Air Force Civil Engineering

Integrity - Service - Excellence

Airfield Damage Repair (ADR) Robotic Applications

BRIAN SKIBBA
AFCEC/CXAE
2 Mar 2016

DISTRIBUTION STATEMENT A: Approved for public release; distribution unlimited. AFCEC-201575; 4 Nov 15

U.S. AIR FORCE

AFIMSC/AFCEC BLUF

- **AFIMSC activated 5 May 15**
  - Goals reduce costs and create efficiencies
  - Standardize support across all AF installations and mission support activities
  - AFIMSC's capabilities include:
    - civil engineering, security forces, base communications, logistics readiness, ministry programs, services, operational acquisition and financial management

- **AFCEC activated 1 Oct 12**
  - Cornerstone of Civil Engineering Transformation
  - Merges legacy FOA roles and missions (AFCEE, AFCESA, AFRPA)

U.S. AIR FORCE

Airbase Acquisition Branch - Mission

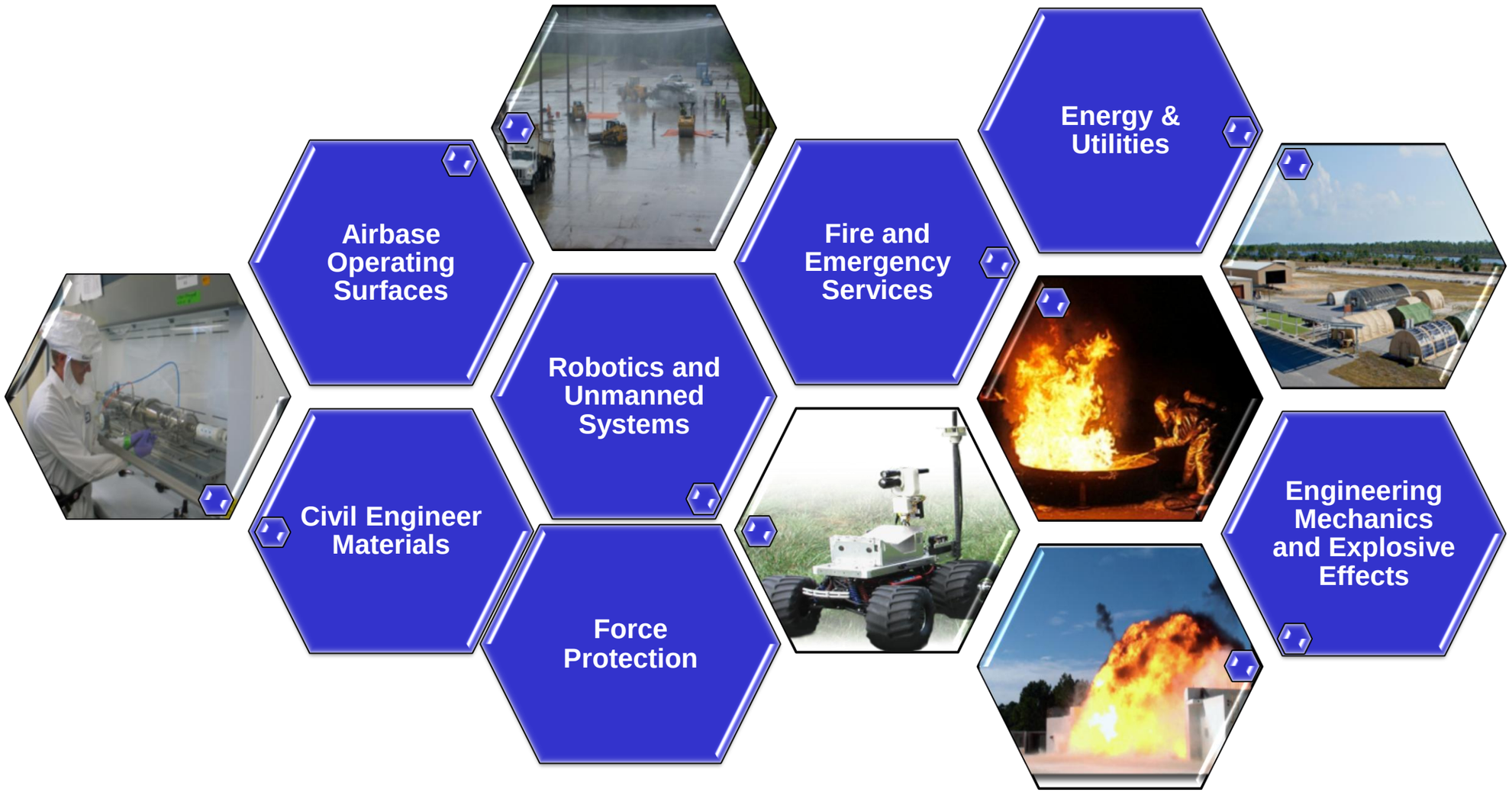
RDT&E and Acquisition

- Develop, evaluate, and field technology to support the full range of USAF installation base & protect missions
- Develop (RDT&E) and field new technology (including prototypes)
- Provide CE unique test & evaluation facilities/ranges
- Evaluate commercially (COTS) available technology/equipment
- Modify existing equipment
- Procure and sustain material solutions
- Provide expert technical advice and reach back support
- And do the ‘HELP ME NOW’ items

“Air bases are a determining factor in the success of air operations.
The two-legged stool of men and planes would topple over without this equally important third leg.” **General of the Air Force Henry H. *“Hap”* Arnold**

U.S. AIR FORCE

AFCEC/CXAE Capability Areas



U.S. AIR FORCE

Airfield Damage Repair (ADR)

- Provide capabilities to open, expand, maintain, and recover airfields

- Extremely time-constrained
- Recovery actions support sustained operations for all aircraft types
- 24/7, all weather capability

U.S. AIR FORCE

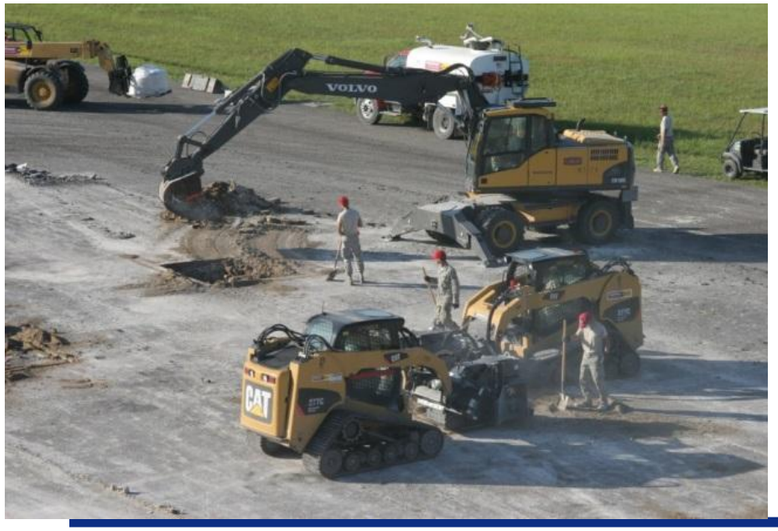
The ADR Processes – 8 Hours

Damage Assessment (30 Minutes)

- Locate, classify, and measure damage
- Utilize remote sensing and GIS technologies
- Goal is a fully automated system

UXO Mitigation (60 Minutes)

- Bombs, missiles, sub-munitions, artillery….
- Locate & neutralize
- Minimize time and runway damage
- Eliminate Explosive hazard



Damage Repair (6.5 Hours)

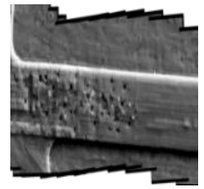
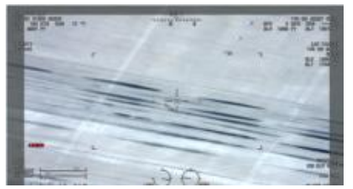
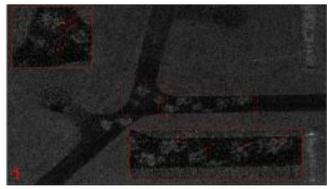
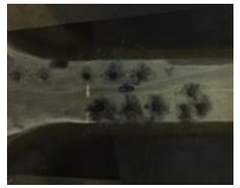
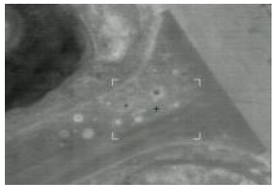
- Pavement Damage
- Expeditionary Airfield Lighting System (EALS)
- Mobile Aircraft Arresting System (MAAS)
- Marking and Striping

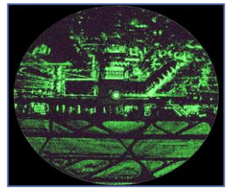
U.S. AIR FORCE

Rapid Airfield Damage Assessment System
RADAS

Platforms – (Has impact on sensors)

- **Ground based**
  Towers, UGVs, Aerostats, building mounted, vehicle mounted, ground emplaced, hand held …..
- **Air based**
  RPAs, Manned aircraft, rotary wing, fixed wing, lighter than air









Sensors – (Drives Processing)

- Still photos & streaming video
- Electro-optical
- Infrared (cooled/non cooled)
  LW, MWIR, NIR, SWIR,
- LIDAR
- RADAR - MMW, Ku, X-Band, SAR
- Acoustic & Seismic
- Multi/Hyper spectral
- Must be machine readable - automated processing

U.S. AIR FORCE

Unexploded Ordnance (UXO)

- Classify A-F (bomb, missile, sub munition)
- Colorings
- Fuze type and condition

U.S. AIR FORCE

Multiple UXO Removal System (MURS)

- **MURS Requirement:**
  - **Rapidly and safely identify, assess, render safe, and dispose of ~1000 UXOs (per event)**
  - **Sufficient space to start repair operations ~1hr**
- **Proposed Solution to MURS requirement:**
  - **Family of systems (FoS);**
    - **SUAS**
    - **High Speed UGV**
    - **MRAP based neutralization system**
- **Plans/Accomplishments:**
  - **FY15: Completed Operational Utility Evaluation (OUE) using RADBO* prototype**
    - **RADBO production decision for AFCENT rqmt - 2qtr FY16**
  - **Development ongoing for SUAS and High Speed UGV prototypes. FoS OUE in FY17.**

* RADBO – Recovery of Airfields Denied By Ordnance

U.S. AIR FORCE

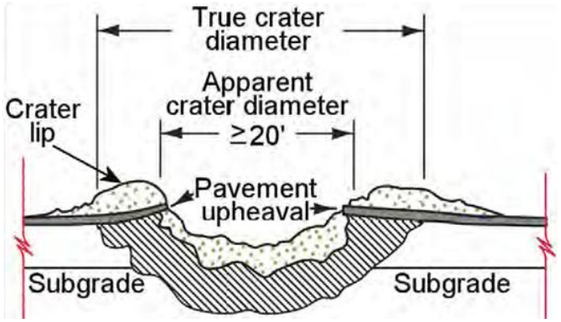
Craters & Camouflets

- Damage will vary with munition size and type
- Most likely very few undamaged areas
- Very difficult environment to navigate if too cautious – LIDAR based OD/OA should be OK
- Damage assessment data transferred from RADAS

20’ Diameter
(16” Concrete)

Craters

20’ Diameter
(8” Concrete)



9’ Diameter
(3” Asphalt)

Camouflets

U.S. AIR FORCE

Automated Airfield Construction and Repair

- Unmanned ground vehicles automatically performing airfield construction and repair
  - Operation at 50-75% manned tempo
- Integrate robotic appliques for airfield construction equipment
- Implement multi-robot and convoy ops
  - Leader/follower
  - Coordinated material handling
  - Operations sequencing
- Develop network of robots that can navigate and repair damaged runways

ADR Program Goal: ***Provide field-ready and timely base recovery supporting all the phases of the Force Module Construct and mitigating A2/AD threats!***

U.S. AIR FORCE

In-Seat Applique System

- DoD has many of the same type of vehicle from different manufacturers
- Highly flexible, multi-vehicle system
  - steering wheel to joystick control
  - Must be able to “push some buttons”
- Does not have to “of human form” but should use human controls
- Provide basic vehicle control functions
  - teleoperation only now
  - future may include some automation – cruise control, task repetition, gps waypoint
- Ship hardened cases on pallet(s) instead of 100s of tons of robotic vehicles
  - Use vehicles of opportunity
  - Right system at the right time and place

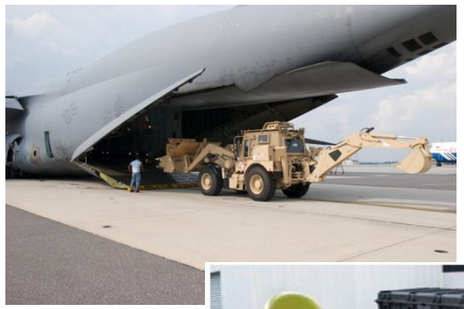


Photo courtesy of Juliana Reyes & Drexel University

U.S. AIR FORCE

Unmanned Civil Engineering Operations

- **Automated ground systems to perform AF Civil Engineer Operations**
  - **Aviation firefighting, hazardous incident response, aircraft decontamination, etc.**
- **Integrate and control appliques or retrofit systems to existing AF platforms**
- **Demonstrate unmanned systems that minimize exposure to risks associated with hazardous operations**

EOD Small Robot Acquisition Overview

Brian Skibba – Program Manager

2 March 2016

U.S. AIR FORCE

Overview

- **CHALLENGE:**
  - **Procure a solution for the USAF EOD small backpackable EOD robotic system requirement by the end of FY15**

- **ACCOMPLISHMENTS:**
  - **Accomplished requirements definition, system evaluation, and source selection in 13 months from authorization**
  - **IPT team implemented innovative standards based evaluation techniques for superior results**
  - **Awarded $25 million ID/IQ contract; 1st AF Small EOD backpackable robotic system to support global ops**

Robot Specifications

AF User Robot Specification

- The system shall be a one-man back packable system able to respond to UXO and IED incidents and conduct ISR in hazardous environments.
- Operate in all weather conditions, day or night
- Operate in all terrain conditions, indoors, outdoors, and inside vehicles and transport aircraft.
- Operate in all environmental conditions including snow, ice, salt, sand, fog, rain, mud, gravel, and extreme temperatures with the exception of underwater and space environments.
- Robot weight shall be 30 lbs. or less. (robot chassis, batteries, camera or cameras and manipulator arm)
- Equipped with at least one electro optical (EO) near-infrared (IR) pan-tilt-zoom (PTZ) camera.
- Equipped with one arm with a gripper end effector allowing manipulation capabilities.
- The system shall have at least a 100 m (328 ft.) wireless line-of-sight (LOS) range.

U.S. AIR FORCE

Testing Methodology

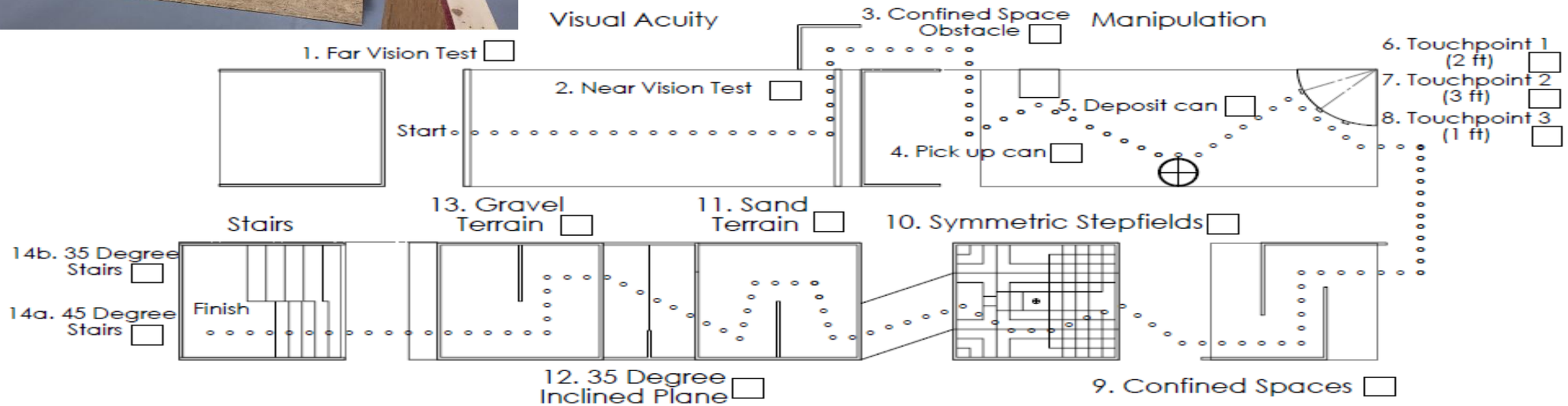
- 3 Phase approach
  - Phase 1 – at Tyndall - 12 Total Force EOD technicians, E3-E7, 50+ deployments, wide range of experience
    - Ran the systems through indoor course, outdoor course, and unstructured free play.
  - Phase 2 – at Gaithersburg MD NIST labs, Systems shipped to NIST, vendor supplied operators to generate best capabilities of systems via industry standard testing regime, ASTM standards
  - Phase 3 – Environmental testing at Tyndall

U.S. AIR FORCE

Indoor Course

Built to and run to NIST Standard Protocols

- Standardized course eliminated variability in tasks
- Provided measurable data based on real world challenges in controlled environment
- Multiple runs and multiple operators reduced operator bias and skill error



U.S. AIR FORCE

Outdoor Course & Unstructured Free Play

- Counter-tunnel course used for culvert tasks
- Outdoor free play allowed operators to explore with systems and setup real world scenarios
- Silver Flag training site used for dismount operations in village environment

U.S. AIR FORCE

Last Thoughts

- **Two issue that will drive vulnerabilities in future robotic systems**

1. **Lack of spectrum availability**

2. **Cyber attacks**

U.S. AIR FORCE

Questions?

Research, Development, Test, and Evaluation (RDT&E) for Air Force Airbase Systems
Solicitation Number: BAA-PKD-2016-0001