Unmanned Systems:
Delivering Capability, Ensuring Safety

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Office of the Secretary of Defense

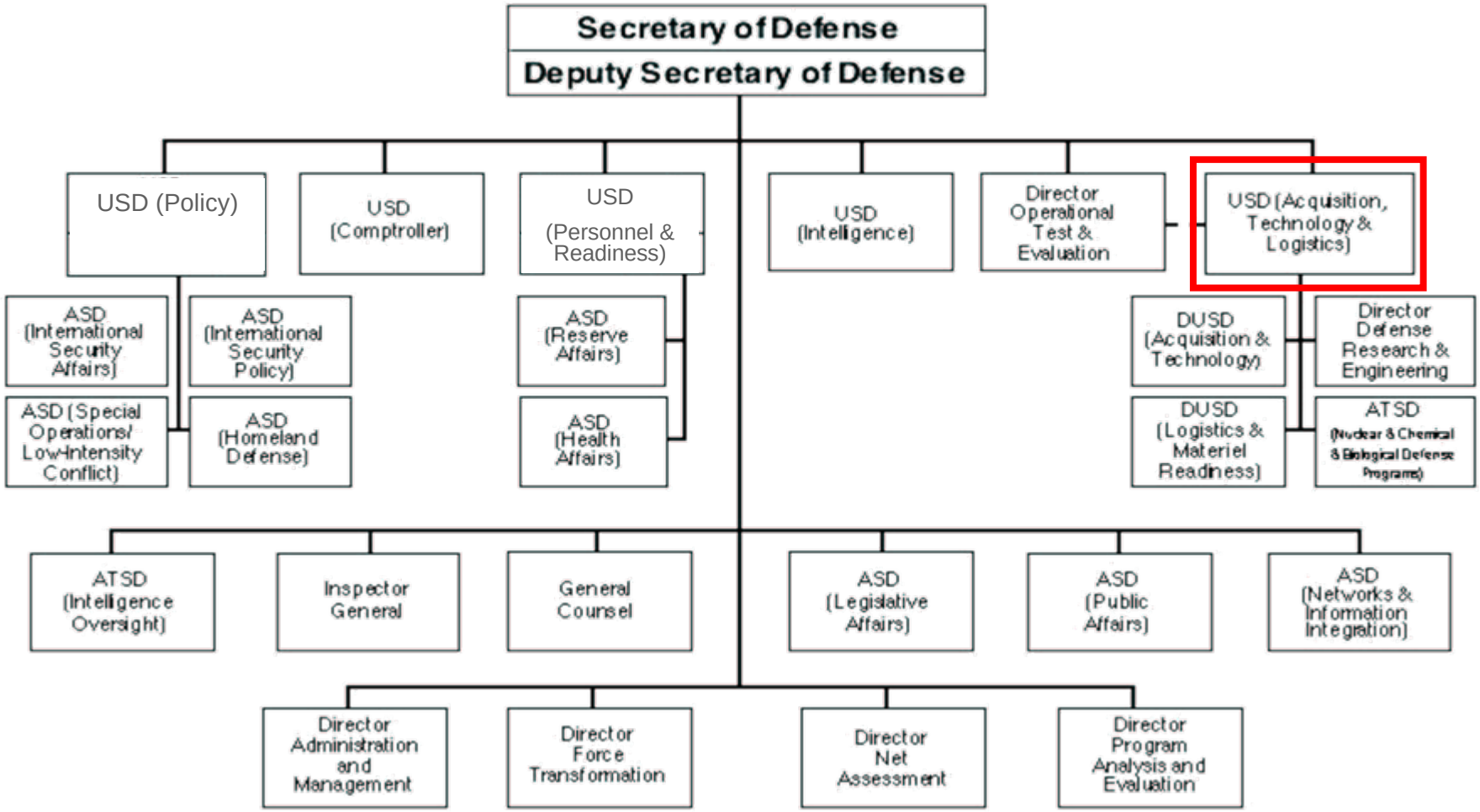
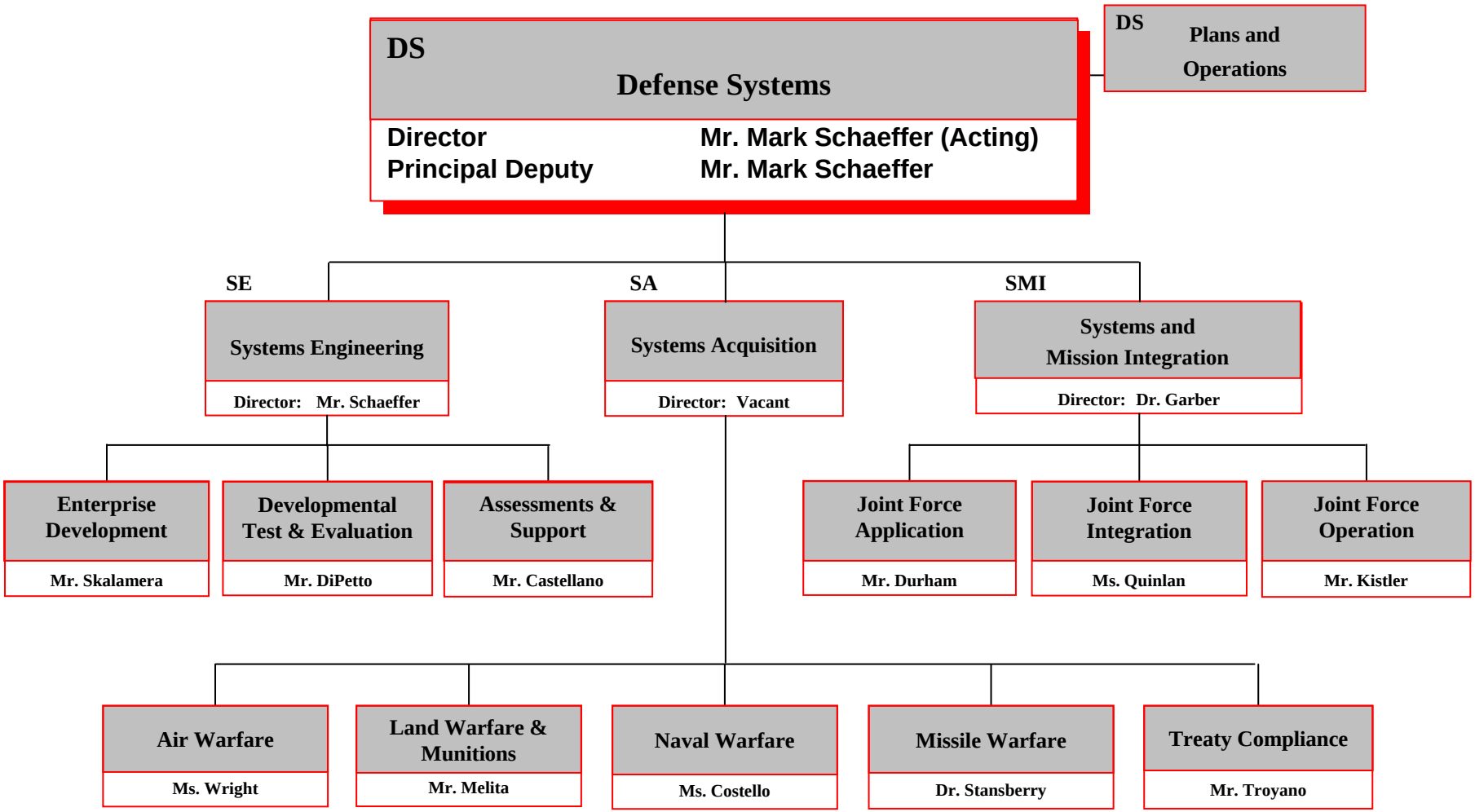


Chart reflects PAS officials and those reporting directly to the Secretary and Deputy Secretary of Defense

Defense Systems Organization



Acquisition and Technology Programs (ATP) Task Force

- Purpose
  - Recommend or implement changes to policies, procedures, initiatives, education and training, and investments to ensure programs address safety throughout the life cycle
- Goals
  - Ensure acquisition policies and procedures for all systems address safety requirements
  - Review and modify, as necessary, relevant DoD standards with respect to safety
  - Recommend ways to ensure acquisition program office decisions consider system hazards
  - Recommend ways to ensure milestone decision reviews and interim progress reviews address safety

Establish dialogue between System Safety and Engineering and Program Management communities

Unmanned Systems Safety

- Issue: The Future Combat Systems Board of Directors raised the issue of whether or not proper procedures and processes were in place to ensure weaponized unmanned systems safety in the joint battle space
- ATP TF Goals
  - To determine the maturity of Unmanned Systems development and governance
  - To determine whether or not proper procedures and processes are already in place to ensure vehicle safety
  - To determine if OSD can or should play a role to help ensure DoD puts the necessary procedures and processes in place

Who's in Charge!

Unmanned Systems QDR Guidance

- The Department will also increase procurement of unmanned aerial vehicles to increase persistent surveillance, nearly doubling today's capacity. It also will begin development of the next generation long-range strike systems, accelerating projected initial operational capability by almost two decades. (pg 6)
- The Air Force has set a goal of increasing its long-range strike capabilities by 50% and the penetrating component of long-range strike by a factor of five by 2025. Approximately 45% of the future long-range strike force will be unmanned. (pg 46)
- Undersea capabilities, both manned and unmanned, will use stealth, survivability, endurance, payload size and flexibility to complicate potential foes' planning efforts and strengthen deterrence. (pg 47)
- The increasing use of robotics has improved U.S. force protection significantly in Operation Iraqi Freedom. (pg 64)

Growth Industry

Unmanned Aircraft (UA) 2006

Theater and Tactical (>10lbs)	
• Buster	20
• Pioneer	34
• Shadow 200	140
• Neptune	15
• Tern	15
• Mako	14
• Tigershark	6
• SnowGoose	25
• Hunter	32
• I-Gnat	4
• Predator	70
• Predator B	6
• Global Hawk(GH) - ACTD	4
• Global Hawk - Prod	5
• GH Maritime Demo	2
• Sub-total	392

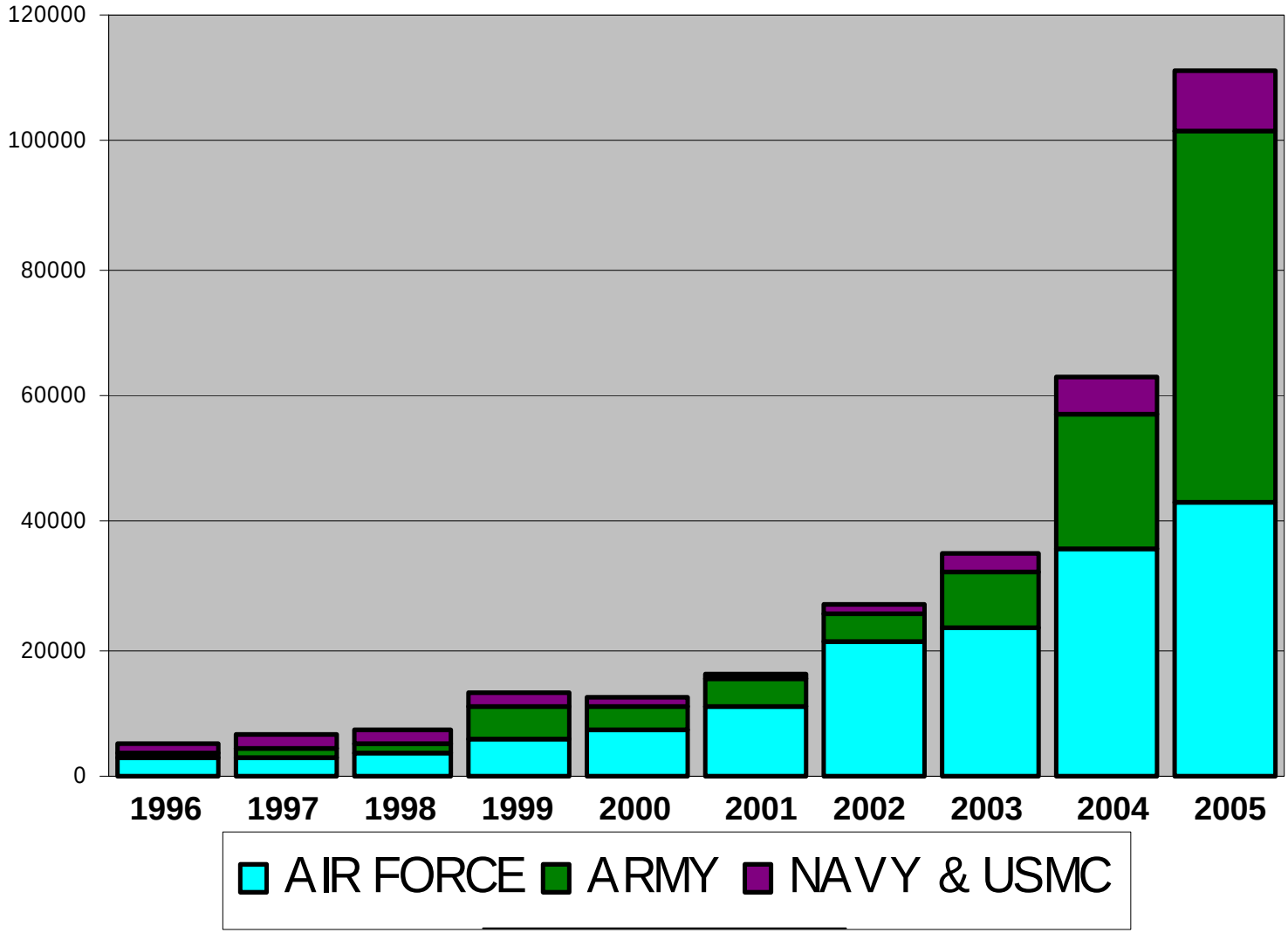
Small (<10lbs)	
• Pointer	126
• Raven	1776
• Dragon Eye	402
• Desert Hawk	126
• BATCAM	54
• Swift	212
• Sub-total	2570

2002	**167 Aircraft**	**$ 763M**
2004	**727 Aircraft**	**$1,631M**
2006	**2,962 Aircraft**	**$1,627M**

Total R&D and Procurement costs per year

1,674% Increase from 2002

DoD Theater and Tactical UA Flight Hours



Unmanned Ground Systems 2006

EOD/Counter Mine	
• Packbot	190
• Talon	172
• Bombot	1000
• MV-4	14
• Sub-total	1376

ISR/Combat	
• Dragon Runner	4
• Marcbot	342
• Small Robotic Scout System	3700
• Throwbot	30
• Gladiator	1
• Sub-total	4077

2002	**15 Systems**	**$1.0M**
2004	**162 Systems**	**$3.5M**
2006	**4,000 Systems**	**$89.0M**

Total R&D and Procurement costs per year

26,567% Increase from 2002

Unmanned Naval Warfare Systems

Underwater	
• MRUUVS	2013 IOC
• SCULPIN	2006 IOC
• BPAUV	2009 IOC
• Surface Mine Countermeasures (SMCM)	2012 IOC

Surface/Semi-submersible	
• Mine Sweeping USV	2011 IOC
• Remote Minehunting USV	2007 IOC

2006	**6 Systems**	**$123M**
2008	**23 Systems**	**$ 73M**
2010	**44 Systems**	**$148M**

Total R&D and Procurement costs per year

633% Increase from 2006

ATP TF Unmanned Systems Findings

- ATP TF brought Unmanned Systems acquisition and operations subject matter experts together to examine and frame the issue and determine possible solutions
- Findings:
  - DoD use of Unmanned Systems will continue to increase substantially over the next decade
  - Mission capability will also increase expanding the range, performance and Joint Service use of Unmanned Systems
  - Unmanned Systems will dramatically reshape doctrine and CONOPS not only for the individual Services but more importantly for the Joint Force Commander
  - Technical pockets of activity but no central leadership
  - Unmanned Aircraft Systems community is further along than Land or Sea communities

Issues are much broader than system safety—weaponized safety, C2, training

This Is Not A Problem Exclusive To DoD…

- Homeland Security
  - Customs and Border Patrol
  - Coast Guard / maritime missions
  - Transportation security
  - Protection of critical infrastructure
- NASA
  - Propulsion
  - Collision avoidance
  - Extremely long endurance aircraft design (HELIOS)
  - Remote sensing
- Transportation (FAA)
  - Airspace integration (See and Avoid)
  - Certification / Airworthiness
- Commerce
  - Migration of unmanned technology to commercial applications
  - Unmanning cargo
- Agriculture / Interior
  - Unmanned spraying & remote sensing
  - Firefighting support

Unmanned Systems Challenges

Airspace	Weapons	Spectrum	Safety	Reliability
Architecture	Payloads	C2	Interoper-ability	Training
Inter-Agency	Treaty	Data Sharing	Legal	Industrial Base

Inter-Agency Challenges

- Transportation (Federal Aviation Administration)
  - Safety of flight concerns
    - Airspace integration (See & Avoid)
    - Certification / Airworthiness
- Homeland Security
  - Customs and Border Patrol
  - Coast Guard / maritime missions
  - Transportation security
  - Protection of critical infrastructure
- NASA
  - Propulsion
  - Collision avoidance
  - Extremely long endurance aircraft design (HELIOS)
  - Remote sensing
- Commerce
  - Migration of unmanned technology to commercial applications
  - Unmanning cargo / airborne mobile cell phone support
- Agriculture / Interior
  - Unmanned spraying and remote sensing
  - Firefighting support

Training Challenges

- Are we coordinating training for safe operation of unmanned systems?
  - Operator qualification
  - Currency requirements
  - Standardization and evaluation
- Why do pilot and operator requirements differ?
  - Service culture
  - Established operations constructs
  - Capability differences
- Is some standard UAS training appropriate (within UA class)?
  - Entrance requirements appear to be loosening
  - Established career pipelines are being modified
  - Documentation for currency, evaluation, and decertification
- Do the Services have similar specialty codes for the UAS field?
  - Services are creating new manning specialties
  - Maintenance effects on training

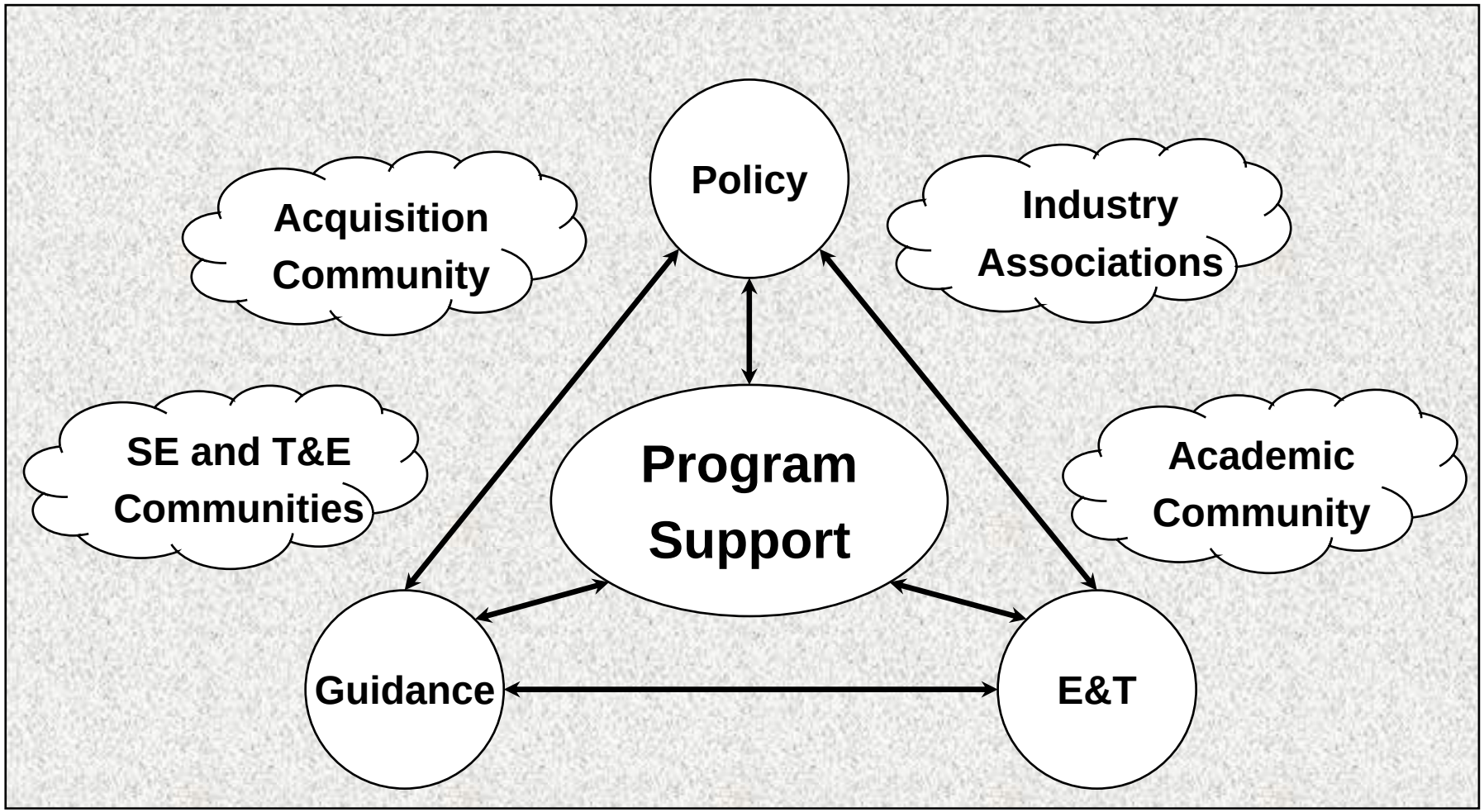
Pursuing common solutions to instill safety into unmanned systems operations

Safety Challenges

- Do we know all the hazards associated with unmanned systems?
  - Airspace deconfliction
  - Perception of friendly / non-combatants in area of operations
  - Inadvertent fire / launch
- What are the safety critical functions of unmanned systems?
  - Firing a weaponized unmanned system
  - Transporting an unmanned system
  - Render safe / render useless / render useful
- What are the risks associated with unmanned systems?
  - Loss of communications
  - Balance between safety in peace time not too constraining for war time
  - Controller / operator “spoofing”
- What technologies can be leveraged to mitigate the hazards / risks?
  - Real-time diagnosis / fault detection
  - Real-time image-processing algorithms
  - Data compression techniques

Take Charge and Be the Leader!

Systems Engineering Framework



Driving Technical Excellence into Programs!

The Way Ahead

- Capture workshop findings and recommendations
- Adjudicate through the ATP TF
- Develop actionable recommendations to take forward to implement appropriately

Delivering Capability while Ensuring Safety!