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T-6A Texan II Systems Engineering Case Study

Air Force Center for Systems Engineering

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T-6A TEXAN II SYSTEMS ENGINEERING CASE STUDY



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FORWARD

At the direction of the former Secretary of the Air Force (SAF), Dr. James G. Roche, the Air Force Institute of Technology (AFIT) established an Air Force Center for Systems Engineering (AFCSE) at its Wright-Patterson Air Force Base (WPAFB), Ohio, campus in 2002. The AFCSE was tasked to develop case studies focusing on the application of systems engineering principles within various aerospace programs. The intent of these case studies was to examine a broad spectrum of program types and a variety of learning principles using the Friedman-Sage Framework to guide overall analysis. In addition to this case, many other studies are available at the AFCSE web site, such as:

- Global Positioning System (GPS) (space system)
- Hubble Telescope (space system)
- Theater Battle Management Core System (TBMCS) (complex software development)
- F-111 Fighter (joint program with significant involvement by the Office of the Secretary of Defense [OSD])
- C-5 Cargo Airlifter (very large, complex aircraft)
- International Space Station (highly complex multinational manned space system)
- A-10 Attack Aircraft (competitive development of critical technologies)
- Global Hawk (intelligence, surveillance, and reconnaissance air system)

These cases support academic instruction on systems engineering within military service academies and at both civilian and military graduate schools, as well as training programs in industry. Each case study is comprised of elements of success, as well as examples of systems engineering decisions that, in hindsight, were not optimal. Both types of examples are useful for learning. Plans exist for future case studies focusing on various space systems, additional aircraft programs, munitions programs, joint Service programs, logistics-led programs, science and technology/laboratory efforts, and a variety of commercial systems.

The Department of Defense (DoD) continues to develop and acquire joint complex systems that deliver needed capabilities to our warfighters. Systems engineering is the technical and technical management process that focuses explicitly on delivering and sustaining robust, high-quality, affordable products. The Air Force leadership has collectively stated the need to mature a sound systems engineering process throughout the Air Force.

As we uncovered historical facts and conducted key interviews with program managers and chief engineers, both within the Government and those working for the various prime and subcontractors, we concluded that today's systems programs face similar challenges. Applicable systems engineering principles and the effects of communication and the environment continue to challenge our ability to provide a balanced technical solution. We look forward to your comments on this case study and the others that follow.

John Paschall, Col, USAF
Deputy Director, Air Force Center for Systems Engineering
Air Force Institute of Technology

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The views expressed in this Case Study are those of the author(s) and do not reflect the official policy or position of the United States Air Force, the Department of Defense, or the United States Government.

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1. SYSTEMS ENGINEERING PRINCIPLES

1.1 General Systems Engineering Process

1.1.1 Introduction

The Department of Defense (DoD) continues to develop and acquire joint military service weapon systems and deliver the needed capabilities to the warfighter. With a constant objective to improve and mature the acquisition process, it continues to pursue new and creative methodologies to purchase these technically complex systems. A sound systems engineering process, focused explicitly on delivering and sustaining robust, high-quality, affordable products that meet the needs of customers and stakeholders must continue to evolve and mature. Systems engineering is the technical and technical management process that results in delivered products and systems that exhibit the best balance of cost and performance. The process must operate effectively from identified gaps in mission-level capabilities to establish system-level requirements; allocate these down to the lowest level of the design; and ensure validation and verification of performance, meeting cost and schedule constraints. The systems engineering process changes as the program progresses from one phase to the next, as do the tools and procedures. The process also changes over the decades, maturing, expanding, growing, and evolving from the base established during the conduct of past programs. Systems engineering has a long history. Examples can be found demonstrating a disciplined application of effective engineering and engineering management, as well as poorly applied, but well-defined, processes. Throughout the many decades during which systems engineering has emerged as a discipline, many practices, processes, heuristics, and tools have been developed, documented, and applied.

Several core life-cycle stages have surfaced as consistently and continually challenging during any system program development. First, system development must proceed from a well-developed set of requirements. Secondly, regardless of the evolutionary acquisition approach, the system requirements must flow down to all subsystems and lower-level components. And, third, the system requirements need to be stable and balanced and properly reflect all activities in all intended environments. However, system requirements are not unchangeable. As the system design proceeds, if a requirement or set of requirements is proving excessively expensive to satisfy, the process must rebalance schedule, cost, and performance by changing or modifying the requirements or set of requirements.

Systems engineering includes making key system and design trades early in the process to establish the system architecture. These architectural artifacts can depict any new system, legacy system, modifications thereto, introduction of new technologies, and overall system-level behavior and performance. Modeling and simulation are generally employed to organize and assess architectural alternatives at this introductory stage. System and subsystem design follows the functional architecture. System architectures are modified if the elements are too risky, expensive, or time-consuming. Both newer object-oriented analysis and design and classic structured analysis using functional decomposition and information flows/data modeling occurs. Design proceeds logically using key design reviews, tradeoff analysis, and prototyping to reduce any high-risk technology areas.

Important to the efficient decomposition and creation of the functional and physical architectural designs are the management of interfaces and integration of subsystems. This is applied to subsystems within a system or across large, complex systems of systems. Once a solution is

planned, analyzed, designed, and constructed, validation and verification take place to ensure satisfaction of requirements. Definition of test criteria, measures of effectiveness (MOEs), and measures of performance (MOPs), established as part of the requirements process, takes place well before any component/subsystem assembly design and construction occurs.

There are several excellent representations of the systems engineering process presented in the literature. These depictions present the current state of the art in the maturity and evolution of the systems engineering process. One can find systems engineering process definitions, guides, and handbooks from the International Council on Systems Engineering (INCOSE), Electronics Industrial Association (EIA), Institute of Electrical and Electronics Engineers (IEEE), and various DoD agencies and organizations. They show the process as it should be applied by today's experienced practitioner. One of these processes, long used by the Defense Acquisition University (DAU), is depicted by Figure 1. It should be noted that this model is not accomplished in a single pass. This iterative and nested process gets repeated to the lowest level of definition of the design and its interfaces.

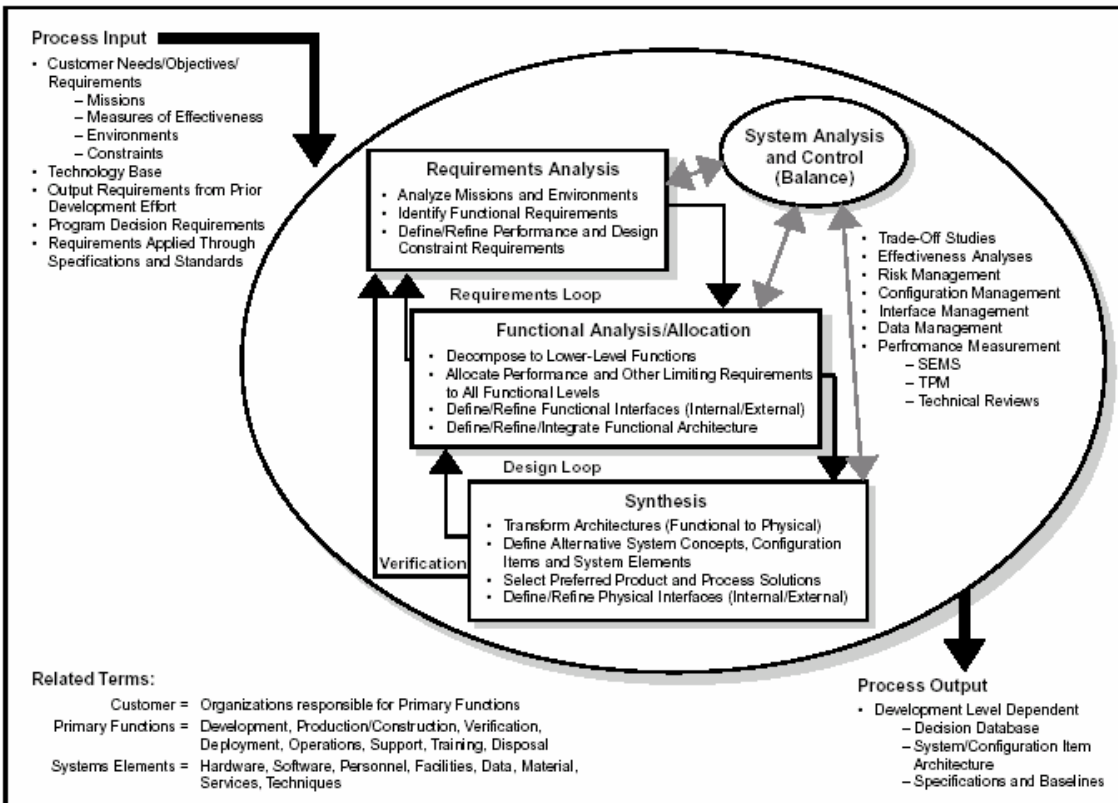


Figure 1. The Systems Engineering Process as presented by the Defense Acquisition University (DAU)

1.1.2 Evolving Systems Engineering Process

The DAU model, like all others, has been documented in the last two decades and expanded and developed to reflect a changing environment. Systems are becoming increasingly complex internally and more interconnected externally. The process used to develop aircraft and other weapons of the past was a process effective at the time. It served the needs of the practitioners and resulted in many successful systems in our inventory. However, the cost and schedule performance records of the past programs are fraught with examples of some well-managed programs and programs with less than stellar execution. As the nation entered the 1980s and 1990s, large DoD and commercial acquisitions were overrunning costs and running behind schedule. The aerospace industry and its organizations were becoming larger and more geographically and culturally distributed. The systems engineering process, as applied within the confines of a single system or single company, was no longer the norm.

Today, many factors overshadow new acquisitions, including system-of-systems (SoS) context, network-centric warfare and operations, and rapid growth in information technology (IT). In the context of SoS, a group of independently operated systems are interdependently related within and across all lanes of the interoperability to effectively support an overarching objective. These factors have driven a new form of emergent systems engineering, which focuses on certain aspects of our current process. One of these increased areas of focus resides in the architectural definitions used during system analysis. This process is differentiated by greater reliance on reusable architectural views describing the system context and Concept of Operations (CONOPS), interoperability, information and data flows, and network service-oriented characteristics. The DoD has recently made these architectural products, described in the DoD Architectural Framework (DoDAF), mandatory to enforce this new architecture-driven, systems engineering process throughout the acquisition life-cycle.

1.1.3 Case Studies

The systems engineering process to be used in today's complex SoS projects is a process matured and founded on the principles of systems developed in the past. The examples of systems engineering used in other programs, both past and present, provide a wealth of lessons to be used in applying and understanding today's process.

The purpose of developing detailed case studies is to support the teaching of systems engineering principles. Case studies facilitate learning by emphasizing to the student the long-term consequences of the systems engineering and programmatic decisions on program success. The systems engineering case studies assist in discussion of both successful and unsuccessful methodologies, processes, principles, tools, and decision material to assess the outcome of alternatives at the program/system level. In addition, the importance of using skills from multiple professions and engineering disciplines and collecting, assessing, and integrating varied functional data is emphasized. Analysis of these aspects will provide the student with real-world, detailed examples of how the process plays a significant role in balancing cost, schedule, and performance.

The utilization and misutilization of systems engineering principles are highlighted with special emphasis on the conditions that foster and impede good systems engineering practices. Case studies should be used to illustrate both good and bad examples of acquisition management and learning principles, including determining if:

- Every system provides a balanced and optimized product to a customer
- Effective requirements analysis was applied
- Consistent and rigorous application of systems engineering management standards was applied
- Effective test planning was accomplished
- Effective major technical program reviews were conducted
- Continuous risk assessments and management was implemented
- Reliable cost estimates and policies were developed
- Disciplined application of configuration management was demonstrated
- A system boundary was well defined
- Disciplined methodologies were developed for complex systems
- Problem-solving methods incorporated understanding of the system within a bigger environment (customer's customer)

The systems engineering process translates an operational need into a set of system elements. These system elements are allocated and translated by the systems engineering process into detailed requirements. The systems engineering process, from the identification of the need to the development and utilization of the product, must continuously integrate and optimize system and subsystem performance within cost and schedule to provide an operationally effective system throughout its life-cycle. Case studies highlight the various interfaces and communications to achieve this optimization, which include:

- The program manager/systems engineering interface, which is essential between the operational user and developer (acquirer) to translate the needs into the performance requirements for the system and subsystems
- The Government/contractor interface, essential for the practice of systems engineering to translate and allocate the performance requirements into detailed requirements
- The developer (acquirer)/user interface within the project, essential for the systems engineering practice of integration and balance

The systems engineering process must manage risk, known and unknown, as well as internal and external. This objective specifically focuses on external factors and the impact of uncontrollable influences, such as actions of Congress, changes in funding, new instructions/policies, changing stakeholders or user requirements, or contractor and Government staffing levels.

Lastly, the systems engineering process must respond to mega-trends in the systems engineering discipline itself, as the nature of systems engineering and related practices vary with time.

1.1.4 Framework for Analysis

This case study is presented in a format that follows the learning principles specifically derived for the program, using the Friedman-Sage Framework to organize the assessment of the application of the systems engineering process. The framework and derived matrix can play an important role in developing case studies in systems engineering and systems management, especially case studies that involve systems acquisition. The framework presents a nine-row by three-column matrix shown in Figure 2.

Concept Domain	Responsibility Domain		
	1. Contractor Responsibility	2. Shared Responsibility	3. Government Responsibility
A. Requirements Definition and Management			
B. Systems Architecting and Conceptual Design			
C. System and Subsystem Detailed Design and Implementation			
D. Systems and Interface Integration			
E. Validation and Verification			
F. Deployment and Post Deployment			
G. Life-Cycle Support			
H. Risk Assessment and management			
I. System and Program management			

Figure 2. Framework of Key Systems Engineering Concepts and Responsibilities

Six of the nine concept domain areas in Figure 2 represent phases in the systems engineering life-cycle:

- Requirements Definition and Management
- Systems Architecting and Conceptual Design
- Detailed System and Subsystem Design and Implementation
- Systems and Interface Integration
- Validation and Verification
- System Deployment and Post-Deployment

Three of the concept areas represent necessary process and systems management support:

- Life-cycle Support
- Risk Management
- System and Program Management

While other concepts could have been identified, the Friedman-Sage Framework suggests that these nine are the most relevant to systems engineering in that they cover the essential life-cycle processes in systems acquisition and systems management support in the conduct of the process. Most other concept areas identified during the development of the matrix appear to be subsets of one of these areas. The three columns of this two-dimensional framework represent the responsibilities and perspectives of the Government and contractor and shared responsibilities between the Government and contractor.

The Friedman-Sage Matrix is not a unique systems engineering applications tool, but rather a disciplined approach to evaluate the systems engineering process, tools, and procedures as applied to a program. The Friedman-Sage Matrix is based on two major premises as the founding objectives:

1. In teaching systems engineering, case studies can be instructive in that they relate aspects of the real world to the student to provide valuable program experience and professional practice to academic theory
2. In teaching systems engineering in DoD, there has previously been little distinction between duties and responsibilities of the Government and industry activities. More often than not, the Government role in systems engineering is the role of the requirements developer

1.2 T-6A Texan II Major Learning Principles and Friedman-Sage Matrix

The authors' selection of learning principles and the Friedman-Sage Matrix are reflected in the Executive Summary of this case (separate attachment).

2. T-6A Texan II Description

2.1 Background

The history of the T-6 dates back to the pre-World War II days. When one “googles” the T-6, numerous “hits” appear on the T-6 Texan designed by North American Aviation in the early 1930s. The T-6 was a single engine trainer used by the Army, Navy, and Royal Air Force to train their forces during World War II. Over 15,000 aircraft were built. The Army designated the original T-6 Texan as the AT-6, the Navy as the SNJ, and the Royal Air Force as the Harvard.



AT-6/SNJ/Harvard¹

The current version of the T-6 is designated the T-6 Texan II to distinguish it from its predecessor, the T-6 Texan. The T-6 Texan II is a derivative of a commercial aircraft, the PC-9, manufactured by Pilatus Aircraft, a company located in Switzerland. In addition to the United States Air Force, the primary users of the PC-9 are the Swiss Air Force, Royal Australian Air Force, Royal Saudi Air Force, Royal Thai Air Force, and Irish Air Corps. First flight of the PC-9 prototype occurred on May 7, 1984, with certification being obtained in September 1985. Beech Aircraft and Pilatus teamed to develop the Beech Mark II with a larger cockpit, stepped ejection seats, and a ventral brake. The Beech Mark II ultimately won the competition and became designated the T-6 Texan II.



Pilatus PC-9²

2.2 T-6A Texan II

The T-6 Texan II is a two-seat, single-engine aircraft whose purpose is to train Air Force and Navy pilots in basic flying skills. The T-6 replaces the T-37B for the Air Force and T-34C for the Navy. The aircraft is produced by Hawker Beechcraft, formerly Raytheon Aircraft Company (RAC). The aircraft is a derivative of the Pilatus PC-9 with numerous design changes necessary to meet the Air Force and Navy requirements. The aircraft cockpit is designed with stepped, tandem seating (one crewmember in front of the other) with the rear seat raised slightly to improve visibility. The instructor typically sits in the rear seat, but the student and instructor positions are interchangeable, and a single pilot may fly the aircraft alone from the front seat. The cockpit is also designed to accommodate a minimum of 80 percent of the eligible female pilot population.



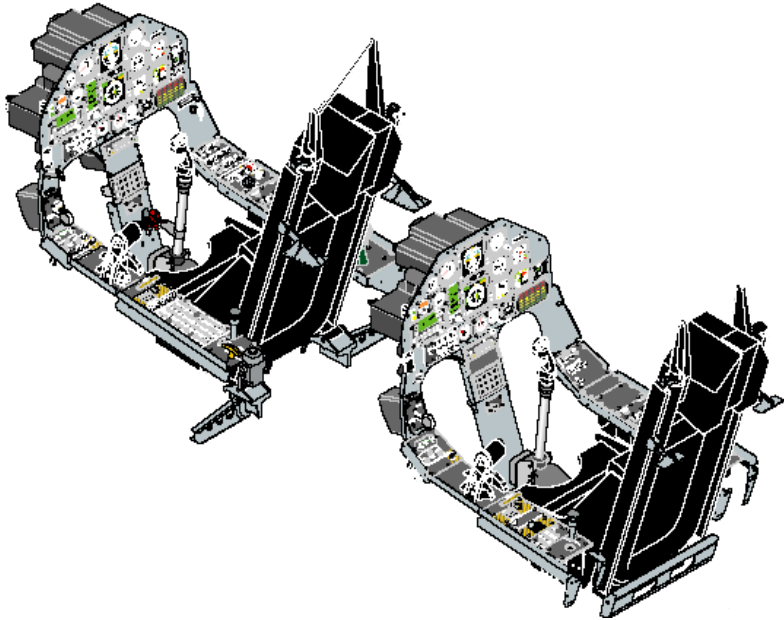
T-6A Texan II³

An egress system is provided, which allows for zero altitude/zero speed ejection through the canopy. The canopy is single opening, non-jettison, and capable of surviving a four-pound bird strike up to 270 knots true air speed (KTAS). The cockpit is pressurized and has an Onboard Oxygen Generating System, which, together, permits training at higher, less congested altitudes. Figure 3 depicts the cockpit layout.

¹ T-6 Texan, Wikipedia, http://en.wikipedia.org/wiki/T-6_Texan, 28 May 2009

² Pilatus PC-9, Wikipedia, http://en.wikipedia.org/wiki/Pilatus_PC-9, 28 May 2009

³ T-6A Texan II, http://www.af.mil/factsheets/factsheet_media.asp?fsID=124, 28 May 2009



Front Instrument Panel

Rear Instrument Panel

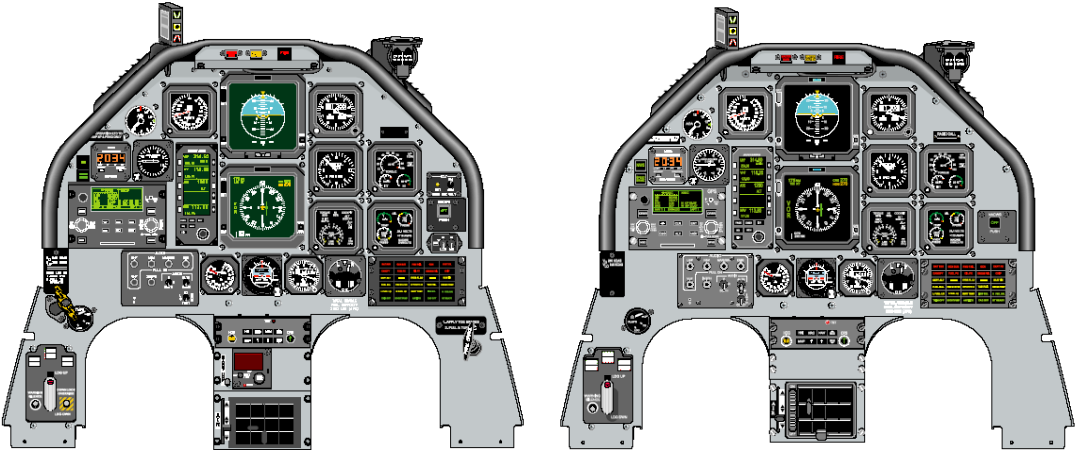


Figure 3. Cockpit Configuration

The T-6 Texan II has a Pratt & Whitney Canada PT6A-68 turbo-prop engine with 1830 equivalent thermodynamic shaft horsepower, flat rated to 1100 shaft horsepower, and is equipped with a four-blade propeller. The aircraft can climb at a rate of 3,100 feet per minute, reaching 18,000 feet in less than six minutes.

A 3,000 psi hydraulic system powers the flaps, speedbrake, and landing gear.

The aircraft is fully aerobatic and has an advanced avionics suite that includes an Angle of Attack System; Electronic Attitude Director Indicator; Electronic Horizontal Situation Indicator; UHF communications; Integrated Landing System; and Airborne Traffic Collision Warning System. The instrumentation package is Instrument Flight Rule Certified.

In reality, the T-6A configuration represents a significant modification to the baseline Pilatus PC-9. Figure 4 depicts some of the more significant changes. Figure 5 lists the aircraft's general characteristics.

- New aft fuselage for better handling qualities
- Redesigned wing for durability and damage tolerance
- New canopy shape for pressurization
- New cowling for reduced maintenance time
- Enhanced engine (PT-6A-68 ilo PT-6A-62)
 - Increased horsepower for excellent aerobatics
 - Digital engine control for jet-like performance
 - Continuous initial separator for foreign object damage (FOD) protection

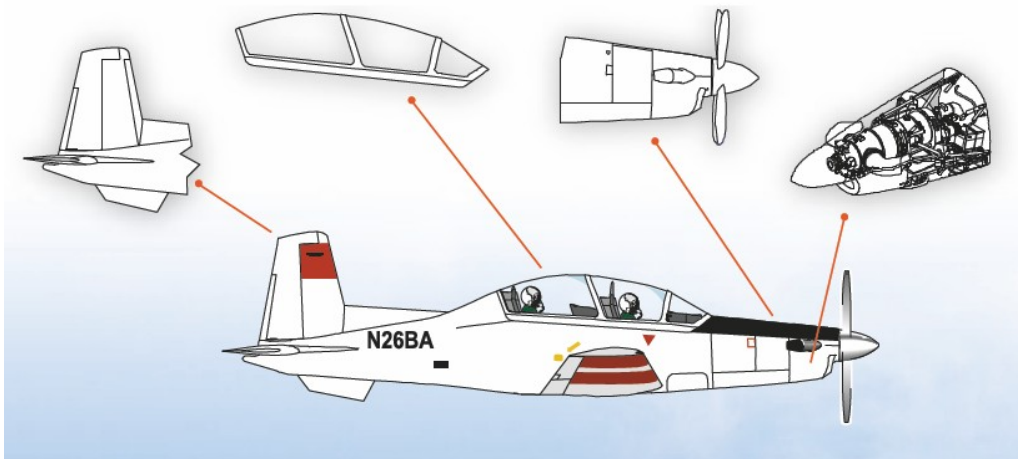


Figure 4. Differences between T-6A and PC-9⁴

⁴ Dispelling the Myth: The T-6 Is Not a PC-9, www.hawkerbeechnraft.com/military/t-6a/not_pc_9.pdf, 3 June 2009, Page 1

Air Force Designation: T-6
Navy Designation: T-6
Primary Function: Entry level trainer
Builder: Hawker Beechcraft Corporation (formerly Raytheon)
Wingspan: 33.5 feet
Length: 33.4 feet
Height: 10.7 feet
Speed: 320 miles per hour
Standard Basic Empty Weight: 4,707 pounds
Maximum Takeoff Weight: 6,500 pounds
Ceiling: 31,000 feet
Range: 900 nautical miles
Crew: Two; student pilot and instructor pilot
Seating: Stepped, tandem seating with one crewmember in front of the other
Powerplant: Single 1,100 horsepower Pratt & Whitney Canada PT6A-68 turbo-prop engine
Flight Controls: Dual-forward and aft
Landing Gear: Tricycle, retractable
Armament: None
Date Deployed: May 2000

Figure 5. General Characteristics

2.3 Joint Primary Aircraft Training System (JPATS)

The focus of this case study is limited to the T-6 aircraft. However, one must note that the T-6 is but one element of the total training system dubbed JPATS. JPATS consists of the T-6 aircraft, Ground Based Training System (GBTS), and Contractor Operated and Maintained Base Supply (COMBS) System. Hawker Beechcraft is the prime contractor for all three elements.

The GBTS consists of the following four segments:

- Aircrew Training Devices
- Development Courses
- Conversion Courses
- Operational Support

The Aircrew Training Devices consist of five non-motion simulators that include the Operational Flight Trainer, an Instrumental Flight Trainer, a Unit Training Device, an Escape System Trainer, and an Egress Procedures Trainer.

The Development Courses include the Principal Courses, Naval Flight Officer Courses, and Administrative Courses.

The Conversion Courses consist of two elements: a) the Computer Aided Instruction to New Computer Based Training System, which are the courses that must be converted from their existing media to the new JPATS media and b) the Training Integration Management System (TIMS), which is a networked computer-based system that manages and tracks student training. It encompasses the resource scheduling, performance evaluation, and deficiency tracking for each

trainee.

COMBS is the contractor-operated and maintained logistics support system for supporting all phases of operations without exceeding the Not Mission Capable Supply rate specified in the aircraft Prime Item Product Function Specification (PIPFS).

Figure 6 is a depiction of the integrated training system.



Figure 6. JPATS⁵

⁵ Joint Primary Aircrew Training System (JPATS) History, Hawker Beechcraft, 21 May 2009, Chart 2

2.4 History of Hawker Beechcraft

Hawker Beechcraft had its origin in 1932 when Walter H. and Olive Ann Beech founded the Beech Aircraft Corporation. Their first aircraft was the Beechcraft Model 17 “Staggerwing,” designed for the business traveler. The aircraft proved to be faster than the military pursuit airplanes of the day, and it won numerous air races. In 1937, Beech introduced its second aircraft, the Model 18 “Twin Beech,” which, amazingly, remained in production until 1970. During World War II, Beech produced 7,400 airplanes for the United States and Allied armed forces. “It is estimated that 90



Staggerwing

percent of all U.S. Army Air Corps bombardiers and navigators are trained in AT-7 and AT-11 aircraft – derivatives of the Beechcraft Model 18.”⁶ During the 1960s and 1970s, Beech established itself as a leader in the business jet arena, producing aircraft, such as the Baron B55, Baron G58, Model 90 Beech King Air, Beechcraft 99 Airliner, and Beech King Air 200.

On February 8, 1980, Beech Aircraft Corporation became a subsidiary of Raytheon Company, an electronics and technology company located in Lexington, Massachusetts. Following the acquisition, Beech continued to develop new models, such as the Beech King Air 300, Beechjet 400, Beech King Air 350, and T-1A. In August 1993, the Raytheon Company acquired Raytheon Corporate Jets from British Aerospace, a company that produced the mid-sized Hawker jet line. A year later (September 1994), during the JPATS Source Selection, Beech Aircraft and Raytheon Corporate Jets merged to become Raytheon Aircraft. Following the merger, Raytheon Aircraft developed aircraft, such as the Raytheon Premier I, Hawker 800 XP, Hawker 900 XP, Hawker 750, and T-6.

On March 26, 2007, the Raytheon Company sold Raytheon Aircraft “in order to focus on its military contracting business.”⁷ Goldman Sachs Group and Onex Corporation bought the company for about \$3.3 billion and changed the company’s name to Hawker Beechcraft. The new company continues, benefiting from the rich history associated with the two former companies.

3. T-6A Texan II Program

3.1 History

3.1.1 Trainer “State of the Union”

In the 1980s, the Air Force and Congress realized that the current Air Force training resources, the T-37 and T-38, were rapidly approaching obsolescence. This was mainly because of the age of the T-37 and T-38 and the rapidly evolving performance, advanced avionics, and cockpit displays of the new generation aircraft. Fairchild-Republic Corporation won a contract to develop the T-46 Eaglet trainer aircraft, and the Air Force planned to buy 650 of these aircraft to replace the aging T-37. First flight occurred in 1985, but the program was cancelled because of budget cuts required to comply with the Gramm-Rudman Act. With the loss of the T-46, the Air

⁶ About Us – History, Hawker Beechcraft, http://hawkerbeechcraft.com/about_us/history, 28 May 2009, Page 1

⁷ Hawker Beechcraft Corporation, Hoover’s, http://www.hoovers.com/hawker-beechcraft/--ID_103890___/free-co-profile.xhtml, 18 June 2009



Cessna T-37⁸



Northrop T-38⁹

Training Command (ATC) began drafting a Trainer Master Plan to identify a preferred training path, as well as the types and numbers of training aircraft required to achieve this training. They also felt the need to use commercial aircraft and training devices as much as possible to reduce development time and costs based on their T-46 experience.

3.1.1.1 Air Force Trainer Master Plan

The Air Force Trainer Master Plan was published in April 1988. The training path it identified was to move from the current generalized (i.e., primary) training to Specialized Undergraduate Pilot Training. Specialized training would be tailored to fighter-bomber and transport-tanker pilots to ease the transition into these advanced aircraft. ATC required three new training aircraft to achieve this objective: a subsonic, entry level (i.e., primary) trainer to serve as a replacement for the T-37; a supersonic, fighter-bomber type of trainer to serve as a replacement for the T-38; and a new airlift and tanker trainer.¹⁰

ATC's initial step was to pursue the new Tanker-Transport Training System (TTTS), which became the T-1A system and included 211 modified business jets, training devices, and other equipment. The second step would be the acquisition of a Primary Aircraft Training System (PATS) to replace the T-37. In light of the T-46 experience, ATC decided to follow the same acquisition strategy as the TTTS and pursue a commercially available aircraft for expediency and cost effectiveness. The expected PATS fleet size was 538 aircraft. Initially, all of the companies interested in competing were foreign but were seeking to partner with United States companies, since it was perceived that the United States Government would not be inclined to buy a foreign manufactured aircraft. The Request for Proposals (RFP) was to be released in February 1994 with contract award in October 1994. Delivery of the first aircraft was projected to be in 1995 with Initial Operational Capability (IOC) in 1999 and Full Operational Capability (FOC) in 2004.¹¹

The third and final step was to develop the Bomber-Fighter Training System (BFTS) as the replacement for the T-38. Since this would likely be a development program, ATC planned to complete pre-concept studies and perform a program analysis before beginning the competition.

⁸ Cessna T-37, http://en.wikipedia.org/wiki/File:T-37_021203-O-9999G-003.jpg, 18 June 2009

⁹ Northrop T-38, http://upload.wikimedia.org/wikipedia/commons/5/50/Northrop_T-38A_Talon_USAF.jpg, 18 June 2009

¹⁰ A Training System for the 21st Century: JPATS and the T-6, Richard H Emmons, June 2004, Page 1

¹¹ Ibid, Page 2

3.1.2 Defense Authorization Act

Following a review of the Air Force Trainer Master Plan, Congress directed the DoD, through the Defense Modernization Act for Fiscal Year (FY)89, to submit a report containing their future plans for both Air Force and Navy training. The House and Senate Armed Services Committees wanted a combined DoD plan that would allow the Navy and Air Force to procure similar training aircraft to minimize costs. The Air Force was directed to take the lead by Under Secretary of Defense (USD) Costello and develop the report for Congress.

The DoD Trainer Master Plan was developed and contained one major difference from the Air Force Trainer Master Plan; this concerned the costs to extend the T-37's useful life. The Air Force had contracted Cessna to perform a Durability and Damage Tolerance Analysis (DADTA) of the T-37. The results of this analysis identified new Structural Life Extension Program¹² (SLEP) procedures that could save \$85 million over the previously defined SLEP procedures. The original SLEP indicated the need to replace six fatigue critical structural components at a high cost. Following the DADTA, only two components were judged to require immediate replacement, and three others could be replaced, as needed. A two-phase inspection, field level and depot level, was required to accomplish this update.¹³ Even with the change in T-37 life extension costs, the DoD Trainer Master Plan indicated the need for a new PATS.

The DoD Trainer Master Plan still laid out the plan to procure a PATS in increased numbers to accommodate Navy requirements and phase out the T-37. But contrary to the DoD Trainer Master Plan, Congress authorized \$14 million to begin a T-37 life extension program instead of procuring a PATS. They also suggested that the Air Force consider the Navy's T-45 as a replacement for the T-38. This would allow joint development of a PATS aircraft to replace both the T-37 and T-34. Replacing the T-38 with the T-45 was a no-win situation in the Air Force's opinion. Although costs would be lower, since the T-45 was already in production, it would mean slipping the PATS T-37/T-34 replacement. Likewise, the T-45 would not be economical from the Air Force perspective. The T-45 aircraft carrier requirements included a heavier nose gear for catapult launches and structurally beefed up main landing gear and wing structure for carrier landings, which added unneeded weight for Air Force training operations. The Air Force would bear the cost of either decreased fuel efficiency because of the extra weight or the increased procurement costs for the removal of Navy specific design requirements.¹⁴

¹² Also known as Service Life Extension Program

¹³ A Training System for the 21st Century: JPATS and the T-6, Richard H Emmons, June 2004, Page 3

¹⁴ Ibid, Page 4



Beechcraft T-34¹⁵



T-45 Goshawk¹⁶

There were also other issues with buying T-45s and delaying PATS. The T-45 was not advanced enough to fulfill the Air Force requirement to prepare pilots to fly aircraft with the technological advances expected in the 21st century. This would also require yet another T-37 SLEP and miss the opportunity to procure a JPATS.

The Navy and Air Force signed a training Memorandum of Understanding (MOU) on December 6, 1988. The MOU stated that both Services would cooperate in identifying the need and requirements for three training systems, one to fulfill the Air Force tanker-transport and Naval flight officer training requirements, one to serve as a JPATS aircraft, and one to meet Air Force fighter-bomber and Navy strike training system requirements.

DoD trusted that these arguments, along with the DoD Trainer Master Plan, would show Congress that reversing the T-37 and T-38 acquisition strategy was not in the best interest of the Navy or Air Force.¹⁷

3.1.2.1 Validated Primary Aircraft Training System (PATS) Statement of Need (SON)

ATC began gathering the information necessary to fulfill the direction of the DoD Trainer Master Plan. In June 1988, they sent a draft SON for primary aircraft training to the Major Commands (MAJCOMs) for comment. They also sent a fact-finding team, not the first, to Europe to evaluate and explore the technologies of six candidate aircraft and reinforce their commitment to the PATS program. This team consisted of Maj Gen Robert Delligatti (ATC Vice Commander); Capt LynnAnne Merten (ATC PATS Acquisition Manager); and Capt Patrick Nolan (the General's Executive Officer). The candidate aircraft included the British Aerospace Hawk; Gruppo Agusta S-211 from Italy; Pilatus PC-9 from Switzerland; Aermacchi MB 339 from Italy; CASA C-10 from Spain; and Proavia Jet Squalus from Belgium. The team was unable to fully evaluate the Squalus because of bad weather. The team was also able to evaluate the IA-63 Pampa from Argentina when the Argentine Air Force flew the aircraft to Randolph Air

¹⁵ Beechcraft T-34, <http://en.wikipedia.org/wiki/File:T-34C-1.jpg>, 18 June 2009

¹⁶ T-45 Goshawk, <http://www.patrickaviation.com/uploads/photos/23165.jpg>, 18 June 2009

¹⁷ A Training System for the 21st Century: JPATS and the T-6, Richard H Emmons, June 2004, Page 5

Force Base (AFB), Texas. The SON was then updated and validated by the ATC Commander, Gen Oakes, in December 1988 and sent to Headquarters (HQ) Air Force for review.¹⁸

3.1.2.2 JPATS SON

In late 1988, ATC requested that the Aeronautical Systems Division release a contract for a PATS pre-concept study. This study was to develop a total training approach by integrating primary training with BFTS and TTTS training. The contract was awarded to the Illinois Institute of Technology Research Institute (IITRI). The three objectives of the study were to (1) identify the flying skills the student needed to acquire in primary training and the tasks the student must perform to acquire them; (2) identify the total training system (flight hours, ground hours, training devices, etc.); and (3) identify the benefits and life-cycle costs of training in a turboprop, twin engine jet, single engine jet, and single engine jet with more thrust. The Navy pursued a similar study as the Air Force. The results of both studies would then be used to identify common requirements leading to a JPATS acquisition.¹⁹

ATC issued the PATS SON on January 11, 1989, to begin the acquisition process. This was to become the JPATS, which would include commercially available off-the-shelf simulators, courseware, and a training management system.

As the prospect of a joint primary trainer was coming closer to reality, the Navy and Air Force began attending each other's training conferences and visiting their training bases. This allowed them to understand the training philosophies and, in the Navy's case, airfield flight restrictions. An O-6 working group, along with a JPATS committee of Action Officers, was formed to develop a draft Joint System Operational Requirements Document (JSORD). A tandem seating



T-37²¹

configuration was selected over side-by-side, as it would provide a wider field of view, lower drag, and be more representative of high-performance cockpits. This was a huge paradigm shift for the Air Force, since it had been using the side-by-side cockpit configuration of the T-37 for 30 years. The type of power plant required (turbo jet, turboprop, or turbo fan) and the number of engines was left open. The members decided that performance and handling characteristics should have the greatest importance.²⁰

In September 1989, ATC again sent a team to Europe to evaluate commercially available JPATS candidates (Figure 7). They evaluated five tandem seating aircraft, a ducted fan aircraft from Germany, the PC-9 turboprop from Switzerland, the MB-339 and S-211 from Italy, and the Tucano from Ireland. Another team went to Europe to evaluate the logistics aspects of the candidate aircraft, as well as the third flight evaluation team within the past three years. The information gathered during these fact-finding trips put ATC in a better position to determine achievable operational requirements. ATC also held an Industry Day in April 1989, which 24

¹⁸ Ibid, Page 6

¹⁹ Ibid, Page 8

²⁰ Ibid, Page 9

²¹ T-37 Cockpit, <http://www.airbum.com/pireps/PirepCessnaT-37.html>, 1 July 2009

contractors attended. This gave the contractors insight into ATC's training and maintenance operations and restrictions.²²



British Aerospace Hawk²³



Pilatus PC-9²⁴



Aermacchi MB 339²⁵



Proavia Jet Squalus²⁶



IA-63 Pampa²⁷



Fantrainer 600²⁸



Shorts Tucano²⁹

Figure 7. Candidate PATS/JPATS Aircraft

²² Ibid, Page 12

²³ British Aerospace Hawk, http://en.wikipedia.org/wiki/File:Bae_hawk_t1_xx245_inflight_arp.jpg, 1 July 2009

²⁴ Pilatus PC-9, <http://www.pilatus-aircraft.com/html/en/products/>, 1 July 2009

²⁵ Aermacchi MB 339, <http://upload.wikimedia.org/wikipedia/commons/7/76/MB-339CD.jpg>, 1 July 2009

²⁶ Proavia Jet Squalus, <http://www.hi-litesbyhigh.com/OtherCountriesAircraft/Belgium/BelgiumAircraft.html>, 1 July 2009

²⁷ IA-63 Pampa, http://www.aircraftinformation.info/Images/at-63_01.jpg, 1 July 2009

²⁸ Fantrainer 600, <http://www.airliners.net/photo/Unknown/RFB-Fantrainer-600/0372958/L/>, 1 July 2009

²⁹ Shorts Tucano (under license to Embraer), http://en.wikipedia.org/wiki/File:Short_tucano_t1_zf210_flying_arp.jpg, 1 July 2009

3.1.2.3 JPATS Program Management Directive (PMD)

A new PMD for specialized undergraduate pilot training was released by HQ Air Force in July 1990, which stressed joint Air Force/Navy procurement of a JPATS. As the means to achieve this, it directed the development of two documents, the Joint Statement of Operational Need (JSON) and JSORD.³⁰

3.1.2.4 Concept Studies

In June 1989, IITRI was well into the PATS study begun under contract to the Aeronautical Systems Division. As the concept of a joint acquisition evolved, the Navy decided to have a similar study performed. The contract to IITRI was extended to perform a Navy study to identify a concept for replacing the T-34C and determining the feasibility of using common aircraft and training system components. The Air Force PATS study was completed in July 1990. The study divided the candidate aircraft into groups according to type of engine (turboprop or jet), number of engines, and thrust/power. The results were that costs, complexity, and maintenance requirements were directly related to aircraft performance.

The study also identified issues with the current T-37 primary training program. It recommended increased instruction in instrument flying, formation flying, and visual flight rules flying. It recommended more than doubling the ground training hours and noted that the drivers in the life-cycle costs were the operation and maintenance of the aircraft. The ground-based training costs contributed little to the overall costs. Increases in ground-based training could improve effectiveness with little impact to life-cycle costs.³¹

HQ Air Force released the PMD for Specialized Undergraduate Pilot Training in February 1991. This directed the procurement of the T-1A Training System and directed that the necessary actions be taken to procure an enhanced flight screening aircraft. This included replacement of the T-37 with a JPATS and the development of a JSORD with the Navy.³²

3.1.2.5 Joint Statement of Operational Need (JSON)

Development of the JSON was well underway within the Navy. The Air Force had already developed a PATS SON, and the Navy developed a similar document, the Tentative Operational Requirements (TOR), for the Navy training system. The two documents were merged, and the JSON was released on September 14, 1990. The JSON's preferred acquisition strategy was to buy a missionized commercially available training aircraft and ground-based training systems common to both Services. The JSON also stated that some portions of the training systems could be tailored for Service-unique requirements.³³

3.1.3 Trainer Aircraft Summit

When the Air Force and Navy concept studies were complete and the results were analyzed, it became obvious that acquisition of a joint primary training aircraft made good sense. The type of flying skills that needed to be acquired and the tasks that needed to be performed to achieve those skills were remarkably similar between the Services. A trainer aircraft summit was held at

³⁰ A Training System for the 21st Century: JPATS and the T-6, Richard H Emmons, June 2004, Page 13

³¹ Ibid, Page 14

³² Ibid, Page 14

³³ Ibid, Page 15

Randolph AFB in October 1991. Participants included all interested acquisition and training organizations, as well as the Chief of Staff of the Air Force (CSAF) and Chief of Naval Operations (CNO). Both the Navy and Air Force laid out training plans that funneled the pilots from the primary training program to various specialized undergraduate pilot programs.³⁴

3.1.3.1 Draft Joint System Operational Requirements Document (JSORD)

In preparing the student pilots for specialized training, the JPATS aircraft had to meet certain minimum requirements:

1. Operate from sea level to 22,000 feet
2. Maintain 250 knot speed with a 270 knot dash requirement
3. Withstand G loads of +6 to -3
4. Take off and land with 25 knot crosswinds
5. Operate with handling characteristics forgiving of student pilot errors
6. Eject safely at sea level and 60 knots
7. Accommodate students with a seating height of 34 to 40 inches
8. Operate on 5,000-foot runways

Tandem seating was a previously agreed to configuration, but the number and type of power plants remained unspecified.

At the end of the trainer summit, both the CSAF and CNO agreed with joint planning and approved release of the JSORD, which occurred on October 22, 1991.³⁵

3.1.3.2 Solicitation for Information

Before the Trainer Summit, a solicitation for information was released by the System Program Office (SPO), inquiring about industry interest in competing for JPATS. More than 12 firms from Europe and Latin America with trainers already flying expressed interest in competing. Knowing of the United States dislike for buying foreign, most of these companies partnered with major United States aerospace firms.³⁶

3.1.3.3 Operational Requirements Document (ORD) Revised

The Air Force and Navy plan was to update the JPATS ORD periodically up to the release of the RFP as new requirements were developed or refined. A new version was released in April 1992, approved by the CSAF and CNO, and released to perspective JPATS competitors. The major change in the ORD was the reduction of Air Force aircraft because of an estimated reduction in navigator and pilot slots.³⁷ It should be noted that, during this time, there was a major realignment of the Air Force MAJCOMs. The Tactical Air Command (TAC) and most of the Strategic Air Command (SAC) were merged into the new Air Combat Command (ACC). The

³⁴ Ibid, Page 16

³⁵ Ibid, Page 16

³⁶ Ibid, Page 17

³⁷ Ibid, Page 18

Military Airlift Command (MAC) was transformed into the Air Mobility Command (AMC), which included some SAC assets.³⁸

3.1.3.4 Revised Department of Defense (DoD) Trainer Master Plan

The Navy had become much more involved since the original Trainer Master Plan was released, and this resulted in a new version of the plan in 1992. The new plan also included a helicopter specialized training plan for the Air Force. Previously, Air Force helicopter pilot trainees did not get fixed wing experience before attending helicopter flight school at Fort Rucker, Alabama. This now meant that all Air Force pilots would complete primary training together and receive their specialty aircraft training preferences based on class standing and slots available. This also brought the Air Force and Navy specialized training tracks even more in line.

3.2 JPATS Acquisition

The history of the JPATS acquisition illustrates the programmatic impacts of continual change and subsequent program redirection. During this process, many of the DoD senior leaders were changing. A new administration was installed, and Acquisition Reform became the new buzz word. The Federal Acquisition Streamlining Act (FASA) was enacted in 1994. The DoD 5000 series was being changed to accommodate Acquisition Reform. The DoD created a new position just to manage the change, Deputy Undersecretary of Defense for Acquisition Reform (DUSD[AR]), which reported to the Secretary of Defense (SECDEF). Some of the key Acquisition Reform events are presented in Figure 8.

February 1991	DoDD 5000.1 DoDI 5000.2 changed and reissued and 5000.2M promulgated
June 1993	Colleen Preston assumes the position as DUSD(AR)
October 1993	FASA of 1994 enacted
February 1994	William J. Perry replaces Les Aspin as Secretary of Defense
October 1994	Paul Kaminski is sworn in as USD for Acquisition and Technology (A&T)
December 1994	The Defense Acquisition Pilot Program (DAPP) is launched as allowed by FASA

Figure 8. Key Acquisition Reform Events

3.2.1 Acquisition Strategy

The Air Force was in the process of acquiring the T-1A to fulfill their tanker-transport training requirement, a very slightly modified commercial aircraft. It remained on schedule mainly because of the non-developmental nature of the program. The Navy, on the other hand, was having schedule issues with the T-45 Goshawk. It was based on a British aircraft already in service overseas, but developmental issues with the Navy specific requirement of carrier operations were causing acquisition schedule delays. Through these acquisition experiences and courseware development issues, both Services realized the need to have more Government interaction during the development phase of the courseware. Based on the T-1A and T-45 acquisitions and the Trainer Master Plan, the Air Force and Navy concluded that they could use common off-the-shelf GBTS hardware. They decided that a fixed price contract would be used for the ground-based hardware, but a cost plus contract would be best for the courseware because of the need for extensive Government involvement.

³⁸ Ibid, Page 18

Core to the acquisition strategy was the utilization of commercial items, practices, and processes to the maximum extent possible in order to reduce acquisition cost. The aircraft was to be largely non-developmental with only limited missionization required to fulfill the needs of the using Services. Thus, the JPATS would be based on the existing production aircraft and commercial components, such as avionics and engines.³⁹ ATC's preferred acquisition strategy was to use one contractual vehicle for both the airframe and GBTS. This would give them a single point of contact (POC) when issues arose in any part of the training system.

3.2.2 Initial Partnering

After the single contract acquisition strategy was developed, the airframe manufacturers looked for simulator and ground-based training partners. Beech/Pilatus added British Aerospace to the team, and Grumman/Agusta added Hughes to their team. Vought/Fabrica Militair De Avionics teamed with Loral; Lockheed/Aermacchi teamed with AAI; Northrop/Embraer teamed with Quintron; and Rockwell/Deutsche Aerospace MBB teamed with CAE Link.⁴⁰

3.2.3 Operational Demonstrations

One of the actions from the Trainer Summit in 1991 was for the JPATS SPO to set up operational demonstrations for the candidate aircraft at Wright-Patterson AFB (WPAFB), Ohio. The 4950th Test Wing (TW) would run the demonstrations with the participation of Navy and ATC pilots. This would give the Government an opportunity to evaluate the various candidates before release of the draft RFPs. This also gave the contractors a chance to market their hardware and capabilities. Two candidates completed the demonstrations when they were halted by the USD(A&T), Mr. Donald Yockey, because of cost concerns.

3.2.4 Definition of Non-Developmental

The USD(A&T) was concerned that the operational demonstrations were using too much research and development funds. He and his staff were also questioning the definition of "non-developmental," as well as the single contract acquisition strategy. Some of the candidate aircraft were strictly off-the-shelf, but other candidates were making major design changes. How much change can be made and still be considered non-developmental was and still is open to interpretation. Any proposed candidate aircraft still had to be developed to United States or foreign commercial or military standards and had to have an aerobatic civil certificate or the military equivalent. The result of these questions was a pause in the program, a change in acquisition strategy, and a resulting schedule slip.

3.2.5 Change in Acquisition Strategy

The acquisition strategy shifted from a single airframe/GBTS contract to separate airframe and GBTS contracts. Teaming arrangements had already been made to accommodate the single contract concept, and proprietary information was flowing among the teams.

The new acquisition plan was for the Air Force to first select the airframe manufacturer. Following that selection, a GBTS source selection would be held. One benefit to this approach is that JPATS would get both the best airframe and best GBTS.

³⁹ "A Case Study: Acquisition Reform and the Joint Primary Training Aircraft System (JPATS)," Kenneth W. McKinley, 18 June 2000

⁴⁰ A Training System for the 21st Century: JPATS and the T-6, Richard H Emmons, June 2004, Page 21

The Milestone 0/I review was held on January 19, 1993. The resulting JPATS Acquisition Decision Memorandum (ADM) stated that “the source selection criteria must clearly favor proposals involving the lowest development risk and the lowest total system cost to the Government.”⁴¹ USD(Acquisition, Technology, and Logistics [AT&L]) then designated the Air Force as the lead Service and required that the Air Force obtain approval of the Acquisition Strategy Report, documenting a two-contract approach with sequential aircraft and GBTS competitions.

JPATS acquisition officials continued to retain the two-contract approach, and, on May 19, 1993, USD(AT&L) convened a second Milestone I review. The Chairman recommended that USD(AT&L) approve the single airframe/GBTS contract and that the Air Force improve accessibility of the JPATS aircraft to women by adjusting the anthropometric thresholds.

Congress felt the need to become involved. The authorization committees stated that the JPATS should proceed with the single contract strategy. The Defense Acquisition Board (DAB) met in May 1993 to find a compromise. The compromise called for the acquisition of a non-developmental aircraft and that the airframe contractor would have total system performance responsibility. Once the airframe contractor was selected, the Government would hold a GBTS competition with airframe contractor input. The selected GBTS contractor would then become a major subcontractor to the airframe contractor. This would still allow the Government to get the best airframe and best GBTS while having a single POC.

The ADM approved the single contract strategy on July 7, 1993, with two stipulations: “The first stipulation was to limit acquisition costs to the greatest extent possible and the second was to ensure JPATS is fully consistent with DOD’s policies on women in combat.”⁴² Also, in July 1993, HQ Air Force redesignated ATC as the Air Education and Training Command (AETC). With this change, AETC also had responsibility for Air University and its education mission.

3.2.5.1 Accommodate for Female Population

The new USD for Acquisition, Mr. John Deutch, reviewed this new strategy and added another stipulation. JPATS had to follow DoD’s policy of supporting women in combat and be equally accessible to the same percentage of men and women. If that could not be accomplished, then the JPATS had to be accessible to at least 80 percent of the female population.

Mr. Deutch wanted the next draft RFP to contain source selection factors striving for lowest developmental risk and lowest total system cost. Acquisition costs were to be limited to the maximum extent possible. The contractors were to be asked for acquisition streamlining recommendations that would reduce cost. References to military specifications, standards, and service regulations were to be kept to a minimum. He also wanted a new Trainer Master Plan.⁴³

3.2.5.2 ORD Number 3

The third version of the ORD was released in September 1993. The changes in this version mainly dealt with the number of aircraft, instructor pilot training, and sequence of training location stand-up. The total number of aircraft was now 711, somewhat lower than the 765

⁴¹ Ibid, Page 24

⁴² Ibid, Page 24

⁴³ Ibid, Page 25

originally anticipated. The instructor pilot training date slipped, and the first instructors would be trained at the contractor's facility.⁴⁴

3.2.6 Draft Request for Proposals (RFP) Developed

Finally, the draft RFP, including all of the actions from the ADM, was ready. It was not well received at the Office of the Secretary of Defense (OSD) review. Senior leaders felt it fell short of acquisition reform ideals. It was too long at 1,000 pages and contained too much specific direction and not enough performance-based requirements. It also referenced numerous military specifications and standards that were not in step with the move to commercial practices and processes under acquisition reform. It was obvious that the RFP would not make it out of OSD, so Ms. Darleen Druyan, from the Office of the Assistant Secretary of the Air Force (SAF) for Acquisition, formed a Red Team to scrub and streamline the RFP. The team cut the page count 25 percent, deleted the "how to" language, cut down references to military specifications and standards to 64, and reduced the data requirements by 50 percent. They also recommended a change to the GBTS acquisition strategy. The acquisition strategy from the DAB put the Government in charge of selecting a GBTS contractor with airframe contractor input. This strategy made the Government culpable if GBTS problems arose. The new strategy proposed by the Red Team put the airframe contractor in charge with Government input.⁴⁵

In March 1994, the Assistant SAF for Acquisition held a review of the JPATS program. As a result, the contract strategy was changed to require that the prime contractor select the GBTS contractor instead of the Government per the recommendations of the Red Team. The Defense Acquisition Executive concurred and signed the Acquisition Strategy Report on May 17, 1994.⁴⁶

3.2.7 Defense Acquisition Pilot Program (DAPP)

Acquisition streamlining continued to be emphasized. FASA provided the initial impetus, but changing the Federal Acquisition Regulations (FARs) and Defense Federal Acquisition Regulations Supplement (DFARS) and DoD 5000 series took time. DoD developed DAPPs to showcase the cost and schedule savings of Acquisition Reform. The purpose of the pilot programs was "to demonstrate new and innovative approaches in the use of commercial practices and the acquisition of commercial products."⁴⁷ The pilot programs emphasized Acquisition Reform, particularly in the following areas:

1. Commercial Practices, Processes, and Products, whereby the Government acquisition process would use the commercial practices, processes, and products to the maximum extent practicable.
2. Affordability, whereby acquisition managers would use total budget and requirement trade-offs to achieve target prices by world-class techniques.

DAPPs could implement the provisions of FASA before the regulations were published and could use commercial item exemptions for non-commercial items. They also had expedited

⁴⁴ Ibid, Page 26

⁴⁵ Ibid, Page 27

⁴⁶ A Case Study: Acquisition Reform and the Joint Primary Aircraft Training System (JPATS) Program, Kenneth W. McKinley, Naval Postgraduate School, Monterey, CA, June 2000, Page 26

⁴⁷ Ibid, Page 23

deviation authority from the FAR/DFAR and DoD 5000 series regulations. They essentially had carte blanche authority to become as commercial-like as possible.

The DUSD(AR) recommended that JPATS become a DAPP. Mr. Deutch, USD at that time, concurred with the recommendation and formally designated the program as a DAPP.

3.2.8 RFP Released

The new RFP containing the changes from the Red Team and acquisition streamlining changes allowed by the designation as a DAPP was released on May 18, 1994. The Key Performance Parameters are listed in Figure 9.

Key Parameters	Threshold	Objective
Syllabus Maneuvers and Mission Profiles (Contact/Familiarization, Instruments, Formation, Navigation-High and Low, Training Mission Accomplishment)	Accomplish all five mission profiles	Same
Operational G Envelope (Gs)	+6 to -3 +4 to 0 asymmetric	+7 to -3 +4 to 0 asymmetric
Sustained Speed (1,000 feet MSL, hot day)	250 KTAS (270 KTAS Dash)	270 KTAS
Ejection Seat Envelope with Survival Kit	0 FT - 60 KTS	0 FT - 0 KTS
Pressurization (psi differential)	3.5 psi Diff	5.0 psi Diff
Able to Perform An Engine Out Landing	To Runway	Unprepared Surface
Birdstrike Capability (4 pound bird, no catastrophic damage)	270 KTAS	Max low level A/S
Cockpit Seating Configuration	Stepped Tandem	0 degree over-the-nose visibility from the rear cockpit at design eye height
Anthropometric Accommodation (Sitting height)	32.8 to 40 inches	31 to 40 inches
Cockpit Configuration	Able to be operationally flown from either cockpit	Interchangeable Instructor/Student
Takeoffs/Touch and Go/Land (Wx, weight, configuration) at Main Operating Bases	5,000 feet Runway	4,000 feet Runway
Exterior Noise	FAR Part 36, Most Restrictive Applicable Standard	Same
IFR Certified Instrumentation	IFR Certified (Selectable EADI/EHSI)	All digital except backups
Visual System for IFT/OFT	Provide a visual field of view commensurate with the JPPT syllabus training requirements	Same

Figure 9. JPATS Key Performance Parameters⁴⁸

⁴⁸ Operational Requirements Document for the Joint Primary Aircraft Training System, 1 April 2000

3.2.9 Source Selection

The source selection was a “best value” competitive source selection as delineated in FAR Part 15 and the Air Force FAR Supplement for aircraft and logistics support. The best value acquisition considering development risk and total system life-cycle cost was determined through proposal evaluation of a number of factors. The JPATS evaluation factors⁴⁹ were:

- A. Operational Utility/Technical
 - a. O.1 Operational Capability (includes flight evaluations)
 - b. O.2 Crew Accommodation
 - c. O.3 Structural Integrity (Service Life)
 - d. O.4 Certification/Qualification
 - e. O.5 Aircraft Missionization
 - f. O.6 System Safety
- B. Manufacturing and Quality Assurance
 - a. P.1 Manufacturing
 - b. P.2 Production Control and Quality Assurance
- C. Cost/Price
- D. Logistics Support
 - a. L.1 Acquisition Logistics
 - b. L.2 Contractor Logistics Support (CLS)
- E. Management
 - a. M.1 Aircraft Management
 - b. M.2 GBTS Support and GBTS Management
- F. Schedule

The factors are listed in descending order of relative importance with Manufacturing/Quality Assurance slightly more important than Cost. Factors O.1 and O.2 are of equal importance, and Factors O.3 through O.6 are of equal importance. Individually, Factors O.1 and O.2 are of greater importance than any single Factor O.3 through O.6. The Factors under Manufacturing/Quality Assurance are of equal importance. The Factors under Logistics are of equal importance, and the Factors under Management are of equal importance.

When the RFP was released, the only discussions that could be held with the bidders were through the Contracting Officer. Communications were terminated effectively at the worker level.

The risk in two areas was assessed during source selection. A proposal risk assessment evaluated the bidders’ proposed approach to fulfill the requirements, and a performance risk assessment evaluated the bidders’ past and present performance.

⁴⁹ Joint Primary Aircraft Training System Request for Proposals, F33657-94-R-0006

3.2.9.1 Requirements and Goals

The System Requirements Document (SRD) in the RFP served as the foundation for defining the JPATS requirements. The SRD contained numerous TBDs (To Be Determined), which were accompanied by a combination of requirements (“required” or “minimum required”) and goals (“desired”). One example that mixes both requirements and goals is in the area of anthropomorphics, Figure 10, which is not surprising given the high interest in accommodating the greatest percentage of female pilots possible.

Other specific examples include:

- The service life of the aircraft fleet will be sufficient for TBD years (24 years desired)
- The aircraft will cruise at altitudes up to TBD (18,000 feet mean sea level [MSL] minimum required)
- The aircraft will maintain a low-level cruise speed of TBD (250 KTAS required; 270 KTAS desired)
- The aircraft will take off and climb from sea level to 18,000 feet MSL at maximum takeoff gross weight and within established engine operating limitations in TBD minutes or less (8 minutes desired)
- The aircraft will not exceed TBD Maintenance Man-hours Per flight Hour (4.25 desired)
- The aircraft Turnaround Time will not exceed TBD minutes (30 minutes desired)

The numerous TBDs embedded in the SRD caused confusion among the bidders, particularly those not familiar in doing business with the Government. Many wanted clarification as to which goals were more important than the others, since the contractors all wanted to provide the “best value” to the Government. Some of the aircraft being bid were truly off-the-shelf, and from a goal perspective, you get what you get. Other companies were bidding modified off-the-shelf and had some leeway to make changes to try to achieve these goals. The Government could not tell an individual bidder which goal was more valuable than another, since it would give the bidder an unfair advantage.

3.2.9.2 Flight Evaluations

Seven contractors submitted proposals (see Figure 11). The RFP stated that flight evaluations would comprise a portion of the Operational Capability factor. Flight evaluations began in July 1994 with the Grumman/Agusta Team and S-211 turboprop. Vought/Fabrica Militair De Avionics with the turboprop PAMPA 2000 was next, followed by the Rockwell/Deutsche Aerospace-MBB Ranger2000. Cessna was next with its twin turboprop CitationJet, and Northrop/Embraer followed with the Tucano H. Lockheed/Aermacchi provided the MB-339, and, lastly, Beech/Pilatus brought their Mk II Turboprop, which was a derivative of the Pilatus PC-9. The flight evaluations were held at WPAFB and included a combined test force of Air Force and Navy pilots. The Air Force Operational Test and Evaluation Center (AFOTEC) also had pilots at the evaluations to perform an Early Operational Assessment.

3.3.7.3 Anthropometry.

The cockpit, including the escape system, shall accommodate (see paragraph 3.3.7.3.1 Accommodation) an anthropometric range associated with sitting heights of TBD [32.8 to 40.0 inches required, 31.0 to 40.0 inches desired] while wearing the environmental flight clothing and personal equipment listed in paragraph 3.4.6.5.2, Table 10. The anthropometric range is defined as multivariate anthropometric cases TBD in Table 3 [cases 1-6 (required), define the range associated with a 32.8 - 40.0 inch sitting height and cases 1-7 (desired), define the range associated with a 31.0 - 40.0 inch sitting height] and shall be used for meeting the reach requirements as defined in paragraph 3.3.7.3.2 Cockpit Reach and additional pilot interface requirements elsewhere in this document. The additional anthropometric characteristics TBD [Table 4 desired] shall be accommodated.

TABLE 3 - Anthropometric Characteristics

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
Thumb tip reach	27.0	27.6	33.9	29.7	35.6	36.0	26.1
Buttock-knee length	21.3	21.3	26.5	22.7	27.4	27.9	20.8
Knee-height sitting	18.7	19.1	23.3	20.6	24.7	24.8	18.1
Sitting height	32.8	35.5	34.9	38.5	40.0	38.0	31.0
Eye height sitting	28.0	30.7	30.2	33.4	35.0	32.9	26.8
Shoulder height sitting	20.6	22.7	22.6	25.2	26.9	25.0	19.5
Shoulder breadth range	14.7-18.1	16.4-20.6	16.2-21.2	16.8-21.7	16.9-22.6	16.8-22.5	14.2-18.0
Chest depth range	7.4-10.9	6.9-10.6	7.2-11.3	7.1-11.0	7.3-12.1	7.4-12.2	7.2-10.2
Thigh Circumference range	18.5-25.0	17.1-25.0	20.2-27.6	17.6-26.3	18.6-29.2	19.1-29.7	17.8-25.2

TABLE 4 - Additional Anthropometric Characteristics For Accommodation

CHARACTERISTIC	Cases 1 - 6	Cases 1 - 7
Forearm to forearm breadth (seated)	14.5 - 25.5	14.3 - 25.5
Hip breadth (seated)	10.8 - 18.1	10.8 - 18.1
Shoulder to elbow length (arm flexed)	11.7 - 17.2	11.0 - 17.2
Elbow to fingertip length (arm flexed)	15.4 - 23.2	14.7 - 23.2
Buttock to popliteal fossa length (leg flexed)	16.7 - 23.2	16.5 - 23.2
Popliteal height sitting	13.0 - 21.3	12.4 - 21.3
Boot size (U.S.)	6 - 13	5-13
Thigh clearance (sitting thickness)	4.9 - 8.1	4.7 - 8.1
Chest circumference	29.6 - 48.0	28.9 - 48.0
Waist circumference	23.6 - 44.7	22.9 - 44.7

The cockpit measurements in Table 4 are also of importance and should be accommodated. This table specifies a range of values for each dimension corresponding to Cases 1 - 6 and Cases 1 - 7.

Figure 10. System Requirements Document (SRD) Anthropometry, Required versus Desired

3.2.9.3 Jet Versus Turboprop

Throughout the process so far, the type and number of power plants required was not specifically addressed. The Air Force’s motto had been “an all jet Air Force.” The entire Air Force hierarchy had been attuned to this throughout their careers. The idea of taking a step backwards into the world of propellers was not an easy adjustment to make. Their whole paradigm might have to be

changed. True to the ideals of Acquisition Reform, the power plant requirement was never identified, just the performance requirements and flight envelope. The type and number would be fallout from all of the other requirements and best value source selection evaluation.

AIRCRAFT TYPE	POPULAR NAME	UNITED STATES MANUFACTURER/FOREIGN MANUFACTURER
Turboprop	EMB-312HJ	Northrop/Embraer (Brazil)
	Beech Mk II	Beech/Pilatus (Switzerland)
Jet (single engine)	MB-339 T-Bird II	Lockheed/Aermacchi (Italy)
	Pampa 2000	Vought/FMA (Argentina)
	Ranger 2000	Rockwell/DASA (Germany)
	S211A	Grumman/Agusta (Italy)
Jet (twin engine)	Citation Jet	Cessna

Figure 11. Proposed JPATS Aircraft

3.2.9.4 Beech Aircraft Selected

Dr. Sheila E. Widnall, SAF, announced the selection of Beech Aircraft Corporation to develop the JPATS on June 22, 1995. The program called for the delivery of 711 aircraft, 372 for the Air Force and 339 for the Navy. The program budget was \$7 billion, which included development, manufacturing, and initial support. Two contracts would be used, one for missionizing the aircraft and a second for CLS. Once these contracts were in place, Beech would begin source selection for the GBTS portion of the system.⁵⁰

The RFP asked the bidders for any alternate proposals that would streamline the acquisition process and decrease cost. Beech had proposed several initiatives that were accepted by the Government and resulted in reduced life-cycle costs. Using their own certified Earned Value Management System (EVMS) streamlined the process and reduced the amount of oversight and contract management, which resulted in a cost savings. They also changed the paint scheme. Five coats of the color white specified by AETC would be required to cover the primer, but, by using another color white, only two coats would be required. Beech also planned to put primer on piece parts, including rivet holes, before assembly, which would improve corrosion prevention. They also made their subcontractors switch from safety wire to self-locking screws, which eliminated the cost of safety wire, reduced FOD, and reduced manufacturing and life-cycle costs. They also had Pratt & Whitney add a wash ring to the engine inlet. This allowed maintenance personnel to flush the engine further, improving corrosion control.⁵¹

It should be noted that Beech Aircraft Corporation had been a subsidiary to the Raytheon Corporation since 1980. Following a corporate realignment in September 1994, they became RAC. Paragraph 2.4 depicts Beech’s history from inception to the present.

⁵⁰ A Training System for the 21st Century: JPATS and the T-6, Richard H Emmons, June 2004, Page 31

⁵¹ A Case Study: Acquisition Reform and the Joint Primary Aircraft Training System (JPATS) Program, Kenneth W. McKinley, Naval Postgraduate School, Monterey, CA, June 2000, Page 30

3.2.9.5 Protests

Immediately following the selection of RAC, Lockheed filed a protest with the Government Auditing Agency. Cessna, a division of Textron, also filed a protest citing their superior product and shortcomings of Raytheon's product:

“You can do more with a twin engine, you tend to have a longer service life and that will cut costs,” Textron Cessna spokesman Dave Franson said. Franson added that the Raytheon⁵² JPATS candidate is “not suitable” for the Air Force and Navy. Textron has also said that Raytheon aircraft's ejection seat is not suitable for all female pilots. In its Government Auditing Agency protest, the company alleged that the Raytheon airplane was not tested properly to determine whether women can work the control stick or eject safely.⁵³

Rockwell also followed suit and filed a protest. Lockheed subsequently withdrew its protest. Both Cessna and Rockwell complained that “the JPATS winner was chosen based on the lowest bid, and not on ‘best value,’ which bidders were told would be the basis for selection.”⁵⁴

The Government Auditing Agency denied both protests, and the contract was finally awarded on February 1, 1996. RAC then selected Flight Safety Services to develop the GBTS.

3.2.10 Official Designation of T-6A Texan II

Under normal circumstances, naming a new aircraft by a single service is not a quick and easy process. In this case, there were two Services trying to establish the designation for the new trainer. The candidate designations were the T-6A Mustang II, T-6A Mark II, and T-6A Texan II. The Air Force and Navy Training Commands agreed on the T-6A Texan II because of the huge role the North American T-6 had in training both Services' pilots in World War II and beyond.⁵⁵

3.3 Engineering and Manufacturing Development (EMD) Phase

The protests delayed the contract award for seven months. During that time, RAC tweaked their design, even though the effort was unfunded. Once the protests were resolved and the contract was awarded, EMD officially began.

3.3.1 EMD Contract

The EMD contract was a fixed price incentive-firm with an award fee. It included the development of an instrumented manufacturing development aircraft (Lot 1), as well as seven production options. The initial contract was awarded under FAR Part 15 (Contracting by Negotiations) and, thus, had most of the regulations and reporting requirements of a typical Air Force development contract. In an effort to become more “commercial like” consistent with acquisition reform, JPATS used its designation as a DAPP to pursue relief from certain statutory and regulatory requirements. These requirements were inherently governmental and virtually non-existent in a commercial off-the-shelf (COTS) acquisition. Figures 12 and 13 identify the

⁵² The reference states “Textron” which is likely a typo

⁵³ GAO ruling on Textron's JPATS protest expected next week. (Joint Primary Aircraft Training System contract awarded to Raytheon's Beech Aircraft), Defense Daily, 2 February 1996

⁵⁴ “Rockwell joins protest at JPATS selection”, Flight International, 8 February 1995

⁵⁵ A Training System for the 21st Century: JPATS and the T-6, Richard H Emmons, June 2004, Page 32

JPATS regulatory and statutory relief. Except for the areas of “Special Test Equipment” and “Value Engineering,” the regulatory relief did not impact systems engineering.⁵⁶

The contract included a number of elements key to systems engineering, as reflected in Section H, Special Requirements and Statement of Work (SOW). The contract also included an Integrated Master Plan (IMP) and product specification (i.e., PIPFS).

FAR 52.203.4	Contingent fee representation and agreement
FAR 52.203-5	Covenant against contingent fees
FAR 52.209-6	Protecting Government interests when subcontracting with contractors debarred, suspended, or proposed for disbarment
DFARS 252.203-7001	Special prohibition on employment
DFARS 252.242.7004	Material management and accounting system
FAR 52.203.7	Anti-kickback procedures
FAR 52.223-5	Certificate for drug-free workplace
FAR 52.223-6	Drug-free workplace

Figure 12. JPATS Statutory Relief

⁵⁶ A Case Study: Acquisition Reform and the Joint Primary Aircraft Training System (JPATS) Program, Kenneth W. McKinley, Naval Postgraduate School, Monterey, CA, June 2000, Page 43

FAR 52.212-9	Variation in Quantity
FAR 52.229-5	Taxed-contracts performed in United States possessions or Puerto Rico
FAR 52.232-1	Payments
FAR 52.232-2	Payments under fixed-price R&D Ks
FAR 52.232-9	Limitations on withholding of payments
FAR 52.232-11	Extras
FAR 52.245-18	Special test equipment
FAR 52.246-11	Higher-level contract quality requirement (Government spec)
FAR 52.247-1	Commercial Bill of Lading
FAR 52.247-65	FOB origin prepaid freight-small packages
DFARS 252.242-7003	Application for United States Government Shipping Docs/Instructions
FAR 52.222	Notice to Government of labor disputes
FAR 52.248-1	Value engineering
DFARS 252.203-7002	Display of DoD hotline poster
DFARS 52.242-7000	Post-award conference
DFARS 252.208-7000	Intent to furnish precious metals as GFM
FAR 52.244-1	Subcontracts (fixed price contracts)
DFARS 252.209-7000	Acquisition from subcontractors subject to on-site inspection under INF treaty
DFARS 252.210-7003	Acquisition streamlining
DFARS 252.234-7000	Notice of Cost/Schedule Control systems

Figure 13. JPATS Regulatory Relief

Section H - Special Contract Requirements

Section H contained several requirements that supported the systems engineering process directly. Although JPATS was to be as “commercial like” as possible, the Government had their unique requirements that required some method of Government insight and risk management. The Section H requirements were used to address the implementation and management of these unique requirements. The “Required Demonstration Milestones” were defined to lay in a top-level disciplined systems engineering framework. They include:

1. Required Demonstration Milestones
 - Aircraft Preliminary Design Review (PDR) Complete
 - Aircraft Critical Design Review (CDR) Complete
 - GBTS Contract Change Proposal (CCP) Definitized
 - First Shipset of Aircraft Components for GBTS Delivered
 - Final Design Data for GBTS Delivered
 - All Major Flight Conditions to Ultimate Load on Static Test Article Complete
 - Birdstrike/Ejection System Testing Complete
 - Physical Configuration Audit (PCA) Complete
 - One Lifetime of Durability Testing Complete
 - Two Lifetimes of Durability Testing Complete
2. Configuration Management
 - The contractor will be responsible for the functional and allocated baseline of the JPATS program
3. Specification and Standards
 - JPATS aircraft will be designed according to Federal Aviation Administration (FAA) standards and FAA-approved contractor standards and processes and certified by the FAA
 - Military specifications and standards will be used when there are no applicable FAA standards or FAA-approved contractor standards and processes or when a military specification or standard is specifically required by the terms and conditions of this contract
4. Integrated Product Development
 - Both the contractor and Government will use integrated product development for the JPATS program
5. EVMS
 - The contractor may manage the JPATS contract using his own EVMS
 - Note: The Government's intent is to use the contractor's EVMS for integrating and inter-relating the technical, schedule, and cost parameters associated with contract performance
6. Commercial Items
 - The contractor will maximize the use of DFARS 211.70 when acquiring commercial items from subcontractors or suppliers. DFARS 211.70 objectives are to acquire a system that meets stated performance requirements while avoiding over-specification and ensuring that cost-effective requirements are included in the acquisition

SOW

The SOW was reasonably comprehensive and contained a number of additional elements key to the systems engineering process. The Government was acquiring a COTS trainer aircraft, but, initially, they would be the only customer. Without a viable alternative trainer aircraft or larger customer base to provide leverage over the contractor, the Government would be locked into this

JPATS. The SOW included risk management tasks similar to typical developmental acquisition programs to mitigate the risk. These additional elements include:

- Aircraft Structural Integrity Program (ASIP)
- Structural Force Management Program
- Engine Structural Integrity Program (ENSIP)
- Program Status Reviews
- Aircraft System Test and Evaluation
- Aircraft Data Requirements
- Logistics Support Analysis
- Corrosion Prevention and Control Plan
- Integrated Support Plan
- Integrated Test Plan

Data Rights

In many ways, the T-6 contract was structured as a commercial buy but with Government involvement. The basic PC-9 design clearly met the COTS criteria, since it was an existing commercial design developed by Pilatus. However, in order to meet Government specification requirements, numerous design changes had to be incorporated. The extensiveness of the changes even led many to state that the “T-6 is not a PC-9.” In order to experience the cost savings associated with a commercial acquisition, most of the changes to the basic PC-9 configuration were developed similar to a commercial buy. As a result, the changes were generally developed at Raytheon’s expense, with the data (drawings, analyses, etc.) belonging solely to RAC or the subcontractors. However, RAC did have to show compliance to the Government requirements. Below is an example of how incorporation of a new “widget” was typically funded:

Effort associated with presenting a concept to the Government	Government-funded
Establishing and implementing the design, creating drawings, etc.	RAC-funded
Testing	Government-funded
Drawing updates, tooling changes, Class II Engineering Change Proposals (ECPs)	RAC-funded

The result is that much of the data associated with the design changes are also proprietary, with the Government having only unrestricted data rights to the test reports. Without the data rights, the Government does not own the design and will be largely dependent upon Hawker Beechcraft for future modifications, design changes, and manufacturing of replacement parts.

Even though most of the data are proprietary and involve limitations on the data distribution, the T-6 contract does have provisions allowing the Government access to the data. Below are the paragraphs from the SOW, which address the data provisions:

“3050.2.1 Contractor Existing Engineering Data File (EEDF)

Beech shall maintain a Beech Mk II aircraft engineering data file and shall arrange for the Government to have access at Beech facility(ies) to all engineering data, and their reference documents, that describes the aircraft, including Beech Mk II new and modified features of all systems, subsystems, assemblies, and parts. All requests by the Government for copies of EEDF information will be in writing and will be signed by the Contracting Officer. (DI-A-3027A/T)”

“3050.3.1 Data Accession List

Beech shall provide the Government with access at Beech’s facility(ies) to internal documents which were produced to manage the JPATS program and to design, develop, and test the aircraft. Beech shall provide, upon written request, copies of all internal data generated in compliance with contractual tasks. Beech shall flow this Data Accession List requirement down to major subcontractors and include subcontractor data on the Data Accession List. Beech shall honor only those written requests for accession list data which are signed by the Contracting Officer. (DI-A-3027A/T)”

The reality is that the contractor, for the most part, developed the data to manufacture the airplane at their own expense, and, thus, the data are proprietary. The contractor continues to maintain the drawings, specifications, and other documents required for the parts and aircraft assembly through company funding, so the data remain proprietary. On the other hand, the T-6 does have some Government-funded items. These items are typically related to documentation information, such as test reports, and the Government does have rights to these, since they provided the funding. The program documents are marked based on the contractual requirements in place for that particular activity.

Per the SOW, the data listed on the Data Accession List (DAL) that are proprietary are provided to the Government freely with the condition that they are proprietary and marked so. Each DAL request is handled individually, only because some data on the DAL were generated through Government funding, and these would be marked in a different manner as stated above. While the contract states that the Contracting Officer is the official requestor for data either in the EEDF or DAL, the contractor and Program Office eventually established an agreement that these data requests would be signed by the 664th Aeronautical Systems Squadron (AESS) Configuration Manager to facilitate the activity. In addition to the EEDF and DAL, there are some data that are provided as specifically required in the contract per other Contract Data Requirements List (CDRL) requirements.

IMP

The IMP established at contract award contained 29 milestones, 102 accomplishments, and 458 criteria. The IMP accomplishments, along with the corresponding criteria, were written around the major program milestones. The IMP included most of the required demonstration milestones included in Section H of the contract discussed above, as well as additional milestones. The milestones addressed in the IMP include:

- Air Vehicle PDR
- Air Vehicle CDR
- Phase 1 Aircraft Data Package for GBTS
- Training System Integration Review GBTS Joint Primary Pilot Training PDR

- Second Shipset of AV Components for GBTS
- Phase 2 Aircraft Data Package for GBTS
- Flight Readiness Review (FRR)
- Third Shipset of AV Components for GBTS
- Fourth Shipset of AV Components for GBTS
- GBTS Integration Review
- AV Functional Configuration Audit (FCA)
- AV PCA – Start
- AV PCA – Completed
- Phase 3 Aircraft Data Package for GBTS
- AV Planning for Rate Review (PFRR)
- Required Assets Available (RAA) at Randolph AFB
- JPPT Small Group Tryout Started
- Aircraft Deployment for Reese AFB, Texas
- Two Lifetime Durability Test Completed
- Preparation for GBTS Site Readiness Review (SRR) at Reese AFB Completed
- FOC at Reese AFB
- FOC at Laughlin AFB, Texas
- FOC at Randolph AFB
- FOC at Vance AFB, Oklahoma
- FOC at Naval Air Station (NAS) Whiting Field, Florida
- FOC at Columbus AFB, Mississippi
- FOC at NAS Corpus Christi, Texas
- FOC at Sheppard AFB, Texas
- FOC at NAS Pensacola, Florida

PIPFS

In concert with being designated as a DAPP that focused on the objectives of acquisition reform, the PIPFS referenced only a limited number of military specifications and standards, i.e., 17 specifications and 21 standards. The PIPFS was still a 140-page document with 1,250 individual requirements needing verification, but it focused more on the system-level requirements instead of detailed design solutions. The specification addressed requirements related to areas, such as:

- Operational Service Life
- Aerodynamic Performance
- Flying Qualities
- Reliability
- Maintainability and Availability
- Environmental Conditions
- Materials, Processes, and Parts
- Electromagnetic Effects

- Identification and Marking
- Safety
- Human Performance and Human Engineering
- Structural Requirements
- Flight Controls
- Utility Systems
- Propulsion
- Avionics
- Crew Systems
- Support Equipment
- Facilities
- Packaging, Handling, Storage, and Transportation

Shortly after EMD contract award, both the SPO and RAC engineers realized that certain requirements were not in the PIPFS. For example, there was a requirement to cool the cockpit and avionics, but there was no heating requirement. Following this realization, RAC and SPO management agreed that, for a short period of time, requirements could be added to the specification if the RAC and SPO engineers agreed. Unfortunately, some requirements took longer to define than the agreed to period of time, and, sometimes, the extensiveness of the change required an ECP to implement.

3.3.2 Organizational Structure

The JPATS program organized according to Integrated Product Teams (IPTs). Throughout the entire program, the emphasis has been on teaming between the Government Program Office and prime contractor. The Chief Engineer for both the Government and contractor is responsible for technical management and systems engineering. Both the Government and contractor have organized according to the three basic elements of the JPATS program: Air Vehicle, GBTS, and Sustainment.

Government

The JPATS program is managed by the 664 AESS, formerly the JPATS SPO. From program inception, the Program Office has been organized using IPTs. The structure has changed slightly with time as the focus of the program has changed. However, Figure 14 is a representative depiction of the engineering organization over time. As the figure shows, there is a separate Systems Integration IPT, which interacts with the functional areas to ensure that all appropriate systems engineering activities are accomplished. The team focuses on systems engineering planning, process development and execution, risk management, scheduling and schedule tracking, deficiency reporting, etc. All of the IPTs also have formal representation and participation from the Systems Integration IPT.

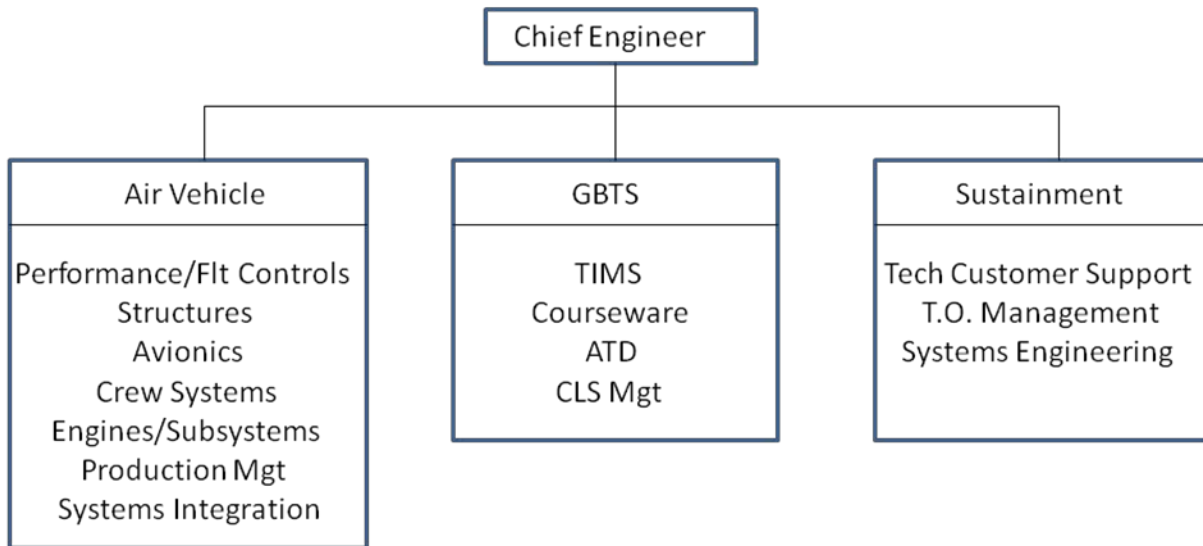


Figure 14. Government Engineering Organization

Raytheon

The contractor has also been organized according to IPTs since program inception. Like the Government, the contractor has tweaked their IPT structure over time as the program has changed in product focus, phase, etc. However, the basic structure has been retained as depicted in Figure 15. Within each IPT, there are representatives, as appropriate, from each of the involved disciplines, e.g., Engineering, Manufacturing, Producibility, Quality Assurance, Test, Safety, Program Management, Configuration/Data Management, etc. Key to the operation of the IPTs is the concept that each contractor IPT has a designated Government counterpart to participate in discussions, decisions, etc. The Chief Engineer, along with his deputy, is responsible for implementing systems engineering across all the IPTs. They ensure that the company’s “best commercial practices” are implemented. These practices often involve processes necessary to obtain FAA certification. There is no one specifically identified as a systems engineer that is assigned to the IPTs, nor is there a separate Systems Engineering IPT. Instead, the Chief Engineer chooses IPT leaders who are knowledgeable and experienced with their systems engineering processes.

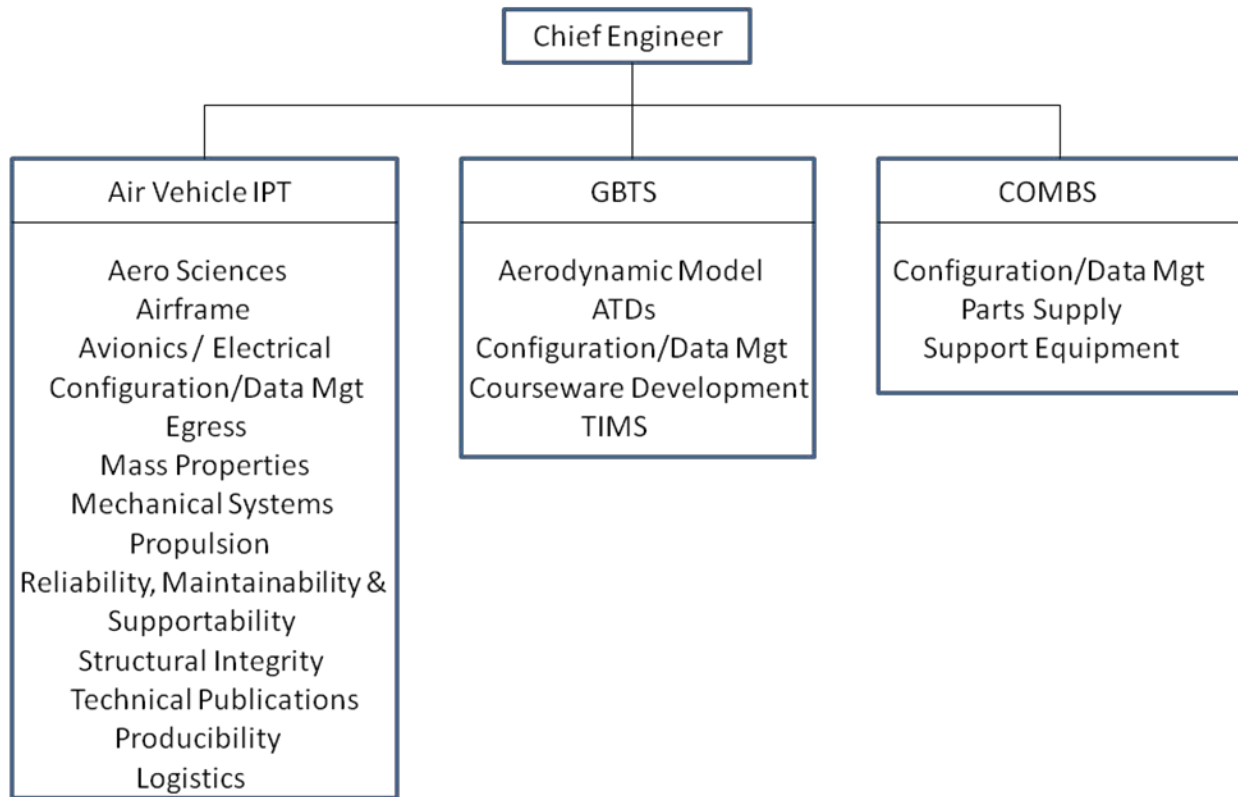


Figure 15. Contractor Engineering Organization

3.3.3 Design Evolution

The T-6A design evolved from the Pilatus PC-9, which was one of the aircraft AETC included in their early fact-finding trips to Europe. Pilatus teamed with Beech in 1991. The team knew that the baseline needed significant modifications to satisfy the mission requirements. These included:

- A. Anthropometric Considerations – Accommodate 80 percent of the female population
- B. Improved Flight Characteristics – Forgiving handling qualities for student pilots
- C. Pressurized Cockpit
- D. Canopy and Structure Birdproofing
- E. Increased Power
- F. Single Point Pressure Refueling and Defueling
- G. New Avionics Suite
- H. Increased Reliability and Maintainability
- I. Zero-Zero Ejection Seat – A JSORD objective
- J. Linear Power Response – More jet-like acceleration characteristics (minimize prop torque)

A PC-9, Serial Number (S/N) 176, was procured by Beech and used as the baseline aircraft. Beech flew over 500 demonstrations and evaluation flights in the 1990 time period to determine what changes were needed to successfully meet their requirements. The debriefings from those flights formed the basis of their requirements and design document. In 1991, the contractor built the first prototype, PT-1. The modifications included installation of the more powerful Pratt &

Whitney PT6A-68 and a new canopy. This prototype was used to evaluate the handling qualities with the modifications. The next prototype, the PT-2, was built the following year and was fully missionized. The tail, rudder, and elevator were redesigned. The only parts Pilatus supplied were the wing assembly, a portion of the aft fuselage, the landing gear, the vapor cycle cooling system, and miscellaneous parts. First flight took place on December 23, 1992. The flight test program for PT-2 evaluated flutter characteristics through a greater flight envelope; validated flying qualities, including common student errors; evaluated a new trim aid device; and evaluated aircraft flight, including takeoff and landing performance.

PT-3 was built in 1993 and included modifications, such as a canted instrument panel, liquid crystal displays, a reshaped ejection seat head box, and numerous maintainability improvements. First flight was July 29, 1993. PT-3 was used for continued flight testing, flutter, flying qualities validation, performance checks, and final systems checks. It was also used for the source selection evaluation flights, was the FAA conformity article, and performed initial FAA certification flights.

Below is a summary of the more significant design changes leading up to source selection:

- “New aft fuselage for improved flying qualities
- New canopy shape for pressurization
- New cowling to reduce maintenance time
- Integration of external shapes for enhanced handling characteristics
- PT-6A-68 engine integration
 - Digital engine control for jet-like performance
 - Increased horsepower for excellent aerobatics
 - Continuous inertial separator for FOD protection
- Single-point refueling for minimum turnaround time
- Zero altitude/zero airspeed ejection seat for maximum student safety
- Bird-strike canopy for pilot protection in low-altitude training environment
- Fuselage enhancements
 - Cockpit redesigned to accommodate widest range of pilot body sizes
 - Pressurization and larger air conditioner for crew comfort
 - Large aft fuselage avionics bays to reduce maintenance man-hours
 - Improved seat installation hardware to expedite replacement
- Active-matrix LCD displays that improved sunlight readability
- State-of-the-art avionics for maximum training benefit and lower life-cycle costs
- Environmentally friendly HFC air-conditioning system
- Avionics mounted one deep in aft bay to speed maintenance on the line
- Replacement of safety wire with captive nut plates to eliminate foreign-object damage (FOD) hazard
- Wing rotated forward 1.5 degrees nose up to improve visibility for instructor”⁵⁷

⁵⁷ Dispelling the Myth, http://www.hawkerbeechcraft.com/military/t-6a/not_pc_9.pdf, Hawker Beechcraft Corporation, Copyright 2007, Pages 1 to 3, 28 July 2009

RAC continued to refine the design while the contract protests were being resolved. The improvements included:

- Airframe Improvements
 - DADT Designed Wing
 - Bird Strike Resistant Leading Edges for Wing and Empennage
 - Structural Beef-Ups
 - Design Updates for Manufacturing
- Propulsion Improvements
 - Single Point Refueling Nozzle Moved to Left Side
 - Automatic Fuel Balancing
- Systems Improvements
 - Onboard Oxygen Generating System
 - 13 FPS Landing Gear
 - Heavy Duty Brakes
- Avionics Improvements
 - GPS – KLN-900
 - VHF and UHF Radio

All of this significant development activity, which was before contract award, was entirely funded by the contractor.

Following EMD contract award, additional changes were made in establishing the final production configuration. These include:

- “Maintenance-free hydraulic accumulator
- New hydraulics system, wheel and brakes to reduce maintenance man-hours
- Advanced surface sealing for optimal corrosion protection
- 18,720-hour fatigue life design ...
- Removable vertical stabilizer to reduce maintenance workload
- ON-condition engine hot-section inspections
- 4,500-hour time between engine overhaul – highest in its category
- Wing enhancements
 - Integral aerobatic fuel tanks for reduced maintenance
 - Exposed wing spar to facilitate inspectability
 - Removable bird-strike leading edge to reduce repair costs
 - +7 to -3.5 G capability to maximize training
 - Designed with consideration of future external store”⁵⁸

The bottom line is that almost every system on the PC-9 was redesigned, and almost every component was reproced to obtain an FAA-certifiable aircraft that satisfied Government requirements. The Government requirements addressed the differences between commercial versus military missions, design usage, and Government-unique requirements. However, no information could be found concerning any studies that may have been done to determine the JPATS cost savings associated with starting with the PC-9 design as opposed to starting with a totally new design.

⁵⁸ Ibid, Page 4

3.3.4 Requirements Verification Process

The T-6A program developed a good systems engineering approach to requirements verification. Their process was embedded within the IMP. The IMP identified the initial program integration planning processes and overall program process that had to be developed, including the ASIP, ENSIP, and System Safety Plan. The Air Force and Navy systems engineers in the Program Office developed a requirements traceability plan. They laid out the 1,250 PIPFS requirements and their verification in notebooks with one page for each requirement/verification. Closing out a requirement required signatures by the RAC and Air Force subject matter expert (SME), signifying that the requirement had been verified. Some requirements also required the systems safety and program manager's signature. Verification methods included demonstration, analysis, ground test, and flight test.

Verification of requirements involving flight test became an issue. First and foremost, the T-6A was to be FAA-certified to FAR Part 23. In RAC's eyes, this testing had first priority. The Government was not totally familiar with FAA certification requirements and how a combined flight test program could achieve verification of both FAA and PIPFS requirements. This unfamiliarity required a great deal of research to identify where the requirements were similar or different.

SPO engineers attended some component qualification tests but relied heavily upon the flight test results to verify requirements.

3.3.5 Qualification Test and Evaluation (QT&E)

The QT&E phase of the T-6A program consisted of two elements: 1) airworthiness certification by the FAA and 2) military verification testing. The two elements of QT&E were integrated into a single test program with tests sometimes satisfying both elements. Throughout the QT&E, the Government pilots worked side-by-side with the RAC pilots.

QT&E occurred at Wichita, Kansas, between June 1996 and February 2000. An Integrated Test Team (ITT) was formed to support FAA certification and military qualification. The ITT consisted of Air Force, Navy, RAC, and FAA personnel. One Air Force and one Navy test pilot and two Air Force flight test engineers were permanently assigned to the Wichita test facility. The on-site team was augmented on an "as needed" basis by one Air Force and two Navy members from Edwards AFB, California, and NAS Patuxent River, Maryland. The test program was originally planned with two aircraft, but, as the plan matured, one prototype and four aircraft (PT-4 through PT-7) were flown. Testing consisted of 871 flights encompassing 1,095 hours. Below is a description of the two individual elements of QT&E.

3.3.5.1 Federal Aviation Administration (FAA) Certification

Background: In order for a military aircraft to operate in civil airspace, the aircraft has to be certified as airworthy either by the military branch of service or FAA.

When the Air Force certifies an aircraft, it uses the following three-step process:

1. Development and approval of a Tailored Airworthiness Certification Criteria (TACC) document for use as the basis of certification. Military Handbook (MIL-HDBK)-516 defines the criteria to be tailored.
 2. Design evaluated against the criteria contained in the TACC, using a combination of analysis, laboratory, simulator, flight, and demonstration data to verify compliance.
-

3. All non-compliances assessed for operational safety risks and all identified risks accepted by the appropriate authority.

The process is controlled by the Aeronautical Systems Center (ASC) Airworthiness Board at WPAFB, and the TACC requires coordination of the functional experts within the ASC Engineering Directorate.

When the FAA certifies the aircraft, it uses a very disciplined process involving FARs, Orders, Advisory Circulars, and Forms. Certification efforts must be conducted, and compliance must be determined by the FAA or designated representatives of the FAA. The rules governing FAA certification are relatively stable. They are based on years of experience, and it takes about seven years to publish a new rule. The day that a program applies for certification is the date that determines the rules that apply. There is some latitude available for a modification if a new rule results in significant changes to the existing baseline design. Two advantages to FAA certification of the T-6 were that the contractor is well versed on FAA certification, and the rules are reasonably fixed.

There are three different certificates involved in certifying that an aircraft is safe to fly. They are:

1. Type Certificate, which is given to aerospace manufacturers by the FAA after it has been shown that the particular design meets all the regulatory requirements for safe flight under all normally conceived conditions. The Type Certificate Data Sheet (TCDS) is the part of the Type Certificate documenting the conditions and limitations necessary to meet the certification airworthiness requirements of the regulations. TCDSs are publicly available from the FAA, and TCDS A00009WI for the T-6 (Hawker Beechcraft Corporation 3000) is shown in Appendix C.
2. Standard Airworthiness Certificate, which is issued to an individual serial numbered aircraft. It indicates that the individual aircraft has been registered, has a Type Certificate, has been manufactured according to the Type Certificate, has been found to conform to its TCDS, and is in a condition safe for operations. In order to retain the Standard Airworthiness Certificate, the aircraft must be maintained according to the rules issued by the FAA.
3. Production Certificate, which serves as an approval document to manufacture duplicate aircraft under the FAA-approved type design.

The FAA certification process is somewhat similar to the Air Force certification process. The overarching steps can be summarized as follows:

1. The manufacturer submits a certification plan for FAA Engineering approval. The plan documents how the applicant intends to demonstrate compliance with the applicable FARs.
 2. The FAA or its designated representatives evaluate the design against the criteria contained in the applicable FARs, using a combination of analysis, laboratory, simulator, flight, and demonstration data to verify compliance. Once compliance is ascertained, a Type Certificate (FAA Form 8110-9) is awarded.
 3. The manufacturing facility must apply for and obtain a Production Certificate. A Production Certificate is an approval (document) to manufacture duplicate products under an FAA-approved type design.
-

4. For each serial numbered aircraft, the FAA or its designated representatives determine that the individual aircraft conforms to its TCDS and is in a condition safe for operations. Once compliance is determined, a Standard Airworthiness Certificate (FAA Form 8100-2) is granted for the individual aircraft.

The FARs serve as the framework that address safe operation. They are not intended to drive the manufacturer to a design solution. One example is that Human Factors does not fully address the size of the pilot population; market sales will bear the fallout of any size limitations. However, it is worth noting that Human Factors for FAA certification is being addressed increasingly more over the last 10 years. Included in the certification rules for both Part 23 and Part 25 are very general requirements for items, such as pilot interface; use of color and instrument arrangement in displays; and messaging, to name a few. The anthropometrics are a critical parameter for JPATS and were dictated by more stringent requirements from the military.

T-6A Certification Basis: The JPATS acquisition strategy was built around the concept of procuring a COTS aircraft that would be FAA-certified. Consequently, Section H (Special Contract Provisions) of the JPATS contract stated "...the JPATS Aircraft shall be designed in accordance with FAA standards and FAA approved Contractor standards and processes, and certified by the FAA. However, military specifications and standards shall be used when there are no applicable FAA standards or FAA approved Contractor standards and processes or when a military specification or standard is specifically required by the terms and conditions of this contract."⁵⁹ As a result, the T-6 was certified under FAR Part 23, Airworthiness Standards: Normal, Utility, Acrobatic, and Commuter Category Airplanes.

FAA testing was given number one priority with Government tests occurring as time permitted. This allowed the FAA certification tests to proceed smoothly. Throughout the QT&E, the Government pilots worked side-by-side with the RAC pilots. However, only RAC or FAA pilots could conduct the FAR 23 tests and make the flight certification findings. This was because of the constraints of the FAA civil certification process and not a reflection on the technical competence of the military test pilots. As a result, many of the subjective handling qualities assessments associated with the PIPFS had to wait until after FAA certification was complete.

Initial FAA certification was gained through the Aircraft Certification Office (ACO) in Wichita. Both the FAA Type Certificate and Production Certificate for the Model 3000 were granted in July 1999. The Model 3000 is the FAA-approved version of the T-6A. Appendix C contains a copy of the TCDS. On September 10, 2004, a Memorandum of Agreement (MOA) between the DoD and FAA was signed, creating the Military Certification Office (MCO) within the FAA. The MCO now provides the technical liaison and support to the DoD for certification of commercial derivative aircraft. DoD reimburses the FAA for the expenditures of the MCO. The MCO is located in Wichita.

While FAA issued the Type Certificate and Production Certificate, it was unable to issue the individual aircraft Standard Airworthiness Certificates because of certain military qualified deviations. Thus, each aircraft delivered to the Government has several deviations written against it signifying that certain items on the aircraft do not conform to FAA-approved type design because of military deviations. The specific items not FAA-certified are:

⁵⁹ Award Contract, F33657-94-C-0006, Issued by USAF/AFMC to Beech Aircraft Corporation, Item H-011, 5 February 1996, Page 48

1. Onboard Oxygen Generating System (off-the-shelf Air Force design)
2. External Paint and Markings (military unique paint scheme)
3. Control Stick Grip (off-the-shelf Air Force design)
4. Angle of Attack (AOA) Indexer (format conflicts with civil display convention)
5. Various markings, decals, and annunciations in the cockpit unique to the military (e.g., in some instances, the military requires yellow/black markings, while the FAA requires red).
6. Footman loops on the glareshield, so the Government can attach an additional storage bag in the cockpit. Because of the acrobatic category for the FAA, the contractor is unable to state that the storage method meets FAA requirements.
7. Rudder and Elevator Trim Actuator and Traffic Advisory/Vertical Speed Indicator. The Government wanted product improvements to these items before completion of FAA certification. These items were part of a recent Change Proposal and will eventually become FAA-certified.

The result is that each individual aircraft receives an FAA Form 8130-31, Statement of Conformity – Military Aircraft, instead of the Standard Airworthiness Certificate. The form contains three signatures: the signature of the Authorized Company Representative and the signature of the FAA Representative/Authorized Designee, stating that the individual aircraft has passed the FAA-required ground inspections and flight tests, and the signature of the Responsible Military Airworthiness Authority/Authorized Designee, stating that “The cognizant receiving military authority acknowledges the identified deviations to the FAA approved type design for the subject commercial derivative aircraft and is responsible to determine airworthiness and final acceptance for the removal, or installation of, modifications, installations, or parts listed hereon.”⁶⁰ The T-6 Chief Engineer is the Authorized Designee for the Responsible Military Airworthiness Authority. Figure 16 is a copy of a signed FAA Form 8130-31. By signing the form, the T-6 Program Office Chief Engineer is responsible for ensuring that:

1. Future modifications to the FAA-certified baseline obtains FAA Part 23 approval (or is listed on the FAA Form 8130-31).
2. Aircraft continues to conform to the approved FAA type design.
3. Aircraft is maintained according to the maintenance program approved by the FAA.
4. Aircraft is operated within the envelope defined by the FAA-approved flight manual.
5. Aircraft remains in a condition for safe operation.

To meet these requirements, the Chief Engineer must work closely with Configuration Management, Maintenance, Safety, and Engineering.

In reality, the FAA will certify most anything for the Government except for a few items, such as warheads, chafes, and pyrotechnics, since these items violate FAA Civil Rules. Also, the FAA will not certify equipment that is not authorized for commercial use (e.g., Identification, Friend

⁶⁰ Statement of Conformity – Military Aircraft, FAA Form 8130-31, 24 April 2009, Page 1

or Foe [IFF]) or equipment that is subject to conditions or limitations prohibiting use by unauthorized parties in the civil environment.

The FAA could have certified the Onboard Oxygen Generating System, but certification would have been time-consuming. Since the FAA has no experience with an Onboard Oxygen Generating System, they would have had to ask numerous questions, develop a position relative to minimum requirements, collect and review data, etc. Thus, it was a programmatic decision to proceed with the military qualification only, resulting in an FAA Form 8130-31 instead of the Standard Airworthiness Certificate. Similar logic was behind FAA not certifying the Control Stick Grip, which is identical to a proven Air Force design.

Model 3000, S/N PT-457

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
STATEMENT OF CONFORMITY - MILITARY AIRCRAFT

(Continued)

A. DESCRIPTION OF AIRCRAFT

Manufacturer	Model	Manufacturer's Serial No.	Military Model Designation	Military Serial No.
Hawker Beechcraft Corporation	3000	PT-457	T-6A	07-3888
Contract No. FA8617-07-D-6151			Identification Markings Displayed on Subject Aircraft 07-3888	

B. CONTRACTOR INFORMATION

Contractor Name and Facility Address:
Hawker Beechcraft Corporation
9709 E. Central
Wichita, KS, 67206

FAA Delegated Organization? Yes N/A
 FAA Delegated Organization Type: DOA
 FAA Identification No.: 2803392E

New Aircraft Manufactured Under Production Certificate (Complete Section E)
 Modification of In-Service Aircraft Using FAA Approved Type Design (Complete Section F)

C. GROUND INSPECTION AND FLIGHT TEST

Date Completed	Contractor's Ground Inspection and Flight Test Approved By	FAA Ground Inspection and Flight Test Approved By
04/24/2009	<i>Howard A. Harris</i> (Signature of Authorized Company Representative)	<i>Bill Harrod</i> (Signature of FAA Representative or Authorized Designee)
Flight Observations (TMS)	DOA 2803392E (FAA Office, Delegated Organization, or Designee No.)	

D. MILITARY ACCEPTANCE OF DEVIATIONS TO FAA APPROVED TYPE DESIGN

The signatory receiving military authority acknowledges the identified deviations to the FAA approved type design for the subject commercial derivative aircraft and is responsible to determine airworthiness and final acceptance for the removal, or installation, modifications, installations, or parts listed herein.

[Signature]
(Responsible Military Airworthiness Authority or Authorized Designee)

[Signature]
(Date)

Page 1 of 3 Pages

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
STATEMENT OF CONFORMITY - MILITARY AIRCRAFT

(Continued)

E. STATEMENT OF CONFORMITY- INITIAL DELIVERY OF NEW AIRCRAFT

This certifies that the aircraft described above has been manufactured in conformity with the data forming the basis for Type Certificate No. A000099W, and any revision or modification thereof approved by the FEDERAL AVIATION ADMINISTRATION (FAA) dated as of May 19, 2008.

The subject aircraft has also been modified by installation of the following FAA-Approved Supplemental Type Certificate(s) with the consent and permission of the Supplemental Type Certificate (STC) holder(s):

STC Number	Description of Modification	STC Holder
Continuation on Page _____		

There are no identified deviations to FAA approved type design.

MILITARY DEVIATIONS. FAA conformity inspection(s) of the aircraft configuration have identified deviations in configuration from the FAA approved type design which are not FAA certified or approved, but may be required or specified by military contract. The deviations may include installations, assemblies, or components which have been either (REMOVED) or (ADDED) to the FAA approved type design configuration. (Deviations are listed in Section G of this statement of conformity.)

F. STATEMENT OF CONFORMITY- MODIFICATION OF IN-SERVICE MILITARY AIRCRAFT

The subject aircraft has been modified by installation of the following FAA Approved Supplemental Type Certificate(s) with the consent and permission of the Supplemental Type Certificate (STC) holder(s). FAA inspection(s) of the subject installation(s) have determined that the STCs have been installed in conformance with the approved data, and any revision or modification thereof approved by the FEDERAL AVIATION ADMINISTRATION (FAA) dated as of _____.

STC Number	Description of Modification	STC Holder
Continuation on Page _____		

There are no identified deviations to FAA approved type design defined by the subject STC(s).

MILITARY DEVIATIONS. FAA conformity inspection(s) of the aircraft configuration have identified deviations in configuration from the FAA approved type design which are not FAA certified or approved, but may be required or specified by military contract. The deviations may include installations, assemblies, or components which have been either (REMOVED) or (ADDED) to the FAA approved type design configuration. These deviations are listed in Section G of this statement of conformity.

Page 2 of 3 Pages

Figure 16. FAA Form 8130-31

3.3.5.2 Military Verification Testing

The objective of the verification testing was to quantitatively and qualitatively evaluate the overall system performance, including flying qualities, avionics, and subsystems. Specific test objectives included:

1. Verification of the PIPFS according to the approved test plans and procedures
2. Verification of the Flight Manual
3. Collection of required flight data for the GBTS
4. Support of the AFOTEC operational assessments

One of the realities of airworthiness certification is that the certification, whether military or FAA, does not satisfy many of the requirements required for military verification. Airworthiness focuses on safety, while military verification focuses on verification of the design against the PIPFS, which includes not only safety related requirements but also mission requirements. Likewise, while FAA certification and military related safety testing sometimes share the same test objectives, there are times when they do not. These unavoidable discrepancies in test objectives obviously resulted in some inefficiencies to the QT&E program.

One example is that the Government had a broader responsibility to ensure that the design was fault tolerant relative to student operation. Testing needed to address errors that could be expected from student operation, e.g., high-power entry into spins, rolling maneuvers at high power, low speeds at high power, propeller stress resulting in bearing touchdowns, etc., all of which could impact student safety. On the other hand, the FAA has an established set of test procedures to be used during the certification process, and these procedures assume that a qualified pilot will be flying the aircraft. Thus, these student error-type of conditions are outside the bounds of FAA certification and, therefore, not addressed in FAA requirements. The Government preferred changing the recommended FAA procedures to address one integrated set of testing, satisfying both qualified and student pilot operation, but it would have required the approval of the FAA, which is time-consuming and, therefore, costly. Thus, RAC elected to stay with the FAA-recommended procedures.

The broad spectrum of “common student errors” was dictated by the contract specification for JPATS and not only included evaluating tolerance to spin/acrobatic errors but other errors in traffic pattern, formation, and instrument flight. Specifically, Paragraph 3.2.2.3 (Flying Qualities) of the PIPFS required:

“The aircraft shall possess flying qualities compatible with the primary student training environment. The aircraft shall have levels of safety, redundancy, performance, and normal and emergency procedures commensurate with the skill levels of students with no prior aviation experience. Therefore, the aircraft shall be tolerant of common student errors. Common student errors shall include, as a minimum, low airspeed departures, exceeding maximum operating speed by 20 knots, wrong rudder application during erect spin recovery, and delayed and/or misapplied controls during 1) accelerated pitchout stall in the traffic pattern (clean), 2) nose-low accelerated stall in the traffic pattern (configured), and 3) landing

attitude stall (configured). In the following requirements, subjective terms such as objectionable, excessive, etc., have been used. Final determination of compliance with these requirements shall be made by the government.”

These differences drove separate flight tests after formal certification testing.

As a result of QT&E, the majority of the T-6 performance characteristics were found to be satisfactory. This included the flying qualities, avionics, and subsystems. The aircraft was found to be easy to fly throughout the range of aerobatics, stalls, spins, low level, and formation flights. In general, the aircraft was deemed tolerant to student error. Several shortfalls that were noted as requiring a fix or resolution before IOC included:

1. Potential for significant and costly damage to the engine because of the result of student error
2. Unsuitable performance of the Environmental Control System (ECS) during warm weather operations
3. Performance of the aircraft at higher AOA, both positive and negative, warranting further high AOA and post-stall testing

3.3.6 Multi-Service Operational Test and Evaluation (MOT&E)

DoD policy requires that “Systems that multiple services will acquire or use must undergo multiservice operational T&E (MOT&E). The designated lead service has primary responsibility for the test program and test procedures, with participation from the other services. A service with unique requirements does its own planning, testing, and funding for them. Because of differences in employment, test results that may be satisfactory for one service may not be for another.”⁶¹

The resultant aircraft-level MOT&E took place at Randolph AFB from June – November 2000. The purpose of MOT&E was to evaluate aircraft safety and suitability, using the ORD as the basis. The evaluators included pilots from AFOTEC, Navy Operational Test and Evaluation Force (OPTEVFOR), AETC, and Chief of Naval Air Training (CNATRA). During the evaluation, eight pilots completed 200 sorties and 303 flight hours. The team also performed day and night flights out of NAS Corpus Christi to evaluate the aircraft in a Navy environment. Various issues hampered the test program. Testing was halted initially because of landing gear problems. The maintenance manuals did not provide adequate troubleshooting information, increasing repair times. Two major issues identified during MOT&E were the ECS and UHF radio. The ECS was not providing the required cooling, and the UHF radio had intermittent loss of reception. The test program was halted again in August 2000 following a Class A mishap (see Paragraph 3.5.2).

The final MOT&E report stated that the T-6A was operationally effective for use in the joint primary training environment but was not operationally suitable to meet the sortie rate requirements. It also restricted operations because of problematic ECS and UHF radio performance.

⁶¹ “Test and Evaluation Trends and Costs for Aircraft and Guided Weapons,” Rand Project Air Force, Bernard Fox, Michael Boito, John C. Graser, Obaid Younossi, 2004

3.4 Production

RAC built a new T-6A production facility in Wichita. Besides the 732 aircraft expected in the Government buy, RAC expected to produce a large number of aircraft (over 400) for Foreign Military Sales (FMS).

3.4.1 Lots 1 through 8

The contract, which was awarded on February 1, 1996, provided for eight lots of aircraft. Like the EMD contract, the production contract was awarded under FAR Part 15 (Contracting by Negotiations) and had most of the regulations and reporting requirements of a typical Air Force contract. Lot 1 included the development and delivery of an instrumented manufacturing development aircraft to be used for QT&E. The last seven lot options were for production aircraft. The contract was a fixed price incentive, firm with award fee. The contract was definitized in February 1996, effectively capping the prices of the aircraft. This contract strategy was used to buy the maximum number of aircraft possible while ramping up the production line during this Low Rate Initial Production (LRIP) phase. Figure 17 identifies the aircraft quantities for each lot.

LOT	Number of Aircraft
1	1 Air Force
2	2 Air Force
3	6 Air Force
4	15 Air Force
5	22 Air Force
6	22 Air Force
7	24 Air Force/8 Navy
8	30 Air Force/24 Navy

Figure 17. Production Deliveries⁶²

When manufacturing costs rose and the projected FMS sales did not materialize, aircraft unit costs rose from \$3.9 million to \$4.4 million. RAC initially planned to reduce costs by using a one-piece wing box hogged out of a single billet of material instead of a wing box built up by hand. Once the program was underway, material costs skyrocketed, forcing RAC back to a built-up wing box. Since unit costs were capped under the fixed price contract, RAC was subsidizing the \$0.5 million cost differential through Lot 8. A Joint Estimating Team (JET) was formed in the summer of 2000 to develop methods to reduce costs to both RAC and the Government in the out-year lots. The JET made two recommendations to reduce unit cost back to the \$3.9 million level. First, they recommended changing to FAR Part 12 (Commercial) contract procedures for Lots 9 and on. They also recommended that RAC outsource some of its in-house manufacturing. The second recommendation would require an initial investment, so Lots 7 and 8 were changed to FAR Part 12 procedures, giving RAC early cost relief.

3.4.2 First Flight

First flight of the initial production aircraft occurred on July 15, 1998, at the contractor's field in Wichita. Piloted by experimental test pilot, Mr. Bob Newsom, the turboprop trainer lifted off at 86 kts and reached an altitude of 13,000 feet. The flight profile was designed to assess basic

⁶² Contract F33657-94-C-0006, 5 February 1996, Page 45

flying qualities; idle power characteristics; stalls; and basic aerobatics, including loops, aileron rolls, and barrel rolls. The flight lasted 1.8 hours and included a functional systems check. First flight resulted in no major problems and was deemed a success.

3.4.3 Canadian Sales

Canada also procured 24 T-6A-1s commercially to support the North Atlantic Treaty Organization (NATO) Flying Training Program. They began taking deliveries on February 29, 2000. The Canadian T-6A is also used as a primary aircraft trainer leading to subsequent training in the BAE Systems Hawk 115 jet trainer. This is a joint venture of Bombardier and the Canadian government. Flight training is available to international Air Forces through Government-to-Government agreements.⁶³ These commercial sales were strictly between RAC and the Canadian government. The SPO did not form an FMS office to support this buy.

3.4.4 Greek Sales

The Hellenic Air Force (HAF) (Greece) bought 45 aircraft commercially for the primary flight training program. Deliveries of the first 25 aircraft similar to the Air Force configuration began in July 2000. The remaining aircraft include provisions for light armament to be used in the more advanced stages of the training syllabus. As with the Canadian buy, the SPO was not directly involved with the sales.

3.4.5 Basing Concept

The T-6A would be used for pilot training at numerous locations. Primary training would be conducted at NAS Whiting Field (three Squadrons); NAS Corpus Christi (two Squadrons); Columbus AFB (one Squadron); Laughlin AFB (one Squadron); Reese AFB (one Squadron); Vance AFB (one Squadron); and Moody AFB (one Squadron). Euro-NATO Joint Jet Pilot Training would be conducted at Sheppard AFB. T-6A Instructor Pilot Training was conducted at Randolph AFB, NAS Corpus Christi, NAS Whiting Field, and NAS Pensacola.

3.4.6 Delivery of First T-6A to the 12th Flying Training Wing (FTW)

The first T-6A was delivered to the 12 FTW at Randolph AFB on May 23, 2000. This began the organic instructor pilot training for the Air Force. The initial group of instructor pilots was trained by RAC in Wichita. These instructor pilots would then train future instructor pilots and fly newly delivered aircraft before distribution to their training bases.

3.4.7 Druyan Declares Full Rate Production

The Director of Operational Test and Evaluation (DOT&E) for the DoD sent the SAF a letter on August 7, 2001, with concerns about beginning student pilot training before they addressed the MOT&E issues. He also stressed his concern about entering full rate production before the safety and suitability issues were addressed. The Secretary's response was "Through ongoing and planned hardware change, focus on training procedures, and additional testing, we are resolving all 15 safety concerns." He also provided a letter from AFOTEC withdrawing their ECS and UHF safety concerns. The DOT&E still released a report that expanded upon his concerns. Other than making headlines, the report did not impact the program, and initial student pilot training began at Moody AFB in October 2001.

⁶³ NATO Flight Training Center, <http://www.nftc.com/nftc/en/flash/nftc.jsp>, 28 July 2009

Following Milestone II discussions, the Air Force Principal Deputy Assistant Secretary (Acquisition and Management), Ms. Darlene Druyan, authorized the air vehicle portion of JPATS to enter full rate production on December 3, 2001.

3.4.8 Lots 9 through 13

The JET recommendations included changing to a FAR Part 12 (Commercial) contract for Lots 9 through 13. This change greatly reduced the required deliverables and Government oversight, which resulted in a cost savings. Unfortunately, changing the contract type to save money comes at a price. A huge number of contractor and Government man-hours were expended to implement this change.

3.4.9 Deliveries Fall Short

Early in the program, RAC began falling short of scheduled aircraft deliveries mainly because of a lack of personnel building the wing. RAC told AETC that it would step up its efforts to regain a schedule, but, when deliveries still fell short, AETC asked the SPO for a schedule assessment. The SPO's assessment indicated that it was unlikely that RAC would catch up. The contract called for the delivery of 54 aircraft by the end of 2001, and, at the current rate of three aircraft per month, they would deliver only 45. The SPO analysis predicted an achievable production rate of 4-5 per month, resulting in 49 deliveries. However, RAC needed to deliver 6-7 aircraft per month to reach the scheduled delivery of 54. RAC had been improving assembly and delivery time from an average of 234 days in 2000 to 105 days in 2001, and the last five aircraft were down to 86 days. RAC increased the workforce by 65 percent, added new manufacturing processes, and increased overtime hours 30 to 40 percent. They managed to deliver 5-7 aircraft per month and deliver the required 54 aircraft by the end of 2001.⁶⁴

Parts shortages were a continual problem, forcing RAC to send aircraft to the paint facility short of parts. The result was that the after-installation required touch-up and rework. This added 6-8 days to the schedule, and deliveries again fell behind in early 2002. They initially fell short by three aircraft and, later, five aircraft by the end of February. They managed to reduce the backlog to four aircraft by the end of April, but a shortage of hydraulic parts was a major problem. Changes to the production line to install the enhanced ECS also worked against meeting the delivery schedule. The company proposed delaying the delivery of 13 aircraft, so they could make the ECS changes and get back on schedule. The SPO and AETC agreed with this proposal. RAC managed to get the parts shortages under control, which eliminated the need for touch-up and rework. They also implemented a new paint system, using appliqués and decals, which reduced production delays. Now that RAC was back on schedule, AETC could begin standing up the Laughlin AFB Training Squadron.⁶⁵ T-6A deliveries are listed in Figure 18.

⁶⁴ A Training System for the 21st Century: JPATS and the T-6, Richard H Emmons, June 2004, Page 42

⁶⁵ Ibid, Page 42

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
USG	1	49	47	60	68	67	62	62	25	36
CUM Total	1	50	97	157	225	292	354	416	441	477
Ahead of Contract Status USG	0	(6)	0	13	5	18	38	46	15	0

Figure 18. T-6 Deliveries

3.5 Fielding and Sustainment

RAC was also responsible for logistics support, including spares provisioning. During original spares planning, the Government Auditing Agency recommended structuring a spares part program in which the contractor would be responsible for the procurement and management of the spares. This was because of the number of design shortfalls requiring a fix. When stable, the Government would assume responsibility for the spares. The Program Office implemented the recommendation and eventually used the spares savings for other items, such as upgrading the cooling capability of the ECS. In early 2008, the Air Force decided that the configuration was sufficiently stable to reconsider whether the Air Force should assume the procurement and management of the spares. The Program Office conducted a cost analysis that showed a lifetime cost of \$72 million (\$60 million for air vehicle spares and \$12.2 million for support equipment spares) for the Air Force procurement and management of the spares. The minimum projected cost savings to the Air Force was \$750 million with a break-even point in 2014. There was also a need for an additional \$30 million in engine spares. Senior Air Force management liked the savings, and, in the spring of 2008, the program received \$60 million for the spares with another \$12.2 million following in the fall of 2008. This covered the costs of all projected air vehicle and support equipment spares for the lifetime of the delivered aircraft at the signing of the contract. The engine spares still needed to be addressed. The cost savings is predicated on the premise of a contractor managing the spares but the Air Force owning the spares. Thus, the Air Force would only pay for the services associated with the handling of the spares, i.e., the handling services associated with the procurement, shipping, etc. The Navy is responsible for their own spares.

3.5.1 Initial Operational Capability (IOC)

Although aircraft deliveries were on schedule, portions of the GBTS lagged. AETC decided to begin joint undergraduate flight training without a fully operational GBTS. The first class (13 Air Force and two Navy) began training at Moody AFB in October 2001. The final portion of the GBTS was tested in March and April 2002 with resulting discrepancies fixed by the first of May. Gen Cook, AETC Commander, officially announced IOC on July 12, 2002.

3.5.2 Class A Mishaps

The T-6 Texan II has experienced four Class A mishaps since 2000. In August 2000, one of the crew inadvertently cut off the engine during landing. A contributing factor was the close

proximity of the flap lever and the power control lever cut off finger lift. The Accident Investigation Board Executive Summary is in Figure 19.⁶⁶

The second Class A mishap occurred in April 2004. The mishap pilot performed maneuvers outside the limits of the aircraft, which resulted in the crash. Both occupants were killed. The Executive Summary is in Figure 20.⁶⁷

The third mishap happened in November 2007. Two T-6s collided while performing training sorties. Both aircraft were destroyed, but all four occupants ejected safely. The Executive Summary is in Figure 21.⁶⁸

The fourth mishap was in June 2008. The engine was shut down following uncommanded power changes and vibrations. The aircraft was set up for a no-power approach per the manual, but the propeller did not feather, causing additional drag, which resulted in failure to reach the runway. The Mishap Instructor Pilot contributed to the mishap by not resetting the Propeller System Circuit Breaker before in-flight engine shutdown. The Executive Summary is in Figure 22.⁶⁹

⁶⁶United States Air Force Class A Aerospace Mishaps, <http://usaf.aib.law.af.mil/index.html>, 14 July 2009

⁶⁷ Ibid

⁶⁸ Ibid

⁶⁹ Ibid

EXECUTIVE SUMMARY

AIRCRAFT ACCIDENT INVESTIGATION
T-6A; SERIAL NUMBER 95-3008
THE 559th FLYING TRAINING SQUADRON
RANDOLPH AIR FORCE BASE, TEXAS
31 AUGUST 2000

On 31 August 2000, at 1632 Central Daylight Time, a T-6A, *S/N* 95-3008, crashed 3.5 miles south of Stinson Municipal Airport, San Antonio, Texas. The T-6A Texan II (MA), assigned to the 559th Flying Training Squadron (FTS), 12th Flying Training Wing, Randolph Air Force Base, Texas, was on an instructor enhancement program training mission. Both the Mishap Instructor Pilot (MIP) and the Mishap Pilot (MP) ejected safely sustaining minor injuries. The MIP received cuts and abrasions on his face from ejecting without his oxygen mask fully connected and a broken ankle from his parachute landing fall. The MP had several shards of canopy embedded in his eyes due to ejecting without his visor down. The aircraft impacted in a cornfield causing virtually no property damage. The MA was destroyed upon impact, with loss valued at \$5,538,549.00.

Shortly before impact, the mishap crew (MC) was flying a Global Positioning System (GPS) approach to Stinson Municipal Airport, Texas. As they approached the final approach fix, the MIP directed the MP to configure the aircraft. After lowering the gear, the MP was unable to locate the flap lever. The MIP described the location of the flap lever and then stated he was lowering the flaps. As the MIP lowered the flaps, the crew experienced a total loss of power. After one restart attempt, the crew ejected.

It is found by clear and convincing evidence the primary cause of the mishap was the MP inadvertently placing the power control lever (PCL) to the cut-off position. As a result, the engine lost all power. All aircraft systems functioned as designed throughout the entire flight. Both pilots testified that the MIP moved the flaps to "TAKEOFF". The MP was flying the airplane and at the time searching for the flap lever. He had his hand above and around the PCL. According to the Flight Data Recorder, the flap lever was moved from "UP" to "TAKEOFF" during the same second of flight the PCL was moved below idle. Due to the relationship of the flap lever and the PCL cutoff finger-lift, it is impossible for one person to do both without intentionally trying to do so.

But for the fact the MP was unfamiliar with the T-6A cockpit, he would not have been looking for the flap lever during the approach.

But for the fact that the MP inadvertently placed the power control lever (PCL) to the cut-off position, the engine would not have lost power.

Under 10 U.S.C. 2254(d) any opinion of the accident investigators as to the cause of, or the factors contributing to, the accident set forth in the accident investigation report may not be considered as evidence in any civil or criminal proceeding arising from an aircraft accident, nor may such information be considered an admission of liability by the United States or by any person referred to in those conclusions or statements.

T-6A TEXAN II, *S/N* 95-3008, 31 August 2000
Executive Summary, Page 1 of 1

Figure 19. Accident Investigation, August 2000

EXECUTIVE SUMMARY AIRCRAFT

ACCIDENT INVESTIGATION T-6A,

SERIAL NUMBER 99-3553

THE 479th FLYING TRAINING GROUP, 3d FLYING TRAINING SQUADRON
MOODY AIR FORCE BASE, GEORGIA

3 APRIL 2004

On 3 April 2004, at 0916 Eastern Standard Time (EST), a T-6A, *SIN* 99-3553 crashed 1540 feet south of runway 27 at Savannah Hilton-Head International Airport, Savannah, Georgia. The mishap aircraft (MA), a T-6A Texan II, assigned to the 3d Flying Training Squadron (3 FTS), 479th Flying Training Group (479 FTG), Moody Air Force Base, Georgia, was on a continuation training (CT) cross country mission. The Mishap crew (MC), consisting of Mishap Pilot 1 (MPI) and Mishap Pilot 2 (MP2), were assigned to the 39th Flying Training Squadron (39 FTS) and were fatally injured in the mishap. MPI ejected after the MA was out of the survivable ejection envelope. The aircraft impacted the ground within the Savannah Hilton-Head International Airport causing minimal property damage. The MA was destroyed with the loss valued at \$4,200,000.

The MC had been cleared for takeoff and one left closed traffic pattern before departing under Visual Flight Rules (VFR) to the west. After takeoff, the MC retracted the landing gear and flaps, leveled off at 30 feet above the runway, accelerated to 168 knots, pitched up 37 degrees nose high (3.6 times the gravitational force (Gs)) climbing to an altitude of 530 feet while simultaneously rolling into 131 degrees of left bank (nearly inverted). MPI ejected at an altitude of 337 feet above ground level (AGL), three seconds prior to the MA impacting the ground in a 45 degree nose down attitude.

Clear and convincing evidence suggests the cause of this fatal aircraft mishap was pilot error. For unknown reasons, the pilot flying the MA performed a closed pattern exceeding the maximum bank angle of 90 degrees and allowed his airspeed to decrease to 131 knots, below the minimum airspeed of 140 knots as directed in Air Force Manual 11-248. The 37 degree 3.6 G pitch up coupled with the high bank angle and slow airspeed caused the MA to stall and roll further towards inverted flight. The MC made no attempt to apply proper stall recovery procedures. As a result, the MA was nearly inverted at a much lower than normal altitude and was too low for safe ejection. Aircraft engine and flight control systems were operating normally when the aircraft crashed.

Under 10 U.S.C. 2254(d), any opinion of the accident investigators as to the cause of, or the factors contributing to, the accident set forth in the accident investigation report may not be considered as evidence in any civil or criminal proceeding arising from an aircraft accident, nor may such information be considered an admission of liability by the United States or by any person referred to in those conclusions or statements.

T-6A Texan II, *SIN* 99-3553, 3 April 2004
Executive Summary, Page 1 of 1

Figure 20. Accident Investigation, April 2004

EXECUTIVE SUMMARY
ACCIDENT INVESTIGATION BOARD T-6A, 01-3613/00-3579
14th FLYING TRAINING WING, 41st FLYING TRAINING SQUADRON
COLUMBUS AIR FORCE BASE, MISSISSIPPI
28 NOVEMBER 2007

On 28 November 2007, at 12:38 Central Standard Time (CST), two T-6As, tail numbers 01-3613 (MA1) and 00-3579 (MA2), operating out of the 14th Flying Training Wing, 41st Flying Training Squadron, Columbus Air Force Base (AFB), Mississippi, collided in mid-air. The collision occurred three miles northeast of Gunshy Auxiliary Airfield, which is 40 miles south of Columbus AFB. Both mishap aircraft (MA) were conducting flying training on approved Air Education and Training Command syllabus sorties with a mishap student pilot (MSP) in the front seat and a mishap instructor pilot (MIP) in the backseat. The collision occurred while both MA were operating under Visual Flight Rules, in Visual Meteorological Conditions (VMC), in Class D airspace. After the mid-air collision, both MA were determined to be unflyable by their respective MIPs, and all four crew members safely ejected. They were all treated at Columbus AFB Medical Clinic and released the same day. Both MA were completely destroyed at a total loss of \$10,010,740.08. The collision resulted in debris fields on three separate parcels of uninhabited private property. To date, there are no known claims for damage to any of the properties. Wreckage recovery and environmental remediation is forecasted to cost under \$40,000.

Just prior to the collision, MA1 approached the Gunshy VFR entry point and executed a pre-planned breakout maneuver with a right climbing turn from 1300 to 2300 feet Mean Sea Level (MSL). During the maneuver, MSP1 initially turned the wrong direction, failed to make an advisory radio call, and began an aggressive climb that would overshoot the desired altitude. Correcting these three simultaneous errors resulted in task saturation to the point where MSP1 and MIP1 did not adequately clear their flightpath during their climbing turn. MA1 had no awareness of any other aircraft operating in the pattern until they impacted MA2.

MA2 was previously established in the Gunshy pattern and also operating in the vicinity of the VFR entry point at 2300 feet MSL after initiating a breakout from the perch point. They had radio Situational Awareness of MA1 entering the pattern, but had never acquired them visually. MA2 did not hear or process MA1's late "VFR entry, breaking out" call. At impact, MA2 was flying straight and level, heading 040° with MIP2 at the controls instructing MSP2.

Clear and convincing evidence suggests that the cause of this aircraft mishap was pilot error, specifically, failure of the MIPs and MSPs to adequately clear their flightpaths in accordance with Air Force Manual 11-248.

<p>Under 10 U.S.C. 2254(d) any opinion of the accident investigation as to the cause of, or the factors contributing to, the accident set forth in the accident investigation report may not be considered as evidence in any civil or criminal proceeding arising from an aircraft accident, nor may such information be considered an admission of liability of the United States or by any person referred to in those conclusions or statements.</p>
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Figure 21. Accident Investigation, November 2007

AIRCRAFT ACCIDENT INVESTIGATION BOARD REPORT
T-6A, S/N 06-3851
VANCE AIR FORCE BASE, OKLAHOMA
04JUN 08

EXECUTIVE SUMMARY

On 4 June 2008, at 1016 local time, the Mishap Aircraft (MA), a T-6A, serial number 06-3851, sustained damage as the Mishap Instructor Pilot (MIP) attempted an engine out Forced Landing (FL) approach to Vance Air Force Base (AFB), Oklahoma. The Mishap Student Pilot (MSP) suffered minor injuries. The MA, MIP, and MSP were assigned to the 71st Flying Training Wing at Vance AFB. The MIP and MSP were flying a contact training mission designed to continue the MSP's preparation for an initial solo flight in the T-6. The MA sustained damage to the left wing, landing gear, and propeller estimated at \$831,631.00. The MA impacted a taxiway short of the intended landing runway at Vance AFB. This caused incidental damage to the taxiway, and the grass infield area to its west, but no damage to private property or structures.

During initial departure from Vance AFB, approximately 85 seconds after takeoff, the MA experienced an uncommanded power change. The MIP initiated a return to base via a Precautionary Emergency Landing. During the return, the MA experienced an additional uncommanded power change event accompanied by engine vibrations and a "CHIP" warning light, indicating possible metal contamination in the MA's engine oil supply. The MIP shut down the MA's engine after reaching Vance AFB airspace and once established at an appropriate altitude and airspeed for the FL approach. During the MA's FL approach, the propeller did not move to the commanded streamlined "feathered" position, resulting in increased drag and an increased aircraft descent rate. As a result, the MA failed to reach the runway. The MA impacted Vance AFB Taxiway B, short of Runway 17L, damaging the aircraft. After impact, the MA continued to slide into the grass infield area west of Taxiway B and came to rest approximately 585 feet from its original impact point.

The Accident Investigation Board President determined by clear and convincing evidence the primary cause of the mishap was due to the MA's propeller not feathering in a timely manner. This led to an increase in aerodynamic drag and an excessive descent rate during the MA's FL attempt, which caused the MA to impact short of the runway and sustain damage. Two substantial factors contributed to this mishap. The first factor was the MA experiencing multiple Propeller Sleeve Touchdown (PSTD) events. These PSTDs led to the MA suffering an uncommanded power change on departure which ultimately prompted the MIP to shut down the MA's engine while airborne. The second factor was the MIP not completing the Uncommanded Power Changes/Loss of Power/Uncommanded Propeller Feather checklist procedures. Specifically, the MIP did not reset the Propeller System Circuit Breaker prior to the in-flight engine shutdown which contributed to the MA's propeller not feathering in a timely manner.

Under 10 U.S.C. § 2254(d) any opinion of the accident investigators as to the cause of, or the factors contributing to, the accident set forth in the accident investigation report may not be considered as evidence in any civil or criminal proceeding arising from the accident, nor may such information be considered an admission of liability of the United States or by any person referred to in those conclusions or statements.

Figure 22. Accident Investigation, June 2008

3.5.3 Requirements Management

The T-6A program was now on track, systematically standing up Training Squadrons at the various bases. As the JPATS was fielded, new requirements began to surface. A program is naturally more complex when it involves multiple Services. This is particularly true when establishing new requirements, since the requirements must first be coordinated with each of the users (i.e., Services). To address this concern, AETC implemented a disciplined process in calendar year (CY)02 called the Joint Priority List (JPL). The purpose of the JPL is to give both the Air Force and Navy the capability to provide the Program Office with user direction/guidance for the project priority and funding priority. With this process, it takes a new requirement typically 4-6 months to become listed on the JPL with a new JPL being released every six months. Usually, a requirement can wait for the next update, because it takes time to identify the details of the change with engineering. Typically, there are 22-46 requirements on the JPL at any given moment. Whenever a new JPL is sent to the Program Office, it is accompanied by a letter stating that this is the new JPL and that the Program Office should reprioritize their implementation according to the new priority. AETC has found that the process works well, and other Commands are now implementing the JPL. Below is a summary of the process.

“JPATS Joint Priority List (JPL)

PURPOSE: USAF and USN will bi-annually provide the 337 AESG with user-direction/guidance for JPATS project and funding priority

PREPARATION:

1. Prior to the User’s JPL Meeting, AETC/A5RU and CNATRA N38 will review the current JPL within each service JPATS functional areas
2. 664AESS will forward program office input, to include Hawker Beechcraft Corporation (HBC) recommendations, to AETC/A5RU and CNATRA N38 for consideration during each service’s pre-meetings, as well as the User’s JPL Meeting

USER’s JPL Meeting:

1. The User’s JPL Meeting will be held twice a year, early enough to provide guidance at the next PMR (NLT Mar/Sep)
2. Venue for the User’s JPL Meeting normally is held at Randolph AFB (hosted by AETC/A5RU) but can alternate to NAS Corpus Christi (hosted by CNATRA N38)
 - A. Required participants are:
 - AETC/A5RU (Co-Chair) Voting Member
 - CNATRA/N38 (Co-Chair) Voting Member
 - CNATRA/N42
 - AETC/A4MAU
 - AETC/A3FI
 - 19AF/DOU

- 664AESS/PM
 - 664AESS/FM
- B. Other attendees may be invited (i.e. AETC/CNATRA Safety, Stan/EVAL, GBTS, 664 AESS/EN/PK/LG
3. All attendees must be prepared to review and discuss JPL issues such as deletions, and re-prioritization. Documented justification (normally accomplished via AF Form 1067) is required for any new projects/issues introduced at the User's JPL Meeting. This User meeting will consolidate/prioritize all inputs with representatives from CNATRA, AESS, and AETC into a single JPL. CNATRA and AETC will coordinate the new JPL at the 3-digit level at HQ AETC and CNATRA N3

ROE:

1. When either a project is cut-in to production or a retrofit begins, Priority 0 is assigned to the project/issue
 - All Priority 0 projects will be listed at the top of the JPL and are must pay budget items
2. When both production cut-in and retrofit have begun, the project moves to Monitor (M) status
3. If a project is cut into production and retrofit is by attrition, then the project moves to Completed/Fielded/Deleted (CFD) Tab
4. Projects that do not modify the aircraft (such as ELMP and TOLD) will move to Priority 0, M, or CFD as determined by JPL committee
5. CLS/Sustainment and GBTS Projects are tracked on separate TABS
6. A project is moved to CFD status when:
 - Production cut-in and retrofit actions are complete (Exception see #3 of ROE)
 - A requirement is deleted by AETC and CNATRA
 - Upon completion of contractual effort (i.e. CLS/Sustainment and GBTS projects)
7. The following colors identify changes to the JPL:
 - New requirements or name change are identified in RED
 - Funded projects are identified in GREEN⁷⁰

3.5.4 Mission Capable Rates

A JPATS system-level MOT&E was conducted at Moody AFB and completed on January 30, 2003. The system-level evaluation concluded that JPATS effectively trained students that were prepared for their solo flight and that the students performed better on instrument flights. The evaluation rated the T-6A safe and suitable following modifications to fix the ECS and UHF radio issues. However, the required joint primary pilot training sortie generation rate was rated unsuitable. A mission capable rate of 90 percent was reached, which is less than the 91 percent

⁷⁰ JPATS Joint Priority List (JPL), AETC/A5RU, 19 June 2009

requirement in the ORD. The mission reliability rate was 96.6 percent versus the ORD requirement of 98.5 percent.

3.6 Follow-on Operational Test and Evaluation (FOT&E)

An FOT&E was accomplished from May 2003 through November 2004 to evaluate issues that the MOT&E could not address because of GBTS problems at the time. The FOT&E performed a Navy specific evaluation of the T-6A at NAS Pensacola, a suitability evaluation of the T-6A at Laughlin AFB, and a GBTS evaluation at Laughlin AFB and NAS Corpus Christi.

The T-6A was evaluated, performing Navy specific maneuvers, patterns, and environments. In reality, the Navy training environment was very constrained in terms of runway length and airspace as compared to the Air Force. Likewise, the evaluation included the effects of salt air and wash rate, since the Navy training typically occurred near the ocean. The conclusion of the FOT&E was that JPATS would support the needs of Joint Primary Pilot Training, Undergraduate Naval Pilot Training, Specialized Undergraduate Pilot Training, Joint Undergraduate Navigator Training, Joint Navigator/Naval Flight Officer Training, and Euro-NATO Joint Jet Pilot Training.

3.7 Nunn-McCurdy Breach

The Nunn-McCurdy Amendment was first introduced in the 1982 Defense Authorization Act and was made permanent in 1983. The amendment was designed to curtail cost growth in United States military weapon procurements.

Appendix 3 of this case study contains a copy of the amendment. Simply speaking, the amendment requires that the Pentagon notify Congress when cost growth on a major acquisition program reaches 15 percent. If the cost growth reaches 25 percent, the Pentagon must recertify the program based on the following criteria:

1. The system is essential to national security.
2. There are no alternatives to the system that will provide equal or greater military capability at less cost.
3. New estimates of total program unit cost or procurement unit cost are reasonable.
4. Management structure for the system is adequate to manage and control the total program acquisition unit cost or procurement unit cost.

Rarely is a program cancelled under this law. However, the recertification results in numerous program improvements, and Congress typically accepts the Secretary of Defense's recertification.

The Defense Authorization Act of 2006 revised the Nunn-McCurdy Amendment and added thresholds for the original program baseline. Previously, programs would rebaseline, which avoided breaching the Nunn-McCurdy Amendment criteria, allowing cost growth to go unreported. Original program baseline cost growth exceeding 30 percent results in a "Significant" breach, and exceeding 50 percent results in a "Critical" breach. Many programs, including the JPATS T-6A, found themselves breaching the amendment criteria based on original program baseline cost growth.

The JPATS T-6A was one of seven programs during that period that had a critical breach to their original program baseline cost following revisions to the Nunn-McCurdy Amendment.⁷¹ A DoD review⁷² concluded that the cost growth of just over 50 percent was attributed to changes in Government requirements. The program was recertified without restructuring with the following ADM direction:

“The Air Force and Navy shall fully fund the certified JPATS program in accordance with the Program Office cost estimate. The Air Force, as Executive Agent, must submit a Change Proposal to reflect a total program cost of \$5.137 billion, an Average Procurement Unit Cost of \$6.7 million, and a total quantity of 767 aircraft.”⁷³

3.8 Lots 14 through 20

The sole source contract for Lots 14 through 20 was signed in late 2007. The period of performance (PoP) for this contract is FY07 to FY16 with a ceiling cost of \$3 billion. Lot 14 and a portion of Lot 15 will be Air Force aircraft, and the remainder will be delivered to the Navy. Contrary to the JET recommendations, the contract type reverted to a FAR Part 15 contract with some streamlining. Again, change is not free. The contractor estimates that changing the contract type for Lots 9 through 13 and back again for Lots 14 through 20 required tens of thousands of hours.

3.9 Future of the T-6

The Air Force took the initial deliveries of the T-6A while the Navy planned to take deliveries in the outer years. While the Air Force was taking deliveries of T-6As, the Navy decided to pursue a significantly upgraded version, the T-6B. They plan to procure 260 T-6B aircraft to compliment the 79 T-6A aircraft they are currently operating. The T-6B features open-architecture and advanced avionics suite, including a Heads-Up Display (HUD). It reflects the systems and capabilities of current frontline aircraft, which enables the training of complex advanced systems and information management skills. The Operational Flight Program (OFP) in the T-6B includes a weapon delivery training capability.

During the Farnborough Air Show in 2006, RAC announced plans to build the AT-6B, which is a light attack version of the T-6B for the centric battlefield. The multi-role AT-6 will be capable of performing missions, including net-centric Intelligence, Surveillance, and Reconnaissance (ISR), with the ability for precise geo-registration, streaming video, and datalinks; light attack, including Combat Search and Rescue (CSAR), close air support, forward air control, and convoy escort; homeland defense (border security), port security, and counter-narcotics operations; and civil missions, such as disaster area reconnaissance, search and rescue, and firefighting.

⁷¹ Testimony of John J. Young, Undersecretary of Defense (Acquisition, Technology & Logistics), Before the Senate Committee on Armed Services, 3 June 2008, Page 16

⁷² DoD hits Lockheed missile program on performance concerns, MarketWatch, <http://www.marketwatch.com/news/story/dod-hits-lockheed-missile-program/story.aspx?guid={3D62C654-7AE6-47BA-8C53-F6B47C3A19BD}>, 6 June 2007

⁷³ “Acquisition Chief Directs Program Updates,” Forecast International, 18 September 2007

Iraq has been interested in the T-6 platform. They have requested 20 T-6As and 36 AT-6Bs for training and counter-insurgency. As of June 2009, this has changed to 15 T-6As but no AT-6Bs yet.⁷⁴

T-6B's export version is called the T-6C, which is an upgraded aircraft with a hardpoint wing. Morocco is the lead customer for the T-6C and has requested 24 aircraft. The hardpoint wing provides the capability to carry external fuel tanks, practice bombs, weaponry, etc. The Moroccan's plan is to use the hardpoints for fuel tanks.⁷⁵

Israel has requested the procurement of 25 T-6A Texan II trainer aircraft to replace its current fleet of Zukit trainers.⁷⁶ They took delivery of their first aircraft in early 2009.

Although FMS have been slow to materialize, some Government personnel believe there will be many foreign sales. They believe that the foreign governments have been waiting for the system to mature under United States Government funding before proceeding with their buys.

4. SUMMARY

In the mid-1980s, the Air Force realized that their current flight training resources were rapidly approaching obsolescence. As a result, they published a Trainer Master Plan in 1988 that required three new trainers: a subsonic, entry level (i.e., primary) trainer to serve as a replacement for the T-37; a supersonic, fighter-bomber trainer to serve as a replacement for the T-38; and a new airlift and tanker trainer. Following a review of the Trainer Master Plan, Congress directed DoD to submit a report containing plans for both Air Force and Navy training. The Armed Services Committees wanted a combined DoD plan that would allow the Air Force and Navy to procure similar training aircraft to minimize costs. The Air Force was directed to take the lead.

A Trainer Summit was held at Randolph AFB in October 1991. Both the Air Force and Navy laid out training plans that funneled the pilots from the primary training program to various specialized undergraduate pilot programs. At the conclusion of the summit, both the Air Force and Navy agreed with joint planning and approved release of the JSORD.

The Milestone 0/I review was held on January 19, 1993. The resulting JPATS ADM required that "the source selection criteria must clearly favor proposals involving the lowest development risk and the lowest total system cost to the Government."⁷⁷

The DAB met in May 1993 and called for the acquisition of a non-developmental aircraft. It also specified a two-contract approach in which the Government would first select the airframe contractor and then the GBTS contractor. The airframe contractor would have total system performance responsibility. In March 1994, the Assistant SAF for Acquisition held a review and slightly changed the strategy to require the prime contractor to select the GBTS contractor

⁷⁴"U.S. Air Force AIM Points: BLOG: Hawker Beechcraft and the COIN of the Realm," <http://aimpoints.hq.af.mil/display.cfm?id=34198>, 18 June 2009

⁷⁵"Morocco's Air Force Reloads," Defense Daily, <http://www.defenseindustrydaily.com/moroccos-air-force-reloads-04469/>, 19 Dec 2007

⁷⁶"Israel Requests Delivery of 25 U.S. T-6A Texan II Trainers," http://www.defense-update.com/newscast/0608/news/news1006_texan_il.htm, 28 July 2009

⁷⁷"A Case Study: Acquisition Reform and the Joint Primary Training Aircraft System (JPATS)," Kenneth W. McKinley, 18 June 2000, Page 24

instead of the Government. The Defense Acquisition Executive concurred and signed the Acquisition Strategy Report on May 17, 1994.

The JPATS T-6 program was at the convergence of several initiatives constituting the “Perfect Storm” of acquisition reform. As it began, acquisition reform initiatives/laws were being aggressively established to reduce costs, a new administration that heavily pushed acquisition reform during the elections had just entered office, and AETC was looking for an off-the-shelf trainer. DoD developed DAPPs “to demonstrate new and innovative approaches in the use of commercial practices and the acquisition of commercial products.”⁷⁸ Mr. Deutch, USD at that time, formally designated the JPATS program as a DAPP.

Source selection was a “best value” competitive source selection in which development risk and total system life-cycle cost was determined through proposal evaluation. Seven contractors participated, and the source selection included a Flight Evaluation. Dr. Widnall, then SAF, announced the selection of Beech Aircraft Corporation as the prime contractor on June 22, 1995. The program called for 711 aircraft, 372 for the Air Force and 339 for the Navy, at a total cost of \$7 billion.

The EMD contract was a Fixed Price Incentive Firm with an Award Fee. The initial contract was awarded under FAR Part 15 (Contracting by Negotiations) and, thus, had most of the regulations and reporting requirements of a typical Air Force development contract. Being a DAPP, JPATS did get some statutory and regulatory relief.

The T-6 design evolved from the Beech Mk II Turboprop, which was a derivative of the Pilatus PC-9. The Pilatus PC-9 was one of the aircraft that AETC included in their early fact-finding trips to Europe. When AETC started the fact-finding trips, it was with the understanding that the acquisition would be off-the-shelf. They actually tried to keep the acquisition as close to an off-the-shelf buy as possible and believed that major design changes would not be required. The first few fact-finding trips were oriented to help AETC understand what was available in the market, so they could write the requirements for the off-the-shelf acquisition realistically. Eventually, AETC realized that a pure off-the-shelf procurement was not realistic and that changes would be necessary to missionize the aircraft. This was because of the differences between the commercial and military missions, usage, and specification requirements.

The T-6 aircraft was FAA-certified according to the EMD contract. The aircraft underwent an integrated QT&E program whose objectives were military qualification and FAA certification. There was a subsequent MOT&E that evaluated safety and suitability using the JSORD as the basis.

The type of production contracts varied over time. Like the EMD contract, the production contract for Lots 1 through 8 was procured under FAR Part 15. Lots 9 through 13 were procured under FAR Part 12 (Commercial). This change greatly reduced the required deliverables and Government oversight, which resulted in a cost savings. Procurement of Lots 14 through 20 reverted back to FAR Part 15 with some streamlining.

AETC began joint undergraduate flight training at Moody AFB in October 2001. Gen Cook, AETC Commander, officially announced IOC on July 12, 2002.

⁷⁸ A Case Study: Acquisition Reform and the Joint Primary Aircraft Training System (JPATS) Program, Kenneth W. McKinley, Naval Postgraduate School, Monterey, CA, June 2000, Page 23

The T-6 has a very stellar safety record with only four Class A mishaps, all of which have been attributed to pilot error. The mission capable and mission reliability rates fall just short of the JSORD requirements but are still very good. The T-6 has a mission capable rate of 90 percent (versus 91 percent required by the JSORD) and a mission reliability rate of 96.6 percent (versus 98.5 percent required by the JSORD).

Since JPATS is a joint Service program with each Service having its own priorities, requirements management has been challenging. As a result, AETC implemented a disciplined process in 2002 called the JPL. The purpose of the JPL is to give both the Air Force and Navy the capability to provide the Program Office with user direction for the project priority and funding. The process works well, and other Commands are now implementing the JPL.

Because of the success of the JPATS program, sales to other countries continue to increase. Canada and Greece have already bought T-6s, Israel has requested a sale, and Iraq has shown interest. An advanced avionics version, the T-6B, is being developed for the Navy, and Morocco is the lead customer for the T-6C, which will be an upgraded aircraft with hard points in the wing. During the Farnborough Air Show in 2006, Hawker Beechcraft (formerly Beech Aircraft Corporation) announced plans to build the AT-6B, which is a light attack version of the T-6B. With all of these sales either in work or under consideration, the T-6 aircraft should remain as the premier primary trainer for years to come.

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6. APPENDICES

Appendix A. AUTHORS' BIOGRAPHIES

A.1 Bill Kinzig

Bill Kinzig joined MacAulay-Brown, Inc. (MacB), as a Senior Systems Engineer in 2006, providing flight systems and systems engineering support to Government and industry clients. He has over 38 years of leadership and management experience in acquisition and sustainment of Air Force weapon systems. While working at MacB, he has conducted several research studies for the KC-X Program Office; led an E-10 airworthiness certification effort for the Electronic Systems Center (ESC) at Hanscom Air Force Base (AFB), Massachusetts; consulted with ESC on developing an airworthiness certification approach for the E-8; and rewrote the Aeronautical Systems Center (ASC) Guidance Document for Systems Engineering Plans (SEPs) at Wright-Patterson AFB (WPAFB), Ohio.

Before his employment at MacB, Mr. Kinzig spent 35 years at ASC/EN, working aircraft acquisition. He began his career in the Subsystems Branch, supporting a myriad of aircraft, such as the E-3, F-4, A-7K, F-16, B-2, and KC-10. He expanded his responsibilities while working on the F-22, eventually leading the Aircraft Systems Integrated Product Team (IPT). From there, he was assigned as Technical Advisor for Air Vehicle Subsystems and ended his career as Technical Director for Flight Systems Engineering. While serving as Technical Director, he was a Senior Member of the Airworthiness Control Board, Senior Member of the Air Force Fleet Viability Board, and Senior Air Force Representative to the biyearly Airworthiness Summits.

Mr. Kinzig earned a B.S. in Mechanical Engineering from the University of Dayton in 1970 and an M.S. in Mechanical Engineering from the University of Dayton in 1978.

A.2 Dave Bailey

Dave Bailey joined MacB as a Senior Systems Engineer in November 2007. He has provided Flight Systems and Systems Engineering support to the Wide-Body Airborne Sensor Platform (WASP) for the Raytheon Corporation. He has also supported ASC/EN, reviewing Unmanned Air Vehicle (UAV) airworthiness requirements as compared with proposed Standardization Agreement (STANAG) UAV airworthiness requirements.

Before MacB, Mr. Bailey spent 31 years in ASC/EN, working weapon systems acquisition and sustainment. Early in his career, he worked in the Subsystems Branch as an Environmental Control Systems and Thermal Engineer. There, he supported the B-52, Air Launched Cruise Missile (ALCM), B-1, and Advanced Cruise Missile (ACM). He later provided subsystems, flight systems, and systems engineering support as a member of various program offices, including the B-2, ACM, Global Hawk, and DarkStar. He closed out his career with the Federal Government as the Chief Systems Engineer of the F-117, providing sustainment support and retiring the weapon system.

Mr. Bailey earned a B.S. in Aerospace Engineering from The Pennsylvania State University in 1976 and an M.S. in Aerospace Engineering from the University of Dayton in 1981.

Appendix B. ACRONYMS

ACC	Air Combat Command
ACM	Advanced Cruise Missile
ACO	Aircraft Certification Office
ADM	Acquisition Decision Memorandum
AESS	Aeronautical Systems Squadron
AETC	Air Education and Training Command
AFB	Air Force Base
AFCSE	Air Force Center for Systems Engineering
AFIT	Air Force Institute of Technology
AFMC	Air Force Materiel Command
AFOTEC	Air Force Operational Test and Evaluation Center
ALCM	Air Launched Cruise Missile
AMC	Air Mobility Command
AOA	Angle of Attack
ASC	Aeronautical Systems Center
ASIP	Aircraft Structural Integrity Program
ATC	Air Training Command
BFTS	Bomber-Fighter Training System
CCP	Contract Change Proposal
CDR	Critical Design Review
CDRL	Contract Data Requirements List
CLS	Contractor Logistics Support
CNATRA	Chief of Naval Air Training
CNO	Chief of Naval Operations
COMBS	Contractor Operated and Maintained Base Supply
CONOPS	Concept of Operations
CSAF	Chief of Staff of the Air Force
CSAR	Combat Search and Rescue
CY	Calendar Year
DAB	Defense Acquisition Board

DADTA	Durability and Damage Tolerance Analysis
DAL	Data Accession List
DAPP	Defense Acquisition Pilot Program
DAU	Defense Acquisition University
DFARS	Defense Federal Acquisition Regulation Supplement
DoD	Department of Defense
DoDAF	DoD Architectural Framework
DOT&E	Director of Operational Test and Evaluation
DUSD(AR)	Deputy Under Secretary of Defense for Acquisition Reform
ECP	Engineering Change Proposal
ECS	Environmental Control System
EIA	Electronics Industrial Association
EMD	Engineering and Manufacturing Development
ENSIP	Engine Structural Integrity Program
ESC	Electronic Systems Center
EVMS	Earned Value Management System
FAA	Federal Aviation Administration
FAR	Federal Acquisition Regulation
FASA	Federal Acquisition Streamlining Act
FCA	Functional Configuration Audit
FMS	Foreign Military Sales
FOC	Full Operational Capability
FOD	Foreign Object Damage
FOT&E	Follow-on Test and Evaluation
FRR	Flight Readiness Review
FTW	Flying Training Wing
FY	Fiscal Year
GBTS	Ground Based Training System
GPS	Global Positioning System
HAF	Hellenic Air Force
HQ	Headquarters
HUD	Heads-Up Display

ICBM	Intercontinental Ballistic Missile
IEEE	Institute of Electrical and Electronics Engineers
IFF	Identification, Friend or Foe
IITRI	Illinois Institute of Technology Research Institute
IMP	Integrated Master Plan
INCOSE	International Council on Systems Engineering
IOC	Initial Operational Capability
IPT	Integrated Product Team
ISR	Intelligence, Surveillance, and Reconnaissance
IT	Information Technology
ITT	Integrated Test Team
JET	Joint Estimating Team
JPATS	Joint Primary Aircraft Training System
JPL	Joint Priority List
JSON	Joint Statement of Operational Need
JSORD	Joint System Operational Requirements Document
KTAS	Knots True Air Speed
LRIP	Low Rate Initial Production
MAC	Military Airlift Command
MacB	MacAulay-Brown, Inc.
MAJCOM	Major Command
MCO	Military Certification Office
MIL-HDBK	Military Handbook
MOA	Memorandum of Agreement
MOE	Measure of Effectiveness
MOP	Measure of Performance
MOT&E	Multi-Service Operational Test and Evaluation
MOU	Memorandum of Understanding
MSL	Mean Sea Level
NAS	Naval Air Station
NATO	North Atlantic Treaty Organization
OFF	Operational Flight Program

OPTEVFOR	Operational Test and Evaluation Force
ORD	Operational Requirements Document
OSD	Office of the Secretary of Defense
PATS	Primary Aircraft Training System
PCA	Physical Configuration Audit
PDR	Preliminary Design Review
PFRR	Planning for Rate Review
PIPFS	Prime Item Product Function Specification
PMD	Program Management Directive
POC	Point of Contact
PoP	Period of Performance
QT&E	Qualification Test and Evaluation
RAA	Required Assets Available
RAC	Raytheon Aircraft Company
RFP	Request for Proposals
S/N	Serial Number
SAC	Strategic Air Command
SAF	Secretary of the Air Force
SAR	Selected Acquisition Report
SECDEF	Secretary of Defense
SEP	Systems Engineering Plan
SLEP	Structural Life Extension Program
SME	Subject Matter Expert
SON	Statement of Need
SoS	System-of-Systems
SOW	Statement of Work
SPO	System Program Office
SRD	System Requirements Document
SRR	Site Readiness Review
STANAG	Standardization Agreement
TAC	Tactical Air Command
TACC	Tailored Airworthiness Certification Criteria

TBD	To Be Determined
TBMCS	Theater Battle Management Core System
TCDS	Type Certificate Data Sheet
TIMS	Training Integration Management System
TOR	Tentative Operational Requirements
TTTS	Tanker-Transport Training System
TW	Test Wing
UAV	Unmanned Air Vehicle
USD(A&T)	Under Secretary of Defense for Acquisition and Technology
USD(AT&L)	Under Secretary of Defense for Acquisition, Technology, and Logistics
WASP	Wide-Body Airborne Sensor Platform
WPAFB	Wright-Patterson AFB

Appendix C. T-6 Type Certificate Data Sheet

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

A00009WI Revision 14 Hawker Beechcraft Corporation 3000 May 19, 2008
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TYPE CERTIFICATE DATA SHEET NO. A00009WI

This Data Sheet, which is part of Type Certificate No. A00009WI prescribes conditions and limitations under which the product for which the Type Certificate was issued meets the airworthiness requirements of the Federal Aviation Regulations.

TypeCertificateHolder: Hawker Beechcraft Corporation
9709 East Central
Wichita, Kansas 67206

TypeCertificateHolderRecord: Raytheon Aircraft Company transferred to
Hawker Beechcraft Corporation on March 26, 2007

I. MODEL 3000 (U. S. Military T-6A) (ACROBATIC CATEGORY) (See note 12. for restrictions)
APPROVED JULY 30, 1999.

Engine One (1) Pratt and Whitney of Canada, Ltd. of United Technologies Corp. Pratt and Whitney Division PT6A-68 (turboprop).

Fuel JP-4, JP-5, JP-8, JET-A, JET-A1, and JET-B.

Anti-Icing Additive per MIL-I-85470 is required in concentration of .10% - .15% by volume.

Oil(Engineand Gearbox) Pratt and Whitney Service Bulletin No. 18001 lists approved brand oils.

EngineLimits

	Shaft horsepower	N ₁ Gas Generator Speed (%)	Prop Shaft Speed (RPM)	Maximum Permissible Turbine Interstage Turbine (Deg. C)
Take Off	1100	104%	2000	820
Maximum Continuous	1100	104%	2000	820
Ground Idle	-	51% min.	-	750
Starting	-	-	-	1000 (5 sec.)
Transient	1447 (20 sec.)	104%	2200	870 (20 sec.)

All other engine limits as noted in engine TCDS E26NE

PropellerandPropellerLimits One Hartzell HC-E4A-2 () Hub with E9612 Blades
Diameter: 97 Inches (Maximum):
Minimum allowable for repair: 96 inches
No further reduction permitted.
Pitch Settings at:
Low Pitch Stop 15.1° ± .2°
Feathered 86 ± .5°

Propeller limits as per TCDS P10NE

AirspeedLimits(KIAS)

Maximum Operating Speed	316
Maximum Operating Mach No.	0.67
Maximum Flap Extension Speed	147
Landing Gear Extended	147
Maneuvering Speed	236

C.G.Range(Landing GearExtended)

Allowable Forward C. G. Up To 5212 Lbs-F. S. 163.8
Allowable Forward C. G. Up To 6200 Lbs-F. S. 164.8
Allowable Forward C. G. Up To 6500 Lbs-F. S. 166.8
Allowable Aft C. G. Up To 6500 Lbs-F. S. 169.4

EmptyWTC.G.Range

F.S. 163.9 TO F.S. 165.0

MaximumWeight

Ramp	6550 LBS
Takeoff	6500 LBS
Landing	6500 LBS
Zero Fuel	5500 LBS

MinimumCrew

One (1) Pilot

No.ofSeatsand

Pilot (F. S. 162.8)

Loading

Passenger (F. S. 218.9)

MaximumBaggage

80 Lbs. (F. S. 271.0)

FuelCapacity

TANK	CAP. GAL.	USABLE GAL.	ARM
LH	92.0	90.0	+169.9
RH	92.0	90.0	+169.9

See Note 1. for data on unusable and undrainable fuel.

Note: Fuel tanks are interconnected and function as one tank. Fuel is free to flow between tanks. Total usable fuel 90.0 + 90.0 = 180 gallons.

OilCapacity

18 Quarts total at F. S. 89.4
See Note 1. for data on undrainable oil.

MaximumOperatingAltitude

31,000 feet

ControlSurfaceMovements

Rudder	Right 24 °	Left 24 °
Rudder Tab	Right 9 °	Left 9 °
Elevators	Up 18 °	Down 16 °
Elevator Trim Tab	Up 5.5 °	Down 22 °
Ailerons	Up 20 °	Down 11 °
Aileron Trim	Biased Centering Spring	
Wing Flap	Takeoff 23 °	Landing 50 °
Speedbrake	67.5 °	

SerialNos.Eligible

PT-4 and after;
PF-1 and after (See note 10 for special information relating to serial number PF-3) &

<u>Datum</u>	PG-1 through PG-25 (See note 11) Firewall Location F.S. 118.1
<u>LevelingMeans</u>	Inclinometer on canopy rail measuring -6.00 degrees
<u>CertificationBasis</u>	<p>FAR Part 23 effective February 1, 1965 as amended by Amendment 23-1 through 23-47; FAR 23.201, 23.203, 23.207 as amended by Amendment 23-50; FAR Part 34 effective September 10, 1990 as amended by Amendment 34-3 effective February 3, 1999; FAR Part 36 effective December 1, 1969, as amended by Amendment 36-21 effective December 28, 1995; the Noise Control Act of 1972; Exemption No. 6869; and Special Conditions 23-98-03-SC and 23-98-02-SC.</p> <p>Equivalent Safety findings have been granted as follows: 23.562; 23.777(d); 23.785(d); 23.807(b)(5); 23.841(b)(6); 23.1305(c)(5); and 23.1549(b).</p> <p>Application for Type Certificate was dated January 15, 1996. A one (1) year extension of Type Certification date was granted via FAA letter dated January 26, 1999. The Model 3000 Type Certificate was obtained by Hawker Beechcraft Corporation under Delegation Option Procedures under authority of FAR Part 21,Subpart J.</p>
<u>ProductionBasis</u>	Production Certificate No. PC- 8. Delegation Option Manufacturing No. DOA-230339-CE. S/N PT-4, PT-5 and PT-8 not Produced under PC-8. Authorized to issue airworthiness certificates under Delegation Option Procedures of Part 21 of the Federal Aviation Regulations.
<u>Equipment</u>	<p>The basic required equipment as prescribed in applicable airworthiness regulations (see Certification Basis) must be installed in the aircraft for certification. (See Limitations Section of FAA Approved Airplane Flight Manual for Kinds of Operation equipment list.)</p> <p>All pilots and passengers must receive Hawker Beechcraft Corporation (HBC) approved egress training and wear HBC approved flight apparel per the AFM.</p>
NOTE 1.	<p>Current weight and balance data, loading information and a list of equipment included in empty weight must be provided for each airplane at the time of original certification.</p> <p>(a) Basic empty weight includes unusable fuel of 41.7 lb. at (167.7 in.) with 14.5 lb. being undrainable.</p> <p>(b) Basic empty weight includes engine oil of 36.35 lb. at (89.4 in.) with 2.55 lb. being undrainable.</p>
NOTE 2.	All placards required in the FAA Approved Flight Manual P/N 133-590003-5 must be installed in the appropriate location.
NOTE 3.	A mandatory retirement time for all structural components is contained in the FAA Approved Limitations Section, of the HBC Model 3000 Maintenance Manual, P/N 133-590003-7. The limitations may not be changed without FAA engineering approval.
NOTE 4.	Inverted flight is limited to fifteen (15) seconds. Intentional zero G is limited to 5 seconds.
NOTE 5.	Airplane must be operated in accordance with FAA Approved Airplane Flight Manual P/N 133-590003-5.
NOTE 6.	This aircraft contains a canopy fracturing system and ejection seat system that was FAA approved based on the Equivalent Level of Safety provisions on FAR 21.17. Due to the uniqueness of this equipment, corresponding Operational characteristics, and need for recurring maintenance activity, all ejection seat training, maintenance, and component replacement schedules must be conducted in accordance with the FAA approved Airworthiness Limitations Section of HBC Maintenance Manual P/N 133-590003-7.

- NOTE 7. This aircraft incorporates design features which install components in the fire zone (forward of the firewall) that normally are not installed in a fire zone (i.e. battery, nose gear actuator, tire, etc.). These components required special tests and/or analysis to insure that no additional hazard was caused when exposed to the effects of an engine fire. Any replacement of non-original components in this area must meet original airworthiness requirements.
- NOTE 8. Prior to issuance of a U. S. Standard Airworthiness Certificate, the Model 3000 must be modified in accordance with HBC drawing 133-005001.
- NOTE 9. Model 3000 serial number PF-1 and after are defined by drawing 133-000001 for operation by the Canadian Military. To return to an FAA approved configuration, the airplane must be modified in accordance with HBC drawing 133-005001; and AFM supplements 133-590003-49, 1330590003-51, 133-590003-55 and 133-590003-57 are required to be inserted in the AFM (133-590003-5).
- NOTE 10. PF-3 is eligible for delivery with restrictions which require changing the FAA approved category from Acrobatic to Normal per HBC Service Instructions T-6A-0001. Airplane Flight Manual Supplement 133-590003-61 is required with this change. These restrictions will be in effect until the airplane is modified per HBC Service Instructions T-6A-0002.
- NOTE 11. Model 3000 serial number PG-1 through PG-25 are defined by drawing 133-000006 for operation by the Greek Military. To return to a FAA approved configuration, the airplane must be modified in accordance with HBC 133-005001.
- NOTE 12. Restrictions to Acrobatic Category are defined below and in Airplane Flight Manual Supplement P/N 133-590003-65 for airplanes equipped with the Lori oil cooler 117-389011-1 installed per drawing 133-005001 (Reference Note 14.)
- Additional Prohibited Maneuvers
- Intentional Zero-G or Negative G flight during or on recovery from Approved Maneuvers
- Slow Roll
- Stall Turn (Hammerhead)
- Vertical Roll
- Sustained Vertical Nose Down
- Knife Edge
- NOTE 13. Prior to issuance of a U.S. Standard Airworthiness Certificate, the Model 3000 must be modified in Accordance with HBC drawing 133-005001. In accordance with FAR 23.1529, Instructions for Continued Airworthiness acceptable to the Administrator must be available at delivery of first aircraft or issuance of a standard certificate of airworthiness.
- NOTE 14. For aircraft equipped with Stewart Warner Oil Cooler P/N 133-389029-1 (10662E) installed per drawing 133-930002, and aircraft complying with SI T-6A-0026, Revision 1, the restrictions in AFM P/N 133-590003-65 and in note 12 herein do not apply.
- NOTE 15. Model 3000 serial number PG-26 through PG-45 are defined by HBC drawing 133-000004 for operation by the Greek Military. Serials PG-26 through PG-45 are not eligible for FAA approval.
- NOTE 16. Installation of HBC Kit 133-5004 Enhanced ECS System requires installation of Kit 133-5005 Crew Oxygen System. Installation of the crew oxygen system requires FAA approval.
- NOTE 17. Company name change effective 3-26-07. The following serial numbers are manufactured under the name of Hawker Beechcraft Corporation: PT-358 and after.

Appendix D. AMENDMENT

Amendment

Report No. 97-311

DEPARTMENT OF DEFENSE AUTHORIZATION ACT, 1982

November 3, 1981. – Ordered to be printed.

CONFERENCE REPORT

(To accompany S.815)

TITLE IX—GENERAL PROVISIONS

REPORTS ON UNIT COSTS OF MAJOR DEFENSE SYSTEMS

Sec. 917 (a)(1) The program manager (as designated by the Secretary concerned) for each major defense system included in the Selected Acquisition Report dated March 31, 1981, and submitted to Congress pursuant to section 811 of the Department of Defense Appropriation Authorization Act, 1976 (Public Law 94-106; 10 U.S.C. 139 note), shall submit to the Secretary concerned, within seven days after the end of each quarter of fiscal year 1982, a written report on the major defense system included in such selected acquisition report for which such manager has responsibility. The program manager shall include in each such report --

- (A) the total program acquisition unit cost for such major defense system as of the last day of such quarter; and
 - (B) in the case of a major defense system for which procurement funds are authorized to be appropriated by this Act, the current procurement unit cost for such major defense system as of the last day of such quarter.
- 2) If at any time during any quarter of fiscal year 1982, the program manager of a major defense system referred to in paragraph (1) has reasonable cause to believe that (A) the total program acquisition unit cost, or (B) in the case of a major defense system for which procurement funds are authorized to be appropriated by this Act, the current procurement unit cost has exceeded the applicable percentage increase specified in subsection (b), such

manager shall immediately submit to the Secretary concerned a report containing the information, as of the date of such report, required by paragraph (1).

- 3) The program manager shall also include in each report submitted pursuant to paragraph (1) or (2) any change from the Selection Acquisition Report of March 31, 1981, in schedule milestones or system performances with respect to such system that are known, expected, or anticipated by such manager.

(b)(1) If the Secretary concerned determines, on the basis of any report submitted to him pursuant to subsection (a), that the total program acquisition unit cost (including any increase for expected inflation) for any major defense system for which no procurement funds are authorized to be appropriated by this Act has increased by more than 15 percent over the total program acquisition unit cost for such system reflected in the Selected Acquisition Report of March 31, 1981, then (except as provided in paragraph (3)) no additional funds may be obligated in connection with such system after the end of the 30-day period beginning on the day on which the Secretary makes such determination. The Secretary shall notify the Congress promptly in writing of such increase upon making such a determination with respect to any such major defense system and shall include in such notice the date on which such determination was made.

(2) If the Secretary concerned determines, on the basis of a report submitted to him pursuant to subsection (a), that –

(A) the procurement unit cost of a major defense system for which procurement funds are authorized to be appropriated by this Act has increased by more than 15 percent over the procurement unit cost derived from the Selected Acquisition Report of March 31, 1981, or

(B) the total program acquisition unit cost (including any increase for expected inflation) of such system has increased by more than 15 percent over the total program acquisition unit cost for such system as reflected in the Selected Acquisition Report of March 31, 1981, or

then (except as provided in paragraph (3)) no additional funds may be obligated in connection with such system after the end of the 30-day period on the day which the Secretary makes such determination. The Secretary shall notify the Congress promptly in writing of such increase upon making such a determination with respect to any such major defense system and shall include in such notice the date on which such determination was made.

(3) The prohibition contained in paragraphs (1) and (2) on the obligation of funds shall not apply in the case of any major defense system to which such prohibition would otherwise apply if the Secretary concerned submits to the Congress, before the end of the 30-day period referred to in paragraph (1) or (2), a written report which includes –

(A) a statement of the reasons for such increase in total program acquisition unit cost or procurement unit cost;

(B) the identities of the military and civilian officers responsible for program management and cost control of the major defense system;

(C) the action taken and proposed to be taken to control future cost growth of such system;

(D) any changes made in the performance or schedule milestones of such system and the degree to which such changes have contributed to the increase in total program acquisition unit cost or procurement unit cost;

(E) the identities of the principal contractors for the major defense system; and

(F) an index of all testimony and documents formally provided to the Congress on the estimated cost of such system.

(c)(1) If the Secretary concerned –

(A) on the basis of a report submitted to him pursuant to subsection (a), determines (i) that the total program acquisition unit cost (including an increase for expected inflation) for a major defense system has increased by more than 25 percent over the total program acquisition unit cost or such system reflected in the Selected Acquisition Report of March 31, 1981, or (ii) in the case of any such system for which procurement funds are authorized to be appropriated by this Act, that the current procurement unit cost of such system has increased by more than 25 percent over the procurement unit cost derived from the Selected Acquisition Report of March 31, 1981, and

(B) has submitted a report to the Congress with respect to such system pursuant to subsection (b)(3),

then (except as provided in paragraph (2)) no additional funds may be obligated in connection with such system after the end of the 60-day period beginning on the day on which the Secretary makes such determination.

(2) The prohibition contained in paragraph (1) on the obligation of funds shall not apply in the case of a major defense system to which such prohibition would otherwise apply if the Secretary of Defense submits to the Congress, before the end of the 60-day period referred to in such paragraph, a written certification stating that -

(A) such system is essential to the national security;

(B) there are no alternatives to such system which will provide equal or greater military capability at less cost;

(C) the new estimates of the total program acquisition unit cost or procurement unit cost are reasonable; and

(D) the management structure for such major defense system is adequate to manage and control total program acquisition unit cost or procurement unit cost.

(d) As used in this section:

(1) The term “total program acquisition unit cost” means, in the case of a major defense system, the amount equal to (A) the total cost for development and procurement of, and system-specific military construction for, such system, divided by (B) the number of fully configured end items to be produced for such a system.

(2) The term “procurement unit cost” means, in the case of a major defense system, the amount equal to (A) the total of all procurement funds available for such system in any fiscal year, divided by (B) the number of fully-configured end items to be procured with such funds during such fiscal year.

(3) The term “Secretary concerned” has the same meaning as provided in section 101(8) of title 10, United States Code.

(e) Section 811 of the Department of Defense Appropriation Authorization Act, 1976 (Public Law 94-106; 10 U.S.C. 139 note), is amended by addition at the end thereof the following new subsection:

“(c)(1) Each report required to be submitted under subsection (a) shall include the history of the total program acquisition unit cost of each major defense system from the date on which funds were first authorized to be appropriated for such system.

“(2) As used in this subsection, the term ‘total program acquisition unit cost’ means the amount equal to (A) the total cost for development and procurement of, and system-specific military construction for, a major defense system, divided by (B) the number of fully configured end items to be produced for such a system.”