures Trainers (EPTs), Part Task Trainers (PTTs), Cockpit Procedures Trainers (CPTs), Operational Flight Trainers (OFTs), and Weapons Systems Trainers (WSTs). The training available from this family of ATDs varies from simple repetition of tasks required for safe aircraft operation to full mission rehearsal in a simulated combat environment. Safety-of-flight training is a core requirement for any aircraft training program, while practice of warfighting skills enhances survival in combat. A family of ATDs allows specialization of training devices to satisfy safety-of-flight and warfighting simulation requirements. This paper discusses how the family of ATDs concept evolved, defines the type and capability of each type of ATD, comments on acquisition strategy, and discusses user acceptance issues important to integration of ATDs into training programs. Although this paper is limited in content to aircrew training, the family of ATD concept has broad application to any training program that uses training devices to simulate actual equipment employed in a real environment.

DEFINITIONS

Aircrew Training Devices (ATDs).

Synthetic training devices (simulators) used in support of aircrew training programs.

Cockpit Familiarization Trainer (CFT).

A device that looks like the aircrew stations of a specific aircraft. It is used to teach the location of controls, instruments, switches, and lights, and to practice tasks such as checklist use, normal procedures and emergency procedures. The controls, switches and instruments do not have to respond to trainee inputs.

Cockpit Procedures Trainer (CPT).

A device used to train normal, emergency and instrument procedures. Aircraft instruments and other displays are activated to respond to flight control inputs; however, exact dynamic simulation of all functions is not required.

Egress Procedures Trainer (EPT).

A device that looks like the aircrew station of a specific aircraft. It is used to practice emergency aircraft egress and ejection procedures. The egress and ejection equipment must be an exact copy of aircraft equipment and actuation controls must function as they do in the aircraft.

Operational Flight Trainer (OFT).

A device which dynamically simulates the flight characteristics to train normal, instrument and emergency procedures and includes limited mission execution.

Part Task Trainer (PTT).

A device used to practice specific tasks such as avionics operations, air refueling, or radar operation. Used to develop skills independently from other mission tasks.

Weapon System Trainer (WST).

A device which provides a synthetic flight and tactics environment in which aircrews learn, develop and improve the techniques associated with their crew position. Crew members work individually or as a team in completing simulated missions.

INTRODUCTION

The aircrew training device program is probably the most complex, least understood program in the training world. This has been brought about by a number of factors. Users didn't always know what it was they wanted. Simulators were recognized as a valuable training tool, but lack of analysis of what tasks were required to be trained resulted in simulators purchased under a design concept of, "do what the aircraft does." As technology advanced and simulator costs escalated, it became obvious that complete simulation of all aircraft capabilities was not affordable for every aircraft location. Thus evolved the present concept of a family of aircrew training devices, each specifically designed to fulfill a defined training requirement.

CFTs and EPTs evolved from the need to accomplish repetitive tasks prior to aircraft operation. PTTs were developed to cope with the need to train aircrews on specific complex equipment. Flight dynamic CPTs are required to practice instrument navigation procedures and inflight emergency situations. Where limited mission training must be included, OFTs replace CPTs. Finally, full mission training

in a WST provides the highest level of training for full utilization of a weapons system through combat mission rehearsal.

The family of ATD concept is in line with recent Air Force policy that divides aircrew training devices into two categories designed to satisfy safety-of-flight and warfighting skill requirements. The family of ATDs concept also results in acquisition efficiency since it uses the lowest order (and usually lowest cost) device capable of training a required task. It allows efficiency of utilization in that high order devices are not used to accomplish low order tasks. Although the concept of a family of ATDs is not new, formal adoption of the concept provides direction to previously fragmented ATD programs.

HISTORY

There has been a long line of simulators designed and used to support aircrew training, starting with the original Link instrument procedures trainer. A complete history of aircrew training devices is beyond the scope of this paper. Therefore, I will start with what I consider the event that has most significantly affected present simulation programs--the energy crisis of the 1970s.

During the 1970s energy crisis, the Air Force attempted to acquire aircrew training devices designed to replace flying time. This required full aircraft and mission simulation, including a full field-of-view visual display system. For the Tactical Air Forces these full mission simulators were called Tactical Combat Trainers (TCTs). They were designed under the concept to do everything the aircraft does with sufficient fidelity to be used to replace flying time. The TCT program was a noble effort; however, it exceeded the capability of available technology, and costs were spiraling at such rapid rate that the pursuit of the TCT was abandoned.

When the TCT program was abandoned, several new weapon systems (F-15, F-16, A-10) had no clear concept for ATD development. Using past requirements to provide simulation at each location, OFTs were designed and acquired to fly like the aircraft, to include some mission capability. The full visual requirement still existed but funding constraints prevented its acquisition. Also, since ATD programs had no clear direction, they were the first to be cut or delayed during cost reduction budget reviews. The end results were aircrew training devices that were late to need and not optimized for the tasks they were capable of training. Based on these failures, the Air Force adopted the philosophy that aircrew training devices complement not replace flying. The family of ATDs concept evolved to acquire training devices that would complement flying time by training those tasks that are unsafe, too expensive or simply cannot be trained in aircraft. Commitment to the family of ATDs requires two key elements to be successful:

1. Early, up-front task analysis to determine the number, type, and location of ATDs.

2. Funding approval to ensure on time delivery of required safety-of-flight and warfighting ATDs.

TASK ANALYSIS

Accurate specific task analysis is the key to any successful training program. Without task analysis, ATDs designed and acquired under broad statements of need seldom meet training needs, or result in training programs structured on training capability rather than training requirements. Also, simplistic tasks trained on complex devices result in utilization inefficiency and restricts availability of these training devices for training at design capability. Task analysis makes obvious the fact that more than one type of training device results in better training efficiency, especially given the complexity of modern weapon systems with the vast number of tasks to be accomplished. A pilot new to a weapon system, although impressed by a single full-up weapon system trainer, might be overwhelmed by its capability while he is trying to learn simple cockpit flight procedures.

Tasks for training device development can generally be divided into three categories.

1. Procedural tasks involved in safe operation of an aircraft--checklists, switchology, cockpit familiarity, normal procedures, emergency procedures.

2. Complex tasks required to operate a specific aircraft system, or to accomplish a complex procedure, that can be practiced separate from aircraft operation--electronic combat, systems operation (radar, avionics, etc.), air refueling, weapons employment.

3. Mission tasks involving total integration of the weapon system and aircrew for full mission employment.

Additional task analysis is necessary to divide tasks into those required for safety-of-flight training and those that provide warfighting skills. In general terms, any task required for safe operation of the aircraft without consideration for its designed mission is safety-of-flight. Those tasks required for full mission execution of an aircraft in its designed role, could be classified as warfighting skills. In certain areas, tasks overlap and cannot be clearly divided into one category or another. For example, inertial navigation systems are as much a part of normal operations as for mission execution. Safety-of-flight tasks are a core requirement, and training devices capable of safety-of-flight training must be available at the start of any aircrew training program. Task analysis must also include identification of training requirements based on the types of aircrews to be trained. Formal training units conducting Initial Qualification Training (IQT) have different training device requirements than operational units conducting Continuation Training (CT). Finally, we must look at tasks that cannot be accomplished in the aircraft due to safety, airspace or cost considerations.

It is here that the family of ATDs can fill gaps in aircraft training with cost effective simulation.

ACQUISITION STRATEGY

Acquisition strategy is where we marry task analysis to the family of ATDs concept in defining the numbers, types and locations of aircrew training devices required to support training for a specific weapon system. Acquisition strategy must initially be based on reasonable funding expectations, yet be flexible to changes in funding profiles.

In considering acquisition strategy, the aircraft beddown schedule is a key issue, as is the number of formal training and operational units. Acquisition strategy must provide safety-of-flight ATDs ready for training prior to first aircraft delivery at the first training unit, and continue to provide ATDs concurrent with aircraft delivery. Although not critical, the acquisition schedule for more complex ATDs designed to train warfighting skills should also coincide with aircraft delivery.

For acquisition strategy to be successful, early program decisions are necessary to keep ATDs concurrent with aircraft developments. In the past ATD programs have been a prime target of budget cuts. This has forced use of alternative means to conduct required training, to include static use of real aircraft cockpits as ground training devices. Now, with tasks defined that make ATDs an integral part of the total training program, any slip in ATD acquisition significantly impacts training program success.

Formal training units will require a full complement of ATDs to lead IQT aircrews through a building block approach to final qualification in the aircraft. Operational units may need only those devices necessary for safety-of-flight training currency, and to maintain proficiency in the operation of complex equipment and tasks difficult or impossible to accomplish in the aircraft.

One question that is difficult to resolve is location of weapons systems trainers. They fit nicely at formal training units to provide the final increment in the building block approach towards combat mission training. They also are nice to have at operational units for continuation training proficiency in the combat mission of the aircraft. Since these trainers are the highest cost items in the family of ATDs, the numbers acquired must be held down to keep total program costs within acceptable limits. Perhaps the best compromise is to locate WSTs at formal training locations to support initial aircrew training and refresher training for operational aircrews.

USER ACCEPTANCE

Without user acceptance, even the best thought out ATD program is doomed to failure. There are several key factors involved in user acceptance. First, the training device must be available when it is needed. It must work when it is turned on. It must have an easily recognizable training value. Finally, it must be compelling. A compelling simulator could be compared to a video game in that it should provide a thrill, a challenge and immediate feedback. Just as childern line up with quarters to play the video games, aircrews must be made willing to spend time in ATDs to overcome penalties and achieve a solution, and, therefore, be trained. But like the video game, if the training device is too simple, too difficult, or lacks appropriate data base, it will soon be put in the corner to collect dust.

Past performance of our ATDs has prejudiced users. Simulators that had no relation to reality because of wrong configuration, small data base, poor flight fidelity and outdated scenarios have continually demotivated users to the point that many users consider ATDs to be a necessary evil. A concentrated effort to acquire compelling ATDs is necessary to sell the value of ATDs in aircrew training programs.

Perhaps the most compelling feature of any ATD is a visual display system. But, due to cost we have only a few visual attachments on some of our ATDs. Acquisition of a full fidelity visual display system would do wonders for user acceptance of ATD programs.

SUMMARY

The family of ATDs concept has great promise to solve the dilemma that has plagued Air Force aircrew training programs. To be successful, this concept requires the cooperation of both military and industry. The military must clearly state requirements and provide funding support to allow acquisition. The simulation industry must be able to provide training devices at a reasonable cost on time to provide required training.

ABOUT THE AUTHOR

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