Estimating Unmanned Aircraft Systems Lessons Learned

Briefing Content

- Introduction/Purpose
- Background
- Lessons Learned
  - Defining an Unmanned Aircraft System
  - WBS
  - Ground Segment
  - Payloads
  - System Integration, Assembly, Test and Checkout
- Special Considerations
  - Concurrency
  - Test
  - Proprietary Systems
  - Operations and Support
- Summary/Conclusions/Q&A

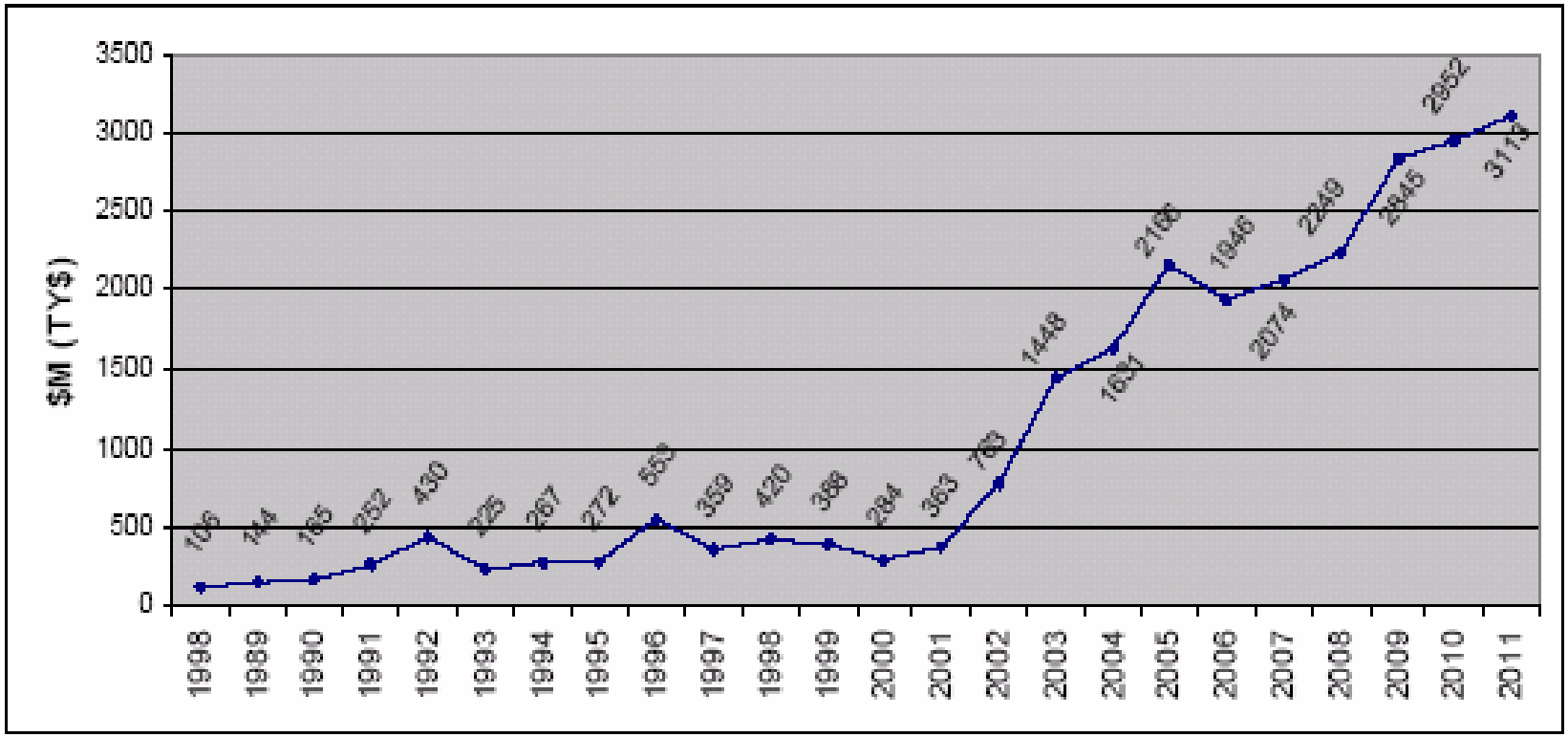
Introduction/Purpose

- Introduction
  - USAF major UAS systems are Global Hawk and Predator
  - Reaper is sister program to Predator
    - ACAT II
- Purpose
  - Present lessons learned on estimating the costs of Unmanned Aircraft Systems (UAS).
  - Provide a basis for further discussion and study

Background

- Global Hawk
  - System Overview
  - History
- Predator/Reaper
  - System Overview
  - History

UAS Funding



DoD Annual Funding for UAS

Source: Unmanned Aircraft Systems Roadmap (2005)

Global Hawk System Overview

Global Hawk: High-altitude, long-endurance capability providing intelligence, surveillance and reconnaissance information

Aircraft and Payloads

Mission Control Element (MCE)

Launch and Recovery Element (LRE)

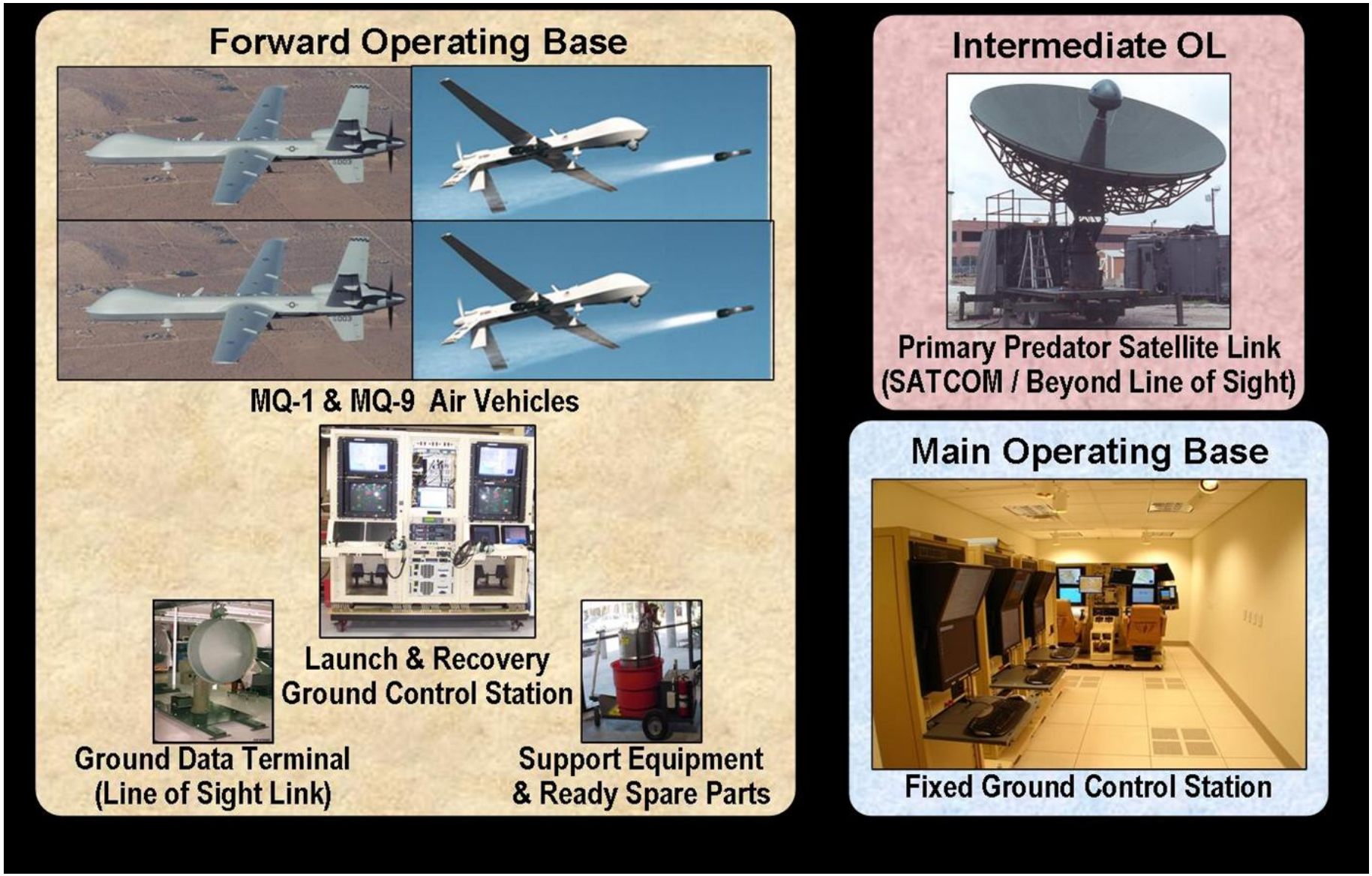
Global Hawk Program History

- Started in 1994 as part of High Altitude Endurance (HAE) UAS ACTD program
  - DARPA led effort
  - HAE program included another air vehicle (Dark Star) and a Common Ground Station
- First Flight - Feb 1998
- AF designated Executive Agent Oct 1998
- Milestone II approval (EMD/LRIP start) Feb 2001
- GH ACTD system deployed to OEF - Nov 2001
- First air vehicle production delivery - Oct 03

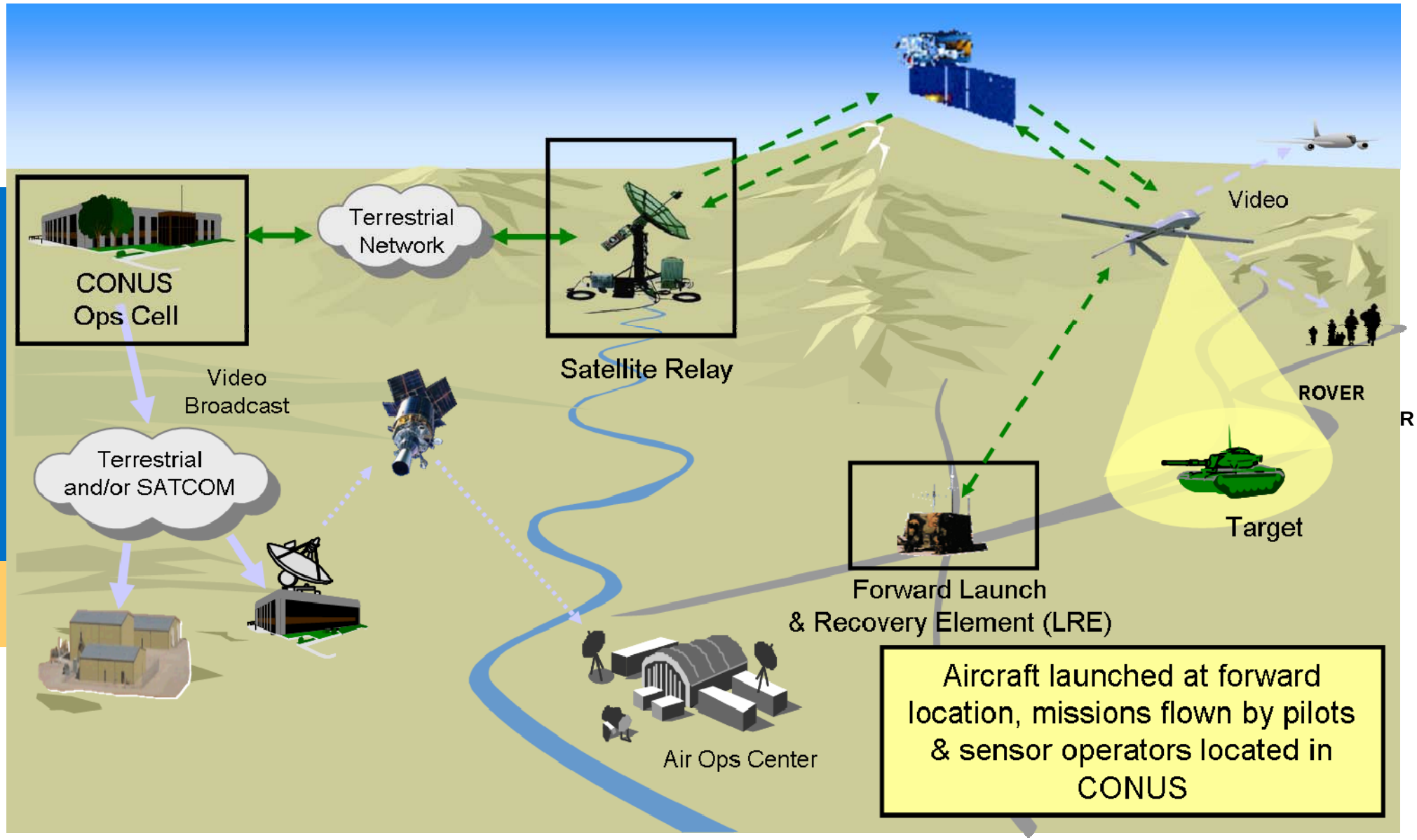
Global Hawk Program History

MAR 01	MAR 02	DEC 02	APR 05	DEC 05	MAR 07
Transition from ACTD to "normal" EMD/LRIP	Transformation and acceleration	Less complex & costly rebaseline	Refine low risk acq approach consistent with early fielding. Deploy 2 Blk 10 acft	Restructure program to address evolving user needs while stabilizing dev pgm	OSD N-M Certifies program. Limits production to 5 per year thru IOT&E
63 AVs 14 GSs	51 AVs 10 GSs	Same	Same	Same	54 AVs 10 GSs
EMD Approved: Both spirals	EMD Approved: 2 of 6 spirals	EMD Approved: 4 of 6 spirals	Same	Same	Introduced Modernization
LRIP Approved: 6 AVs of 63	LRIP Approved: 17 AVs of 51	LRIP Approved: 19 AVs of 51	Same	Same	LRIP annual approvals: 34 AVs of 54
One AV config, 2,000 lbs payload	Two AV configs, 2,000 & 3,000 lbs	Same	Same	Same	Same
Mix of dedicated IMINT and later SIGINT Payloads	Multi-Int PL (EO/IR, SAR, phased SIGINT & RTIP	Mix of Multi-Int (EO, IR, SAR, phased SIGINT) & RTIP- only	Same	Same	Same
2 Blocks: IMINT only and IMINT & SIGINT	Spirals describe capability updates	ORD increments describe capability updates	Introduce 5 Blocks to clarify capability updates	Same	Same

Predator/Reaper System Overview



Remote Split Ops Capability



Predator-Reaper History

323,000+ Total MQ-1 Flight Hours
17,500+ Total MQ-9 Flight Hours

1st ORD From ACC

Allied Force - Laser

Predator Assigned to Big Safari by SAF/AQ

Hellfire Deployed

MQ-9 Fielded

658 AESG Established

Flies Operationally In Bosnia

OEF

OIF

1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008 +

ACTD w Navy JPO 1st Flt 6 Mo ARO

ACTD Complete

Hellfire Demonstrated

Multi-UAV Control

1st ACC MQ-9 Deployment & 1st UK A/C Delivered

USAF Assumes Control – ACC

1st Prod Pred B Flies

Fixed Facility GCS

Lessons Learned and Special Considerations

Defining an UAS

- 1st step in any estimate is to define what you're estimating
  - WBS is the usual tool cost estimators use to help define the weapon system
    - Appendix H of Mil-Hdbk 881A, DoD Handbook Work Breakdown Structures for Defense Materiel Items, dtd 25 Jul 2005, specifically addresses UAS
    - Tailored to match unique elements of systems
  - Operating and Support costs are defined and organized according to the six standard CAIG cost elements

UAS WBS

- Unique 881A Level Two Elements
  - Air Vehicle
  - Payload(s)
  - Ground Segment
  - System Integration, Assembly, Test and Checkout
- System of Systems approach may be applicable
- Integration is an area of concern
- Payload(s) and Ground Segment are just as important (if not more so) than the air vehicle

Ground Segment

- Is Cockpit of UAS, and center of communications and data
- 881A lists Ground Control Systems and Command and Control Subsystem as WBS Level 3 items
  - GH experience is that Command and Control Subsystem is a Level 4 element within Ground Control System (GCS)
  - Predator and Reaper GCSs fly the aircraft – no autonomous mission capability - and also includes command and control
    - No separate transport or launch and recovery systems
- Estimating concerns:
  - Certification and Accreditation
  - Interface with base comm systems
  - Interfaces with payloads

Payload(s)

- Payloads are critical - they perform the mission
- Can cost as much or more than the air vehicle
- 881A provides good WBS definition
- Estimating Concerns:
  - Size, weight and Power (SWaP)
  - Interface with air vehicle's mission computer
  - Interface with ground segment
  - End user of payload data may not be part of ground segment and may need a different/separate interface
  - Payloads may be common across multiple platforms, which may add schedule and technical complexity

System IAT&CO

- UAS WBS is the only WBS in 881A to specifically list System IAT&CO as a Level 2 element
  - Emphasizes concerns of integrating air vehicle, ground segment and payloads into one system
- However… GH and Predator/ Reaper do not use IAT&CO at Level 2
  - Integration and Assembly Costs captured and estimated at Level 3
  - Test and Checkout costs captured and estimated in System Test and Evaluation element

Concurrency

- Both GH and Predator/Reaper have a high degree of concurrency in their programs
  - Development, production, and O&S all happening at the same time
    - Predator and Reaper began as NDI systems, with enhancements funded with RDT&E dollars
  - Significant numbers of mods are also beginning to take place
- Complicates estimating
  - Phasing of estimates is difficult because schedules constantly change
  - Be careful of “chasing” technology

Test

- Estimating concerns
- Adequate number of test assets
  - Air vehicles
  - Payloads
  - Ground Segments
- Scheduling
  - Driven by development and production events

Proprietary Systems

- UAS weapon systems are more likely to contain or consist of nondeveloped items (NDI)
- Both Predator and Reaper were developed by General Atomics ASI and evaluated by the Navy & USAF
  - Good : Saved DoD time and development dollars
  - Bad: Less insight into design and data
    - May impact future testing, design and support decisions
- Estimating impacts:
  - Descriptive hardware and software data may not be available
    - Limit to government independent technical evaluation of cost inputs

Operations and Support

- Warfighters still refining operations and employment concepts
- Estimating concerns
  - OPSTEMPO not settled
  - Basing not finalized
    - Flexible deployment process
  - SATCOM costs
  - Depots
    - Subject to 50-50 rule, but proprietary data reduces flexibility

Summary

- UAS is a growth area
- Cost estimators need to be aware of unique/special UAS concerns
- WBS is the basic tool to help define and highlight areas of concern
- Ground segments and payloads are important
- Integration between air vehicles, ground segments and payloads can be a significant cost
- Growing applications of UAS will significantly impact operations and support cost estimates

Questions?