

## Section 4

# FUTURES

### “Focus the Future Faster” via the Concept to Capability Process

The PEO LS S&T Director remains focused on the transition of affordable, reliable, and relevant capabilities into PEO LS POR and ultimately into the hands of the warfighter. The PEO uses technology investment Focus Areas as a lens through which to concentrate resources on the critical needs of warfighters. By identifying these Focus Areas in the ATIP, PEO LS has been able to align available resources within the Naval Research Enterprise, address the warfighter’s needs expeditiously, and ultimately transition technologies into POR in a timely manner.

These Focus Areas serve as the primary means for identifying critical technology enablers and resolving critical capability challenges. They also incorporate natural supporting technologies that align to PEO LS programs such as fuel efficiency, intelligent power and thermal management, autonomy, corrosion resistance, crew visibility, fuel containment/fire suppression, safety, and weight reduction.

The PEO LS S&T Directorate monitors Marine Corps, Navy, and Joint efforts in the areas of futures

assessment and combat development in order to articulate the potential impacts and influences across the PEO LS portfolio. This process supports the identification and prioritization of the PEO LS Top Technical Issues and associated technology needs in order to inform, influence, and align S&T investments in support of transitioning critical capabilities to the Warfighter.

PEO LS’s Concept to Capability approach, depicted in Figure 2-1 in section 2 (S&T Collaboration and Engagement), provides a validated, repeatable process for addressing an uncertain future within the context of the evolving Marine Corps Force Development System. Future risks are minimized by selecting well researched areas of focused investment based on technical issues that share common warfighting connections to multiple programs within the PEO. Focusing S&T funding on these key areas enables the Marine Corps to maximize its return on investment and to better prepare for the future.

The Concept to Capability process outlined in this plan is initiated by the Combat Developer,

*“Expeditionary Force 21 provides an aspirational vision of how we will operate in order to guide experimentation, force development activities, and inform programming decisions. Some goals within Expeditionary Force 21 will be achieved quickly while others will require continued work and coordination to develop. However, the overarching goal is to improve how we support the requirements of Geographic Combatant Commanders (GCCs) by providing the right force in the right place at the right time.”*

—Expeditionary Force 21

specifically by DC CD&I's Futures Directorate (see Figure 4-1). PEO LS engages with the Futures Directorate to understand and contribute to futures assessments, concepts, and other force development actions to include experimentation and wargaming. This engagement and communication helps inform the future required capabilities. Those concepts, as well as the processes that follow, to produce the capabilities needed are driven by wide-ranging assessments of the future include everything from adversary capabilities to fiscal constraints.

PEO LS S&T must access a wide variety of sources and perspectives to develop and validate future threats and opportunities as they apply to the PEO LS portfolio. In order to get a tailored perspective of the future, the S&T Director uses the Assessment of Plausible Future Security Environments (see Figure 4-2) which examines the possible future with all potentials that include the preferable, probable, and an alternative future. The assessment of the plausible future helps to augment existing concepts as part of the initial steps of the Concept to Capability process.

This methodology of examining current and future capability gaps to inform the ATIP provides relevant context to understanding the most likely future security environment and the capabilities required to address it. The process references and responds to DoD, Joint, and Service assessments and guidance relative to what the future is expected to hold. It also considers other likely and plausible futures (as well as less probable scenarios) as espoused by experts from industry, academia, and the international community.

These probable futures are derived from baseline forecasts that extrapolate existing trends into the out years. Trends and forecasts used to support our examination of the most likely future security environments are outlined in a number of key U.S. defense-related publications:

- ▶ *Sustaining U.S. Global Leadership: Priorities*

*for 21st Century Defense* (DoD 2012)

- ▶ *Capstone Concept for Joint Operations: Joint Force 2020* (CCJO 2012)
- ▶ *Joint Operational Access Concept* (JOAC 2012)
- ▶ *Mission Command White Paper* (CJCS 2012)
- ▶ *Naval Operations Concept 2010* (NOC 2010)
- ▶ *Marine Corps Operating Concepts 2010* (MOC)
- ▶ *The Marine Corps Service Campaign Plan 2014-2022* (2014)
- ▶ *Quadrennial Defense Review 2014*
- ▶ *Expeditionary Force 21* (2014)
- ▶ *Commandant's Planning Guidance 2015*
- ▶ *Cooperative Strategy For 21st Century Seapower, March 2015*

The trends and forecasts outlined in these seminal documents, relevant to PEO LS, include:

- ▶ An era of fiscal austerity and government debt
- ▶ Cyber threat from governments and non-government actors
- ▶ Technological diffusion/weapons of mass destruction proliferation
- ▶ Increased urbanization, particularly in the littorals
- ▶ The traditional view of the three primary domains (air, land, and sea) within the "global commons", with the increasingly important addition of the space, cyberspace, and human domains
- ▶ The demand for critical resources is likely to continue to exceed supply, even with advanced conservation and efficiency measures coupled with alternative sources
- ▶ Transnational crime, regional instability, and violent extremism

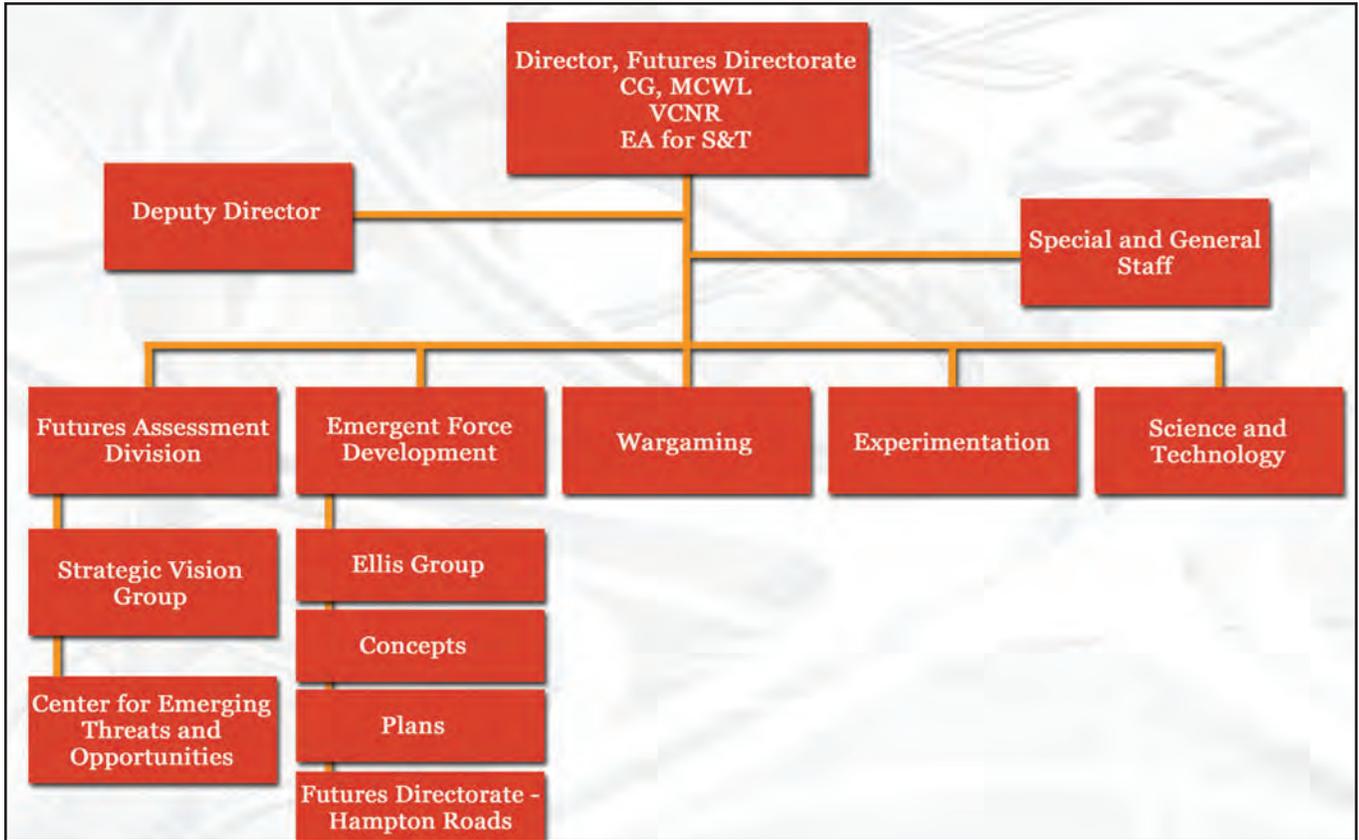


Figure 4-1. Futures Directorate Organizational Chart

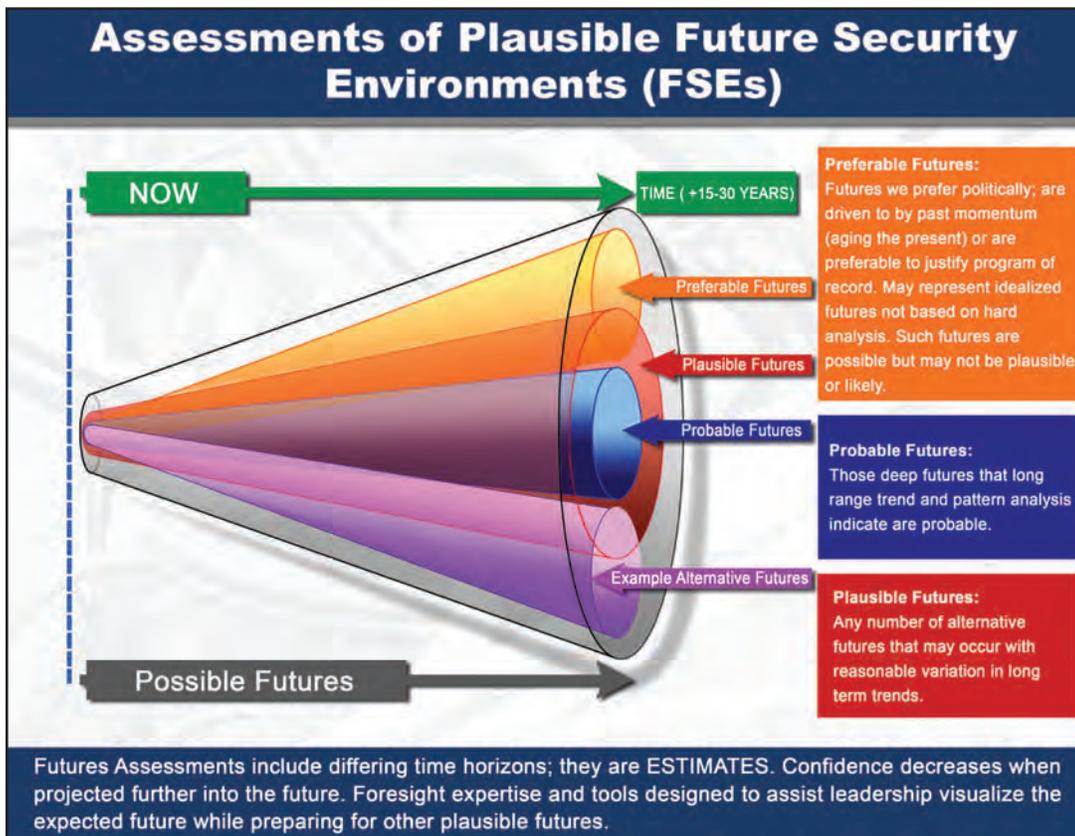


Figure 4-2. Futures Directorate Organizational Chart

- ▶ An increased emphasis on a forward-postured crisis response force in readiness to address an unstable and uncertain operating environment, with an emphasis on Phases 0 through 2 (Shape, Deter, Seize Initiative)

## Influences within the Marine Corps on Future Development

### **Commandant's Planning Guidance 2015 and Expeditionary Force 21**

The Marine Corps' acquisition community is addressing the need to equip that force with the right equipment. Having the right equipment at the right time is a major challenge that every military organization must address. There is a growing need for greater equipment flexibility and adaptability at the company level, where the vehicle operator can reconfigure the vehicle from a weapons platform capability to a protected troop carrier at the discretion of the company commander. **Modernization through Modularity** is a key future enabler and the theme of this year's ATIP. The premise is that a module will be less expensive to procure than a new platform and will allow legacy equipment to be modernized and better keep pace with expected threats in a fiscally restrained environment. A **Modernization through Modularity** approach allows for current platforms to receive periodic technology refresh while the development of new vehicles is underway.

*"We must win today's battles while evolving, innovating, and adapting to win tomorrow's fight."*

—U.S. Marine Corps 36th  
Commandant's Planning Guidance  
2015

### **Potential Advantages of Holistic Modularity**

- ▶ Total structure is more comprehensible.
- ▶ Modules can be easily replaced.
- ▶ Work division is possible without all participants having an overview of the complete system.
- ▶ Effects of changes to one part of a system on other parts are minimized.
- ▶ Many different configurations of the system are possible.
- ▶ Vendor lock-in is prevented due to standardization.
- ▶ Open innovation – enabling external entity innovation input.

### **Balancing the Tensions Across the Life Cycle**

To adequately modernize the force using a HMA, the Marine Corps must balance all the tensions of current and new platforms across the life cycle of the vehicle. From a programmatic perspective, the most important of these tensions is cost. Life cycle cost includes all lifecycle management costs: development, acquisition, operations, support, and disposal. A key factor in the consideration of any system development (or recapitalization) is the impact of the cost to keep the system relevant throughout its life cycle.

By using a modular approach and decomposing the features or characteristics into less complex and more comprehensible pieces, stakeholders can identify the benefits of a system's features or characteristics by life cycle phase, which can aid in balancing competing priorities across the entire life cycle. As depicted in Figure 4-3, balancing the tensions across the system's life cycle will require understanding the benefits of each decomposed feature and characteristic (module). ONR is investigating a Holistic Modular Approach that will provide the knowledge needed to

## HOLISTIC MODULARITY (Balancing the Tension Across the Life Cycle)

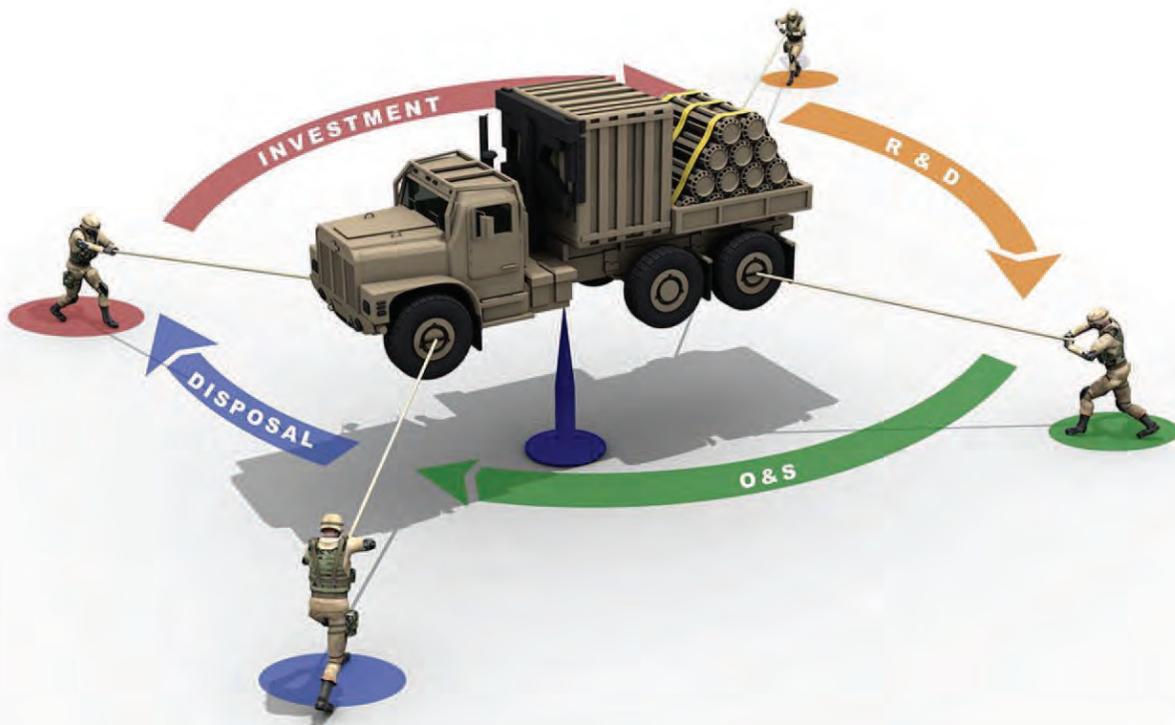


Figure 4-3. Holistic Modularity - Balancing the Tension

make informed decisions regarding necessary trade-offs and ensure the maximum benefit to the end user.

As defined in the previous chapter, modularity can be described as the development of interchangeable system components for a larger complex system that are linked together through a set of common or standard interfaces to perform specific missions or tasks. Modularity enables plug-and-play capabilities that will allow the expeditionary warfighter of the future the flexibility to adapt to the dynamic battlefield by enabling the rapid reconfiguring of forces, ensuring they are optimally configured for any mission.

The current and projected security environment that the Marine Corps will face will require a reshaping

of the force. The force must evolve from focusing on capabilities that are designed for major combat operations to focusing on meeting the growing demand for security cooperation activities and crisis response requirements. In addition, this evolution must occur without forfeiting our ability to fight as a significant force in any large conflict or enduring war. Building on the proven concepts of Operational Maneuver from the Sea, Ship to Objective Maneuver, and Seabasing, Expeditionary Force 21 expands the scope and capabilities of these concepts to meet the operating environment challenges of today and tomorrow. Accordingly, building systems that are modular, scalable, and flexible ensures that the future Marine Corps will be able to rapidly innovative, adapt, and win.

*“The current and future operating environment requires an expeditionary mindset geared toward increased efficiency and reduced consumption, which will make our forces lighter and faster. We will aggressively pursue innovative solutions to reduce energy demand in our platforms and systems, increase our self-sufficiency in our sustainment, and reduce our expeditionary footprint on the battlefield. Transforming the way we use energy is essential to rebalance our Corps and prepare it for the future.”*

—James F. Amos General, U.S. Marine Corps 35th Commandant of the Marine Corps

## PEO LS Future Focus – Exponential Technologies

Exponential technologies are those technologies that fundamentally disrupt the ‘balance of power’. These technologies typically have the following characteristics:

- ▶ **Decentralization** - Work is performed by a diverse network of individuals using mass collaboration in a virtual environment.
- ▶ **Transparency** - The work is usually open-source.

The impact of transparency is further amplified when technologies coalesce into open platforms thus enabling insertion and upgrades by rapidly building on previous versions. Furthermore, the ability to combine and recombine technologies lends itself to exponential innovation – where the combined capability is greater than the sum of its parts.

PEO Land Systems’ future investments will focus heavily on exponential technologies to include:

- ▶ 3D Printing/Digital Fabrication
- ▶ Virtual Collaboration Tools
- ▶ Energy Harvesting
- ▶ Nanotechnology/Nanomaterials
- ▶ Autonomy/Robotics/Artificial Intelligence

## Additive Manufacturing

Additive Manufacturing refers to a process by which digital 3D design data is used to build up a component in layers by depositing material. Additive manufacturing uses three-dimensional printing to transform engineering design files into fully functional and durable objects created from sand, metal, and glass. The idea is to use this process at the lowest tactical level where the end user can produce their own repair parts at the Forward Operation Base and reduce the strain on the logistics supply system, thus reducing convoys and enhancing combat power and readiness. A reliable 3D type printer will require raw materials, a reliable power source, and expeditionary equipment. All of these issues must be addressed, but independence from the supply chain affords the Operational Commanders tremendous flexibility.

### **Decentralized, Transparent Collaboration**

PEO LS is currently collaborating with ONR to enhance data discovery, data management, and develop state-of-the-art visualization tools. Integral to this capability is a tool that will learn the decision maker’s search patterns, data preferences, and output format preferences (similar to a NETFLIX™ movie search) to automate many of the routine functions that are often tedious and time consuming. In addition, an enhanced interactive visualization tool will be developed to support the display and manipulation of the data to strengthen decentralized collaboration and provide greater transparency.

To enhance this capability, predictive analysis tools will be developed that will be capable of identifying critical data/information that potentially will impact PEO LS programs' design requirements. The ultimate goal is to identify potential technology solutions through a transparent collaboration environment that provides decision makers with actionable information/solutions before a problem reaches critical mass.

### **Energy Harvesting**

In the current and future battle space, the warfighter's continuing appetite for energy will drive the need for other sources of energy beyond the current battery/fossil fuel based power sources. Portable power sources that result from these efforts will yield field applications that are lighter in weight with increased capacity. Ideally, the goal is to operate all Marine Corps equipment with a universal or interchangeable self-recharging/regenerating power source.

The Marine Corps seeks innovative, versatile, scalable renewable energy and energy storage capabilities that can be deployed in expeditionary environments.

### **Nanotechnology/Nanomaterials**

Nanotechnology is the engineering of functional systems at the molecular scale and provides a number of technical opportunities for the PEO LS portfolio and the warfighter. The field of nanotechnology offers tremendous potential for the Marine Corps in "lightening the MAGTF" through the use of nanomaterials and in the production of lightweight armor and vehicle components.

Various basic research efforts are under way to explore nanotechnologies to enhance protective coatings, camouflage, lubricants, and lightweight materials for both vehicle infrastructure and armor applications.

*"To strengthen interoperability in the future we will experiment with new concepts and technologies to achieve integrated effects on tomorrow's battlefield..."*

—General Joseph F. Dunford  
Commandant of the Marine Corps

### **Autonomy/Robotics/Artificial Intelligence**

Robotics, once solely the domain of the Sci-fi Genre now permeate our daily lives and in the near future will reach the intelligence singularity - where artificial intelligence outpaces human intellect. Advances in motion and sensing technologies continue to improve the precision of robot motion and will eventually allow robots to perform tasks once exclusively the domain of humans. When combined with advances in nanotechnology and artificial intelligence, robotics promises to not only reduce casualties and collateral damage but dramatically lighten the MAGTF.

Therefore, PEO Land Systems' future S&T investments will focus heavily on this critical exponential technology to ensure the Marine Corps remains relevant and is able to evolve, innovate, adapt, and win tomorrow's fight.