Progress, Challenges and Way Ahead for the Navy Insensitive Munitions Program

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Outline

- Introduction
- Background
- Process Changes and Needs
- Technology Progress and Challenges
- Summary

Introduction

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- **US Navy recognized need for IM many years ago**
- **Concentrated efforts for less sensitive explosives in the 1950's-60's**
- **Aircraft carrier incidents during the 1960's/1970's accelerated IM efforts**
- **Significant progress thus far**
  - US Navy has Qualified/Final (Type) Qualified more than 20 PBX formulations
  - Composite motor cases with HTPB or HTPE propellants offer potential IM improvements

Background

- **IM Advanced Development (IMAD) Program**
  - US Navy's focused effort to demonstrate and transition IM technology to weapon programs

Background

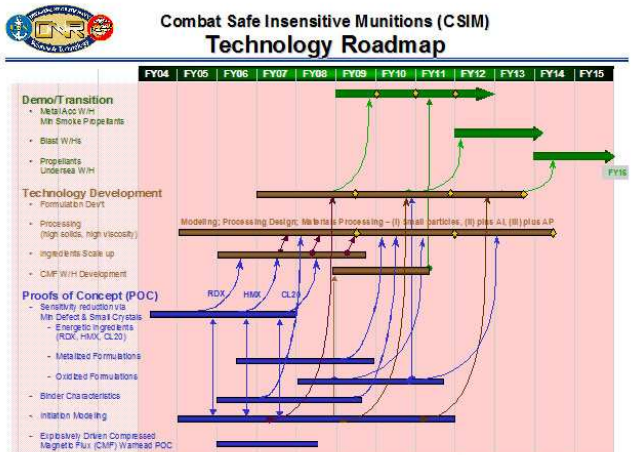
S&T

6.1/6.2/6.3

DoD & ONR

Example:

CSIM, 6.2



IMAD 6.4

NOSSA Mgmt

NSWC IHD Explosives

NSWC DD Ordinance

NSWC WD Propulsion

NSWC IHD Gun Propulsion

6.6/6.6 PIP

PEO IWS, LMW, SUB, W, A&T

FLEET

Progress to Date

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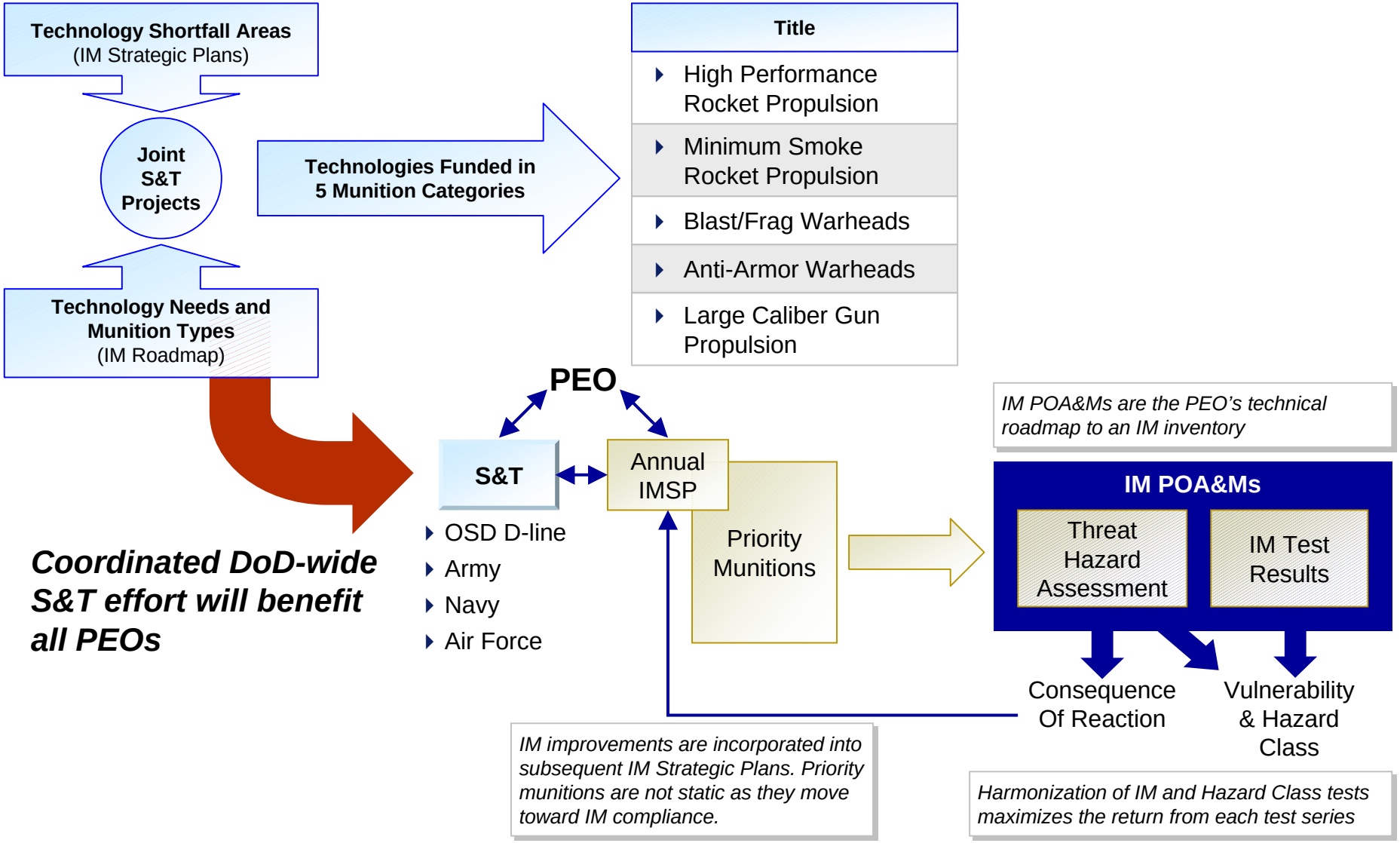
Technology Applications	In-Service Systems
General Purpose Explosives PBXN-109	General Purpose Bombs; Penguin; BLU-118/B
Metal Accelerating Explosives PNXN-9 PBXIH-135 PBXN-10 PBXW-11 PBXN111 PBXN-112	HARM; Tomahawk; STANDARD Missile; MK50 Torpedo; Hellfire; Anti-Personnel Obstacle Breaching System (APOBS); JSOW (BLU-97/B Warhead); SMAW; Phoenix; TOW; MK54 Naval Gun Ammunition; ERGM/Excalibur' WAM-Hornet; Mongoose; AGS LRLAP
Underwater Explosives PBXN-103	Mine Neutralization Devices; MK50 Torpedo; Sonobuoys
Reduced Smoke Propellants	Penguin, Evolved Sea Sparrow Missile (ESSM); Sidewinder
Ordnance Design (e.g., stress risers, eutectics)	Tomahawk; Penguin
Rocket Motor Mitigation Technology	AMRAAM; HARM
Containers, Barriers, and Shielding	Standoff Land Attack Missile (SLAM); MK50 Torpedo
Booster, Lead, and Primary Explosives	STANDARD Missile; GP Bombs

Process Changes



Improved M&S

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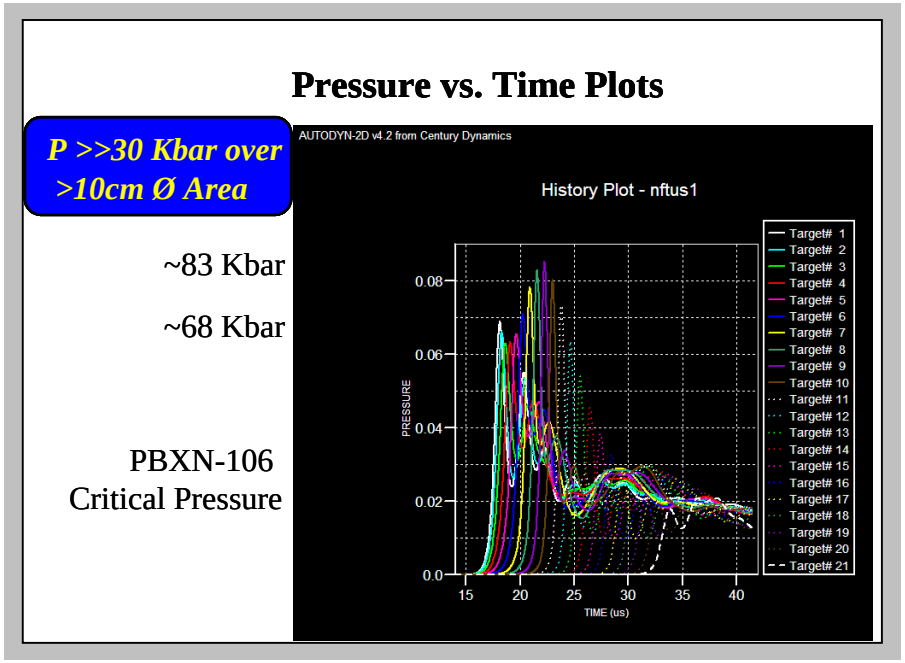
- Need robust modeling to correlate full-scale IM tests to affordable small-scale tests.
- Modeling and small-scale testing will improve confidence in limited number of IM tests that are run today
- Need increased collaboration, leveraging investments



- Utilize existing tools to assess current IM M&S tools
- Conduct phenomenology tests
- Apply conventional engineering analysis in conjunction with M&S tools as appropriate

Enhanced T&E

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- Improved T&E methods
  - Offer greater insight into reaction phenomena and increased understanding regarding the physics of IM reactions
  - Standardized IM tests within NATO
  - Standardization Agreements (STANAGs) contributed to a common approach
    - Test results can be compared across the international community
  - Additional benefits accrue from increased harmonization between IM and Hazard Classification (HC) testing

- Need to develop standardized quantitative methods to assess reaction levels

Navy PEOs' IM Technology Needs

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- **Rocket Motors and Propellants**
  - Less Sensitive Propellants
  - Less Sensitive Oxidizers
  - Propellants w/Reduced Perchlorate Content
  - Min smoke propellants with low operational temp & high burn rate
  - Extinguishable Propellants
  - Low-Velocity Fragment-Producing RM Cases
  - Venting Technologies for FCO & SCO
  - Energy Management [subset of less sens prop]
  - Advanced composite cases (e.g., high temperature resins, high performance fibers, delaminating/decomposing)
  - Large diameter rocket motors
  - Advanced RM Igniter/Arm-Fire Devices
  - Thin-coat Internal Insulation for Aero Heating
  - Techniques to Correlate Aging Data to Changes in IM
  - Replacement for Butarez propellant binder
  - Annular grain designs

- **Systems Design**
  - Advanced venting systems
  - W/H & RM Design – Integrated Venting/ Shielding/ Mitigation
  - Composite/Hybrid Case Designs with Venting

- **Explosives and Warheads**
  - Improved explosives that have reduced shock and impact sensitivity
  - New underwater bulk charge explosive
  - Outgassing / reactive liners
  - High Energy Binders
  - Low-Cost Energetic Molecules for HE
  - Advanced venting systems with stress risers, vent plugs and/or aluminum base plates
  - Predictive Modeling & Simulation
  - Advanced initiation / fuze components

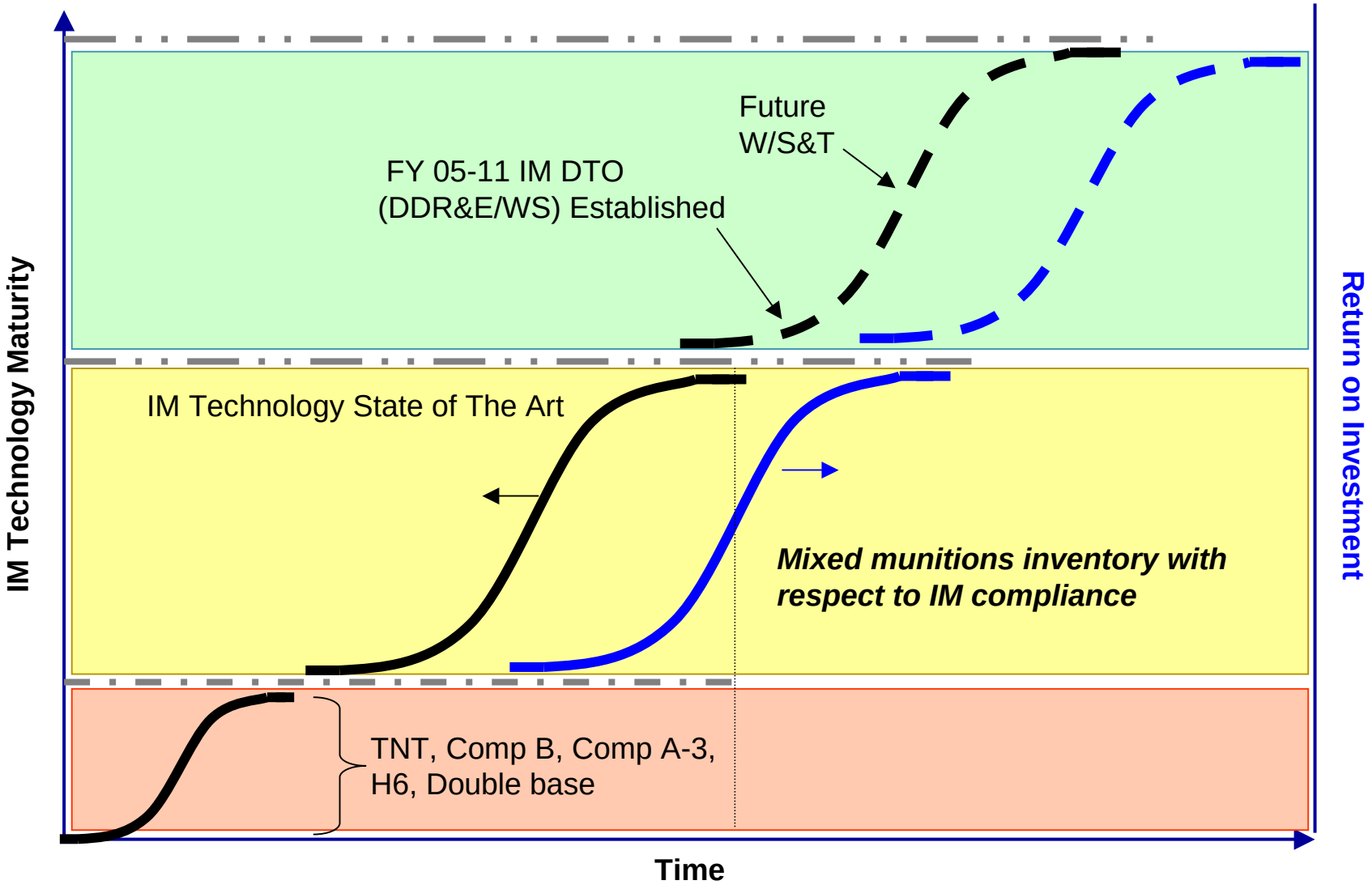
- **Gun Propulsion**
  - IM-Compliant Gun Primers
  - Less Sensitive Single & Double-based Gun Propellants
  - Thermal Ignition-Resistant Gun Propellants
  - Thermally active ingredients f/Gun Propellants

- **Transportation and Storage**
  - Lightweight Barriers/Shielding
  - Lightweight Venting & Mitigation Concepts
  - Improved barrier materials.
  - Advanced packaging materials
  - Integrated Tech – Packaged/ Unpackaged Systems

IMAD Thrusts

IM Technologies	Potential Weapon Transitions
High Explosives ▸ Scale-up and demonstration of new melt cast formulations ▸ Scale-up and demo of advanced PBXs ▸ BDNPN-RDX replacement	BLU-110/111; Penguin; JSOW Unitary; Harpoon; JDAM; Tomahawk BLK IV; GBU-24B/B; Hellfire AGM-114M; MK 80 Series Bombs; FOTS; Javelin; Predator; SMAW; Sidewinder; 5”54 Gun Ammo; 155mm Artillery; 76mm Gun Ammo; Torpedoes
Propellants and Propulsion ▸ Develop new binder systems for HTCE propellant ▸ Evaluate high energy density materials ▸ Evaluate non-aluminized propellants (non-AP) ▸ Scale-up baseline high performance propellant [HTCE-based, aluminized, reduced smoke	STANDARD Missile; ESSM; Harpoon; Tomahawk; 2.75” Rocket Motor; Predator; Javelin; TOW; Hellfire; Sidewinder AIM-9X; AMRAAM
Ordnance Technology ▸ Leverage advanced coating technology for gun-launched and missile systems to improve thermal protection and possibly improve blast performance ▸ Exploit S&T development in reactive liners to improve IM response in large diameter warheads	5” Navy Gun Ammo; 76mm Navy Gun Ammo; 155mm Advanced Gun System; 57mm Close-in Gun System (CIGS); STANDARD Missile; ESSM; Tomahawk; GP Bombs
Gun Propulsion ▸ Develop and transition insensitive primers ▸ Insensitive gun propellant development, demonstration and qualification ▸ Improve current case venting and closure plug techniques to increase IM performance	5” Navy Gun Ammo; 76mm Navy Gun Ammo; 105mm Artillery; 155mm Artillery; 20mm Gun Ammo; 25mm Gun Ammo; 30mm Gun Ammo; 40mm Gun Ammo

Weapon Insensitivity Gains



Summary

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IM, enhancing warfighter survivability...through system engineering