Name of Program: QF-16 Full-Scale Aerial Target (FSAT) Program

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Bio for program leader:

Thomas “Tom” R Lepe is Program Manager for the QF-16 FSAT & T-38 Avionics Upgrade Program (AUP), a position he has held since June 2012. Mr. Lepe has full RAA and manages all aspects of the programs. He is responsible and accountable for program cost, schedule, quality, technical performance, and customer satisfaction.

Prior to this assignment, Mr. Lepe was the Program Manager for the T-38 AUP since Dec 2007 with same responsibilities. Before that he served as Chief Engineer for the T-38 AUP and as the T-38 AUP Integration Integrated Product Team (IPT) Leader.

Mr. Lepe joined The Boeing Company in 1980 as an Electronic Engineer. He has held leadership positions of increasing responsibility within Support Systems and TACAIR on various programs including Ground Support Equipment on the F-15 and A-12, and within Avionics Integration on the F-15 and T-38 AUP. Mr. Lepe holds a bachelor degree in electronics engineering.

“Charting the Course” is a Boeing Leadership Attribute and Lepe’s strong suit. His leadership approach is customer-focused, demonstrating that a contractual agreement defines the scope of a program; however, truly understanding customer enduring needs and delivering results is the measure of success.
**Program Overview** – The U.S. Air Force QF-16 Full Scale Aerial Target (FSAT) Program contract was awarded to the Boeing Global Services & Support business unit in March 2010. The QF-16 FSAT is a replacement for the QF-4 FSAT and scheduled for Initial Operational Capability (IOC) in fiscal year 2015. It provides a 4th generation full-scale target for Threat-Representative Weapon System Testing & Evaluation on the target ranges at Tyndall and Holloman Air Force Bases. The QF-16 FSAT program is a multi-phased fixed price contract.

Phase 1, Preliminary Engineering Manufacturing Development (Pre-EMD), is the design, development, and integration of the Drone Peculiar Equipment (DPE), conversion of six aircraft (two each Block 15, 25 & 30) to the QF-16 configuration, and development of the Peculiar Support Equipment (PSE). It includes risk reduction testing with a government developed and supplied portable target control system equivalent to the systems currently used at Tyndall and Holloman. The aircraft retains full F-16 performance capabilities and can be flown by an on-board pilot or by the target control system.

Phase 1 was a Fixed Price Incentive Firm (FPIF) contract using an accelerated version of the standard DoD 5000.02 Defense Acquisition Management System. It was very aggressive in terms of both cost and schedule because Critical Design Review (CDR) and a tailored System Verification Review (SVR) were required prior to Milestone B. That condition necessitated concurrent design, development, production, and risk reduction test of the DPE, PSE, and Technical Manuals. It created special engineering challenges that required risk taking and resourcefulness to overcome.

Phase 2, Engineering Manufacturing Development (EMD), is the contractor Development Test, Integrated Test, and Operational Test at Tyndall and Holloman. The testing at Tyndall will support a Milestone C decision and approval to start Low Rate Initial Production (LRIP). Upon completion of EMD, the remaining drones will be delivered to the Air Force at Tyndall to support initial pilot and maintenance training. This requires the aircraft to be production representative.

Phase 3 is the Low Rate Initial Production phase with most probable quantity (MPQ) for LRIP being 15 aircraft. The Lot 1 aircraft will be delivered to Tyndall and provide the IOC. Phase 4 is Full Rate Production (FRP) with most probable quantities ranging from 18 to 25 aircraft per year.

The use of fixed-price contracting type for engineering development presented additional difficult and unique challenges.

Boeing leaned forward, assuming risk and initiated program startup on company funds in advance of contract award to enable immediate execution upon award. A key enabler for program excellence was the decision made to staff the proposal team with individuals committed to program execution upon award. This approach ensured that continuity and momentum were maintained. The early startup preparation and the program team stability made it possible, at award, to very quickly and effectively baseline the program within 100 days and advance into design and development in order to meet schedule milestones. As a result, the program successfully executed a very aggressive Pre-EMD phase, completing subsystem design and procurement, aircraft assembly, support equipment assembly, technical publications development, system ground verification testing, and 84 test flights. Pre-EMD culminated with
full incentive fee award and favorable Milestone B decision in December 2012.

**Value of the program** – Full Scale Aerial Targets (FSAT) provide high fidelity threat representation of adversary air superiority fighters for air-to-air and surface-to-air weapon systems testing and training. Such testing is mandated by U.S. Code Title 10 and ensures counter air weapon systems will be effective and lethal in combat. In this role, the QF-16, while procured by the US Air Force, will also be used by the US Navy and US Army. Currently, the sole FSAT is the QF-4, which the Air Force determined must be replaced to meet today’s threats. The high rate of consumption of the remaining QF-4s requires an aggressive IOC date for the QF-16 to prevent a training and test capability gap.

As a Test and Evaluation (T&E) asset for the US DoD, the QF-16 solution is an enabler for the development of air-to-air and surface-to-air weapon systems and an essential component of the acquisition process that equips US forces with the inherent capability to provide air superiority.

The QF-16 also provides value to The Boeing Company by expanding markets. Boeing was not the original equipment manufacturer (OEM) for the F-16 base platform or the incumbent for the QF-4. The addition of the QF-16 to the portfolio and successful execution of the program furthers Boeing’s ability and grows its reputation as an engineering development company that can and will reach out beyond its familiar portfolio with confidence and competence. The QF-16 program expands Boeing’s experience in designing high performance unmanned air vehicles, and confers significant value to the US Air Force by integrating state of the art flight control software in the aircraft as well as the Gulf Range Drone Control System (GRDCS).

**Why the Program Excels** – Technical engineering development in a fixed-priced contract environment is commonly considered by the defense industry to be impractical and difficult to execute. To overcome the inimitable challenges, the program required ground breaking ingenuity, innovation, intense focus on cost and schedule, detailed planning, sound and timely decision making, diligence, and flawless communication internally and externally. The QF-16 program found ways to overcome and excel.

Early recognition and successful implementation of three key tenants were instrumental in overcoming challenges. The three key tenants are: 1) qualified & experienced people; 2) mature, comprehensive, and proven processes; and 3) standard, effective tools. The “One Boeing” enterprise concept was implemented in earnest to satisfy the tenants. The program office is located at Boeing in St. Louis, Missouri, enabling easy access to engineering design and development, test planning, program management expertise, available infrastructure, and easy reach-back for full and part time management and engineering subject matter experts. The program also reached across business units and functions to optimize available experience and expertise. The deputy program manager resides at Boeing’s Fort Walton Beach, Florida site, along with the Integrated Logistics Support IPT, due to its proximity to the Aerial Targets program office at Eglin AFB and affordable rate structure. The location enables frequent, in-person dialog with the customer, further enhancing the customer relationship. Boeing’s Cecil Field, located in Jacksonville, Florida, was chosen to execute the aircraft modifications, future LRIP and FRP, and contractor risk reduction ground and flight test due to its proximity to Eglin, its skilled, low cost production operations work force, its proximity to experimental test air
space, and its long airstrip for risk reduction.

Customer satisfaction was installed as the first program operating principle. A comprehensive joint communication plan with a well defined operating rhythm was developed with the customer. The weekly Program Management Meeting and Joint Configuration Change & Risk, Issue, & Opportunity Boards are customer inclusive and provide program transparency. A web based program portal was deployed to provide a collaborative open environment to share near real-time program management information with full customer access and helps the program sustain focus on the program indicators and metrics. All of this is an enabler to quick decision making and assures the program manages from the front (proactive) and responds with speed and agility (reactive) when necessary.

Early in Pre-EMD execution it was discovered the QF-16 was required to follow a new process to achieve Air Worthiness Certification via the Technical Airworthiness Authority (TAA). The TAA process was unfamiliar to both Boeing and the Aerial Targets program office. It was also not fully deployed in terms of documented process (aka Air Worthiness Bulletins). This added unexpected complexity, and new cost and schedule tension. To overcome, the program reached back into Boeing Flight Operations and Flight Engineering organizations for expert help, worked closely with the program office, and attended the USAF Systems Engineering & Airworthiness Certification Conference in August 2011. Furthermore, through close collaboration and study of available Airworthiness Bulletins, a proper Certification Basis and Compliance Report with a full set of supporting artifacts was developed in accordance with the bulletins, enabling the program to achieve Military Flight Release on time for first flight.

The schedule challenge to design and build production representative aircraft and conduct first flight two years after contract authorization was daunting. To overcome this challenge, the engineering and supplier management organizations had to function as an integrated product team and work with key suppliers to develop plans with a great deal of concurrency between design and build. This required frequent communications and visits with suppliers to ensure initial designs and all design changes were properly captured in the build of the subsystems. Suppliers were ingrained in the risk management process to help anticipate and avoid design issues. Risk was further reduced by employing component risk reduction testing, prototyping, and early fit checks. The schedule risk was mitigated by working closely with production operations at Cel Field, incorporating ideas made by electrical and structural/mechanical technicians, and redlining engineering on site.

Metrics were used throughout the program to track progress and enable quick decision making. Each IPT presents its key performance metrics at the weekly Program Manager’s Meeting (PMM), along with plans to make adjustments and help needed. During development, metrics used included drawing release schedules, schematic releases, and software lines of code. As the program evolved toward build, metrics expanded to include part orders, part deliveries, shortages, quality nonconformances, and build status by aircraft. During testing, test point burn down curves and Problem Reports (PRs) from test anomalies were reported and tracked. Throughout the program, financial measures were tracked via the Earned Value Management system, and included cost and schedule variance analysis and corrective actions.
Technical challenges were overcome by extensive use of a weekly Engineering Review Board (ERB) and a weekly Joint Configuration Change Board (CCB)/Risk Board. The ERB was used to assign and track all design issues, address interface and system integration issues, and track and assign corrective actions on all PRs discovered during build and test. Early in the program, actions included activities such as building stereo lithography parts for fit checks and having an engineer on aircraft to troubleshoot wiring or subsystem operations. When combined with the risk board, this approach facilitated early detection of high risk areas and proactive mitigation. It also allowed time for alternate plans if an initial approach did not work.

**Teachable Lessons** – The program implemented Boeing’s Program Management Best Practices and Systems Engineering Best Practices from the very beginning with sustained focus and rigor. Proven processes were deployed extensively and implemented with discipline. However, practices and processes were tailored when necessary to more appropriately fit the size and speed of the program and to better serve within the FPIF contract environment to control costs and maintain schedule. That which was determined to not create value was removed or altered. As a result, all program milestones were achieved on time (IBR, SRR, SFR, PDR, CDR, SVR-1). The first flight on May 4, 2012 was successfully accomplished in a very aggressive two year schedule.

Program Management Best Practices were implemented immediately using a formal Program Execution Plan. The program utilized Boeing internal governance to perform startup assessment and best practice assessment mid way through Pre-EMD. By maintaining emphasis on “help” versus “audit,” the assessments proved to provide good value and helped the program refine and improve practices and processes.

As part of the disciplined Systems Engineering process, Boeing enterprise management and functional experts were engaged prior to each major review to conduct independent reviews that included the customer. This approach resulted in improved quality of the program reviews, gave the customer early opportunity to review the material, and provided first hand exposure to the Boeing enterprise subject matter experts, Boeing culture, and the reach-back capability. The use of independent reviews in this way has been recognized within Boeing as a best practice.

**Summary** – As a result of the outstanding team effort and disciplined implementation of best practices, in less than 3 years, the QF-16 program has been able to design 5 subsystems made up of over 200 parts, including over 3100 new wires and connections, qualified all subsystems for airworthiness, developed flight control software for unmanned flight, procured, modified and installed all parts, completed ground verification testing on all aircraft, designed and built 2 ground test stations, developed and verified ground test software, conducted 84 test flights, and ferried 6 aircraft to Tyndall AFB for start of Developmental Testing and Operational Testing (DT/OT). The DPE is currently in flight testing and has not experienced a failure in 3 months, and PRs are down to a handful of non-flight critical anomalies. All of this was accomplished while maintaining a positive financial position on a FPIF development contract. The end result is an extremely challenging and rewarding program that will greatly benefit the US Department of Defense for many years.