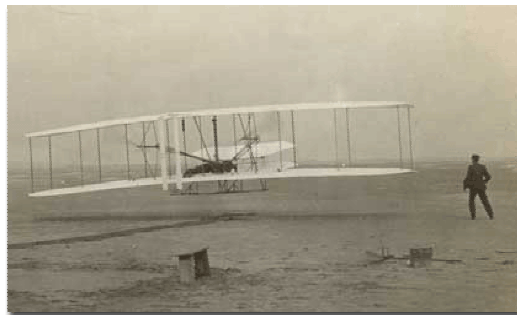


## High Fidelity Training for UAS Aircrew



1903

~30 years

1934

From the Wright Flyer to the "Blue Box"



1975

From Mastiff to PMATS  
~30 years

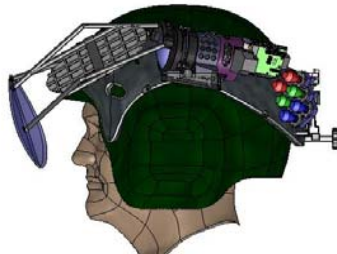
2005



**CERI UAV Human Factors Workshop**  
21 May 2007

# Outline

- Corporate Introduction
- UAS Training Context
- Predator Mission Aircrew Training System (PMATS)
  - Background
  - Program Specifics
- UAS Community Signposts



We Know  
Training  
From The  
Ground Up

# CY06E Sales By Segment - Preliminary

L-3 Consolidated (CY06E)

\$12.4B



**34%** Specialized Products

**\$4.2B**

**24%**

C<sup>3</sup>ISR

**\$3.0B**

**19%**

Aircraft Modernization, and Maintenance

**\$2.4B**

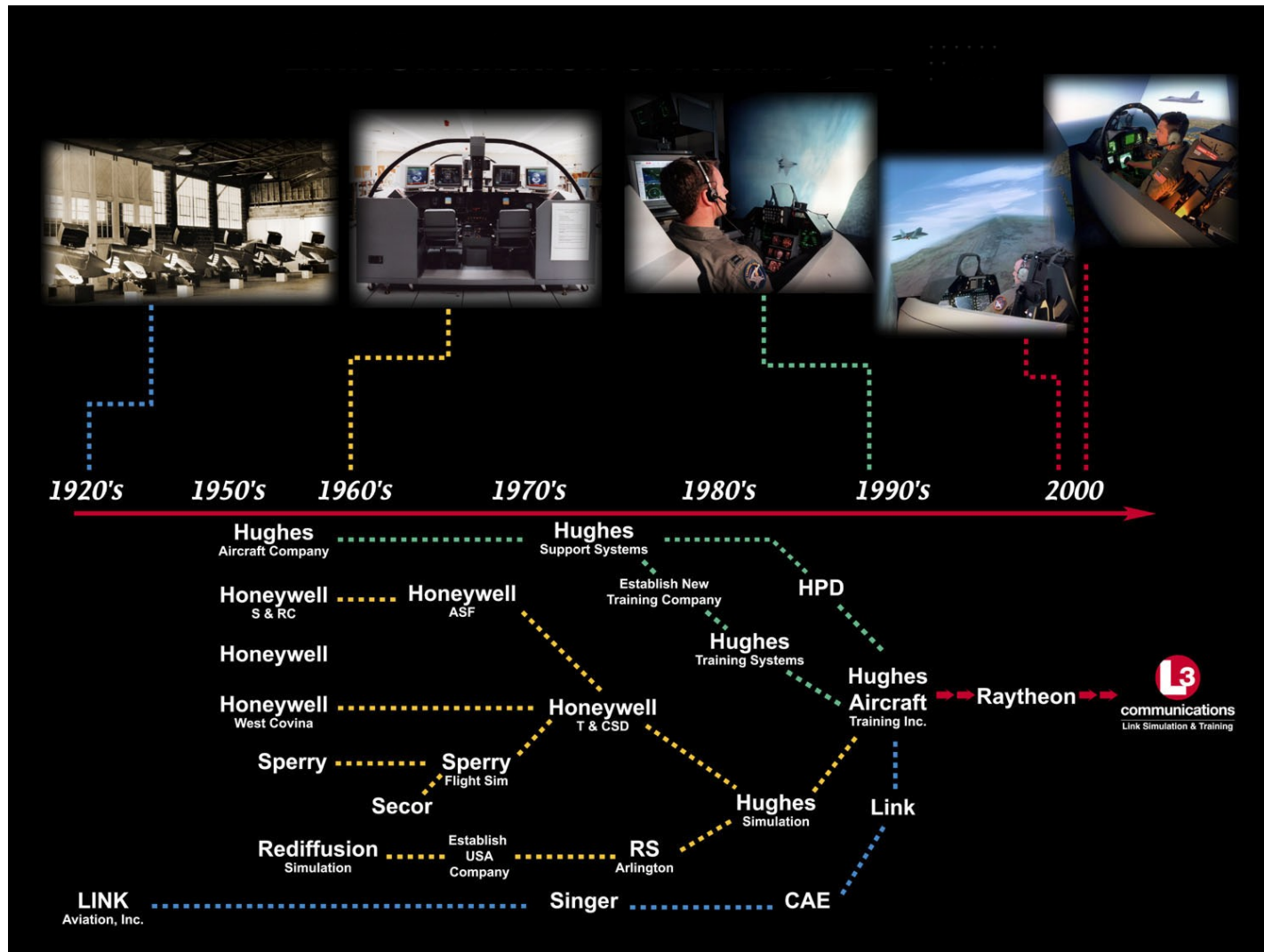
**23%**

Government Services

**\$2.9B**



# Link Simulation & Training Legacy



# Industry Leader ... Fixed and RW Training Solutions

## PRODUCTS

Distributed Mission Operations (DMO)  
 Collective Training Systems - AVCATT  
 Tactical Operational Flight Trainer  
 Operational Flight Trainers  
 Weapon System Trainers  
 Weapon Tactics Trainers  
 Part Task Trainers  
 Deployable Training Devices  
 Aircrew Systems Trainers  
 Computer-Based Training  
 Maintenance Trainers  
 Front End Analysis  
 Instruction  
 Training Management  
 CLS / CTSS

## AIRCRAFT

|               |               |              |
|---------------|---------------|--------------|
| <b>A-4</b>    | <b>F-15</b>   | <b>AH-1S</b> |
| <b>A-5</b>    | <b>F-16</b>   | <b>AH-1W</b> |
| <b>A-6</b>    | <b>FA-18</b>  | <b>AH-64</b> |
| <b>A-7</b>    | <b>EA-18G</b> | <b>CH-46</b> |
| <b>AV-8</b>   | <b>F-22</b>   | <b>CH-47</b> |
| <b>B-2</b>    | <b>F-111</b>  | <b>CH-53</b> |
| <b>B-52</b>   | <b>F-117</b>  | <b>UH-1H</b> |
| <b>C-130</b>  | <b>KC-10</b>  | <b>UH-1N</b> |
| <b>C-141</b>  | <b>KC-135</b> | <b>UH-60</b> |
| <b>E-3</b>    | <b>MQ-1</b>   | <b>SH-60</b> |
| <b>E-6</b>    | <b>P-3</b>    | <b>OH-58</b> |
| <b>EA-18G</b> | <b>T-37</b>   |              |
| <b>F-4</b>    | <b>T-38</b>   |              |
| <b>F-5</b>    | <b>T-45</b>   |              |
| <b>F-14</b>   |               |              |

## SPECIALITY

Systems Integration  
 Instructional Systems  
 Performance Enhancement  
 Brief/Debrief/AAR  
 PC Architectures  
 Avionics Modeling  
 Interoperability  
 Aero Modeling  
 Image Generation  
 Visual Displays  
 HMD  
 Sensors  
 Legacy Simulator Upgrades  
 Distributed Microprocessors

# Brief History of DoD UAS Training

- 80s: Israeli Mastiff & Pioneer enter DoD inventory
  - Creation of dedicated schoolhouse at Ft. Huachuca
  - Classroom theory + live flights
- 90s: The MUSE Generation
  - Initially designed solely to train Hunter crews
    - 6-DOF aircraft model + Visual Scene Generator + training scripts
    - Plug MUSE into GCS and “fly” it around
  - Additional platforms & sensors added:
    - Pioneer, Outrider, Predator, U-2, etc.
  - From operator training to staff level training
    - Original intent under utilized
    - Primarily due to operational burden on “flight-worthy” systems
  - Crew training syllabus remained heavily dependent on live flights
- 21st Century: Embedded Training
  - Difficulty with fault insertion into “flight-worthy” system
  - UAV training pipelines remain live flight dependent
  - Student throughput perennially backlogged

# PMATS Overview

- Predator Mission Aircrew Training System (PMATS)
  - Requirements
    - High-fidelity, fully immersive, Predator simulation for both pilots and sensor operators
    - Maintain concurrency with fielded system
  - Front End: (Nearly) exact replica of flight-worthy system
    - OEM supplied
  - Back End:
    - 6-DOF flight model (OEM provided)
    - Virtual Environment
      - Terrain, sensor imaging, synthetic targets / forces
    - Instructional System Support
      - Instructor Operator Station (IOS)
      - Fault insertion; recording/playback; briefing / debriefing
    - Networked server backbone; distributed training (i.e., DMO)

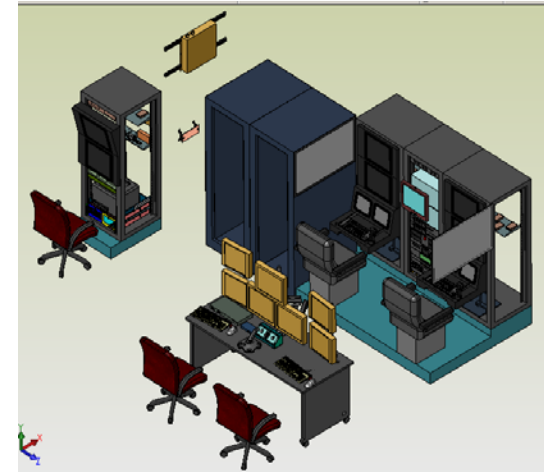
# PMATS Overview

## ■ Program Specifics

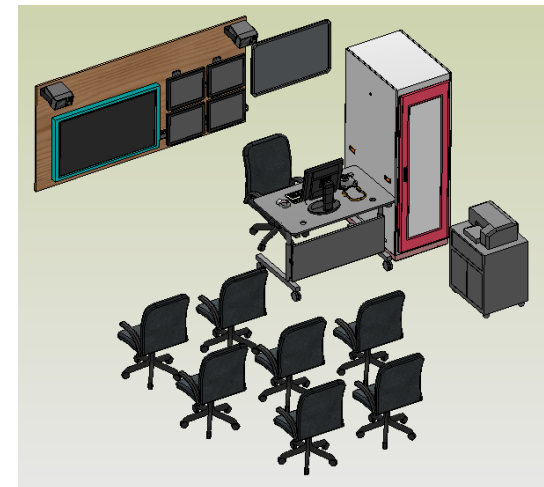
- Awarded: Jun3, 2005
- Deliver 7 systems to Creech AFB
  - System Includes:
    - Student workstation (Predator GCS)
    - Instructor Operator Station (IOS)
    - Brief / debrief workstation
  - Retain a “testbed” system at Link

## ■ Current Status

- Initial Delivery: Commenced Dec 2006
  - 8 PMATS
  - 3 Brief / De-brief
- April 2007: USAF Exercised Option
  - 8 more PMATS
  - 2 more Brief / De-brief



GCS & IOS



Brief / Debrief

# Core Enabling Technologies

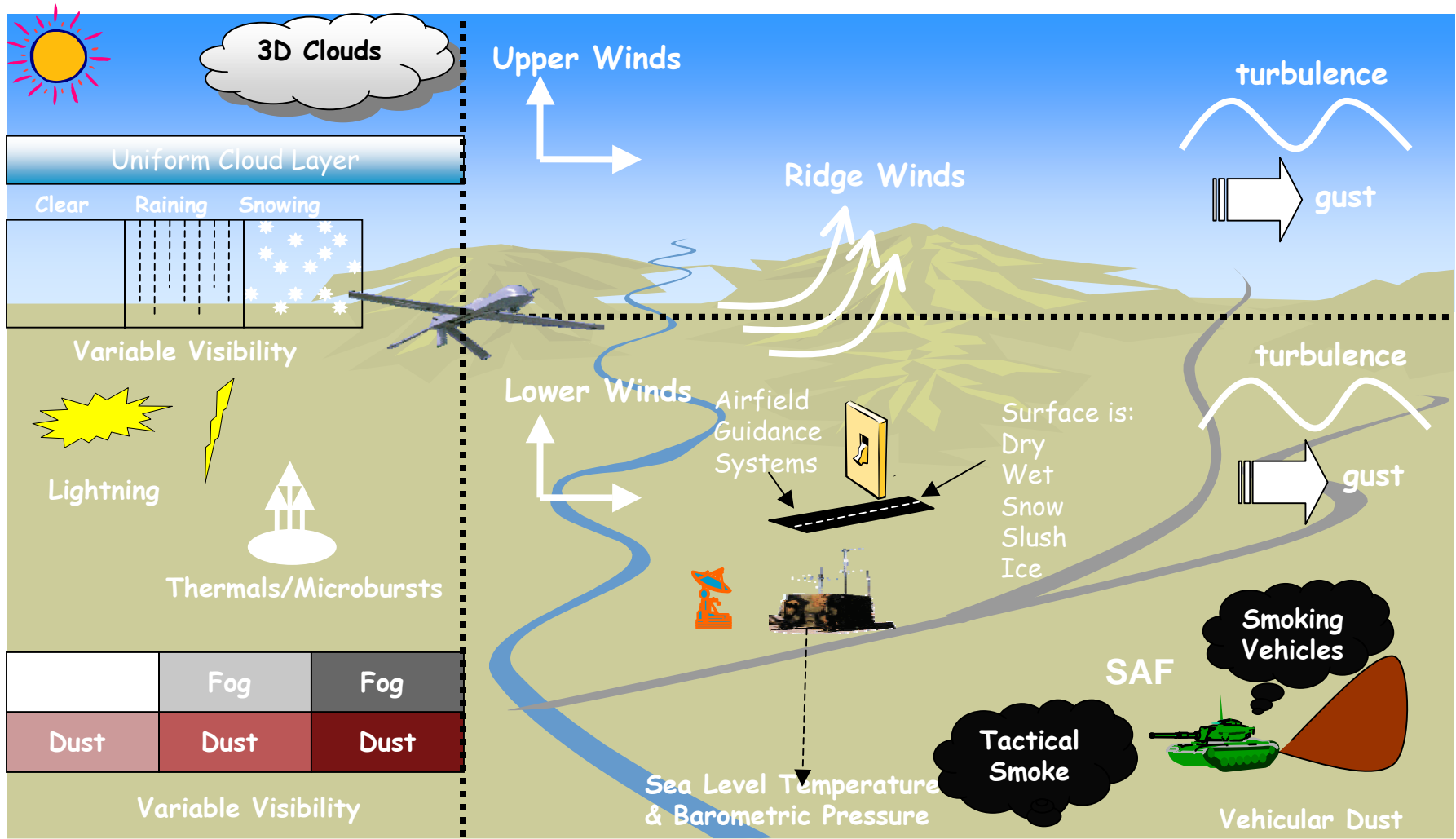
- Instructional Systems
  - IOS, Brief/Debrief, Malfunctions, Role Players
- Interoperability
  - Local and long haul networks
- Environments
  - Physics based, Natural, Battlefield, Targets, Crowds
- COTS PC Architecture
  - Host Computer, Image Generator, Instructional Systems
- Modeling
  - Aero, Sensors, Weapons, Communications

***Enables Realism to the Operators***  
***Leverages Existing DoD Investment***

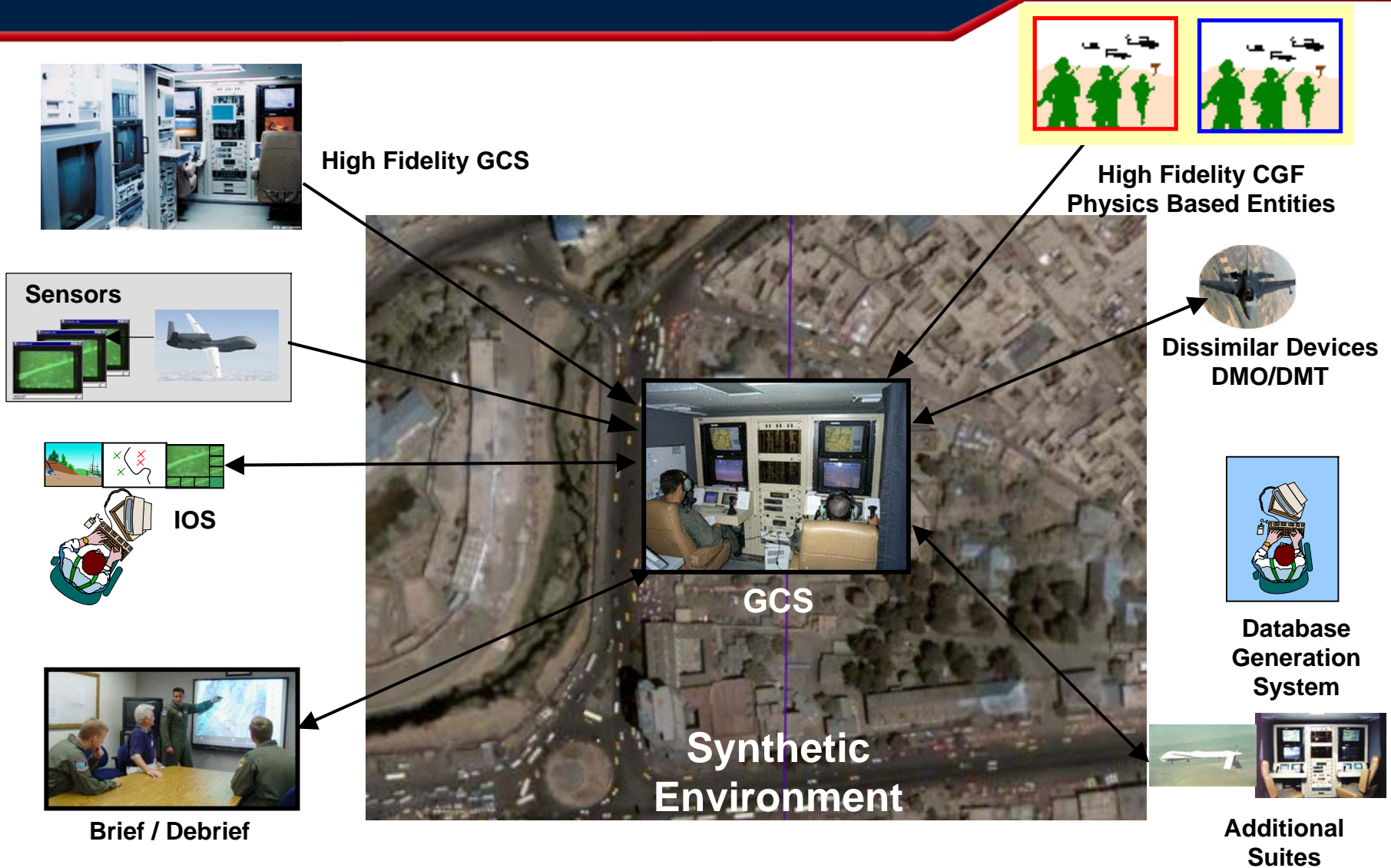
# UAS-Unique Simulation Technology

- UAS Datalink Modeling
  - For accurate training of both LOS & SATCOM procedures
    - Handoffs between forward and read GCS
    - Link loss emergency procedures training
- Environmental effects on aircraft and sensors
  - Icing, winds, clouds, haze, smoke, thermal crossover
- Extendable training system matches fielded platform
  - Sensors: EO / IR, SAR, Nose camera
  - Weapons
  - Communications: ARC-210 voice comms
  - Configuration: RQ-1B, MQ-1B, MQ-9, etc.
- Emergency Procedures Training
  - Instructor console configured to inject UAS-centric faults

# Environment Realism



# UAS Training Systems Concept



# PMATS Training Advantages

- From Taxi to Shutdown
  - Visuals precisely replicate Creech airfield and Nellis ranges
  - Potential to eliminate (some number) of live syllabus flights
- Emergency procedures training
  - Overcomes reluctance to insert complex faults into flight-worthy system
  - Some UAV emergencies cannot be simulated during a live flight
    - Examples: Engine Cut; Datalink Loss; Severe Weather (icing)
- Reconfigurable on the fly
  - Ability to replicate wide variety of fielded configurations (when available)
    - RQ-1A, RQ-1B, MQ-1, MQ-9...
  - Customized crew training (concurrency)
- Tactics Development
  - “Try before you fly”
  - Reduces live flight demos

Same advantages as  
seen in manned aircraft  
training systems

# Positive UAS Community Signposts

- From the Wright Flyer to the Blue Box
  - Simple airplanes; small quantities; few pilots
  - Hard to justify the case for fully immersive simulators
- From Mastiff to PMATS
  - Relatively small worldwide investment in UAS (vs. manned aviation)
  - Hard to justify value of PMATS-like concept during those early years
  - UAS community “mass” in 2006 changes the equation
    - Complexity, cost, number of affected personnel
- PMATS Contract Signposts
  - Formal recognition of the value of immersive training
  - Contract awarded to a recognized training company
  - Acknowledgment that embedded training has limitations
  - Potential Return on Investment
    - Reduced live flight syllabus
    - Increased student throughput
    - Enhanced training experience; more qualified graduates

# Conclusion

## “Aviation Discipline / Culture One Standard for Manned / Unmanned”

- PM UAVS Pathfinder 06 presentation.

- “Moving the Army’s UAS program from MI oversight into the manned aviation world allows us to bring the same technical and safety rigor to these systems as we employ on all our other aircraft.”
  - Paraphrased from COL Hazelwood’s (PM UAVS) presentation at AAAA Symposium, Feb 2007
- We agree.
  - Especially regarding simulation and training.

**For more info:**

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