SEMINAR READ AHEAD

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Multi-Domain Operations: The Future of Warfare

"I firmly believe that whoever is first to master Multi-Domain Operations (MDO) may not control the world, but they will have a significant advantage in it."
As we continue to develop capabilities for the Alliance, it will be critical to consider the lessons of the past as we provide advice to inform the future fight. Now is the time to re-assess the 'old' ways of doing things and look at how our current strengths need to evolve to meet new challenges. As NATO's Allied Air Commander General Harrigian stated, our "challenge is to move from today's operations across all domains, to tomorrow's Multi-Domain Operations" where operations occur with humans 'on-the-loop' instead of in it. [1] Whether we use the term Multi-Domain Operations, All-Domain Operations, or Multi-Domain Command and Control (MDC2) the ability to operate seamlessly and simultaneously throughout the entire spectrum of warfare will be the lynchpin to success on the battlefields of tomorrow.

Today, NATO is performing multiple Deterrence and Defense operations across their Area of Responsibility. These activities illustrate efforts taking place simultaneously in several domains, supported by multiple nations, and with varying degrees of integration. The integration between operations and between the domains themselves has proven to be effective. Still, our current efforts require large amounts of human interaction to coordinate between operations and domains, which reduces the potential efficiency of such operations. Think about the level of human involvement required to fuse information between forward presence troops in Eastern Europe, airborne early warning assets over Central Europe, and standing naval forces in the Atlantic and you start to develop a picture of the complexities involved with providing timely and accurate information to strategic-level decision makers. "Now assume that every decision made or action taken in one domain influenced the environment of nearly all of the others, as shown in the image below." In today's interconnected world, we must consider the implications of every decision and leaders rightly demand the right information at the right time. Moving forward, we must build a structure of interoperability under an MDC2 umbrella that not only enhances our effectiveness, but also increases efficiency as we fuse data into actionable information faster than our enemy. I acknowledge up front that this challenge will be complex. We must be the first to the finish line with MDC2 in order to maintain our collective security. NOW is the time to think about what this future state will be and how we will get there, together.

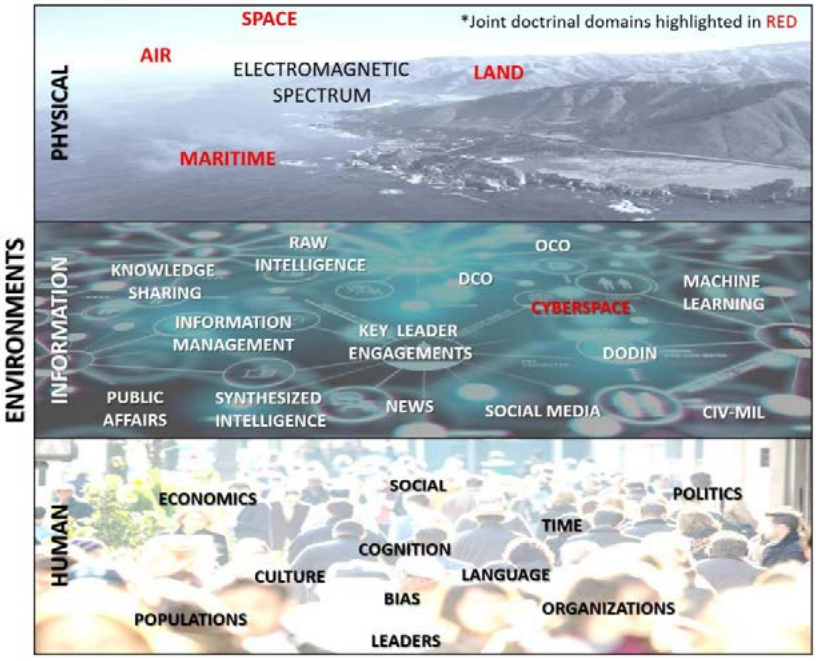


Image Credit: USAF Doctrine Annex 3-1)[2]

As an Alliance, we are in the driver's seat in the pursuit of a safer and more secure world but we can only help to shape this future if we pay attention to what got us here. Let's take our time and make the right choices based on what we have learned and what we know to expect. As I often say, I'd rather do something right than do something quick and when it comes to MDO, we cannot afford to get it wrong. That said, our adversaries are not waiting for us to figure this out so we must work fast, but we must also do it right…There will only be one chance.

To seize this opportunity, we must establish a baseline understanding of what Multi-Domain Operations are. As one of his Focus Areas the US Air Force Chief of Staff stated, "multi-domain battle is more than the ability to work in multiple domains."[3] Rather it is the ability to "sense, decide, and act rapidly and in concert across all domains…[to] master command and control of the multi-domain battle."[4] An underlying premise for MDC2 is that commanders will have and act upon decision quality information faster than their adversary. We must recognize now that the advantage in future conflicts will go to those who can harness speed in their ability to acquire, fuse, and decipher data across all domains.

For centuries, great powers have seized upon opportunities presented by superior information and their ability to act swiftly based on that information. Typically, the side with the clearest information and most rapid response has been victorious. In 1805, Napoleon skillfully navigated the power of information to emerge victorious in the Battle of Austerlitz. Despite having 20,000 fewer troops, he utilized superior C2 to present multiple issues in concert, while not only directing his troops, but also influencing the decisions of his enemies. Through a genius disinformation campaign, he led the Russio-Austrian forces into executing an overwhelming attack on his forces, leaving their main control center weakly fortified. The enemy believed they could afford this risk since their information told them the attack would hit a weakness in Napoleon's defenses…they were wrong. Not only did Napoleon have reinforcements ready to meet the enemy, he also seized upon the opportunity presented by the lightly defended control center—encircling their troops and forcing their retreat into Russia.[5] It is unlikely that another war will be won through mastery of information and speed in a single domain but as Napoleon showed, the victor will continue to be the side that can fuse information from the domains available to them and take decisive action the fastest. Future conflicts will take new approaches but will always be influenced by the lessons of the past.

New approaches to warfare dictate the establishment of foundational requirement(s). One requirement that is inherent in NATO philosophy and is an absolute for MDO is interoperability. Interoperability is our ability to act together coherently, effectively and efficiently to achieve the objective. A simple example we may learn from is the inability to exchange information across different security 'domains' (NATO CRONOS & US SIPRnet) during Operation Allied Force. This resulted in situations "where critical operational and intelligence products…were not disseminated in time to US forward units due to lack of access", ultimately causing "duplication of effort [for] an already overworked staff."[6] This severely hindered the Alliance's ability to communicate and subsequently produced the desired effects, but in a much less efficient manner that otherwise would have been possible. As we pursue MDO and MDC2 we must be cognizant that we can no longer afford inefficiency. Focus prior to the conflict on properly integrating systems across the Doctrine, Organization, Training, Material, Leadership, Personnel, Facilities, Interoperability (DOTMLPFI) spectrum, would have reduced or even eliminated this hindrance in the ability of strategic and tactical level leaders to execute their mission. This also highlights two key truths of Command and Control. First, when C2 is working properly you don't even notice, but everyone immediately knows if it's bad. Second, it's wicked hard! Our current C2 structures were developed over time, based on centuries of lessons learned through successes and failures on the battlefield. We have adapted these structures to single service, joint, coalition, and Allied operations but ultimately our doctrine, exercises,

equipment, and plans all developed around what worked and what did not in the last similar conflict.

So how do we capitalize on the lessons that brought us to our current C2 structure and transform them into the MDC2 structure for tomorrow? The change will not be simple, and we should be ever mindful that MDC2 requires interoperability and interoperability is complex. For an individual nation, the complexity of C2 grows with each domain added — A single domain is challenging, multi-domain is complex, and all-domain is exacerbating. As the number of nations increases, the complexity builds. If we are going to encompass the capabilities of all 30 Allies and multiple partner Nations, the complexity in NATO is exponentially more difficult.

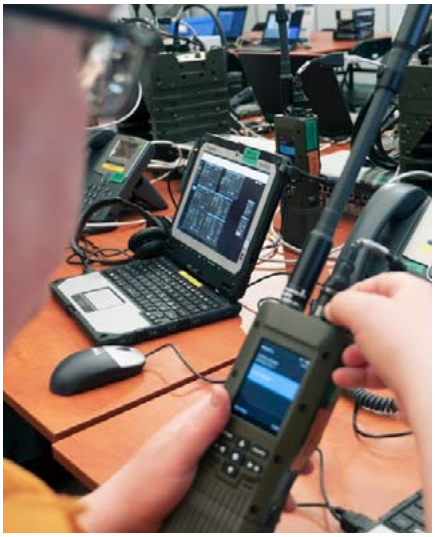
As I said earlier, the requirement to act together coherently mandates interoperability, yet interoperability is the source of the complexity of MDO...the solution will be nothing short of groundbreaking. Such moments are often termed Revolutions in Military Affairs (RMA), 'game changers', or a 'third offset'. They shatter, change, and rebuild our approach to warfare and MDO and MDC2 have the potential to change everything.

The late Andrew Marshall, former US director of the Office of Net Assessments described RMAs as:

> *"A major change in the nature of warfare brought about by the innovative application of new technologies which, combined with dramatic changes in military doctrine and operational and organizational concepts, fundamentally alters the character and conduct of military operations."*[8]

RMAs force us to reevaluate the continued potential of the 'old' ways of doing things while determining how best to apply the strengths of the new capability. Aviation has repeatedly created RMAs. Lighter than air was initially viewed with skepticism, but we saw the potential. We moved to powered flight, then multiengine, then jets, and now hypersonics. Every step of the way we took a moment to learn how best to use these new tools and brought them into our military lexicon. I personally look at it as a 'crawl, walk, run' approach. We have to take time upfront to understand the capability if we want to master it later. For MDO and MDC2, now is the time to focus on our foundational skills, to influence and provide insights into what we keep and what is replaced in the lexicon. Let's focus on the decision maker and think about how to best use the information we have. In a single domain, how do we distribute the right data, at the right time, and in the right amounts to each decision-making level? Now how do we do it when all domains are interconnected and providing data all the time? Whether decisions are made at the tactical level from the controls of an aircraft, the operational level by an AOR commander, or by strategic leaders such as SACEUR, SecGen, or the Nations, the most critical detail will be how we share information up and down the chain while providing the right information at the right time and faster than our adversaries can do it. Timely and accurate decision-making capability at every level is the promise of MDC2 and MDO. Now is the time to define what C2 should be as we build the road into our future.

The collective insight and expertise of those in NATO is the blueprint for us to build this road. The Alliance provides unmatched opportunities for Nations to assist one another in the development of new capabilities and integrate into legacy systems. The ideas and concepts that many Nations are developing right now are truly revolutionary and will provide almost incomprehensible capabilities to the Alliance. Continued development will create new capabilities, yet new capabilities create new interoperability challenges. The future of MDO relies upon these advancements and we need to consider this challenge as we move forward.



NATO is already taking steps to address the interoperability conundrum. Two examples are the Coalition Warrior Interoperability Exercise (CWIX) and NATO's Federated Mission Networking (FMN). CWIX brings together scientists, industry representatives, and military operators to explore, experiment, examine, and exercise emerging, near-fielded and fielded capabilities. The success and potential of this initiative was clear when, during the 2019 exercise, experts from Germany and the Netherlands developed a means to synchronize previously incompatible tactical communications devices. While this solution was focused on operations in one domain, it highlights the important role that exercises such as CWIX can play in our quest for MDO. With a cycle of test, fail, and fix until resolved the results create a baseline for further alignment of C2 capabilities that can be evolved to solve multi-domain obstacles. As mentioned above and closely aligned with CWIX, NATO's FMN framework allows Nations to rapidly "plug in" their systems to enable better decision-making and C2 through improved information sharing.[8] As we look towards a future where mastery of the multi-domain spectrum is truly ours, it will be lessons from programs like these that provide the tools we need. Together, they play a critical part in our journey and the good news is that they exist today. Interoperability initiatives provide a means to evaluate our activities in a disciplined manner.

Sir Francis Bacon was right when he said *Scientia potentia est… knowledge is power.* I firmly believe that the more you know, the better the decisions you can make. I specifically say the more you know because having data is only helpful if you can decipher its meaning and glean some knowledge from it. Data without meaning serves no purpose. In an attempt to rapidly turn data into actionable knowledge, military commanders have often turned to Commander's Critical Information Requirements (CCIRs). At the strategic level, this typically becomes a sort of 'If-Then' problem statement to determine when conditions warrant specific action. For example — If the enemy makes it beyond the blockade at checkpoint X, begin civilian evacuation of Village Y. Not a very good example but I'm sure you get the idea. By the time the all of the critical decision points are determined, CCIRs end up filling entire walls with complicated 'chiclet charts' listing actions, decision authorities, and plans that all ultimately rely upon multiple layers of detailed human involvement to determine when and if they apply. There has to be an easier way…and there could be very soon with AI, data analytics, and predictive analysis.

John Allen and Darrell West of the Brookings Institution wrote that "AI will significantly impact the world's economy and workforce, the finance and health-care systems, national security, criminal justice, transportation, and how cities operate."[9] While AI will cross into every aspect of our lives, the implications for military operations are profound.

Imagine being able to instantly fuse every piece of data across a multinational C2 network and having an intelligent system provide military options for response based on capabilities that are available that second. Given the endless differences in design and capabilities of the systems currently in place throughout the Alliance, an autonomous AI could "address dynamic sensor configuration to support mission-relevant collection that is tied to [CCIRs] ."[10] As with most military organizations, NATO struggles to accurately share data between generations of sensors and systems. In many cases, we are still trying to figure out how to connect tactical decision makers to one another, nevertheless linking tactical, strategic, and national decision makers into a rapid, streamlined process. AI has the potential to help us do this much sooner than at any other time in the past.

Taking this yet a step further, what else can we do when we have all of the data we need fused into a coherent picture for decision makers? General Terrence O'Shaughnessy, head of US NORTHCOM recently said, "the key to winning tomorrow's all-domain wars is predicting an adversary's actions — as well as the impacts of US military responses — hours and even days in advance."[11] While this statement is focused on predictive analysis of one nation's actions, the ultimate objective is much larger. What if we could provide commanders with a list of potential responses, coupled with an accurate list of second and third order effects for each decision before they even make them? Essentially, we would allow leaders to make decisions that are more complex than ever before, with a clear picture of the implications of those decisions. Until this point in human history, strategic decisions were based on a "best guess" of what would come next. Human nature seems unpredictable but AI, predictive analysis, and data analytics are bringing us into an era of being able to predict it.

We have already seen that the typical military way of doing things will not be enough to provide these capabilities by the time we need them. Collaborating with and learning from industry will also be essential. Dr. Will Roper, Assistant Secretary of the Air Force for Acquisition, Technology and Logistics, is approaching development of game changing technology in an innovative way. Instead of relying on the regular list of major US DoD contractors, he is reaching out to a wide variety of new firms. He believes that "there is a lot that can be contributed from companies that are commercially focused that know a lot about data, that know a lot about machine learning and AI, and that know a lot about analytics."[12] He has designed these efforts to coincide with a four-month spiral development acquisition model that has revolutionized many projects for the Department of Defense. While the term "Spiral Development" has become somewhat passé, we have continued to evolve the concept and are approaching these challenges using Agile development and DevSecOps.

According to the US Assistant Secretary of Acquisition's office, Agile development:

> *"describes an approach to software development under which requirements and solutions evolve through the collaborative effort of self-organizing and cross-functional teams and their customer(s)/end user(s). It advocates adaptive planning, evolutionary development, early delivery, and continual improvement, and it encourages rapid and flexible response to change."*[13]

From ACT's perspective, DevSecOps is:

"a set of practices that combine software development (Dev) and information technology operations (Ops) which aims to shorten the systems developmental life cycle and provides continuous delivery and continuous integration with high software quality." All while integrating "security practices (Sec) within the DevOps process, creating a 'Security as Code' culture with ongoing, flexible collaboration between release engineers and security teams."[14]

Utilizing these processes, firms are constantly testing and improving models to avoid "traditional IT disasters where flaws only become obvious too late."[15] In the past and in line with many of the world's military organizations, NATO's approach to developing capabilities has been based on defining a fixed requirement then finding a firm who would contract to achieve the entirety of that requirement. This led to extremely protracted negotiations and even longer time to delivery for new capabilities. Utilizing DevSecOps and Agile development, we can now seek out the firms who are in the best position to provide a specific portion of a capability while simultaneously identifying additional suitable technologies or alternatives for subsequent portions. The result is a faster acquisition process that ensures the best technology is in place for the warfighter when the final product is delivered.

Our willingness to exploit innovative processes and ideas is setting the foundation of our success in the pursuit of MDO superiority. This will also inform where we set our level of ambition in these efforts. Simply put, our ambition cannot be greater than what is possible and what we are capable of doing. Our focus at this moment should be on developing the architecture needed to embrace the technology we have, while allowing future capabilities to be integrated as they are developed, through a system-of-systems approach. Failure to do so could result in us losing our competitive edge as well as the edge on our sword.

If we are not proactive, MDO and MDC2 could be the Sputnik moment of this generation. In 1957, Russia put the first man-made satellite into orbit around our planet. In response, the governor of Michigan wrote a poem to US President Dwight D. Eisenhower that said:

"Oh little Sputnik, flying high
With made-in-Moscow beep,
You tell the world it's a Commie sky
and Uncle Sam's asleep."[16]

Sputnik's launch caught the world off guard. We took our eyes off the ball and our adversaries took advantage. Like getting to space or landing on the moon, mastering MDC2 and MDO will not be easy but if we do not master it first, others will...we cannot afford to repeat this mistake. The systems we are attempting to create have the potential to provide future commanders the tools they need to understand the battlespace more rapidly, direct forces faster than the enemy, and deliver synchronized combat effects across multiple domains.[17]

I am excited for what the future holds and the operator in me wants to see these capabilities in action. I want to see them work, objectively validate their capabilities, test and find their weaknesses, and use them operationally. I look forward to the day we can provide the right data at the right speed to the tactical decision maker in a cockpit, the operational commanders in an AOC, and the strategic leaders of our Alliance — bottom to top and back again. Imagine the strength of this Alliance in a world where all of our capabilities communicate and provide a clear, articulated picture of reality for the warfighter. With the right focus, MDO and MDC2 are within our grasp and our ability to master them will not just enhance the deterrence of this Alliance, it will ensure the strength of it for generations.

While drafting this article I was discussing MDC2 and the challenges of achieving it with Vice Admiral Paul Bennett, ACT's Chief of Staff. To paraphrase what he said — Without C2 and interoperability, we are just 30 Nations...from a NATO perspective, this is not only important, it is the fundamental enabler of what makes the Alliance strong.

We cannot do this without your help. Those taking the time to think through these challenges and pushing towards a future where the right people control this technology are the ones that we need leading the charge. If you have ideas, tell us. You are always welcome on our team at ACT!

About the Author

Allied Command Transformation (ACT) is NATO's warfare development command located in Norfolk, Virginia, USA. The command's purpose is to define future military context and identify challenges and opportunities in order to maintain a warfighting edge for the Alliance. ACT ensures maximum interoperability, gives structure and priority to NATO forces through defense planning and capability development, applies innovation to leverage ideas, and connects with the intellectual horsepower of a large network of industry, academia, military and civilian expertise in nations, in NATO Agencies, and NATO Centers of Excellence. As Deputy Chief of Staff for Capability Development at ACT, Lieutenant General Thomas Sharpy (USAF) oversees one of four directorates that comprise the command. He is responsible for developing operational and strategic capability requirements on behalf of the 30 NATO Nations and serves as the senior US Department of Defense representative within ACT. His career has involved numerous supervisory and leadership positions at wing, Major Command, and Air Staff levels. He also served in a number of joint assignments, including: Senior Military Aide to the Vice President of the United States; Director of Plans, Programs and Analyses for Headquarters U.S. Air Forces in Europe and U.S. Air Forces Africa, Ramstein Air Base, Germany; Vice Commander, 18th Air Force, Scott Air Force Base, Ill.; and Director, Strategic Plans, Requirements and Programs, Headquarters Air Mobility Command, Scott AFB, Illinois. Prior to his current assignment, General Sharpy served as Deputy Commander, Air Mobility Command, at Scott AFB, Ill, where he was responsible for the U.S. Air Force's air mobility strategic transportation mission and fleet of more than 1,160 aircraft.

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