Advanced Planning Briefing to Industry

Presented by

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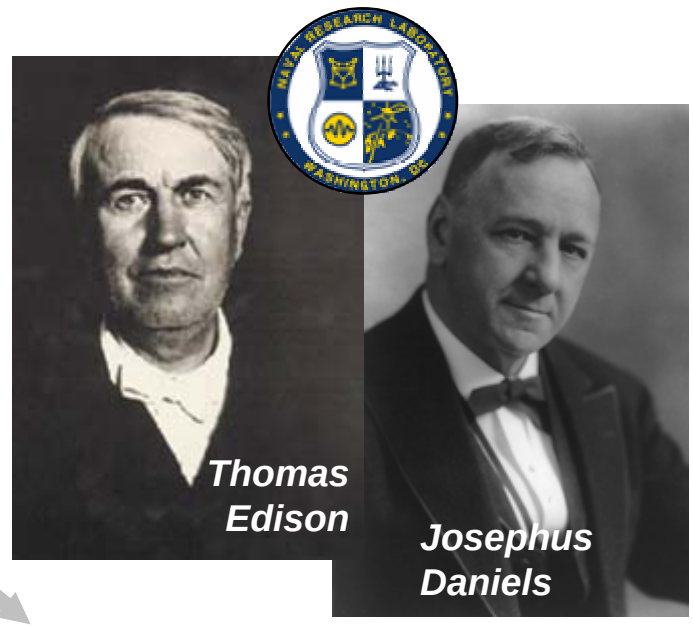
http://www.onr.navy.mil/sci_tech/30/

13 April 2006

Naval Research: A Statutory Mission

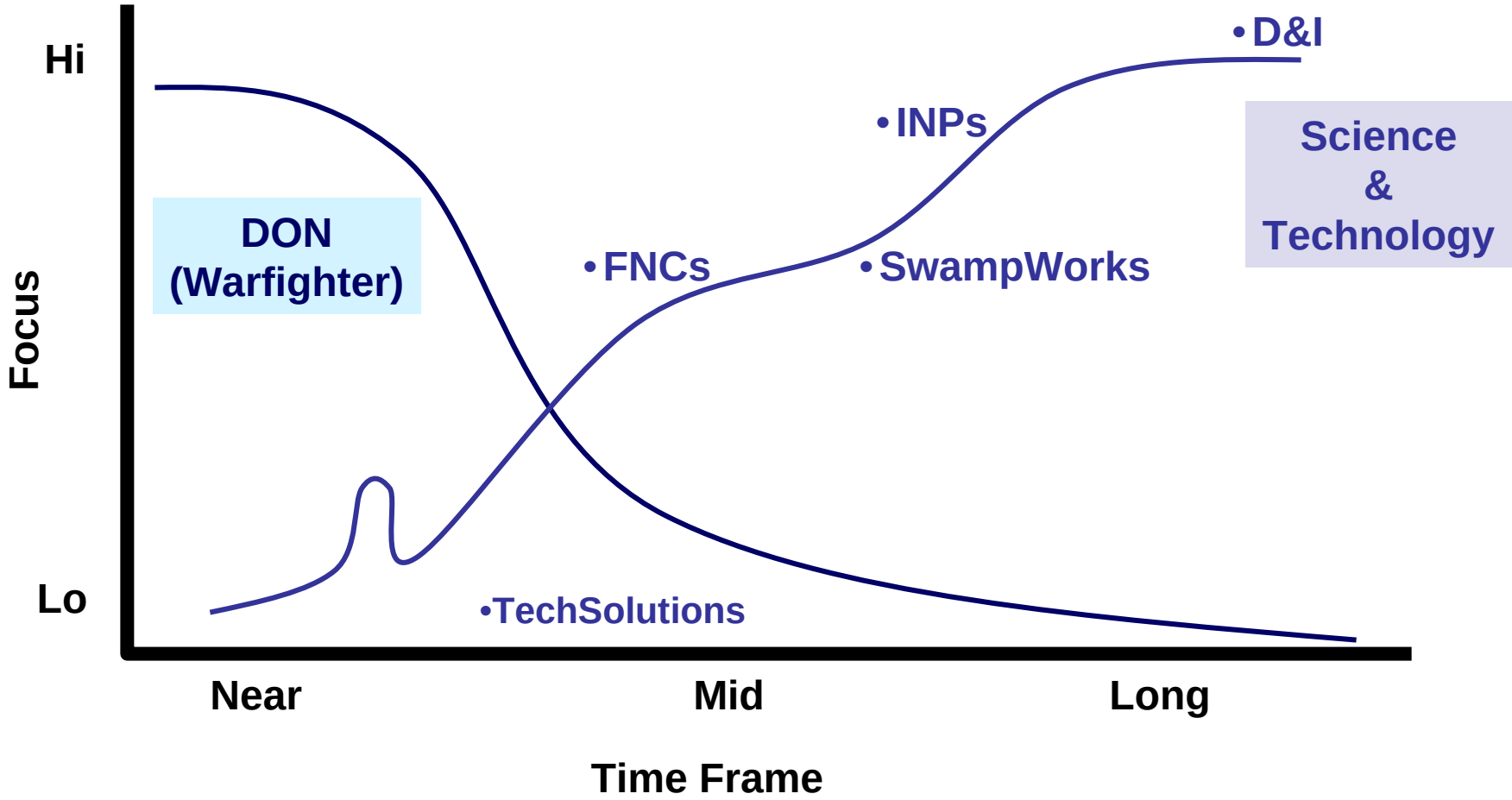
Naval Research Laboratory ***(Appropriations Act, 1916)*****:**
"[Conduct] exploratory and research work…necessary… for the benefit of Government service, including the construction, equipment, and operation of a laboratory…."

Office of Naval Research ***(Public Law 588, 1946)*****:**
"… plan, foster, and encourage scientific research in recognition of its paramount importance as related to the maintenance of future naval power, and the reservation of national security…. "



Transitioning S&T ***(Defense Authorization Act, 2001)*****:**
"…manage the Navy's basic, applied, and advanced research to foster transition from science and technology to higher levels of research, development, test, and evaluation."

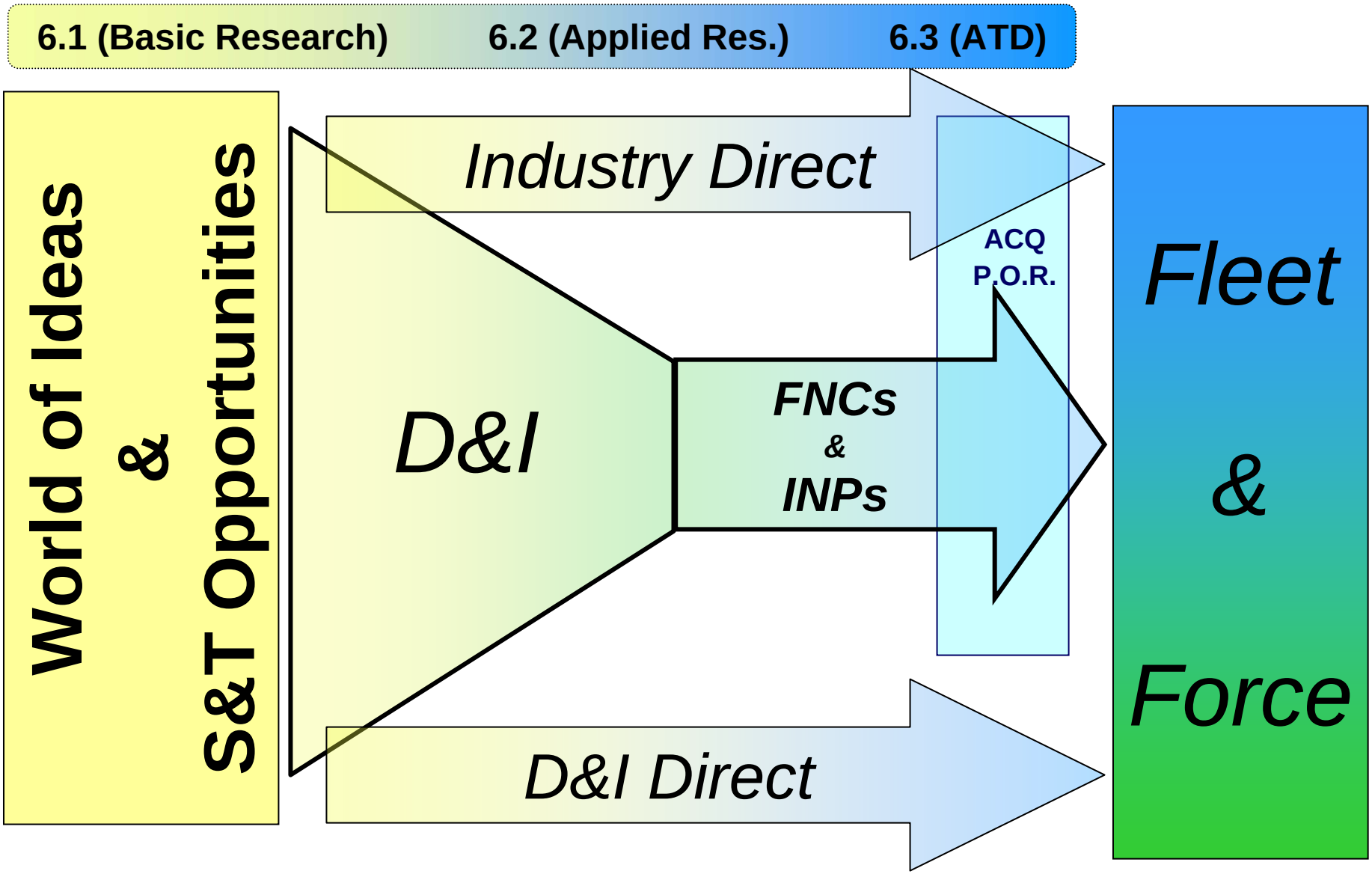
Conceptual View of DON Warfighters & S&T Focus Over Time



ONR FY06 S&T Portfolio

Discovery & Invention (40%) • Naval scientific disciplines • NRL/Warfare centers • National Naval Responsibilities • Technical workforce sustainment • High impacts/surprises	**Acquisition Enablers (31%)** • Future Naval Capabilities • Warfighter Protection • Capable Manpower • LO/CLO
Directed/Pass-through (19%) • Joint Experimentation • University Research Initiatives • Others	**Leap-ahead Innovations (10%)** • Innovative Naval Prototypes • SwampWorks • Tech Solutions • SEA TRIAL • Fleet/Force Response

S&T Product Flow



Discovery & Invention Program

- **DON S&T Corporate Board Guidance:** ***"This area invests in: Naval unique research, where DON must be the world leader; strong participation in research communities important to future naval applications, but not necessarily lead by DON; and, harvesting and advancing research results from all sources in areas of potential naval pay-off."***
- **Maturity: Very High. Well-established Grant process.**
- **Focus: Broad-based program of scientific inquiry.**
  - **Naval unique research, where DON must be the world leader**
  - **Strong participation in research communities important to future naval applications, but not necessarily led by DON.**
  - **Harvesting and advancing research results from all sources in areas of potential naval payoff.**
  - **Developing future national naval S&T workforce … funding about 3,000 students per year.**
- **Objective: Advance research to allow incorporation in Future Naval Capabilities (FNCs) or Innovative Naval Prototypes (INPs).**
  - **Includes Naval Research Enterprise (NRL, Warfare Centers, Academia, etc.)**
- **Governance: Chief of Naval Research <u>under</u> DON S&T Corporate Board.**
  - **Includes coordination with DON & DDR&E Leadership.**

PBR-07 ($M)	FY07	FY08	FY09	FY10	FY11
D&I	$670	$690	$701	$730	$689

Innovative Naval Prototypes

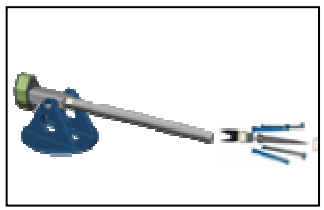
- **DON S&T Corporate Board Guidance:** *"Programs in this category may be disruptive technologies that are unlikely to survive without top leadership endorsement. Investments should be planned with the critical mass to achieve a level of maturity suitable for transition with 4 – 8 years."*
- **Maturity**: Very Low. FY06 start.
- **Focus**: Opportunity-driven.
  - Critical mass investment may yield transformational advance.
- **Objective**: Take advantage of opportunities ***outside*** of conventional requirements and acquisition processes.
- **Governance**: Corporate Board.
  - High risk or radical departure from established requirements and concepts of operation, are unlikely to survive without senior leadership advocacy.
- **Process**: The CNR, in consultation with other stakeholders (DON leadership, TOG principals), nominates candidates for Corporate Board approval.

PBR-07 ($M)	FY07	FY08	FY09	FY10	FY11
INP's	$87	$113	$147	$150	$150

INP Program Snapshot

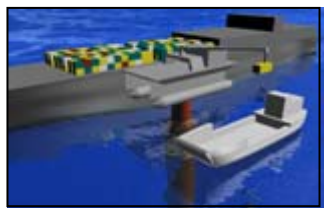
- Guidance
  - Innovative and game-changing.
  - High risk, high payoff.
  - Useable prototype available at completion.
  - Deputy PMs for transition from Acquisition PEOs.

Current INPs



EM Railgun

PLUS



Sea Basing

SPACE

Future Naval Capabilities

- **DON S&T Corporate Board Guidance:** *"This area is focused on requirements-driven, transition-oriented thrust areas. Its objective is to provide Enabling Capabilities (ECs) to fill identified gaps in NP-21 warfighting and enterprise capabilities."*
- **Maturity**: Medium. POM02 start.
- **Focus**: Requirements-driven, transition-oriented.
- **Objective**: Provide ECs to fill identified gaps in Naval Power 21 warfighting and enterprise capabilities identified by OPNAV and MCCDC requirements analyses.
- **Governance**: The FNC Technology Oversight Group (TOG) establishes priorities for investments.
- **Process**: FNC Integrated Process Team structure to assure connectivity between requirements, technology, and acquisition.

PBR-07 ($M)	FY07	FY08	FY09	FY10	FY11
FNC	$416	$409	$445	$446	$446

ONR 30 Mission: Expeditionary Maneuver Warfare and Combating Terrorism

Office of Naval Research *(Public Law 588, 1946)*:
"… plan, foster, and encourage scientific research in recognition of its paramount importance as related to the maintenance of future naval power, and the preservation of national security.… "

Expeditionary Maneuver Warfare and Combating Terrorism (Code 30)
To lead the Department of the Navy's Science and Technology efforts that develop future combat capabilities for Naval Expeditionary Maneuver Warfare and the Department's role in Combating Terrorism, through:

…the exploitation and subsequent application of Science and Technology in order to enhance the ability of the Navy-Marine Corps team to achieve assured access and conduct decisive operations as the naval portion of a joint campaign.

Investment Thrust Areas:

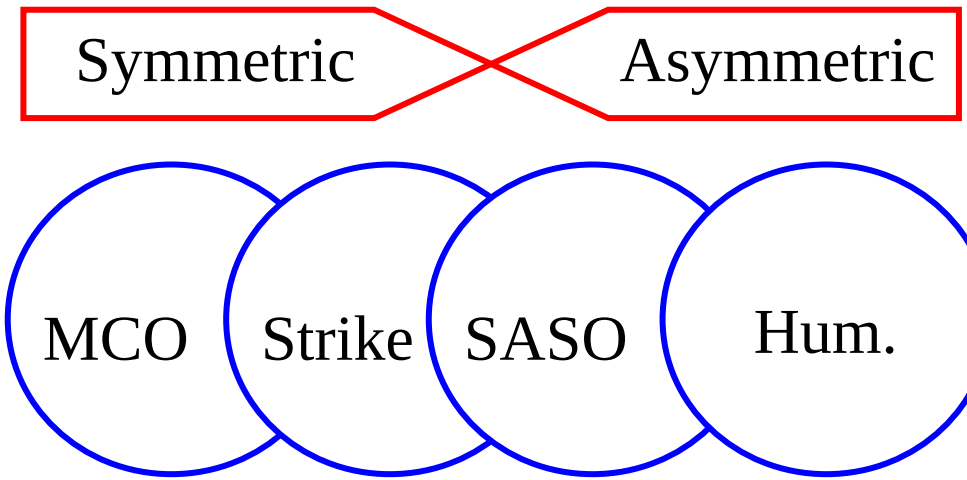
-C4
-Fires
-Maritime Domain Awareness
-ISR
-Logistics
-Maritime Special Operations
-Maneuver
-Mine Countermeasures (MCM)
-Human Performance/Training and Survivability
-Force Protection

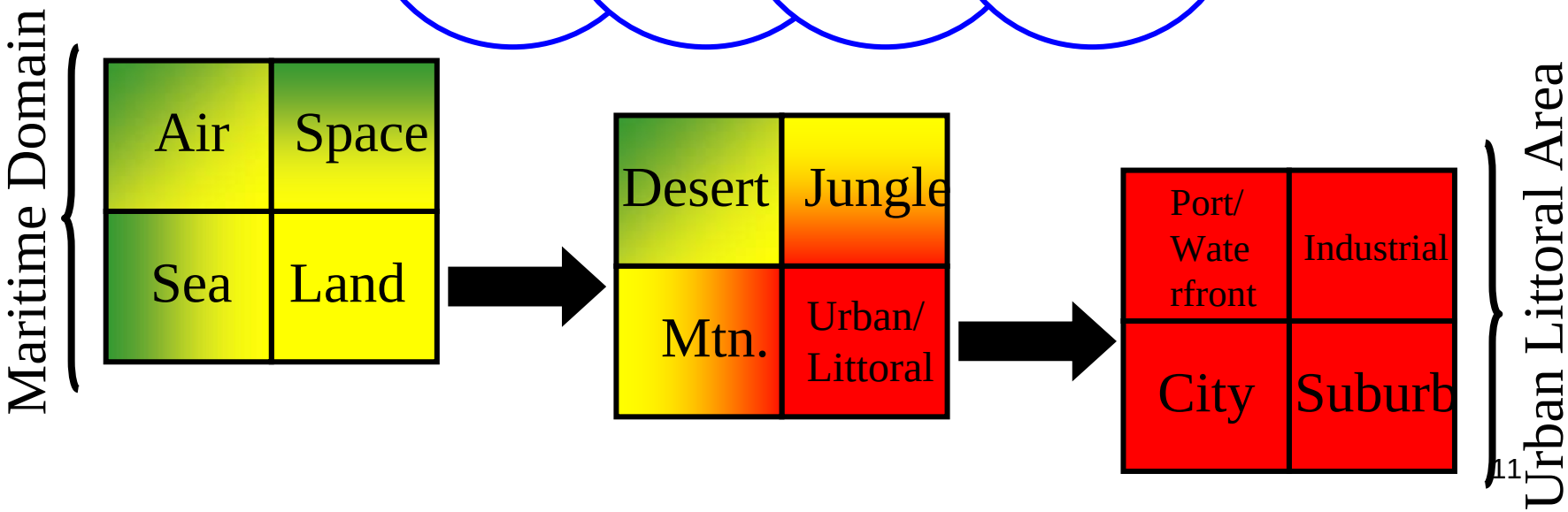
ExWar & Combating Terrorism

Most Contested

–

Least Invested



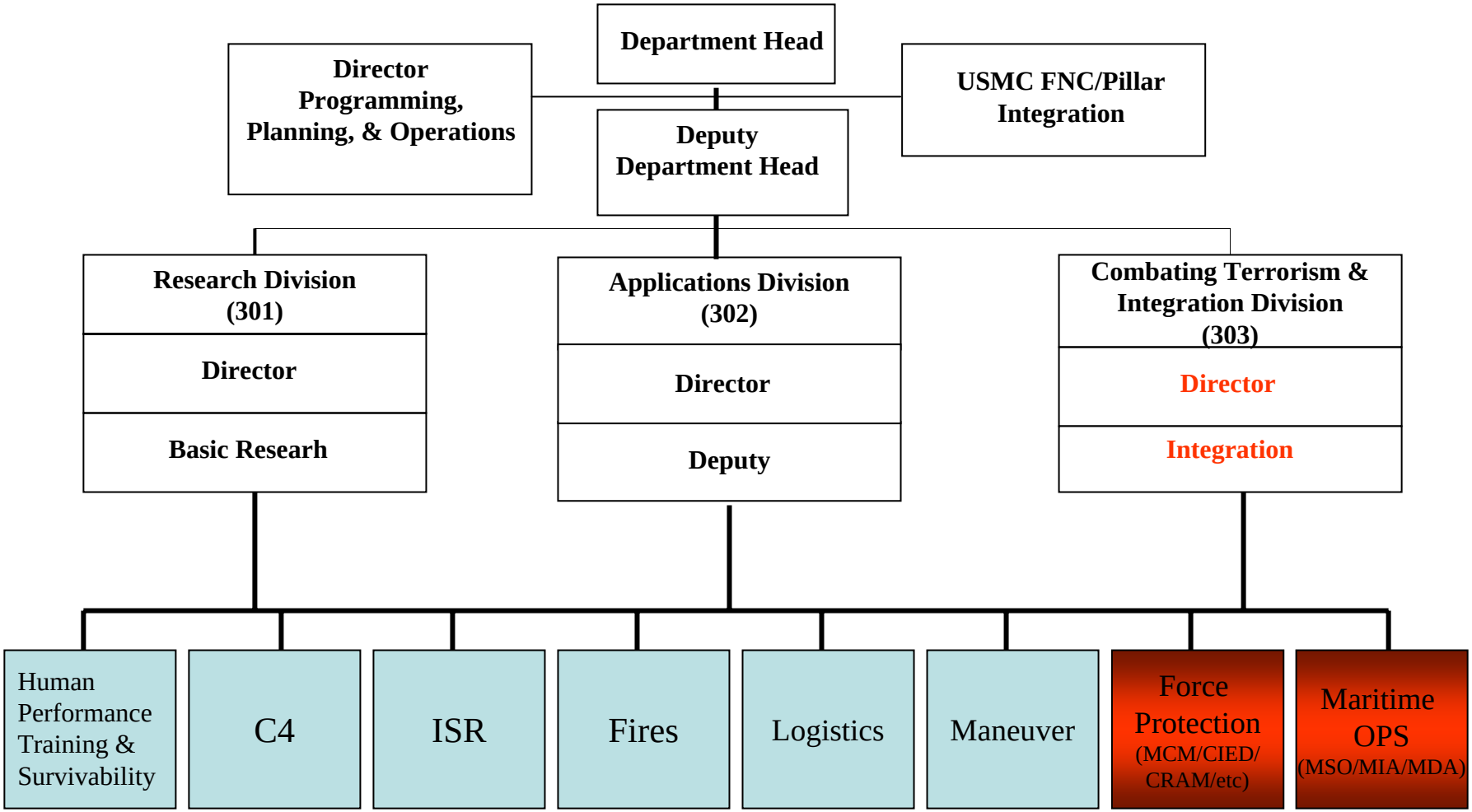


S & T Departments: Customers and Portfolios

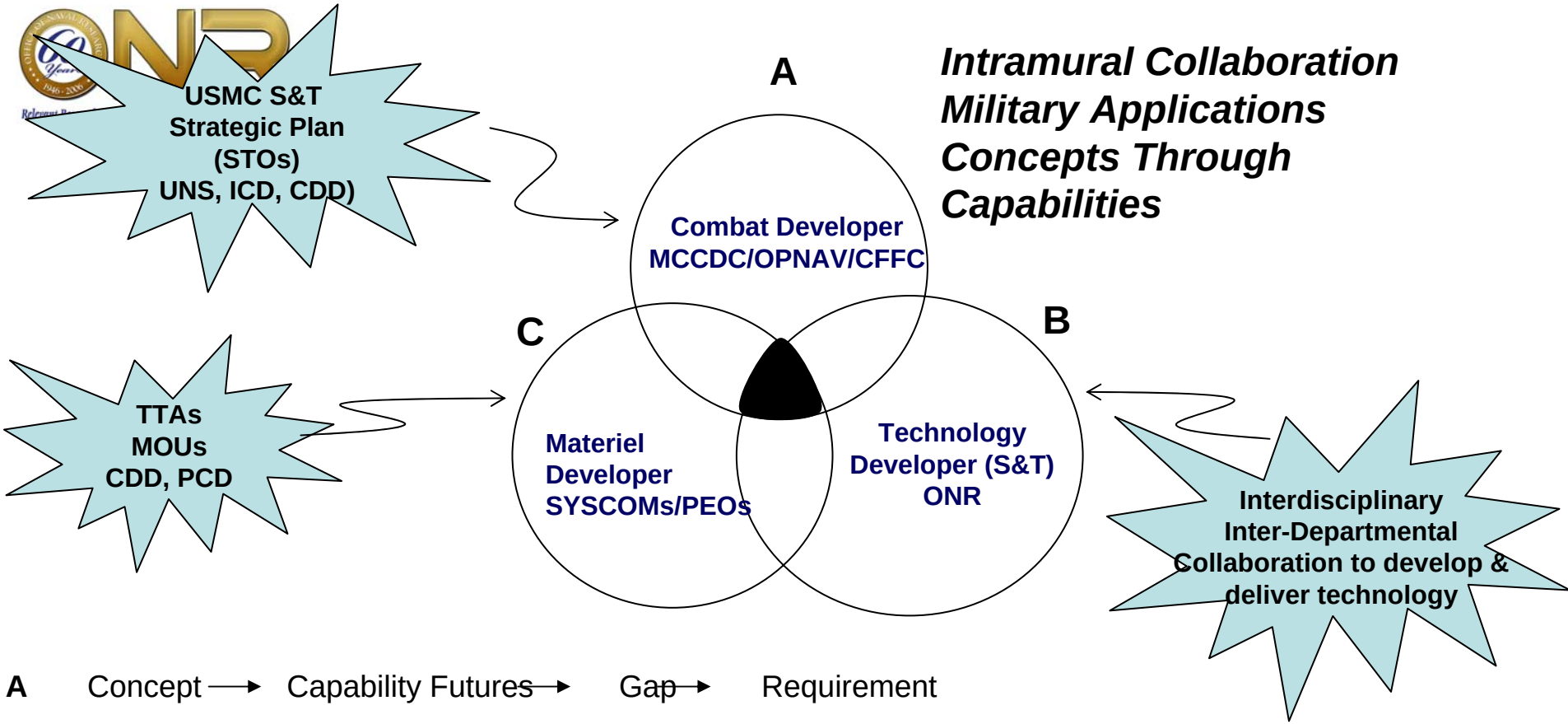
EMW	FORCENet	SEA SHIELD	SEABASE	SEA WARRIOR	SEA STRIKE
MCCDC, MCWL, MARCORSYSCOM MARFOR, NAVFAC NCIS, DTRA, DHS SOCOM SPECWARCOM JNLW Directorate Army Research Lab NECC MARSOC	SPAWAR NETWARCOM ONI NRO NSA	N096 NAVMETOC CORE NOPP NOAA NASA UNOLS	NAVSEA NAVSURFOR NAVSUBFOR NAVAIRFOR (for ship systems) USCG DOE	Surgeon General Medical Officer of the USMC CNET CNP NIH	NAVAIR NAVAIRFOR Air Force Research Lab
DASN LMW	DASN IWS/LMW/ AIR/C4I	DASN SHIPS/ IWS/AIR	DASN SHIPS/LMW	DASN SHIPS/C41/ LMW	DASN SHIPS/ IWS/AIR
30 – Exp. Warfare & Combating Terrorism	31 – C4ISR	32 – Ocean Battlespace Environment	33 – Sea Warfare and Weapons	34 – Warfighter Performance	35 – Air Warfare and Weapons
Exp. Man. Warfare USMC STOs in multiple warfighting areas – C4; ISR; Logistics; Human Performance, Training & Survivability; Maneuver; MCM Warfare (w/32); Ground-based Firepower; Non-lethal Weapons; Naval Specwar; EOD	Electronics Computer & Info Sciences Radar/EO/IR Maritime sensors EM propogation & interaction Signal & image processing C3 Networking Surveillance EW	Oceanography Coastal Geosciences Marine geology & geophysics Modeling & Sim Marine metrology Atmospheric effects Space MCM (w/30) UUV's (w/33)	Chemistry Power & energy conversion Naval materials Non-linear dynamics Ship Structures Ship HM&E ASW & UUV's (w/32) Ocean eng. & marine systems	Cognitive science Neural science Behavioral science Social org./science Manpower, personnel & training Human factors Medical science Bimolecular science Biosystems Biomaterials	Physics Aerospace materials Energetics Surface & Air launched weapons Kinetic & Directed energy weapons Robotics UAV's Air Vehicles

Combating Terrorism

Expeditionary Maneuver Warfare & Combating Terrorism Department (Code 30)



Intramural Collaboration Military Applications Concepts Through Capabilities

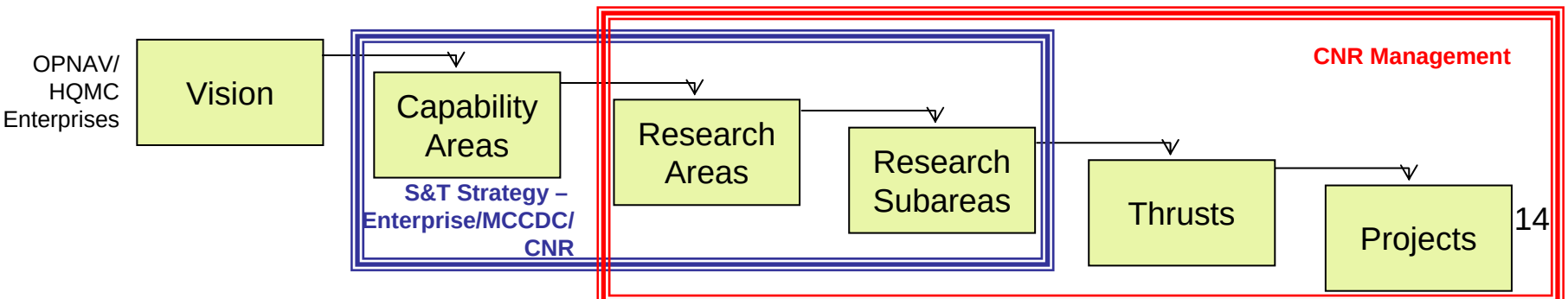


A Concept → Capability Futures → Gap → Requirement

B Capability Futures → Gap → Requirement → Technology

C Requirement → Technology → R&D/ Production

Capability



Example of Thrusts

MANEUVER

Develop, demonstrate, and transition technologies that will increase the warfighting capabilities and effectiveness of the Marine Corps Air Ground Task Force (MAGTF). This Thrust will capture emerging and "leap ahead" technologies in the areas of mobility, materials, propulsion, survivability, and unmanned systems.

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RECENT TRANSITIONS

GLADIATOR TACTICAL GROUND UNMANNED VEHICLE (FNC)
Transitioned to MCSC

RECONNAISSANCE, SURVEILLANCE, & TARGETING VEHICLE (FNC)
Transitioned to MCSC

MODELING & SIMULATION BASED DESIGN (D&I)
Transitioned to MCCDC

SHOCK MITIGATED SEAT - PHASE I (D&I)
Transitioned Phase I to MCSC

FOCUS AREA	PROJECT
SURVIVABILITY **MVR STO-1**: Advanced power plants, drive trains, and suspensions **MVR STO-2**: Advanced and composite materials to enhance the performance and survivability of combat vehicles **FP STO-**3: Incorporation of improved materials for future vehicles and aircraft that provide improved levels of protection at reduced weight and volume **FP STO-4**: Active protection system for vehicles against rocket propelled grenades.	SURVIVABILITY SYSTEMS MATERIALS (D&I) SHOCK MITIGATED SEAT - PHASE II (D&I) ELECTROMAGNETIC NON-EXPLOSIVE ARMOR (D&I) COMBAT S&T VEHICLE SURVIVABILITY EFFORTS (D&I) ADVANCED ELECTROMAGNETIC ARMOR (D&I) ACTIVE RPG DEFENSE (FNC) ULTRA ARMORED PATROL VEHICLE (D&I) ULTRA APV SURVIVABILITY ENHANCEMENTS (Plus-Up) EXPLOSION RESISTANT COATING ACTD (D&I)
UNMANNED SYSTEMS **MVR STO-6**: Advanced robotic systems for ground combat	GUNSLINGER HOSTILE FIRE DETECTION (FNC)
ADVANCED MOBILITY **MVR STO-1** **MVR STO-2** **MVR STO-3**: Augmented cognition for combat vehicle crews and operators of maneuver systems	COGNITIVE ASSESSMENT & TASK MANAGEMENT (D&I) EXPEDITIONARY DECISION SUPPORT SYSTEM (FNC) COMBAT S&T VEHICLE MOBILITY EFFORTS (D&I) BATTLEFIELD POWER GENERATION (FNC) ELECTRONICALLY CONTROLLED ACTIVE SUSPENSION (D&I) ADVANCED LEAD-ACID BATTERY (Plus-Up) FUTURE TACTICAL TRUCK SYSTEM ACTD (D&I) EXTREME TERRAIN MEDEVAC VEHICLE (Plus-Up) EFV OBSTACLE DETECTION SYSTEM (FNC)

Expeditionary Warfare Operations
Maneuver Discovery & Invention and Enabling Capability Projects


Gladiator TUGV


RST-V


MEFFV


Gunslinger


Survivability


JLTV


Human Interface


Light Vehicles


EFV ODS


Ultra 3T APV


Active RPG Defense

Objectives/Challenges:

- **Research and develop advanced technologies for tactical and combat vehicles focusing on mobility, propulsion, suspension, survivability, crewmen situational awareness, and unmanned ground systems.**
- **Enhance mobility for the surface landed MAGTF elements.**
- **Provide knowledge-based situational awareness as well as land mine and obstacle avoidance and breaching capabilities from the line of departure, through the beach exit zone, to the objective.**

Technical Areas:

- **Survivability/Materials:**
  - **Nano-materials, smart materials, active defense systems, advanced armor systems, obstacle detection systems, seats, blast modeling and simulation**
- **Advanced Mobility:**
  - **Suspensions, hybrid electric power, drivetrains, modeling and simulation, future HMMWV replacement**
    Examples: RST-V- *most advanced electric tactical vehicle in the world.* Active suspension for HMMWV
- **Unmanned Systems:**
  - **Unmanned ground vehicles, operator controls**
    Examples: Gladiator TUGV- *transition to MCSC will lead to first ever fielding of a multi-purpose tactical UGV.*
    Gunslinger Hostile Fire Detection and Counterfire System

Payoff:

- **Improved warfighting effectiveness of the MAGTF (Ground Combat Element).**
- **Increased mobility and survivability of ground platforms.**
- **Improved fuel efficiency and exportable power.**
- **Simulation based design tools to support future vehicle concept development and technology trades.**
- **Improved situational awareness and navigation capability**
- **Seamless transition of combat from ship to shore**

FY07 Plans
Blast/Fragmentation/Consortium
Human Factors Consortium

- **Synergy of efforts and information exchange across the diverse fields of conventional weapons, vehicles, personnel protective equipment, human factors, and modeling and simulation. The objective is to investigate the basic phenomenology of weapons effects and advances in materials and designs to impact future vehicle and personnel survivability.**
- **Consortium includes scientists and warfighters from Marine Corps, Army, Navy, Air Force, OSD, Academia, and Industry.**

EVENT

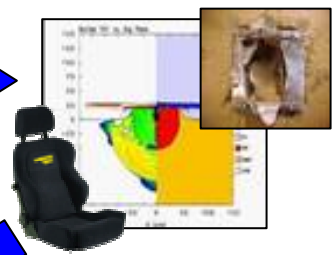
II MEF
NHRC
AFMET
JIEDDO
. . .

ARA
OSD
NRL
AFRL
USA ARL
. . .

BIO EFFECTS

BLAST AND FRAGMENTATION

ARA
ARL
NRL
UMD
NSWC
. . .



SIMULATION BASED DESIGN

Causes of IED Injury

1st – Blast
2nd – Fragmentation
3rd – Displacement
4th – Burns and Toxins
5th – Wound Contamination

JLTV/CTV/CSTV

Joint Light Tactical Vehicle/Combat Tactical Vehicle/ Combat S&T Tactical Vehicle

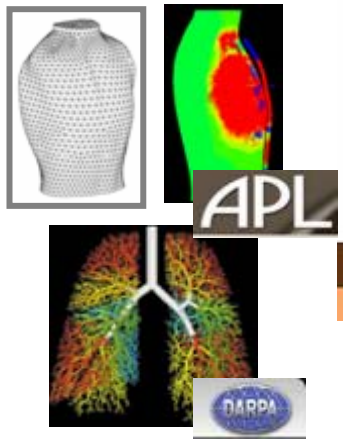
FY07 Plans
Blast/Fragmentation/Consortium
Human Factors Consortium

- Collect and analyze wound data
- Conduct knowledge exchange and concurrence on definitions, issues and future needs (i.e. gap analysis)
- Foster interaction between medical, vehicle, & personal protective equipment disciplines
- Design requirements for blast and ballistic loads of vehicles, particularly Joint Light Tactical Vehicle (JLTV)

Autopsies
X-Rays
CT Scans

Wound Mapping

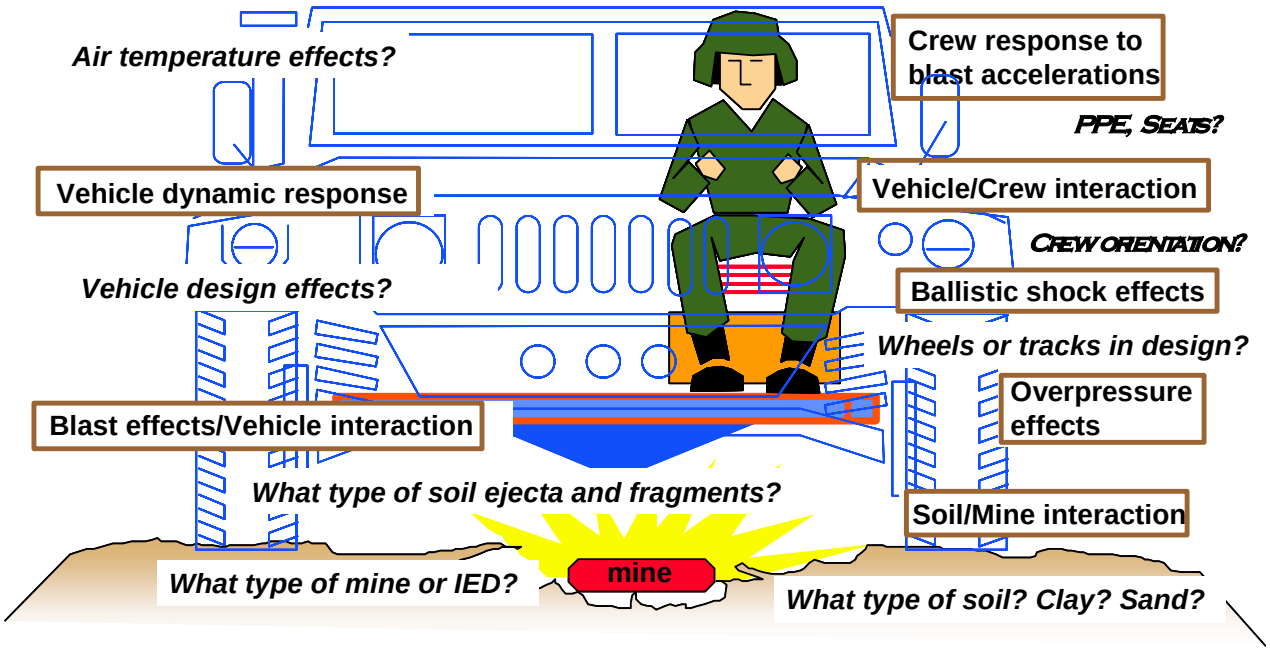
Testing Surrogates

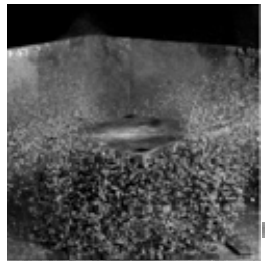


Physics Based Medical Models

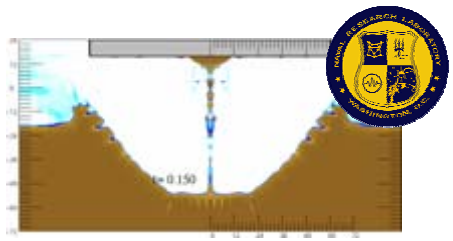
Blast/Vehicle/Human Interaction

FY07 Plans
Blast/Fragmentation/Consortium
Human Factors Consortium





Blast Effects



Soil Models

All interactive events have been locally modeled to some degree . Current goal is to <u>accurately</u> portray the complete event.

FY07 Plans
Combat S&T Vehicle (CSTV)

Trades, Concepts, Technology Demonstrator:

Conduct trade studies, design, build & test a Combat Science and Technology Demonstrator platform. Leverage Simulation Based Design Tools.

Superior Mobility / Performance:

State of the art drive train & suspension technologies. Leverage hybrid electric systems from the RST-V, ECASS, and private sector.

Advanced Armor Design:

Leverage Army Research Lab ceramic composite and EM armor designs for medium vehicles.

Crew station:

Expand on lessons learned from ULTRA to design superior ergonomics, safety and "fightability" of platform.

Integrate Active RPG Defense:

Incorporate evolved active net system from current effort.

Advanced Automotive Safety:

Best available safety features to reduce roll-over, collisions and from AugCog platform (autonomous obstacle avoidance system, optical lane sensing, computer stability control).

Integrated Combat Systems:

A "plug & play" ready vehicle that can be quickly adapted to a variety of missions. Power, hard points and crew stations compatible with remote weapons and sensor systems. Leverage Gunslinger & AugCog programs.

Mine / IED Survivability:

Cab floor and crew seats designed to mitigate shock loading from mines & IEDs.

Human Performance Training & Survivability

Marine Corps S&T Objectives

Navy S&T Objectives (emerging)

Physical Performance Enhancement

Training Technology Enhancements

The Warrior

Survivability

Cognitive Performance Enhancement

Operational Filters

- Combating Terrorism
- Distributed Operations
- Expeditionary Warfare

Current Physical Performance Enhancement &Survivability Focus:

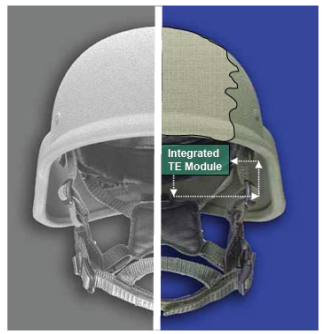
- Head, Neck, Face, Torso, and Extremities Protection
- Fatigue Mitigation
- Combat Situational Awareness
- Combat Nutrition (Monitoring Army Efforts)
- Pharmacological Interventions
- Combat Load / Endurance

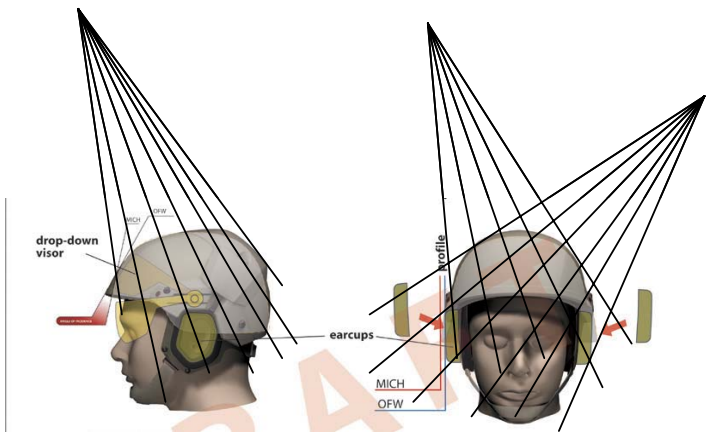
Current Cognitive Performance Enhancement & Training Technology Enhancement Focus:

- Individual & Small Unit Training
- Cognitive Performance Evaluation
- Virtual & Simulated Environments
- Enhanced Mission Rehearsals
- Human & Autonomous System(s) Interaction
- Uninstrumented Environments
- Cognitive Performance Enhancing Technologies Under Stress

Human Performance & Survivability Plans

- Review of ONR30 Previous, Current, & Future Investments within:
  - Armor Protection
    - Head, neck, face, and torso
  - Combat Load Reduction
    - Overall Combat Endurance
- Overview of other initiatives.





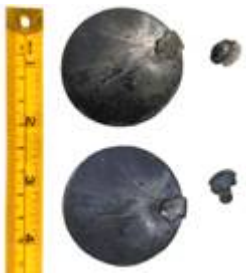
Torso & Extremity Protection

"A problem arises when the desire to protect…against 'worst case' collides with the weight/ mobility & cost penalties associated with that level of protection."

–Mark Miller, *S&T Support for "Bulletproof Marines"*

Current Protection:

- 2 Enhanced Small Arms Protection Plate Inserts (ESAPI) plates: Coverage of torso = ~ 3/ft²
- ESAPI weights 8 lbs/ft²
- Outer Tactical Vest (OTV) with 2 ESAPI = ~ 30 lbs



DARPA

For Full Body (minus head):

- 50th percentile Marine = ~ 10ft² (surface area)
- 10ft² at ESAPI Level = ~ 90 LBS
- Tactically Impractical
- State-of-the-art, compared to ESAPI, *NOT likely to improve*

ONR/NRL

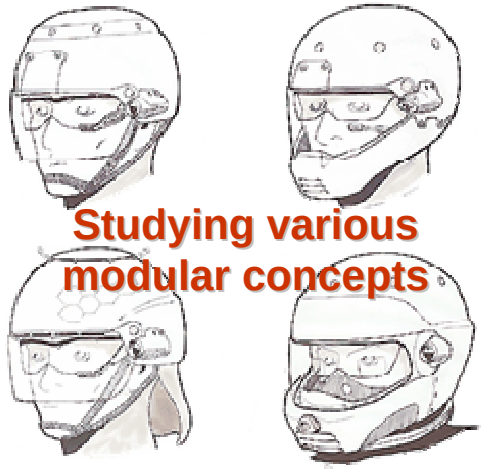
Extremity protection prototype (Frag ONLY)

Marine Advanced Combat Headborne System Initiative (MACHSI)

- **An initiative to address the threat of higher facial and head injuries experienced by Marines in Iraq.**

- **An effort to scope and define helmet requirements and potential technologies to support the modular, integrated helmet of the future.**

The head, face, & neck are the most difficult areas to protect



Studying various modular concepts

<u>& Need to Address Functional Ergonomics:</u>
Listen—Observe–Communicate—Shoot

Possible Designs

Modular Concept Adaptable to Battlefield Environments

Increased Survivability via Improved Materials and Area of Coverage

Increased Sustainability (Venting/Cooling, Weight Reduction) for Operational Readiness

Input from S&T, user & medical communities

<u>A collaboration between:</u>

- **ONR 30 (HPT&S)**
  - **U.S. Army Natick Soldier Center**
- **Marine Corps Systems Command (PM MERS)**
  - **Director Soldier Systems, Canadian National Defense**

Levels of Protection Addressed

1. Mission Operation Posture (MOP): Base Helmet

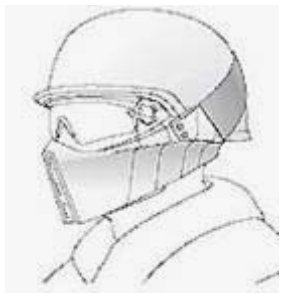
a. 2-grain RCC, V50 4,400 ft/sec.
b. 4-grain RCC, V50 3,800 ft/sec
c. 16-grain RCC, 2,700 ft/sec.
d. 64 grain RCC, V50 1,775 ft/sec.
e. 124-grain 9mm FMJ, V50 no less than 1,650 ft/sec.

2: Mission Operation Posture (MOP): Base Helmet Plus Side Components

a. Reduce potential causalities by 30% over MOP 1 configuration.

3. Mission Operation Posture (MOP): Base Helmet, Side Components Plus Throat/Neck Protection.

a. Reduce potential causalities by 20% over MOP 2 configuration.



4. Mission Operation Posture (MOP): Hard Armor Appliqué.

a. 5.56mm M855 @ 3150 ft/sec (muzzle)
b. 7.62mm M1943 @ 2000 ft/sec (100 meters)
c. 7.62mm M1943 AP @ 1700 ft/sec (200 meters)

5. Mission Operation Posture (MOP): Hard Armor Appliqué.

a. 7.62mm M1943 @ 2400 ft/sec (muzzle)
b. 7.62mm M1943 AP @ 2000 ft/sec (100 meters)
c. 7.62mm M80 Ball @2300 ft/sec (200 meters)
d. .30 Cal APM2 @ 2000 ft/sec) (400 meters)]

Challenges with head and neck protection:

- Requires integration of impact protection, ballistic protection, ventilation/cooling, retention/suspension systems, communications, hearing protection, eye protection and articulation issues

- Problems with conformance and ergonomics (e.g., rifle Cheek weld)

Decreasing the Marine's Load

Yesterday's & Today's Marine – Overloaded!

1960s

Today

No Change

Treat the Marine as a system – Focus on the entire individual

~Make smart tradeoffs between performance & weight~

Improvements in:

- **Combat Load**
- **Ergonomics**
- **Nutrition**
- **Physiologic Performance (Endurance, Strength)**
- **Fatigue Management**
- **Protection**

Tomorrow's Marine: Optimized for Combat Endurance

Equals improvements in a Marine's load-bearing capability

Developing A Virtual Warfighter System

- Historically, Marines have been overloaded
- Not likely to change as advances in reducing size/weight motivate adding more
- *More performance (kinetic, weapon, armor, sensors, comms) = more weight!!*
- **Human/Technology Performance tradeoffs are key**
  - ONR 30 is building a Virtual Marine tradeoff analysis tool to make performance/weight tradeoffs

The Ultimate Customer – The Warfighter!

Caveat: Real Customer: SYSCOMs, PEOs, DRPMs

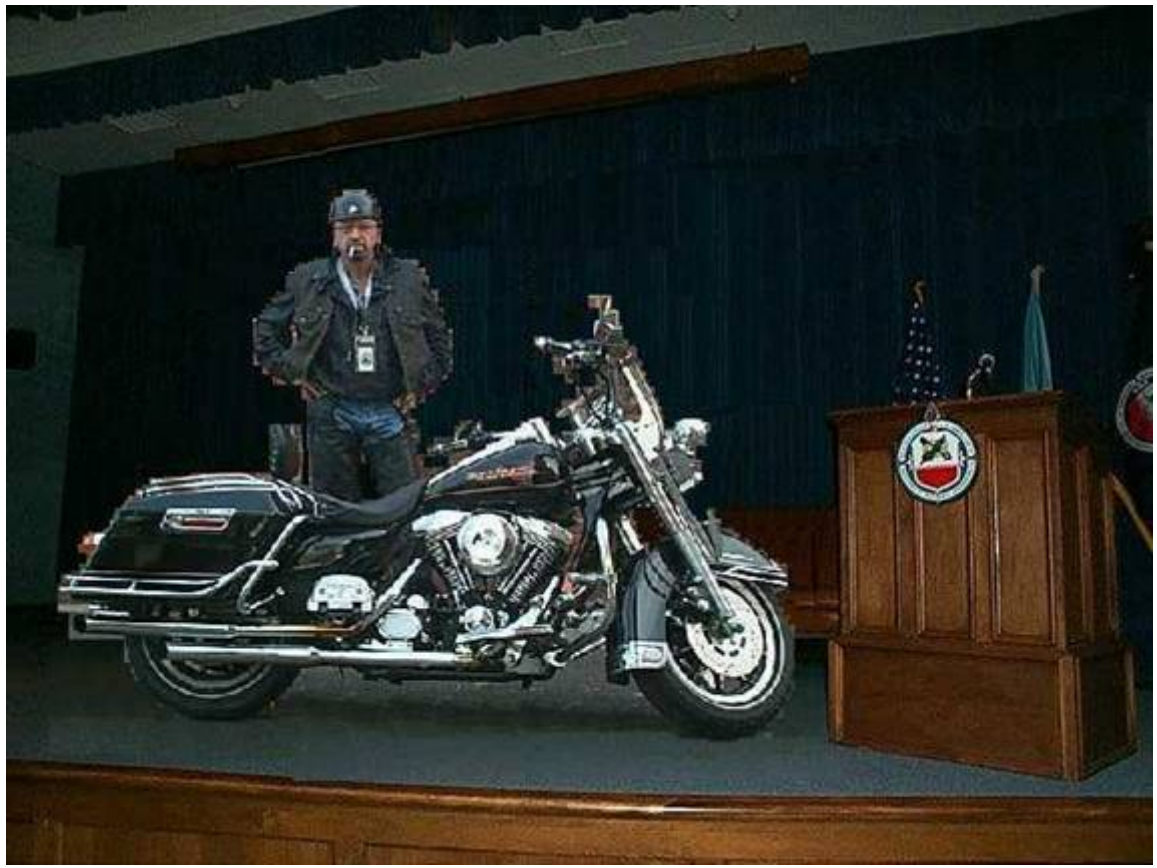
HOT Buttons:

1. **Survivability**
2. **Reduce Combat Load**
3. **Small Unit Excellence**
4. **Fuel Efficiency**
5. **Light weight portable power sources**

ONR Key Goals

- Innovation in product & process
- Transitioning science, technology, & ideas to the PEOs, SYSCOMs & Fleet/Forces
- Flexibility to solve *today*'s critical challenges while focusing on *tomorrow* & the *Navy/USMC After Next*

QUESTIONS?



http://www.onr.navy.mil/sci_tech/30/