FUTURE ARTILLERY

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CHRISTELLE COLLET (NATO): RETHINKING INDIRECT FIRES FOR A CONTESTED BATTLESPACE





Defence iQ

Indirect fires are undergoing rapid transformation as modern conflicts become more contested, technology-driven, and multi-domain in nature. The experiences emerging from recent conflicts, particularly in Ukraine, have accelerated the need for artillery systems that are not only more precise and able to achieve longer range, but also more survivable, scalable, and digitally integrated. Christelle Collet, Land Munitions Officer within NATO's Defence Industry, Innovation and Armaments (D2IA) Division, works at the intersection of technical expertise, operational lessons, and multinational capability development. With a background in energetic materials research and munitions safety, she now supports NATO efforts to advance land munitions capability development while strengthening interoperability across Allied forces. Ahead of Defence iQ's Future Artillery 2026 conference, Christelle shares her perspective on the evolving role of indirect fires, the growing importance of industrial resilience and munitions production, and the technologies likely to reshape artillery over the coming decade.



Christelle Collet [FRA]

Land Munitions Officer

Defence Investment Division, NATO HQ

2002: Graduated from ENSMA engineer school, in Poitiers, France. 2002 – 2003: Engineer at CNES (National Centre for Space studies) in Evry, France. 2003 - 2017: Research Scientist in the Detonics & Safety Laboratory of Ariane Group's Research Center, in Vert le Petit - Le Bouchet, France. 2017 - 2024: Technical Specialist Officer in Propulsion Technology at Munitions Safety Information Analysis Center (MSIAC) – NATO HQ, Brussels. Since 2024: Land Munitions Officer at NATO International Staff / Defence Investment, in the ILM (ISR, Land & Maritime) Section. NATO IS Advisor for the Indirect Fires (ICGIF) and the Dismounted Soldier System (LCGDSS) subgroups of the NATO Army Armaments Group (NAAG)."



You began your career in space systems and energetic materials research before moving into NATO roles focused on munitions safety and now land munitions capability. How has your background in detonics, propulsion, and safety engineering shaped your perspective on today's indirect fires challenges?

I started my career as an engineer, with a very technical background, and I also worked in scientific research. That means I was trained to conduct very deep technical analysis on complex subjects, particularly explosives, detonics, and propulsion systems. This experience shaped the way I think about problems. I am naturally inclined to ask questions and to investigate topics in depth whenever I encounter something I do not fully understand. In my current role, particularly when addressing indirect fires challenges, this often means I ask people a lot of questions. I want to ensure that what is said at a high level is consistent with what is happening at the technical level. Interchangeability of indirect fire munitions, for example, is frequently described as one of the major challenges today. My first reaction when hearing terms like that is to ask what is actually meant by interchangeability in practice. What does "interchangeability of indirect fire munitions" really involve? When I began exploring this topic, I realised that the answer is quite complex. However, that does not discourage me. I am comfortable digging into very technical and complicated issues. While I do not have the user's perspective, and I have not spent 20 or 30 years working on one specific niche area, I know enough about the technical foundations to understand the challenges involved. This allows me to help orient studies on indirect fires, propose recommendations to nations, and speak or write about these issues in an informed way. So, in essence, my technical and research background allows me to approach indirect fires challenges with curiosity, rigour, and a willingness to explore the detailed realities behind high-level concepts.

Having spent several years at MSIAC focusing on propulsion technology and munitions safety, how has your move into the Defence Investment Division altered your focus - from analysing risk to shaping future land munitions capability?

When I describe the transition from the Munitions Safety Information Analysis Center (MSIAC, a NATO Project Office) to my current position, I often say that the scope of my work has effectively been reversed. At MSIAC, I looked at all types of munitions across all domains—air, land, and maritime—but only from a safety perspective. My work focused on risk and safety aspects, such as how munitions are stored safely, transported safely, manufactured safely, and used safely. The domain coverage was broad, but the thematic focus was narrow, more centered specifically on safety aspects. In my current role within the D2IA Division, it is the opposite. I now focus specifically on land munitions rather than across all domains, although I still maintain connections with the air and maritime communities. However, my work now covers a much wider range of topics beyond safety. This includes lethality, operational use, training, exercises, and capability development, alongside safety considerations. With my previous experience at MSIAC and my current experience in this position—although it has only been about a year and a half—I feel that I now have exposure to a fairly complete spectrum of munitions activities. I have worked across different domains and across different aspects of the capability. For me personally, this is very rewarding because I am naturally curious. I want to understand as much as possible about the topics I work on. Of course, the more you learn, the more new questions appear. As the saying goes, the more you know, the more you realise you do not know. At the same time, this combination of experience helps build credibility when engaging with national delegates in NATO meetings. I hope that they see that I understand the issues and that I know what I am talking about. That credibility is important, because it means they are more likely to listen to the recommendations I present. Ultimately, my goal is simply to do my best to be informed, credible, and useful when working with nations on land munitions issues.

Indirect fires are being redefined in increasingly contested and multi-domain environments. From NATO's perspective, what are the most critical capability gaps or operational lessons currently driving change in artillery and land munitions development?

Recent operational lessons - particularly from Ukraine - are significantly shaping NATO's evolving view of indirect fires and the move towards multi-domain operations. One of the most notable developments has been the emergence of unmanned aerial systems (UAS) and loitering munitions, which have proven to be a real game changer. Artillery units must now survive and deliver effects in a sensor-saturated, electronically contested environment. As a result, the focus is shifting away from massing guns towards massing effects through dispersed, mobile, and low-signature assets. This is driving the development of faster "shoot and scoot" systems, robust digital command and control resilient to electronic warfare, and deeper integration of UAS and loitering munitions into a network-enabled artillery kill chain. At the same time, the scale and duration of high-intensity fighting in Ukraine has highlighted the importance of long-range, precise, and above all sustainable fires. Sustained deep strikes against logistics nodes and command and control infrastructure require interoperable families of systems - including guns, rockets, missiles, loitering munitions, and UAS - that can operate together within joint, AI-enabled targeting networks. Equally important is the growing recognition that munitions production capacity, stockpiles, and resilient supply chains are themselves core elements of deterrence. This is driving a "design for mass" approach in land munitions development and encouraging an ecosystem perspective, where survivability, industrial depth, and the speed of the kill chain matter just as much as platform performance or the number of artillery tubes deployed.



https://upload.wikimedia.org/wikipedia/commons/7/74/1-82_Field_Artillery_On_the_move_%28156310908 91%29.jpg

As adversaries improve counter-battery, ISR, and electronic warfare capabilities, survivability is becoming just as important as lethality. How is NATO balancing precision, range, mobility, and resilience when considering future artillery investments?

Precision and range are being enhanced through advanced fire control systems that enable forces to hit the intended target with the first shot. Mobility and survivability require a combination of active and passive protection systems, including counter-drone detection, identification, and neutralisation capabilities. At the same time, resilience depends on the ability to operate jointly in multi-domain environments with interoperable and interchangeable systems - an effort currently being pursued among NATO Allies for indirect fire munitions. More broadly, NATO is reshaping artillery investment around the principle of being "hard to kill" in a sensor - and electronic warfare - saturated battlespace. Future artillery systems must be capable of delivering precise, long-range effects while spending less time in firing positions. This requires high mobility, dispersion, camouflage, integration with drones, and counter-UAS capabilities to survive persistent ISR and counter-battery threats. Guided munitions and long-range rockets or missiles play a key role in delivering precision and lethality, while rapidly deployable platforms and resilient digital fires networks contribute to survivability. Increasingly, the emphasis is on connecting national systems so dispersed batteries can mass effects without physically massing forces. Digital networks must also be able to reroute fire missions to any available shooter if elements are jammed, degraded, or destroyed. The result is an artillery capability viewed as a true system of systems - integrating guns, rockets, loitering munitions, UAS, counter-UAS systems, command and control networks, and the industrial base that sustains them.

Recent conflicts have highlighted both the intensity of ammunition expenditure and the fragility of supply chains. From your vantage point, what are the key technical and industrial considerations NATO must address to ensure both safety and scalable production of land munitions?

The emergence of loitering munitions has also highlighted an important shift in thinking: in many cases, it may be wiser to prioritise systems that are "good enough" but affordable and scalable rather than focusing exclusively on highly sophisticated and expensive solutions. It is important to note that NATO itself does not direct industry. NATO interacts with national governments, and it is up to those governments to translate NATO priorities and requirements to their industries and to contract with them accordingly. However, NATO is currently exploring ways to involve industrial partners more effectively in the development of defence capability requirements. At the same time, recent conflicts have pushed NATO to view land munitions production as a core strategic capability rather than simply a peacetime commodity. The Alliance needs predictable, multi-year demand signals for key munitions - such as 155 mm artillery rounds, rockets, missiles, and anti-tank guided missiles - built on interoperable NATO standards. Production capacity across explosives, propellants, and guidance components must also expand. Industrial networks should be geographically distributed and resilient, with diversified raw material sources, robust stockpiles of critical inputs, and strong cyber and physical protection for production plants, logistics nodes, and transport corridors. From a technical perspective, NATO should encourage munition designs that are safe, scalable, and modular - for example by sharing common fuze designs, rocket motors, or guidance kits across families of systems. At the same time, test, certification, and refurbishment infrastructures need to be modernised and expanded. Underlying all of this is the need for a sustainable workforce, a strong safety culture, and cleaner production and demilitarisation processes, ensuring that high-rate manufacturing of land munitions remains politically, economically and environmentally viable over the long term.

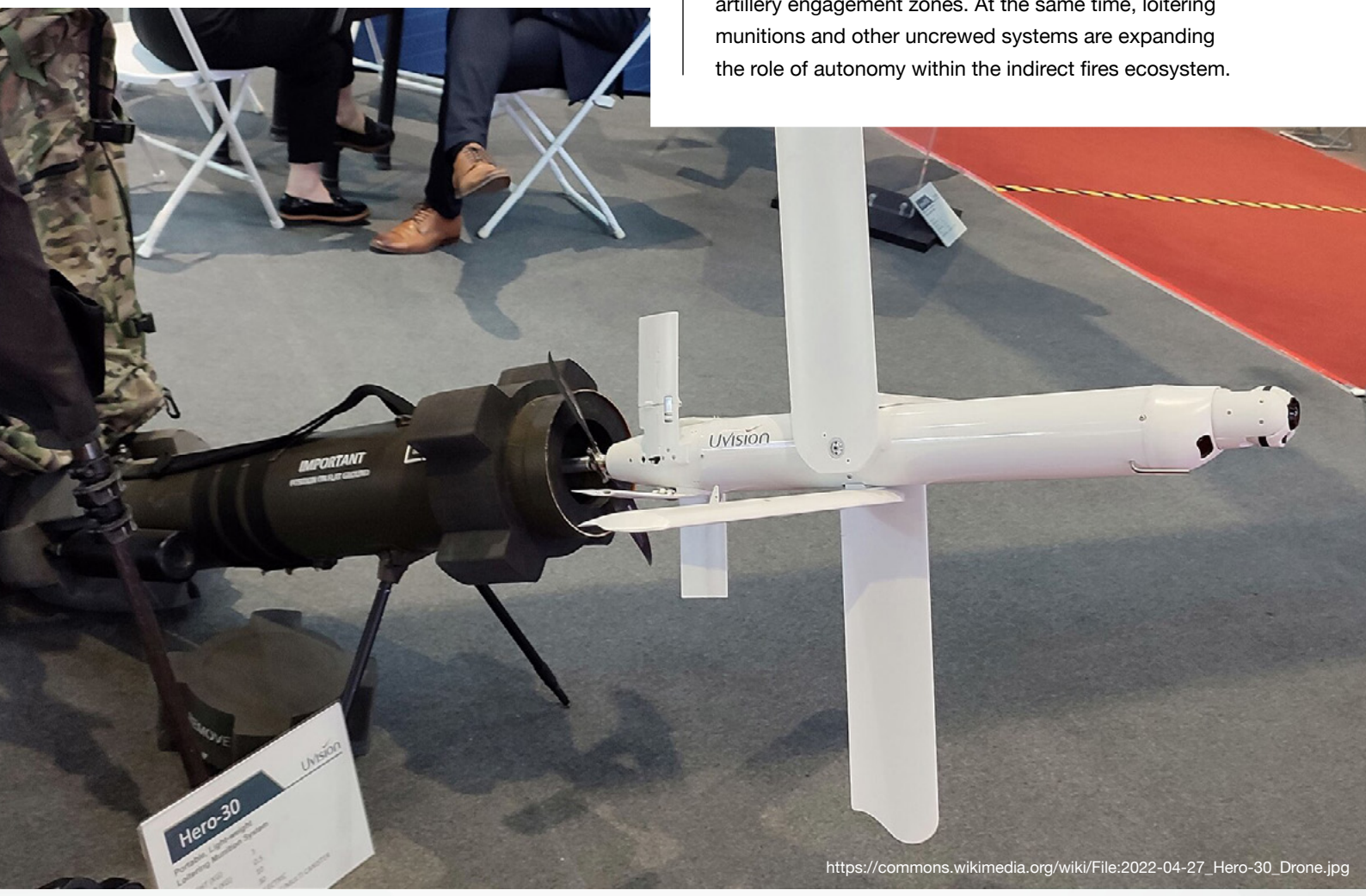
You serve as NATO IS Advisor to both the Indirect Fires subgroup and the Dismounted Soldier System subgroup. How important is interoperability between fires systems and the soldier at the tactical edge, and where do you see the biggest integration challenges?

Interoperability between NATO Allies is fundamental in the event of a conflict. It is, in many ways, the 'raison d'être' of NATO. At the tactical level, interoperability between fires systems and the soldiers operating at the edge is decisive. The side that can connect sensors, decision-makers, and shooters more quickly and reliably tends to win the counter-battery and UAS-driven fight. Experiences from Ukraine have demonstrated how digital kill chains - linking forward

observers, UAS operators, JTACs, and artillery crews - can dramatically reduce sensor-to-shooter timelines while improving deconfliction and control of collateral damage. However, several integration challenges remain. Technically, nations operate different battle management systems, artillery platforms, fire control systems, radios, data formats, and security architectures. Ensuring that a forward observer from one nation can generate a digital fire mission that another nation's artillery unit can receive and execute — across systems such as ASCA, SitaWare, and national equivalents — remains complex. Procedurally, aligning rules of engagement, safety templates, and clearance-of-fire procedures across Allied forces is also challenging and can slow multinational live-fire exercises. At the human level, training remains a critical issue. Leaders and commanders at every level face the challenge of preparing personnel to use rapidly evolving technologies such as loitering munitions and digital fires systems. Soldiers must not only trust these tools but also be able to operate effectively if networks are degraded or denied, which requires intensive, realistic, multinational training focused on digital fires integration rather than simply platform proficiency.

Autonomous systems, smart munitions, advanced propulsion, and digital fire control are transforming artillery. Which emerging technologies do you believe will have the most disruptive impact on indirect fires capability over the next decade and why?

Long-range precision strike capabilities are likely to be among the most disruptive developments in indirect fires over the next decade. More broadly, three technological trends are converging to transform artillery: long-range precision projectiles - particularly ramjet and glide shells - autonomous and uncrewed sensing and strike systems such as loitering munitions, and fully digital, partially automated fire control chains that dramatically reduce sensor-to-shooter timelines. Advances in propulsion, including ramjet-based 155 mm projectiles, could extend artillery ranges into the 70–150 km band while remaining compatible with existing NATO gun systems. This would fundamentally alter counter-battery dynamics, allowing artillery to strike targets traditionally reserved for missile systems while increasing survivability by firing from outside many enemy artillery engagement zones. At the same time, loitering munitions and other uncrewed systems are expanding the role of autonomy within the indirect fires ecosystem.



https://commons.wikimedia.org/wiki/File:2022-04-27_Hero-30_Drone.jpg

These systems provide persistent ISR, target designation, and additional strike options, often at significantly lower cost than traditional missile systems. The most disruptive impact, however, will likely come from the integration of these technologies with digital fire control networks and smart munitions such as course-correcting fuzes or guided rockets and shells. Once a target is detected and validated, automated systems will increasingly be able to generate or execute fire solutions within seconds, significantly increasing the tempo and volume of precision fires while reducing the number of rounds required to achieve an effect.

Future Artillery 2026 brings together military leaders, industry, and policymakers to discuss adapting fires for the fight ahead. From your perspective at NATO HQ, why is this kind of multinational forum essential right now and what conversations or outcomes would you most like to see emerge from the conference?

Forums such as Future Artillery 2026 are important reminders that the current strategic environment is unusual: we are not at war, but we are also not fully at peace. NATO Allies therefore have a unique opportunity to demonstrate that they are stronger together and ready to respond if any Ally is threatened. For NATO, this kind of multinational gathering is particularly valuable because it brings operators, industry representatives, and policymakers together in the same place. This allows them to reconcile three major pressures simultaneously: the operational lessons emerging from ongoing conflicts, the rapid pace of technological change in indirect fires, and the practical constraints of industrial capacity and defence budgets. These discussions are essential for aligning national modernisation plans with Alliance-level priorities on range, precision, survivability, and munitions production. They also provide an opportunity to test assumptions about how indirect fires will operate in a future European conflict characterised by dense ISR and electronic warfare environments before those assumptions are translated into formal requirements and long-term procurement decisions. From a NATO perspective, the most valuable outcomes would be concrete commitments. This could include greater adoption and implementation of digital fires interoperability standards, and increased use of these systems in NATO exercises. It would also be useful to develop a shared understanding of what “good enough” capability looks like for long-range precision fires and counter-UAS solutions by the early 2030s. Equally important would be practical roadmaps for scaling the production of 155 mm ammunition and rocket and missile systems, agreed jointly by governments and industry. Finally, the conference should encourage open discussions about integrating autonomy and artificial intelligence into targeting and fire control while preserving human responsibility, as well as ways to embed operational lessons from Ukraine into NATO doctrines, training scenarios, and multinational capability development programmes.



https://upload.wikimedia.org/wikipedia/commons/2/20/Firing_High_Mobility_Artillery_Rocket_systems.jpg

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Join us at Future Artillery this May

To explore these challenges and opportunities in greater depth, join senior military leaders, policymakers, and industry experts at Future Artillery 2026 - The World's Largest Fires Forum, taking place 19–21 May 2026 at Novotel London West, United Kingdom.

As indirect fires are reimagined for contested and multi-domain operations, the conference will examine how precision, mobility, survivability, and industrial capacity are converging to shape the next generation of artillery capabilities. The agenda will address critical developments including advanced munitions, autonomous platforms, resilient logistics, and multinational interoperability, bringing together the stakeholders responsible for delivering decisive firepower in the battlespace of tomorrow.

Secure your place at Future Artillery 2026 to engage with the technologies, tactics, and partnerships driving the future of indirect fires.

MEET THE SPEAKERS:



Lieutenant General John Mead OBE

Deputy Commander
NATO Allied Joint Force Command Brunssum

Brigadier General Steven Carpenter

Commander, 56th Artillery Command
US Army



Brigadier Mark Comer

Deputy Chief of Staff (DCOS) PLANS
Joint Support and Enabling Command (JSEC)



Brigadier Adam Fraser-Hitchen

Deputy Commander 3 UK Division
British Army



Brigadier General Dimitrios Tagkalakis

Director of Artillery
Hellenic Army

Brigadier General Olivier Coquet

Director Of The French Army Technical Branch
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Brigadier Paul Hughes B.Eng (Hons) MBA C.Eng MAPM FRAeS

Head of Engineering Assurance – Land Domain
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Colonel Kris Reeves

Commander, Multinational Brigade Latvia NATO
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