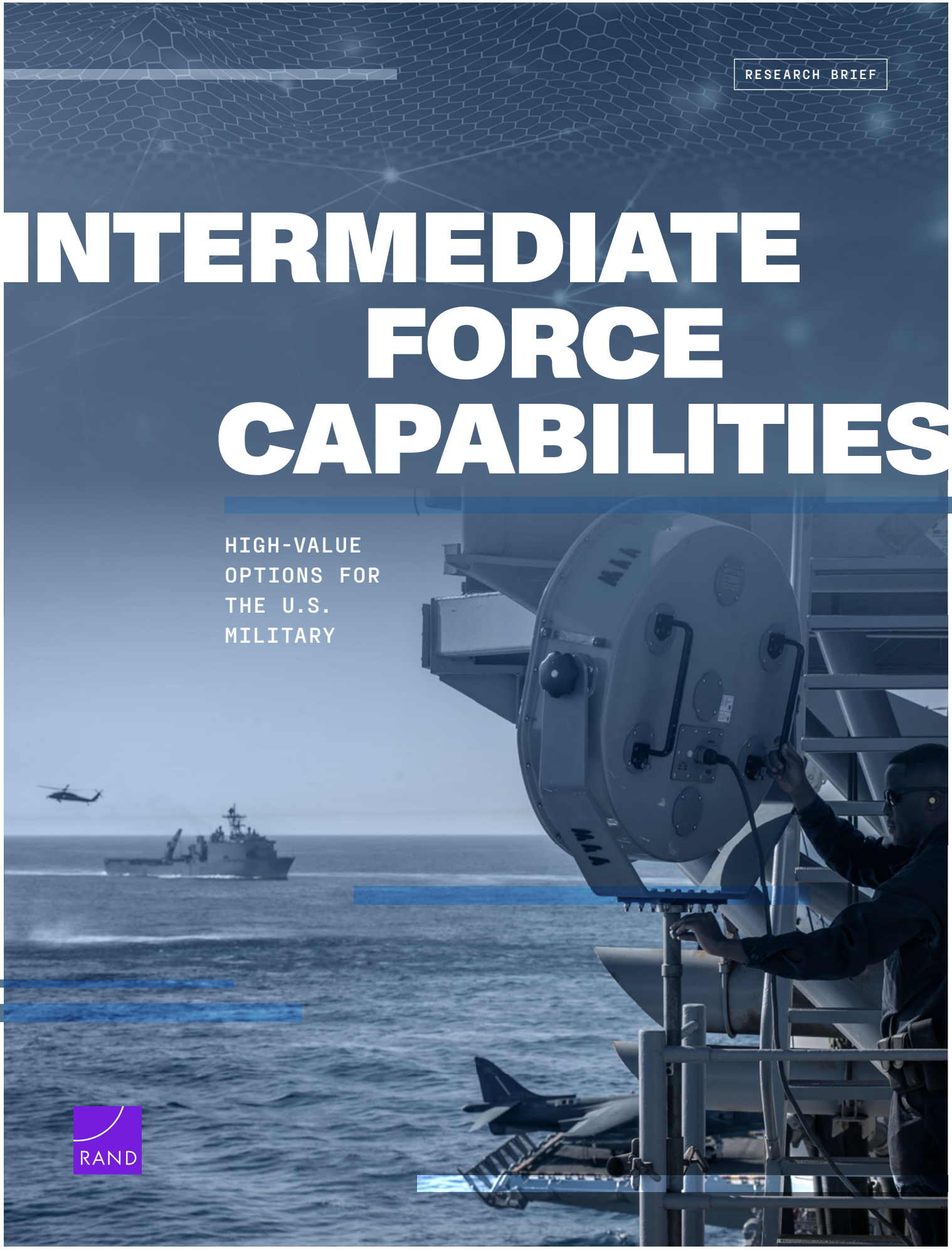
RESEARCH BRIEF

INTERMEDIATE FORCE CAPABILITIES

HIGH-VALUE OPTIONS FOR THE U.S. MILITARY



RAND

SAILORS SET UP A LONG-RANGE ACOUSTIC DEVICE FOR A WEAPON DEMONSTRATION ABOARD THE *TICONDEROGA*-CLASS GUIDED-MISSILE CRUISER USS *NORMANDY* DURING SURFACE WARFARE ADVANCED TACTICAL TRAINING ON SEPTEMBER 11, 2022.

KEY FINDINGS

- LOGIC MODELS AND METRICS CAN BE USED TO SHOW HOW NON-LETHAL WEAPONS (NLWs) AND OTHER INTERMEDIATE FORCE CAPABILITIES (IFCs) CONTRIBUTE TO STRATEGIC GOALS AND PROVIDE SUPPORT FOR A COMPREHENSIVE IFC CONCEPT.
- THE RAND TEAM'S ANALYSIS SUGGESTS THAT THE CONCEPT OF IFCs AS AN UMBRELLA INCLUDING NLWs, INFORMATION OPERATIONS, ELECTROMAGNETIC WARFARE, AND CYBER CAPABILITIES HAS VALUE.

Non-lethal weapons (NLWs) include a highly diverse set of systems, including acoustic hailing devices, eye-safe laser dazzlers, flash-bang grenades, rubber bullets, millimeter-wave emitters that cause a temporary heating sensation, microwave emitters that shut down electronics, and entangling devices to stop vehicles or vessels. The intent of these systems is to achieve military objectives while limiting harm to people and objects. NLWs are part of a suite of intermediate force capabilities (IFCs), alongside information operations (IO), electromagnetic warfare (EW), and cyber capabilities, whose effects do not directly stem from explosive or penetrating force. Another feature that they share is that it is difficult to measure their impact.

Building on prior research that used a logic model and associated metrics to measure the impact of NLWs, a more recent report updates and extends that model to encompass all IFCs and uses a series of 11 vignettes centered around the North Atlantic Treaty Organization to further the understanding of how these systems can be integrated into and contribute to military operations.

These tools can help strategic decisionmakers and operational communities decide whether and how IFCs can contribute to military effectiveness in gray-zone environments, combat, and other contexts, as well as how to employ them. They can also

help research and development, acquisition, training, and other communities determine how much emphasis to put on pursuing and strengthening specific IFC capabilities.

A LOGIC MODEL FOR INTERMEDIATE FORCE CAPABILITIES

Logic models characterize how the activities of systems, processes, or organizations contribute to fulfillment of their goals. There are various types of logic models, but in the type used in this analysis, a series of *inputs* enable *activities*, that result in *direct outputs*, which contribute to higher-level outcomes and, ultimately, strategic goals. All these items are collectively termed *elements* of the logic model.

In prior research, RAND developed a logic model for NLWs for the U.S Department of Defense.[1] This logic model, recently updated to the strategic goals in the 2022 National Defense Strategy, was the starting point for developing an all-IFC logic model, which included IO, EW, and cyber capabilities.

Various documents and interviews about IO, EW, and cyber helped the research team identify additional elements of the logic model to address those areas. The resulting logic model (Figure 1) is an expansive model with 75 elements.

The colors in the logic model, as well as the symbol used for the bullet before each item, indicate the IFCs to which they relate:

- ▶ Elements that primarily relate to NLWs are shown in purple.
- ○ Elements that primarily relate to IO are shown in yellow.
- ✱ Elements that primarily relate to EW and cyber are shown in blue and grouped together because the elements that relate to one often relate to another.
- ❖ Elements that relate to NLWs, IO, EW, and cyber are shown in green.

In addition, elements that appeared in the DoD-centric model are marked with a double dagger (‡).

Most inputs to the logic model apply not only to NLWs but also to IO, EW, and cyber, including such inputs as concepts of operation, tactics, doctrine, training, and sustainment. Here the RAND team focused on the evolution from activities to outcomes to outputs as they relate to IFCs collectively.

ACTIVITIES. In contrast to inputs, which largely apply to all IFCs, most activities relate to missions specific to one category of IFC. The first several shown in the figure are specific to the NLW mission and generally involve warning, impeding mobility, and incapacitation activities; other activities are specific to the IO mission, namely disseminating information and countering disinformation. EW and cyber missions involve countering adversary actions in these areas and targeting adversary networks while protecting U.S. networks. The items in green relate to disruption of the adversary and apply to all four warfare areas.

OUTPUTS. The outputs that had been originally developed for NLWs alone in the original DoD logic model turned out to be versatile, applying to all four categories of IFCs, which is why they are shown in green. For example, all four types of IFCs can increase options while constraining those of the adversary. The outputs specific to IO, shown in orange, relate to having influenced others and having countered adversary influence efforts. The outputs addressing EW and cyber deal with the degree to which adversary networks had been penetrated or affected, as well as the degree of avoidance of adversaries achieving the same.

OUTCOMES. Outcomes turn out to be highly versatile: 15 of the 18 outputs apply across all four categories of IFCs, including all the outcomes that had originally been designed for NLWs alone. This stems from a common feature of IFCs: Compared with many kinetic weapons, they generally achieve their impact while limiting the amount of permanent damage to humans, and often to buildings or systems. The culmination of common outcomes is an important feature of this logic model and supports the notion of integrating the four types of systems into a single conceptual group.

Of the few outcomes that relate to specific IFCs, two relate primarily to IO: maintaining credibility and legitimacy of U.S., allied, and partner forces and reducing the credibility and legitimacy of adversaries. One outcome relates primarily to preventing and deterring malicious cyber and EW activities and increasing the resilience of critical infrastructure.

STRATEGIC GOALS. The strategic goals, derived from the 2022 National Defense Strategy, reflect the ultimate goals of the U.S. Department of Defense.

FIGURE 1

Logic Model for Intermediate Force Capabilities

INPUTS

- ○ Communications platforms and media
- ✱ Network infrastructure and software
- ❖ Integration into warfighting processes
- ❖ Domain-specific expertise
- ❖ Industrial base
- ❖ IFC systems‡
- ❖ Concepts of operations (CONOPS) and employment (CONEMP)‡
- ❖ Tactics, techniques, and procedures‡
- ❖ Doctrine‡
- ❖ Training‡
- ❖ Sustainment‡
- ❖ ISR‡

ACTIVITIES

- ▶ Hail to clarify, demarcate, and warn‡
- ▶ Reveal other parties' intent‡
- ▶ Affect mobility: Slow, impede, halt, prevent from approaching or leaving, redirect, disperse, impel departure‡
- ▶ Compel/tactically deter: Convince others to take or not take specific actions‡
- ▶ Temporarily incapacitate personnel‡
- ▶ Incapacitate infrastructure/materiel‡
- ○ Disseminate information to inform and persuade
- ○ Expose malign information operations
- ○ Disseminate information to affect adversary perceptions and assessments
- ✱ Detect and identify sources of electromagnetic (EM) radiation
- ✱ Characterize, locate, and track sources of EM radiation
- ✱ Conduct reconnaissance against, exploit, and establish persistent presence in adversary systems to prepare the cyber battlespace
- ✱ Defend/protect/remediate DoD front-line systems against EW
- ✱ Defend and remediate DoD networks and critical infrastructure (e.g., data backbone) against cyber and EW (includes diagnosis of issues)
- ✱ Secure, configure, maintain, and protect existing networks to prevent attacks
- ❖ Deceive, distract, disorient, or confuse‡
- ❖ Degrade, disrupt, and destroy adversary systems and C⁴ISR

OUTPUTS

- ○ Affected perceptions, decisionmaking, and behavior of adversary leadership
- ○ Affected perceptions, decisionmaking, and behavior of adversary personnel
- ○ Affected adversary leadership's emotional state, judgment, and will to fight
- ○ Affected adversary personnel's emotional state, judgment, and will to fight
- ○ Avoided effects of adversary manipulation of information to affect perceptions, attitudes, decisions, and behaviors of DoD and partner forces
- ○ Avoided effects of adversary manipulation of information to affect perceptions, decisionmaking, and behavior of populations in U.S., partner nations, and neutral nations
- ○ Influenced perceptions, decisionmaking, and behavior of populations
- ✱ Achieved knowledge of adversary networks
- ✱ Created actionable objectives in adversary networks to facilitate their potential disruption/degradation/destruction (potentially prior to conflict)
- ✱ Disrupted, degraded, manipulated, and/or destroyed adversary networks
- ✱ Minimized disruption, degradation, manipulation, and destruction of networks and systems, as well as recovery time and costs, from EW and/or cyberattack
- ❖ Effectively responded to situations despite constraints‡
- ❖ Enabled pre-emptive action without appearing to be aggressor‡
- ❖ Increased options for engaging targets‡
- ❖ Reduced risk of exceeding rules of engagement or Laws of War‡
- ❖ Reduced adversary options and imposed costs‡
- ❖ Gained time/distance before deciding to take lethal action‡
- ❖ Enabled lower-signature clandestine ops‡
- ❖ Reduced risk of DoD, partner personnel casualties‡
- ❖ Minimized collateral damage and fratricide‡
- ❖ Reduced risk to DoD systems or facilities‡
- ❖ Gathered intelligence from captured personnel and materiel, as well as from cyber and EW means‡
- ❖ Conserved and augmented lethal capabilities‡
- ❖ Reduced DoD tactical costs (broadly defined)‡
- ❖ Disrupted adversary decision cycle to provide relative advantage to DoD forces and degrade adversary ability to employ forces effectively

OUTCOMES

- ○ Maintained credibility and legitimacy of U.S., allied, and partner forces
- ○ Reduced credibility and legitimacy of adversaries
- ✱ Prevented and deterred malicious cyber and EW activities and increased resilience of critical infrastructure
- ❖ Competed effectively and demonstrated resolve while managing escalation in peacetime, gray-zone, and hybrid contexts‡
- ❖ Conducted operations in environments that were otherwise too dangerous due to collateral damage, fratricide, or escalation risks‡
- ❖ Avoided alienation of population, military forces, and government in non-member states where DoD is operating‡
- ❖ Enhanced perceptions of DoD forces in U.S. and internationally‡
- ❖ Increased partner cooperation‡
- ❖ Set standards for partner nations‡
- ❖ Reused captured infrastructure and materiel‡
- ❖ Avoided rebuilding costs‡
- ❖ Reduced negative effects on morale from collateral damage or substantially harming individuals without lethal intent‡
- ❖ Enhanced U.S. public support for policies, objectives, and goals
- ❖ Achieved desired outcomes through influence on adversary militaries, governments, and populations
- ❖ Delayed, degraded, disrupted, manipulated, or precluded adversary actions
- ❖ Reduced effects of adversary attempts to delay, degrade, disrupt, manipulate, or preclude U.S. and partner actions
- ❖ Projected power or demonstrated capabilities using IFCs
- ❖ Enhanced cyber, EW, IO, and NLW capabilities to deter, cooperate, deploy/sustain, and shape stability and peace

STRATEGIC GOALS

- Strengthen alliances and partnerships
- Improve competitive advantage over adversaries
- Build a resilient joint force and defense ecosystem
- Defend the homeland
- Deter aggression and strategic attacks against the U.S., allies, and partners
- Prevail in conflict when necessary

Color legend:

- ▶ Primarily NLWs
- ○ Primarily IO
- ✱ Primarily EW and cyber
- ❖ Combined NLWs, IO, EW, and cyber
- ‡ Appeared in the previous NLW-centric logic model (see Romita Grocholski et al., 2022)

NOTE: ISR = intelligence, surveillance, and reconnaissance; C⁴ISR = command, control, communications, computers, intelligence, surveillance, and reconnaissance.

USING THE LOGIC MODEL TO ASSESS THE UTILITY OF IFCs

As in the previous research, the RAND team identified metrics that can be used to evaluate IFCs in an operational context, including 153 new metrics that align with the 31 new activities, outputs, and outcomes in the all-IFC logic model.

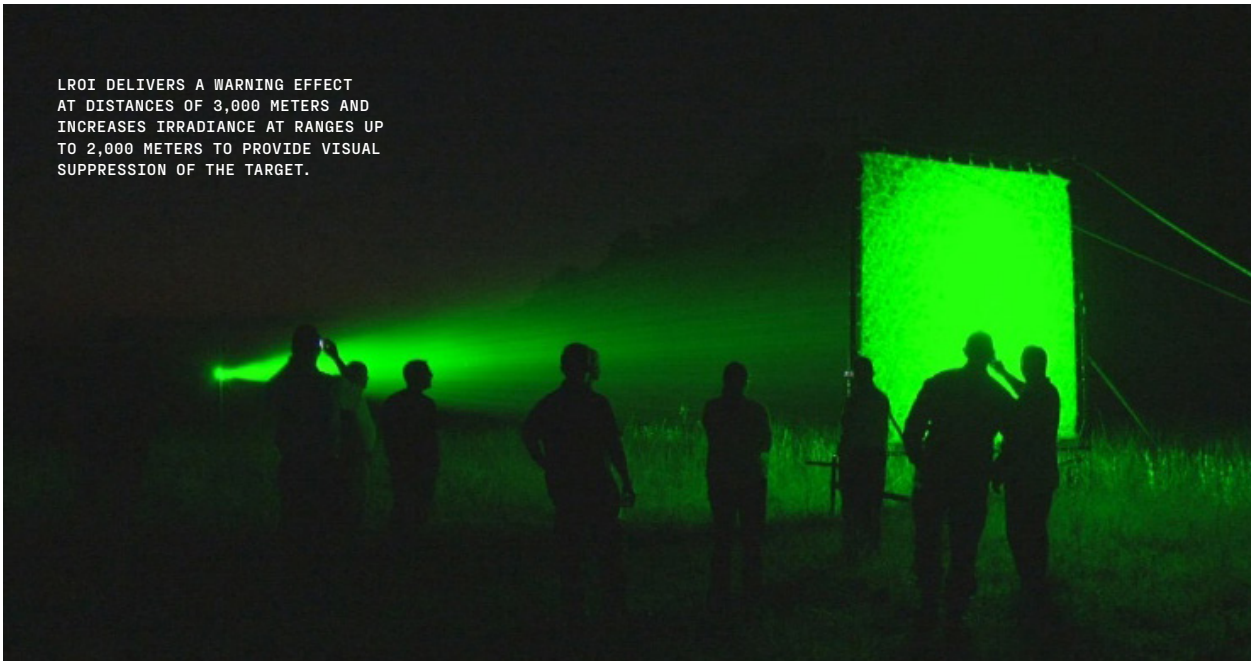
Generally, the metrics for activities relating to EW and cyber focus on measuring the detection and characterization of systems, as well as whether those systems were affected by the adversary, while metrics for activities relating to IO focus on measuring the receipt and interpretation of information. Metrics for NLWs focus on measuring the percentage of targeted and non-targeted populations that experience NLW effects and the time from NLW use to when responses to their effects are observed.

For outputs, the metrics for EW and cyber largely focus on measuring the extent and nature of impacts (e.g., duration, disruption, destruction), and metrics for IO focus on measuring the behavior of target populations. NLW output metrics generally are aimed at comparing NLWs to lethal weapons in various ways and measuring time gained for decision-making or making the switch to lethal capabilities.

Metrics for EW- and cyber-related outcomes largely measure how U.S. and adversary actions and options are affected by damage to their systems, and the metrics for IO-related outcomes focus on measuring perceptions of targeted populations as measured by polls and online activity. Similarly, many of the NLW metrics focus on measuring various reactions to the use of NLWs outside of a tactical context (e.g., population-level reactions).

The research team also developed a series of 11 vignettes that illustrate how IFCs might be employed—either individually or collectively—in a range of missions, challenges, operational contexts, and geographic regions. The vignettes help validate the logic model and illustrate how IFCs could be used in diverse situations.

The development and review of the vignettes highlighted several overarching findings. First, IFCs were relevant in a wide range of potential contexts, even ones that might not be intuitive—such as the use of NLWs during full-scale combat in "Not Quiet on the Eastern Front." Second, many of the potential uses of different types of IFCs were complementary and even synergistic. For example, the "Tanks, but No Tanks" vignette involves a combined use of NLW, IO, EW, and cyber to deter the advance of tanks from a hostile nation into a partner nation. In "Gently Seizing Control of the Very Dangerous Weapons," cyber and EW contribute to incapacitation of key adversary systems, facilitating the use of NLWs to take control of a facility without explosives or guns that might release chemical or biological agents. This overall approach also contributes to an IO campaign that would maximize positive perceptions.



LROI DELIVERS A WARNING EFFECT AT DISTANCES OF 3,000 METERS AND INCREASES IRRADIANCE AT RANGES UP TO 2,000 METERS TO PROVIDE VISUAL SUPPRESSION OF THE TARGET.

MEMBERS OF THE 216TH SPACE CONTROL SQUADRON (SPCS) SET UP ANTENNAS AS PART OF A "HONEY BADGER SYSTEM" AT VANDENBERG SPACE FORCE BASE, CALIFORNIA, ON SEPTEMBER 20, 2022. THE 216 SPCS SPECIALIZES IN ELECTROMAGNETIC WARFARE AND IS PARTICIPATING IN THE SPACE TRAINING AND READINESS COMMAND'S (STARCOM'S) BLACK SKIES 22, A LIVE SIMULATION EXERCISE DESIGNED TO REHEARSE THE COMMAND AND CONTROL OF MULTIPLE JOINT ELECTRONIC WARFARE FIRES.

Collectively the vignettes support the value of a single IFC umbrella encompassing NLWs, IO, EW, and cyber insofar as they can contribute to each other's success. Thus, it makes sense to consider these technologies as a set of complementary capabilities.

TOOLS TO INFORM DECISIONMAKING

The all-IFC and NLW-only logic models, along with the associated vignettes and metrics, can be used by decisionmakers to help measure, document, and communicate the impact of NLWs and other IFCs. These logic models provide a structure to clarify how the activities employing NLWs and other IFCs contribute to ultimate aims. Measuring the values of metrics associated with those elements in real-world operations, exercises, and wargames can provide hard data with which to evaluate the impact of IFCs. The vignettes provide examples of usage that can inform discussions and serve as a basis for wargames that further elucidate IFCs' impact. They can also contribute to analysis of the degree to which various types of IFCs complement one another.

NOTES

[1] Krista Romita Grocholski, Scott Savitz, Jonathan P. Wong, Sydney Litterer, Raza Khan, and Monika Cooper, *How to Effectively Assess the Impact of Non-Lethal Weapons as Intermediate Force Capabilities*, RAND Corporation, RR-A654-1, 2022; Krista Romita Grocholski, Scott Savitz, Jonathan P. Wong, Sydney Litterer, Raza Khan, and Monika Cooper, *Evaluating the Use of Non-Lethal Weapons in Operational Environments*, RAND Corporation, RB-A654-1, 2022.

This brief describes work done in the RAND National Security Research Division and documented in *Assessing the Impact of Diverse Intermediate Force Capabilities and Integrating Them into Wargames for the U.S. Department of Defense and NATO*, by Krista Romita Grocholski, Scott Savitz, Sydney Litterer, Monika Cooper, Clay McKinney, and Andrew Ziebell, RR-A1544-1, 2023 (available at www.rand.org/t/RRA1544-1). To view this brief online, visit www.rand.org/t/RBA1544-1. RAND is a research organization that develops solutions to public policy challenges to help make communities throughout the world safer and more secure, healthier and more prosperous. RAND is nonprofit, nonpartisan, and committed to the public interest. RAND's publications do not necessarily reflect the opinions of its research clients and sponsors. RAND® is a registered trademark.

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