Trends

Defense 2020

Security and warfare look very different in 2020. Electronic intelligence and surveillance functions driven by big data have become key defense requirements. Wearable sensors, smart uniforms, and performance-enhancing supplements significantly boost the capabilities of the next-generation soldier. Robot and drone armies strike with precision but sometimes blur the lines drawn by conventional laws governing warfare. An upsurge in cyber-warfare makes it increasingly difficult to distinguish between the actions of terrorists, organized criminals, fringe movements, nation states, and teenage hackers. Procurement sees a departure from historic norms with the rise of 3D printed weapons and challenge-based R&D models.

Intelligence and surveillance become top defense requirement

Big data analytics in defense

Organizations tracking key security issues, such as weapons of mass destruction, combine new collection methods with big-data intelligence analytics. Future advances may lead to significant leaps in computer processing and engineering that allow computers to process huge data sets and portray the data in ways that mimic human intuition and judgment, leading to a new generation of powerful campaign and tactical decision aids.

DARPA launched the XDATA program in 2012 to develop tools and algorithms to analyze massive volumes of mission-specific data. The objective was to eliminate background clutter and help warfighters easily understand and benefit from the most relevant pieces of information.

Improved joint forces engagement

Precision engagement, now normalized, supports the armed forces' ability to identify, locate, and track objectives or targets; select, organize, and use the appropriate systems; assess results; and engage and reengage with decisive speed and overwhelming operational tempo as required, throughout the full range of military operations.

Evolutionary design

Bio-inspired engineering creates new data collection devices for intelligence services and the military that resemble snakes, spiders, and birds. The ability to swarm allows users to overwhelm the enemy with numbers.

Improved risk detection

Applying psychosocial analysis, militaries mitigate risk, detect intrusions, and leverage agile networks to keep warfighters' laptops, radios, and small computers secure, mitigating the possibility of spoofed orders and premature ordnance detonation.

The super-empowered soldier

Power in small packages

Soldiers' packs, currently including up to 30 pounds of power packs, become radically smaller, using radioisotope batteries roughly the size and weight of a D-cell battery. The new power packs deliver 1–5 watts of power for years and have important civilian and commercial applications as well.

The UK Ministry of Defense's future infantry soldier technology (FIST) program is testing technologies related to soldier equipment, weapons, and sighting system. One of the "modified power system" being tested provides power to multiple equipment —including GPS, computer, thermal imaging, and radios—addressing the power requirements of the future soldier. FIST is expected to enter the UK military service between 2015 and 2020.

Wearable sensors and multifunctional solider kits

Wearable sensors measure vitals and can assess damage to and residue on clothing fibers to assess factors such as how deep a bullet has penetrated, or whether the wearer has been exposed to chemical agents. This information can be transmitted to a central command center that can deploy rescue missions or other resources as necessary. Fibers too thick to be sewn into military uniforms can be placed in biostatic patches that transmit information. Similarly, sensors that can measure the presence of landmines are developed for boots.

Zephyr BioHarness, a wearable sensor in the form of a shirt or strap, measures critical vital signs including ECG, heart rate, breathing rate, and skin temperature. The data collected by the harness can be viewed through an online portal or sent to mobile applications.

Soldier kits are built to withstand all climates, reducing the cost of maintaining uniforms. Climate-controlled jackets protect soldiers from extreme heat and cold. 2020 sees the development of responsive, flexible polymers that can be used in multiplexed "litmus test" arrangements, configured as small "stickers" or large coating sheets, or even integrated into fabric or coatings used in the soldier's uniform and kit.

A wellness cocktail for soldiers

Nutraceuticals, pharmaceuticals, and supplementation regimes provide soldiers with greater resilience and performance. Tailored nutritional support is prescribed for specific roles and performance requirements, supporting the various mental and physical demands placed on each soldier.

Rise of robot/drone armies

Robot teams

Computer networks provide end-to-end network connectivity for autonomous teams of robots, keeping them on task and connected with their handlers. Applications include search and rescue missions in hazardous environments and the mapping of buildings and terrain in advance of the arrival of human fighters. Navies overcome the duration issue and routinely use unmanned underwater vehicles as scouting submarines, supporting port security, enemy port scouting, and surveys at depths inaccessible to humans.

DARPA Robotics Challenge (DRC) is a competition of robot systems and software systems with the aim of developing robots capable of assisting humans in disaster response. The focus of the challenge is to develop robots with task-level autonomy that can operate in hazardous disaster zones.

Drone warfare maturation

Unilateral drones join warfighters and alliance partner military forces in launching raids and other military maneuvers. The integration of UAVs into conventional warfighting offers more versatility than drone strikes alone and becomes the wave of the future as big wars wind down.

DOD's Unmanned Systems Integrated Roadmap establishes a technological roadmap for the next 25 years (2013–2038) and outlines actions and technologies for DOD and industry to pursue to align with the vision.

Robotics and UAVs blur the definition of war

In a game changer for constitutional democracies, leaders claim that hostilities do not require legislative authorization because people are not in harm's way. Precedents are set without considering the long-term implications. Military applications contrast with the use of drone warfare for intelligence purposes. Military strikes have a system of law to guide strikes; covert operations by definition are not discussed, and civilians call the shots, leading quickly to murkiness about applicable law.

Asymmetric warfare and altered cultural norms

Rise of the faceless opponent

The rise of cyber-warfare makes it increasingly difficult to distinguish between terrorists, organized criminals, fringe movements, nation states, and teenage hackers. This complicates response (retaliation) in several ways:

- Who do you target? Individual, state, organization?
- How do you target those—courts or military action?
- What response should be made—a missile or a retaliatory cyber-attack?

Cyber-defense operations

Cyberspace is operationalized with capabilities spanning the electromagnetic spectrum. A debilitating code can be sent to a missile or submarine via radio, enabling a cyber-attack without traveling through the Internet.

Holistic QDR strategies

Cyber-warfare joins nuclear, missile defense, and space forces in the Quadrennial Defense Review (QDR). This better supports planning for the complexity of the international system and the potential for cross-domain or even hybrid conflicts. Experts call for replacing the QDR with a nonpartisan Quadrennial National Review.

Mass extortion

Super-empowered individuals and nihilist networks use the threat of weapons of mass destruction attacks for mass extortion, seeking everything from state support or corporate backing to policy control (allow the transport of drugs into your country or...). They operate under the assumption that if they can shut down a reactor or a power grid, they can extort governments or the private sector for cash or political ends.

Democratized mass violence

New technologies allow non-state actors to threaten and use lethal force on a scale previously possible only between nations. Who fights wars, how they are fought, and under what rules, all undergo radical transformation as new definitions of war and peace, military and civilian, foreign and domestic, and national versus international are defined.

Norms upended

Threats by terrorist organizations and other new actors lead to increasingly blurred lines between military and criminal law. The separation between military and civilian roles also becomes problematic, as evidenced by armed social workers in Afghanistan's war zones. The lack of clarity between domestic and foreign threats erodes historic notions of sovereignty. Together, these roles and responsibilities are evolving into something new and unfinished.

Defense spending shifts globally

Western countries reduce defense expenditures

Western military services become smaller but more expensive, particularly the infantry. Tradeoffs between security and fiscal responsibility spur wealthier nations to rely increasingly on alliances. One example is NATO's Smart Defense program, under which members agree to concentrate on national strengths and coordinate planned defense budget cuts. R&D spending declines. In the 2000s, militaries rely on stealth, speed, and precision to stay ahead. By 2020, these evolve into survivability, computation, and persistence—all capabilities allowing for constant, undetected monitoring at very high levels of resolution.

By 2021, total spending by NATO nations falls below non-NATO spending for the first time in decades.

Growth of Asian military spending

With healthy economic growth, the Asia-Pacific region increasingly serves as the go-to market for defense suppliers. Peer competition and state-versus-state standoffs in the region drive up defense spending.

The Asia-Pacific military market is expected to grow by 27 percent from 2013–2017, with more than 60 percent of the growth accounted for by China alone.

"Leapfrog" nations

Singapore and other countries eschew traditionally heavy and expensive Western defense models, instead "leapfrogging" to unmanned, autonomous models. Just as mobile phones allowed developing countries to skip land lines, the self-sufficiency and cost-effectiveness of emerging tools strengthen these actors' roles in future conflicts. China, among others, effectively skips years of costly R&D, allowing it to benefit from speedy weaponry and equipment modernization, thereby reducing the competitive edge of foreign nations. Iran, taking advantage of less expensive and widely available munitions and battle-networking technologies, develops ballistic missiles and guided munitions, and transfers them to non-state proxies.

By 2015 China's military spending exceeds that of Britain, France, and Germany combined.

Security cooperation and multinational forces take center stage

Building partnership capacity

Security cooperation, once seen primarily as a way to offset reductions in defense spending, now plays an increasing role in bolstering allied capabilities and advancing domestic interests, particularly in light of budget constraints, operational limitations, and persistent sovereignty concerns. Many countries re-examine their ability to field the full spectrum of military capabilities. Allied countries coordinate to prioritize or divest certain capabilities. Close allies engage in comparative advantage by concentrating on those capabilities where they have a strategic interest or strength, permitting their partners to assume different responsibilities.

Increased operational tempo for multinational forces

Joint forces gain positional advantage with decisive and overwhelming operational speed. Widely dispersed joint air, land, sea, special operations, and space forces, capable of scaling and massing force rapidly secure advantage through the application of information, deception, engagement, mobility, and counter-mobility capabilities.

Improved communications for multinational forces

Today's multinational forces often have problems communicating, and not only due to language differences. Technical incompatibility between communications systems can hinder information sharing and timely command and control decisions. In 2020, these technological problems are overcome via advances in mobile technology, allowing coalition forces to communicate seamlessly in real time.

DARPA's Mobile Ad hoc Interoperability Network Gateaway (MAINGATE) program is helping overcome incompatibility issues in communication systems of multinational forces, US government agencies, and the warfighter.

Changing force posture

Army's fluid adaptation

Speed and adaptability become all-important as asymmetric warfare becomes the norm. Twenty-eight nations now have weapons-grade plutonium. Troops must deal with the proliferation of proxies, collapsing governments, and humanitarian disasters beyond the scope of anything seen previously. Turmoil in Arab nations and weapons proliferation pose new risks. Coalition building around specific problems becomes more common, making the survival of existing alliances such as NATO problematic.

Interoperable forces

Soldiers have more operational flexibility against a myriad of state and non-state actors. Enlisted personnel are less likely to specialize but receive more varied training in ground combat, clearance operations, paratroop experience, and extraction. Officers become more specialized, and then teach those under their command on the job in different environments. Traditional military structures are transformed. For example, instead of an army, air force, and navy, some nations move to a reaction force (high readiness, light force), prevention force (heavy force used for deterrence), and integration force (joint military-civilian, multi-agency force).

Long-range, rapid strikes supplant stealth

Speed becomes more important as evolving air defenses degrade the utility of stealth technology. In light of intensifying anti-access/area-denial threats in some parts of the world, greater emphasis is placed on long-range, rapid strikes (for example, prompt global strike), including long-range bombers operating from protected domestic facilities and the hypersonic delivery of conventional munitions worldwide.

Direct-energy lasers

Direct-energy lasers may eliminate the need for conventional shipboard cannon, creating a big impact on logistics and space availability. Their tremendous speed and unlimited "ammunition" offers an asymmetric advantage to those with this capability.

Space defense becomes priority

A variety of issues dealing with the protection of space assets, ranging from policy to technology investment, give rise to new defense priorities. Significant investments are required to develop effective countermeasures to new state-of-the-art technologies. Examples include end-to-end capabilities supporting maritime operations in the absence of satellite connectivity and miniature space satellites called CubeSats weighing only a few kilos and propelled by ion beams.

Transformed weapons procurement

Asia-based commercial IT supply chain brings new vulnerabilities

Software is increasingly obtained overseas, particularly from Asia. Each node within the global IT supply chain presents adversaries with an opportunity to introduce a cyber-threat or exploit the system for their own purposes. The navy uses IT hardware and software developed overseas every day. Acquisition systems seek greater visibility and more effective controls across the entire supply chain.

Incentivized innovation results in reduced defense R&D costs

Governments provide incentives to contractors to do more with less, including greater use of fixed-price contracts that force contractors to meet both deadline and price. Build contracts remain single source due to the sheer number of suppliers.

Joint acquisition

More military assets are shared and joint procurement offices strengthened. Joint acquisition strategies within militaries lead to greater efficiencies including streamlined acquisition processes, standardized acquisition procedures, a fusion of acquisition regulations, and, perhaps most importantly, agile centers of excellence capable of meeting the dynamic needs of the military and other defense customers.

Rapid prototyping of defense weapons via 3D printing

The current holy grail of additive manufacturing is to build entire systems (for example, engines, wings) rather than parts. As the cost of 3D printing declines, it will become possible to make the additive machines bigger and more relevant to weapon manufacturing. By 2020, a majority of parts for aircraft engines are created using additive manufacturing. Smaller countries leverage this technology and other advanced industrial techniques to enhance their ability to create next-generation military capabilities and produce them in quantity.

Network model applied to defense R&D

In a departure from historic military R&D norms, challenge prizes become more popular, "pulling" great ideas to the surface, shortening the time to production and shrinking budgets.

The Pentagon's blue sky researchers awarded $1 million in 2013 to a team of designers who built an innovative drivetrain for a Marine swimming tank. The winning three-person team was a group of engineers united for the prize money DARPA offered in the Fast, Adaptable, Next-Generation Ground Vehicle (FANG) Challenge. In a sign of things to come, the impromptu collaborators used online design tools and open-source code to win the challenge.

Military healthcare transformation

Dressing wounds in the battlefield

Some wounds sustained by soldiers receive anti-infection treatment in the battlefield before arriving at the hospital. High-quality facial restorations with fewer surgeries become the norm, resulting in improved healing and a corresponding reduction in scarring and the need for further surgeries later on. New technologies may include agents that can be sprayed on a wound on the battlefield to decrease infection, inflammation, and scarring; the harvesting of adult stem cells from fighters to use in controlling inflammation; and the development of peptides that destroy bacteria in wounds.

Resource optimization in military health

Budget cuts force militaries to consolidate and rationalize resources for military health care and graduate medical education. The focus is on applying commercial best practices, upgrading the skills of military healthcare staff, and preventative care.

Integrated military health care model

Military health agencies increasingly offer an integrated care model that coordinates care delivery, health insurance, interaction with multiple entities, and more, producing better outcomes for beneficiaries. More emphasis is placed on health and patient engagement, involving family members in patient care, redesigning primary care, and aligning financial systems and incentives toward better outcomes.

In 2010, Veterans Health Administration implemented the patient-centered medical home model (PCMH) in line with the federal PCMH collaborative initiative. The model aims at providing primary care to veterans that is accessible, patient-centered, coordinated, and team-based.

Health insurance exchanges substitute for veterans' care

In the United States, veterans, retirees, and their families can now obtain insurance through Affordable Care Act (ACA) exchanges, Tricare, or VHA. Under ACA, many veterans and retirees will qualify for Medicaid and others might get lower-cost insurance coverage. This could render the existing separate health system for veterans redundant.

The population of living veterans drops to 14 million in 2036, from a high of 22.2 million in 2011. Half of this veteran population is aged above 65 years.

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