Maintaining System Viability for the Long Term

Paladin/FAASV Integrated Management (PIM)

10th Annual NDIA Systems Engineering Conference
San Diego, California

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- M109 family of vehicles
- The rise of sustainability/support issues
- Synchronizing goals
- Paladin/FAASV Integrated Management (PIM)
- Project organization
- Engineering challenges
- Conclusion

M109 FOV Evolution

1950's Design

1950's Technology Still Resides in a Large Portion of the Platform

1963 M109

- 25 Caliber "Short Tube" Range 15/20 Km

1973 M109A1

- 39 Caliber Cannon Range 18/24 Km

1978 M109A2/A3

- RAM & Safety Improvements
- A2-New Build
- A3-Upgrade

1982 M992

1992 M992A1

- LHR Engine
- XTG 411-4 Transmission
- Stacker Removal

1992 M109A5

- A4-NBC/RAM Improvements
- A5-New Cannon (24/30 Km)

1994 M992A2

- GPS Integration
- Improved Engine Fire Extinguishing
- Stowage Improvements
- Up-Powered APU

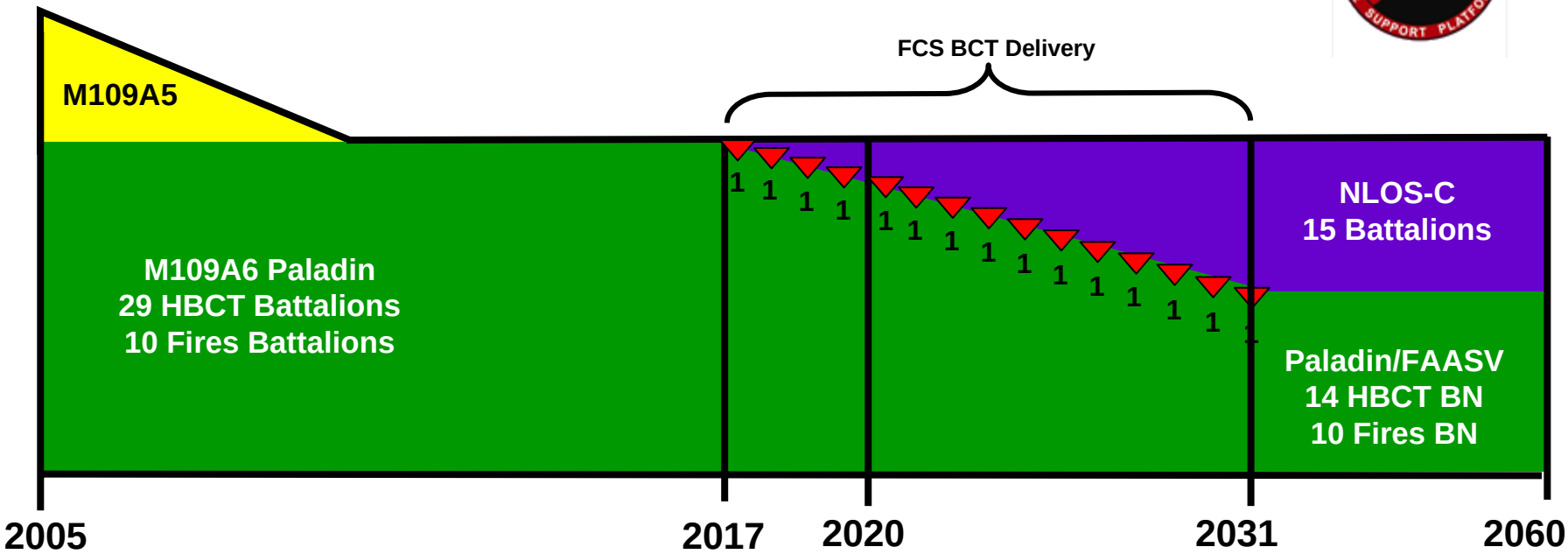
- Digital Fire Control System
- Automated Gun Laying
- Onboard ballistic computation
- Inertial/GPS navigation

1993-Present M109A6

Changing Environment

- Through the 1990's the expectation was that Crusader and Re-Supply vehicle would replace the Paladin/FAASV by 2008
- Long-term design sustainment of the M109 FOV was not required
- In 2002, the Future Combat Systems Non-Line of Sight Cannon (NLOS-C) replaced the Crusader in Army development plans; M109 family was still expected to be supplanted by NLOS-C
- Army Decision Point 41.1 dictated a path to a modular force comprised of a mix of current force and future force components, with platforms viable and sustainable through 2050
- Long-term sustainment of Paladin again became a requirement

SPH Distribution Plan



- **Fully Sustainable Paladin/FAASV Baseline required to support the HBCT**
- **Must be Interoperable With Future Force – Will fight together**
- **Must keep pace with Bradley & Abrams – maintain operational relevance**

Significant challenges with obsolescence; very limited growth potential;
On the verge of becoming unsustainable

Trends & Drivers

- **Downward Readiness Trend:**
Total Army	Average
FY04-05	93.1%
Last 12 Mos	90.7%
  - Data Gathered From Logistics Integrated Database (AMSAA)
- **Vehicle Age Versus Maintenance Costs and Burden (14 yrs vs. 8 yrs)**
  - 73% Increase in Maintenance Costs
  - 142% Increase Maintenance Burden
  - Data Gathered From SDC at Ft. Stewart & Ft. Hood

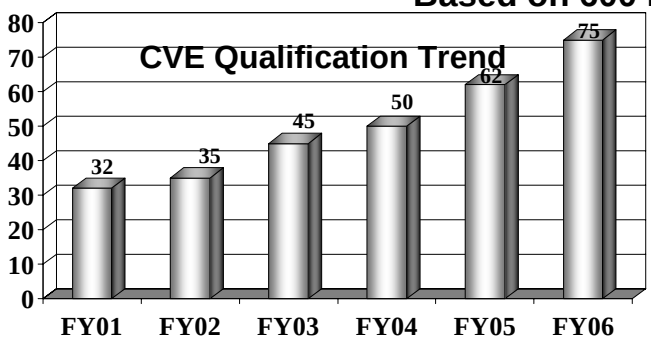
Decreases at 5 of 6 Location For Last 12 Months

Europe	NG	FORSCOM	2ID	SWA	TRADOC
92.7%	95.2%	93.4%	92.6%	89.0%	92.3%
94.1%	92.3%	91.3%	87.8%	86.4%	73.8%

Ft. Stewart	Ft. Hood	NTC
94.7%	91.1%	90.4%
93.7%	90.5%	88.6%

Location	Ft. Hood	Ft. Stewart
Vehicle Age	14 yrs	8 yrs
* Maint Action Per Year	24	14
Manhour Per Maint Action	9.8	7.2
* Maint Cost Per Year	$11,754	$6,798
* Maint Manhour Per Year	235.2	97.2

*** Based on 600 Mile OPTEMPO Per Year**



Sustainability: Paladin/FAASV Component Age

- **Vehicle Chassis and Major Component Designs Over 45 Years Old (TDP developed in late 1950's/early 1960's)**
- **Vehicle Design Life 20 Years**
- **M109 First Fielded in 1963**
  - All M109A6 Paladins Built on Refurbished M109 Chassis
- **M109 Major Component Age**

Basic M109 – Circa 1965

Average Age

1. **Based on Paladin Production Data at York/LEAD**
2. **Based on Serial Numbers of Chassis Inducted Into LEAD Production, Analyzed Against OEM Production Records (A2) & Historical Data from TACOM (A0 & A1)**

Average Age		Calendar Year 2006	2025	2050
	Cab / Paladin Unique Items [1]	**9**	**28**	**53**
	Chassis / Re-Used Parts [2] e.g. ▪ **Chassis Structure** ▪ **Transmission** ▪ **Road-Arms** ▪ **Final Drives** ▪ **Rammer / Elevating Cylinder**	**36**	**55**	**80**

1990's Design (Post Desert Storm)

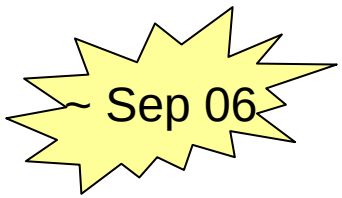
1960's Design (Vietnam Era)

Perspective

- Competing priorities have limited Army/OEM investment in Paladin
- HBCT-centric approach brings focus & visibility
  - Three legs to the stool – Tanks, Bradleys & Paladin
  - Acknowledgement that like Bradley & Abrams, Paladin will be in the fleet for foreseeable future
- Efforts coming together – positioning program
  - Dedicated program to maintain fleet at acceptable average age
  - Formal establishment of “Paladin Integrated Management” (PIM) line
- Sync between Combat Developers, Material Developers & OEM

Prioritized Goals

- PM Priorities
- Support the fight
  - Reset
  - Excalibur
- Sustain the fleet
  - PDFCS/APU/MACS Retrofit
  - RESET/RECAP
  - Mitigate Obsolescence
- Build the future
  - Modularity fieldings
  - Develop PIM program
  - Spin-out / tech insertion



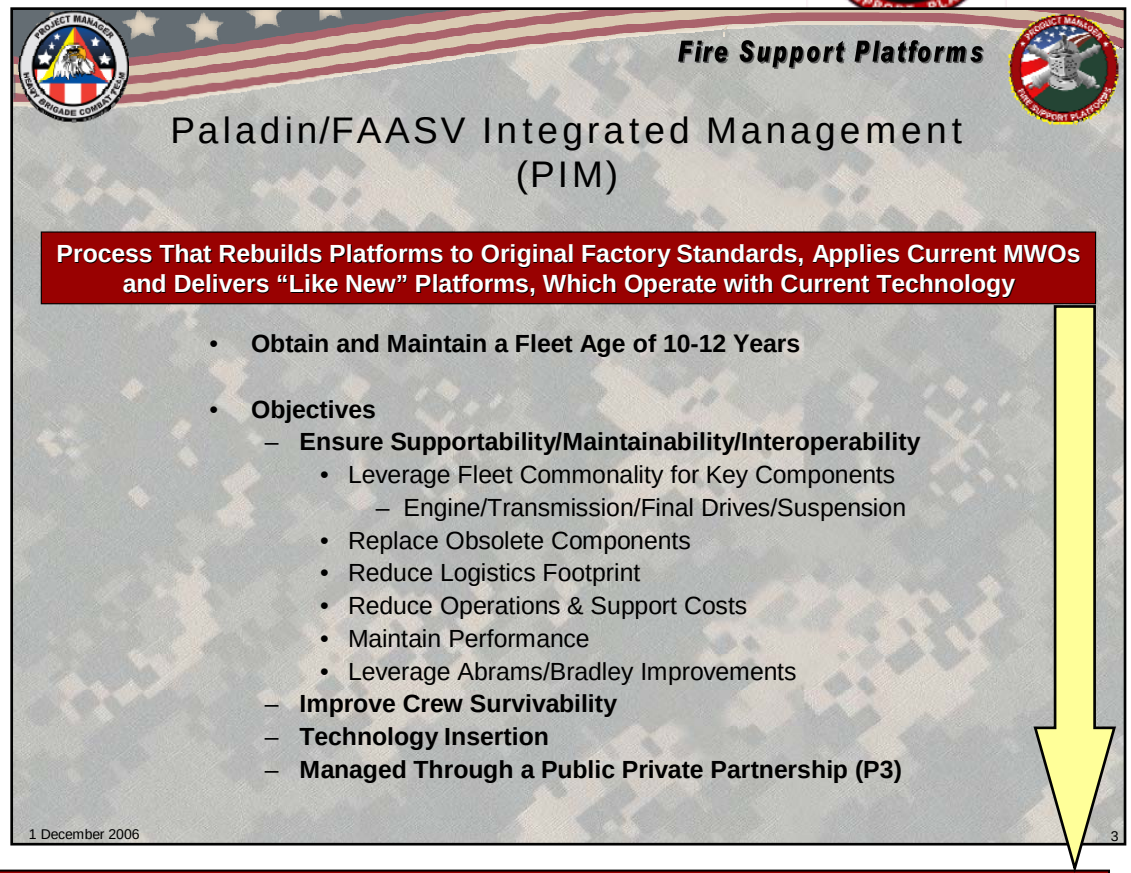
TCM Priorities

- Survivability
- Power train
- Suspension
- Power Management
- Digital communications (cab - hull)
- Rammer Improvements
- Vehicle Health Management

Challenge: convert 1-N list into manageable Army program

Paladin Integrated Management (PIM)

- Specific program & plan to address long-term viability of Paladin
- Keyed to HBCT (read Bradley) commonality
- Leverages FCS/NLOS technologies as appropriate



Process That Rebuilds Platforms to Original Factory Standards, Applies Current MWOs and Delivers "Like New" Platforms, Which Operate with Current Technology

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PIM Strategy

- Many Issues are Inter-Related; Requires Total Weapon System Approach (vice individual efforts to solve point problems)
- PIM Strategy IAW DP 41 (Viable & Sustainable Platforms beyond 2050)
- Provide Viable Life-Cycle Solution Beyond 2050
- Design, Test, and Qualify an Affordable Alternative Structure Around Selected Components
- Current Planning Leverages Commonality With HBCT e.g.
  - Bradley Common Track, Engine, Transmission, etc
  - Eliminate Hydraulics (Except Recoil System)
  - Vehicle Health Management
  - Reduces Logistics Footprint, O&S Costs & Development Time/Cost

Rebuilds Platform, Applies Current Modification Work Order's (MWO) and Delivers a Ready, Relevant and Sustainable Platform

PIM Howitzer Features

Achieving Sustainability via HBCT Commonality

LEGEND
- Bradley Common
- NLOS common
- Common Modular Power System
- Paladin/FAASV

ISCS - Individual/Spot Cooling System (improved MCS)

CREW 2

COS Cupola TAGS

Armament
- 39 caliber/ 155 mm (Paladin)
- Travel Lock (Paladin)
- 600V electric rammer (NLOS)

Gun Drives
- Integrated with PDFCS
- 600V Electric Elevation drive (NLOS)
- 600V Electric Traverse drive (NLOS)
- Electric Joysticks
- Manual Gun Drive backups

Electrical System
- 600V, 70 kW Integrated Starter / Generator (CMPS)
- 600V – 28V Bi-Directional conversion (CMPS)
- Cable Management for power & reliable high data transmission capability between Cab & Chassis

Electronic Systems
- PDFCS
- DRU-H
- VHM

Power Train
- Engine 600 HP (BFV)
- Transmission HMPT 500-3ECB (BFV)
- PTO (upgraded BFV-style)
- New Cooling system
- Engine Compt AFES (FAASV)
- Final drive (BFV)

Blue Force Tracking
- P3I for BFT

Chassis (new structure)
- Additional ground clearance
- Structure integrity (71500 lbs GVW)
- Provisions for Mine Blast kit and side Armor

Driver's Compartment
- Shift Tower (BFV)
- Brakes (BFV)
- Steering (BFV/Paladin)
- Seat (BFV/Paladin)
- Hatch – larger diameter than Paladin
- Composite Armor
- Instrument Panel (BFV/M109 & Digital Display)

Suspension &Track
- 6 Road Arm Stations (BFV)
- Torsion Bars (BFV)
- 4 Rotary Dampers (U2)
- Track 19.1" (BFV)

PIM-FAASV Features

Maximal commonality with PIM Howitzer

LEGEND
- Bradley Common
- NLOS common
- Common Modular Power System
- Paladin/FAASV

Mission Equipment
- Projectile Racks (FAASV)
- MACS Stowage (FAASV)

Cupola TAGS

CREW II

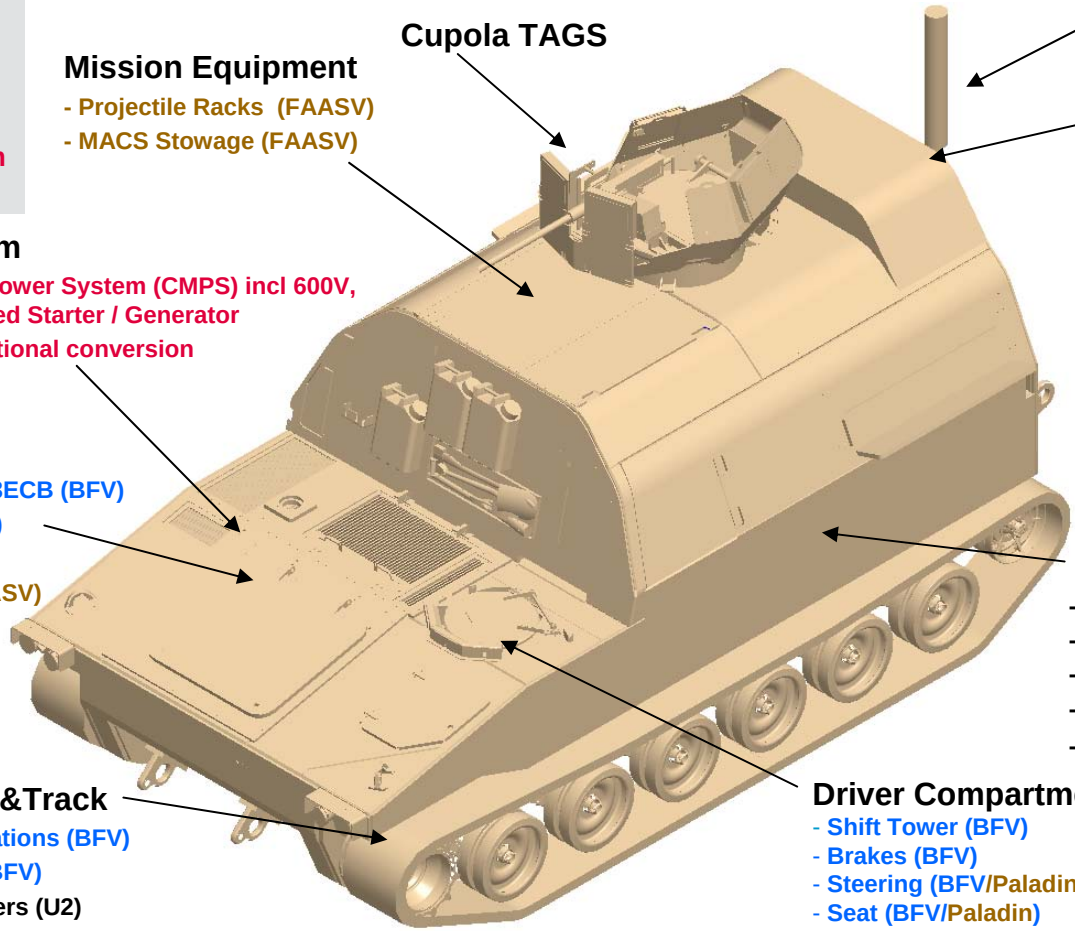
ISCS - Individual/Spot Cooling System (improved MCS)

Electrical System
- Common Modular Power System (CMPS) incl 600V, 70 kW Integrated Starter / Generator
- 600V – 28V Bi-Directional conversion

Crew Compartment
- Crew seating (FAASV)
- Rear door (FAASV)
- Crew AFES (FAASV)

Power Train
- Engine 600 HP (BFV)
- Transmission HMPT 500-3ECB (BFV)
- PTO (upgraded BFV-style)
- New Cooling system
- Engine Compt AFES (FAASV)
- Final drive (BFV)
- Easily accessible Air Cleaner Filter

Blue Force Tracking
- P3I for BFT



Chassis (new structure)
- Lower Chassis common with SPH
- Provisions for Mine Blast kit & Side Armor
- Additional ground clearance
- Flat Floor in rear
- Structure integrity (71500 lbs GVW)

Suspension &Track
- 6 Road Arm Stations (BFV)
- Torsion Bars (BFV)
- 4 Rotary Dampers (U2)
- Track 19.1” (BFV)

Driver Compartment
- Shift Tower (BFV)
- Brakes (BFV)
- Steering (BFV/Paladin)
- Seat (BFV/Paladin)
- Hatch – larger diameter
- Composite Armor (Paladin)
- Instrument Panel (BFV/M109 & Digital Display)

Electronic Systems
- Power Management (CMPS)
- VHM

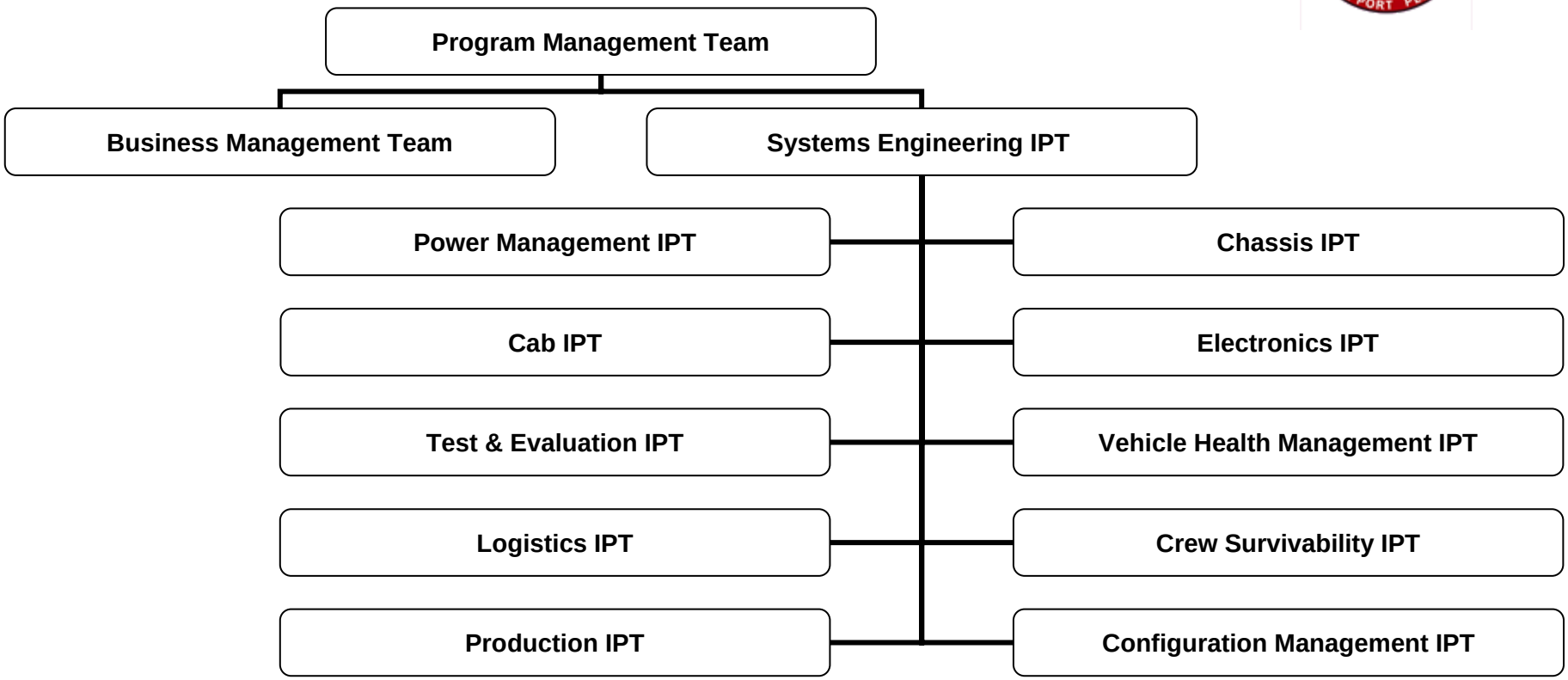
IR&D Prototype – October 2007

PIM System Development Approach

- Total system approach vs. point solutions for individual problems (typical STS task order-approach)
- Design approach is that of a Systems Integration problem vs. a development problem – IPTs to use HBCT-common solution where one exists
- HBCT commonality of subsystems provides lower development and acquisition costs than a new unique design

Public-Private Partnership: Industry-Government collaboration with common goals & objectives sharing successes and failures

PIM IPT Hierarchy



- Each IPT is jointly chaired by Government and Industry leads
- Core and ad hoc / supporting members are identified in IPT charters
- IPT Core membership includes key suppliers

SE Challenges in a Sustainment Project

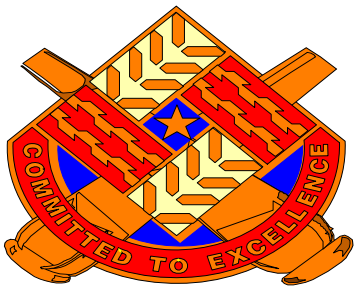
- Baseline Requirements Set may be Incomplete
  - e.g., off-road mobility requirement not explicitly defined
- User can Become Accustomed to or Reliant on Features that are not Defined in the Requirements Baseline
- Design Baseline Documented to Old Documentation Standards
  - e.g., DOD-STD-1679 Software Documentation
  - e.g., Ada Programming Language
- Design Baseline Developed and Tested using Lower-Maturity Processes and Standards
- Performance baseline developed to old mission profiles
  - e.g., Fulda Gap vs. SW Asia
  - May Require Updated or New Mission Profiles

Summary

- PIM leverages components, systems and proven technologies available today to ensure that the Paladin/FAASV fleet remains ready, relevant and sustainable beyond 2050
- HBCT commonality reduces development, acquisition and sustainment costs
- The PIM Public-Private partnership leverages the strengths of both public and private sectors in an open, collaborative process

Partnering for the Soldier

Paladin Enterprise – Leveraging Best of Public & Private Sectors



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