WARNER ROBINS AIR LOGISTICS CENTER

STRATEGIC TECHNOLOGY PLAN

14 JUNE 2005

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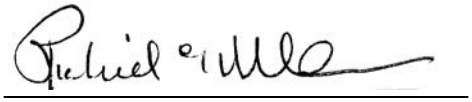

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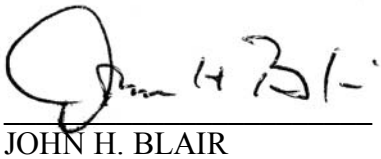

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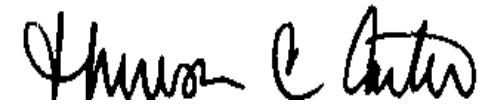

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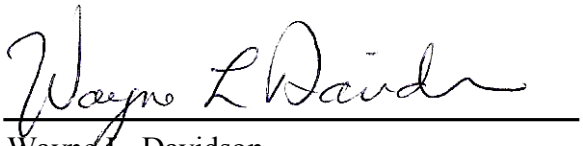

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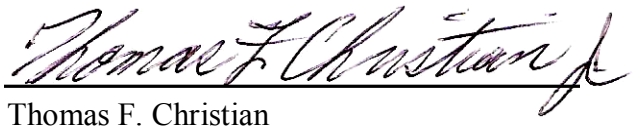

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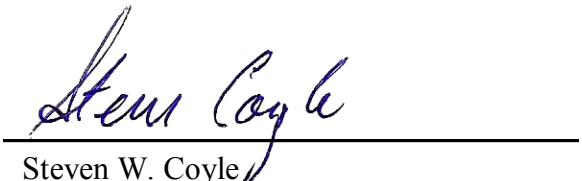

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Appendices

Executive Summary of Strategic Technology Plan

The WR-ALC Strategic Technology Plan (STP) is an output from the September 2004 Executive Council offsite and is the culmination of six months of organizing, data collection, and analysis. The product delivers to WR-ALC a central repository for its long-term capability needs to improve warfighter support and maintain competitiveness and the individual projects making up the Roadmap which delivers those needs. The STP also provides direction for submitting projects to the multitude of technology programs. The STP was developed from information contained in the weapon system's roadmaps, various USAF strategic plans, transformation plans, and from inputs by members of the Technology Steering Group, representing the ASW, CSW, MXW, and 78th ABW; each need relates to the 2004 USAF Master Capabilities List and the WR-ALC SA& D themes. Although there are many ways to sort the needs, the STP separates the needs into distinct product areas: airframes (13 needs and 52 supporting projects), avionics (10 needs and 18 supporting projects), information technology (3 needs and 3 supporting projects), support systems (3 needs and 16 supporting projects), depot remanufacturing (4 needs and 7 supporting projects), and other (1 need). The Roadmap support projects provide the means to deliver the capabilities and are found in Appendix B. The Roadmap will continuously be updated through the center-wide data calls with projects which support the needs.

1. Introduction

1.1 Overview of Strategic Technology Plan

This Strategic Technology Plan (STP) provides guidance on current and future technology needs of Warner Robins Air Logistics Center (WR-ALC). The STP establishes a long term view of technology insertion efforts for WR-ALC and provides a roadmap to future technology insertion efforts to enhance WR-ALC capabilities. One of the primary purposes for the STP is to integrate the technology insertion efforts across the center so that future data calls require less time for the submitters to improve submission packages. The STP will foster coordination with the other centers, AFRL, industry, and technology insertion programs.

1.2 Capability Sources

This guidance expresses WR-ALC objectives and priorities for the near and long terms that will require allocation of resources of WR-ALC and technology providers. While there are many sources of guidance, the primary sources for these objectives and priorities are:

- Weapon System Roadmaps
- U. S. Air Force Depot Maintenance Strategy for Fiscal Years 2004-2020
- U. S. Air Force Depot Maintenance Strategic Plan WR-ALC Implementation Plan for Fiscal Years 2004-2020
- U. S. Air Force Depot Maintenance Master Plan for Fiscal Years 2004-2020
- HQ AFMC Long Term Depot Maintenance Strategy briefing
- Air Force Vision 2020, Global Vigilance, Global Reach, Global Power
- U.S. Air Force Transformation Flight Plan 2004

The process and strategy for the Strategic Technology Plan was to solicit future capabilities and needs, integrate the needs and develop the roadmap for the technologies ensuring the capabilities are developed. The Strategic Technology Plan provides a framework for responding to future technology data calls in a manner that enables the optimum execution of the center's roadmap and technology program resources to support the war fighter.

1.2.1 Process Guidance Sources

Process Guidance must be incorporated into the Strategic Technology Plan to ensure commonality with established and future Air Force capabilities. Air Force guidance includes:

- AFI 63-1101, Modification Management
- AFI 63-1201, Operational Safety, Suitability and Effectiveness (OSS&E)
- AFI 21-118, Improving Air and Space Equipment Reliability and Maintainability
- AFMCI 23-103, Diminishing Manufacturing Supply/Material Shortages (DMSMS)
- DoDD 5000.2, Operation of the Defense Acquisition System
- Executive Order 13148, Greening the Government Through Leadership in Environmental Management
- AFI 32-7086, Hazardous Material Management
- AFI 32-7080, Pollution Prevention
- DoD Green Procurement Strategy

1.3 Roles and Responsibilities

The roles and responsibilities for generating and maintaining the Strategic Technology Plan are defined in the Technology Strategy Panel charter. The Technology Strategy Panel is a subgroup of the Engineering Advisory Board. The working group members are listed in Appendix A.

1.4 Technology Programs

The STP defines the capabilities required for WR-ALC to efficiently perform its mission. To fulfill these capability needs, prioritized technology needs will be submitted to various technology programs. The technology programs supported in the past are listed below, with approximate due dates for submissions to the programs.

Technology Program	Approximate Due Date
Depot Technology Modernization Program	5 January
Commercial Technologies for Maintenance Activities	28 February
Small Business Innovation Research	5 February
Technical Advisory Group (Applied Technology Demonstrations)	1 July (via DTMP)
Applied Technology Council	May and Oct
Material Support Division	10 March
General Support Division	20 May
Cooperative Research and Development Agreements	As Required
Advanced Concept Technology Development	22 April
Aging Aircraft Working Group	1 February (via DTMP)
Foreign Comparative Testing	24 January
Scientific Advisory Board	1 May
Manufacturing Technology (ManTech)	1 February (via DTMP)
Technology Transition Initiative	19 August
Quick Reaction Funds	20 December
Educational Partnership Agreements	As Required
Advisory Group for Electron Devices	24 June
Environmental Security Technology Certification Program (ESTCP)	6 January
Strategic Environmental Research and Development Program (SERDP)	6 January

2. Requirements Format

This section describes the composition of the remainder of this document. The following chapters provide long-range guidance on technology thrust areas. Each chapter focuses on a technology thrust area and its subtopics. The list of technology thrust areas and subtopics are:

- Airframe – Inspection
- Airframe – Repair
- Airframe – Coatings
- Airframe – Modifications
- Avionics – Modifications
- Avionics – Tools
- Information Technology
- Support Systems – Power
- Support Systems – General
- Depot Manufacturing/Repair and Support
- Other

One of the major technology thrust areas is airframe needs for improved coating technologies, inspection and evaluation technologies and modifications and replacement to structural components technologies. The coating area includes corrosion prevention and identification, and painting and painting removal activities. Airframe inspection includes non-destructive inspection, analysis and evaluation tools. Adding capabilities via improved or enhanced structures resulting in lighter and stronger structural components is another airframe area.

Another thrust area is avionics, which consist of the modification and tools areas. Parts obsolescence, supportability, and repair capabilities all are a part of the general avionics technology insertion area. Avionics modifications are concerned with improving the existing avionics supportability and life expectancy. The avionics tools area consist of software tool improvements, automatic test equipment hardware and software and test program sets to support depot maintenance activities.

The depot requires activities in the Support system technology insertion area. Alternative fueled ground equipment is one technology in the support systems power area. General support system activities include integrated support facilities, automated tool tracking, and ground equipment improvements.

The last technology thrust area is a catch all for technology areas that have smaller application areas. Obsolescence management is a major concern that falls into the other category.

2.1 Capability and Technology Linkages

With the FY03 APOM, the Air Force moved strongly towards a "results-oriented" resource allocation process. Rather than focusing on dollars to programs, the AF is pursuing ways to measure outcomes, desired capabilities and military effects that better reflect the impact of resource allocation decisions on the warfighter. Capabilities-based resource allocation actually begins with strategic planning. The capabilities needs in this plan are associated with Master Capabilities List entries in the Capability Review and Risk Assessment (CRRA). This linkage

encourages MAJCOM support and ensures technology efforts focus on warfighter needs. The linkages are included in the WR-ALC Technology Roadmap, Appendix B.

3. Depot 2020

What will WR-ALC look like in 2020? The depot of 2020 is very similar to today's depot, yet different in many aspects. Planned depot maintenance (PDM) continues, however some new tools will make the production lines faster and cheaper. The aircraft will be examined by a robotic system for cracks and corrosion. Whole aircraft NDI/NDE is a goal. Paint removal will be semi-automated with full aircraft reach and minimal waste generation. WR-ALC will be repairing the C-17 and Global Hawk aircraft. Composite structure repair and manufacturing will be common place. Aircraft will automatically self diagnose problems with smart health monitoring systems. Avionics systems will be smaller, have more capabilities and have increased spare capacity.

4. Capability Requirements

4.1 Airframe

The airframe technology area includes all components of the structure of an aircraft. This includes aircraft coatings, airframe inspections and airframe modifications. Coatings include paint, paint removal, corrosion control and associated technologies. The inspection area includes inspection of airframe structural components and associate tools. The modifications area includes material substitutions, airframe repairs and associate tools and processes.
The vision for this area is an improved structural inspection based on known characteristics of repairs, components and processes to determine maintenance cycles, strength, and predicted health of components. The ability to see through all layers of materials and identify cracks, corrosion and other anomalies is expected to reduce unnecessary maintenance. Structural repair will be improved by reductions in material turnover due to longer life materials, materials that are compatible with each other and more precisely machined materials. Improved coatings, application and removal technologies will reduce painting times and hazardous material emissions.

4.1.1 Aircraft Structural Inspection

4.1.1.1 Bonded Repair Inspections

Capability Description

Objective

Reduce the cost and time associated with recurring inspections of bonded repairs process.

Method

Develop a non-destructive inspection method that can evaluate the strength of a bonded joint. The method must be applicable to a variety of repair materials and substrates and be correlated to the failure strength of the bond line.

Need Date: 2011 – 2017

Thread

1. Develop inspection method to detect kissing bonds.

4.1.1.2 Crack and Corrosion Detection

Capability Description

Objective

Increase efficiency of identification of cracks and corrosion.

Method

Implement a program to identify, obtain and provide procedures for existing and emerging NDI technology.

Need Date: 2006 (As soon as possible)

Thread

1. Investigate several technologies and determine effectiveness in materials and probability of detection (POD)
2. Develop procedures for each NDI technology
3. Investigate sensor and data fusion to increase POD

4.1.1.3 Airframe Inspection Tools

Capability Description

Objective

Develop tools and procedures to manage the aircraft fleets. Probabilistic risk assessment tools, probability of detection, material selection and other tools.

Method

Develop tools and write procedures for utilization.

Need Date: 2009

Threads:

1. Develop economic service life extension database.

4.1.2 Aircraft Structural Repair

4.1.2.1 Bonded Repair Common Prepregs and Adhesives

Capability Descriptions

Objective

Reduce the number of stocked prepregs and adhesives required for multiple weapon systems. The effect will be reduction of inventory, out-of-date materials, and consequently costs. Several times each year, adhesives or prepregs are discarded because they are out-of-date and can no longer be certified. This is due to each weapon system requiring different vendor's adhesives although materials may be in stock having adequate properties to accomplish the repair but the materials have not been evaluated for alternate purposes.

Method

Develop a single material database of film adhesives and prepregs in the NSN system. Database should include design properties and the process required to develop the properties. The process must be compatible with on-aircraft repair processes. Environmental/processing factors to account for are:

1. Vacuum bag cure instead of autoclave
2. Low temperature cure data:

2.1. Time required to develop full properties when cured below optimum cure temperature
2.2. Minimum curing temperature which will develop full properties
3. Extreme environmental properties (Hot, wet, and -60F)
4. Compatibility with on aircraft surface preparations.
5. Material certification procedures and acceptance values.

Need Date: 2011 – 2017

Thread

1. Develop a full material database of Air Force wide material properties for composites and adhesives. Update Mil-Hdbk-17 with complete properties data.

4.1.2.2 Accurate Holes in Thick Structures

Capability Descriptions

Objective

Reduce maintenance-induced damage and rework caused by miss-drilled holes in thick structures; these errors are common when back-drilling steel and titanium repair members from aluminum structures. High quality, accurately located holes are mandatory in the repair of cracked structures in order to prevent subsequent cracks in the repaired holes. Consequently, the current method is extremely labor intensive and is required because the existing holes may be not perpendicular to the surface, may be tapered, and may not be drilled from the back side.

Method

Develop an in situ method that can accurately locate holes and their direction in thick structures. There may be commonality of the solution with the mold-making improvement need.

Need Date: 2011 – 2017

Thread

1. Analyze and define set of structures which require removal from airframe.
2. Develop machining tool & processes.

4.1.2.3 Molds for Composite and Metal Bond Parts

Capability Description

Objective

Reduce repair time and costs associated with making low lot quantity molds for composite and metal bond parts. The current process requires five or six days to make a splash mold from a part by building up and curing each layer before adding the next. Technology exists that allows large molds to be made in one or two days.

Method

Select and deploy a modern mold making technology, which can work over head and in a hanger environment. There may be commonality of the solution with thick structure repair need.

Need Date: 2008

Thread

1. Solicit proposals from industry, test in required environs, and implement.

4.1.2.4 Bonded Repair Improvements

Capability Descriptions

Objective

Expand the applicability of bonded repair to steel components. Improve existing bonded repair materials and processes.

Method

Develop a method of on aircraft surface preparation for bonding that is applicable to steel. Develop improved bonded repair capabilities.

Need Date: 2011 – 2017

Thread

1. Study the adhesive qualities and affects upon the various steel alloys.
2. Develop materials & processes to provide bonded repair of steel components.
3. Improve bonded repair capabilities.

4.1.2.5 Improve repair of Aircraft Structural Components

Capability Descriptions

Objective

Improve and expand the capability to repair and manufacture aircraft structural components.

Method

Develop methods to repair aircraft structural components. Components include honeycomb structures, titanium, aluminum, steel, and composite parts.

Need Date: 2008

Thread

1. Develop a method to repair honeycomb structures.
2. Develop and implement a method to produce critical structural components efficiently from CAD drawings or by scanning a duplicate part. This process should handle titanium, aluminum and steel components of all of the common alloys.
3. Develop the capability to repair, remanufacture and manufacture composite components. This capability should support C-130, C-5, C-17, and any other projected workload.
4. Expand bonded repair and other techniques to repair structural members in place.

4.1.3 Airframes – Coatings

Airframe coatings include painting, paint removal, special coatings, and accessories to improve coating processes. Consideration is given, but not restricted, to reducing volatile organic compound (VOC) and hazardous air pollutant (HAP) emissions, negative health and safety effects on workers, and process costs throughout the life cycle of the weapon system.

4.1.3.1 Reduce Coating Removal Time

Capability Description

Objective

Reduce paint removal time and cost while improving worker safety and reducing environmental concerns.

Method

Develop improved paint removal techniques, improved painting techniques and processes.
Need Date: 2010, at the latest.

Thread

1. Develop techniques and facilities for wet blast media.
2. Extend current technologies to get full aircraft coverage of systems.
3. Develop method to level, raise and lower aircraft and provide more ergonomic working height.

4.1.3.2 Corrosion Prevention

Capability Description

Objective

Reduce corrosion on aircraft and support equipment.

Method

Develop improved coatings and processes to reduce corrosion.

Need Date: 2009

Threads:

1. Develop and test advanced aircraft coatings.

4.1.3.3 Development of Special Coatings

Capability Description

Objective

Develop special coatings for use on aircraft and subsystems.

Method

Develop new coatings.

Need Date: 2010

Threads:

1. Develop UV coatings.
2. Develop scratch resistant coatings.
3. Develop environmentally friendly coatings.
4. Develop powder coatings for avionics.

4.1.4 Aircraft – Modifications

4.1.4.1 Aircraft Modification Methods

Capability Descriptions

Objective

Develop modifications for airframe components and methods for working in association with contractors to perform modifications.

Method

Develop capability to modify aircraft components.

Develop agreements and processes for working with other organizations (internal and external).

Need Date: 2008

Thread

1. Develop modification capability in back shop work for insertion during PDM.

2. Develop standard agreements, including MOAs, CRADAs, and partnerships, for working with contractors to perform modification work.

4.1.4.2 Aircraft Improvements

Capability Descriptions

Objective

Develop modifications and improvements for airframe components and aircraft.

Method

Develop capability to quickly modify and improve aircraft components.

Need Date: 2008

Thread

1. Develop C-130 In Flight Propeller balancing.

4.2 Avionics

Another thrust area is avionics, which includes all aspects of supporting avionics systems. Parts obsolescence, supportability, and repair capabilities all are a part of the general avionics technology insertion area. Avionics modifications are concerned with improving the existing avionics supportability and life expectancy. The avionics tools area consist of software tool improvements, automatic test equipment hardware and software and test program sets to support depot maintenance activities. Increased throughput and bandwidth resources are expected and avionics in general will move toward commercial off the shelf components. Avionics monitor their self health and the health of components they communicate with to ensure graceful degradation and timely maintenance of the system. Software tools will become more standardized and legacy languages will diminish in favor of commercial languages and tools. Common software and hardware across many aspects of a system will allow resources to be devoted to other aging systems. For instance, operational flight programs will be common in the aircraft, mission planning systems, training systems and diagnostic tools. Advanced manufacturing facilities and techniques will be required to convert existing aging avionics into compressed, more reliable avionics.

4.2.1 Avionics - Modifications

4.2.1.1 Communication with other on-board avionics

Capability Description

Objective

Use existing internal avionics data links to communicate with other on-board avionics

Method

Implement the latest MIL-STD-1553 technology in the Electronic Warfare (EW) systems airframe weapons and avionics systems together to provide increased situational awareness, increased countermeasures capability, and improved survivability.

Need Date: 2009

Thread

1. Incorporate 1553 capability into EW systems - 2004-2007
2. Integrate with the avionics systems 2005-2007
3. Integrate with airframe platforms 2007-2009

4.2.1.2 New chip/board level components

Capability Description

Objective

Reduce the chip/board count and maintain/increase functionality; increase MTBF, and decreased repair cost

Method

Implement Field Programmable Gate Array (FPGA) technology across the EW Systems circuit card assemblies to replace obsolete components, increase reliability and increase efficiency of reprogramming software changes.

Need Date: 2009

Thread

1. Replace chips on a single board with FPGA technology 2004-2008
2. Replace multiple boards with a single or common board 2004-2009

4.2.1.3 Improved High Power Amplifiers for Legacy Electronics Warfare Systems

Capability Description:

Objective:

Provide a readily available source of replacement amplifiers for obsolete microwave high power amplifiers in legacy Electronic Warfare (EW) systems to provide higher/or directed ERP.

Method

Develop a common series of scalable Microwave Power Modules (MPMs) that can be tailored to the performance requirements of legacy EW microwave high power amplifiers and are easily adaptable to the legacy form factors.

Need Date: 2012

Thread

1. Survey legacy EW systems to determine requirements, specifications and form factors for microwave high power amplifiers, 2005-2007, Air Force Research Laboratory (AFRL) or CRADA
2. Develop design specifications and form factor requirements for replacement MPMs, 2007-2009, AFRL or CRADA
3. Build and test prototype amplifiers in legacy systems, 2009-2011, CRADA
4. Establish commercial manufacturing sources, 2010-2012, CTMA
5. Implement use of MPMs to repair legacy EW systems, 2012, System Program Office (SPO) or Depot Expense

4.2.1.4 Operational Flight Programs in High Order Language

Capability Description

Objective

Use OFP HOL for faster block cycle updates and emergency/urgent updates and improve support capability.

Method

Equip EW systems with new replacement processors and rewrite large portions or all of the I/C and RP OFP in a high order language.

Need Date: 2013

Thread

1. Develop/Test/Field new embedded processors 2004-2006
2. Redesign OFP to take advantage of new processor and HOL 2007-2009
3. Develop/Test HOL 2010-2012
4. Field 2013

4.2.1.5 Hardware/Software for advanced ECM techniques (such as DRFM-based signals)

Capability Description

Objective

Update/Add hardware and associated software to generate advanced ECM techniques

Method

Advances in digital RF memory, microprocessors, and programmed gate arrays can be implemented as replacement components in EW system RF technique generation circuitry.

Need Date: 2010

Thread

1. Requirements Definition – 2006
2. Incremental Approach Defined - 2006
3. Develop, Design, Prototype - 2007-08
4. Flight Certification: 2009-10

4.2.1.6 Improved System Engineering

Capability Description

Objective

Improve system design techniques to minimize electromagnetic interference, increase reliability, fault tolerance and maintainability.

Method

Develop more robust system engineering processes, and apply to organic and contractor projects.

Need Date: 2010

Threads:

1. Improved EMI control via systems design.
2. Improve reliability via component replacement or system redesign.
3. Develop

4.2.2 Avionics – Tools

4.2.2.1 Common Core Downsized Modular Integrated Support Stations and Support Tools

Capability Description

Objective

Standardize EW and Avionics Integrated Support Stations and support tools to a common core downsized modular and scalable design to mitigate obsolescence, improve reliability, modernize capabilities, reduce support and maintenance costs, and reduce the amount of lab space consumed.

Method

Develop a modular and scalable standard for Electronic Warfare and Avionics Integrated Support Stations and support tools. Replace custom built software integration and

independent verification and validation tools with commercially available software development tools.

Need Date: **2013**

Thread

1. Define a commercial based modular and scalable standard for Integrated Support Stations and support tools, 2005-2008, Cooperative Research and Development Agreement (CRADA) or Commercial Technology for Maintenance Activities (CTMA)
2. Develop and Test prototypes built to the new standard for EW and Avionics Integrated Support Stations and support tools, 2009-2012, CRADA or CTMA
3. Impose standard on all new EW and Avionics programs, 2013, AFMC/ASC/ALCs
4. Implement standard in all AFMC EW and Avionics sustainment facilities to repair or replace existing support stations, 2013, ALC Expense
5. Develop ability to predict when electrical components will fail based on operating characteristics.

4.2.2.2 Common Core Modular Depot Test Stations

Capability Description

Objective

Standardize Depot Test Stations to a common core modular and scalable design to mitigate obsolescence, improve reliability, modernize capabilities, and reduce support and maintenance costs.

Method

Develop a modular and scalable standard for Electronic Warfare and Avionics Depot Test Stations.

Need Date: 2013

Thread

1. Define a commercial based modular and scalable standard for Depot Test Stations, 2005-2008, CRADA or CTMA
2. Develop and Test prototypes built to the new standard for EW and Avionics Depot Test Stations, 2009-2012, CRADA or CTMA
3. Impose standard on all new EW and Avionics programs, 2013, AFMC/ASC/ALCs
4. Implement standard in all AFMC Depot Repair Centers to repair or replace existing test stations, 2013, Depot Expense

4.2.2.3 Test Capability using Common HW/SW among Weapon Systems and Avionics Testers

Capability Description

Objective

Update/Replace current EW testers with new equipment

Method

Implement a common design of ground support equipment that can be used to test multiple countermeasures systems with state of the art commercial test equipment and a high order language to drive the test sequences.

Need Date: 2009

Thread

1. Evaluate existing DoD tester for possible use - 2004-05
2. Develop/Modify/Test replacement tester 2006-2008
3. Produce/Field 2009

4.2.2.4 Depot Technology Insertion (DTI) Project

Capability Description:

The WR-ALC Depot Technology Insertion Project is a partnership to develop an organic capability for quick turn re-design, low rate production, and qualification of re-designed obsolete circuit card assemblies (CCA's). The first part of the requirement includes facilitation of the organic depot (402^{d} Maintenance Wing) with the software tools necessary to map operational parameters from existing obsolete circuit cards into VHDL code compatible with Field Programmable Gate Array (FPGA) technology. Part two of the project improves the depot's Printed Wiring Assembly (PWA) production capability to incorporate surface mount (SM) technology. Part three of the project provides the capability to test and qualify re-designed cards. Operational Safety Suitability & Effectiveness (OSS&E) requirements and Capability Maturity Model (CMM) level III standards will be used.

Objective

The Combat Sustainment Wing (542^{d} CSW) manages over 650 electronics systems. Those systems are populated by over 2,000,000 (two million) total parts which correlates to approximately 86,000 unique parts. These parts are spread across 12,000 circuit card assemblies. The obsolescence issue as identified by the Avionics Component Obsolescence Management (AVCOM) database documents approximately 24,000 unique obsolete parts that have no manufacturing sources and are considered obsolete. Obsolescence is quantified by this method at 27%.

Method:

Currently, we contract for almost 100% of MSD funded obsolescence related redesign efforts. As we see it, partnering is the first step towards transitioning those contracted efforts to organic efforts. Partnering also helps to ensure that future organic maintenance is a consideration in the design process. Partnering equips our organic depot with skills and equipment that were not previously available to them. By having an organic source, we achieve a streamlined mode of conducting business that provides an increased responsiveness and flexibility along with a closer, more collaborative and stable "in-process" working relationship between the systems and design engineers. The depot would be proactive in identifying obsolescence and diminishing manufacturing source (DMS) trends prior to AVCOM flags. In short, onsite co-location of repair facilities, design engineers and tools would enable faster response to obsolescence/DMS issues which in turn would lead to greater responsiveness to the field and ultimately the warfighter.

Redesigning around existing depot tools such as their PWA layout and fabrication capabilities along with their visibility across a wide array of items from different Original Equipment Manufacturer's (OEM's) should lead to common design solutions with multiple system applications and ultimately lower support costs.

Increased workload is derived from the organic depot receiving payment for those functions they are currently capable of performing that probably would have been performed elsewhere without DTI partnering.

Re-design of obsolete CCA does require an ability to capture the CCA functionality parameters and transfer those parameters into FPGA program code. Limited technical data exists for most of the existing legacy systems and their system level interfaces. In some instances we have been required to develop a system level mock-up to understand performance requirements. Commercial software, work stations and orientation is required to develop this re-design capability.

CCA manufacture requires both a printed wiring assembly (PWA) and a component attachment capability. WR-ALC currently has a PWA and Flex Circuit capability but lacks a complete surface mount capability. Surface Mount technologies include Ball Grid Array (BGA), Column Grid Array (CGA) and flip chip designs.

The capability to adequately test and qualify the redesigned and manufactured assemblies becomes critical when the CCA's are manufactured. Standard parameters of environment, stress, shock and performance become coupled with system operability. The new CCA must work as well or better than the item replaced in all aspects and does not cause system degradation.

Threads

1. Thread one is intended to gain assistance in improving the design capability by using continuous process improvement methodologies and current industry standard design tools.
2. Thread two is intended to have an independent analysis of the printed wiring board manufacture process to identify process inefficiencies, decrease the variability, and improve the manufacturing throughput to achieve competitive advantage.
3. Thread three is intended to improve the qualification testing process through an integration of available resources in the area to eliminate wasted effort and non value added wait time.
4. Thread four is intended to integrate new static health monitoring and detection technology into the newly designed CCA's.

Incremental Projects:

1. **Incremental Project: Improve Shop Replacement Unit (PWB/CCA) Design Capability**

Problem: Legacy systems are experiencing obsolescence problems in supply and technology performance.

Solution: Improve design cycle effectiveness to reduce response time from idea to qualified production and reduce cost of design process (better design tool technology, software programs/processes)

Proposed DoD Participants: WR-ALC, NWSC Crane, Tobyhanna Army Depot, Air Force Research Laboratories

Proposed Industry Participants: Georgia Tech Research Institute (GTRI); Titan Industries Inc; Systems Research Corporation (SRC); Manufacturing Technology Inc (MTI); Teradyne Inc., Flexible Acquisition Support Team (FAST)
Point of Contact: John Shawhan, WR-ALC

2. **Project: Improve Printed Wiring Board Production Efficiency**
Problem: Printed wiring board production is inefficient
Solution: Lean printed wiring board process - possible application of Six Sigma and Continuous Process Improvement (CPI) methodologies
Proposed DoD Participants: WR-ALC, NWSC Crane, Tobyhanna Army Depot
Proposed Industry Participants: NCMS; Georgia Technical Research Center (GTRI); Mercer Engineering Research Center (MERC); Auburn University; Flexible Acquisition Support Team (FAST)
Point of Contact: John Shawhan, WR-ALC

3. **Project: Improvement of Qualification Testing and Operational Safety Suitability and Effectiveness (OSS&E) Process**
Problem: CCA qualification testing and compliance are ineffectively managed
Solution: Apply Continuous Process Improvements (CPI) and Six Sigma principals to the systems design and qualification process
Proposed DoD Participants: WR-ALC, NSWC Crane, Tobyhanna Army Depot
Proposed Industry Participants: NCMS; Georgia Tech Research Institute (GTRI); Mercer Engineering Research Center (MERC); Auburn University; Flexible Acquisition Support Team (FAST)
Point of Contact: John Shawhan, WR-ALC

4. **Project: Static Health Monitoring of Warner Robins CCA Redesign Process**
Problem: Inadequate ESD static health monitoring for FPGAs on CCAs
Solution: Incorporate SED devices in FPGAs
Proposed DoD Participants: Warner Robins AFB, NSWC Crane, Tobyhanna Army Depot
Proposed Industry Participants: VCD Technologies, Titan Industries Inc.
Point of Contact: John Shawhan, WR-ALC

4.3 Information Technology

Currently, the IT needs will consist of those Automated Identification Technologies (AIT) pertaining to the Depot activities and those submitted to command-wide funding programs. Full tracking of products and pallets through the logistics system will be commonplace. Wireless networks will pervade work areas, providing access to technical orders, work instructions, time accounting systems, and other data systems "at the worker". Information assurance issues will be addressed through biometrics and other non-intrusive identification technologies.

4.3.1 Ability to capture cradle-to-grave maintenance activities

Capability Description
Objective

Capture all maintenance activities for end items both in the field and for depot repair. This capability will improve end item maintenance visibility, allow for improved supply efficiencies, and provide the capability for enhanced predictive maintenance.

Method

Provide the depot and the field the ability to access and update maintenance activities for the units using automatic identification technology (AIT) such as contact memory buttons or newer technology. Integrate the AIT technology selected with the depot maintenance system of record.

Need Date: 2010

Thread

1. Evaluate tools, perform Market Research for preferred technology 2007-2008
2. Prototype technology, 2008-2009
3. Implement 2009-2010; AIT, SPO, or Depot Expense

4.3.2 End to End Supply Chain Visibility

Capability Description

Air Force needs the ability to provide end-to-end supply chain visibility for CONUS and OCONUS shipments to include Depot repair locations, shipping points, and final delivery

Objective

Track asset movement through the supply chain using AIT. Provide real-time visibility for all stakeholders via a web interface. This will significantly reduce lost in transit items and improve depot delivery to the field..

Method

Provide active Radio Frequency Identification (RFID) tracking for all shipments utilizing the DoD Global Tracking Network (GTN) and the Global Air Transportation Execution System (GATES). Integrate the GTN/GATES logistics information with current depot material tracking systems.

Need Date: 2010

Thread

1. Evaluate tools, perform Market Research for preferred technology 2005-2006
2. Prototype technology, 2006-2007
3. Implement 2007-2010; AIT, SPO, CPP, and/or Depot Expense

4.3.3 Asset Tracking

Capability Description

Develop the capability to track Air Force assets using automated means.

Objective

Decrease time to track assets, while improving tracking and control.

Method

Use RFIDs and other electronics signal technology to locate assets in real time.

Need Date: 2008

Thread

1. Develop unmanned tool tracking and issuing.
2. Identify tracking technology and apply to select (critical) Air Force assets.
3. Scale system up to include real time tracking of assets.

4.4 Support Systems

Support systems include power generation and alternative fueled vehicles, support equipment, and associated tools and processes. Integrated support facilities, automated tool tracking, ground equipment improvement and other infrastructure areas. The vision for support equipment is lighter, reconfigurable, more power and cleaner. Support equipment will be multiuse such as tugs that act as generators. Tents will act as generators of electricity via photocells built in to the fabric and will be networked to provide power to and from a bare base grid.

4.4.1 Support Systems – General

4.4.1.1 Improve Basic Expeditionary Airfield Resources (BEAR) Support Infrastructure Technologies (SIT)

Capability Description

Objective

The Air Force rapid mobility concept is to deploy a force with sustaining infrastructure capable of independently generating and launching sustained combat operations with the same effectiveness as fixed-theater installations. The focus of the support infrastructure platform is developing and modernizing resources that are light and lean, providing support across the full range of military operations.

Method

Investigate and implement (1) Alternate Energy Sources, (2) Small Scale Energy Generation, and (3) Large Scale Energy Generation.

Need Date: 2011 – 2017

Thread

1. Investigate materials and methods for low cost, lightweight, flexible photovoltaic, thermo, or wind energy generation. Study efforts include Polymer Photovoltaics. Application would be for remote, high cost, usually low power energy needs without utility infrastructure.
2. Investigate small volume high-density energy storage such as micro-fuel-cells, ultracapacitors, and microturbines. Study efforts include Electrified BDU for Soldier Needs. Application would be to power manportable devices, unmanned air/ground vehicles, sensors, and weapons.
3. Investigate fuel cells, hydrogen generation, low and high-pressure hydrogen storage, regenerative systems using alternative energy systems. Study efforts include fuel cells, reformers, and Advanced Energy Storage Concepts. Application would be utility, vehicular, and major equipment power.

4.4.1.2 Improved System 463L Cargo Handling Technologies

Capability Description

Objective

Explore and assess the feasibility of increasing the mean-time between failure, service life, and visibility of System 463L Cargo Handling Assets. System 463L cargo nets and pallets are the backbone of the military airlift system. The inventory objectives are approximately 240,000 pallets and 360,000 nets. Cargo is moved from the supply depots to the front line using these assets. Currently, the AF expends $20 annually on depot repair for pallet and

nets. Switching to new materials and tracking systems could greatly reduce the annual bill paid by the Air Force.

Method

Investigate the integration of new polymer and composite materials used in the construction of pallets and nets. The materials have advanced significantly since the last engineering studies conducted in 1982. In addition, tracking techniques for the pallets has not changed in the last thirty years. These assets are tracked manually.

Need Date: 2011 – 2017

Thread

1. Investigate and prototype the use of plastic, foam, and honeycomb cores in the pallets. Currently, the pallet core is balsa wood. When compromised, the balsa wood core can degrade significantly. By switching to an alternate core, the mean-time between failure and service life can be greatly increased.
2. Investigate and prototype the use of new polymers in the cargo nets. Currently, the net webbing is Nylon 6. The life of this material is finite. Cargo nets degrade due to usage and environmental conditions. Manufacturers of new polymers state the cargo nets can have an increased life and strength. By switching to alternate webbing, the mean-time between failure and service life can be greatly increased.
3. Investigate and prototype the use of an automated asset tracking system. This would include installing the Army's Radio Frequency Identification tags as an integral component of the pallets.

4.4.2 Support Systems – Power

4.4.2.1 Alternative Energy Technologies

Capability Description

Objective

Explore and assess the feasibility of expanded military applications of deployable alternative energy technologies (Solar, Wind, Thermal, Mobile Electric Power, Waste Heat, for Mobile Energy Power Generation). While fuel cell technology affords high reliability and efficiency, alternative power generation affords an even higher potential flexibility of applications.

Method

Investigate the integration of alternate energy building blocks into Support Equipment and Vehicles to determine the minimum building blocks. Then standardize on the minimum building block for the majority of the applications.

Need Date: 2011 – 2017

Thread

1. Investigate and prototype the conversion of traditional Support Equipment and Vehicles into hybrid platforms. Deploy the prototypes and conduct a load profile study. Using this information, develop a scaleable alternative power source. This scaleable source would provide a common building block. By having a common building block, we would be able to reduce the logistics footprint, reduce resupply, enhance deployed capability, and enhanced efficiency.

4.5 Depot Manufacturing/Repair and Support

4.5.1 Develop Materiel Handling Equipment

Objective

Acquire capability to position materiel, including raising and lowering entire aircraft, for various maintenance activities. Also includes loading and unloading equipment and materiel on aircraft.

Method

Develop in ground jacking systems for aircraft. Develop materiel handling equipment to meet current and future needs.

Need Date: 2008

Threads

1. Develop jacking system for fighter sized aircraft.
2. Develop man lifts and extended around aircraft reach for maintenance activities.
3. Develop materiel handling equipment.

4.5.2 Aircraft Subsystem Diagnostics

Objective

Acquire capability to diagnose aircraft subsystems as a complete entity on aircraft.

Method

Develop wiring and avionics diagnostic tools and procedures.

Need Date: 2008

Threads:

1. Define and acquire wiring diagnostic systems for aircraft use.
2. Develop on board smart diagnostics for aircraft.

4.5.3 Maintenance Shop Improvements

Objective

Improve capabilities of the maintenance shops to more efficiently repair, remanufacture and manufacture components.

Method

Automate routine tasks and upgrade equipment.

Need Date: 2009

Threads:

1. Develop data collection to determine machine health and determine maintenance schedule based on usage rather than time.
2. Update machine shop with more automated and flexible tools.

4.5.4 Environmental Compliance

Capability Description

Reduce or eliminate Environmental, Safety, and Occupational Health (ESOH) compliance burden on depot maintenance manufacturing and repair processes and support operations thus enhancing sustainable operations in the future.

Objective

To reduce or eliminate dependence on hazardous materials in processes that drive environmental compliance concerns and impact the safety and health of the workforce.

1. Reduce/Eliminate dependence on Class I and II Ozone Depleting Substances
    a. Class I – Halons use in Hush House Operations
    b. Class II- HCFC 141 b used in Avionics Maintenance on LANTIRN Pods and contact cleaners

2. Reduce/Eliminate hexavalent chrome emission processes regulated by the Chrome National Emission Standards for Hazardous Air Pollutants (NESHAP). New chrome standard being considered that will severely restrict chrome emissions.
    a. Chrome Plating
    b. Chromic Acid Anodize
    c. Chromate Conversion Coatings (airframe and parts)

3. Reduce/Eliminate solvent based paints processes regulated by the Aerospace NESHAP
    a. Avionics black box painting

4. Reduce/Eliminate Halogenated Solvents regulated by the Halogenated Solvent Cleaning NESHAP
    a. Perchloroethylene (PERC) used in vapor degreasing in plating and sheet metal shops

5. Reduce/eliminate toxic paint strippers
    a. Methylene Chloride – known carcinogen
        - Radome Stripping

6. Reduce/eliminate nitrogen oxide (NOx) and sulfur oxide (SOx) emissions from combustion sources

    a. Diesel engine driven ground support equipment
    b. Non alternative fueled vehicles

7. Reduce or eliminate use of lead based solders, primarily in avionics.

Method

1. Determine the technical requirements that solutions must meet as directed by the weapon system engineering authority and production requirements.

2. Develop weapon system pollution prevention projects through the weapon system pollution prevention group (402 MXW/QPE)

3. Leverage, when possible, solutions that have been developed through the Strategic Environmental Research Development Program (SERDP) and candidates for demonstration/validation through the Environmental Security Technology Certification Program (ESTCP).

4. If no acceptable solutions are available, submit new technology starts based on solid process owner requirements.

Need Date:
Objective 1 – Class I ODS- Depends on the availability of Halons stored in the Defense Reserve – Essentially production ceased in 2000, with only mission critical needs being serviced. For Class II ODS, HCFC 141b production and importation ceased in 2003. All other Class II ODS production and importation will cease in 2030

Objective 2 - 2007

Objective 3 - TBD

Objective 4 – TBD

Objective 5 – TBD

Objective 6 – TBD

Thread
1. Implement installed High Velocity Oxygen Fuel coating system to replace hard chrome plating on C-130 propeller parts for outer diameter applications

2. Demonstrate/validate any candidate inner diameter chrome plating alternatives coming out of SERDP/ESTCP

3. Find alternative to Chromic Acid Anodize on C-130 propeller. Sulfuric based anodizes are good candidates but have the potential to cause hydrogen embrittlement on the high strength steel thrust ring which was discovered during a previous EM P2 Project

4. Find alternative to conventional painting of avionics black boxes, aircraft parts and ground support equipment. Good candidate is powder coating. Low temperature curing powder coatings are being evaluated for heat sensitive substrates – current ESTCP effort being initiated by AFMC/LG is looking at cure temperature less than 250 deg F. Has potential for ground support equipment and aircraft parts. Black boxes are painted only for aesthetics – good candidate for powder, but assessment of both depainting the box one time and coating needs to be evaluated. EM proposing to do process specific opportunity assessment (PSOA). EM along with LE is involved in the ESTCP mentioned above.

5. Develop and validate alternative to PERC in vapor degreasing. Currently N-Propyl Bromide has been tested and seems to clean well. Still had concern over one contaminant that needs PERC to clean. If the PERC was eliminated from the vapor degreasers in B 142 (Plating Shop) and Bldg 169 (Phos Anodize Shop) the Center

would no longer be subject to the Halogenated Solvent Cleaning NESHAP elimination of as regulatory compliance burden.

6. Develop and validate an alternative to using Methylene Chloride (a known carcinogen) for radome stripping in Bldg 680. A previous EM project was trying to site adapt an environmentally friendly alternative used at Tinker on B-52 and KC 135 radomes (Skykleen); however, since Robins repair process poly top coated the dome, the product would not work. Skykleen designed not to attack polyurethane paints since it is also used as a hand wipe solvent. Robins engineers should take a look at requirement to topcoat radomes with poly paints to see if really required. Skykleen would also replace Methyl Ethyl Ketone used as a post gross depaint with Methylene Chloride.

7. Logistically, the Center needs to pursue a coordinated effort to incorporate the use of alternatively fueled vehicles for local transportation and ground support equipment. This will assist is lowering NOx and SOx emissions. Advanced battery driven technology as well as fuel cell and other renewable energy sources should be considered. A feasible, logical strategic plan needs to be developed.

8. Electronic Manufacturing and Repair functions, primarily in Avionics, need to take a look at the Joint Council Aging Aircraft/JG-PP Lead-Free Solder Project looking at non lead based solder alternatives. United States legislation, the Emergency Planning & Community Right-To-Know Act (EPCRA), lowered lead toxic release inventory reporting limits from 10,000 to 100 lbs. Executive Order 13148, Greening the Government, has established goals to reduce lead solder use by 50%. Kris Krueger/ENA is the Center OPR for the JGPP consortiums efforts preceded by Debora Personius.

4.6 Other Technologies

The last technology thrust area is a catch all for technology areas that have smaller application areas. As these areas grow and expand, separate thrust areas may develop. Many of the general processes and materials used by the Depot fall into this thrust area. Obsolescence issues will continue to plague the Air Force; however, solutions will be available to redesign the components or assemblies. These assemblies will be form, fit and function replacements with increased space capacity and less power and cooling requirements.

4.6.1 Obsolescence Management

Capability Description

Identify policies, procedures, practices, methodologies and tools for proactively determining avionics, structures and other mechanical and non-mechanical flight systems material requirements and implementing upgrades to those aircraft/systems while ensuring OSS&E is maintained and followed as required by AF regulations.

Objective

To automate the processes by which obsolescence in aircraft and aircraft systems is managed by utilizing all field and depot maintenance data sources to determine the current and future sustainment needs for each platform/system. Possible data sources include REMIS, LDMS, EDW, D200, AFTOC, DLA parts inventory database and DoD DMSMS database.

Method

Develop integrated automated system and process to determine current and future sustainment needs for each platform/system.

Need Date: 2QFY07

Threads

1. Implement a center wide depot data gathering and extraction entity to automate the process by which information on repair histories, parts ordering, AWP & surge, shop floor tracking, MDC, WIP, parts consumption and systems configuration control is managed.
2. Develop a Unique Item Identification process and/or system by which all depot parts are inventoried and tracked.
3. Develop an automated sustatinment tool that can: predict force structure reduction and mission degradation; perform depot repair assessment, reliability analysis and inventory assessment; estimate sustainment cost; and highlight a probable sustainment action to implement technology insertion.
4. Utilize the DoD DMSMS center of excellence databases for capturing manufacturer currency and parts commonality between other DoD agencies systems.
5. Electronically link the WRALC obsolescence management system with other DoD obsolescence management systems and automate the process for efficiently managing system reliability and maintainability throughout the system's life cycle.

APPENDIX A
Strategic Technology Plan Working Group Members

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Robert David	WR-ALC/LEEV
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Mary Jackson	WR-ALC/ITM
Mark Leslein	WR-ALC/XRCA
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Clay Mims	WR-ALC/IT
Maj. Tim Oldenburg	330 ASW/330 FSG
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APPENDIX B
WR-ALC Technology Roadmap
14 June 2005

WR-ALC's Technology Roadmap outlines current and potential technology projects of interest to our technical areas. This listing is a subset of the data included in the full roadmap which is available from WR-ALC/ENEP. The data included here provides the links from the technology area to the projects and to the master capabilities list produced by the Capabilities Review and Risk Assessment process. The "Capability ID" maps projects to the paragraphs within the Strategic Plan. The "Project Area" number provides a unique identification number for each project.

Technology Area	Project Title	2004 MCL 5.5	WR Capability ID	WR-ALC SA&D Action Theme	Project Area
Airframes - Inspection	Advanced NDE for Aging Structures	8.2.1 9.4.6.1	4.1.1.2	3, 5	1.1.1
Airframes - Inspection	Aircraft Composite Component Inspection System	8.2.1 9.4.6.1	4.1.1.2	3, 5	1.1.2
Airframes - Inspection	Aircraft Corrosion Inspection by Electromagnetic Induction Spectroscopy	8.2.1 9.4.6.1	4.1.1.2	3, 5	1.1.3
Airframes - Inspection	Damage detection using Ultrasonic Technology	8.2.1 9.4.6.1	4.1.1.2	3, 5	1.1.4
Airframes - Inspection	Corrosion Effects on Structural Integrity (CESI)	8.2.1 9.4.6.1	4.1.1.2	3, 5	1.1.5
Airframes - Inspection	Detection and Imaging of Damage, Including Hydrogen Embrittlement Effects in Landing Gear and other High Strength Steel Components	8.2.1 9.4.6.1	4.1.1.2	3, 5	1.1.6
Airframes - Inspection	Economic Service Life Extension	8.2.1 9.4.6.1	4.1.1.3	3, 5	1.1.7
Airframes - Inspection	Enhanced Probablistic Risk Assessment Tool	8.2.1 9.4.6.1	4.1.1.3	3, 4, 5	1.1.8
Airframes - Inspection	F-15 and all Aircraft NDI Modernization	8.2.1 9.4.6.1	4.1.1.2	3, 5	1.1.9
Airframes - Inspection	Helicopter Individual Aircraft Tracking and Loads Environment Spectra Survey	8.2.1 9.4.6.1	4.1.1.3	3, 5	1.1.10
Airframes - Inspection	Portable Large Shape Inspection System	8.2.1 9.4.6.1	4.1.1.2	3, 5	1.1.11
Airframes - Inspection	Measurment of Residual Stresses in Difficult Locations	8.2.1 9.4.6.1	4.1.1.2	3, 5	1.1.12
Airframes - Inspection	NDI of Cracks in Fastner Holes w/o Fastner Removal in Single and Multi Layer	8.2.1 9.4.6.1	4.1.1.2	3, 5	1.1.13

Airframes - Inspection	NDI of Delaminations in Metal, Composites and Bonded Structures	8.2.1 9.4.6.1	4.1.1.2	3, 5	1.1.14
Airframes - Inspection	NDI of Fatigue Cracks Non-Fastner Hole, Single, Multilayer Structures	8.2.1 9.4.6.1	4.1.1.2	3, 5	1.1.15
Airframes - Inspection	NDI of Honeycomb Composites	8.2.1 9.4.6.1	4.1.1.2	3, 5	1.1.16
Airframes - Inspection	NDI Process Improvements	8.2.1 9.4.6.1	4.1.1.2	3, 4, 5	1.1.17
Airframes - Inspection	Nondestructive Inspection for Aircraft Fatigue Damage	8.2.1 9.4.6.1	4.1.1.2	3, 5	1.1.18
Airframes - Inspection	Optimization of Probability of Detection (POD) for NDI	8.2.1 9.4.6.1	4.1.1.3	3, 4, 5	1.1.19
Airframes - Inspection	Structural Analysis to Determine Optimal Inspection Intervals	8.2.1 9.4.6.1	4.1.1.3	3, 4, 5	1.1.20
Airframes - Inspection	Testing and Evaluation Cracks by Non Destructive Testing on F-15 Pylon Rib	8.2.1 9.4.6.1	4.1.1.2	3, 5	1.1.21
Airframes - Inspection	Three Dimensional Magnetic Imaging of Damage in Multiple Layer Aircraft Structures	8.2.1 9.4.6.1	4.1.1.2	3, 5	1.1.22
Airframes - Inspection	Identification of cracks and corrosion improvements	8.2.1 9.4.6.1	4.1.1.2	3, 5	1.1.23
Airframes - Inspection	Improved Inspection of Bonded Repairs	8.2.1 9.4.6.1	4.1.1.1	3, 5	1.1.24
Airframes - Inspection	Vibration Monitoring and Control	8.2.1 9.4.6.1	4.1.1.3	3, 5	1.1.25
Airframes - Repair/Replace	Bonded Repair Capabilities Enhancements	9.4.3.2 9.4.6.1	4.1.2.4	3, 5	1.2.1
Airframes - Repair/Replace	Bonded Repair of Thick/Complex Structures	9.4.3.2 9.4.6.1	4.1.2.4	3, 5	1.2.2
Airframes - Repair/Replace	Bonded Repair Optimization	9.4.3.2 9.4.6.1	4.1.2.4	3, 5	1.2.3
Airframes - Repair/Replace	Flat Wire Deposition	8.2.1 9.4.6.1	4.1.2.5	3, 5	1.2.4

Airframes - Repair/Replace	Isotropically Conductive Adhesives	8.2.1 9.4.6.1	4.1.2.5	3, 5	1.2.5
Airframes - Repair/Replace	Laser Engineered Net Shape Forming (LENS)tm	8.2.1 9.4.6.1	4.1.2.5	3, 5	1.2.6
Airframes - Repair/Replace	Prevention of Fatigue Cracks	8.2.1 9.4.6.1	4.1.2.5	3, 5	1.2.7
Airframes - Repair/Replace	Better mold making techniques	8.2.1 9.4.6.1	4.1.2.3	3, 5	1.2.8
Airframes - Repair/Replace	Expand applicability of bonded repair to steel components	9.4.3.2 9.4.6.1	4.1.2.4	3, 5	1.2.9
Airframes - Repair/Replace	Reduce damage and rework from mis-drilled holes	8.2.1 9.4.6.1	4.1.2.2	3, 5	1.2.10
Airframes - Repair/Replace	Reduce variety of prepregs and adhesives	9.4.3.2 9.4.6.1	4.1.2.1	3, 5	1.2.11
Airframes - Repair/Replace	Repair of Honeycomb Structure	8.2.1 9.4.3 9.4.6.1	4.1.2.5	3, 5	1.2.12
Airframes - Repair/Replace	Replacement of Structual Components	8.2.1 9.4.3 9.4.6.1	4.1.2.5	3, 5	1.2.13
Airframes - Coatings	Advanced Aircraft Corrosion Protection (AACP)	8.2.1 9.4.6.1	4.1.3.2	3, 5	1.3.1
Airframes - Coatings	Large Size Aircraft Lower Fuselage Mobile Blast Depaint	8.2.1 9.4.6.1	4.1.3.1	3, 5	1.3.2
Airframes - Coatings	Large Size Aircraft Lower Wing Mobile Blast Depaint	8.2.1 9.4.6.1	4.1.3.1	3, 5	1.3.3
Airframes - Coatings	Large Size Aircraft Tail Media Blast Depaint Augmentation	8.2.1 9.4.6.1	4.1.3.1	3, 5	1.3.4
Airframes - Coatings	Powder Coating Demonstrations/Validations to Replace Conv Coatings	8.2.1 9.4.3.2 9.4.6.1	4.1.3.3	3, 5	1.3.5
Airframes - Coatings	Fighter Robotic Paint	8.2.1 9.4.6.1	4.1.3.1	3, 5	1.3.6
Airframes - Coatings	Prevention of Corrosion	8.2.1 9.4.6.1	4.1.3.2	3, 5	1.3.7

Airframes - Coatings	Robotic Paint Optimization	8.2.1 9.4.6.1	4.1.3.1	3, 5	1.3.8
Airframes - Coatings	UV Cured Coating for Use on Radomes	8.2.1 9.4.3.2 9.4.6.1	4.1.3.3	3, 5	1.3.9
Airframes - Coatings	UV-Curable, No VOC Aircraft Repair Spray-Coating	8.2.1 9.4.3.2 9.4.6.1	4.1.3.3	3, 5	1.3.10
Airframes - Coatings	Wet Blast Media Paint Stripping	8.2.1 9.4.6.1	4.1.3.1	3, 5	1.3.11
Airframes - Coatings	Wheat Starch Paint Stripping	8.2.1 9.4.6.1	4.1.3.1	3, 5	1.3.12
Airframes - Coatings	Improved Coatings and painting/depainting techniques	8.2.1 9.4.6.1	4.1.3.1	3, 5	1.3.13
Airframes - Mod	C-130 In-Flight Active Propeller Balancing	8.2.1 9.4.6.1	4.1.4.2	3, 5	1.4.1
Airframes - Mod	Modification Processes	8.2.1 9.4.6.1	4.1.4.1	3, 4, 5	1.4.2
Avionics - Mod	EMI Control Via Systems Design	9.4.4 9.4.6.1	4.2.1.6	3, 4, 5	2.1.1
Avionics - Mod	1553 Databuss	4.1.1.4 9.4.6.1	4.2.1.1	3, 5	2.1.2
Avionics - Mod	AN/ASW-38 AutoFlight Control System (AFCS) Redesign	9.4.4 9.4.6.1	4.2.1.6	3, 5	2.1.3
Avionics - Mod	Communication among On-board Avionics	4.1.1.4 9.4.6.1	4.2.1.1	3, 5	2.1.4
Avionics - Mod	New Chip/Board level Components	4.2.1.2 9.4.3.2 9.4.6.1	4.2.1.2	3, 5	2.1.5
Avionics - Mod	Improved High Power Amplifiers for legacy systems	9.4.1 9.4.6.1	4.2.1.3	3, 5	2.1.6
Avionics - Mod	Field Prog Gate Array Technology Insertion	4.2.1.2 9.4.3.2 9.4.6.1	4.2.1.2	3, 5	2.1.7
Avionics - Mod	Operational Flight Programs in High Order Language	9.4.1 9.4.6.1	4.2.1.4	3, 5	2.1.8

Avionics - Mod	Hardware/Software for Advanced ECM techniques	9.4.1 9.4.6.1	4.2.1.5	3, 5	2.1.9
Avionics – Mod	Improved System Engineering	9.4.1 9.4.6.1	4.2.1.6	3, 5	2.1.10
Avionics - Tools	Automatic Test Equipment Synthetic Instrumentation	9.4.6.1 9.4.6.8	4.2.2.1	3, 5	2.2.1
Avionics - Tools	Automatic Test Markup Language	9.4.6.1 9.4.6.8	4.2.2.1	3, 5	2.2.2
Avionics - Tools	Electrical Signature Analysis	9.4.6.1 9.4.6.8	4.2.2.1	3, 5	2.2.3
Avionics - Tools	ATE - TPS Migration System	9.4.6.1 9.4.6.8	4.2.2.3	3, 5	2.2.4
Avionics - Tools	EWAISF Simulation / Testing Transformation	9.4.6.1 9.4.6.8	4.2.2.3	3, 4, 5	2.2.5
Avionics - Tools	Common Core Downsized Modular Integrated Support Stations and Support Tools	9.4.6.1 9.4.6.8	4.2.2.1	3, 5	2.2.6
Avionics - Tools	Common Core Modular Depot Test Stations	9.4.6.1 9.4.6.8	4.2.2.2	3, 5	2.2.7
Avionics - Tools	Test Capability using Common HW/SW among Weapon Systems and Avionics Testers	9.4.6.1 9.4.6.8	4.2.2.3	3, 5	2.2.8
Avionics - Tools	Depot Technology Insertion Project	8.3.2.4 9.4.3.3 9.4.6.1	4.2.2.4	3, 5, 6	2.2.9
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Information Technology	Unmanned issuing and tracking of tools	8.3.1.11 9.4.3.2 9.4.6.1	4.3.3	3, 4, 5	3.2
Information Technology	End to End Supply Chain Visibility	8.3.1.11 9.4.3.2 9.4.6.1	4.3.2	3, 4, 5	3.3
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Support Systems - General	Smart Machines	9.4.1 9.4.6.1	4.5.3	3, 5	4.1.3
Support Systems - General	Smart Machines 2	9.4.1 9.4.6.1	4.5.3	3, 5	4.1.3
Support Systems - General	Synthetic Test Station Instrumentation	9.4.6.1 9.4.6.8	4.2.2.1	3, 5	4.1.4
Support Systems - General	Universal Munitions Handling Robotic Arm	8.2.1 9.4.6.1	4.5.1	3, 5	4.1.5
Support Systems - General	Man Portable Electro-Optic Test System	9.4.6.1		3, 5	
Support Systems - General	Improve Basic Expeditionary Airfield Resources Support Infrastructure Technologies	8.3.2.4 9.4.6.1	4.4.1.1	3, 5	4.1.6
Support Systems - Power	Advanced Electric Vehicle Research	8.1.3 9.4.4 9.4.6.1	4.4.2.1	3, 5	4.2.1
Support Systems - Power	Advanced EV/HEV Energy Storage Module Incorporating Wireless Magnetic Communication	8.1.3 9.4.4 9.4.6.1	4.4.2.1	3, 5	4.2.2
Support Systems - Power	Advanced Hydrogen Transfer Sensor Research	8.1.3 9.4.4 9.4.6.1	4.4.2.1	3, 5	4.2.3
Support Systems - Power	Advanced Multi-Use Fuel Cell Powered Tactical Vehicle (Tow Tractor) With Distributed Power	8.1.3 9.4.4 9.4.6.1	4.4.2.1	3, 5	4.2.4
Support Systems - Power	25KW Hybrid Engine for GSE (Cold Turbine Engine)	8.1.3 9.4.4 9.4.6.1	4.4.2.1	3, 5	4.2.5
Support Systems - Power	Universial Rapid Charger for Electric Ground Support Equipment	8.1.3 9.4.4 9.4.6.1	4.4.2.1	3, 5	4.2.6
Support Systems - Power	Fuel Cell Powered 25K Loader Using Plasma Reformed JP8	8.1.3 9.4.4 9.4.6.1	4.4.2.1	3, 5	4.2.7
Support Systems - Power	Fuel Cell Reformate Management System	8.1.3 9.4.4 9.4.6.1	4.4.2.1	3, 5	4.2.8
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Support Systems - Power	Micro JP8 Fuel Reformer	8.1.3 9.4.4 9.4.6.1	4.4.2.1	3, 5	4.2.11
Support Systems - Power	Modular Fuel Cell Based Power Generators	8.1.3 9.4.4 9.4.6.1	4.4.2.1	3, 5	4.2.12
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