Maintaining the U.S. Military’s Advantage in Precision Strike
Overview

- Background
- Emerging salvo competition
- Operational concepts and weapons technologies to sustain our precision strike advantage
- Recommendations
Background: Precision guidance changed how the U.S. military conducts strike operations

**Germany, 1944**
- 1,000 bomber sorties
- 9,000 weapons (2,250,000 lbs)
- 1 target

**Vietnam, 1970**
- 30 fighter sorties
- 176 unguided bombs (88,000 lbs)
- 1 target

**Iraq, 1991**
- 1 fighter sortie
- 2 laser-guided bombs (4,000 lbs)
- 1 or 2 targets

**Iraq, 2003**
- 1 bomber sortie
- 16 PGMs (32,000 lbs)
- Up to 16 targets

**Today**
- 1 bomber sortie
- 80 PGMs (40,000 lbs)
- Up to 80 targets

**Precision can “replace” mass**
- WWII: Many weapons needed to compensate for lack of precision guidance
- PGMs in Desert Storm: Demonstrated how precision could greatly reduce the need for mass
## Some advantages of precision

<table>
<thead>
<tr>
<th>Conflict</th>
<th>Unguided Bombs</th>
<th>Precision-Guided Munitions</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Number Used</td>
<td>Total Number PGMs Used</td>
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<tr>
<td>1991 Desert Storm</td>
<td>210,900</td>
<td>17,162</td>
</tr>
<tr>
<td>1999 Allied Force</td>
<td>2,334</td>
<td>3,590</td>
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<tr>
<td>2003 Iraqi Freedom (reported April 2003)</td>
<td>9,127</td>
<td>19,269</td>
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</table>

**Creates advantages in time:** Enables synchronized strikes 24/7 and in all weather conditions

**Enables standoff strikes:** Reduces risk to launch platforms operating in contested areas

**Improves effectiveness against challenging targets:** Moving, relocatable, hardened, buried

**Has a force multiplying effect:** More targets per platform; part of rationale for cutting force structure
PGM procurement budget reflects assumption that U.S. strike forces will operate in permissive conditions.
• Enemy active and passive defenses can reduce the probability that U.S. PGMs will arrive at their targets (reduce PGM “probability of arrival” or “PA”)
  – Active defenses include surface-to-air weapons capable of intercepting PGMs
  – Passive defenses include deception tactics that can result in strikes on false targets

Find   Fix   Track   Target   Engage   Assess

Offensive Cyber Operations   Anti-Satellite Weapons   Surface-to-Air Missiles

Capabilities to counter each element of the U.S. “F2T2EA” precision strike kill chain

High-fidelity decoys   Buried/Hardened Facilities   Electronic Warfare
Precision guidance \textit{plus mass} may be needed in future strike campaigns.

- **Vietnam, 1970**: 30 fighter sorties, 176 unguided bombs (88,000 lbs), 1 target.
- **Iraq, 1991**: 1 fighter sortie, 2 laser-guided bombs (4,000 lbs), 1 or 2 targets.
- **Iraq, 2003**: 1 bomber sortie, 16 PGMs (32,000 lbs), up to 16 targets.

More sorties and PGMs needed per target.

One or two weapons per aimpoint no longer the rule for target sets protected by precision defenses and other active and passive countermeasures.
Salvo competition = the dynamic between opposing militaries that each have PGMs and effective defenses against precision strikes. Both combatants seek advantages by increasing size or survivability of their strikes, and by increasing their defensive capacity and lethality.
• DoD accustomed to PGM PA of nearly 100%

• Against enemies with capable defenses, PGM PA values likely to be far less

Probability of Damage (PD) is a measure of PGM effectiveness against various targets. Probability of Arrival, a subset of PD, is an estimate of the likelihood that PGMs will actually reach their targets once launched.

Result of reduced PA: Need more PGMs and strike sorties to achieve desired results on target sets
**Campaign level example**

**PGMs and Sorties Needed to Strike the Number of OIF Targets Attacked in 2003 Campaign**

- **Total PGMs**
- **Total Sorties**

- **149,250 PGMs**
- **86,000 aircraft sorties**

- **300,000 PGMs for two OIF-sized campaigns = about the total number of PGMs DoD bought from 2001 through 2014**

- **86,000 strike sorties = 5 times the number flown during the 2003 OIF air campaign**
Example: Penetrating Bombers Needed for a 30-Day Campaign Against Number of OIF Targets Attacked in 2003

128 penetrating bombers needed (current inventory = 20 B-2s)

Penetrating bombers delivering direct attack PGMs = greatest efficiency, but campaigns that rely heavily on direct attack PGMs may not be feasible against enemies with effective defenses.
Using many more large, expensive standoff weapons would be a much greater challenge.

**Total PGMs Procured Since 2001**

- Direct Attack
- Short-Range Standoff
- Long-Range Standoff

**Total PGM Procurement $ Since 2001**

- Direct Attack
- Higher average cost of standoff weapons
- Short-Range Standoff
- Long-Range Standoff

**Bomber-Sized Aircraft Needed for 30-Day Standoff Strike Campaign Against Number of OIF Targets Attacked in 2003**

- More than 500 aircraft needed

Use of larger standoff weapons = even more platforms and sorties
Alternatives to precision + mass

- Operational concepts that increase salvo size and PGM PA values
- Technologies that increase probability of arrival for PGMs and PGM salvos
**Benefits:** Less risk of enemy attacks that cut U.S. operational tempo and salvo size

**Challenges:** Reduced sortie rates caused by operating from range; offset by using larger strike aircraft with bigger payloads, and shifting fighters to counterair role

**Recommendation:** conduct large-scale strikes from lower threat areas (including undersea)

- **Fighters provide air cover for main operating bases**
- **Higher payload efficiencies decrease refueling requirements**
- **Carrier-based fighters protect LRS aircraft**
- **MRBMs, SRBMs, and LACMs threaten close-in U.S. bases and forces**
- **Long-range strike aircraft deliver bulk of PGMs**
**Recommendation:** conduct dispersed operations inside higher threat areas

**Distributed STOVL Operations**

**Cluster Basing**

**Benefits:** Operating closer to target areas could increase sortie generation and salvo size of smaller aircraft; fighter aircraft can suppress threats to U.S. bombers operating from more distant bases; dispersal complicate enemy targeting

**Challenges:** Logistics to support dispersed bases, and command and control of dispersed forces in degraded communications environments
1. Stealthy platforms deliver large numbers of small, short-range decoys and inexpensive PGMs to temporarily deplete enemy defenses.

2. Creates window in time and space to allow other PGMs reach targets.

**Benefits:** Increase probability that salvos of today’s PGMs would penetrate enemy defenses and reach their designated targets

**Challenges:** Coordinating strike operations across platforms and domains; coordinating operations between individual weapons
Salvos of loitering PGMs with autonomous target attack technologies and weapon-to-weapon datalinks:

- Self-select best weapon-target matches
- Synchronize arrival to saturate enemy sensors & overwhelm defensive capacity
- Compensate for PGMs lost to defenses to ensure all targets are hit

Future cruise missiles autonomously share info on status of targets and enemy defenses
**Benefits:** Enables penetrating platforms to deliver weapons despite more lethal point defenses protecting targets; may increase PGM PA by reducing warning time

**Challenges:** Using very large, long-range standoff weapons would reduce salvo size
Recommendation: shift PGM mix toward short-range standoff attack weapons

Balance platform survivability, payload size, and PGM cost

• There may be a 100-400 nm “sweet spot” for standoff attack PGMs
  – Today, only the JASSM is in this range band

• Recommendations:
  – Modify some direct attack PGMs with inexpensive rockets or motors to extend range
  – Increase mission functionality of some standoff weapons
  – Develop and field new short-range standoff weapons
Other recommendations to increase PGM PA values and salvo sizes

**Multiple Targets per Weapon**
- Future PGMs with brilliant submunitions
- PGMs with HPM or other RF warheads

**PGMs for Hard or Deeply Buried Targets**
- Boosted penetrators
- Energy-dense explosives to increase penetration with multiples less weight

**Swarming and Miniaturization**
- Small, loitering weapons capable of cooperatively swarming targets from multiple directions
- Miniaturized PGMs to increase salvo sizes

**High-Speed / Hypersonic (Mach 5+) Weapons**
- Increase PGM survivability, reduce target location errors
- Possible sweet spot: Mach 6 for air-breathing weapons, size/range similar to JASSM to ensure they fit in bomber weapon bays
• The U.S. military is losing its precision strike monopoly

• Salvo competitions could greatly increase PGM and platform (not just strike platforms!) requirements

• Reverting to using much larger numbers of weapons and sorties in future strike campaigns would be very challenging if not infeasible

• DoD’s weapons mix appears to be best suited for operations in permissive environments
Smart investment in future PGM mix needed

- Less than 0.5% of DoD’s budget on average allocated to PGMs
- Most of the FY16 increase is for direct attack weapons
Need capabilities that will “bend the curve”

- Maximize PGMs per payload: Short-range standoff, small/miniatuized
- Multiple targets per weapon: Brilliant submunitions, non-kinetic warheads
- Increased survivability: Hypersonic speeds, self protection features
- PGMs for challenging targets: Loitering, autonomous, enhanced penetrators
- Multi-mission PGMs: Increase flexibility and responsiveness of strike platforms
Questions