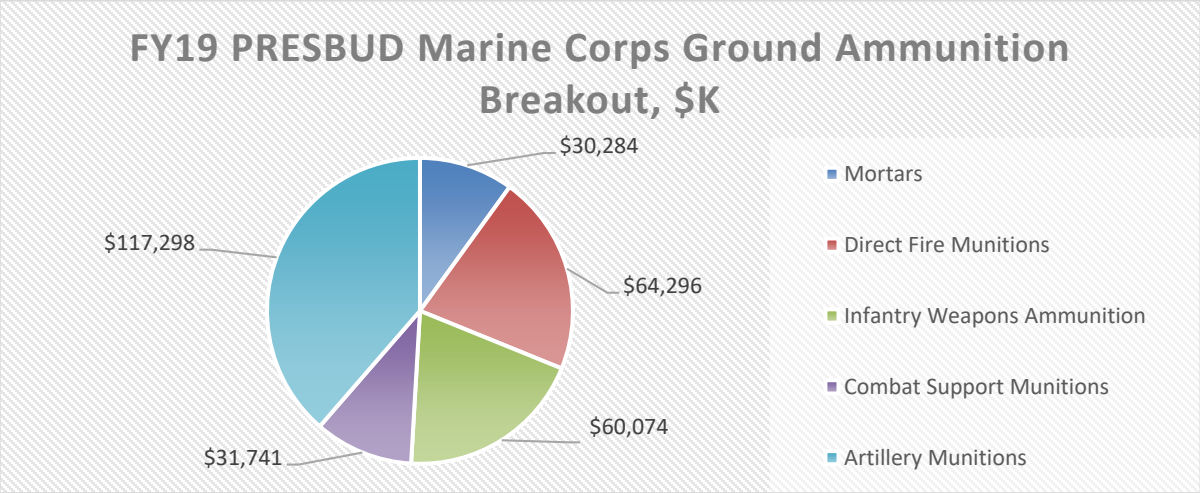
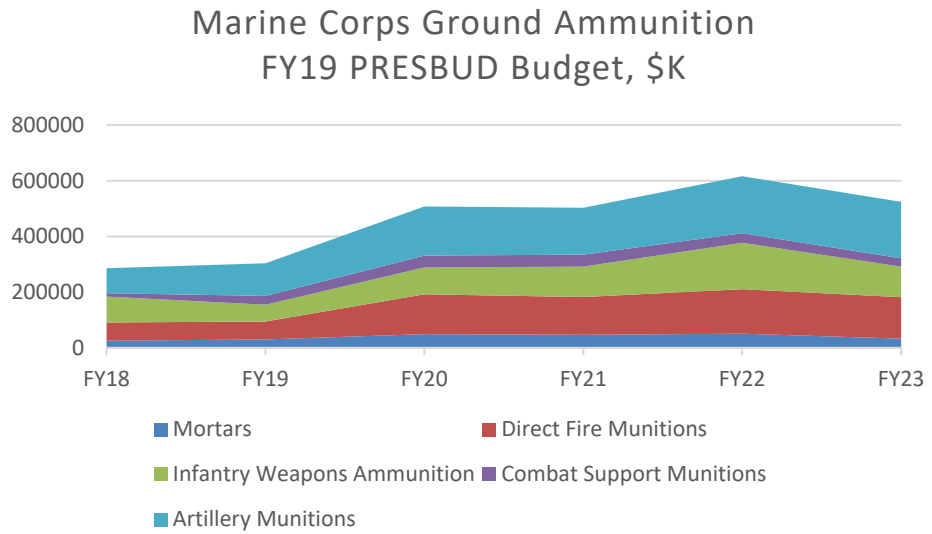
PM AMMO

April 2, 2019

Mr. Warren Clare

- Marine Corps Ammunition Budget Trends
- Quality Assurance
- Surveillance Feedback
- Additive Manufacturing
- Lightweight Ammo



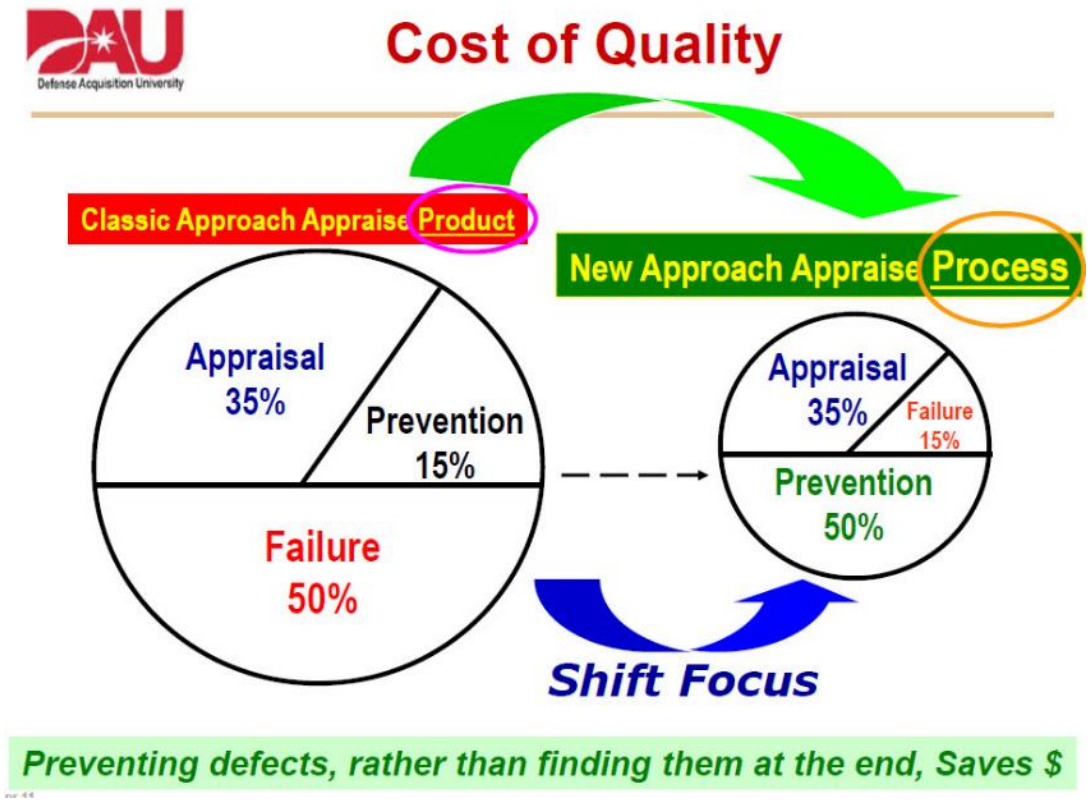


The Burning Platform:

- **Safety, reliability, and service life risks are realized decades later.**
- **Can significantly affect warfighters and operational capabilities.**
- **Challenging and unique boundary conditions of munitions:**
  - ***Variable portfolio from small arms through guided projectiles***
  - ***Long life-cycle***
  - ***Deployed globally***
  - ***Large inventories***
  - ***Velocity of the supply and logistics chain***
  - ***Single use items***
  - ***Diverse industrial base***
  - ***Federal Law***

The Approach:

- **Prevention based strategy to mitigate risks prior to acceptance or fielding.**
- **Adoption of industry best practices into the supplier quality requirements.**
- **Flexibility/scalability within requirements to align with risk.**



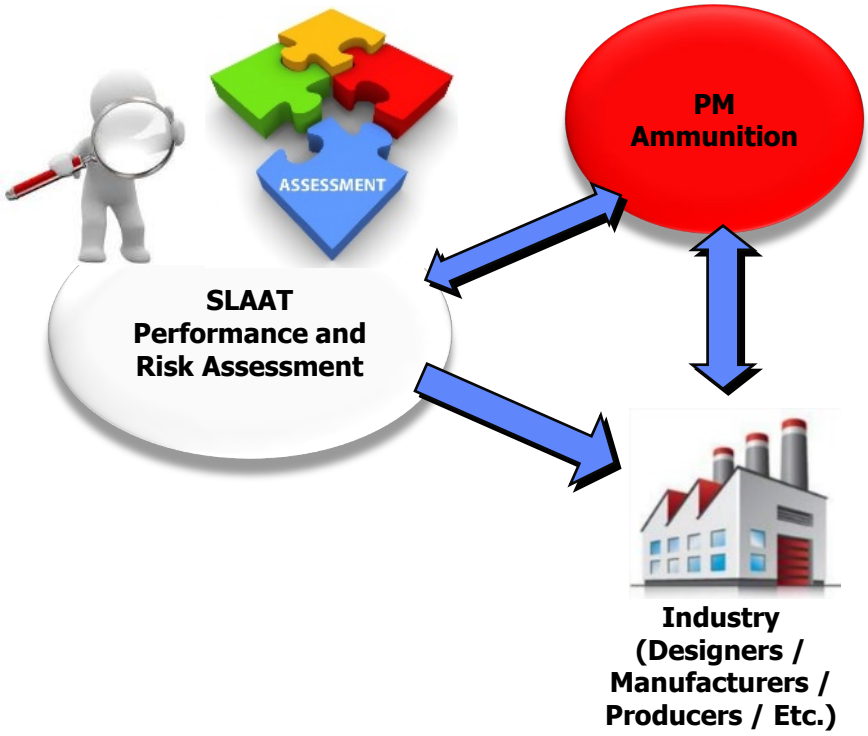
The Solution:

- **Requirements collaboration through initiatives of the military munitions community, while engaging the supplier base through industry days. Examples:**

Risk to	Mitigating Requirements	Aligned to Industry Practice
Safety	Critical Characteristics Control	- LEAN/Six Sigma - FMEA (Automotive/Aerospace)
Reliability	Process Capability, Control, & Improvement (PCCI)	- AS9100 (Aerospace) - FMEA (Automotive/Aerospace) - AIAG APQP (Automotive) - Statistical Process Control (ANSI/ISO)
	MIL-STD-1916	- ISO 9001 Quality Management System - ISO 28594:2017 (industry counterpart of 1916) - Preferred acceptance by contractor provisions, SPC, or tables
	Measurement System Evaluation (MSE)	- ISO 10012 - ANSI, ASTM, ASME, etc.
Service Life	- Energetic Materials Traceability - Ammunition Data Cards - Lot Acceptance Test data	- LEAN; transparency in the supply/logistics chain

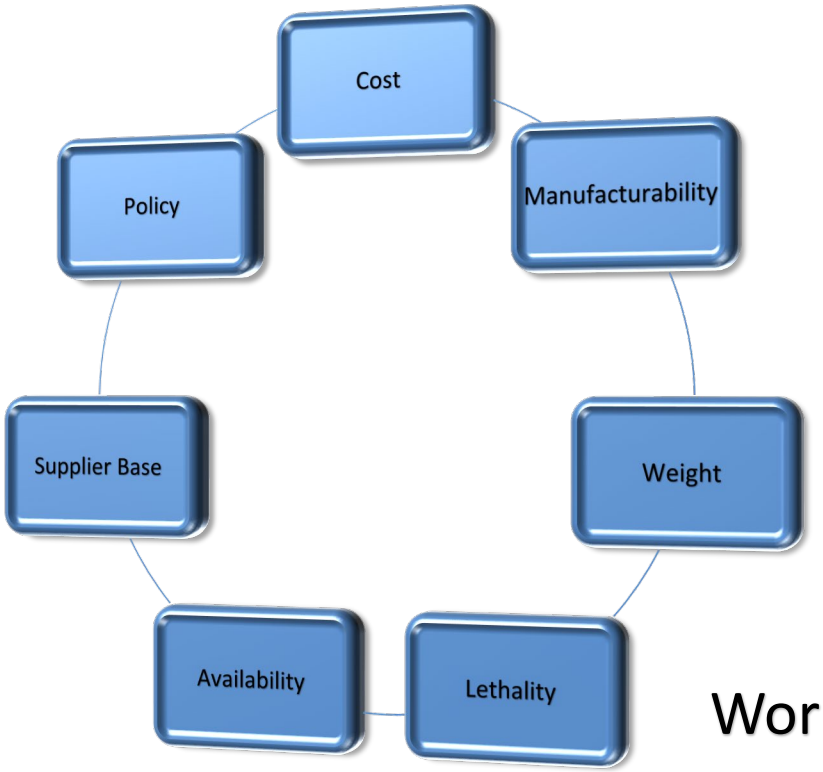
- **The USMC Service Life and Accelerated Age Test (SLAAT) Program is a methodical, process-oriented T&E program that monitors and assesses the health and reliability of 300+ USMC DODICs.**
- **SLAAT reports are made available on the Defense Technical Information Center (DTIC) www.dtic.mil**
- **Examples of SLAAT findings that identify opportunities to improve design, update specifications, renovate parts, etc.:**
  - **FY17 C869 IST indicated that for select strata, fuze renovation/replacement could eliminate excessive duds**
  - **FY17 C870 GAMs SI resulted in recommending replacement of GAMs over 6 years of age**
  - **FY17 LA45 IST resulted in recommending that the specification review/update may be necessary**
  - **FY18 ML82 SI resulted in recommending process improvements to eliminate residual debris from the solder process**

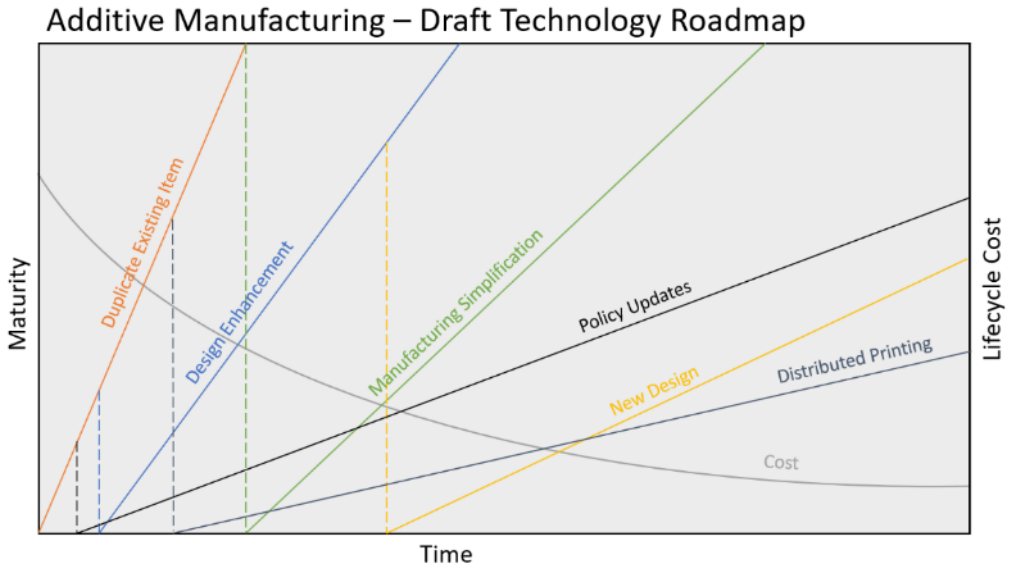
Engineering Feedback Loop



AM is a rapidly progressing manufacturing technical capability

USMC is identifying the means to apply this technology.





Working within the DoD community to assess value proposition to the ammunition enterprise.

Duplicate Existing Item

- Use existing DoD capability to print J143 rocket motor cap.

Design Enhancement

- Improve fragmentation of warhead or grenade.
- Decrease weight through incorporation of AM techniques.

Manufacturing Simplification

- Identify items that exhibit low manufacturability and use AM to produce small quantity.

New Design

- Shape charge utilizing copper impregnated filament.
- Design for additive manufacturability as a consideration.

Distributed Printing

- Use existing ASP technology to print mortar obturator rings.
- Use existing depot technology to print SMAW endcaps.
- Identify additional end items that could benefit from increased supply chain and begin small batch printing.

Mk22 Rocket Motor for MICLIC

Utilize additive manufacturing to produce rocket motor cap and nozzle

- -Reduce Cost
- -Increase Supplier Base
- -Improve Manufacturability

Mortar Obturator Ring

Utilize additive manufacturing to replace obturator in ASP or field

-Increase Availability

SMAW End Cap

Utilize additive manufacturing for end cap during maintenance at depot

-Increase Availability

LEGACY VS. LIGHTWEIGHT .50 CAL AMMO/LINKS/PACKAGING

Legacy vs. Lightweight

Legacy Round / Links

- Brass Cartridge Case
- Steel links

Lightweight Round / Links

- Polymer Cartridge Case
- Lightweight links

Cartridge Case = 4 lb. savings per 100 rd. can
Link Material = 3 lb. savings per 100 rd. can

Legacy Packaging

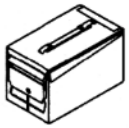
- Steel Can

Lightweight Packaging

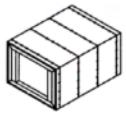
Lightweight Can = ~ 3 lb. weight savings

Weight Comparison

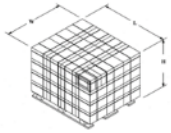
Current packaging configuration for DODIC A576 (.50 Cal 4&1 Linked), NSN 1305-00-028-6603



1 can = 100 rds. (35 Lbs.)

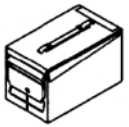


1 Box = 2 cans = 200 rds. (78 Lbs.)



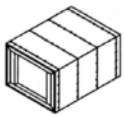
1 Pallet = 48 Boxes = 96 cans = 9,600 rds. (3,790 Lbs.)

Future packaging configuration of DODIC A576 (.50 Cal 4&1 Linked) w/
(Lightweight rounds, links and container)



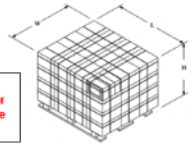
Ammo – 4 Lbs. less
Links – 3 Lbs. less
Can – 3 Lbs. less

(25 Lbs.) 29% Reduction



(58 Lbs.) 26% Reduction

960 Lbs. Lighter per Warehouse Pallet



(2,830 Lbs.) 25% Reduction

Transportation Impacts

Inter-Theater Air Resupply – Lightweight Ammo/Can = 3,840 lbs less per 463L Pallet

Intra-Theater Air Resupply – Example via C-130 with 10 pallets covering 3100 miles (EUCOM to Afghanistan)

- Legacy ammo/can = $35,837 fuel cost and refueling necessary enroute
- Lightweight ammo/can = $26,759 fuel cost and no refueling necessary
- Bottom Line - ~$9,000 in fuel savings and no need to refuel enroute

CONUS delivery (manufacturer to depot & depot to ASP)

- Legacy ammo/can = 10 pallets per truck
- Lightweight ammo/can = 14 pallets per truck
- Bottom Line = Every 4th truck is eliminated (Significant SDT Savings)

Shipment of 20' ISO Container from CONUS to EUCOM

- Legacy ammo/can = 8 pallets per container
- Lightweight ammo/can = 12 pallets per container
- Every third container is eliminated
- Bottom Line - Cost savings per eliminated container = ~$22K

Operational Impacts

- Aircraft can stay "on station" longer
- Marines will have more stamina / can carry more ammo
- Supports future UAS deliveries
- Reduces aircraft fuel costs
- Reduces commercial/tactical vehicle fuel costs
- Reduces MHE "wear & tear"