

The Race to Digitalization

How digitalization will revolutionize military capability and the seven strategies we need now to harness it

by Col John Shafer, USMC(Ret) & Charles Rath

The machinegun. The tank. The airplane. These technological innovations fundamentally changed the way wars have been waged. Those who ignored the technologies or failed to appropriately adapt to them were found to be ineffective and suffered disproportionate casualties.

Now, in the 21st century, digitalization—the convergence of big data, cloud computing, artificial intelligence (AI), and the Internet of things (IoT)—will be the single most transformative development that revolutionizes war more quickly and dramatically than ever before. Leaders of nations who invest in, appreciate, and ultimately embrace this movement will thrive. Those who fail to respond will never catch up and will rapidly lead their countries into being irrelevant or extinct. It is a scary proposition. But it is not up for debate.

The fundamental problem that commanders face—making the right decisions at the right time to achieve desired outcomes—has not changed since the time of Alexander the Great. Gaining and maintaining information dominance is key to timely decision making at the strategic, operational, and tactical levels.

The difference between Alexander's time and ours is in the speed, volume, platforms, and formats of the information—the data—to be processed. To be effective in the modern operating environment and make decisions at a faster pace than adversaries, whether facing peer competitors or non-state actors, our C2 architectures need assured, secure global access to data with mechanisms

>Col Shafer retired after serving 37 years as an Infantry and Reconnaissance Marine. He commanded at every level from the platoon to the regiment, and he experienced five combat tours. In retirement, Col Shafer is the President of Centurion Solutions, a company that provides defense-related consulting services as well as serving as a site lead for Metris Global in Camp Lejeune, NC.

>>Mr. Rath is the President & CEO of RS21, a data science and visualization company that leverages insights from data to empower people to make data-driven decisions. He has more than fifteen years of experience as a global resilience expert and brings unique expertise in the field of resilience and risk management, having been in leadership positions in private, public, and national laboratory settings relating to this kind of work.

The speed of modern military decision-making must exceed the speed of modern war.

—Gen Joseph Dunford

to identify, filter, and deliver information at the right time and in the right format for leaders to make appropriate decisions.

Furthermore, the United States must be able to operate in denied, degraded, intermittent, and low-bandwidth (DDIL) environments, as well as master and dominate the data realm to compress the decision-making process. Masterfully merging all data interfaces and developing and refining algorithms is the best way to outpace adversaries and maintain a strategic advantage.

DOD officials have wrestled with the digitalization challenge for some time and have yet to achieve the objective of big-data management. But the ability to integrate different data sets then analyze and deliver them in understandable, applicable formats is at our fingertips.

To truly embrace and invest in digitalization, the key will be to partner with the private sector to transform reams of data which have long been catalogued but have become too cumbersome to mine into actionable insights.

The private sector has been most affected by digitalization, and nowhere is the adaptation toward this trend more evident than in business. Nearly 50 percent of the Fortune 500 companies listed at the turn of the century are no longer relevant. It is estimated that 40 percent of companies currently on the list will be extinct in 10 years.

Behemoth corporations, long known for strength and dominance, are being upended by small, agile companies whose leaders are smarter, faster, and far more capable of disrupting traditional industries.

The same trajectory is feasible for today's global warfighters. Who can forget Russian President Vladimir Putin's ominous quote: "Whoever becomes the leader within this sphere [AI] will become the ruler of the world."

Data Deluge

Ninety percent of the world's data was created in the last two years. This data comes from satellites, sensors, cell phones, and nearly every electronic gadget. It creates opportunities to understand our world in ways that were inconceivable just a few years ago. The source of this data is known as the IoT. But we always had a lot of data. What is so different now?

Rapid developments in cloud computing allow the capability to crunch and store massive amounts of information. Processing terabytes and petabytes of data is no longer novel and is actually considered quite pedestrian in the Information Age.

AI makes it possible for machines to learn from experience, adapt to new data, and perform human-like tasks. Machine learning models quickly sift through massive amounts of data in order to identify trends, make predictions, and inform transformative decisions.

Opportunities

How will convergence of big data, cloud computing, IoT, and AI transform the military? Some areas have advanced more than others, but below are a handful of game-changing examples. Let's examine them through the lens of the six classic Warfighting Functions:

Intelligence. In the traditional sense, development of the collection plan has been a time-consuming task which usually completely relies on intelligence assessments deduced from human interpretation across multiple sources usually spanning a prolonged period of time. This data is then painstakingly evaluated and compiled, and a collective assessment—made by humans—is applied. Many times these assessments are informative and accurate, but arguably more times they are not, because lengthy processing time considerations and human factors introduce error probability. Now in the age of digitalization,

we can create an interface that allows for assessment of collective data, spanning all collection sources over a predetermined time horizon most reflective of current operational considerations. This interface can then instantaneously run those unrestricted data sets against multiple algorithms to determine the most likely and most dangerous enemy courses of action with a high probability of certainty, all in minutes, not weeks. This is intel driving operations.

Maneuver. The U.S. military has preferred methods of maneuver. Our doctrine seeks to pit our strength against our opponents' weaknesses at the appropriate time. Regardless of domain, this approach offers few options to those exercising the offense. Our doctrine has been studied extensively by our adversaries. There are only so many ways one needs to defend against our maneuver. However, our doctrine also states that maneuver is intended to exploit an opponent's weakness. Imagine removing the uncertainty in determining exactly where the adversaries' weaknesses actually are? Data collection and realtime analysis combined with data visualization can predict where enemy exploitability and gaps do and will exist.

Fires. Long range, indirect, and air and surface delivered fires are essential for success on the modern battlefield. Technology has come a long way in creating "smart" munitions, which can deliver fires exactly where you want them. This has greatly enhanced warfighter capability, however, it falls short of where we could be. Today's precision fires do only one thing—deliver fires to an exact location. What they do not do is tell you exactly when and where you want them. Imagine a combined fires system that not only delivers pinpoint accurate fires but also delivers those fires at the right time, in the precise location, achieving desired effects on the target while virtually eliminating the concern of collateral damage. Battlefield target and engagement data, combined with environmental and collateral factors continuously analyzed through AI algorithms, can deliver complete fires solutions at the time of need—accessible from the requesting unit level to the fires releasing authority level—simultaneously.

Logistics. Just in time logistics? Forward logistics depots or "iron mountains?" No more. Image data analytics, from the smallest to the largest units, visually and understandably depict who requires what, when, where, how, and why, and informs the appropriate agencies and systems to deliver those requirements at the right time and place via the most secure methods and routes.

Force Protection. AI can provide realtime information at the individual, unit, and platform level that can pinpoint friendly locations and integrate into fire control systems to eliminate blue-on-blue engagements by overriding human weapons employment decisions. Enemy tactics, techniques, and procedures and partner force behavior patterns can be analyzed to develop predictive models that can be utilized to inform mitigation strategies, greatly reducing surprise engagements.

C2. AI algorithms and machine learning can improve and eventually perfect decision making by placing the human *on the loop* as opposed to relying on the human to be *in the loop*. Imagine an environment with a system that compiles, analyzes, and makes sense of all available, relevant data and conveys that to the human decision maker. And this all occurs at the appropriate time, combined with mission parameters and requirements, to provide a clear, relevant, complete, feasible, suitable, and acceptable course of action—all ahead of an adversary and faster than the speed of war.

The Seven Key Components of a Sound Digitalization Strategy

The sheer scale of change required to establish global digital superiority is tough to comprehend. Where do we start? Following are seven practical ideas for every organization in the DOD to consider while transitioning from the past to the present and future:

People. As companies, research institutions, and governments race toward innovation in AI and smarter everything, one profession has risen above all else: data science. Competition is fierce. LinkedIn recently reported a shortage of 151,717 people with data science skills in the United States. The median sal-



NEXT GENERATION

AMERICAN RHEINMETALL DEFENSE – RESTON, VA
MOBILITY. LETHALITY. PROTECTION.

American Rheinmetall Munitions – Stafford, VA

World class munitions, armaments and propulsion systems
Cutting edge active and passive protection systems

American Rheinmetall Systems – Biddeford, ME

Soldier electronics delivering lethality advances
Advanced SHORAD and turret technologies for the future battlefield

American Rheinmetall Vehicles – Sterling Heights, MI

Delivering next-generation vehicles now
Complete solutions for tactical military vehicles

www.rheinmetall-us.com

FORCE **PROTECTION** IS OUR MISSION.



ary for a data scientist is \$185,000 per year. Currently, there are limited career paths for data scientists at the DOD. But even if there were more opportunities, Department officials would have a hard time winning the war on talent. To compete, leaders must embrace out-of-the-box personnel models in order to attract brain power to join their ranks. DOD's Chief Data Officer Michael Conlin suggests a "public-private talent exchange" as a way to capture top talent who want to make a difference. This is certainly the type of approach that's needed. Given the supply and demand of talent, DOD officials must embrace non-traditional partnerships with innovative industry partners if they want to rapidly move the needle and sustain it.

Non-traditional partnerships. In order to access the Nation's most disruptive companies, DOD leadership must overhaul traditional acquisition strategies. During the time that traditional defense contractors make a push toward digitalization capabilities, they will be challenged to keep up with smaller, more agile companies that are capable of innovating at the speed of technology. Continued use of other transaction authorities that are not encumbered with tedious and prohibitive guidelines will be central to keep pace with emerging technologies and capabilities.

Cloud computing. In his insightful book, *Digital Transformation: Survive and Thrive in an Era of Mass Extinction*, Thomas Siebel highlights elastic cloud computing as the essential foundation of moving toward digitalization. In short, cloud computing enables organizations to crunch massive amounts of information in parallel sequences at once. For example, cloud computing would allow the military to process and understand millions of disparate data from the battlefield at the same time. Cloud computing's infinite capacity and rapid elasticity make it essential for the DOD's digitalization strategy.

Data integration. The problem of "data silos" in the DOD is well documented and understood. Efforts are well underway to solve the problem of structured data integration. However, the ability to seamlessly integrate and

derive insights from structured *and* unstructured data is key. Structured data is what everyone studied in statistics class, such as birth dates and phone numbers, and is usually stored in easy-to-understand databases. Integrating unstructured data (everything else) is where magic happens. Unstructured data can be anything from satellite imagery to cell phone location data, and from sensors to photographs. The ability to integrate all this information—*and derive meaning from it*—will allow military leaders to exponentially increase their intelligence and agility in the battlefield and beyond.

Modern software development. Modern software development methods are quite possibly the least sexy attribute of digitalization to talk about at cocktail parties, especially approaches that allow military officials to harness agility and flexibility in the face of rapid technical advancements. However, it may be the most unnoticed but most important attribute. Traditional approaches to software development at the DOD render the organization incapable of adapting to emerging trends. However, using containers—an open source software development concept that securely packages software and all its dependencies for use across multiple computing environments—is a game changer for the military. Containers dramatically speed up development time while allowing the DOD to quickly and effectively switch out components to meet specific mission needs.

Usability. A major general at the Association of the U.S. Army Conference in downtown Washington, DC, expressed her frustration:

Even when we can get our arms around all of the data, it's impossible to understand—there's just too much of it.

The fields of human-computer interaction and user experience design were created to help the human mind easily process digital information. However, these experts are rarely consulted when big data applications are developed. The result? Big, nasty interfaces that no one understands or wants to use. Integrating designers as part of the development team can drastically increase the likeli-

hood of success. In fact, incorporating user experience research into traditional development cycles can yield a return on investment of between 10-100 times.

DDIL functionality. DDIL environments are omnipresent and should be anticipated in all DOD operations. To no one's surprise, emerging technologies tend to work seamlessly in impeccably clean environments with high-speed Internet service and armies of programmers and tech teams to immediately resolve problems. However, transitioning that capability to the battlefield is significantly more challenging. Researchers and practitioners must build digitalization strategies and networks that make data access and computing assured regardless of the degree of DDIL challenges encountered.

To seize transformational moments, we must embrace out-of-the-box, disruptive solutions. Granted, this can be hard to find in traditional bureaucracies. These solutions must be driven by foundational principles and frameworks that create a united effort across government, industry, and the research community leadership.

The world is at a pivotal moment in modern military history. The pace of technological innovation is so rapid that it nearly defies imagination. Those who harness it will reign supreme. Those approaches that allow militaries to harness agility and flexibility in the face of rapid technical advancements may be the most unnoticed, but most important attributes. Traditional approaches to software development at DOD, for example, tethered the agency to outdated technologies and vendors, rendering the organization incapable of adapting to emerging trends. However, by working with the most innovative companies and leveraging the most cutting-edge technologies, the DOD can dramatically speed up development time to quickly and effectively switch out components to meet specific mission needs. True digitalization is a game changer for the military and DOD.

