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From: "Gibbens, Curtis A CIV WHS ESD (US)"
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Subject: OSD/JS FOIA 15-F-0504 Final Response - Final Presentations for DARPA Contracts with SRS Technologies
Cc: "Santos, Adrienne M CIV WHS ESD (US)"

Sent by electronic mail

This is in response to your attached Freedom of Information Act (FOIA) request, case number 15-F-0504.

The Defense Advanced Research Projects Agency (DARPA) provides the attached document that is responsive to your request. Mr. Brian Eshenbrenner, Director, Mission Services Office, and a FOIA Initial Denial Authority, has determined that certain information is exempt from disclosure pursuant to 5 U.S.C. 552(b)(4), which pertains to trade secrets and commercial or financial data that is privileged or confidential and 5 U.S.C. 552 (b)(6), which pertains to information the release of which would constitute a clearly unwarranted invasion of the personal privacy of individuals.

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Sincerely,

Curtis Gibbens, FOIA Analyst
For Stephanie L. Carr Chief, Office of Freedom of Information OSD/JS FOIA Requester Service Center

Sponsored by:
Defense Advanced Research Projects Agency (DARPA)
Tactical Technology Office (TTO)

Future of VTOL Aviation (FVA) Study

Contract No. NBCHD060013
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Reporting Period: 31 March 2009 to 30 September 2010

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13. SUPPLEMENTARY NOTES

14. ABSTRACT
MSRS provided Scientific, Engineering, Technical, and Administrative (SETA) support to the Future of VTOL Aviation (FVA) Study. The goal of the FVA Study is to assess the tactical vertical lift science and technology developments needed to support future Join operations and to recommend those technologies and/or system concepts required to address future capability gaps. The study panel met between May 2009 and April 2010 and in that time met with leaders in government, industry and academia to discuss the current state of VTOL Aviation and developments moving forward towards a 2025-2035 timeframe. The panel also developed a set of recommendations based on these meetings that highlighted their thoughts and perspectives. These findings and recommendations were then briefed to key Army, DARPA, OSD and other Service leaders to gain more perspective and spread the ideals and themes of the study results.

15. SUBJECT TERMS
Vertical Takeoff and Landing; VTOL; Vertical Lift; Helicopter; Rotorcraft; Aviation; Future VTOL Aviation; FVA; DARPA

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Summary

The Future of Vertical Takeoff and Landing (VTOL) Aviation (FVA) Study assessed the tactical value and role of VTOL Aviation in today's battlefield, the current state of the VTOL fleet, and the need for new S&T developments to provide the capabilities our warfighters will need in the 2025-2035 timeframe. The FVA Study provided a set of findings and recommendations based on the assessment of an array of former senior military and industry leaders and their collected understanding of the issues facing VTOL operations today as well as the needs for dramatic capability improvements in the future.

These findings and recommendations were then delivered to co-sponsors in the Army and DARPA. As a continuation of the study, we then continued to brief the study to senior Army leadership, as well as leaders in DARPA, OSD and the other services.

ManTech Systems Engineering and Advanced Technologies (MSEAT), as Scientific, Engineering, Technical, and Administrative (SETA) support, provided detailed technical and programmatic support to the FVA Program Manager. This Final Technical Report describes MSEAT's efforts in terms of the FVA Program Task Objectives, General Methodology, Technical Results, Significant Hardware Develoment, and Important Findings and Conclusions. By and large, the efforts to attain the task objectives make up the majority of the General Methodology section of this report. This applied methodology resulted in FVA SETA Technical Results and the program's Important Findings and Conclusions.

Introduction

The FVA Study examined the current landscape, assessing the capabilities of the current fleet of VTOL aircraft that the military uses today. Utilizing the collective knowledge of our 12-person study panel, we were able to develop a substantive roadmap and plan for VTOL development in order to provoke and enable the deployment of a new capability in 2030-2035.

MSEAT was the SETA contractor for the FVA Study during the period from March 2009 until September 2010. During this period, we met with leaders in VTOL S&T, developed a briefing based on our findings and recommendations, and socialized this briefing with government leadership in S&T.

Task Objectives

MSEAT provided technical, management, and administrative support to the FVA Study Program Manager. MSEAT performed the following tasks:

1. System Engineering and Technical Assistance:

    - Provide support for the execution of the DARPA FVA Study, including meeting scheduling and coordination, attendance at meetings, coordination with related government organizations, and presentation production.
    - Contacted and scheduled DoD experts in the field to meet with the study panel and review their programs and knowledge of current and future developments in VTOL aircraft.
    - Provide inputs for and develop briefings, for the Program Manager, enabling him and the panel to produce outputs to other government leaders.
    - Provide subject matter experts with expertise in the following technical areas: systems analysis engineering; modeling and simulation of aviation systems; rotorcraft operations and CONOPS, rotorcraft design, rotorcraft physics and engineering expertise; DARPA program management expertise.
    - Assemble a study panel consisting of senior-level experts with extensive knowledge of technical and operational issues associated with the development of new VTOL aircraft. The panel, with the above listed expertise met monthly to provide insight and develop recommendations on the future programmatic, technical, and political needs and issues related to the development of new VTOL technologies for deployment in the 2030-2035 timeframe.
    - Provide system level analysis, rudimentary aerodynamic analysis, and system level trade studies for rotorcraft and other VTOL designs, including sensitivity analysis to vehicle design trades.
    - Produce a set of recommendations and conclusions for the future of technology maturation and development in VTOL aircraft.
    - Prepare briefings to support the development and approval of new program concepts/technologies and coordinate with other government study panels.
    - Develop a technology investment roadmap for future developments in VTOL technologies and platform development.

2. Program Administration

    - Provide administrative functions for conducting all tasks associated with the statement of work.

- Provide inputs for the preparation of briefings, compose and process reports, host meetings, and perform administrative tasks in the form of correspondence, scheduling, documents, and mailings.
- Provide a conference room, with adequate security for SECRET level classified discussions, capable of comfortably accommodating at least 20 people located within 15 minutes walking distance of DARPA.
- Provide meeting support services include planning, organizing, scheduling, agenda planning, conference material and proceedings preparation, provision for audio-visual services/equipment and security services.
- Provide a secure program SharePoint website for members of the study panel to share information in a manner which protects proprietary and competition sensitive data.
- Provide input and maintain all operations of this website including organizational structure and member hierarchy, member registration, and file maintenance. The website shall accommodate multiple simultaneous users as needed and shall incorporate state-of-the-art tools for supporting program activities, including program calendar and meetings.

3. Program Financial Support

- Prepare and track funding documents, congressional reports, budget estimates, and other financial reports associated with the FVA Study.
- Provide obligation and expenditure status reports to the Program Manager that includes all activities funded by the FVA Study.

General Methodology

The FVA Study took an investigative approach in determining the best way to move forward in developing new technologies and platforms for the future of vertical aviation. During the course of the study the MSEAT team undertook a data collection phase, a development phase and then a presentation and socialization phase.

During data collection, leaders from government, industry and academia were brought in to brief the study panel and discuss their current operations. During this period, the study panel was briefed on current operations in the Middle East and how those operations are affecting the VTOL fleet, current acquisition of new air platforms, and current R&D efforts in the Army, Navy, Marines, OSD and private industry. After this process was completed, the study team then undertook developing a set of conclusions and recommendations based on their findings from these briefings and discussions. These recommendations were then formalized and presented to TTO and Army S&T leadership. Once presented to the study sponsors, the MSEAT team then socialized the

briefing with other leaders across the Services and OSD, including the OSD Future of Vertical Lift (FVL) panel and JMR Tech Demonstration team.

The MSEAT Team was responsible for handling all administrative tasks during the study, including organizing monthly meetings and bringing in presenters. Throughout these meetings, we also provided technical and systems engineering expertise to the discussions. Our team was responsible for development of the briefing template and supplemental content to support the broader study panel recommendations. Finally, the MSEAT team continued to spearhead the efforts to socialize the brief among Service leadership and push the effort forward to best support the future of VTOL aviation.

Technical Results

MSEAT facilitated the FVA Study by coordinating all activities and outputs of the study. Throughout the course of the study, the Program Manager was continuously updated and informed of all findings and results the study produced. While no new technologies were developed as a direct result of the study, the following documentation and efforts were put forward to support the new developments for VTOL Aviation in the 2030-2035 timeframe:

- Reviewed more than 35 briefings on efforts in the VTOL industry.
- Drafted technical goals for VTOL aircraft in 2030.
- Developed charts and graphs highlighting current gaps in VTOL vehicle performance, autonomy, survivability and sustainability.
- Developed a recommendations and conclusions briefing that highlights the history, challenges and future needs in VTOL Aviation.
- Prepared briefings for numerous Service and OSD leaders.

Important Findings and Conclusions

During the data collection phase a lot of information from various government aviation departments and industry leaders was aggregated. The following findings were derived as part of this effort:

- VTOL Aviation is vital to Hybrid Warfare mission success
  - Critical over previous eight years to mission execution
- Capability Gaps are projected to widen in the future
  - Current acquisition approach not working (COTS/GOTS)
  - S&T pipeline not adequate to drive new designs
- Revolution in VTOL Technology is needed NOW
  - New VTOL systems technology designs required
- Need to energize and lead major Technology Thrust development efforts

- Pre Milestone S&T solutions needed for next decade acquisition decisions

Based on these findings and other information, roadmaps, and industry intelligence, the study panel came to the following conclusions for path forward development in VTOL:

- Focus on developing technologies in the four major VTOL Technology Thrust areas
  - Vehicle Performance
    - Speed > 250 knots
    - Radius > 500 kilometers
    - Endurance > 4 hours
    - Extended Hover at full payload at > 6K/95Deg
    - Useful load of at least 50% of design gross weight
  - Autonomy and Collaboration
    - Maximize commonality between manned and unmanned systems
    - Increased Autonomy Level to 7+ (Group Tactical Goals)
    - Improved collaboration with spectrum of battlefield systems
    - Manageable crew workloads
  - Survivability
    - Mishap Rate at 0.5/100K flight hours or better
    - Increased operational situational awareness
    - Increase survivability against threat systems
  - Sustainment
    - Increase systems availability to greater than 90%
    - Decrease VTOL support "foot print" 50%
      - Reduce maintenance man hours/flight hours by 50%
      - Reduce fuel consumption to meet vehicle flight performance parameters
    - Government owned open systems architecture
- Develop a pre-Milestone Portfolio of critical VTOL Technology Thrusts
  - Services and Industry are shorter-term focused
    - Services are concerned with the current fight, Industry is concerned with near-term P&L
  - DARPA has longer term mission/demonstrated experience (Global Hawk, FCS, Predator)
  - Unless proposed Technology Thrust recommendations are matured, there can be no future game-changing VTOL designs
- Designate a Revolution in VTOL Aviation (RVA) Portfolio Manager
  - Initiate the Objective Systems Analysis/Design integration effort
  - Defines major Technology Thrust vectors supporting the Objective Systems Analysis/Design
  - Develop program budget and timeline milestones

  - Synchronize efforts with OSD, Services, Industry, and Congress
- Foster cooperation and support with OSD, DARPA, Services, and Industry
  - Communicate DARPA and Services commitment to OSD and Congress
  - Establish necessary partnerships and agreements for success
- Associated studies recommend additional funding – OSD needs DARPA/Services commitment for success

Significant Hardware Development

No hardware was developed by MSEAT during the performance of this effort.

Implications for Future Research

One of the outputs of the FVA Study was a roadmap for future S&T development in VTOL Aviation, including a plan for technology maturation centered on a new concept development Objective System Analysis and Design (OSAD) activity. This plan highlights a necessity for technology developments to spur revolutionary growth in vehicle performance, autonomy/collaboration, survivability and sustainment for VTOL aircraft, as we push towards a potential new IOC in 2030-2035.

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