2015 Program Excellence Award

Phase I Submission
Name of Program: F-22 Raptor Vapor Cycle Controller Partnering Service Depot Stand-Up
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Category in which you are competing (choose one of the following):

- Sub-System Sustainment

Bio for program leader:

Peter Anderson, PMP, P.Eng.

Peter Anderson is currently a Honeywell F-35 Customer Business Manager. Prior to this role he served as the Honeywell Program Manager for various F-35 and F-22 projects including the F-22 Raptor Vapor Cycle Controller Partnering Service Depot Stand-Up.

Peter first joined Honeywell in 1996 as a Systems Engineer and held various positions of increasing responsibility in Systems Engineering, Project Engineering, and Program Management.

He holds a Professional Engineering License and a Project Management Professional designation.

Peter holds a Commercial Pilot’s License and is a Reserve Officer in the Canadian Armed Forces.

Peter earned a Bachelor of Aerospace Engineering from Carleton University, Ottawa, ON and is Six Sigma Green Belt Certified.
**F-22 Raptor Vapor Cycle Controller Partnering Service Depot Stand-Up**

This sustainment project provided the United States Air Force (USAF) at Oklahoma City ALC (OC-ALC Tinker AFB) with the independent capability to Diagnose, Service, Repair, and Return to Service F-22 Vapor Cycle Controllers (VCC). For the F-22 Raptor aircraft, Honeywell is under contract to Lockheed-Martin Aeronautics to provide the systems expertise and the hardware for the Integrated Environmental Control System, which includes the VCC, Air Cycle Machine, Vapor Cycle System Pack, Sensors, and Valves.

United States Federal Legislation requires that a certain proportion of USAF maintenance activity is performed within USAF facilities in order to maintain staff and infrastructure currency. Prior to initiating the project, the proportion was not met and a USAF study highlighted the F22 VCC as a candidate for partnering arrangements to meet the requirement.

**Value Creation**

This project provided value for the three primary stakeholders; USAF, Lockheed Martin, and Honeywell.

The maintenance activity at the Shop Replaceable Unit (SRU) level eliminated the need for piece part stocking and reduced repair/service cycle time. The reduction in repair cycle time translates directly into reduced aircraft lifecycle cost for the USAF.

As SRU level repairs can be conducted at the depot, a reduction in the amount of vendor oversight is required by Lockheed Martin as an intermediary stakeholder and it provides Honeywell the opportunity to focus resources on service/repair at the Printed Board Assembly (PBA) level. Overall it provides for an augmentation in full VCC test capability available to the F-22 fleet.

Honeywell supplied test equipment, tooling, software, work instructions, training and validation of Air Force technicians’ ability to perform repairs with the equipment and instructions provided. The Honeywell intellectual property associated with the resultant test setup was licensed to the depot to allow the work to be performed.
In addition to the project itself, Honeywell was provided the opportunity to evaluate and develop automatic diagnostic capabilities, develop relationships with stakeholders in this sector of the industry, and successfully demonstrate the ability to stand up a service depot for future Department of Defense aircraft on budget and on schedule. The opportunity provided emerging technologies for future offerings to both military and commercial customers in addition to maturing in house capabilities that will reduce cycle time and provide a definitive repair process. The automation of the process is an effective enabler to transfer tribal knowledge into a documented and repeatable process.

**Team Leadership**

The project was multi-tiered with participants from the USAF, Lockheed, Honeywell, and technical/test equipment hardware vendors. Honeywell had many tiers internally as well including Program Management, Project Engineering, Honeywell Technology Solutions Inc, and Engineering organizations in Toronto Canada, Tempe Arizona and Brno Czech Republic. Communication protocols were setup to ensure timely and proper flow up and down the chains. In addition to navigating various external and internal organizations, effective communication had to span 8 time zones.

The project had a specific set of approved procedures covering earned value management, contract change management, baseline change management, program scheduling, risk management, and configuration management which were in line with Honeywell Aerospace Procedure AP1338. Overall project execution and progress was monitored using the Integrated Master Schedule, cost performance metrics that were reported monthly and technical requirements that were maintained in the Systems Verification and Validation matrix. Opportunities were identified during weekly meetings held between the Honeywell and Lockheed engineering along with the program management teams. Once identified, specific action items were identified and tracked using a standard Rolling Action Item List.

Program risks were identified by all members of each Integrated Product Team (IPT), categorized, ranked, prioritized, and mitigation plans developed. The plans and request for Management Reserve, if necessary, were submitted to the IPT lead and ultimately to the program office for review and approval. Risk status was reviewed by the program office weekly and with the customer monthly.
Full team integration and motivation was encouraged by promoting open communication at all program levels during team meetings or during ad hoc communications.

Lessons learned from previous programs such as the F22 VCC Development Program were reviewed for applicability and incorporated into the test equipment design. Peer design reviews with senior engineer and chief engineer participation ensured previous lessons were shared and incorporated. Program performance metrics were reviewed regularly both internally and shared with the external stakeholders.

**Adapting to Innovation and Complexity**

Honeywell’s standard Integrated Product Delivery and Support (IPDS) approach was deployed on this project. This approach ensured that key stakeholders approved and signed off on the test equipment design as it moved through the preliminary design and critical design gates to ensure that all risks were mitigated and that lessons learned were considered.

The Honeywell process involving the X-ref Matrix was used to ensure all the customer requirements were met from the sub contract. The matrix captured requirements from the Statement of work (SOW), the Sub-Contract Data Requirements List (SDRL) and the Depot Partnering Agreement (DPA), and connected them with requirements and assumptions that were defined in the Basis of Estimate (BOE). The matrix provided a single point of reference for requirements flow down from the three primary sources and the Scope of work defined in the BOE. It also was used to track progress against the contract and covered at each of the 6 project phase reviews.

The project leveraged emerging market resources across Honeywell on a military program through active use of import/export compliance strategies. This allowed the project to capitalize on talents across the company, increased test equipment utilization development during a day due to time zone differences, and competitive rate structures.

The project provided for a technological advancement through the development of improved automation in the depot test equipment through creation of a knowledge base system to aid in the diagnostics and the automation of a dynamic compressor motor load. Honeywell AP1152 Strategies and Processes for Software and Hardware development starting at the initial requirements level and flowing through verification/delivery of equipment were integrated into the project upfront leading to the successful equipment delivery and capability demonstration.
Metrics, Measuring Performance

Traditional Earned Value Management metrics were maintained throughout the program. Our internal Management Operating System was developed to require adherence to financial reporting and detailed schedule adherence and risk mitigation processes. Resource Demand and Fill was forecasted and statused using the Manpower Allocation Tool. Monthly Operating Reviews were conducted to evaluate these aspects of the program. Monthly Integrated Master Schedule (IMS) and Status Reports were issued to Lockheed following rigorous internal reviews. In addition to the monthly reporting, key design reviews (System Requirements Review, Preliminary Design Review, Critical Design Review, and Final Design Review) were held with the stakeholders to ensure the project was advancing in accordance with all technical and financial requirements and goals.
The project met all baselined milestones and delivered under budget by ensuring an active relationship and communication between the partnered technical and program staff (USAF, Lockheed, Honeywell, Lockheed, and vendors).

Conclusion

The F-22 VCC Depot will be critical to USAF for years to come. Honeywell’s use of the X-ref Matrix to capture requirements from three unique sources then connect them with the requirements and assumptions in the BOE combined with the effective use of emerging market resources on a military program culminated in a program that was delivered on time and under budget. The value the F-22 Raptor Vapor Cycle Controller Partnering Service Depot Stand-Up Program generated for the stakeholders and the final results clearly demonstrate this as a program to emulate, and one most worthy of Aviation Week’s Program Excellence Award.