ATIP

It's All About the Warfighter

Advanced Technology Investment Plan

2019 - Volume X

PEO Land Systems Marine Corps

Focusing the Future Faster

PROGRAM EXECUTIVE OFFICER
LAND SYSTEMS MARINE CORPS
ADVANCED TECHNOLOGY
INVESTMENT PLAN
2019

Executive Summary

This 10th edition of the Program Executive Officer Land Systems (PEO LS) Advanced Technology Investment Plan (ATIP) is consistent with previously published ATIPs and continues to emphasize our commitment to "Focusing the Future Faster" by leveraging available Science and Technology (S&T) venues.

The 2019 ATIP provides an update of the Top Technical Issues for PEO LS programs and has been vetted through the program managers to ensure an accurate representation of their highest priority technology needs. The ATIP is designed to inform, influence, and align S&T investments and supports concept aligned, capabilities-focused technology transitions across PEO Land Systems.

This plan is published annually and highlights the importance of collaboration and communication across the S&T Enterprise. The PEO LS ATIP is intended to be used as an informative guide in determining how your proposed solutions or technologies might best provide gap-closing capabilities to our Warfighters.

JOHN M. GARNER
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Bottom Line Up Front

This year we celebrate the 10th anniversary of the PEO LS ATIP. Over the years we have explored many themes highlighting modernization (modularity) and innovation (autonomy) but our core mission has stayed consistent—to foster collaboration, align S&T investments, and support effective technology insertion within PEO LS programs.

The ATIP identifies and prioritizes Top Technical Issues within PEO LS programs, with the goal of informing, influencing, and aligning S&T investments to resolve program technical issues and support transition of critical capabilities to the Warfighter.

Each technical issue has been thoroughly vetted through the appropriate S&T representative, lead engineer, deputy program manager, and program manager to ensure an accurate representation of each program's highest priority technology needs. The PEO LS ATIP employs a focused, repeatable process, which informs all key stakeholders, industry, and academia of Top Technical Issues within PEO LS programs.

The ATIP can also be accessed via the Office of the Secretary of Defense's Defense Innovation Marketplace website (www.defenseinnovationmarketplace.mil/ATIP.html). This site is a resource for information about Department of Defense (DoD) investment priorities and capability needs.

In an environment of fiscal austerity, changing requirements, and rapid technical innovation, being engaged and knowing with whom to discuss new ideas is vital to fostering opportunities across the S&T enterprise. With your participation, we can maximize these opportunities and help "Focus the Future Faster" for our Warfighters.

As always, we welcome any comments or suggestions to improve the usefulness of this investment plan. Please forward any suggestions or comments to me at michael.d.halloran@usmc.mil.

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Section 7.0

PEO LS PROGRAMS

Program Executive Officer Land Systems consists of seven program offices overseeing nineteen programs. The following sections discuss each of the pertinent PEO LS programs. Each program has a dedicated section that is described in the three parts listed below. The goal is to use all available S&T venues to leverage resources for PEO LS programs to close Warfighter gaps and solve program technology requirements.

Part One describes the program's background, status, and Top Technical Issues.


Section 7.5

GROUND/AIR TASK ORIENTED RADAR

G/ATOR

Program Background

Ground/Air Task Oriented Radar (G/ATOR) is an expeditionary, lightweight radar employed by units within the Air Combat Element (ACE) and Ground Combat Element (GCE) of the MAGTF. Within the ACE, G/ATOR will provide enhanced situational awareness and additional capabilities to conduct short-medium range radar surveillance and air defense. Within the GCE G/ATOR will provide ground weapons locating capability for counterbattery and counter-fire missions. G/ATOR provides real-time radar measurement data to the CAC2S, Composite Tracking Network, and Advanced Field Artillery Tactical Data System. This system contributes to sea-based air defense sensors and Command and Control capabilities to provide Naval and Joint forces with an expeditionary radar that extends landward battle space coverage.

G/ATOR is a single materiel solution for the mobile Multi-Role Radar System and Ground Weapons Locating Radar (GWLR) requirements and replaces five legacy radar systems. G/ATOR is a three dimensional, short/medium range multi-role radar designed to detect unmanned aerial systems, cruise missiles, air breathing targets, rockets, artillery, and mortars.

G/ATOR is comprised of three major subsystems: the Radar Equipment Group (REG), Communications Equipment Group (CEG) and Power Equipment Group (PEG). The REG is an integrated radar and trailer towed behind a Medium Tactical Vehicle Replacement (MTVR). The CEG is a communications and radar control system transported on the armored M1152A1 High Mobility Multipurpose Wheeled Vehicle. The PEG is a pallet assembly containing a tactical generator, cables and ancillary equipment transported on the bed of the MTVR.

Figure 7-1. Part One

Part Two is the program's quad chart, which addresses the program's fundamental information and characteristics, i.e., specific information, including a detailed program description, status, and schedule.

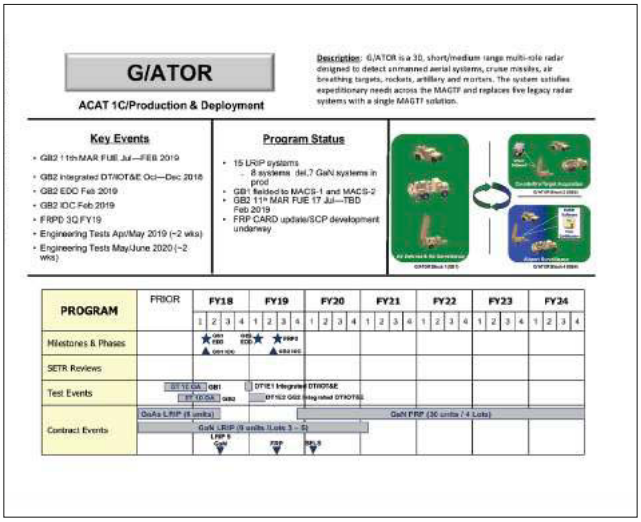


Figure 7-2. Part Two

Part Three graphically addresses the Top Technical Issues for each program. Each technical issue and related S&T projects are aligned to the current program schedule. The graphic is divided into the following four sections:

Row one identifies the program's major milestones.

Row two display's S&T initiatives that are targeted to solve the technology issue.

The dark blue diamond with a yellow number in the center depicts the expected Technology Readiness Levels (TRL) at the beginning and end of projects.

TRLs are used to measure the maturity level of the S&T activities and initiatives.

- **TRL 1** - Basic principles observed and reported.
- **TRL 2** - Technology concepts or applications (or both) formulated.

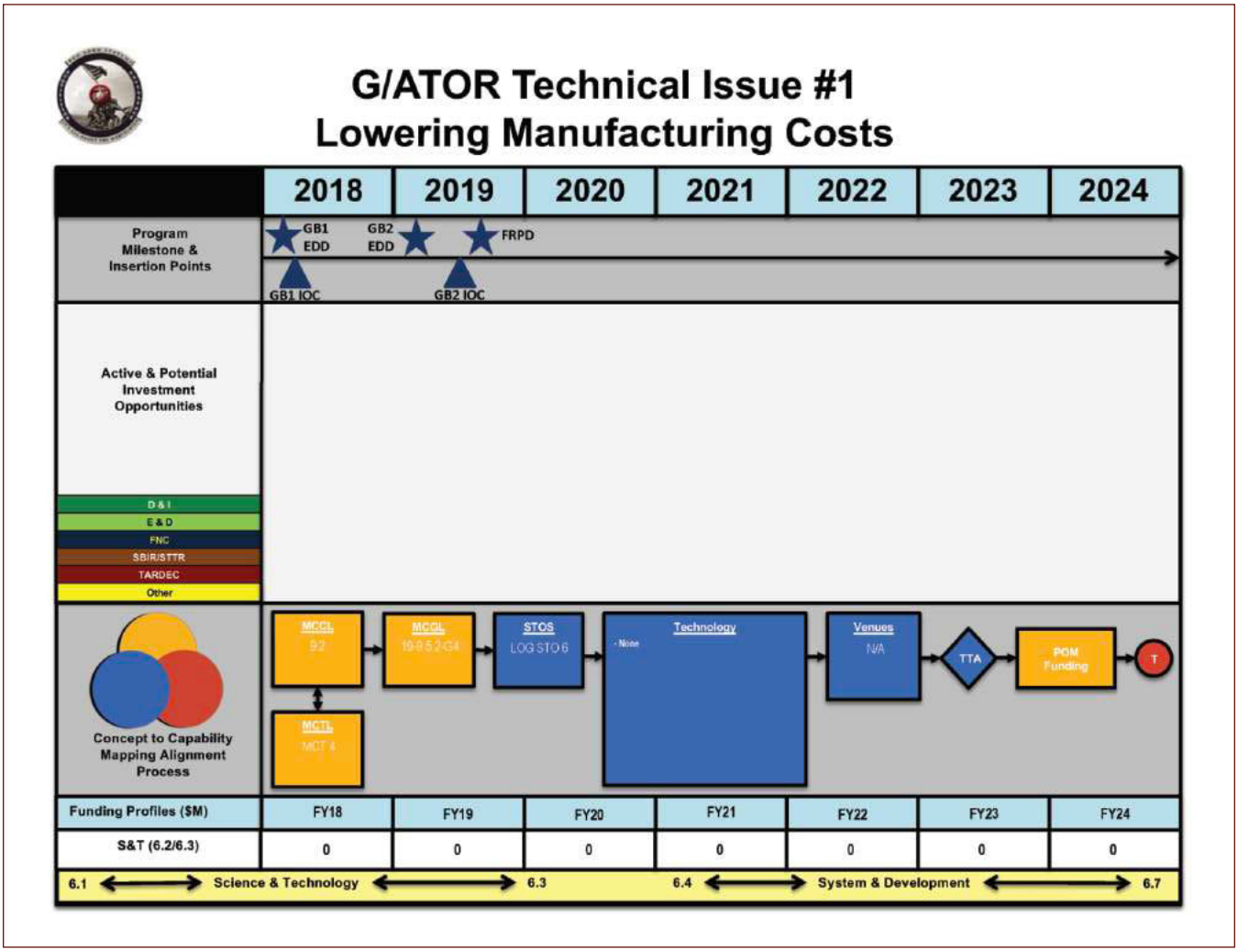


Figure 7-3. Part Three

- **TRL 3** - Analytical and experimental critical function or characteristic proof-of-concept.
- **TRL 4** - Component or breadboard validation in a laboratory environment.
- **TRL 5** - Component or breadboard validation in a relevant environment.
- **TRL 6** - System/subsystem model or prototype demonstration in a relevant environment.
- **TRL 7** - System prototype demonstration in an operational environment.

The color key on the far left side of the chart identifies the seven different types of S&T venues.

Discovery and Invention (D&I) programs consist of basic and early applied research.

Exploitation and Development (E&D) focuses on incorporating research into systems in preparation for inclusion into acquisition programs.

Future Naval Capabilities (FNC) provides the best technology solutions to formally defined capability gaps and usually leverages past D&I and E&D successes.

Small Business Innovation/Small Business Technology Transfer (SBIR/STTR) are composed of programs that are focused on small business innovation.

Tank Automotive Research, Development and Engineering Center (TARDEC), located in Warren, Michigan, is the US Armed Forces' research and development facility for advanced technology in ground systems. It is part of the RDECOM, a major subordinate command of the United States Army Materiel Command. Current technology focus areas include Ground Vehicle Power and Mobility (GVPM), Ground System Survivability, and Force Protection Technology, among others.

Other is a variety of other investment types, including projects involving the Office of the Secretary of Defense; initiatives that are sponsored by the program office, such as Phase "A" studies and congressional "plus ups"; and all those not otherwise covered. See Section 8 for a detailed list of applicable S&T venues.

Row three traces the issue from the originating Marine Corps Capabilities List, through the identified gap via the Marine Corps Gap List, to the Science and Technology Objectives that are identified in the Marine Corps S&T Strategic Plan, and other S&T venues that address the technical issue to illustrate the transition of technology to the Program of Record.

The mapping alignment process traces the technology issue/S&T initiative from the required capability to the transitioned technology. Using G/ATOR Technical Issue #1, Lowering Manufacturing Costs as an example, MCCL 9.2 identifies the capability that is associated with the technical issue. Applicable tasks identified from the Marine Corps Task List (MCTL). LOG STO-6 addresses the Logistic (LOG) STO addressing the enhanced self sufficiency for fuel. The issues are then traced through potential technologies and venues to the funded transition of that advanced technology capability. This is done for each program's top technical issue to map from the concept to the capability, identifying how to solve this technical problem, and how it can transition into a program of record.

The bottom three rows describe the funding profile associated with the S&T initiatives for each listed year.

In summary, the Advanced Technology Investment Plan captures the active S&T initiatives that are currently being pursued by PEO LS and are aligned to high-priority technical issues and capability gaps in order to "Focus the Future Faster" by delivering gap-closing capabilities to the Warfighter.

Section 7.1

ASSAULT AMPHIBIOUS VEHICLE

Assault Amphibious Vehicle

Program Background

The Assault Amphibious Vehicle was initially fielded in 1972 as the Landing Vehicle Tracked 7 (LVT7). It was subsequently renamed the AAV7 and upgraded to the AAV7A1 configuration in the late 1980s, with the last upgrade to the AAV7A1 Reliability Availability Maintainability (RAM)/Return to Standard (RS) configuration between 1998 and 2007. The AAV, which continues to be the Marines' primary amphibious lift and armored personnel carrier, provides ship-to-shore-to-objective mobility as well as direct fire support with organic weapons. The AAV FoV consists of the AAVP7A1 personnel variant, the AAVC7A1 command and control variant, and the AAVR7A1 recovery variant. The AAV is scheduled to remain in service until at least 2028 as a bridge to the fielding of the Amphibious Combat Vehicle.

Program Status

The AAV7A1 RAM/RS program entered the Return to Condition Code A (RCCA) phase during FY17 and began depot level maintenance of vehicles to a fully serviceable condition. RCCA establishes a defined approach to vehicle overhaul and favors replacement over repair of key subsystems.

PdM AAV continues to provide support to the fleet of fielded AAVs by addressing safety concerns, emerging requirements, obsolescence challenges, and fleet identified issues with system level modifications.

Upcoming efforts focus on numerous subsystems and components that will require technology refresh and/or upgrades including:

- Tactical communications modernization with radios,

- ➤ Intercoms and antennas;
- ➤ Remote weapon station;
- ➤ Hydraulics modernization;
- ➤ Recovery variant modernization;
- ➤ Suspension efficiencies;
- ➤ Power and energy management; and
- ➤ Autonomy.

The AAV Program requirements of the RCCA (modernization, modification, and sustainment) may be met with non-developmental items and mature technology. The following areas, however, offer opportunities where advanced technology could benefit the AAV.

Due to the phase the AAVs are now entering, there are less opportunities for new engineering, design, and complete testing of potential modern technology solutions. PdM AAV relies more on available non-developmental items, commercial off-the-shelf, and/or proven systems already fielded to other sources that can be quickly adapted to the current vehicles to address needed capabilities. Testing of these capabilities is focused on system integration and assessment of potential impacts to the platform.

AAV's Top Technical Issues

1. Reliability/Sustainment

The AAV is a 47-year-old platform that will remain in service until at least 2028. The day-to-day logistics, maintenance, and technical challenges of managing such a dated platform would be mitigated by advanced technology that increases reliability, and reduce operations and maintenance support costs. Advances in additive manufacturing and cold spray technologies could assist with corrosion, wear prevention, parts obsolescence, diminishing manufacturing sources, and material shortages to enhance maintenance efficiency and effectiveness throughout equipment life cycle. Alternative lightweight, economical materials that enhance safety, protect buoyancy, improve track and other running gear life and fuel consumption/energy efficiency, reduce vibration/noise, provide corrosion and maintenance-free operations could also assist with life cycle costs.

2. Autonomous

Perception sensors, remote and artificial intelligent vehicle control with near-instantaneous decision making and advanced mobility features, including obstacle avoidance, path planning, and negotiation capabilities that enable surface maneuver from ship through the surf zone, emerge and navigate ashore, and to include the support of other mission sets, package development and integration with autonomous FoV efforts.

3. Communications

Small, lightweight, and versatile antennas for both line of sight and near vertical incidence sky-wave modes non-concurrently, while on-the-move supporting tactical beyond line-of-sight voice and data.

4. Power and Energy

Intelligent power management systems, marinised power inverters, and lightweight efficient high energy storage embarkable onboard naval ships.

AAV Survivability Upgrade

Description: The Assault Amphibious Vehicle (AAV) Survivability Upgrade is an ACAT III program initiated to increase AAV7A1 force protection while maintaining required land and water mobility performance. This upgrade is derived from the need for an operationally effective amphibious armored personnel carrier capability bridge until the future amphibious portfolio of vehicles reaches full operational capability.

Key Events

Milestone C: 17 Aug 17

LRIP Lot 1 Option award: 22 Aug 17

LRIP Lot 2 Option award: 4QFY18

PCM Vehicle RGT: 4QFY18 – 1QFY19

IOT&E: 3QFY19

IOC: 2QFY20

FOC: TBD

Program Status

Acquisition Status: Production and Deployment

Acquisition Objective: 357/389

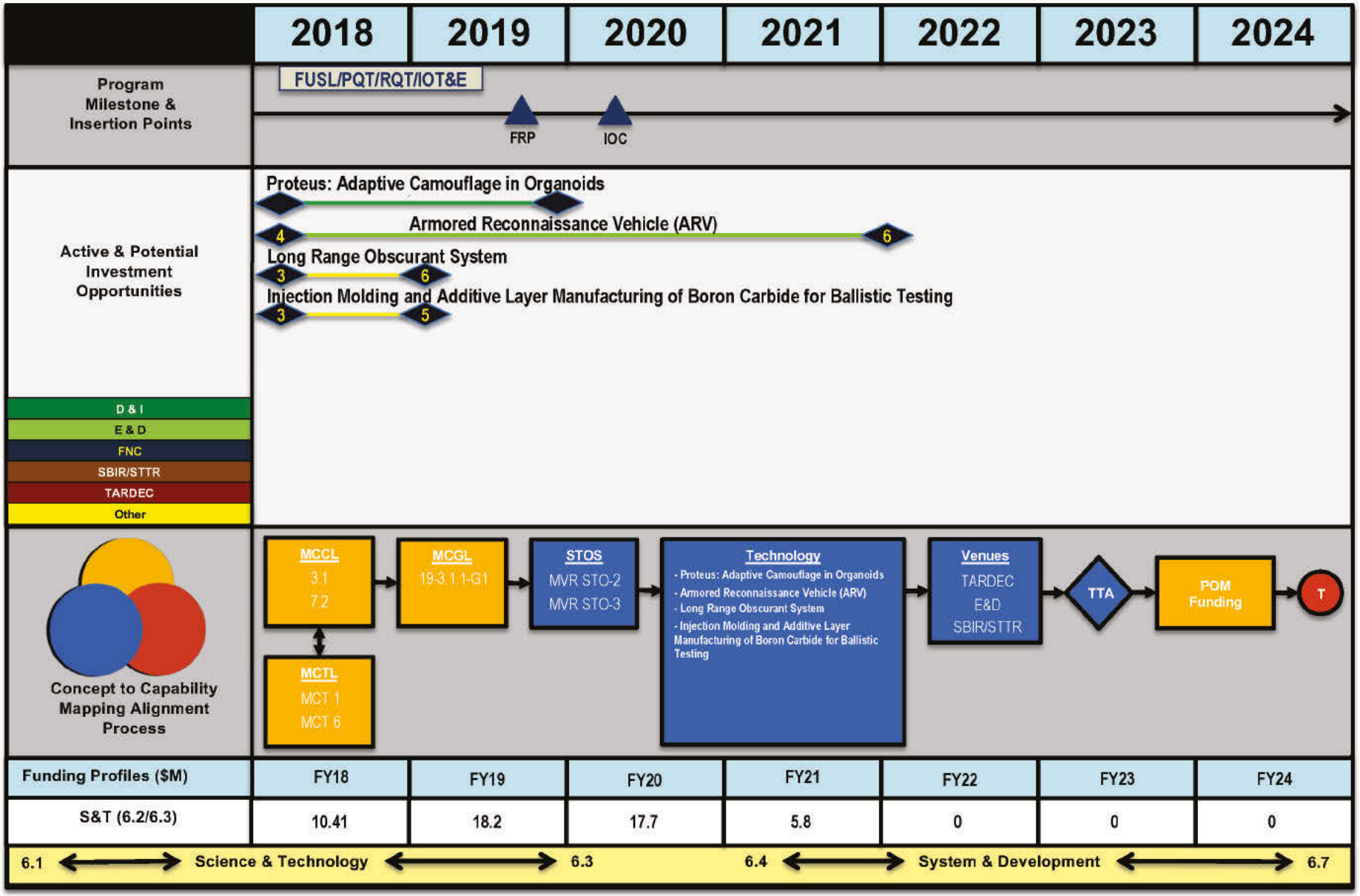
- 322 P7 and 35 C7 for a total of 357
- CPD will add AAV-C7 and 32 additional vehicles to receive partial SU (32 AAV-R7)

Comments:

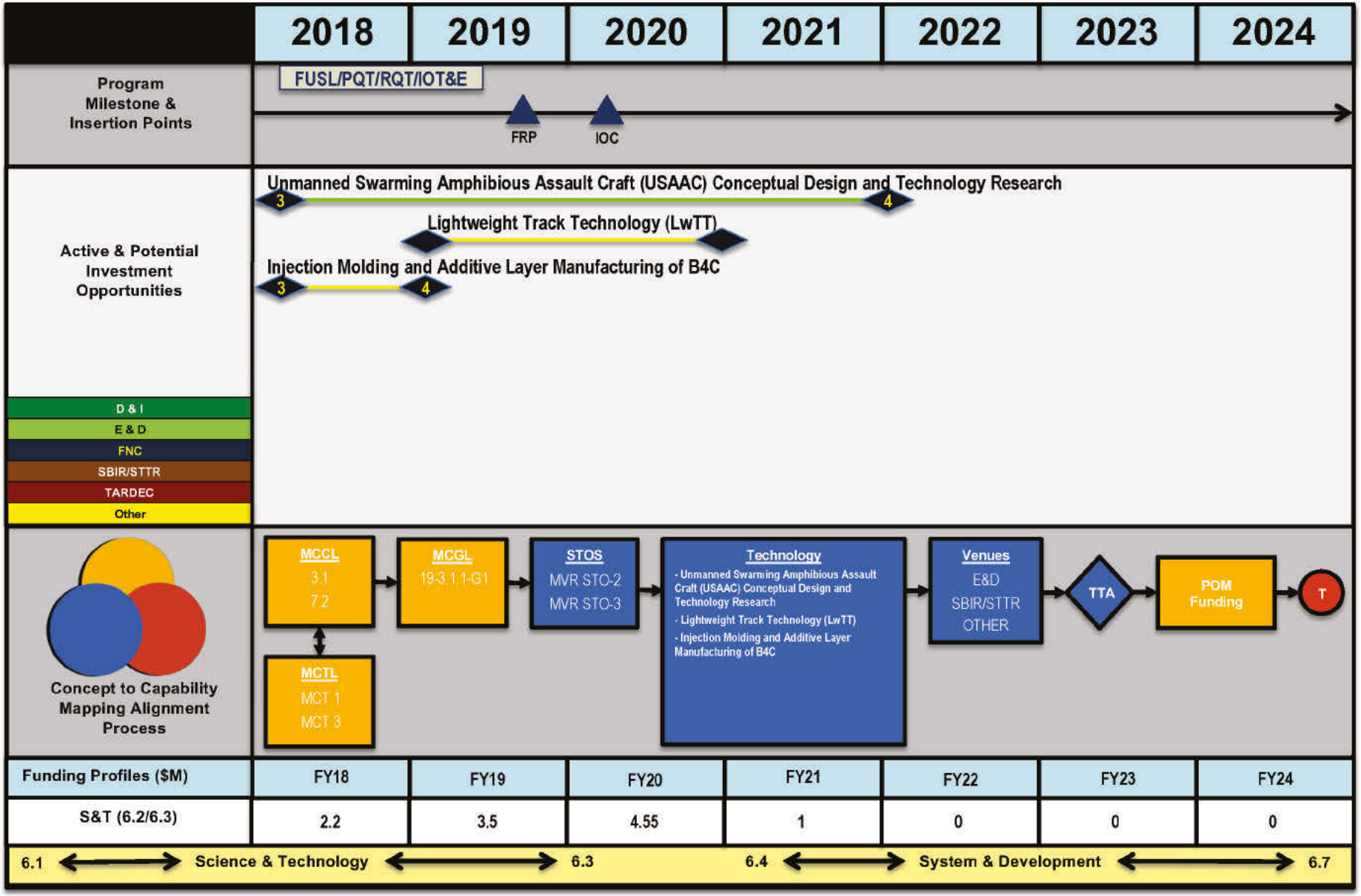
- Prototypes delivered / testing began 4QFY17
- AAO will support MEU deployments and globally source lift for 4 infantry battalions and 2 RLT command element to support a 2 MEB FEO

PROGRAM	PRIOR	FY18				FY19				FY20				FY21				FY22				FY23				FY24			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Milestones & Phases									FRP		IOC																		
SETR Reviews																													
Test Events				RGT	FUSL				C7 PQT/RQT LFT&E		C7 IOT&E																		
				PQT/RQT	IOT&E																								
Contract Events				LRIP														FRP											
				Lot 2				Lot 3			Lot 4				Lot 5				Lot 6										

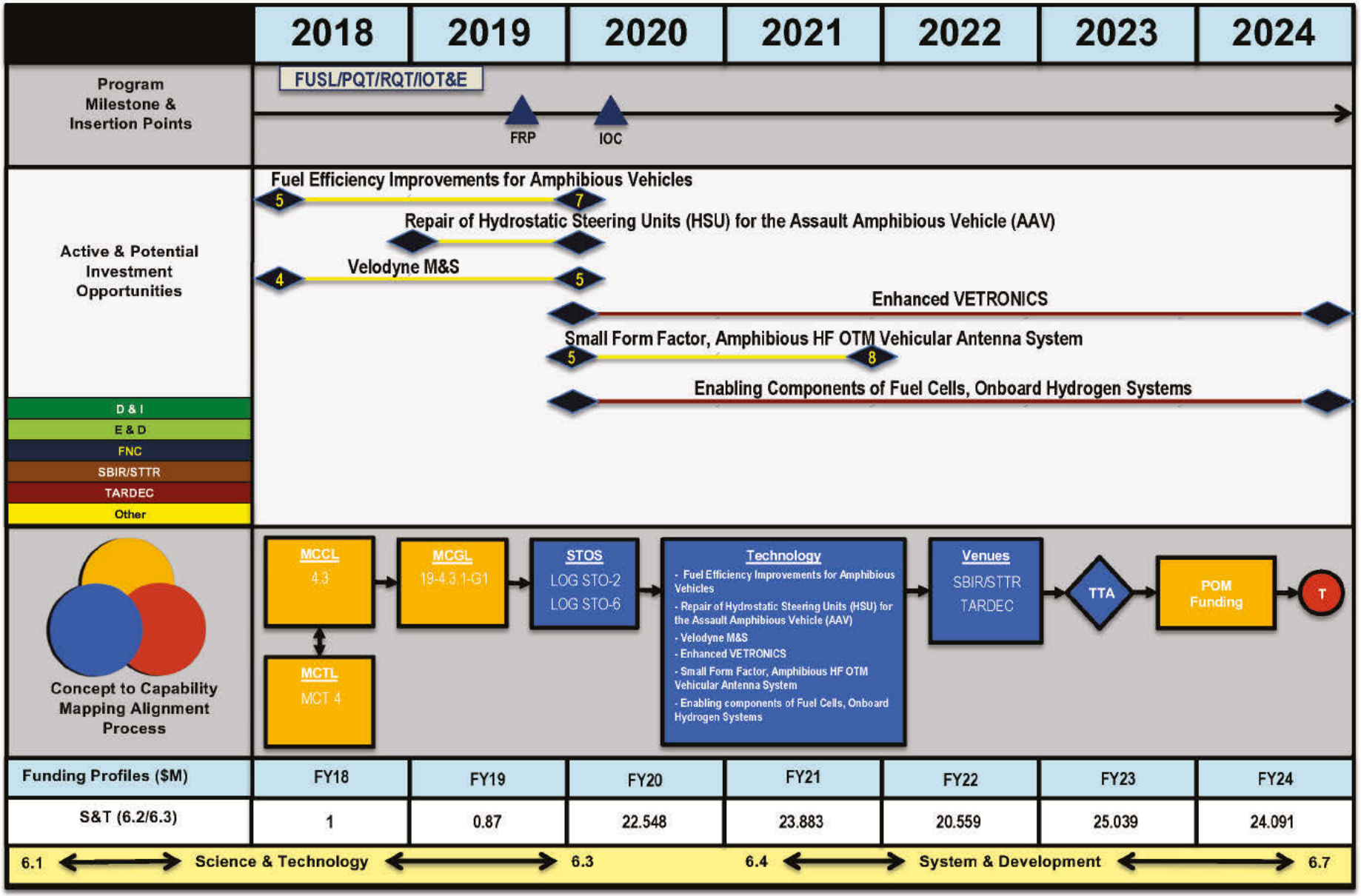
AAV Technical Issue #1 Survivability



AAV Technical Issue #2 Weight/Buoyancy Management



AAV Technical Issue #3 Reliability/Sustainment



Funding Profiles ($M)	FY18	FY19	FY20	FY21	FY22	FY23	FY24
S&T (6.2/6.3)	1	0.87	22.548	23.883	20.559	25.039	24.091

6.1 ⟷ Science & Technology ⟷ 6.3 6.4 ⟷ System & Development ⟷ 6.7

Section 7.2

AMPHIBIOUS COMBAT VEHICLE

Amphibious Combat Vehicle

Program Background

The Amphibious Combat Vehicle is an armored personnel carrier that is balanced between performance, protection, and payload for employment within the Ground Combat Element and throughout the range of military operations, to include a swim capability. ACV leverages and continues the work that was previously accomplished under the Marine Personnel Carrier (MPC) program.

Operationally, the ACV will be employed in such a manner that allows combat units to launch from amphibious ships, operate through the surf zone onto a beachhead, and continue the inland fight toward the objective. ACVs will provide a very robust combat capability, with features including MRAP-level survivability, and amphibious ability to negotiate three-foot significant wave height and six-foot plunging surf.

Program Status

The option was exercised on BAE's Engineering, Manufacturing, and Development (EMD) contract to build low rate initial production (LRIP) vehicles after a successful Milestone C in June FY18. The Marine Corps is conducting additional developmental testing in FY18-19 on the EMD vehicles while manufacturing LRIP vehicles. Production qualification and reliability qualification testing on the LRIP vehicles is planned in FY19-20, and an initial operational test and evaluation is also planned for FY20. The ACV is expected to achieve Initial Operational Capability in FY20, and Full Operational Capability in FY22.

ACV's Top Technical Issues

1. Survivability

Technologies that provide lightweight survivability solutions with specific focus on

blast protection, direct fire protection, and active protection systems are needed for the ACV.

2. Weight

Technologies that provide lightweight solutions for vehicle materials and components are needed for the ACV to achieve future survivability, lethality, and mobility upgrades.

3. Crew Visibility

The ACV crew must maintain direct sensory knowledge of their surroundings to safely and effectively employ the system. This requirement includes, but is not limited to, fully blacked out land/water operations, station keeping, obstacle detection (including near-surface obstacles), and operation in urban environments. Technologies that provide the necessary situational awareness for the crew - including position, navigation, and timing in GPS-denied environments - are critical to the execution of the ACV mission.

ACV

Description:
Provide wheeled, expeditionary, armor-protected mobility and direct fire support expanding the maneuver space of the infantry battalion on land and across littoral and inland water obstacles throughout the range of military operations.

Key Events

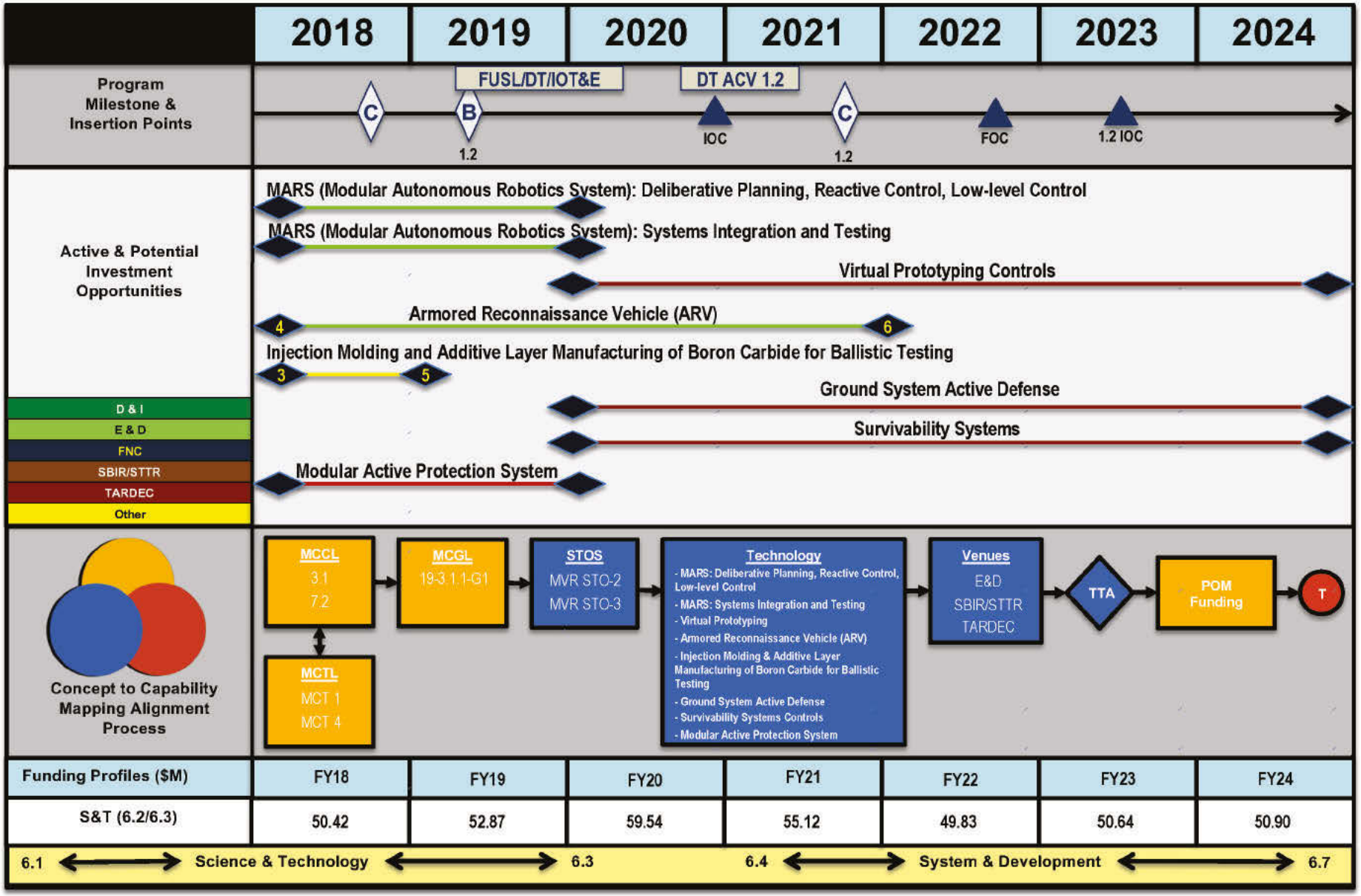
- **Milestone C:** 19 Jun 18
- **FRP Decision:** 3QFY20
- **IOC:** 4QFY20
- **FOC:** 4QFY22

Program Status

- AAO: 204
- Post MS C & LRIP
- BAE Systems Awarded LRIP Contract: Jun 18
- LRIP Lots 1 & 2 will produce 30 vehicles each (First 4 will be R&D FUSL live-fire test vehicles)

PROGRAM	PRIOR	FY18				FY19				FY20				FY21				FY22				FY23				FY24			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Milestones & Phases					MS C			1.2 MS B					IOC					1.2 MS C			FOC			1.2 IOC					
SETR Reviews																													
Test Events				OA				FUSL (4 Vehicles)		IOT&E														FOT&E 1.2					
		EMD (2KTR)						DT (KTR)						DT 1.2										F-FUSL 1.2					
								PQT/RQT																					
Contract Events				LRIP 1 (30 Vehs)				LRIP 2 (30 Vehs)						FRP 1 (56 Vehs)				FRP 2 (92 Vehs)				FRP 4 (120)				FRP 5 (125)			
																		FRP 3 (120)											
					LRIP 1			LRIP 2					FRP 1				FRP 2				FRP 3				FRP 4				FRP 5	

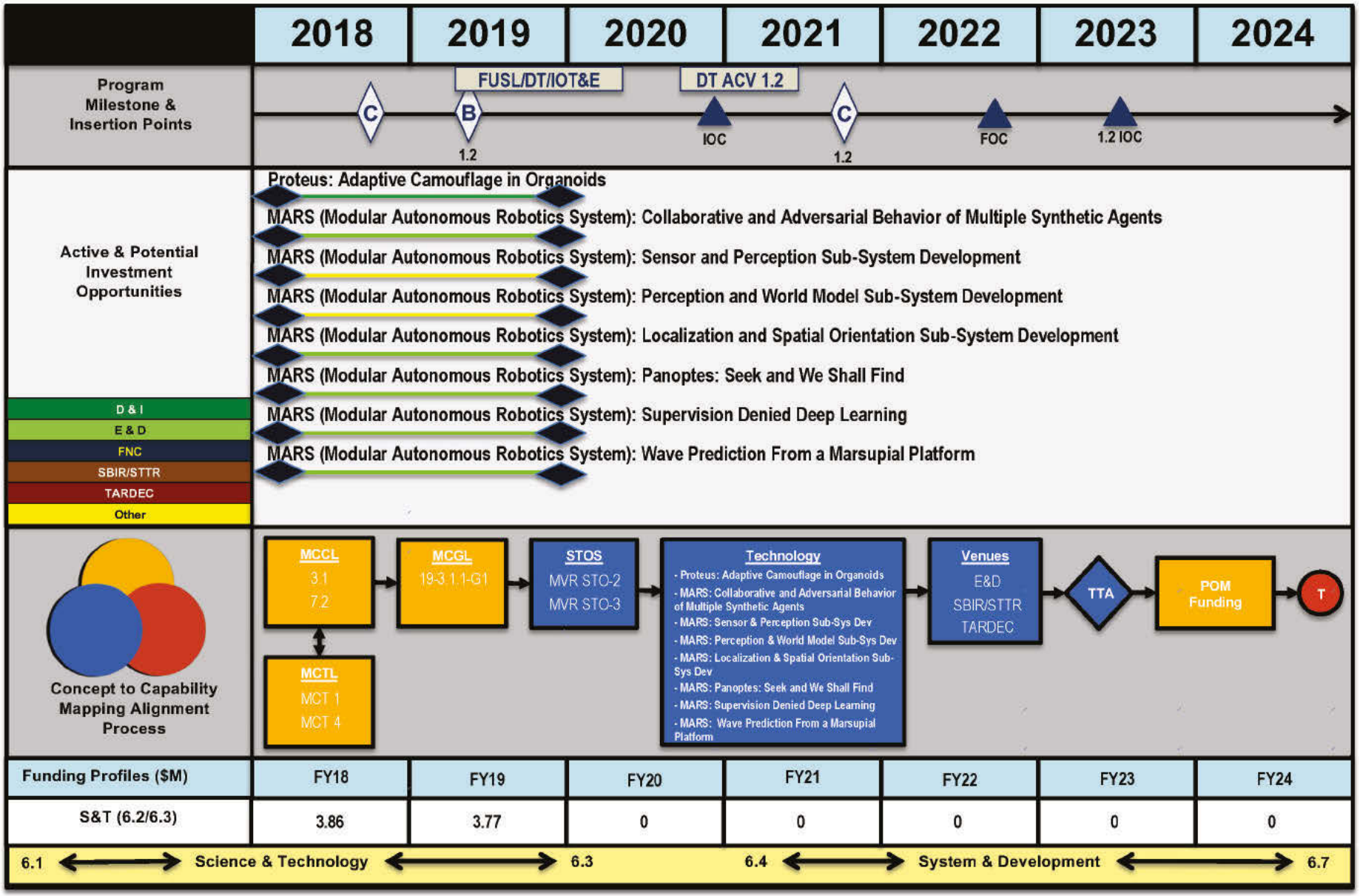
ACV Technical Issue #1 Survivability



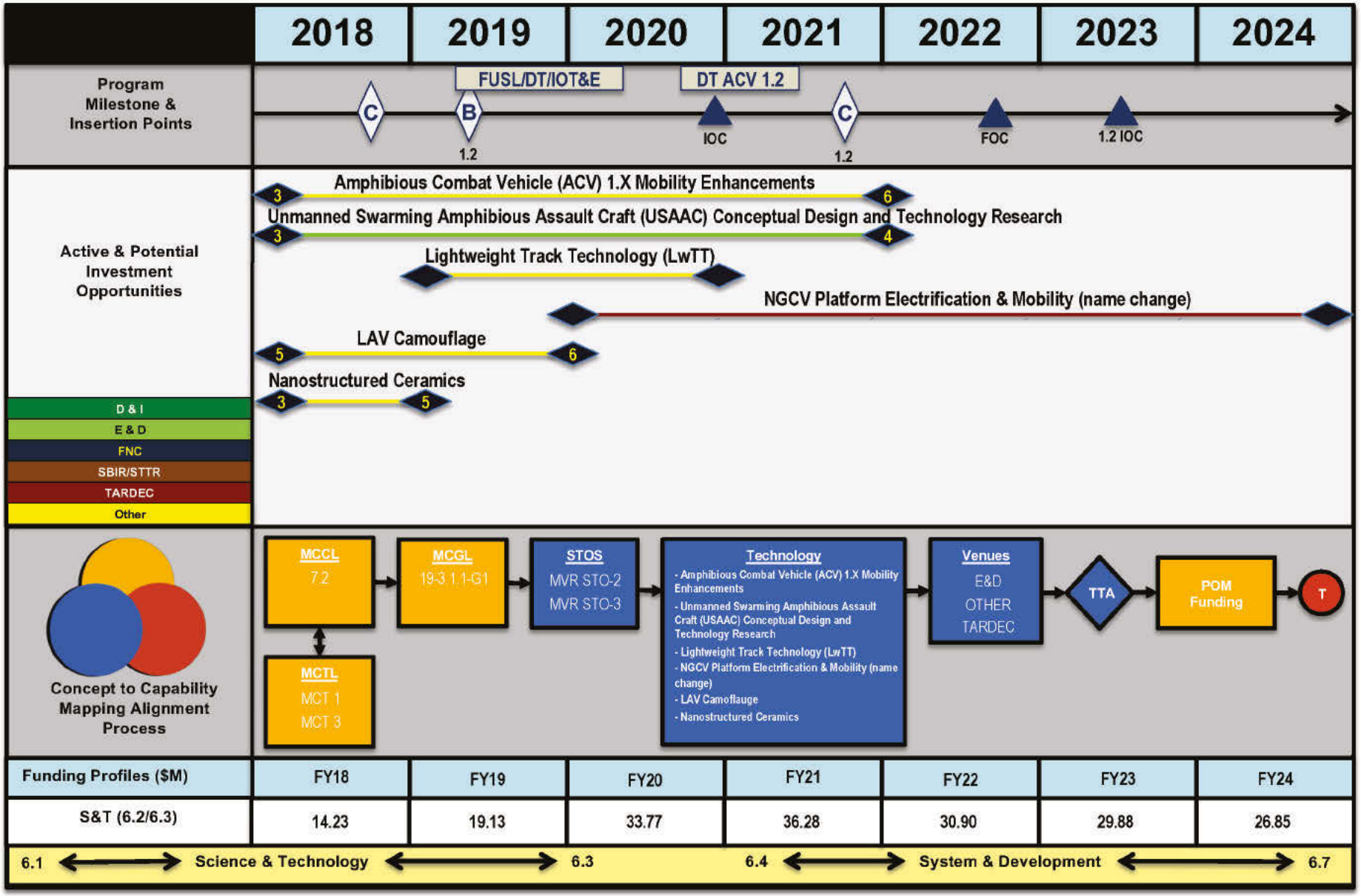
Funding Profiles ($M)	FY18	FY19	FY20	FY21	FY22	FY23	FY24
S&T (6.2/6.3)	50.42	52.87	59.54	55.12	49.83	50.64	50.90

6.1 ⟷ Science & Technology ⟷ 6.3 6.4 ⟷ System & Development ⟷ 6.7

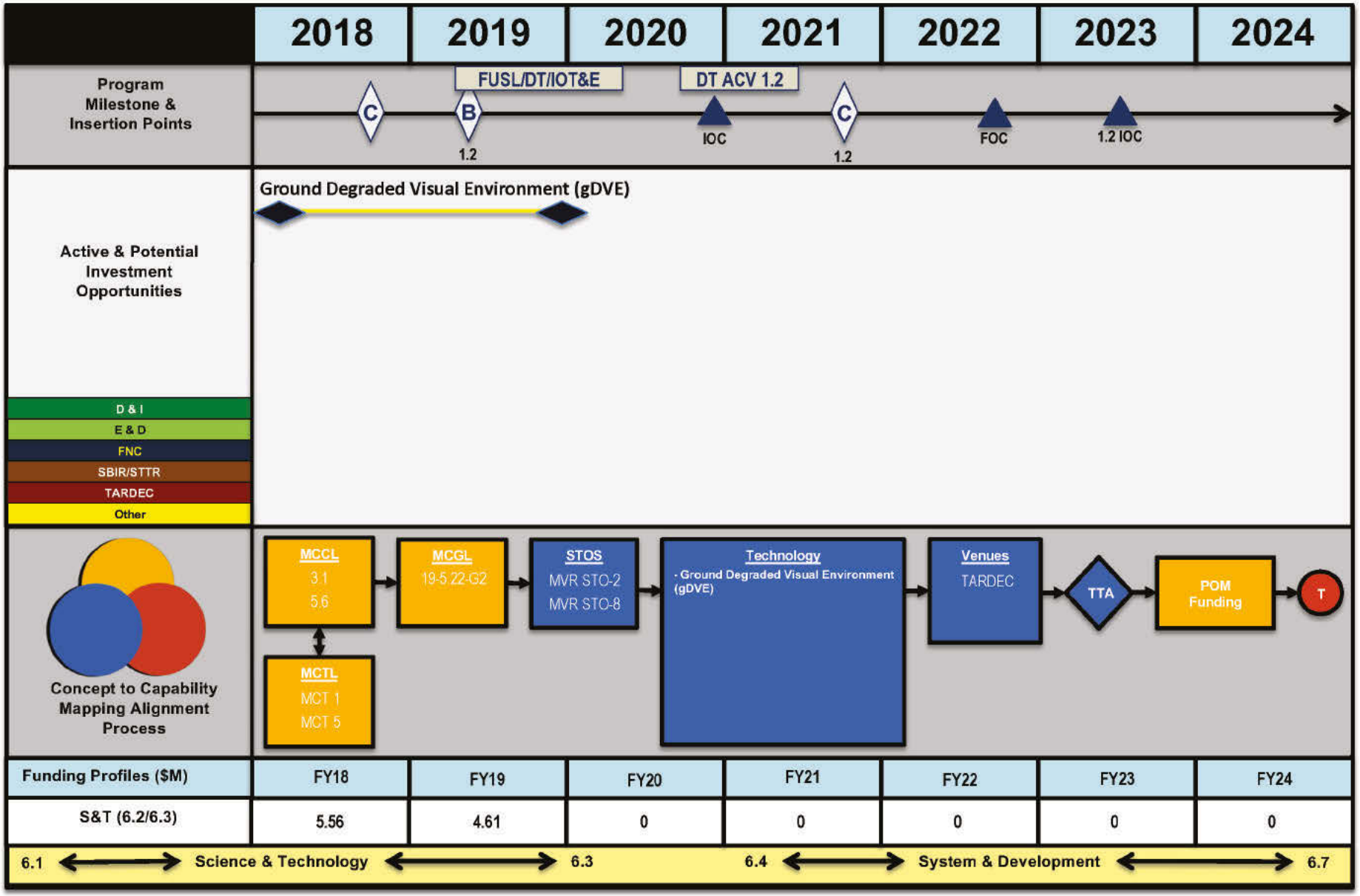
ACV Technical Issue #1 Survivability



ACV Technical Issue #2 Weight



ACV Technical Issue #3 Crew Visibility



Section 7.3

COMMON AVIATION COMMAND AND CONTROL SYSTEM

Common Aviation Command and Control System

Program Background

The CAC2S is a modernization effort to replace the existing aviation command and control equipment of the Marine Air Command and Control System (MACCS). It also provides the Aviation Combat Element (ACE) with the necessary hardware, software, equipment, and facilities to effectively command, control, and coordinate aviation operations. CAC2S accomplishes the MACCS missions using a suite of operationally scalable modules to support the MAGTF, joint, and coalition forces. CAC2S integrates the functions of aviation command and control into an interoperable system that supports the core competencies of all Marine Corps warfighting concepts. CAC2S, in conjunction with the MACCS's organic sensors and weapon systems, supports the tenets of Expeditionary Maneuver Warfare and fosters Joint interoperability.

The CAC2S program employs an evolutionary acquisition strategy using an incremental and phased approach for development and fielding of the CAC2S. The Capabilities Production Document identifies two increments needed to meet and achieve the full requirements set forth for CAC2S. Increment I of the CAC2S modernizes the assault support, air support, air defense, and ACE battle management capabilities of the MACCS.

Increment I of the CAC2S is accomplished through a two-phased approach. Phase 1 accommodates the rapid fielding of operationally relevant capabilities that include: mobility, situational awareness, tactical communications, information dissemination, and operational flexibility. Phase 1 established the baseline CAC2S capabilities for the MACCS and improved overall Aviation Command and Control performance and effectiveness. Phase 1 was accomplished by upgrading fielded MACCS equipment with mature, ready technologies; it also established an initial product baseline for a Processing and Display Subsystem (PDS) as well as a Communications Subsystems.

Phase 2 addresses the requirements for remaining ACE Battle Management and Command and Control requirements.

Additionally, it implements the Sensor Data Subsystem that fuses input from expeditionary sensors, real-time and near real-time data from ground force C2 centers, weapon systems, and Joint Strike Fighter sensors into a common operational picture of the battlespace. Phase 1 Limited Deployment Capability was achieved in 4QFY11. Phase 2 will accommodate the integration of technologies necessary, allowing CAC2S to meet remaining ACE Battle Management and Command and Control requirements. Phase 2 completion will result in delivery of the full CAC2S Increment I capabilities; full deployment fielding began in FY17.

Although requirements beyond Increment I are not yet defined, it is envisioned that CAC2S will continue to be developed in an evolutionary acquisition approach with follow-on increments being defined and captured in subsequent Joint Capabilities Integration and Development System documents. Those increments will potentially focus on capabilities for an airborne node, integration of air traffic control functionality, ground based air defense node, advanced decision support tools, unmanned aerial systems ground station interoperability, integrated fire control, single integrated air picture, integrated architecture behavior model, integration with fifth generation aircraft, and full network enabled command and control.

Program Status

Phase 1 achieved Full Operational Capability in September 2013. Currently, 20 Phase 1 systems are deployed in units comprising the Marine Air Control Group of the Marine Aircraft Wing and the Marine Corps Communications and Electronics School in Twentynine Palms, California.

The government successfully completed Initial Operational Test and Evaluation of the Phase 2 systems in 2QFY16. The government released a Request for Proposal on 7 October 2016 and awarded a contract in FY17. The production contract will enable the program to field systems to attain the program's acquisition objective and provide software sustainment services to produce software builds that maintain the system's cybersecurity posture and address software corrections and capability improvements.

CAC2S' Top Technical Issues

1. Bandwidth Efficient Radar Measurement Data Distribution

CAC2S currently interfaces with United States Marine Corps (USMC) air surveillance radars using high bandwidth, Local Area Networks (LANs) that are connected by tactical fiber optic cables. The Project Management Office (PMO) seeks solutions that enables radar measurement data to be extracted from existing radar outputs/interfaces and compresses this data to enable it to be sent to CAC2S in a bandwidth efficient manner.

2. Bandwidth Efficient Networked Voice Communications Vehicles

The CAC2S AN/MRQ-13 Communications Subsystems (CS) currently interfaces with the CAC2S operations facility using high bandwidth, LANs that are connected by tactical fiber optic cables. As such each CS currently functions as a dedicated communications platform for the agency with which it is deployed. The PMO seeks bandwidth efficient solutions that enables the tactical voice radios contained within the CS to be connected to the CAC2S operations facility using fielded data radios/ wireless communications systems. Additionally, the preferred solution will allow bandwidth efficient networking of CS's across a WAN enabling users to remotely employ tactical voice radios contained within a CS.

3. Cross Domain Security Solutions

MACCS units are increasingly tasked to support exercises and operations that involve coalition forces. The PMO seeks NSA-approved, Marine

Corps Enterprise Network (MCEN) authorized, small form factor solutions that enables CAC2S to operate in cross domain environments, allowing exchange of select information with coalition partners through automated processes, while maintaining security requirements of the discrete network domains.

4. Small Form Factor CAC2S

CAC2S is designed to operate as main unit MACCS agencies (DASC, TACC, TAOC). These agencies often deploy smaller, mobile, forward echelon detachments that require similar information and capabilities (or a subset) that are available with a main unit. Meanwhile, transport and employment considerations for forward echelon forces severely limits the SWaP/footprint of the equipment that these detachments can deploy. The PMO seeks solutions that minimize the footprint of equipment required to employ CAC2S capabilities with forward echelon detachments. The preferred solution will consider environmental conditioning and power consumption/generation factors that tend to increase a system's footprint due to the required addition of ancillary equipment.

5. Contextual Search Engines

CAC2S processes inputs from aircraft, sensors, data links, and other C2 systems. The data is stored and fused in a global track file and displayed to the operator for situational awareness and decision making. Typically, operators in C2 systems get overwhelmed by "too much information" and suffer from the "glare" of information. Data typically flows through the system, but the operator cannot locate or access the data when it is needed. The PMO seeks technologies that can discern the themes and relationships among data in unstructured content. Search results can identify relevant results based on context, not just keyword matches, by examining contents of a document as well as the files by which it is surrounded.

CAC2S

ACAT•IAC•(MAIS)
Phase•1- Operations•&•Support
Phase•2- Production•&•Deployment

Description: Common Aviation Command and Control System (CAC2S) is a modernization effort to replace existing Marine Air Command and Control System (MACCS) equipment. Phase 1 has fielded a product baseline Processing and Display Subsystem (PDS) and Communications Subsystem (CS). Phase 2 is the integration of sensor capabilities and will provide an Air Command and Control Subsystem (AC2S). Fielding of Phase 2 will complete CAC2S Increment I.

Key Events

- Full Rate Production System Fielding for FY19
  - 24 Sep 18 – 15 Nov 19 (V)1 MASS 6

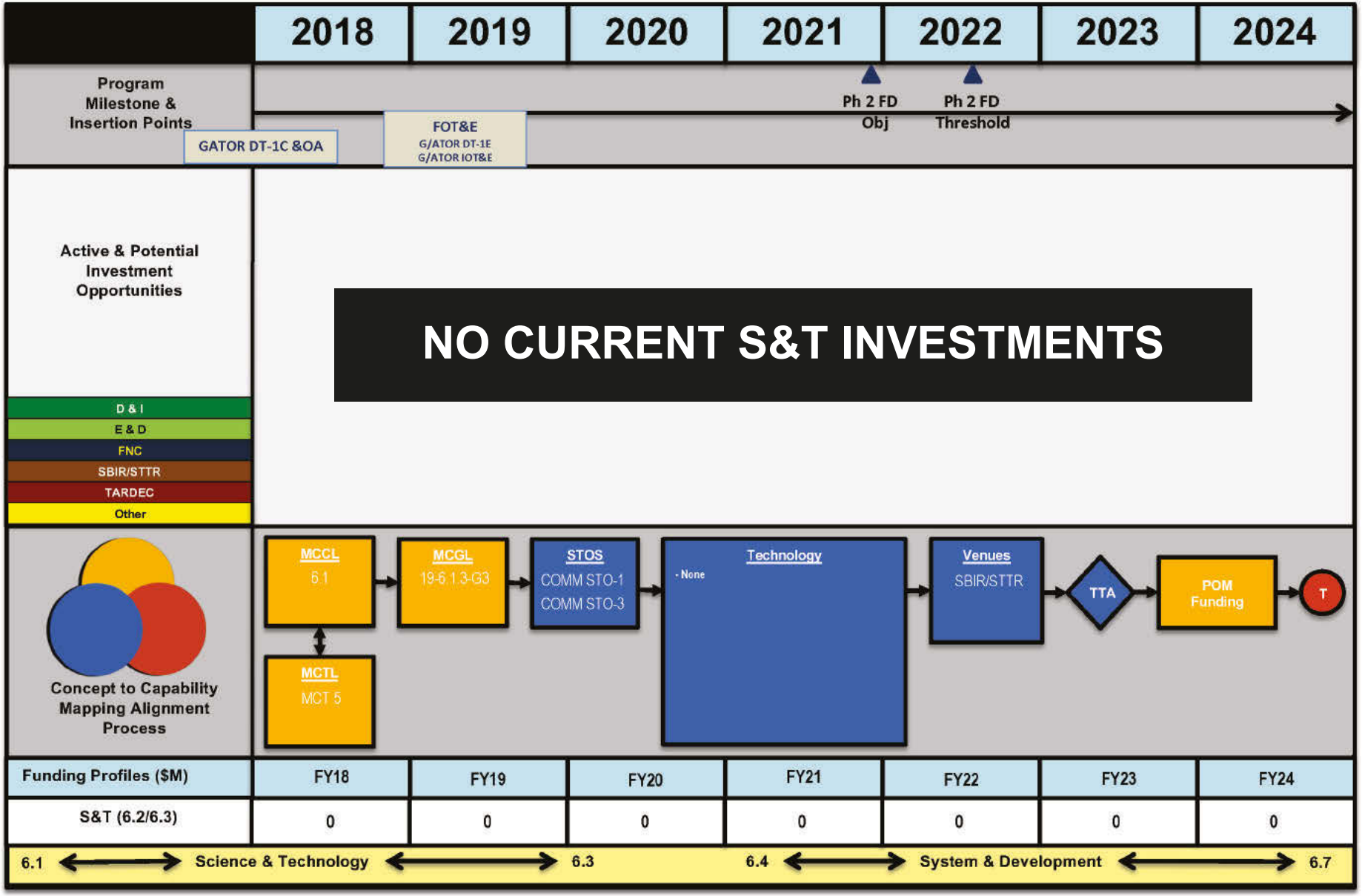
Program•Status

- AAO 50 systems
  - Accelerated award of all production CLINs
  - 9 LDU systems previously fielded
  - 11 of 41 FDU systems received
- Authority to Operate (ATO) valid through 31 January 2021

PROGRAM	PRIOR	FY18				FY19				FY20				FY21				FY22				FY23				FY24			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Milestones & Phases																	Ph•2•FD Obj			Ph•2•FD Threshold									
SETR Reviews		ATO PRR		PIV																									
Test Events		GATOR•DT-1C•&OA LDU•#1-#9				G/ATOR•DT-1E G/ATOR•IOT&E		Mode•5		ATC Demo																				
Contract Events		Solipsys Option Lot 1 Lot 2 Lot 3				Solipsys Award Ultra Award Ternion Award																							
		Phase•2•Full•Deployment•Unit•Production•and•SW•Support•Contract																											

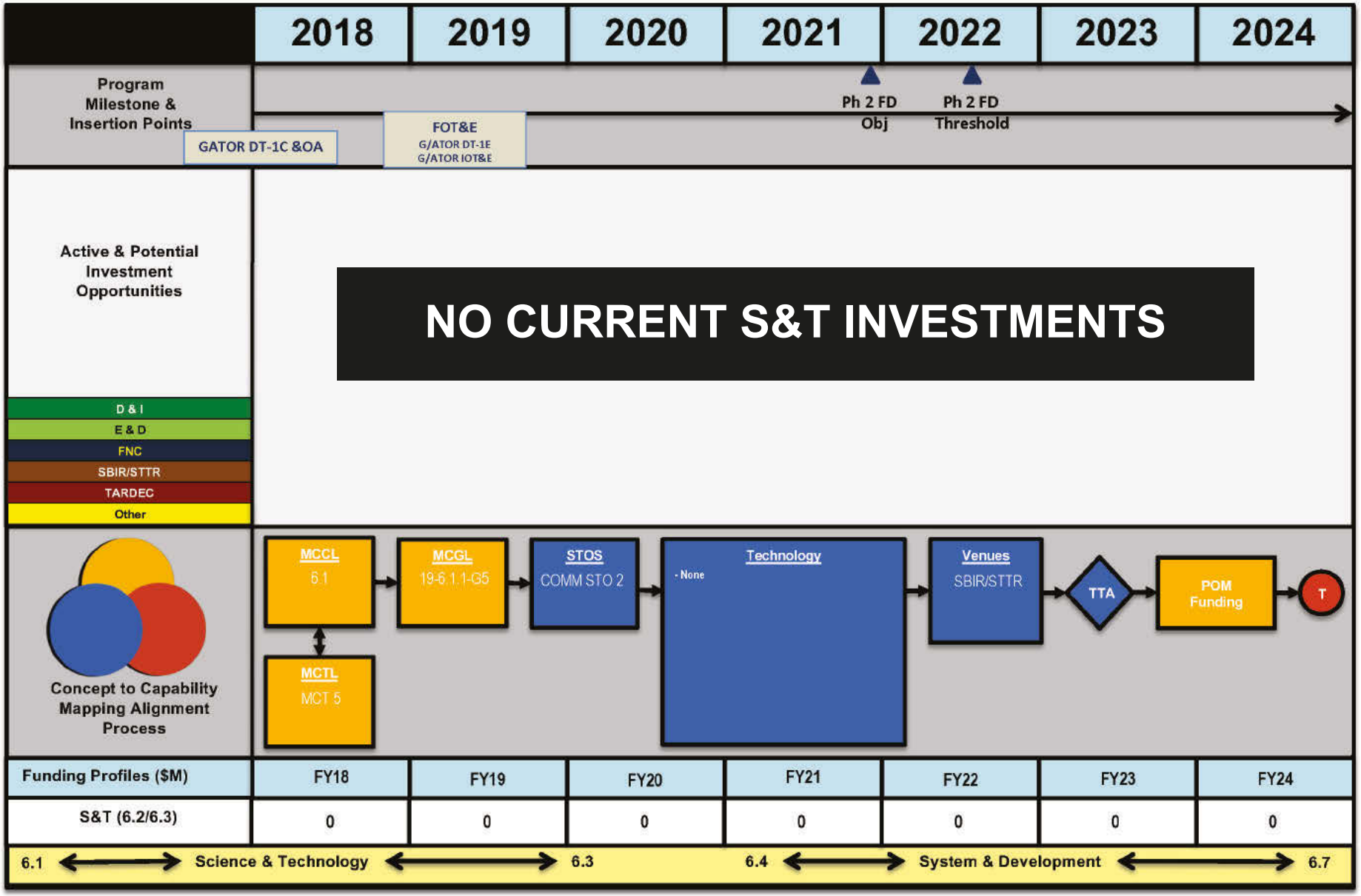
CAC2S Technical Issue #1

Bandwidth Efficient Radar Measurement Data Distribution

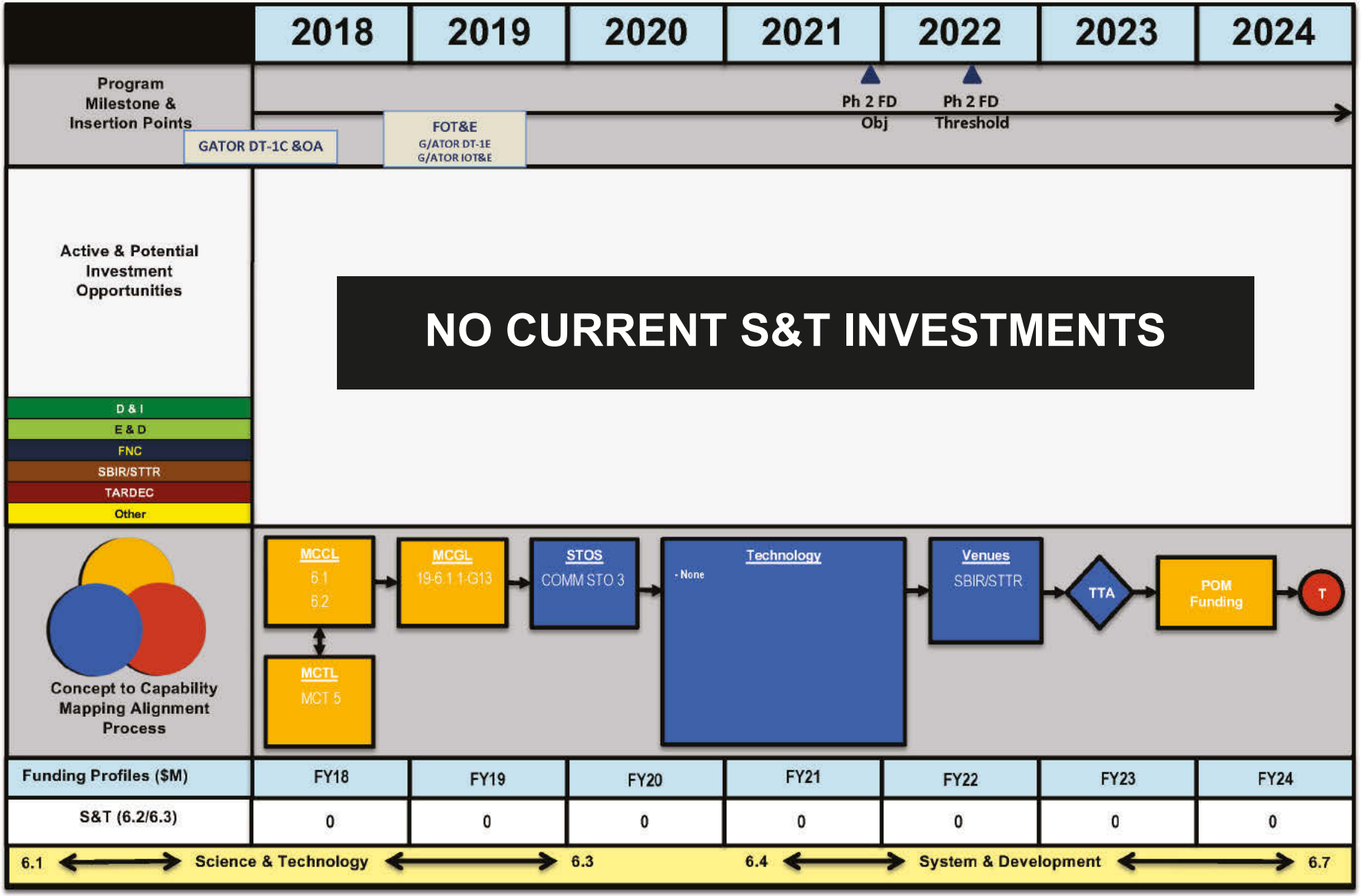


CAC2S Technical Issue #2

Bandwidth Efficient Networked Voice Communications Vehicles



CAC2S Technical Issue #3
Cross Domain Security Solutions



Section 7.4

GROUND BASED AIR DEFENSE

Ground Based Air Defens

Program Background

The Marine Corps' organic GBAD capabilities are centered on the Low-Altitude Air Defense (LAAD) Battalions of Marine Air Wings (MAW). LAAD battalions currently use the FIM-92 Stinger missile, originally fielded in 1981 and upgraded since to Block I configuration, as its primary weapon system for air defense. It is expected that the Stinger missile will be the primary GBAD asset for the near future, and the missile is currently undergoing a Service Life Extension Program (SLEP) to maintain its operational effectiveness and longevity. An Analysis of Alternatives (AoA) for the GBAD Future Weapon System (FWS) has been completed and resulted in a Capability Development Document (CDD) in FY18. The CDD outlines an agile and cost-effective, detect, track, identify, and defeat capability against low-altitude, observable, and low-radar cross-section air threats.

Programs and projects included in the GBAD portfolio are:

- Stinger Missile SLEP
- Advanced Man-Portable Air Defense (A-MANPADS) System Fire Unit Vehicles (FUV)/Section Leader Vehicles (SLV)
- LAAD C2
- Stinger Night Sight Replacement
- Identification Friend or Foe Mode IV Replacement
- GBAD FWS

Program Status

Stinger Missile SLEP

A Stinger Missile SLEP began in FY14 and is scheduled to complete delivery in 3rd Qtr FY-19. The SLEP is essential and required to meet the War Reserve Munitions Requirement and to provide sufficient training rounds after 2019. The SLEP is a joint effort with the Army's Program Executive Officer – Cruise Missile Defense System to prolong the life of the Stinger Missile by replacing aging components such as the flight motors and missile energetics.

A-MANPADS Increments 0 & I

A-MANPADS was designated an Abbreviated Acquisition Program (AAP) in 2005 and is executing a single-step to full capability acquisition strategy by integrating commercial off-the-shelf and NDI subsystems. The concurrence to pursue the full Approved Acquisition Objective for 38 SLV and 143 FUV was received in 2015. An Engineering Change Proposal (ECP) approving the transition to the HMMWV M1114 for all A-MANPADS FUVs, to rectify obsolescence and operational deploy ability of the previous chassis. Included

the ECP was the replacement solution for the Harris Communication secure tactical wireless capability, SECNET-11, which reached obsolescence and is being replaced with the AN/PRC-152A radio. The fielding decision for the 143 FUVs was signed in 2017 and fielding will be complete by 1QFY19.

LAAD C2

A-MANPADS vehicles contain hardware and software for a tactical data link capability, which allows the LAAD BN to connect to various C2 agencies to receive an air picture down to the LAAD Fire Teams. The fielded datalink capability is supported by a Joint Range Extension (JRE) Sustainment contract that was awarded in September 2013 for five years. An additional sixth year of support was ordered and awarded in August 2018 extending support to August 2019. With JRE support due to end in 2019, PM GBAD is exploring the Army's Forward Area Air Defense (FAAD) C2 as a replacement for the current JRE system. FAAD C2 will allow PM GBAD to field government owned software and buy down risk for C2 in the MADIS family of systems. Validation testing of FAAD C2 took place September to October 2018 and will inform the Program Office's decision to continue down that procurement path.

Stinger Night Sight Replacement

The AN/PAS-18 Stinger Night Sight is being replaced by the AN/PAS -13V(2) updating the software to contain the stinger reticle. The AN/PAS -13V(2) will be replaced with a system yet to be identified by the US Army and USMC Program Office Optics, that will provide greater target resolution and detection capability against the full spectrum of threats to include UASs.

GBAD FWS

The GBAD Program Office is currently investigating potential kinetic and non-kinetic capability to counter the full spectrum of threats to include UASs. Efforts include the GBAD On-the-Move (OTM) Future Naval Capability program, funded by the Office of Naval Research and developed by Naval Surface Warfare Center, Dahlgren, VA. This effort is investigating the feasibility of hosting a directed energy solution on tactically relevant vehicles such as the JLTV or HMMWV.

GBAD's Top Technical Issues

1. Counter Unmanned Aircraft System

Based on the proliferation of inexpensive low, slow, and small UAS; a cost effective kinetic and/or non-kinetic counter UAS capability is required to negate the threat at the system's weapon keep out or sensor ranges. The counter UAS system should provide a low cost per shot system with a high probability of kill against a group 1 UAS.

2. LAAD C2

The capability to disseminate an air picture down the LAAD fire team for early warning and cueing purposes is an enduring requirement. PM GBAD has a requirement to field a C2 capability to the LAAD community to support the evolution of current GBAD capability to what the MADIS family of systems will provide.

3. Stinger Night Sight Replacement

Enabling technologies are needed to produce a lightweight, compact night sight, compatible with the stinger missile and suitable to achieve detection and identification of thermal targets (i.e. Type 1-3 UAS and rotary/fixed-wing aircraft) at ranges suitable for man-portable air defense operation. Technologies currently identified as being required are 1) lightweight, quiet, and efficient micro chiller that can be incorporated into a hand held Mid Wave IR thermal sight; 2) High Density Focal Plane Array (16:9 ratio of 1280 or 1920 horizontal pixels) with small 12 micron or smaller pixel pitch; and 3) lightweight compact optical zoom that provides a 20-degree Field of View for missile engagement and narrow FOV for target identification.

GBAD Counter-Unmanned Aerial System (C-UAS)

Description GBAD C-UAS delivers kinetic and non-kinetic C-UAS capabilities to defeat the full spectrum of Low-Altitude Low Observable/Low Radar Cross Section threats to MAGTF commander's vital areas and USMC CONUS & OCONUS Critical Infrastructure.

PROGRAM	PRIOR	FY18				FY19				FY20				FY21				FY22				FY23				FY24			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Milestones & Phases										ACAT Designation				MS C	LRIP						IOC FRP Fielding Decision							FOC
SETR Reviews	CLWS Risk Acceptance/ Safety Release CLWS LUE Risk Acceptance & Training					2kW LRSB 5kW LRSB								FP DR/CDR		FoS ATO PCA	Final TDP												
Test Events	MODI I Network Demo @ YPG L-MADIS Inc 1 TACDEMO @ WTI					2kW RAM SoS Test 5kW RAM Eng Test (2)												OT/DT											
Contract Events		CLWS Production 5												LRIP & Test Support				SW Support In-Service Engineering E-MADIS Production L-MADIS Production											

GBAD Advanced-Man Portable System (A-MANPADS)

Description A-MANPADS provides low altitude air defense against fixed/rotary wing, cruise missile and emerging UAS threats. It utilizes the Joint Range Extension Application Protocol (JREAP) capability to provide a tactical air picture for the LAAD gunner's defense of MAGTF High Value Assets (HVAs). The Fire Unit Vehicle (FUV) and Section Leader Vehicle (SLV) comprise primary mobile platforms for the system.

Key Events

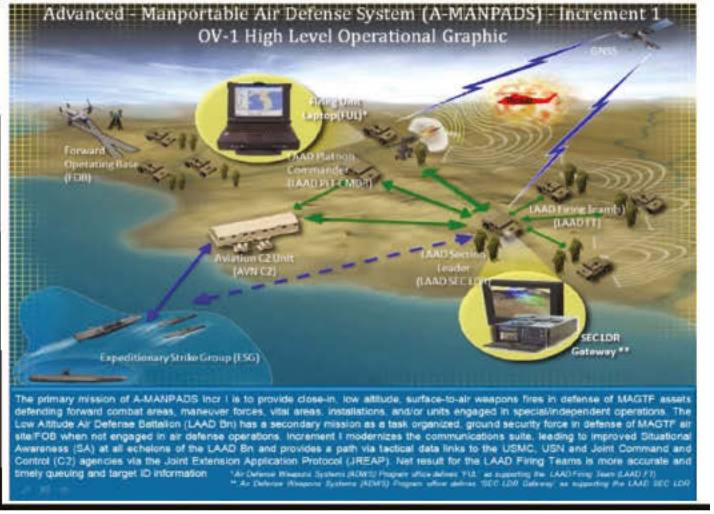
- Bn and AD School House FY19

Stinger FIREXs

- Stinger Blk I SLEP msl del FY19
  - Commenced FY17
  - Concludes 2QFY19
- IFF Belt Pack Mode 5 IOC 2QFY19
- FAAD C2 ECP completion 4QFY19

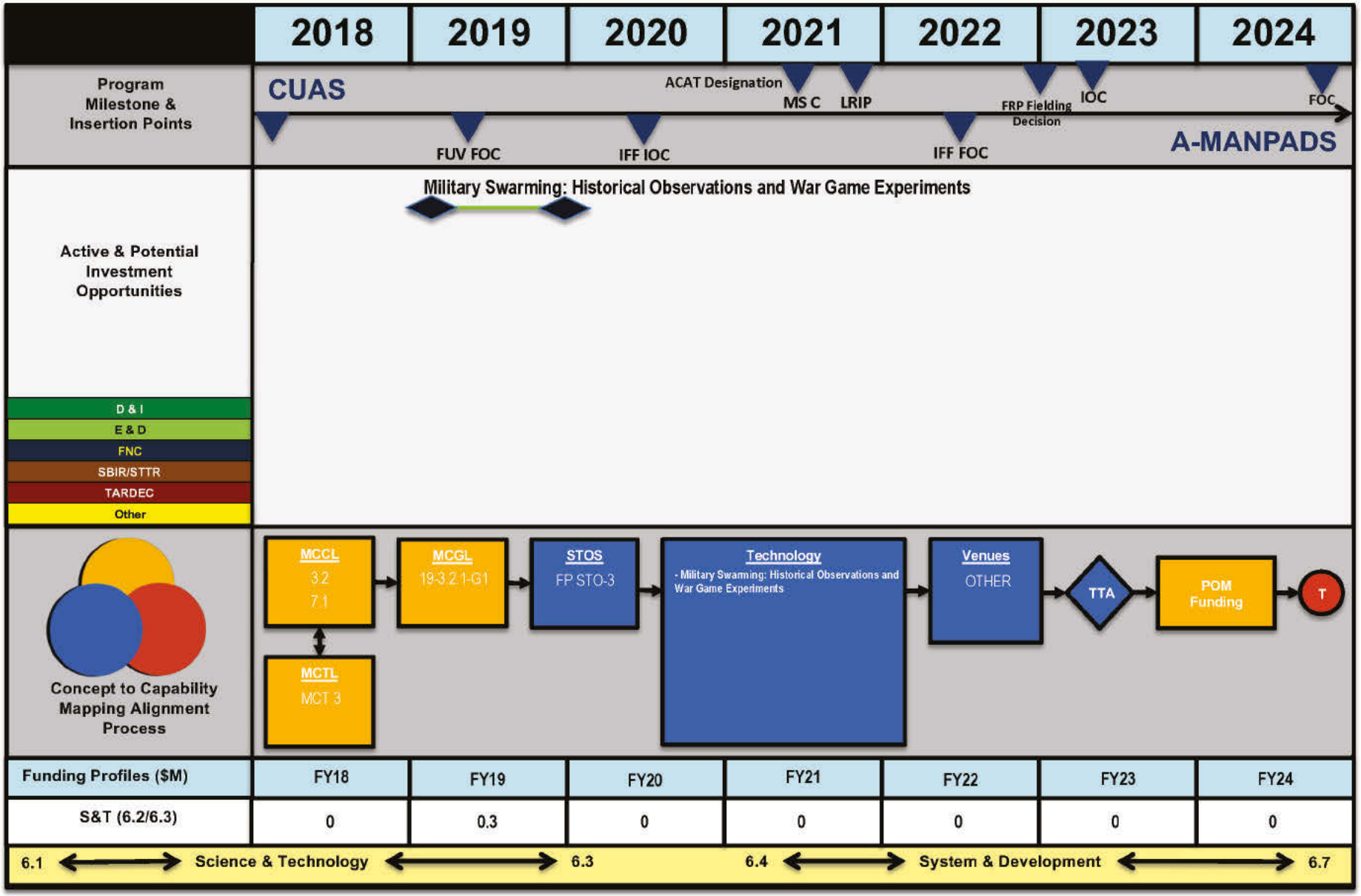
Program Status

- **FAAD C2:** ECP in process; Anticipate implementation by end of Aug 19
- **FUV:** Completed fielding and training events 12Oct18 for 2d and 3d LAAD Bns, the AD School House, and UDP
- **SLV:** Conducting sustainment and engineering efforts to maintain C2 capability for the LAAD community
- **Stinger Missile:** SLEP: Stinger Blk I msls undergoing Army sourced SLEP.
- **IFF:** Upgrade to Mode 5 encrypt via Army sourced Production contract
- **GSE:** Maintain GSE serviceability

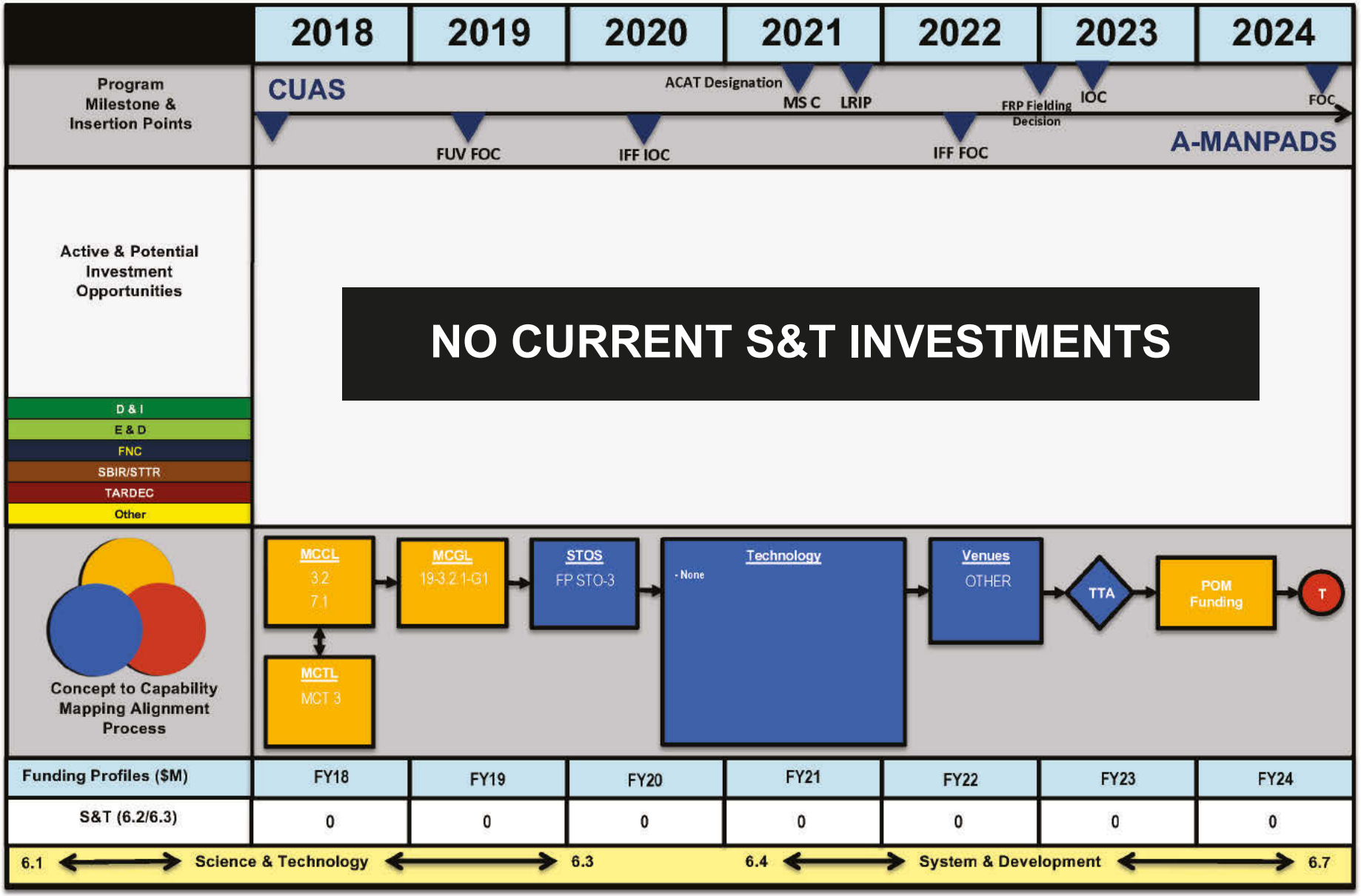


PROGRAM	PRIOR	FY18				FY19				FY20				FY21				FY22				FY23				FY24			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Milestones & Phases		FUV IOC					FUV FOC				IFF IOC								IFF FOC										
						LAAD C2 DP		SLEP Completion																						
SETR Reviews						LAAD C2 JTIC IATC					LAAD C2 JITC CERT																		
						JREJTIC Recert																							
			Optics PoP							IFF Spectrum Cert																			
Test Events																													
Contract Events			JRE DO 6				LAAD C2				IFF DLA								IMTS Tech Refresh										
		Stinger SLEP																					IMTS Tech Refresh						
		FUV (143)						IFF DLA																					
		Aerial Targets PoP								Aerial Targets PoP																			
						IMTS Support																							
											Mode 5 IFF																		

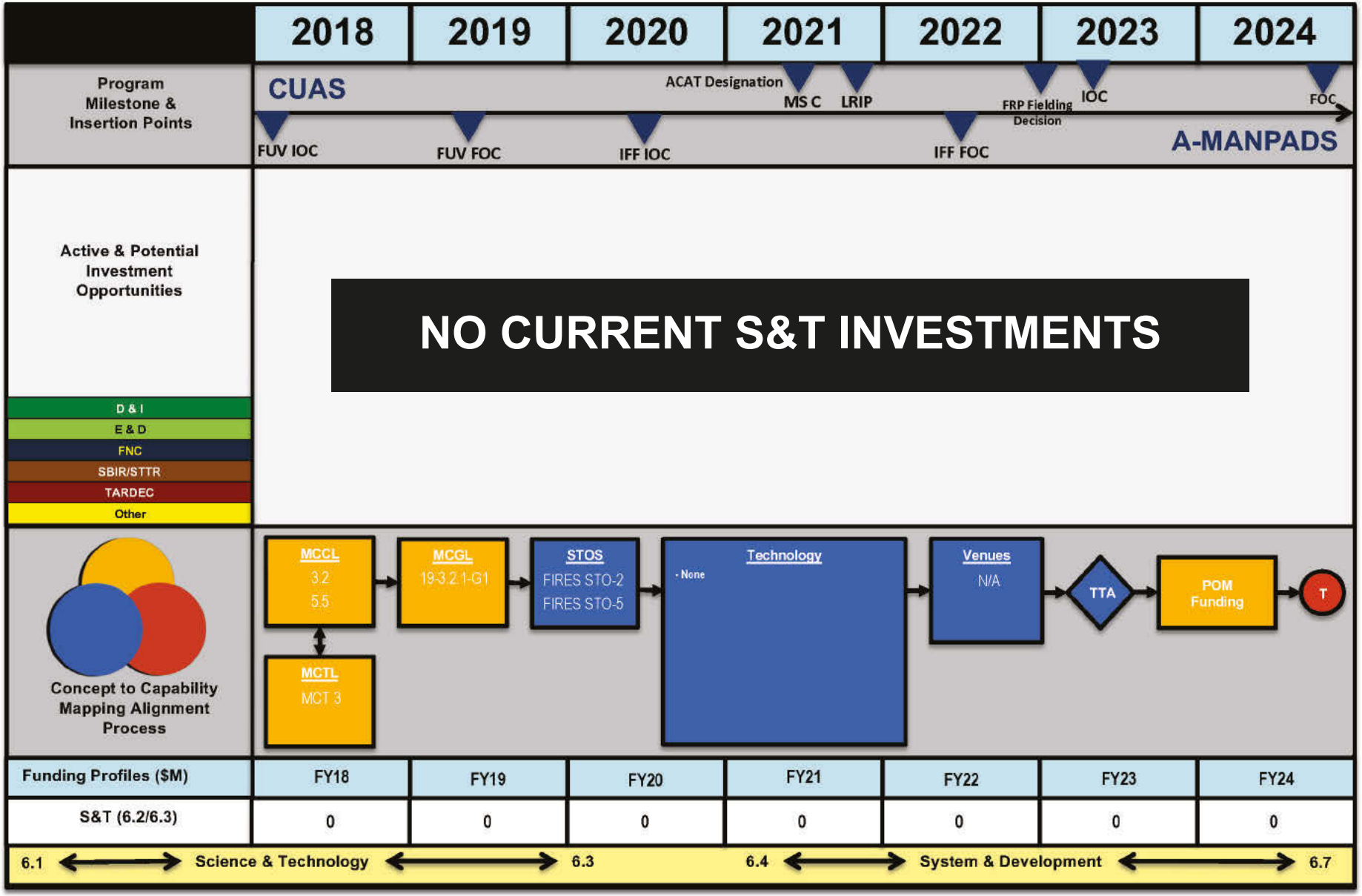
GBAD Technical Issue #1 Counter Unmanned Aircraft System (UAS)



GBAD Technical Issue #2 Low-Altitude Air Defense (LAAD) C2



GBAD Technical Issue #3 Stinger Night Sight Replacement



Section 7.5

GROUND/AIR TASK ORIENTED RADAR

G/ATOR

Program Background

G/ATOR is an expeditionary, lightweight radar employed by units within the Air Combat Element (ACE) and Ground Combat Element (GCE) of the MAGTF. Within the ACE, G/ATOR will provide enhanced situational awareness and additional capabilities to conduct short-medium range radar surveillance and air defense. Within the GCE G/ATOR will provide ground weapons locating capability for counterbattery and counter-fire missions. G/ATOR provides real-time radar measurement data to the CAC2S, Composite Tracking Network, and Advanced Field Artillery Tactical Data System. This system contributes to sea-based air defense sensors and Command and Control capabilities to provide Naval and Joint forces with an expeditionary radar that extends landward battle space coverage.

G/ATOR is a single materiel solution for the mobile Multi-Role Radar System and Ground Weapons Locating Radar (GWLR) requirements and replaces five legacy radar systems. G/ATOR is a three dimensional, short/medium range multi-role radar designed to detect unmanned aerial systems, cruise missiles, air breathing targets, rockets, artillery, and mortars.

G/ATOR is comprised of three major subsystems: the Radar Equipment Group (REG), Communications Equipment Group (CEG) and Power Equipment Group (PEG). The REG is an integrated radar and trailer towed behind a MTVR. The CEG is a communications and radar control system transported on the armored M1152A1 High Mobility Multipurpose Wheeled Vehicle. The PEG is a pallet assembly containing a tactical generator, cables and ancillary equipment transported on the bed of the MTVR.

G/ATOR is being developed and fielded in three blocks and will be employed by the MAGTF across the range of its capabilities. Air Defense/Surveillance Radar G/ATOR Block 1 (GB1) provides capabilities in the short range air defense and air surveillance mission areas; Ground Weapons Locating Radar G/ATOR Block 2 provides the ground weapons locating capability for counterbattery and counter-fire missions and Expeditionary Airport Surveillance Radar G/ATOR Block 4 (GB4) will address Air Traffic Control missions. GB 4 is not included in the Acquisition Program Baseline. Resourcing is planned for future budget builds. G/ATOR Block 3 was a series of enhancements that are now incorporated into other blocks. The term Block 3 is no longer used.

Program Status

The AN/TPS-80 G/ATOR system received a successful Milestone C in March 2014 from the Assistant Secretary of the Navy (Research, Development and Acquisition). Northrop Grumman Mission Systems has delivered six Gallium Arsenide (GaAs) technology LRIP Systems and is under contract to deliver nine G/ATOR LRIP systems with Gallium Nitride (GaN) technology. The total Approved Acquisition Objective is 45 systems. The delivery of six GaAs LRIP systems was completed in January 2018. The delivery of GaN LRIP systems began in July 2018.

Operational assessments for GB1 and GB2 were completed in October 2017 and May 2018 respectively. The Initial Operational Capability (IOC) for GB1 was February 2018; GB2 IOC will follow in Spring 2019. Both blocks are in Developmental Test and completed the Initial Operational Test & Evaluation in 1st Quarter FY19.

G/ATOR's Top Technical Issues

1. Lowering Manufacturing Costs

Technologies are needed that reduce manufacturing cost across multiple areas of production, including: 1) Air ducts that provide precise mounting and cooling of the Transmit/Receive (T/R) modules and array elements (the air duct is very time consuming to produce and assemble, and thus is very expensive); 2) T/R module packaging, which requires expensive materials and hermetic sealing that reduces yield; and 3) an active rectifier, which is required for clean power input to the system and which requires a multi-step, medium yield manufacturing process.

2. Increased Dynamic Range

Under certain adverse conditions, G/ATOR requires additional dynamic range. Dynamic range is limited by the third-order intercept point of the receive chain and the number of effective bits in its analog to digital converters. Increasing the dynamic range of these components would improve the G/ATOR performance in certain adverse (other than nominal) environments. Avenues of improvement include improvements in T/R module design, as well as receiver design.

3. Advanced Electronic Protection

The G/ATOR PMO is seeking advanced electronic protection technologies and techniques that will diminish G/ATOR susceptibility to electronic attack measures. This is an area for research into not merely what is available today to defeat the current electronic attack capabilities but also to look to the future, to predict the next generation of electronic attack means/methods and to develop techniques/technologies to negate or defeat them.

4. Diminishing Manufacturing Sources and Material Shortages (DMSMS)

With the advancement of electronics technology, the G/ATOR system has several components that require upgrading within LRIP and early Full Rate Production. Each of the processors will need to be refreshed to include the Pallet Support Electronics, Communications Control Processing Unit,

Radar Signal Processor, Receiver Exciter Control Module , and Antenna Control Module. Changing processors will likely require a change to the Operating Systems (OS) so techniques and tools to transfer software between OS is needed. Additionally, some of the semiconductor components utilized in the Waveform Generators and T/R modules are no longer produced in the same manner, design, or wafer size. These DMS items require redesigned LRUs that must be tested at the component, LRU, and system levels to ensure proper form, fit, and function within G/ATOR. Northrop Grumman is currently undertaking these tasks to ensure that G/ATOR remains operating at optimal performance.

5. Improvements in Detecting, Discriminating and Tracking UAVs

The threat from UAVs has increased and technology enabling their detection and tracking is increasingly important. The G/ATOR system would benefit from advanced technologies and techniques that will increase G/ATOR's ability to both detect and identify UAVs. This would include improvements in detecting slow moving objects in the presence of clutter and the ability to discriminate UAVs as targets of interest from other slow moving objects such as birds, cars, and atmospheric phenomena.

G/ATOR

ACAT 1C/Production & Deployment

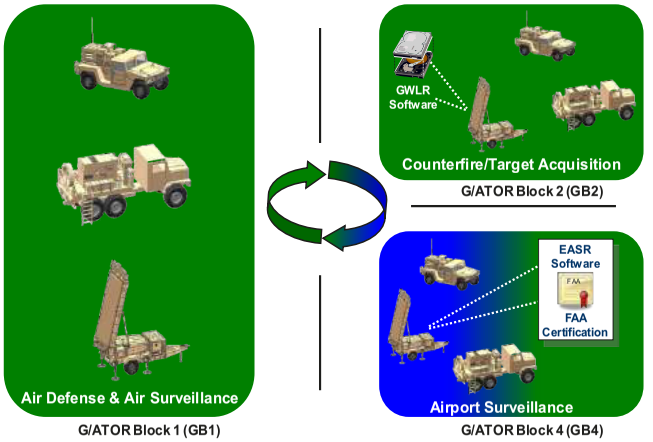
Description: G/ATOR is a 3D, short/medium range multi-role radar designed to detect unmanned aerial systems, cruise missiles, air breathing targets, rockets, artillery and mortars. The system satisfies expeditionary needs across the MAGTF and replaces five legacy radar systems with a single MAGTF solution.

Key Events

- GB2 11th MAR FUE Jul—FEB 2019
- GB2 integrated DT/IOT&E Oct—Dec 2018
- GB2 EDD Feb 2019
- GB2 IOC Feb 2019
- FRPD 3Q FY19
- Engineering Tests Apr/May 2019 (~2 wks)
- Engineering Tests May/June 2020 (~2 wks)

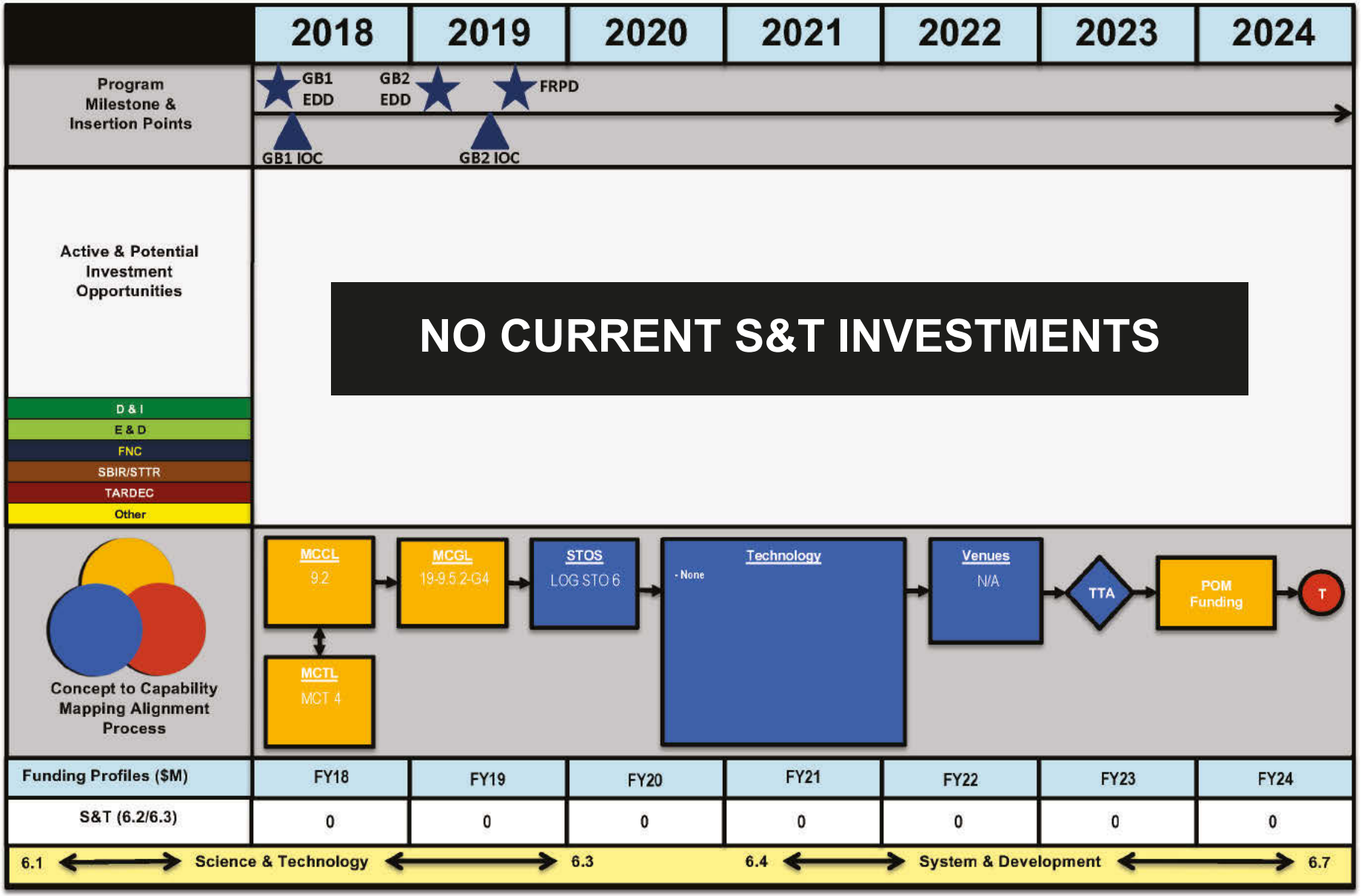
Program Status

- 15 LRIP systems
  - 8 systems del,7 GaN systems in prod
- GB1 fielded to MACS-1 and MACS-2
- GB2 11th MAR FUE 17 Jul—TBD Feb 2019
- FRP CARD update/SCP development underway

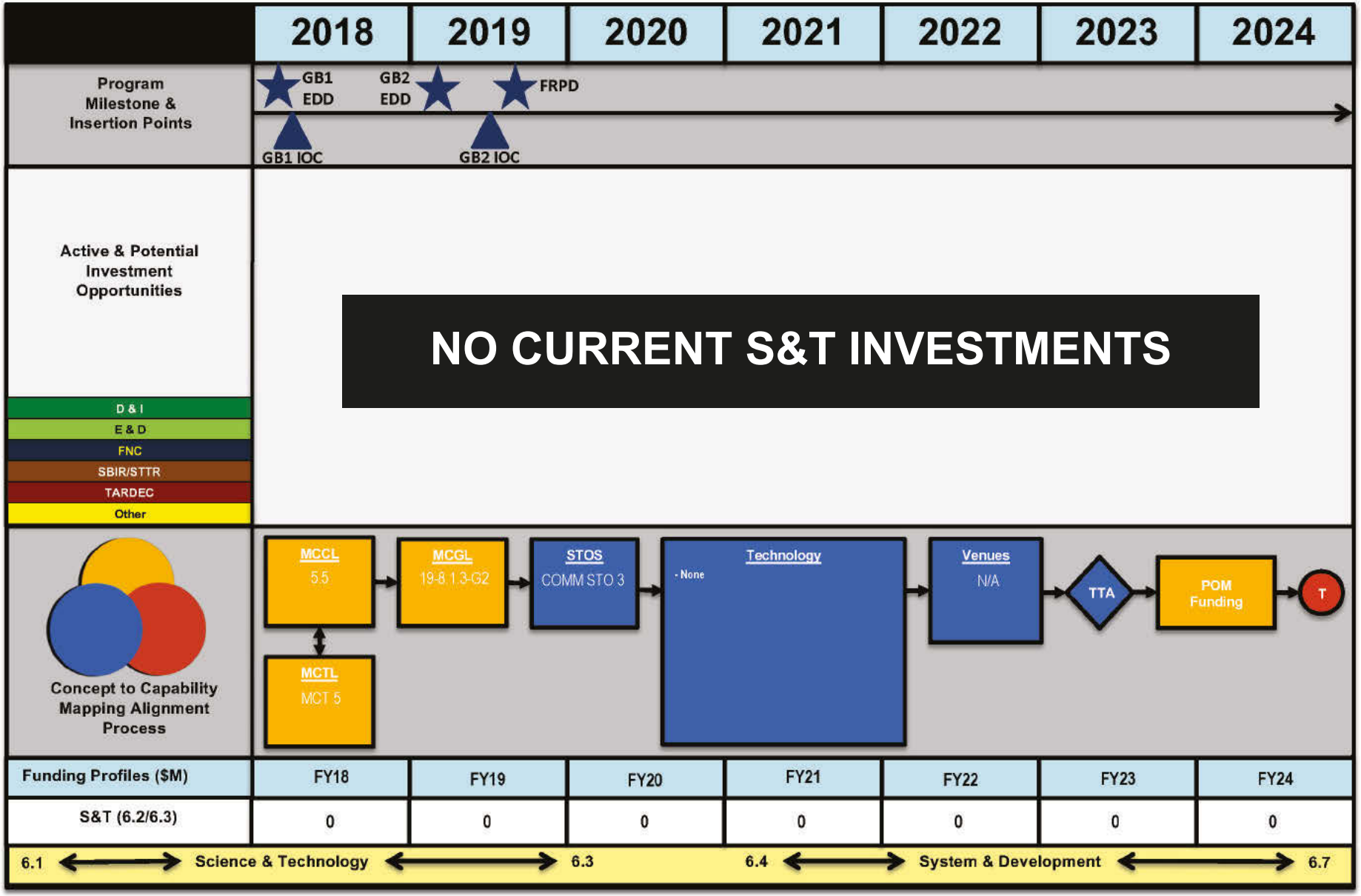


PROGRAM	PRIOR	FY18				FY19				FY20				FY21				FY22				FY23				FY24			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Milestones & Phases		★ GB1 EDD ▲ GB1 IOC				★ GB2 EDD	★	★ FRPD ▲ GB2 IOC																					
SETR Reviews																													
Test Events		DT 1C OA GB1 DT 1D OA GB2				DT1E1 Integrated DT/IOT&E DT1E2 GB2 Integrated DT/IOT&E																									
Contract Events		GaAs LRIP (6 units) GaN LRIP (9 units /Lots 3 – 5) LRIP 5 GaN						FRP		SELS				GaN FRP (30 units / 4 Lots)															

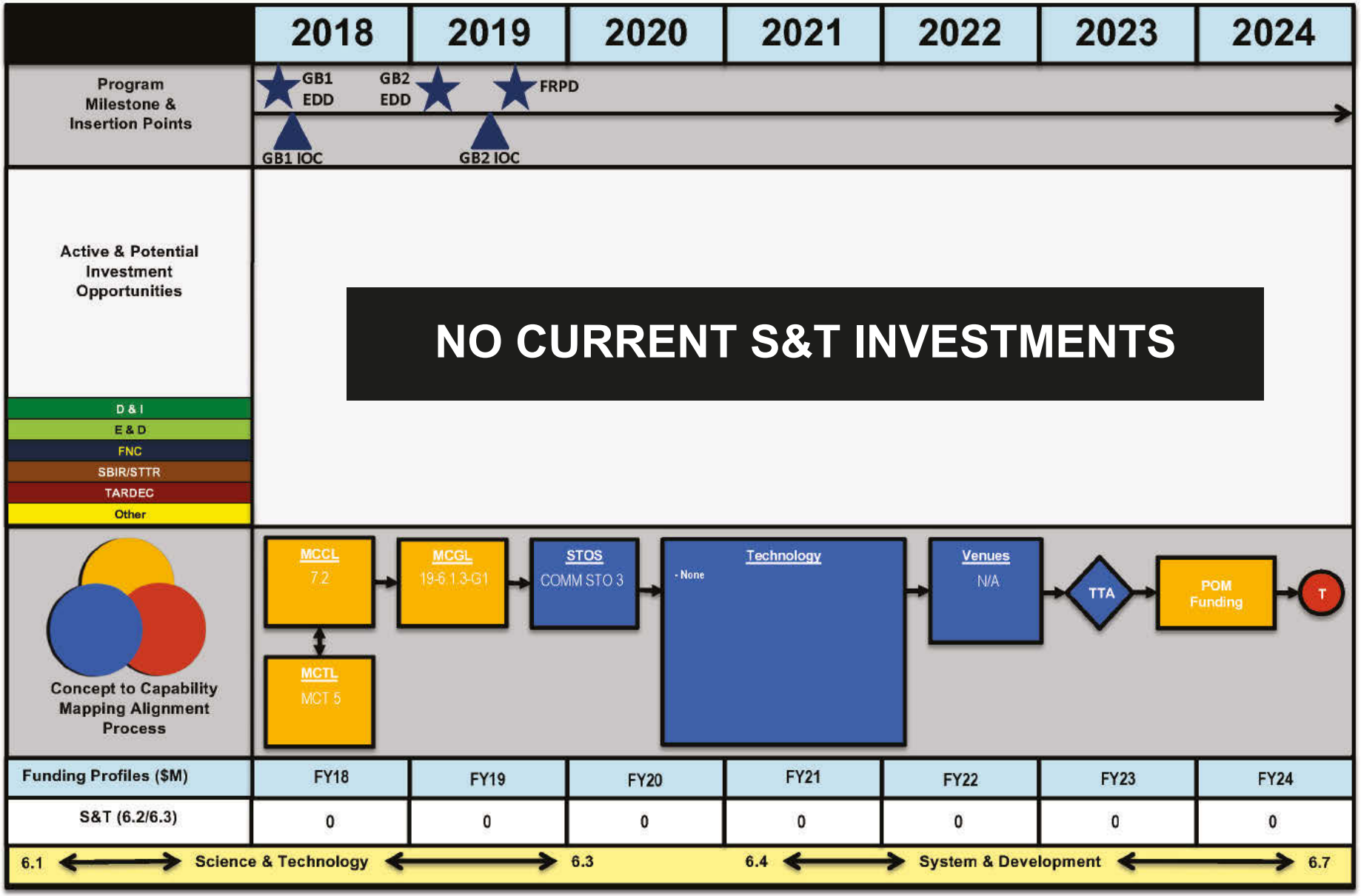
G/ATOR Technical Issue #1
Lowering Manufacturing Costs



G/ATOR Technical Issue #2
Increased Dynamic Range



G/ATOR Technical Issue #3
Advanced Electronic Protection



Section 7.6

JOINT LIGHT TACTICAL VEHICLE

Joint Light Tactical Vehicle (JLTV)

Program Background

The JLTV is an ACAT IC Army-Marine Corps defense acquisition program that introduces a new generation tactical wheeled vehicle to replace a portion of the services' HMMWV fleet. The program's goal is to develop a new family of multi-mission light tactical vehicles with superior crew protection and performance compared to the current HMMWV fleet. The JLTV family of vehicles will balance critical weight and transportability constraints against performance, protection, and payload requirements, while ensuring an affordable solution for the Army and Marine Corps.

The development of the JLTV reinforces the services' approach to interoperable platforms that provide expeditionary and protected maneuver capabilities to forces that the HMMWV fleet of vehicles currently support. The JLTV will improve payload efficiency through state-of-the-art chassis engineering, enabling the vehicles to be deployed with the appropriate level of force protection through the use of scalable armor solutions. The JLTV program will minimize maintenance costs through increased reliability, and better fuel efficiency. JLTVs can be configured to support multiple mission packages derived from two base vehicle configurations: the four-door Combat Tactical Vehicle and two-door Combat Support Vehicle. Commonality of components, maintenance procedures, and training among all vehicle configurations will also minimize total ownership costs.

Program Status

The JLTV program is currently in the Production and Deployment Phase. On 25 August 2015, Mr. Frank Kendall, former Under Secretary of Defense for Acquisition Technology and Logistics (USD AT&L) approved the Milestone C decision authorizing the program to enter into the Production and Deployment Phase and to proceed into LRIP. A production contract that included LRIP quantities was awarded to Oshkosh Defense that same day. The first LRIP test vehicle was delivered in September 2016. Production qualification and reliability qualification testing began during the 1QFY17, live fire test events began during the 2QFY17 and the Multi-service Operational Test and Evaluation (MOT&E) concluded in April, 2018. The Marine Corps is scheduled to achieve its IOC during the 1QFY20. Full Operational Capability (FOC) is scheduled for the 4QFY22.

JLTV's Top Technical Issues

1. Weight/Protection

The JLTV design meets competing requirements for a balanced solution of protection, payload, and performance. Although the JLTV armor system meets the functional requirements, reductions in weight and improvements in vehicle protection are desired. The program office is seeking lower weight and affordable survivability solutions for both the transparent and opaque armor systems, and is interested in evaluating active protection solutions.

2. Vehicle Network Architecture

The JLTV design was configured to support modularity and interoperability with existing and future combat enablers provided by other program managers throughout the DoD. Essential to this modularity and interoperability is the ability to provide an affordable vehicle network architecture that supports sharing of data resources for on-board systems. The vehicle network architecture delivers shared processing, common user interface screens, GPS data, remote radio control, electronic warfare system control, and weapon systems employment. The JLTVs design currently provides a network switch that can support multiple vehicle configurations, minimizes additional and/or re-wiring to support the new system's interfaces, and leverages shared processing (hosting virtualized software) to reduce additional hardware needs. The improved vehicle network solution must be scalable, interoperable, and forward-leaning in order to meet affordability constraints and the need for ever-increasing processing power. Therefore, the Marine Corps is seeking a low cost/affordable network switch which will provide a technically viable solution to provide for "plug-n-play" of additional C4 hosted solutions. Furthermore, solutions to remote radio control and growth in computer processing power in conjunction with expanded software (USMC-specific applications) capabilities are desired.

3. Noise Mitigation

The interior noise within the JLTV cabin can result in increased difficulty to communicate between personnel when an intercom system is not in use. The program office is seeking an affordable method to reduce internal noise. Primary noise sources include the engine alternator, vehicle exhaust, and drivetrain gearboxes.

4. Situational Awareness

The JLTV provides the required situational awareness (SA) outlined in performance documentation but the weight impact of additional transparent armor has limited the overall SA that is provided to the crew. To address this concern, the program office is seeking an affordable camera system to provide 360 degree SA for the crew. Desired capabilities include selectable and stitched video selection and non-thermal low light cameras. The desire is to use 3 or less cameras.

5. Tires

The expeditionary nature of the Marine Corps and JLTV leads to traversing challenging and unprepared terrain. Testing across varied terrain has resulted in damage to JLTV tires, primarily punctures in the tire sidewall. The program office is seeking a design that will reduce sidewall punctures from natural terrain features.

JLTV

Description: JLTV focuses on procuring a family of light tactical vehicles for combat mission roles, providing increased survivability, mobility, payload and reliability over the current family of HMMWVs. JLTVs will provide a high level of scalable protection, improved sustainment and net-ready maneuver platforms which are tactically mobile across all terrain.

Key Events

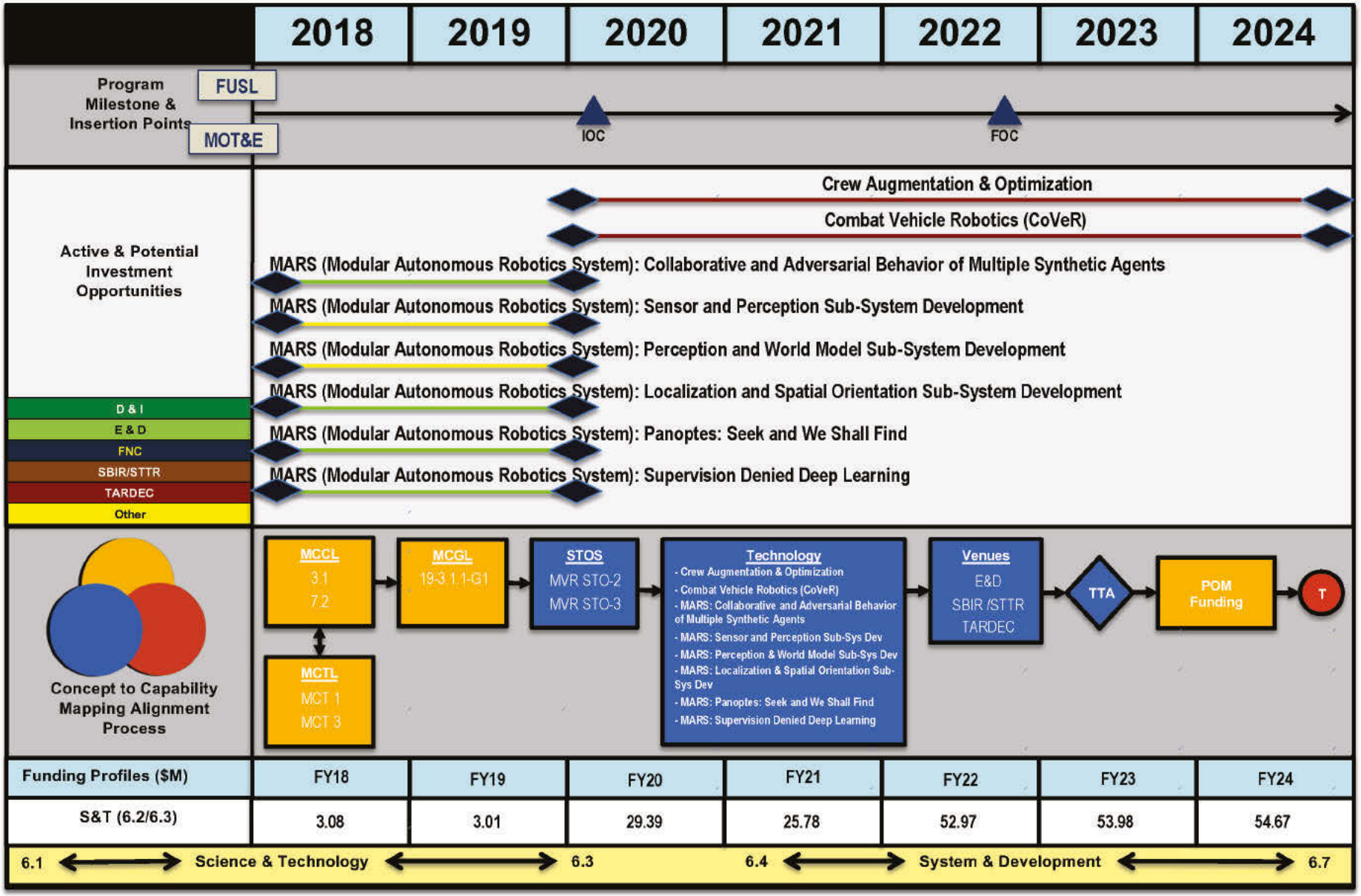
- Standup JLTV Fielding Team — Jan 19
- JLTV Operator Man — Jan– Apr 19
- JLTV Maint Man /IETM — Mar 19
- JLTV fielding to support est — Feb-May 19
- JLTV fielding to 3rd Bn, 8th Mar — Jun 19
- JLTV Training Package complete — Oct 19
- USMC IOC — Nov 19
- USMC FOC — Sep 22

Program Status

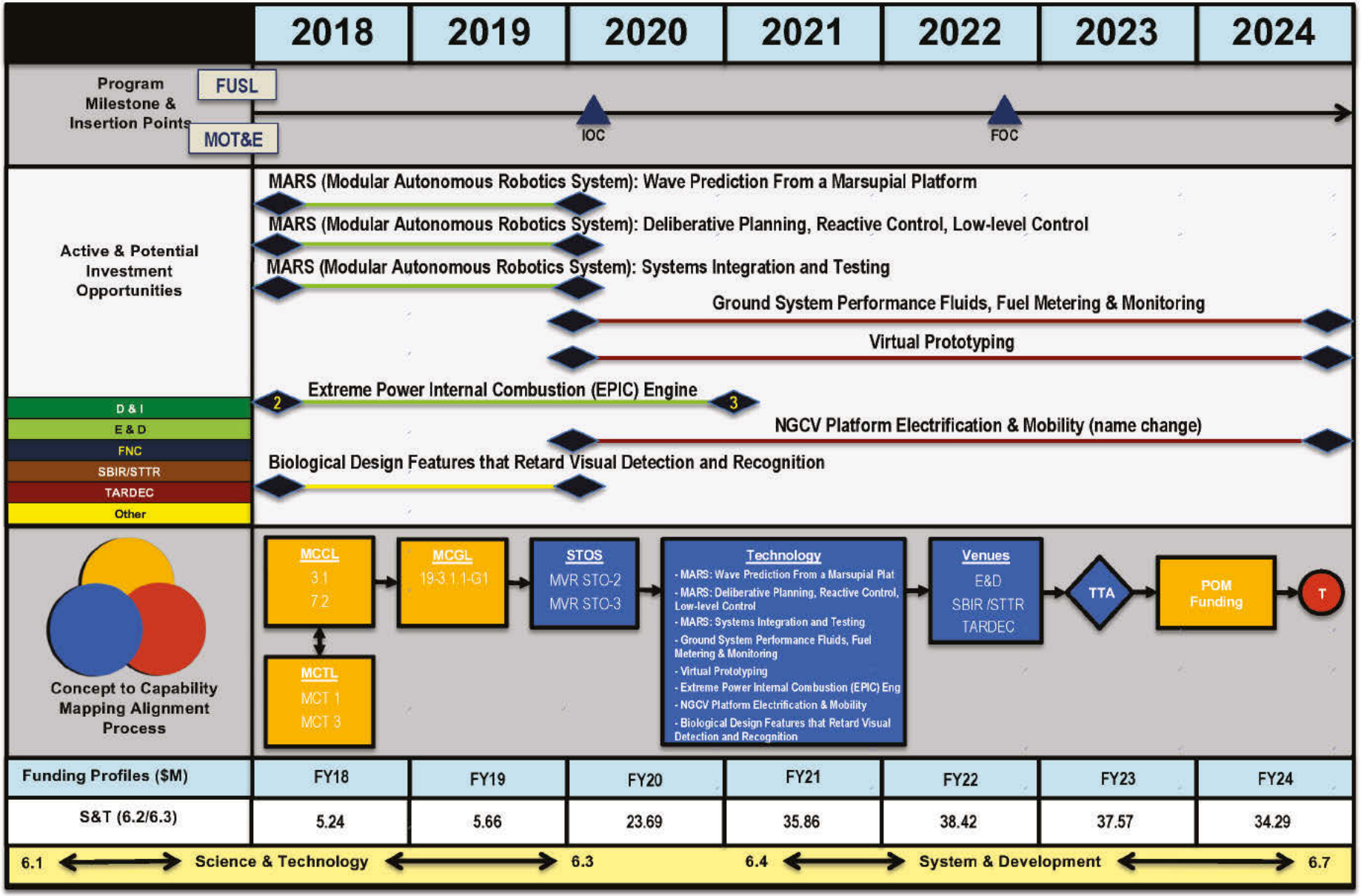
- MOT&E completed. Implementing changes to address driving issues outlined in the report
- USMC procurement objective increased from 5,500 to 9,091 vehicles

PROGRAM	PRIOR	FY18				FY19				FY20				FY21				FY22				FY23				FY24			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Milestones & Phases										IOC											FOC								
SETR Reviews			IATT			ATO																							
						PCA																							
Test Events		PQT/RQT																											
			MOT&E																										
		FUSL																											
Contract Events		LRIP																											
						Production																							
						FRP																							

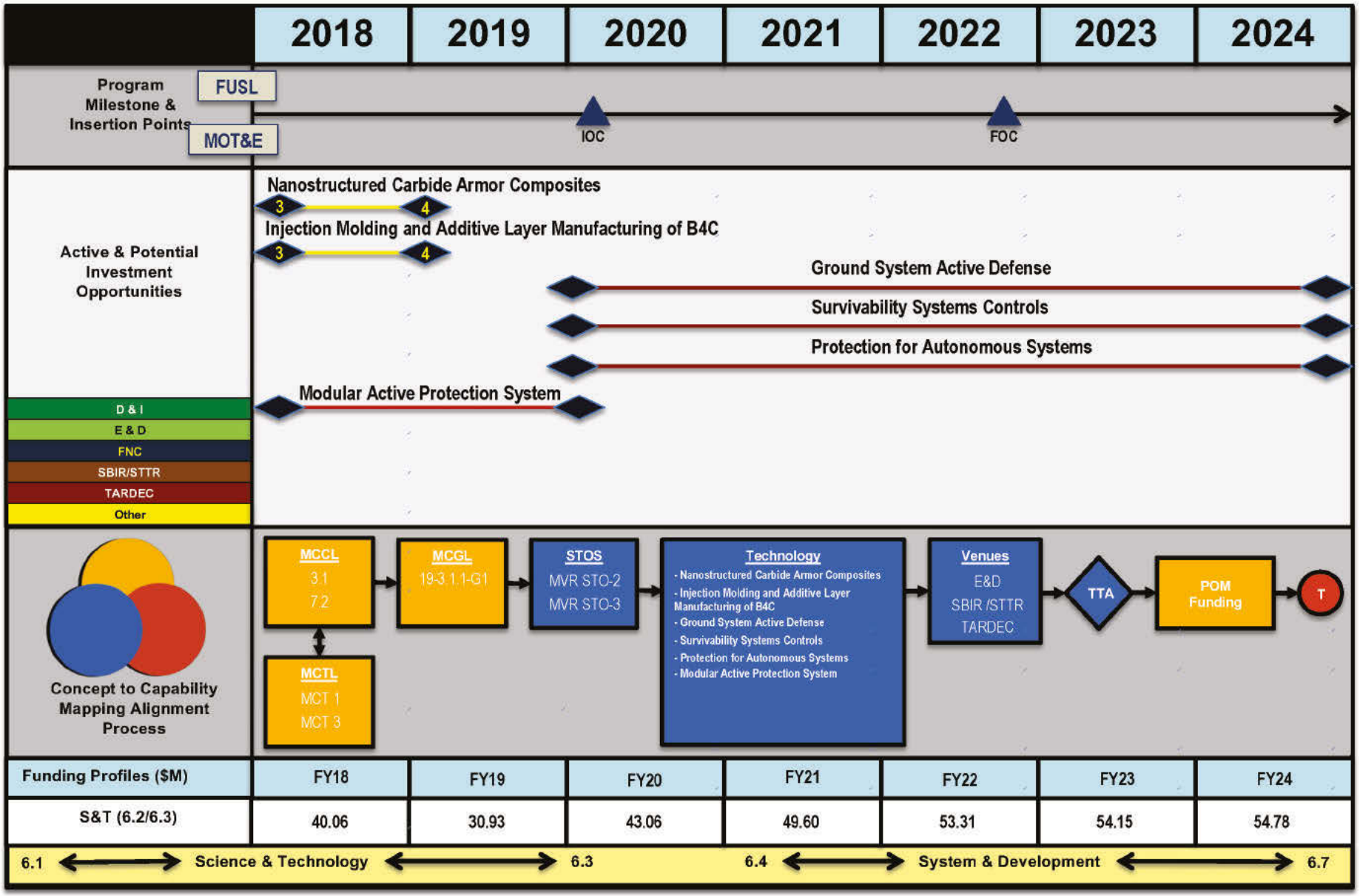
JLTV Technical Issue #1
Weight/Protection



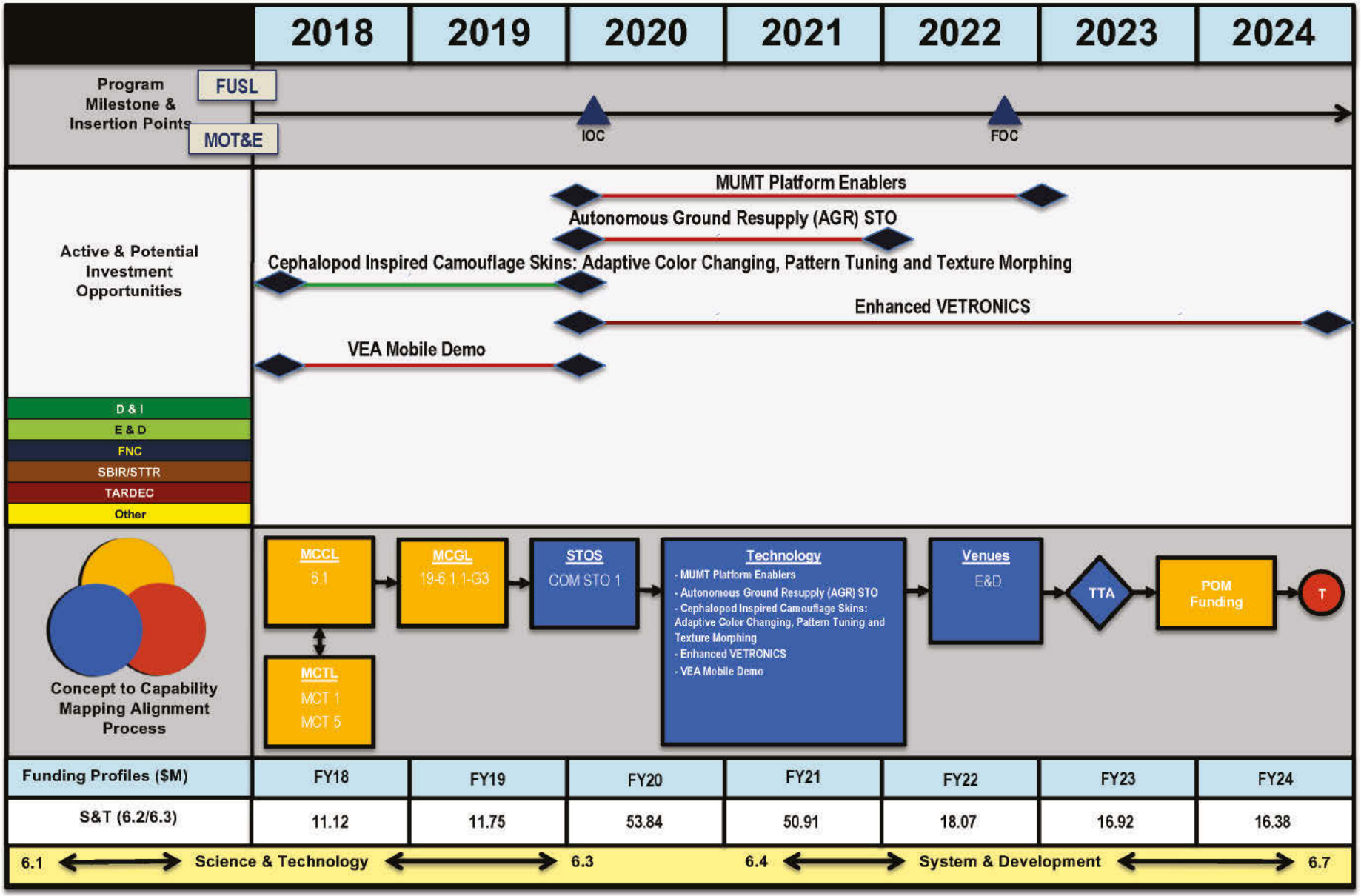
JLTV Technical Issue #1
Weight/Protection



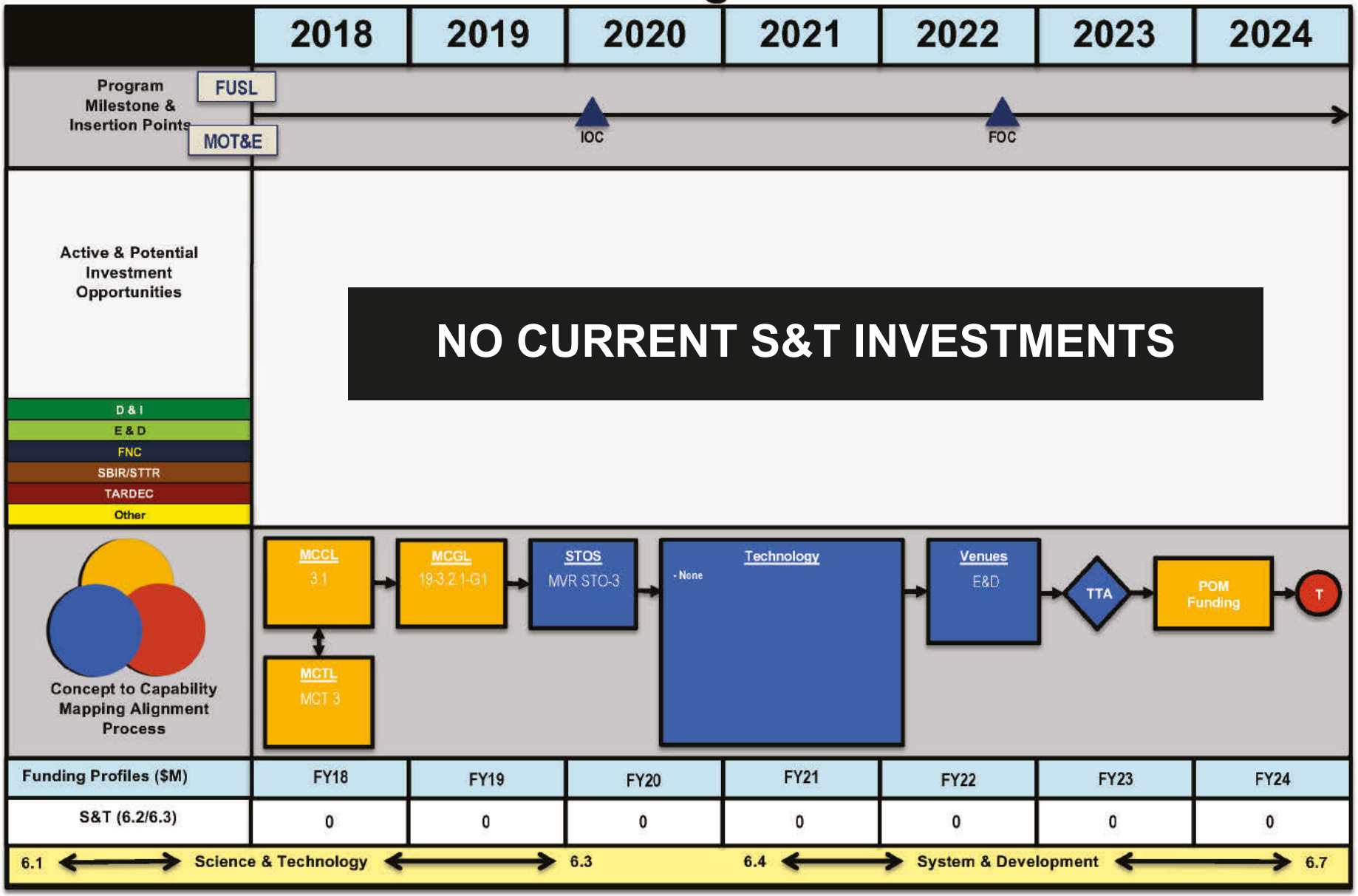
JLTV Technical Issue #1
Weight/Protection



JLTV Technical Issue #2 Vehicle Network Architecture



JLTV Technical Issue #3
Noise Mitigation



Section 7.7

LOGISTICS VEHICLE SYSTEMS REPLACEMENT

Logistics Vehicle Systems Replacement

Program Background

The LVSR serves as the Marine Corps' heavy logistics vehicle and transports large quantities of supplies across the battlefield. The LVSR is deployed in the Marine Logistics Group, Marine Divisions, and Marine Aircraft Wings.

The LVSR includes three variants: MKR 18 Cargo, MKR 16 Tractor, and MKR 15 Wrecker. The 5-axle vehicle has a 22.5-ton (20,412 kilograms) on-road/16.5-ton (14,969 kilograms) off-road payload, a 600-horsepower diesel engine, integrated control and diagnostic electronics, and factory-installed armor integrated into the vehicle design.

The LVSR can travel up to 65 miles per hour on paved surfaces and ford five feet of water. It has a cruising range of 300 miles. The tactical-distribution heavy hauler is capable of carrying fuel, water, ammunition, standardized containers, palletized cargo, and heavy equipment.

The all-wheel drive LVSR has a straight body design supporting its three distinct variants. The LVSR, with a standard two-person cab (and a third position for an optional machine gunner position), uses the TAK-4™ independent suspension system for improved mobility and off-road maneuverability. The acquisition objective of 2,000 vehicles has been fielded.

Program Status

The LVSR MKR 18 Cargo variant achieved Initial Operating Capability in September 2009, and the first LVSRs were deployed to Operation Enduring Freedom in support of the Mobile Trauma Bay in that same month. The LVSR is currently in sustainment.

LVSR's Top Technical Issues

1. Fuel Consumption

Given the LVSR's 2.0 miles per gallon fuel consumption rate and the fully burdened cost of fuel, even a moderate increase in fuel efficiency can potentially save lives and millions of dollars. Practical, cost-effective technologies are required to increase the fuel efficiency of the LVSR while maintaining payload capacity and mobility.

2. Increased Survivability

Technologies are required that maintain or increase survivability of the vehicle and occupants from emerging threats, including technologies that can increase armor protection while maintaining or reducing current weight; improvements in blast resistant seats; crew egress systems; and advanced fire-suppression systems. New methods to mitigate or repair current protection systems issues, such as transparent armor delamination, are critical to the ongoing sustainment of the Armored LVSR fleet.

3. Sustainability

Availability and cost of maintenance parts along with the absence of a verified Technical Data Package increase the challenges associated with sustaining the LVSR platform. Innovative solutions to procure replacement parts and systems that have become obsolete in the commercial market resulting in decreased maintenance time are beneficial.

4. Safety

Safety technologies are required to increase vehicle-to-driver feedback, vehicle control, and vehicle stability. They are also needed to mitigate the effects of vehicle rollovers while maintaining the ability of the LVSR to achieve its 30% on-road/70% off-road mission profile.

LVSR

ACAT II/P&D

Description: The Logistics Vehicle System Replacement (LVSR) is the Marine Corps' heavy-tactical distribution system, the LVSR Cargo variant transports bulk liquids ; ammunition; standardized containers; bulk, break-bulk, palletized cargo, and bridging equipment. The LVSR Wrecker variant performs heavy wrecker/recovery missions, while the LVSR Tractor variant tows heavy engineer equipment and combat vehicles

Key Events

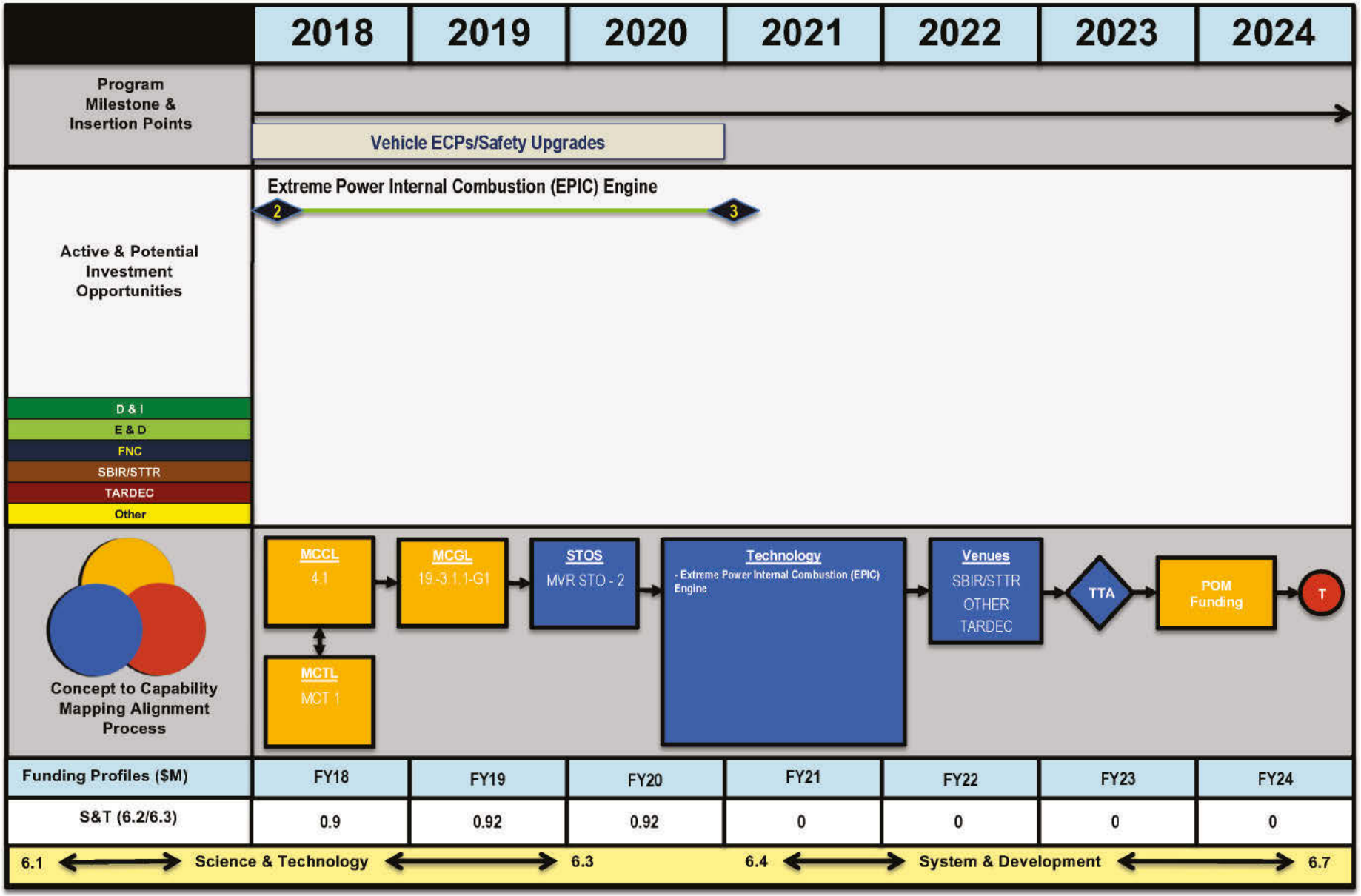
- Brake ECP Production Verification Testing: 1QFY19
- RIA armor technical data packages scheduled for completion and start of production: 1QFY19
- Emergency Egress Lighting ECP completion: 2QFY19
- 349 JBC-P systems fielding: 2QFY19

Program Status

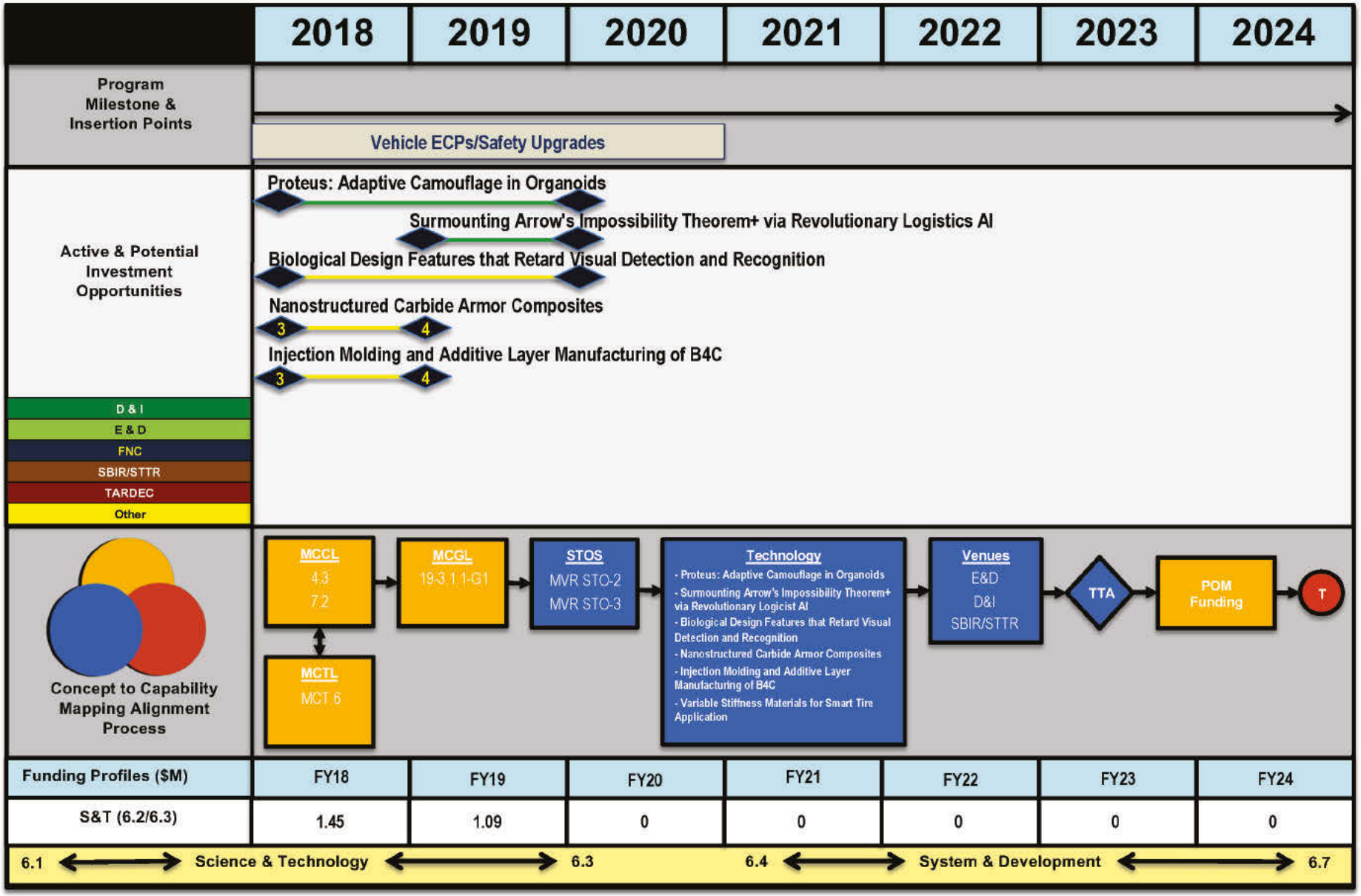
- AAO: 2,000
- PICA: USMC
- Program is in sustainment

PROGRAM	PRIOR	FY16				FY17				FY18				FY19				FY20				FY21				FY22			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Milestones & Phases																													
SETR Reviews		In Sustainment																											
Test Events																													
Contract Events																													

LVSR Technical Issue #1 Fuel Consumption



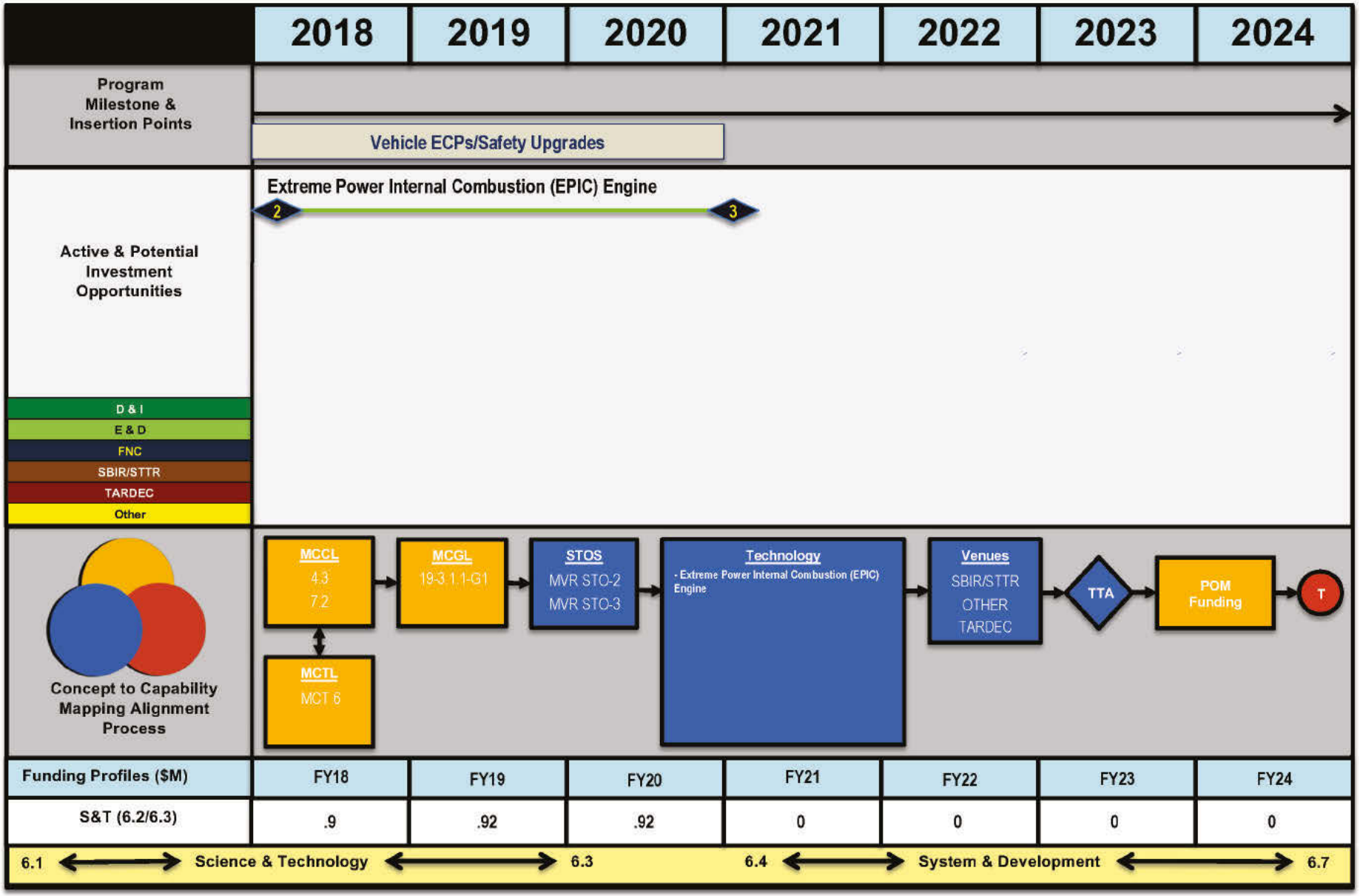
LVSR Technical Issue #2
Increased Survivability



Funding Profiles ($M)	FY18	FY19	FY20	FY21	FY22	FY23	FY24
S&T (6.2/6.3)	1.45	1.09	0	0	0	0	0

6.1 ⟷ Science & Technology ⟷ 6.3 6.4 ⟷ System & Development ⟷ 6.7

LVSR Technical Issue #3
Sustainability



Section 7.8

MEDIUM TACTICAL VEHICLE REPLACEMENT

Medium Tactical Vehicle Replacement (MTVR)

Program Background

The MTVR family of 6-wheel, 7-ton, all-terrain multi-purpose vehicles serves as the Marine Corps' primary means of moving supplies and equipment across severe environments. The vehicles were first fielded in 2001. The platforms have an on-road cruising range of 300 miles (483 kilometers), the ability to ford five feet (1.5 meters) of water and traverse 60% gradients and 30% side slopes with the maximum cross-country load. Operational performance is further enhanced by advanced technologies such as the TAK-4® independent suspension system and integrated control and diagnostics system. MTVR variants include: Standard Cargo and Extended Wheel Base Cargo Trucks, dump trucks, tractors, wreckers and High Mobility Artillery Rocket System Resupply Trucks. Approximately half of the vehicles are armored and some possess a reducible height capability.

More than 8,000 MTVRs are in service with the Marine Corps. The Navy Expeditionary Combat Command also possesses more than 1,800 MTVRs that are used in riverine and combat engineering missions.

To improve the vehicle's level of protection against mines and improvised explosive devices, the MTVR Armor System was designed as a permanent modification to the vehicle. It provides complete 360-degree protection as well as overhead and underbody protection for the cab occupants.

The MTVR was designed with a 22-year service life. Recently, the USMC extended the life of the vehicles to 2042. The program now has begun efforts for a possible Service Life Extension Program with the development of two Tech Demonstrator prototypes.

Program Status

The MTVR began service in 2001. More than 2,000 MTVRs have seen service in Iraq and Afghanistan. With its 70% off-road mission profile and highly survivable armor package, the MTVR has been used heavily in theater for logistics missions as well as for other missions as assigned. The MTVR is currently in sustainment.

MTVR's Top Technical Issues

1. Increased Survivability

Technologies are required that maintain or increase survivability of the vehicle and occupants from emerging threats, including technologies that can increase armor protection while maintaining or reducing current weight, improvements in blast resistant seats, crew egress systems, and advanced fire-suppression systems. New methods to mitigate or repair current protection systems issues such as transparent armor delamination are critical to the ongoing sustainment of the Armored MTVR fleet.

2. Sustainability

Availability and cost of maintenance parts along with the absence of a verified Technical Data Package increase the challenges associated with sustaining the MTVR platform. Innovative solutions to procure replacement parts and systems that have become obsolete in the commercial market resulting in decreased maintenance time are beneficial.

3. Safety

Safety technologies are required to increase vehicle-to-driver feedback, vehicle control, and vehicle stability. They are also needed to mitigate the effects of vehicle rollovers while maintaining the ability of the MTVR to achieve its 30% on-road/70% off-road mission profile.

MTVR

ACAT 1C/SUST

Description The Medium Tactical Vehicle Replacement (MTVR) is a medium lift tactical vehicle capable of transporting 7.1-ton off-road, 15-ton on-road and is available in six variants: cargo, extended wheelbase cargo, dump, tractor, wrecker and HIMARS Resupply Vehicle. Variants come both armored and unarmored. Some armored variants have reducible height armor for greater shipboard transport flexibility.

Key Milestones / Events

2QFY18
- IETM 30% Verification
- FE Testing

3QFY18
- IETM 60% Verification
- FE User Evaluation

4QFY18
- IETM 90% Verification
- FE ECP Approval, Install

1QFY19
- ECP Installs MAP-K
- Wrecker Automotive
- FY19 IETM Start of Work

2QFY19
- IETM 30% Verification
- MTVR TD Consortium Contract Award

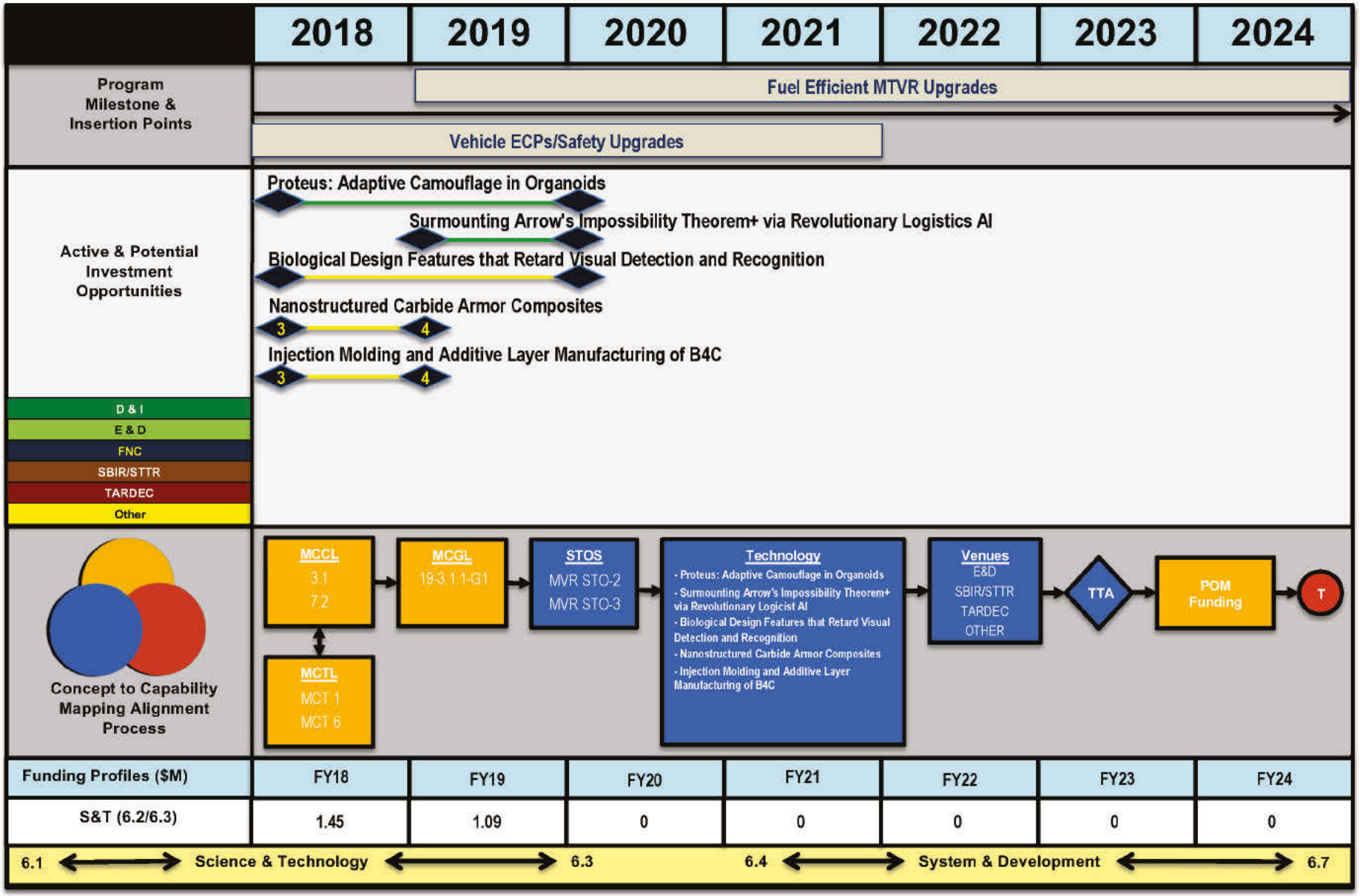
3QFY19
- HIMARS RSV Conversion Contract Award

Program Status

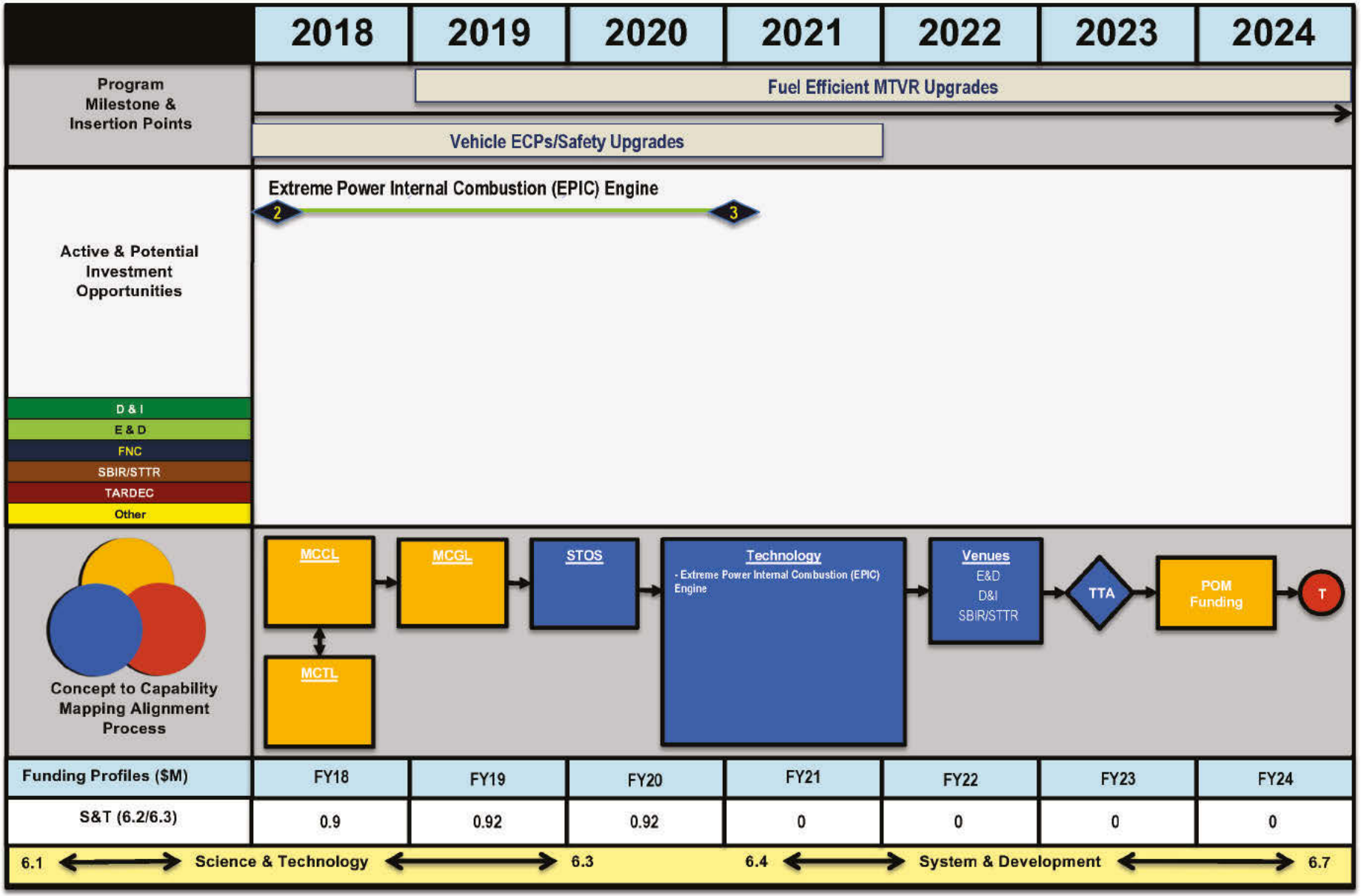
- AAO: 7824
- PICA: USMC
- Currently in sustainment

PROGRAM	PRIOR	FY18				FY19				FY20				FY21				FY22				FY23				FY24			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Milestones & Phases				FE ECP Approval																									
SETR Reviews				FE CDR		FE SVR						TD PDR	TD CDR																
Test Events				FE PPQT				Wrecker Auto				HIMARS RSS																	
Contract Events						Oshkosh Kit Contract																							
								HIMARS RSS Contract																					

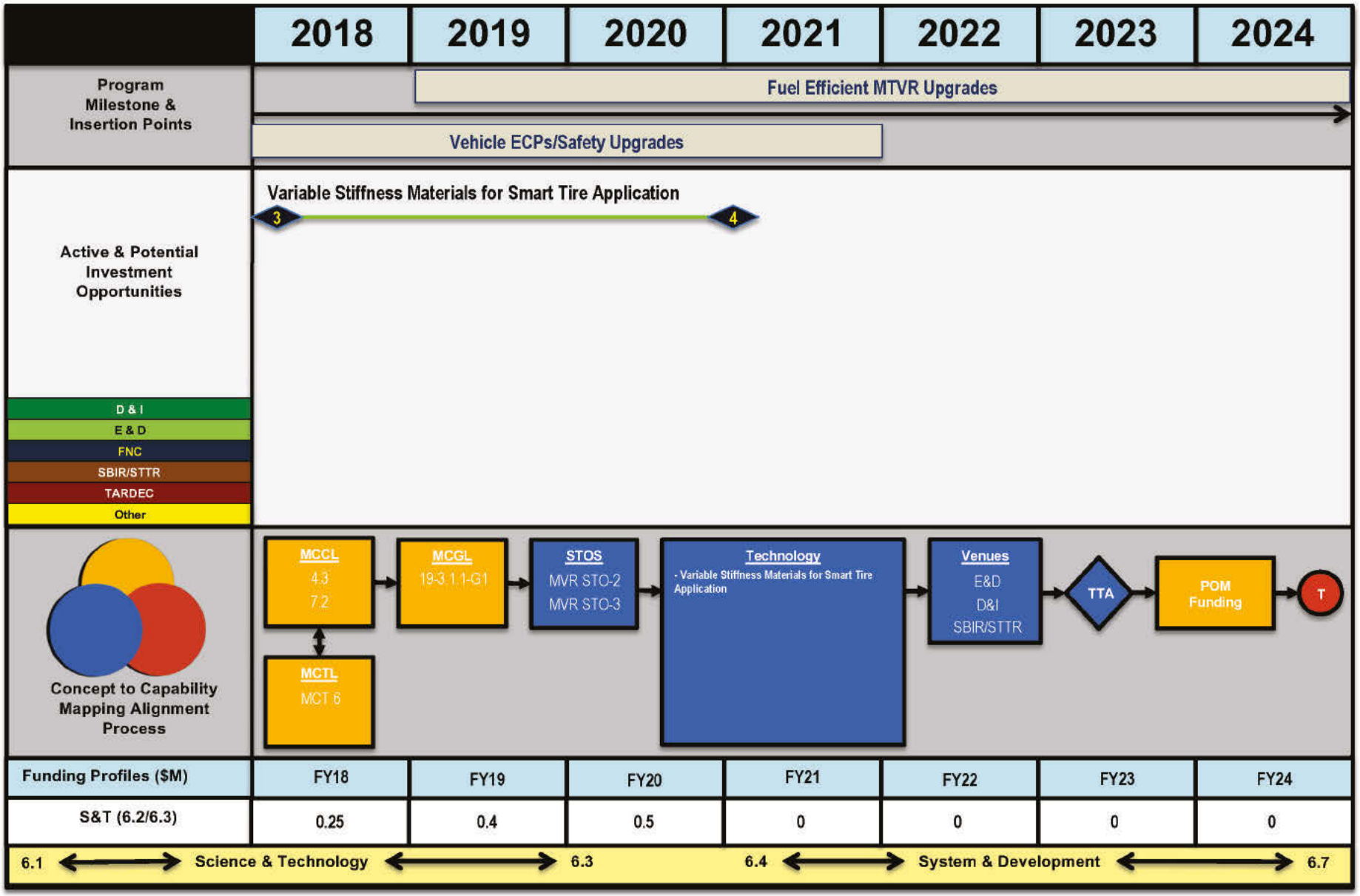
MTVR Technical Issue #1
Increased Survivability



MTVR Technical Issue #2
Sustainability



MTVR Technical Issue #3 Safety



Section 7.9

BUFFALO/COUGAR/M-ATV

From left to right: Buffalo, Cougar 6x6, M-ATV

Program Background

The Marine Corps' Category (CAT) III Buffalo, CAT I and CAT II Cougar variants, and M-ATV are designed to reduce casualties and increase the survivability of personnel subjected to mine explosions, IED detonations and Small Arms Fire. These vehicles were designed under the MRAP umbrella to meet requirements identified during Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF), with a focus on continual improvements in force protection and vehicle survivability through technology insertion. Now incorporated into the Medium and Heavy Tactical Vehicles fleet, the USMC will retain M-ATVs, Cougars, and Buffalos to satisfy the enduring requirement established by the Marine Corps Requirements Oversight Council.

The M-ATV, designed to operate in rugged terrain and on the primitive road network in OEF, provides better overall mobility characteristics than Cougar and Buffalo variants. It supports mounted patrols, reconnaissance, security, convoy protection, data interchange and command and control functions. The addition of the Underbody Improvement Kit further enhances the platform's protection against underbody threats. This kit combines armor and interior occupant upgrades, as well as automotive enhancements to increase survivability while maintaining platform safety and off-road capability.

The Cougar platform includes two primary vehicle variants, the CAT I and CAT II, all fielded with the upgraded independent suspension system. The CAT I (4X4) variant is capable of transporting five crew members and one gunner and supports small unit combat operations in urban and confined areas such as mounted patrols, reconnaissance, communications, and command and control. The CAT II (6X6) variant is capable of transporting nine crew members and one gunner and supports multi-mission combat operations in urban or confined areas such as convoy security, troop, and cargo transportation. In addition to these two primary variants, a select number of Cougar CAT I vehicles have been fitted with the Saber TOW system, which is an anti-heavy armor missile system. The TOW-integrated Cougars provide a survivable platform from which armored and urban enclosed threats can be defeated. Similarly, a select number of the Cougar CAT II vehicles have been modified into ambulance variants providing the ability

to transport and conduct emergency care on multiple critical battlefield casualties while in close proximity to enemy troops. The Cougar ambulance can transport up to four wounded patients or two patients carried on litters plus three crew members.

The USMC CAT III MK2A2 Buffalo is a six-wheel, six-passenger, all-wheel drive vehicle that was developed to conduct route clearance operations. The Buffalo is a blast-protected vehicle that operates in explosive hazardous environments and provides route clearance capability and personnel protection against IEDs, anti-personnel, and anti-tank mines. The Buffalo has a 30-foot articulating arm used to investigate suspected buried IEDs and enable the crew to classify the explosive hazard with precision while protecting the operator.

Program Status

M-ATVs, Cougars, and Buffalos are currently fielded to all three Marine Expeditionary Forces.

MRAP's Top Technical Issues

1. Transparent Armor

Advancements are needed in the area of transparent armor. The current transparent armor meets the requirements for ballistic performance; however, significant logistics and financial burdens are realized as a result of delamination. Delamination reduces visibility and makes it more difficult for the crew members to operate safely and view the surroundings effectively. Finding a solution that retains the armor's ballistic performance and maintains visibility would provide the USMC significant cost savings due to replacement and reduce the logistics burden.

2. Sustainability

Availability and cost of maintenance parts along with the absence of a verified Technical Data Package increase the challenges associated with sustaining the MRAP platforms. Innovative solutions to procure replacement parts and systems that have become obsolete in the commercial market resulting in decreased maintenance time are beneficial.

3. Stress Cracks in Welded Construction and Monolithic Hulls Both Using High-hard Steel

The fleet has undergone a reset at various depots and commercial locations in the continental Unites States. When hulls were stripped and inspected, stress cracks were discovered throughout the welded high-hard construction of Cougars and in high hard panels of M-ATVs. Significant cost was added to the process due to the extensive repair of cracks and replacement of high hard panels. Cracking continues to be discovered in previously reset assets. It is critical that the types of cracks be characterized, the root causes discovered, and repair procedures established that will maintain structural integrity, reduce future cracking, and provide required ballistic protection.

Buffalo

ACAT III / SUSTAINMENT

Description: The Buffalo is a heavy-category CAT III vehicle which provides a route clearance capability and personnel protection against anti-personnel (AP) and anti-tank (AT) mines. The Buffalo has an extendable boom with an attached claw and air digger. Because its primary mission is route clearance it was designated as a B0035K and assigned to Combat Engineer units. Since the vehicle has no weapon systems it cannot operate in a combat environment alone.

Key Events

- Complete delivery of reconditioned windshields: 30 Nov 18
- Complete delivery of Emergency Egress Light Kits: 3QFY19
- Complete Block III Upgrade: 31 Mar 19

Program Status

- AAO: 30
- PICA: US Army
- Program is in sustainment
- Block III Upgrade ongoing at MDMC Albany
  - Estimated completion of Block III Upgrade (examples below) by 31 Mar 19
    - Windshield Interface redesign
    - 3rd plane of egress
    - Camera upgrade

PROGRAM	PRIOR	FY18				FY19				FY20				FY21				FY22				FY23				FY24			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Milestones & Phases																													
SETR Reviews		ECP 3D CAD Mod &TPD																											
		ECP 51 TPD																											
Test Events				Rebaseline																									
				EEL																									
Contract Events						Block 3 Completion (6 Vehicles)																								

Cougar

ACAT III / SUSTAINMENT

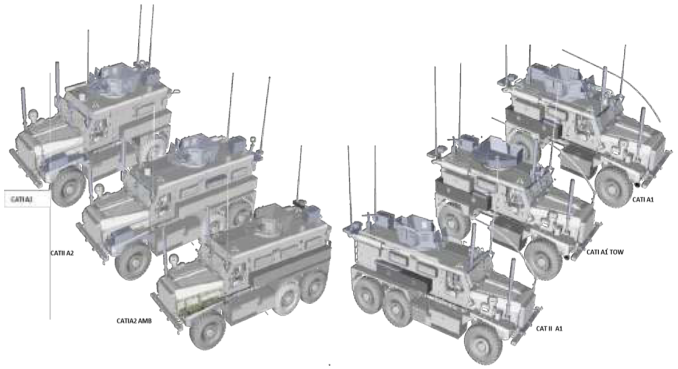
Description: The Cougar FoV is an infantry mobility vehicle designed to resist anti-vehicle mines, IED detonations, and small arms fire. The Cougar FoV is comprised of a four-wheel (4x4 CAT I) version and a six-wheel (6x6 CAT II) version. The Cougar FoV is used for small unit combat operations in urban or confined areas. The Cougar FoV mission includes mounted patrols, reconnaissance, communications, and command and control.

Key Events

- Egress Installation at SPAWAR: 2QFY19
- MROC AAO Decision: TBD

Program Status

- AAO: 1,272
- PICA: USMC
- Program is in sustainment
- Reset activities at Marine Depot Maintenance Command Albany & Barstow
- Delivery of Egress Production Kits ramped up to 115 per month
- Egress Kit Upgrade Installation for 179 USMC assets, 200 USN, and 215 USAF



PROGRAM	PRIOR	FY18				FY19				FY20				FY21				FY22				FY23				FY24			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Milestones & Phases		★ Egress FRPD																											
SETR Reviews		▲ Egress PRR			▲ Egress PCA	TDP Model																							
Test Events						Rebaseline																							
Contract Events																													

M-ATV

Description: The M-ATV provides protected ground mobility capable of operating in a threat environment involving ambushes employing the use of mines, Improvised Explosive Devices (IEDs), Rocket Propelled Grenades (RPGs), Explosively Formed Penetrator (EFPs), and Small Arms Fire (SAF).

Key Events

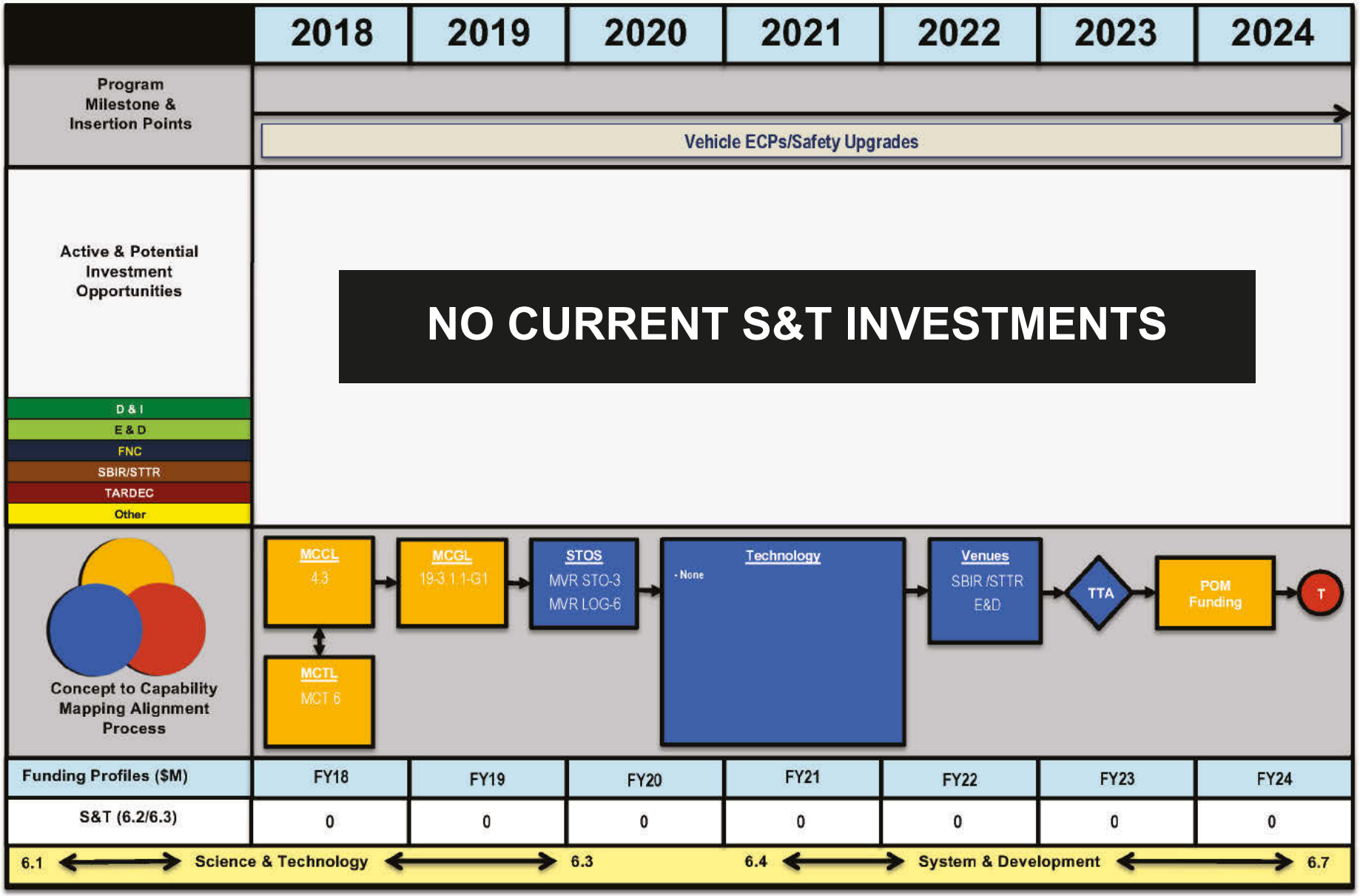
- MROC Decision Memorandum 03-2017 published maintains AAO of 705
- IROAN/RESET of remaining 239 M-ATVs deferred, awaiting MROC decision
- Redistribution of RESET vehicles to prepositioned locations will continue through FY18 and FY19

Program Status

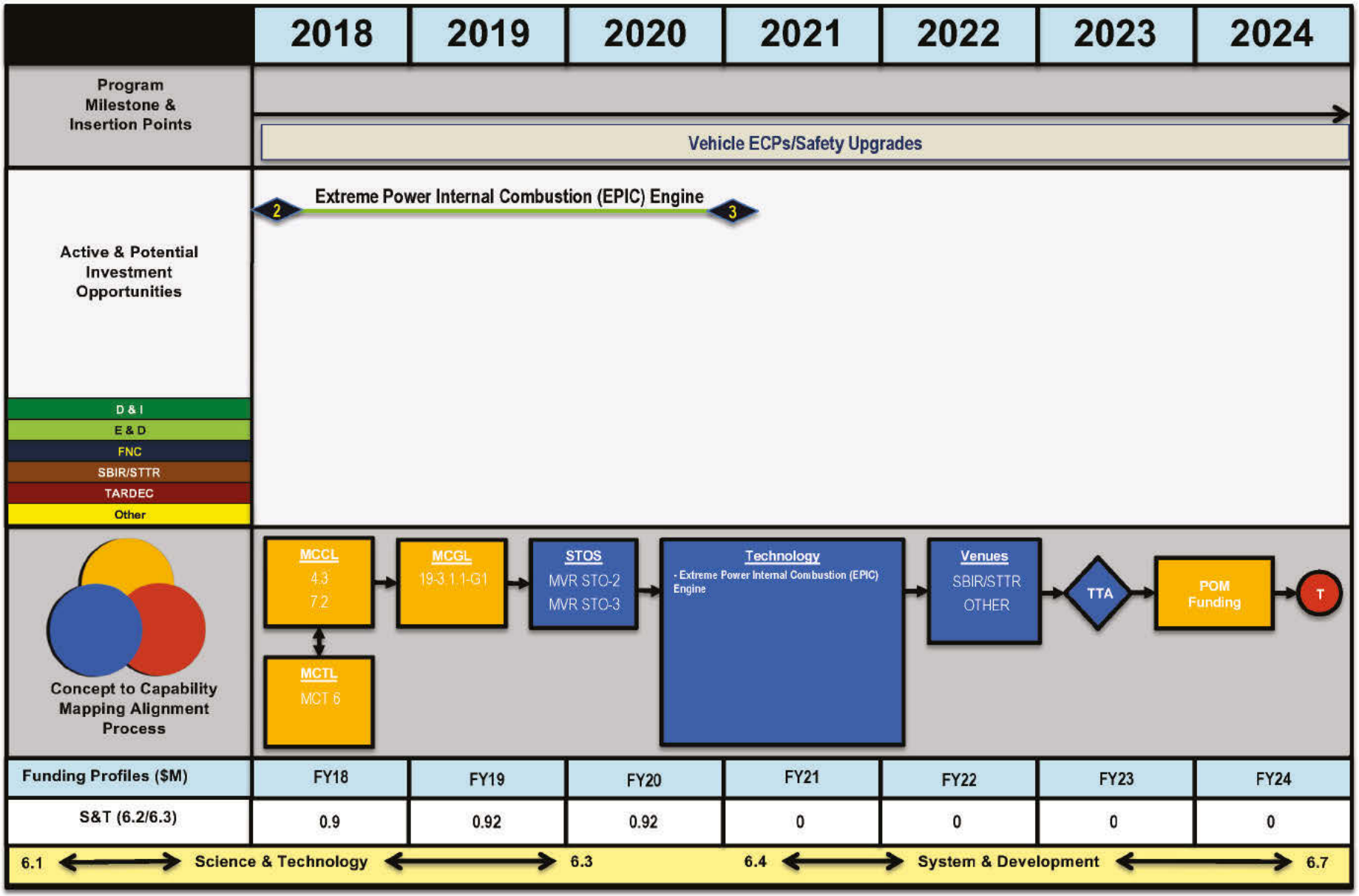
- AAO 705
- PICA: Army
- Program is in sustainment
- Reset activities are ongoing at Red River Army Depot, Maintenance Center Barstow
- Redistribution of reset vehicles to the MEFs is complete

PROGRAM	PRIOR	FY18				FY19				FY20				FY21				FY22				FY23				FY24			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Milestones & Phases						▲ MROC AAO Reduction Decision															▲ MROC Decision Service Life 2024									
SETR Reviews		Counter UAS																											
		C4ISR A-Kit Dev																											
Test Events																													
Contract Events		▲ LOGCOM Commercial Reset Contract Award																											

MRAP Technical Issue #1
Transparent Armor

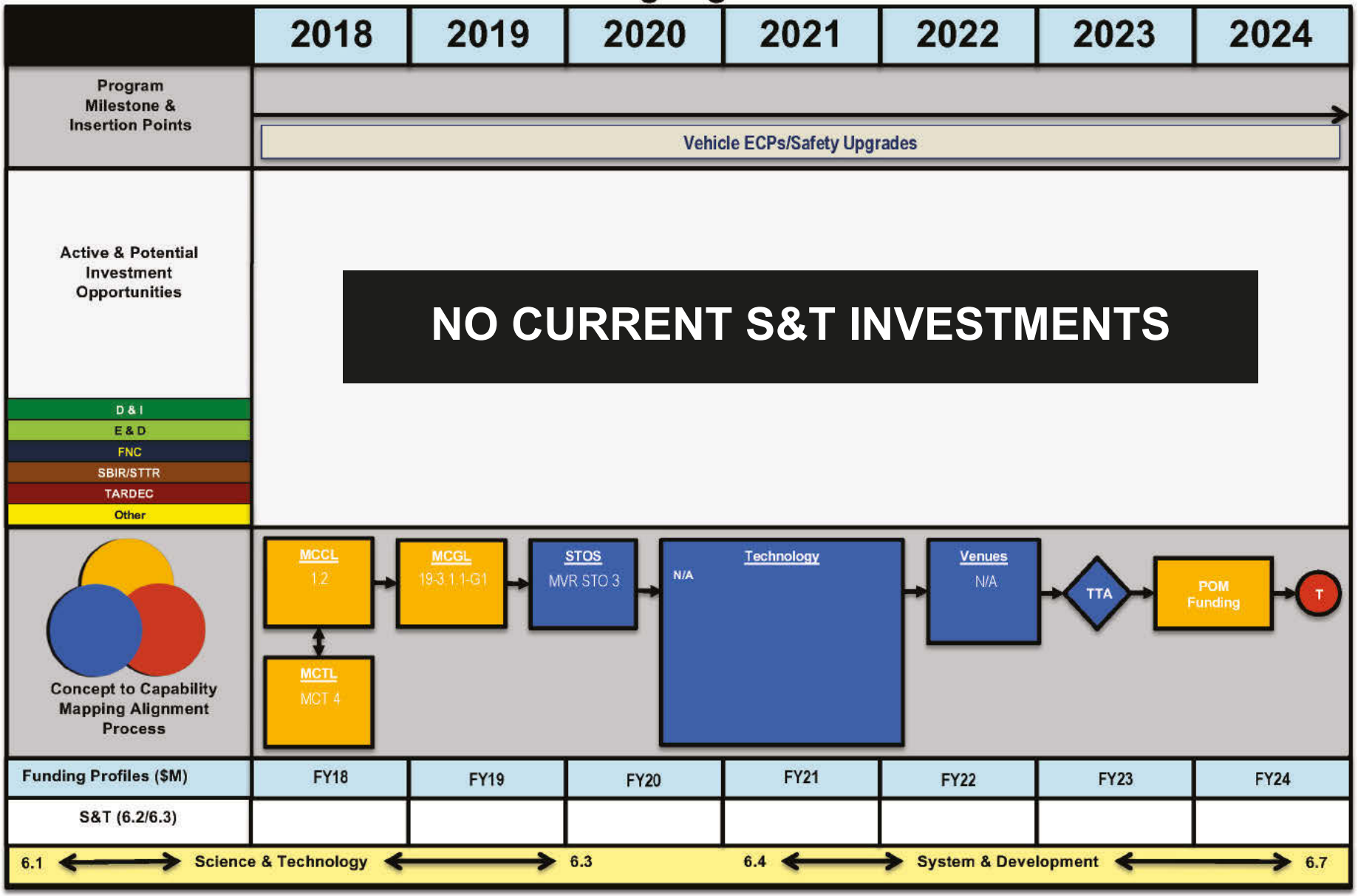


MRAP Technical Issue #2
Sustainability



MRAP Technical Issue #3

Stress Cracks in Welded Construction and Monolithic Hulls Both Using High-Hard Steel



Section 7.10

LIGHTWEIGHT 155MM HOWITZER

Lightweight 155mm Howitzer (LW155)

Program Background

Assembled by BAE Systems in Hattiesburg, Mississippi, the Lightweight 155 is a Marine Corps led joint program with the Army. The M777A2 replaced the Marine Corps' outdated M198 155mm weapon. The cornerstone of the Program Manager, Towed Artillery System (PM TAS) portfolio is the M777A2 Lightweight 155, the "Triple Seven," Howitzer.

The M777A2 is capable of firing standard unassisted projectiles to a range of 15 miles (24 kilometers), assisted projectiles to 19 miles (30.5 kilometers), and the Excalibur munitions to ranges in excess of 25 miles (40 kilometers).

The Triple Seven is the world's first artillery weapon to make widespread use of titanium and aluminum alloys. The the lightweight M777A2 can be air-lifted into remote high-altitude locations inaccessible by ground transportation and is capable of being transported by the Marine Corps' V-22 Osprey, as well as medium and heavy-lift helicopters.

Program Status

The M777 Program is currently conducting activities to "refresh" the system's digitized fire control system. A leap-ahead, towed artillery technology, the digital fire control has transformed how Marines employ artillery. As part of the refresh effort, a new Gunners Display and Assistant Gunners Display has been fielded. Using recent advances in display technology, the display has greater reliability along with greatly improved sunlight readability at a lower overall cost. Other ongoing refresh initiatives include a new Mission System Computer, Chief of Section Display, Power Supply, and upgraded system software. This

modernization effort commenced fielding in 2017 and is on track to complete fielding to active units in 2019.

LW 155's Top Technical Issues

1. Navigation in a GPS Denied Environment

The navigation systems for the digitized Howitzers are dependent on GPS assistance to maintain full operational capability. GPS denial would degrade Howitzer operational tempo and adversely impact delivery of timely fire in support of maneuver. Innovative approaches to counter or mitigate GPS denial at minimum size, weight, and power are required. The technologies could be items such as anti-jam antennas, sensor fusion schemes to leverage other available sensors, or other technologies to establish Howitzer location to better than 4m accuracy in a GPS-denied environment.

2. Safe and Transportable Battery High Capacity Technology

The M777A2 Howitzer powers its electronics with onboard (rechargeable) batteries. The current platforms have power requirements in excess of 2 KWH. Current High Capacity Battery technologies are mainly Lithium Ion based, that requires extensive regulatory qualification testing when the power pack exceeds 1 KWH. As a result, towed artillery program managers seeking improved battery performance are required to execute major development efforts-at significant expense-to design and qualify "system specific" power packs. To mitigate this, the PM requests that industry invest in safe and transportable battery technology that could be implemented into weapons systems in a modular fashion, without the need for "system specific" power packs and the extensive regulatory qualification requirements that come with them.

3. On System Power Generation and Conservation

The M777A2 Howitzer powers its electronics with onboard rechargeable batteries. The current platforms have power requirements in excess of 2 KWH. Due to the current limitations of high capacity batteries, the PM requests alternative innovative technologies that would provide power to the electronics on the Howitzer and extend runtime over the existing configuration. Alternatively, the PM requests investment by industry in displays, computers, and other electronic components with a decreased power consumption. Either solution, or a combination of both, would be used to increase operational capability.

4. Secure Wireless: Ruggedized/Low Energy

Communications between interfacing components of the M777A2 digital fire-control systems is accomplished over physical wires. The required cabling constrains the solution space and introduces points of failure, particularly for cables that need to flex or be moved as part of normal operations. A short-haul, low-energy wireless data transmission can eliminate use of physical wires. Although commercial standards exist, a ruggedized solution using a dongle-like device is required. The solution should be adaptable to enable either serial or Ethernet wireless communications between components. This technology may be incorporated into future devices such as wearable devices and onboard sensors.

5. Weight Management

As a result of various product improvements and corrections to field issues, the M777A2 weight has increased closer to the Joint Operational Requirements Document (JORD) threshold weight of 10,000 lbs. In addition, a developmental M777 Extended Range (M777ER) project may add an additional 800 lbs. to the Howitzer. PM TAS has begun to investigate alternative weight reduction measures and feels there is potential for insertion of lightweight materials into the M777ER adapter kit, which could also be applied to the baseline M777A2 Howitzer.

LW155

ACAT II Sustainment

Description: M777A2 (LW155) Provides direct, reinforcing, and general support fires to maneuver forces. Replaces the M198 howitzer as the general support artillery for light forces in the Army. Replaces all howitzers in all missions in the USMC.

Key Events

- Sep 18: Successfully fired 55 Cal Extended Range demonstrator at Yuma Proving Grounds
- USMC fully fielded: Army IBCT fieldings completed Sep 2018
- Nov 18: Release of tactical software version 4.1.4
- Nov 18: Swap of Digital Fire Control System – Refresh at Camp Pendleton, CA
- Dec 18: Retrofit of new Digital Fire Control System - Refresh components at Ft. Sill, OK

Program Status

- AAO: 360
- PICA: US Army
- Program is in sustainment
- Program supported by Performance Based Lifecycle Support (PBLCS) – FFP Contract with BAE Systems until May 2023
- Contract awarded for 18 additional howitzers for US Army

PROGRAM	PRIOR	FY18				FY19				FY20				FY21				FY22				FY23				FY24			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Milestones & Phases																													
SETR Reviews		In Sustainment																											
Test Events																													
Contract Events																													

LW155 Technical Issue #1

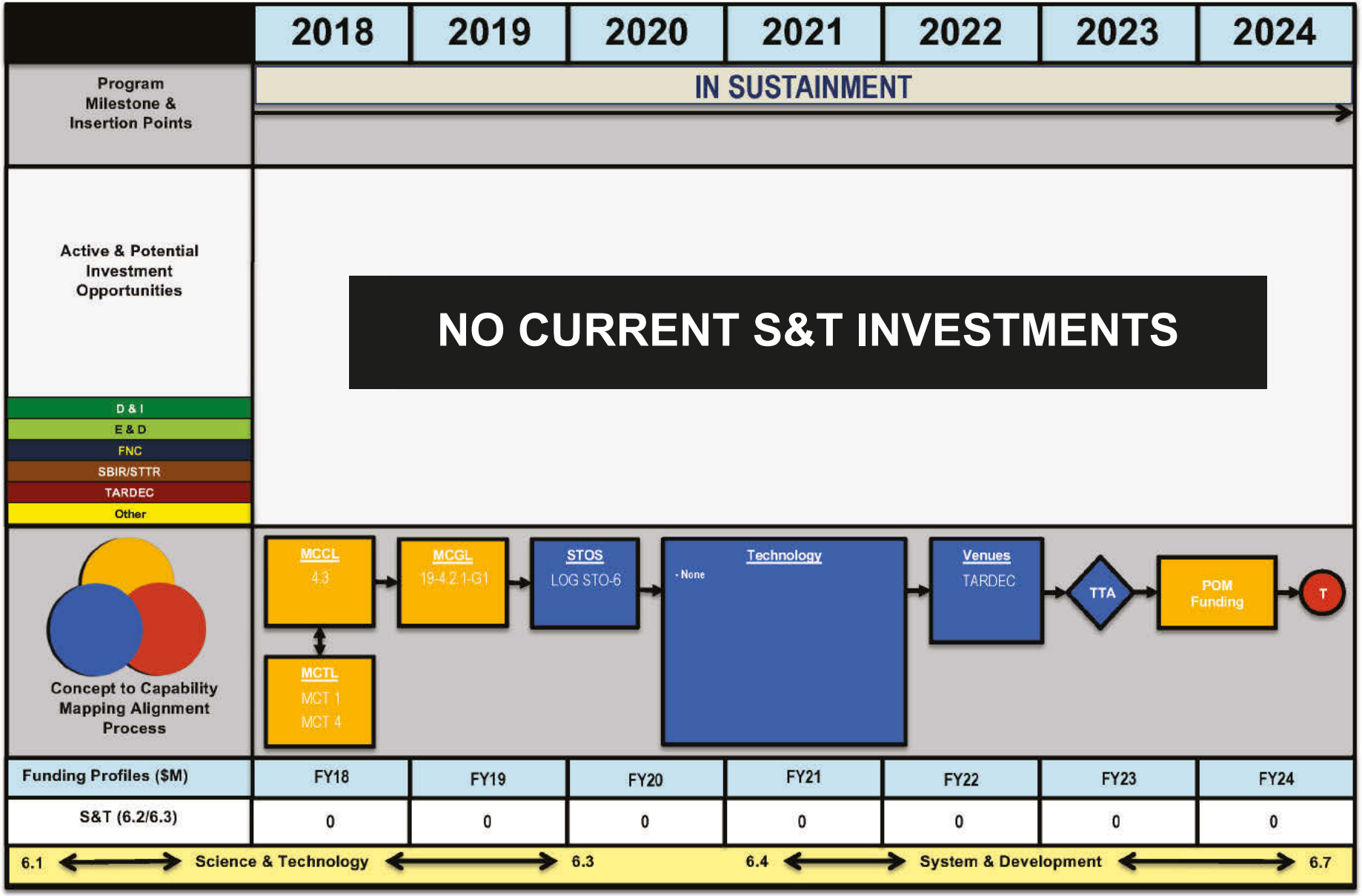
Navigation in a GPS Denied Environment

	2018	2019	2020	2021	2022	2023	2024
Program Milestone & Insertion Points	IN SUSTAINMENT						
Active & Potential Investment Opportunities	NO CURRENT S&T INVESTMENTS						
D & I							
E & D							
FNC							
SBIR/STTR							
TARDEC							
Other							
Concept to Capability Mapping Alignment Process	MCCL 7.2 / MCTL MCT 1 MCT 6	MCGL 19-5.2.2-G2	STOS MVR STO-3 MVR STO-8	Technology - None	Venues D&I	TTA	POM Funding → T
Funding Profiles ($M)	FY18	FY19	FY20	FY21	FY22	FY23	FY24
S&T (6.2/6.3)	0	0	0	0	0	0	0

6.1 ⟷ Science & Technology ⟷ 6.3 | 6.4 ⟷ System & Development ⟷ 6.7

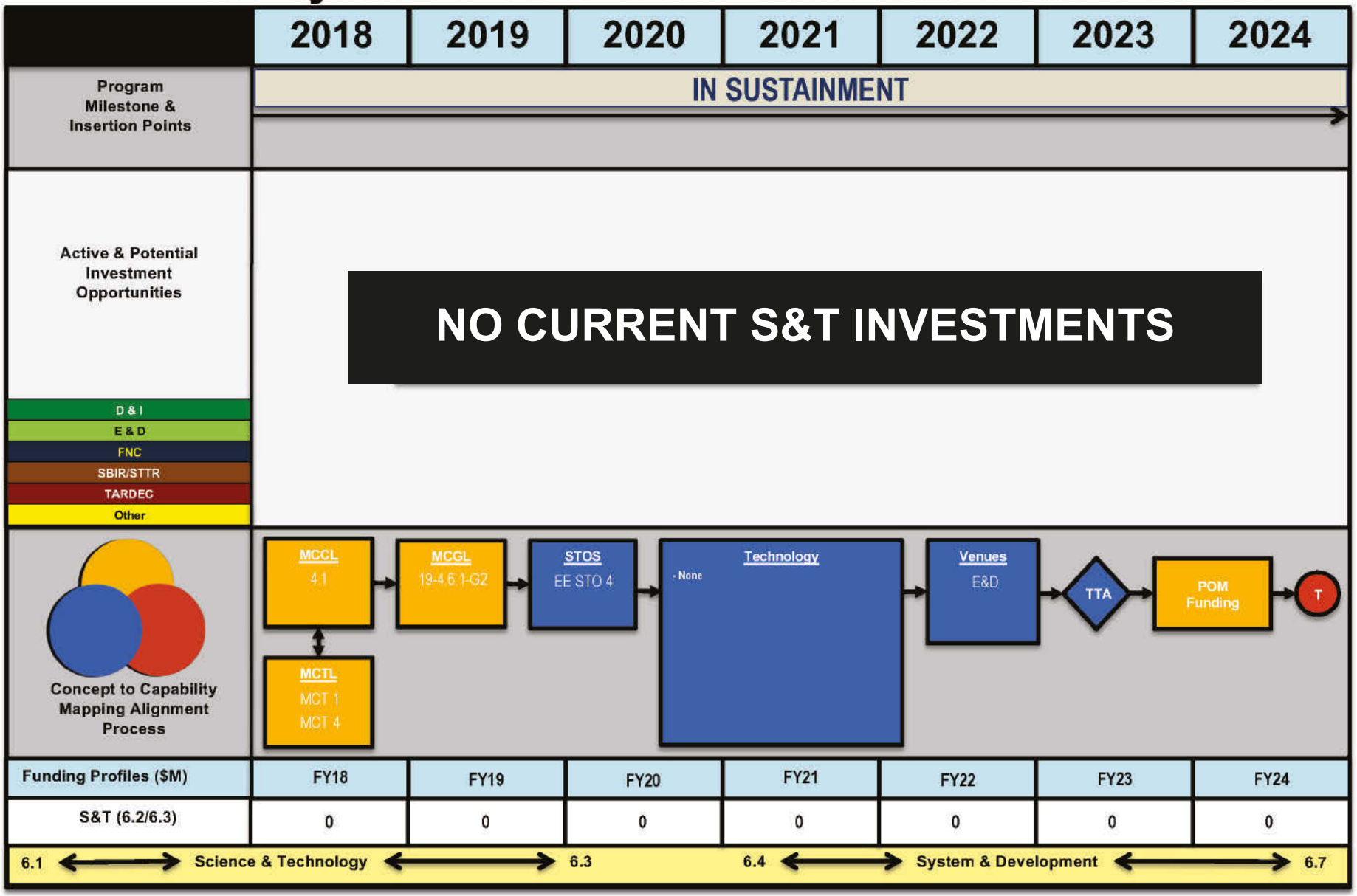
LW155 Technical Issue #2

Safe & Transportable Battery High Capacity Tech



LW155 Technical Issue #3

On System Power Generation and Conservation



Section 8.0

S&T VENUE LIST

The S&T Venue List was developed as a quick reference to identify opportunities within the S&T Enterprise.

This list is not a complete representation of venues that the government uses, but is a list of venues that PEO LS and the Marine Corps use to address specific technology needs and is provided so that PEO LS program offices and industry partners have a better understanding of the opportunities that these venues can provide.

Many venues identified on this list are very specific in nature and may provide funding from outside sources in order to address the needs of the individual program offices.

The included website addresses, email addresses, and phone numbers are verified annually. It is possible that some of these addresses and phone numbers have changed since this publication.

The columns headers describe who is eligible and how funding is secured along with eligibility of the project and the methodology used. Each venue has a different timeline for submission and duration.

Please see the next page for the PEO LS S&T Venue List.

VENUE	PURPOSE	WHO	WHEN	DURATION	FUNDING	ELIGIBILITY	TRL	CONTACT INFORMATION	WEBSITE
Cooperative Research and Development Agreements (CRADA)	Allows collaboration R&D between the Federal government and non-Federal partners to speed the commercialization of federally developed technology.	Varies Agencies DoD DoI	Each Service	0-5yrs	A formal written agreement (not a procurement contract or grant) between one or more federal laboratories and one or more nonfederal parties. The Federal laboratory provides personnel, facilities, equipment, or other resources without reimbursement (no funds) to the nonfederal party. The nonfederal party may supply the same resources, as well as funds, to Federal Labotory under the agreement. This Agreement provides the means to offer intellectual property rights and other fedral resources that would otherwise not be available to a non-federal partner in a manner consistent with the laboratory's mission.	Private Corp (U.S. or Foreign) Non-Profit and Not For Profit (U.S. or Foreign) State and Local Governments (U.S.) Other Federal Agencies	1 to 10	–	http://www.onr.navy.mil/Science-Technology/Directorates/Transition/Technology-Transfer-T2/Partnership-Options.aspx https://www.onr.navy.mil/en/work-with-us/technology-transfer-t2/Partnership-Options/DON-T2-handbook
Data Exchange Agreement (DEA)	Government-to-government subordinate agreement that provides a mechanism for the exchange of Research and Development information to: • create closer alliances • marshall U.S. and friendly foreign nations' technological capabilities • enhance the security of the free world • improve interoperability and standardization and identify cooperative opportunities	Navy International Program Office (NIPO)	Anytime, it usually takes about 12 months to establish a DEA	–	Any amount provided during any fiscal year in relationship to other funding Agreements. Valid for a period of five years Eligible to Renew Data exchange is: • "generic", not platform specific • subject to disclosure guidelines (case-by-case) basis	Navy, US Government Agencies and Foreign Governments	2 to 4	**Jay Wilkins** jacob.wilkins1@navy.mil (202) 433-5004	–
Discovery & Invention (D&I)	Fund Research to: • Develop Naval-relevant fundamental Knowledge • Provide the basis for future Navy and Marine Corps systems and • Maintain the health of the Defense Scientist and Engineer workforce	ONR	Yearly	0-2yrs	Estimated $200K Estimated 2 years BA1 or 2 Amount and period of performance of each selected proposal may vary depending on research area and the technical approach	Varies Depending on Source	1 to 4	–	http://www.onr.navy.mil/Science-Technology/Directorates/office-research-discovery-invention.aspx
Federally Funded R&D Centers (FFRDC)	Studies/Trade-offs of broad Naval operation and composition	CAN, APL, etc.	On-going	–	–	–	Varies	–	http://www.nsf.gov/statistics/ffrdclist/
Foreign Comparative Test (FCT)	Supports the warfighter by leveraging mature equipment and technologies from allied and coalition partner nations to satisfy U.S. defense requirements by: • Rapidly fielding quality military equipment • Eliminating unnecessary duplication of research, development, test, and evaluation • Reducing life cycle or procurement costs • Enhancing standardization and interoperability • Promoting competition by qualifying alternative sources • Improving the U.S. military industrial base	OSD/AT&L	OSD yearly call November	1-2yrs	$200K-2M Varies; total program is ~$32.8M 12 to 18 months	Government-to-Foreign Industry	7 to 9	**ONR FCT Program Manager** DoN_FCT_Contact@onr.navy.mil **OSD FCT Program** FCT@osd.mil **USMC FCT Program** Jacqueline Brent jacqueline.brent@usmc.mil (703) 432-8961	http://www.onr.navy.mil/en/Science-Technology/Directorates/Transition/Foreign-Comparative-Testing-FCT.aspx

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Future Naval Capabilities (FNC)	Provides the best technology solutions to stated OPNAV requirements by bundling discrete but interrelated S & T products that deliver a distinctly measurable improvement to align with the pillars of the Chief of Naval Operation's and the Commandant of the Marine Corps' vision for the future-Naval Power 21-and to focus on providing Enabling Capabilities (ECs) to close warfighting gaps.	ONR	ONR yearly call April/May	3-5yrs	0-$30M Each product ~$4.25M Each program ~$20-$30M	Each major Navy/Marine Corps Systems Command	3 to 6	**Mike Meyers** onr.fnc-team@navy.mil (703) 696-0784 **Robert McGahern** robert.mcgahern@navy.mil (703) 696-4531	http://www.onr.navy.mil/en/Science-Technology/Directorates/Transition/Future-Naval-Capabilities-FNC.aspx
Innovative Naval Prototype (INP)	To design, build, and demonstrate prototypes of innovative (high BA 2 or BA 3) technology. Focus on high-risk/high-payoff opportunities emerging from the D&I portfolio that can significantly impact Naval capabilities if technology can mature.	ONR	Yearly Call October	4-8yrs	$150-$200M 4-8 years	Anyone can propose an INP.	5 to 7	**Ken Heeke** kenneth.heeke@navy.mil	–
Joint Capabilty Technology Demo (JCTD)	The JCTD Program executes operational prototypes to address the most pressing technology gaps facing the Department of Defense. Starting in FY15 JCTD, projects primarily be initiated to develop technology solutions in the four EC&P focus areas	OSD / EC&P	Throughout FY15 and FY16	2yrs	0-$10M ~$10M of S&T funding plus in-kind funding from sponsors	Federal Service programs. Proposals must have a COCOM as the primary sponor and suport joint, coalition, or inter-agency capabilities.	6 to 9	jctdhelpdesk@osd.mil	http://www.acq.osd.mil/ecp/PROGRAMS/JCTD.html
Marine Corps Futures Directorate	To identify future challenges and opportunities, develop warfighting concepts, and comprehensively explore options in order to inform force development.	MCCDC Marine Corps Warfighting Lab	On-Going	–	–	–	–	mcwlpao@usmc.mil	http://www.acq.osd.mil/ecp/PROGRAMS/JCTD.html
Navy Manufacturing Technologies (ManTech) Centers of excellence	The Navy ManTech Program executes its projects primarily through its Centers of Excellence. The Centers of Excellence were established as focal points for the development and transition of new manufacturing processes and equipment in a cooperative environment with industry, academia and the Naval Research Enterprise	ONR	Annually	1-3yrs	$500K-$3M The Centers of Excellence: • Execute projects; manage project teams • Serve as corporate expertise in technological areas • Collaborate with acquisition program offices / industry to identify and resolve manufacturing issues • Develop and demonstrate manufacturing technology solutions for identified Navy requirements • Provide consulting services to Naval industrial activities and industry • Facilitate transfer of developed technologies The Navy Program currently has nine centers of excellence.	• defense contractors • the Naval Research Enterprise • Navy acquisition Program Offices • academia	5 to 7	–	https://www.dodmantech.com/mantechprograms/CentersOfExcellence

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Quick Reaction Fund (QRF)	Focus is on shorter cycle time Conventional Forces and responding to emergent needs during the execution years that take advantage of breakthroughs in rapidly evolving technologies	OSD	Proposals may be submitted any time during the year as opportunities and need arise	0-1yr	$100K- $1M Max	_	7 to 9	_	https://www.acq.osd.mil/ecp/DOCS/NDIA_ST_Conference_2018_MAR.pdf https://www.acq.osd.mil/ecp/DOCS/ECP_Mission_Overview_May2015.pdf
Rapid Innovation Fund (RIF)	The Rapid Innovation Fund (RIF) is designed to transition innovative technologies, primarily from small businesses, that resolve Department of Defense operational challenges.	OSD / ONR(BAA)	Annual BAA Issued early September	24 months Max	$3M Max	Industry and Academia Navy laboratories may team with other responsible sources from academia and industry but are not eligible to receive awards.	5 to 7	**DoN RIF Program** **Scott Bartlett** scott.bartlett@navy.mil 703-696-0340 **USMC RIF Program** **Fatnassi Saber** saber.fatnassi@usmc.mil (703) 432-3762	http://www.defenseinnovationmarketplace.mil/rif.html
Rapid Reaction Fund (RRF)	Focus is on emerging technologies addressing irregular warfare capabilities with the goal of leveraging the DoD science and technology base, other federal departments, academia and industry to accelerate fielding of affordable, sustainable capabilities and concepts to counter emerging threats	OSD	Proposals may be submitted any time during the year as opportunities and need arise	6-8 months	Varies	Varies	7 to 9	**Jon Lazar** jon.e.lazar.civ@mail.mil **Glenn Fogg** glenn.a.fogg.civ@mail.mil (703) 697-4183	http://www.acq.osd.mil/rd/organization/
SBIR Phase I Start up	Feasibility study to evaluate the scientific and technical merit of an idea	ONR	Tri Annual Solicitation November April July	0-.5yr	$150K Max $80K with $70K option 6 months Competitive Solicitation	Small Businesses	0 to 3	**Robert Smith** Robert.L.Smith6@navy.mil (703) 696-7954	http://www.navysbir.com/
SBIR Phase II	Expand on the results of and further pursue the development of Phase I.	ONR	At completion of Phase I	0-2yrs	Based on the results achieved in Phase I, usually does not exceed $1,000,000 total costs for 2 years	Small business that has successfully completed Phase I	2 to 7	**Robert Smith** Robert.L.Smith6@navy.mil (703) 696-7954	http://www.navysbir.com/
SBIR Phase III	Commercialization of the results of Phase II	ONR	As Phase III funds are identified	1-3yrs	$1.5M Max $Unlimited Unlimited time Funding can come from the Government or Private Sector	Any SBIR company that has identified non-SBIR source of funds	6 to 9	**Robert Smith** Robert.L.Smith6@navy.mil (703) 696-7954	http://www.navysbir.com/
Small Business Innovation Research (SBIR)	Funds the critical startup and development stages and encourages the commercialization of technology, product or service from a Small Business (NTE 500 employees)	_	Tri Annual Call March July October	_	Determine topic feasibility and scientific or technical merit in 3 phases.	Determine topic feasibility and scientific or technical merit in 3 phases.	0 to 9 over the 3 phases	**Robert Smith** Robert.L.Smith6@navy.mil (703) 696-7954	http://www.navysbir.com/index.html https://www.sbir.gov/about/about-sttr

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Small Business Technology Transfer (STTR)	Foster the innovation necessary to meet the nation's scientific and technological challenges. Provides: • Funding opportunities in the federal innovation research and development arena • Expansion of public/private sector partnership to include the joint venture opportunities for small business and the nation's premier nonprofit research institutions	OSD/ONR/NAVAIR	Annual Call June	–	Determine topic feasibility and scientific or technical merit in 3 phases.	Small Businesses partnered with Research Academia and nonprofit research institutions	2 to 4	**Robert Smith** Robert.L.Smith6@navy.mil (703) 696-7954	http://www.navysbir.com/index.html https://www.sbir.gov/about/about-sttr
STTR Phase I Start up	Feasibility study to evaluate the scientific and technical merit of an idea	ONR	Annual Topic Call June	0-1yr	$150K Max $80K with $70K option 7 months Competitive Solicitation	STTR Partnerships: Small Businesses partnered with eligible Research Institutions	1 to 3	**Robert Smith** Robert.L.Smith6@navy.mil (703) 696-7954	http://www.navysbir.com/index.html https://www.sbir.gov/about/about-sttr
STTR Phase II	Expand on the results of Phase I and develop a prototype product or process.	ONR	At completion of Phase I	0-2yrs	$1,000,000 Max $500K with $250K option 18 months with 9 month option Government Selected	STTR Partnerships with successful phase I completion	2 to 5	**Robert Smith** Robert.L.Smith6@navy.mil (703) 696-7954	http://www.navysbir.com/index.html https://www.sbir.gov/about/about-sttr
STTR Phase III	Commercialization of the results of Phase II	ONR	As Phase III funds are identified	1-3yrs	$3M Max $Unlimited Unlimited time Funding can come from the Government or Private Sector	Any STTR company that has identified non-STTR source of funds; No research institution partnership required	6 to 10	**Robert Smith** Robert.L.Smith6@navy.mil (703) 696-7954	http://www.navysbir.com/index.html https://www.sbir.gov/about/about-sttr
Swamp Works	Explores innovative, high-risk and disruptive technologies and concepts	ONR	Leverages short exploratory studies to examine the maturation of a proposed technology before making substantial investments. Insertion within 1 to 3 years	1-3yrs	$100K-$1M Max Leverages short exploratory studies to examine the maturation of a proposed technology before making substantial investments. Insertion within 1 to 3 years.	Substantial flexibility in planning and execution; The process allows for the shortest possible technology development timeframe; A formal transition agreement is not required; Programs routinely have strong advocacy outside of the ONR either from the acquisition community or the fleet.	2 to 6	**Dr. Michael M. Simpson** naval_STEM@navy.mil	http://www.onr.navy.mil/Science-Technology/Directorates/office-research-discovery-invention/swampworks-innovation.aspx
Technology Insertion Program for Savings (TIPS)	To increase the rate that new cutting edge technologies are inserted into DoN Acquisition programs in order to significantly reduce operations and maintenance support costs. Structured to rapidly transition applicable commercial off-the-shelf solutions and late-stage development technologies from any source to meet an immediate need.	ONR	NAE CTO call: September Proposals due: October ONR call: November Proposals due from SYSCOMs: 1 Feb	0-2yrs	$2M Max <24 months	Program Office military/civilian (can collaborate with Navy contractors) Requires: Program Office Acquisition Sponsorship OPNAV Resource Sponsorship (responsible for out-year funding)	Start 6+, End 8+	–	–
Technology Solutions	Hot line for meeting current fleet needs Rapid-response S&T solutions to immediate Fleet/Force needs identified by Sailors and Marines; addresses: • New applications of emerging/existing technologies • Well-bounded problems with S&T solutions • Impact to the individual warfighter	ONR	Accepts on-going requests	Maximum 12 months to complete Goal: prototype demo within 15 to 18 months of request	Average project ~ 750K	US Navy and Personnel only Solution developed by Naval Research Enterprise (NRE) or National LabsCommercial &/or academic partners are common	End 6+	**Dr. Michael M. Simpson** naval_STEM@navy.mil	http://www.onr.navy.mil/techsolutions/ http://www.onr.navy.mil/Science-Technology/Directorates/Transition/tech-solutions-innovation.aspx

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University Research Initiatives (URI)	The University Research Initiative seeks to improve the quality of defense research conducted by universities and supports the education of engineers and scientists in disciplines critical to national defense needs. The initiative is a collection of specialized research programs performed by academic research institutions: • Defense University Research Instrumentation Program • DoD Experimental Program to Stimulate Competitive Research • Multidisciplinary Research Program of the University Research Initiatives • The Presidential Early Career Award for Scientists and Engineers Program • Young Investigators Program	Universities	DURIP (FY2016) : Submit by 25 September MURI (for FY16): White Papers due 08 September 2015 Full Proposals due 07 December 2015	2-5yrs	$50K-$5M Max Varies by Program Typically NTE $50K - $1M per year Funded incrementally or as options NTE 2 to 5 years	U.S. institutions of higher education with degree granting programs in science, math, or engineering	1 to 4	–	http://www.onr.navy.mil/Science-Technology/Directorates/office-research-discovery-invention/Sponsored-Research/University-Research-Initiatives.aspx

ATIP

Advanced Technology Investment Plan

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PEO Land Systems Marine Corps

It's All About the Warfighter

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