Research Report

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One Team, One Fight

Volume II, Ground Combat Narratives of Human-Machine Integration for the U.S. Army

For more information on this publication, visit **www.rand.org/t/RRA2764-1**.

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About This Report

This report documents research and analysis conducted as part of a project entitled *Human Machine Integration and Artificial Intelligence*, sponsored by U.S. Army Futures Command. The purpose of the project was to investigate the kinds of difficulties the Army may encounter as it attempts to pair humans with artificial intelligence (AI) algorithms to accomplish specific warfighting tasks. We sought to make recommendations for how these potential obstacles can best be overcome and ensure that the Army effectively creates AI systems that will integrate well with the Army soldiers who must interact with them.

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Chapter 1. Introduction

Recent advances in artificial intelligence (AI), machine learning, and robotics have raised the possibility that the profession of arms will soon include integrating human soldiers with thinking machines as part of the collective whole. Machines and software applications enabled by AI are starting to demonstrate an ability to move autonomously through complex urban traffic and create startlingly human-like and interesting derivative works through large language models.

This does not mean, however, that such developments can be implemented in military settings smoothly. The practice of building cohesive small units is no easy endeavor. The best small units cohere to such an extent that one soldier recognizes the silhouette and gait of another in the dark of a patrol base in an instant. The best staffs internalize their commander's style and specific needs over time. Integrating humans and machines in military contexts will likely draw from civilian parallels, but it will also require substantial contextualization.

To that end, Army Futures Command asked RAND to consider the implications of human-machine integration. In particular, our objective was to investigate the kinds of difficulties the Army may encounter as it attempts to pair humans with AI algorithms to accomplish specific warfighting tasks. Our goal was to make recommendations addressing how these potential obstacles can best be overcome and ensure that the Army effectively creates AI systems that will integrate well with the soldiers who must interact with them.

The main results of this research are described in a companion report; this report contains the two scenarios that were used for analysis.[1] Specifically, this report details the scenarios we used to develop our understanding of the Army's existing but implicit mental model about human-machine integration.

Methodological Approach

Although we initially intended to explore this topic through a literature review, we realized that our own understanding of the current state of human-machine integration in the Army required a more immersive approach. This was especially true because the Army has not articulated an authoritative definition of what human-machine integration is.

To address this, we used fictional narrative to explore the topic and articulate our characterization of what we believe the Army's model of human-machine integration is.[2] The

[1] See Jonathan P. Wong, Alexander C. Hou, Michael Miller, Katie Wilson, Emily Lathrop, Sydney Kessler, Sam Wallace, and Emily Yoder, *One Team, One Fight: Volume I, Insights on Human-Machine Integration for the U.S. Army*, RAND Corporation, RR-A2764-1, 2025.

[2] We adapted a methodology described in Lisbeth A. Pino Gavidia and Joseph Adu, "Critical Narrative Inquiry: An Examination of a Methodological Approach," *International Journal of Qualitative Methods*, Vol. 21, April 2022.

process of writing narrative required the team to mentally "fill in the blanks" by imagining the possible details and considerations related to how humans and machines might interact that are not explicitly stated in the literature. To reduce the likelihood that these imagined details would veer too far from reality, the project team recruited former small unit leaders with recent operational experience to write and review the narratives. Once the initial drafts of the narratives were written, the editing process also allowed the team to examine rough hypotheses in a more unconstrained way.

The narratives are not meant to be prescriptive or predictive; rather, they are an exercise in imagining how the benefits and challenges of effective human-machine integration might arise in future, Army-specific scenarios. Although these narratives are written to adhere to a standard of realism relating to Army operations, and the AI tools described in these scenarios are based in current and projected capabilities, in some instances, realism is tabled in favor of creating a well-crafted situation to illustrate human-machine interactions.

A Note on Sources

The narratives drew inspiration from a variety of sources. We examined more than 50 documents, remarks, and statements; because the narratives are an amalgamation of those sources and our own interpretations, we briefly describe them here rather than attempting to ascribe any given passage in the narratives to a definitive source. The sources fell into three categories:

- **What Army leaders are saying:** We first read and listened to Army leader statements on human-machine integration. Over the past year, this topic has grown in importance, as evidenced by talks at Association of the United States Army events, trade press reporting, and U.S. Department of Defense (DoD) and Army press releases.
- **What others are saying:** Next, we examined reports and papers written by experts outside the Army. These included reports from other research organizations (such as the Center for Strategic and Budgetary Assessments), books and journal articles by relevant experts, and writings by and conversations with our RAND colleagues.
- **Army doctrine and practices:** Finally, we drew on Army doctrine and the operational experience of our team members to ground the narratives in proper tactics, techniques, and procedures (TTPs).

Organization of This Report

Chapter 2 outlines the movement-to-contact scenario and five distinct vignettes. Chapter 3 outlines the attack-in-urban-terrain scenario and four vignettes. We conclude with Chapter 4, which identifies themes that describe the Army's vision for human-machine integration.

Chapter 2. Movement to Contact

Per the Army's Field Manual 3-90, *Tactics*, a *movement to contact* is "a type of offensive operation designed to establish or regain contact to develop the situation."[3] The aim of a movement to contact is to "develop the situation"—that is, to develop a better understanding of an enemy force while putting the unit in a position to maintain the initiative while preserving their freedom of action, allowing them to transition to another type of operation. Fundamentally, a movement to contact can be a preferred type of operation when a commander lacks adequate situational understanding to undertake other tactical tasks and seeks to create the conditions to do so.

One potentially desired result of a movement to contact that can develop the situation is a *meeting engagement*—that is, "a combat action that occurs when a moving force engages an enemy at an unexpected time and place."[4] History is replete with examples of battles that could be reasonably classified as beginning with meeting engagements that developed into larger actions, such as the Battle of Gettysburg.[5]

This chapter imagines a meeting engagement that occurs between one of the lead armored companies of an armored brigade combat team and a platoon-sized force of Russian dismounted infantry in a rural area of Lithuania, just east of the Polish border. About three weeks prior to the start of this and the urban warfare scenario in Chapter 3, U.S. and North Atlantic Treaty Organization (NATO) intelligence indicated a large-scale buildup of Russian forces in Kaliningrad and Belarus. In the week prior to the invasion, Russia and Belarus announced a "joint exercise focused on defending against threats to sovereignty." With limited unambiguous warning of their attack and the use of "little green men" to maximize plausible deniability, Russian and Belarusian forces attacked Vilnius to "support the existing resistance to pro-NATO leadership."

As part of this operation, Russian forces insert company and platoon-sized infantry units along likely routes of approach to Vilnius and task these units to delay the lead elements of a NATO force attempting to reach the city. In the hours before the story picks up, one of these

[3] Headquarters, Department of the Army, Field Manual 3-90, *Tactics*, May 1, 2023, p. 4-1.

[4] Headquarters, Department of the Army, 2023, p. 4-1.

[5] The meeting engagement that occurred when units of Union General John Buford's cavalry division encountered a Confederate column of troops moving toward the town to secure a reported stock of shoes on June 30, 1863, was critical in the early developments of the Battle of Gettysburg. Confederate leaders' understanding that Union infantry remained too far to the south of the town to prevent them from moving in the next day led them to order Major General Harry Heth's division in to seize the supply of shoes. Buford's understanding of the Confederate force's capabilities and aim of moving into Gettysburg led him to establish defenses on the ridges to the west of Gettysburg and set the stage for the opening actions of the battle. See Edwin B. Coddington, "Chapter XI: Reynolds Accepts a Challenge," *The Gettysburg Campaign: A Study in Command*, Simon and Schuster, 1997.

Russian platoon-sized elements conducts an air insertion onto the Paluknys airfield, roughly 30 kilometers southeast of Vilnius. The Russian platoon establishes a hasty defense in the treeline just to the south of the airfield, along the north-south–running A4 highway, with a general awareness that U.S. and NATO armored units will likely attack in the coming hours or days. This hypothetical Russian force is also equipped with imagined future robotic and AI-enabled systems and tools, which it too would seek to employ to achieve its mission. We caveat that the employment of these systems and tools is not rooted in an understanding of Russian doctrine or thinking but instead reflects potential tactics. The point is to emphasize the challenges and opportunities for adaptation that adversary use of these technologies present to the Army and the interactive nature of combat.

The following vignettes focus on Alpha Company, an imagined future armored company (a mixture of mechanized infantry and tank platoons) that is part of a combined arms battalion (CAB). As the CAB makes movement along the A4 highway, Alpha Company is tasked as an advance guard, protecting the CAB's main body (composed of other armored companies) from surprise attacks and developing the situation for the battalion. Throughout the vignettes, we include descriptions of how an armored company's organization and tactics may change to incorporate AI-enabled tools and autonomous systems. Some of these descriptions reflect potential results of ongoing Army efforts, while others have been created to highlight the report's findings on dynamics of human-machine integration.

We recognize that a host of factors reduce the likelihood of a movement to contact occurring in a situation in which one or both sides of a conflict completely lack awareness of their adversary. Improved and proliferated sensors (including those on unmanned and autonomous platforms) and maturing AI and computer-learning algorithms and their military applications are just two technological trends that will enable greater understanding for the future force. However, the continuing processes of adaptation and counter-adaptation and the enduring desire for any military force to improve survivability by denying the enemy accurate information about its capabilities, disposition, and strength mean that, for the foreseeable future, no conflict will be fought in which both sides fully understand what they are up against, especially at the tactical level of combat.

Part 1: Planning and Initial Movement

Behind Captain Graves, Alpha's company commander, a few soldiers piled into an idling XM-30, bent over and stumbling under the weight of belt-fed ammunition.

"Specialist Rodriguez, pull up that overlay again," requested Captain Graves.

The command M1E3's largest screen sparked to life. Where previously only Alpha Company's primary and alternate routes were displayed in black and blue, now shades of red, orange, and yellow intermixed, with red dominating the screen as the routes approached the 83 Northing.

Captain Graves and his company command team had refined the plan for this movement to contact nearly two dozen times using Red Teaming of Operations Orders (RTO2), the AI application that tested the scheme of maneuver against a range of most likely and most dangerous courses of action provided by the brigade and battalion S2s. The plan was, according to the tool, "optimized." It had been effective during the work-up and at the unit's National Training Center (NTC) rotation, but Graves could still hear the words of his West Point advisor as if he were seated next to him in the tank: "No tool will ever fully replace a commander's judgment and initiative."

Specialist Rodriguez, one of the company's young systems operators, continued to tap absentmindedly, populating the Improved Small Unit Common Operational Picture (ISCOP) screen of every vehicle in the company with this same image—a live look at where Route Analysis and Reconnaissance (RAR) assessed the movement times and probability of contact along both routes, "like Google Maps except you're getting shot at," joked the company first sergeant. RAR's readout reflected what Captain Graves and every one of his soldiers could have guessed themselves: There were probably Russians up ahead, although nobody could be sure how many or from what unit, forming a hasty defense in the treeline south of the Paluknys airfield. RAR also displayed an assessment of road conditions and maximum recommended speeds for the column's movement, including identifying the roads and bridges that could hold up to the M1E3s.

"Rod, just the platoon leaders and sergeants, please." The company commander didn't need his junior soldiers fixed on their screens as they approached the areas shaded red.

"Sorry, sir; just a moment."

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In the nearby XM-30, Sergeant Smith growled at his two privates who had just come in with what looked like 5,000 rounds of belt-fed ammunition for the squad's M338. "Would you two geniuses mind telling me where you're going to store that in here? And which one of you is going to carry it when we get out?"

"Sergeant," began Private First Class Jones, a wiry kid who even with months of mandatory physical training in the weight room was still vulnerable to a strong breeze back on Fort Bliss, "Corporal Ski told us to grab more."

Smith spoke to Jones but glared at Corporal Weslowski, who at one time had been his team leader but now was his subordinate: "Ski isn't in charge, I'm in charge. Supply Sergeant Ream ran this thing through PACT like 20 times, Staff Sergeant approved it, and we got ourselves 2,400 rounds."[6]

Ski probably wasn't wrong, thought Sergeant Smith. PACT was pretty good at figuring out the right amount of ammo they had needed for every training exercise they had been on, evaluating the company and platoon operations orders against the unit's own provided data of

[6] PACT = Projected Ammunition Consumption Tool.

their accuracy and effectiveness, even writing the ammo request forms for the unit's officers. But still, he'd rather have too much than not enough, and maybe they won't shoot quite as straight with someone shooting back at them.

His tone softened, now looking at Jones and his co-conspirator. "Store it in the hold behind you. Hope those squats have paid off, Jones; you're going to need it today."

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Back in the command tank, the commanding officer (CO) turned to his radio. "Actuals, take a look at your route overlay on the ISCOP; tell me what you think about what RAR is saying here. Do we need to shift off the primary route at checkpoint 28?" The system displayed the risk of contact for the primary route and alternate route to be about the same, but he knew this decision, which might be the difference between life and death for Lieutenant Herrara's lead tank, couldn't be left to zeroes and ones.

Lieutenant Herrara, platoon leader for Alpha's second tank platoon, thought it wasn't so different from what had happened during training. Sure, that was the middle of the desert, but RAR had worked, and worked well, accurately depicting where the training staff had placed obstacles in the road and saving them precious time in their exercise. But it had its limits. It still didn't account for the value of an extra foot or two of defilade. One of her tanks wouldn't have been assessed as having been a mobility kill from that simulated anti-tank guided missile (ATGM) at NTC. She wouldn't be making that mistake again.

She quickly shared the screen with Staff Sergeant Wolfe, her platoon sergeant, in his vehicle. "Sergeant Wolfe, the CO wants to flex the primary route at checkpoint 28; looks like an unimproved farm road. RAR doesn't really show a difference. LIDAR looks like we'd have more cover.[7] Your thoughts? Over."

"Ma'am, you're right on the LIDAR outputs. Let's change the route," replied her platoon sergeant.

Lieutenant Herrara keyed the radio: "Sir, that makes sense to me. We'll give ourselves a few hundred more meters of cover before we reach Phase Line Black and the bridge."

In his command tank, Captain Graves now switched his frequency to talk only to his company first sergeant, "Mac" MacCormick. "First sergeant, before we get going—any refinements?"

First Sergeant Mac's comforting drawl came over the command tank's speakers. "Sir, I think we're ready."

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Alpha Company's tanks and infantry fighting vehicles began crawling ahead along the A4 highway and adjacent roads, with Herrara's second platoon as an advance guard providing travelling overwatch, followed by Lieutenant Kim's first tank platoon, Lieutenant James's mechanized infantry platoon, and the company commander as the company's main body.

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[7] LIDAR = light detection and ranging.

Captain Graves had thought hard about the right balance of preserving his manned combat power and the need to provide human judgment at the right place and time, and he had tasked many of the company's unmanned ground vehicles (UGVs) to guard the company's flanks, a tactic enshrined in the relevant army field manuals and technique publications since the early 2030s. Even in the advance guard, second platoon's tanks employed their autonomous driving applications, ensuring that they kept their distance from the company's two UGVs. The UGVs, 15-ton tracked autonomous vehicles that typically operated in pairs, were affectionately called "the Twins" by the junior soldiers. Their programmatic name was the Company Ground Combat Vehicle (CGCV), and Alpha had 20 of them with various tasks, including flank security, direct fire support, and sustainment. The Twins' modular configuration allowed the unit to outfit them with the sensors, optics, and weapon systems to meet the mission. The company had chosen to go with a sensor-heavy package for this pair, which provided better detection and classification of terrain anomalies and small unmanned aerial system (sUAS) threats. The cost of this choice was dropping each robot's ATGMs and two of its four Stinger missiles. The Twins swept the route for hazards, both natural and manmade, populating the screens of vehicles designated for the same route with images and suspected classification of any detected anomaly.

Ahead and beyond, Alpha's first unmanned aerial system (UAS) section, consisting of some 30 group 1 Blackbird UASs, employed their sensors. Looking out from her command hatch, Herrara reflected on how fitting the name was—the quadcopter drones' coordinated movement and search pattern resembled a lazy flock of small birds. She knew that this cohort of UASs would be the first to fall to enemy jamming, electronic warfare (EW), and counter–unmanned aerial system (cUAS) lasers, but that wasn't an issue. There would be another. And another.

To the rear of the main body, the company's train and the executive officer (XO), Lieutenant Parker, kept their distance. His small headquarters unit included the company's intelligence specialist, Corporal Brown; the company's sUAS section chief, Sergeant Bonilla; and two of his junior soldiers. The other six sUAS specialists of the section had been tasked out to the platoons to provide expertise on the Blackbirds and to assist in the employment of each platoon's loitering munitions. Together, they monitored the movement of the Blackbirds and the unmanned aerial vehicles' (UAVs') suspected classification (or lack thereof) of enemy positions. The display, so reminiscent of the virtual reality combat games many soldiers had played in high school that they wondered whether the game company could sue the Army for copyright infringement, showed nothing. Without any enemy EW, the sensor feeds and reporting were instantaneous. Brown toggled between different sensors dispersed across the first UAV section, checking for instances where an electro-optical (EO) sensor might have a suspected classification where an infrared sensor did not. Nothing. Maybe the Russians weren't here yet? Or if they were, how were they hiding so well?

The first section of Blackbirds neared Phase Line Black and the co-located unmanned air asset coordination line, an imaginary line that cued the Blackbirds to establish a datalink with ten of the group 2 Sharp Eagle reconnaissance drones from the battalion sUAS platoon that were

tasked in general support, with priority to Alpha, already flying overhead. Their advanced sensors, which included radio frequency (RF) detection and higher-fidelity EO sensors, could cue the Blackbirds to saturate a certain area in order to provide a classification with higher confidence. Per the annex in the battalion's operations order, Alpha would now have the fixed-wing Sharp Eagles in direct support, a reflection of the battalion commander's willingness to trust his company commanders with his most valuable assets. Lieutenant Parker's ISCOP screen blinked with the notification to acknowledge the new support relationship, which he verified with the unique code briefed to him in an annex of the operations order.

Parker pressed his microphone. "Sir, we've got the ten Sierra Echos from battalion in direct support. I'll keep them hovering between Phase Line Black and Phase Line Orange until they think they've found something; over."

Captain Graves acknowledged the message. "Copy, XO, carry on." *Don't lose those things, Parker; none of us can afford the investigation*, he thought to himself. So far, so good. But they weren't in the red yet.

Part 2: Reconnaissance and First Contact

Lieutenant Parker noticed it about the same time Sergeant Bonilla did—the feeds from several of the Blackbirds began to cut out, with a lag in feeds now apparent. Per the unit's standard operating procedure, this first section of Blackbirds would stick to their initial programming, with the more robust Scan Eagles swooping in to collect information, fight out of the jam, and act as a relay to the company's sUAS section.

"Sir, we're getting jammed just north of Phase Line Black; we should have our first update in two mikes," said Lieutenant Parker over his vehicle's radio.

Captain Graves replied, "Copy 5, Rod is showing me the same. Could you get a position on that EW?" *Why is there a jam, and nothing else? What are they up to?*

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The response from the company was instant, and their immediate action drill began with second platoon shifting their route slightly to the east, still trailing the Twins, and first platoon coming up on line to their west, the company now roughly in a "vee" formation. In each platoon leader's tank, the specialists from the sUAS section deployed their own Blackbirds, as well as several loitering munitions. Not long after, the Blackbirds began their preset search patterns, hunting for the source of the jam and directing the loitering munitions to it.

Second platoon's M1E3s positioned themselves on line as they crossed the phase line, stopping short of an open span of about two square miles of fields and farmland, where the A4 highway crossed the narrow Merkys River via a single two-lane bridge. Lieutenant Herrara toggled her ISCOP, closing the RAR overlay and pulling up a projection of enemy positions via the Depiction of Enemy Disposition and Strength (DEDS) tool overlay. She knew that, based on the only contact thus far being a jam, DEDS couldn't tell her much of anything of value. But she

would take all the help she could get in her first fight. The projection changed dramatically as it updated every 30 seconds, but she didn't need a tool to tell her that any Russian lieutenant wouldn't want Americans crossing that bridge without a fight.

The Twins were already on their way to the bridge, having been assigned as direct support to second platoon and paired to Lieutenant Herrara's tank for tasking as she crossed the phase line. *Crossing the bridge first is a job for robots*, she thought to herself. She could assume direct control of the UGVs, but for now she let them proceed on their own.

The platoon would execute just like they did at NTC: The Twins would first conduct a reconnaissance of the crossing site, their sensors trained on data for known Russian TTPs on emplacing mines and booby traps, before securing the far side. Then they would provide security for the tanks against ATGMs with their automatic 40mm grenade launchers and .50 caliber machine gun, scanning assigned sectors until she or Wolfe told them otherwise. Then the unit's tanks would pick up one at a time, push across, get back in a wedge, and they'd be on their way.

The first UGV neared the bridge, taking its time to employ every sensor available. Herrara watched, patiently, and shared the feed from the Twins' cameras with the other tanks in her platoon. There was no need to rush here and miss some concealed mine that would take out a manned vehicle.

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Back at the command post, Captain Graves talked over the common operational picture (COP) with the company's master gunner and First Sergeant Mac as the first of first platoon's UASs went offline, a victim of the same EW attack that had knocked out its company counterparts. At almost the same time, the COP and the radio lit up with reports of sporadic machine gun and mortar impacts in first platoon's zone.

"Not very accurate," snarled First Sergeant Mac, "but they figured out where we were quick—do they have DEDS too?"

As if on cue, DEDS sprung to life, populating the screen with the operational graphics everyone had learned at basic training—one heavy and one medium machine gun; at least one, no, two 82mm mortars; and what looked to be a squad or so dispersed in the far treeline.

But something was clearly wrong with DEDS. With every 30-second update, the enemy force looked totally new. Positions were wiped off the display while new ones reappeared half a kilometer away, and at one point the Russians had what looked like four or five heavy machine guns. The tool's confidence, expressed as "high" on the first update, now read "moderate." That correlated to somewhere between 40 and 60 percent confidence. By the fifth update, First Sergeant Mac had seen enough.

"Sir, there's no way," he said. "We know DEDS works by taking the EO/IR and thermals from the birds, as well as the audio from the gunfire."[8]

[8] EO/IR = electro-optical/infrared.

"And?" said Captain Graves. But the realization came to him just as First Sergeant Mac said it.

"The treeline on the far side and the buildings in that town are screwing with the sensors, and DEDS can't handle it. I don't know if a recent update from the contractors is screwing up the algorithms or not, and I'd put money that the Russians have emitters out too that are screwing with us. There's a pattern here; we just have to find it."

It took two more updates for the command team to be confident in what they were up against: two squads in an inverted, shallow "U," their right (east) flank almost touching the A4 highway. There was probably a heavy machine gun on that flank ("They'd be stupid not to," said the master gunner), with one more heavy and one medium gun several hundred meters to the east. The mortars *had* to be somewhere back around the structures on the east end of the airfield, using buildings for some degree of cover. The unit probably had ATGMs, dozens of UASs, and several UGVs as well, just waiting for the right time and target. *They wanted us to come in close, and then use everything all at once. Overwhelm us and the tools we use. Not a bad idea.*

While the CO, first sergeant, and master gunner deliberated, Specialist Rodriguez took the time to double-check the Automated Report Consolidation System's (ARCS's) new contact report output for the battalion. The system automatically synthesized the contact reports via radio from platoons and squads with the company's unmanned systems to generate a contact report for the battalion, which it automatically sent based on the criteria of the relevant annex of the battalion operations order for automated communications. Now, updating the report with his commander's understanding of the situation, every vehicle and leader in the battalion would have Captain Graves's understanding of the situation on their ISCOPs as soon as he clicked "send." Meanwhile, the vehicle did everything else, repositioning itself in defilade and scanning constantly for air threats, updating its own fuel and maintenance status, and waiting for its next task.

Captain Graves came over the radio: "Leaders, check your screens for the sitrep and enemy positions. Out."

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Back by the bridge, intently focused on the occasional "whump" of a mortar round and bark of a machine gun some distance to the east—*those had to be the ones shooting at First*—it took a moment for Sergeant Frank, one of Lieutenant Herrara's tank commanders, to notice it on his screen. A short trail of dust and dirt kicked out behind—*what?* Something very small and moving very fast directly down the road, straight for the bridge. The M1E3's sensors noticed but couldn't classify a short, squat UGV moving over 60 miles per hour. The little kamikaze robot began to bounce and weave, all the while remaining locked firmly on its target—the first of the Twins, still methodically making its way across the bridge.

Part 3: Gaining and Maintaining Contact

The Twins had never been trained on data that could have allowed the first Twin to recognize the Russian UGV sprinting toward it as a mortal threat, let alone engage it effectively. The contractors hired to source data for the UGVs' classification programs hadn't been able to find more than a few photos of the Volk ("wolf") system, not nearly an adequate amount to enable rapid recognition. Sergeant Frank, realizing that the shockwave from the Twin's main gun would knock the Twin out of commission anyway, tried to get its attention, frantically waving the hand and arm signal to take cover. The computer brain saw the signal through the robot's secondary camera, trained on Frank as the nearest friendly, and recognized that it needed to move. But it was too late.

Sergeant Frank could do nothing but watch and take cover himself. The UGV and the bridge it didn't quite manage to cross vanished in a fireball as the Russian robot slammed into it. When he revisited his optics, he saw a mangled mass of concrete and steel where the bridge had been a moment before.

Before Lieutenant Herrara could reorient her platoon's tanks, the Russian plan became obvious. The four M1E3s' counter-air and artillery sensors rang out: They were about to get boxed in. The sounds of impacting rockets several hundred meters to the rear, between second platoon and the company's main body, were shortly followed by an alert: There were 25 unidentified aerial systems headed right for them.

"Button up! ACATs up!"[9] shouted Staff Sergeant Wolfe over the radio, a process that each tank had already begun automatically.

The unit executed the immediate action drill about as smoothly as it could under fire. While the tanks' autonomous driving capability identified the most survivable positions based on terrain analysis and moved for cover, the crews inside sprang to life on their own tasks—systems operators guided by their ACATs slewed their optics on the heading reported for the Russian sUASs, while commanders engaged with the optics suite, firing computers, and autoloaders. Already receiving the first pieces of Captain Graves's order, they began scanning their assigned sectors for the targets that were soon to appear. In the command tank, Lieutenant Herrara began to think of a way out of the trap.

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Shortly after the Russian rocket platoon had loosed its first salvo, Lieutenant Davis and Sergeant Watson, the company's attached fire support officer and joint terminal attack controller, had been able to use the Rapid Support Tool (RST) to establish a priority for support with one of the brigade's group 3 reconnaissance UAS within seconds, with only a quick approval and authentication needed at the battalion level. The stack of UAS systems at Alpha's disposal

[9] ACATs = Autonomous Counter Air Tools.

stretched far above the formation, coordinating their search patterns and tasking. A portion were now given a new priority mission: Find the mobile launchers.

Simultaneously, the company's attached forward observers began to adjust indirect fires assets onto the enemy positions. Rounds from the CAB's 120mm mortar platoon from the battalion and one six-gun battery of the field artillery battalion's 155mm self-propelled howitzers, for which Alpha had been given priority of fires, all began impacting Russian positions on the far side of the clearing.

Captain Graves had already pushed out the first part of his order: Alpha would conduct a textbook "action right," an envelopment by Lieutenant James's mechanized infantry platoon, supported by fires from both tank platoons and a host of supporting assets from the company and battalion. Lieutenant Kim's first tank platoon would be prepared to follow and support the assault with his tanks. Every vehicle's screen showed that Lieutenant James's soldiers and the attached engineer squad would cross the water feature to the east of first platoon, covered by company and battalion indirect fires assets and the main guns of the company's tanks, cross the several kilometers of open field, and roll up the Russians' left flank toward the highway.

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To his credit, the CAB commander, watching every update to his command display as cooly as if it were a Table I shoot, had thus far stayed out of Captain Graves's hair. He busied himself by taking in the reports Rodriguez had sent up, preparing Charlie Company to assume the role of the advance guard, and monitoring the work of the fire support coordination center. He had known Graves since he was Graves's instructor at Fort Benning and saw now what he had seen in Graves then—Graves understood when to trust—and, importantly, when not to trust—the people and tools at his command, as well as his own plan. But now was the time for the battalion to put their finger on the scale. His AI-enabled Decision Support Tool, which analyzed the assessed Russian capabilities and repeatedly simulated a range of courses of action against them, had another good suggestion. After a quick huddle with his air liaison officer, he flicked his finger to send the request to the brigade aviation element. He had four new assets, a section of sUASs, designated in direct support to the battalion within a minute. This Russian platoon, no matter how effective their opening moves were, wasn't going to slow them down.

"Alpha 6, I'm going to push four sUAS your way; you have priority of fires. Do what you need to with them. Over."

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Back along the line of contact, target identifiers populated the screens and optics of every tank, as the company's second group of Blackbirds entered the fray and identified enemy positions. The identifiers displayed bright red diamonds on enemy positions and allowed the platoon leaders and sergeants to further designate lateral limits and individual targets to their tanks. Soon the reports of main guns began to bark out across the line, 155mm shells soon joined by 120mm mortar shells from one of the CAB's mortar sections.

Traveling the dirt road behind first platoon's line of tanks, Sergeant Smith's XM-30 raced toward the tentative crossing point that the brigade birds had identified with their LIDAR hours earlier. The limiter line of code in the autonomous driving application, which was supposed to keep the infantry fighting vehicle's speed below 35 miles per hour on these kinds of roads, was always the first thing Smith had his squad disable. 50 meters behind, the engineer squad with two autonomous bridging systems struggled to keep up, the gap between them and the lead XM-30 widening, holding up the remainder of the platoon in the process.

Several minutes later, the engineers settled in behind Smith's vehicle, now just meters from the opening and the planned crossing point over the water feature. Two specialists hopped out of the unit's lead XM-30 jokingly making a crude hand gesture at Smith and his soldiers for leaving them in the dust and deployed the engineering unit's two tracked survey UGVs that had been stored inside. After confirming the survey boundaries, the two vehicles began creeping toward the bank. These small, unarmed vehicles had a variety of sensors, that, as far as Smith could tell, primarily focused on understanding soil composition and making measurements that would assist the autonomous bridging systems in their deployment.

The rest of the engineers hurried to position the bridging vehicles, their hand and arm signals cueing the autonomous systems to do most of the driving, although a corporal assumed manual control of one for a short stretch to navigate some especially rough terrain. Within five minutes, the engineer reconnaissance vehicle had found their spots for the bridges to deploy from.

Lieutenant James, the platoon leader of the mechanized infantry platoon, now came forward, pulling Smith and the engineer squad leader into a rare face-to-face huddle. "Are we set?"

"Yes, sir," came their joint reply.

Part 4: Fixing the Enemy

Sergeant Watson turned to Lieutenant Davis, a wide grin on his face. "Ma'am, just got off the net with the battalion air liaison officer. We've got four sUAS at holding area Viper [the company's planned holding area to their southwest], with 45 minutes time on station. Ready when you are."

"Got it; thanks, Watson" she replied. To Lieutenant Davis's front, her forward observers began to make the final adjustments for artillery and mortar rounds onto the enemy positions. It was all coming together, and fast. She tapped the screen mounted on her forearm to send the updated fire support series to the CO.

Captain Graves and Lieutenant Davis, assisted by Sergeant Watson, huddled over their respective ISCOPs to check their geometries one more time. They were able to clear the fires within the company's area in 30 seconds, and within two minutes they had approval at the battalion and brigade levels. Airspace deconfliction for the dozens of drones overhead would come automatically—*that's why we rehearse this a million times in the workup,* thought Davis. Near-immediate updates to the locations of friendly forces allowed the ISCOP to slap a new

operational graphic on the map. A 20km square box north of the 83 Northing appeared with the title “AWFFA: Autonomous Weapons Free Fire Area.”

The notification flashed on every screen on every vehicle and soldier in Alpha Company as each vehicle automatically switched on their signal panels to indicate to the overhead sensors that they, despite looking a lot like a military vehicle, were not what the close air support sUASs were looking for. The sUASs, guided by their reconnaissance counterpart and networked drones from the battalion and company sections, now had free rein to engage anything they identified as enemy.

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The company commander’s tank lurched forward, its autonomous driving capability following the preset guidance he had provided prior to the mission to follow in trace two kilometers behind the rearmost XM-30. He wanted to be in vicinity of the crossing point should he need to take personal command of the movement. Captain Graves was able to turn his attention away from his vehicle’s route and fire support planning and finish updating his fragmentary order, which Rodriguez then pushed to the unit’s leaders. Now complete with Davis’s fire support series and the support from the sUAS birds, he was confident that his soldiers could clear out the Russians on the far side of the fields. He had made his decision to have the sUASs pursue the rocket artillery threat targeting Herrara first—could they do it fast enough for second platoon? His screen flashed with the latest situation update from Herrara.

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Herrara’s voice filled the four M1E3s in her platoon, confirming the commands she had pushed out over the command network: “Thompson, take the three out to the west; SSG, take the two directly over the highway; Frank, you and I split the five to the east.” The remaining Russian UASs, seemingly tired of watching their prey lashing out with their jammers and lasers, climbed before making what would be their terminal dives at the trapped platoon.

With their tasking set, the ACAT began scanning within their defined lateral limits, trying to lock onto their targets. Four more rockets fell all around Herrara’s buttoned-up platoon, showering her optics with dirt and debris.

“Two-one is hit,” came Wolfe over the radio. He was right, saw Herrara; the status symbol on her command screen for Frank’s M1E3 blinked red, indicating some degree of damage from the rocket fire. But how much? Multiple systems were displayed as yellow instead of the normal green, but nothing indicated that the tank’s armor had been breached.

Herrara came over the radio for Frank. “Two-one, come in.”

Silence.

“Two-one, this is Two Actual, radio check.”

Again no response.

She revisited her optics, each already following the five Russian UASs she had designated for herself and Frank to engage. They turned and began their lethal dive from about half a kilometer up—three toward her, the other two at the now unresponsive Sergeant Frank and his

crew, 100 meters to her east. Below her came the voice of her driver, saying aloud what she was had already asked herself over and over in her mind: “Ma’am, what are we going to do?”

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Sixteen kilometers away, the Russian rocket artillery platoon’s luck ran out. Based on the targeting guidance provided by the brigade reconnaissance drone, the first sUAS, flying low over the treetops, popped up and loosed a rocket from just 2,000 meters away, finding its mark on the rear of the mobile launcher as it attempted to displace after its third salvo. This maneuver proved fatal, however, as the launch signature cued Russian cUAS lasers, which quickly found their mark. The disintegrating sUAS fell apart over a stretch of farmland.

It was too late for the Russians, however, as a second launcher, this one co-located with the battery fire control vehicle, met its end. Another sUAS was cued by the classification of the truck’s launcher pods, now only partially full, as something it was supposed to destroy. The drone circled and came in from the northeast as the truck attempted to pull onto the highway, and with a short burst from the cannon, the drone ripped both the launch vehicle and the battery fire control vehicle in half, the unspent munitions exploding as the drone pulled up and reformed with its remaining companions, now headed for the Russian defensive position.

As the four sUASs approached, the Automated Precision Deconfliction Tool (APDT) suite quickly provided deconfliction in the ever-more crowded airspace to the north of Alpha Company. Between the unit’s UASs and that of their enemy, APDT identified more than 150 distinct tracks for the sUASs to navigate over, under, and in between.

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From Sergeant Smith’s perspective, peering over the defilade at the Russian positions 500 meters away—okay, the XM-30’s optics were indicating that he was safely 25 meters behind—he saw the sUASs an instant before the “brrrrrr” of their cannons filled his ears. It reminded him of his grandfather’s stories about having A-10s overhead on deployments to Afghanistan (he was right; there was a certain comfort in having close air support). The sUASs came in low and fast, their cannons blazing as they made their first pass over the Russian lines. Over the radio came Lieutenant James’ voice: “First Squad, push.”

Part 5: Maneuvering on the Enemy, Preparing for Consolidation

Lieutenant Herrara made her decision—she chose to protect her sergeant first. Slewing her high-energy laser to the pair of drones diving for his tank, she directed the autonomous air defense system to identify and prioritize the threats, and it searched frantically to obtain the new targets. As she had hoped, it did so far faster than any human could have, as the drones headed straight for Frank seemed to twitch and then spiral out of control one after another, crashing to the ground several meters short of where the command screen depicted the location of the disabled tank.

She saw none of this, however, her preoccupation being the drones closing in off of her left front at a steep angle, gaining speed as they fell. 300 meters. Her systems operator reoriented the laser to her 11 o'clock, and the first burst seemed to be right on target as the UAS fell apart. Still the remaining two drones came faster and faster. In less than two seconds, they would come screaming through the turret, showering her and her crew with burning hot metal fragments. The ACAT's computer brain directed the laser against the nearest, and it exploded as the shaped charge it carried detonated. She paused, briefly, considering whether she could pull her sidearm in time to get the second, just as the system directed another high-energy laser pulse at the drone closing to within 100 meters. Now the laser, burning through the drone's left wing, sent the robot spinning to earth, crashing directly in front of Herrara's tank, the blast throwing her and her systems operator from their seats into the control panels behind them.

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The first bullets whipped between Smith and Ski as they closed to the small rise of earth 300 meters from the Russian's flank machine gun. Under the withering fire of tank main guns, rocket artillery, mortars, and the platoon's three XM-30s with their .50 caliber guns, more Russians looked to be running then firing back at the advancing dismounts. The machine gun position kept up its fire, however, the next accurate burst throwing dirt up at the feet of Private First Class Jones, struggling to keep up with Ski under the weight of his belts of .338. "Bring the truck up, Smith!" screamed Ski, as Jones now began to low-crawl the final 15 meters to his team leader, shaking from a mix of fear, adrenaline, and sheer exhaustion. Smith sent the order, defaulting to the XM to make the decision as to where its next firing position would be.

The XM-30, having already assessed potential routes to its next support by fire position and determining that none offered terrain that would provide adequate cover from ATGM threats, instead selected the most direct route. It roared out from behind its defilade and began to charge at its selected position off to Smith and Ski's left, in the gap between their squad and the platoon's second squad. Smith realized what was going to happen before the machine did, as a Russian ATGM slammed directly into its front, creating an explosion that sent fragments of the turret flying across Smith's face. Lieutenant James, seeing the loss of one of his three large-caliber guns, quickly reassigned sectors of fire for his squads and remaining XM-30s. The loss of the XM's gun and the ammunition it had stored accelerated his timeline, however. The projection from his toolset: about enough ammunition to buy him 15 minutes to get into the Russian positions. The system was accounting for the lower accuracy and higher rates of fire of all his soldiers, fed continually into the algorithm. His voice came crackling over Smith's headset: "1-1, need you to take down that gun position on the east flank, over."

Jones and his ammunition had caught up to Ski and Smith as the pair began to set up their own machine gun. "Ski, I'm taking the squad around the right; you'll see us pop out at the ditch 20 meters to the right of that gun position. I'm going to use my handheld drones first; don't shoot us," said Smith.

Ski grinned. “I’ll try not to, Sergeant,” and just as the last of Smith’s squad set off for the bunker, Ski muttered under his breath, “You’re welcome for the extra ammo; you’re going to need it.”

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To the rear behind second platoon, First Sergeant Mac, tracking the destruction of the Russian mobile rocket platoon and seeing no immediate air threat on his command screen, now pushed his vehicle rapidly from his staging area to second’s position, a small train of autonomous support and recovery vehicles in tow. The damage indicators from second platoon’s vehicles and projections of crew injuries allowed him to prioritize casualties and understand the level of effort needed to repair or replace the platoon’s platforms. Already the CAB’s medical section had tasked two of their support quadcopter drones, loaded with blood products and burn cream, to link up with the first sergeant for further tasking.

In their vehicle, First Sergeant Mac’s systems operator understood this was no time for autonomous driving—speed was of the essence, and while the program would get them there, they couldn’t forgive themselves for taking their hands off the wheel with soldiers injured, or worse. The unit’s emergency care sergeant and one of the autonomous recovery vehicles split off to the east to tend to Sergeant Frank, while First Sergeant Mac moved straight ahead to get to the second platoon leader, followed by another vehicle and crew of the attached recovery section. Mac directed one of the medical section’s quadcopters to each location, where soldiers would provide immediate care and identify which of their comrades could be immediately airlifted back to the battalion aid station by the systems.

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Now 25 meters from the enemy machine gun, Smith, his first team leader, and a junior soldier dove for cover in a now-abandoned foxhole. Its previous occupants hadn’t bothered to pack up all their belongings before they left; remaining behind were components of a Russian quadcopter and a man-portable EW jammer, an obsolete version from the mid 2020s. As his two soldiers scanned for targets, Smith pulled one of his handheld UASs from a pouch on the side of his plate carrier and switched on the first-person view setting on his goggles. He would get as good of a look as he could at the trench before deciding whether the little drone would be making a one-way trip or coming back for future service. It rose from the foxhole, the buzz of its rotors indistinguishable from the gunfire and explosions around them. The drone’s obstacle avoidance programming helped him avoid the few mangled branches that still hung on through the assault.

He saw the Russian machine gun, a two-man team still working mechanically to fire back at Ski, Jones, and the rest of the platoon. Ski was holding his own, though, as bullets struck all around the Russians and their machine gun. There was a lone soldier five meters away with a grenade launcher mounted under his rifle. A couple of Russians—two, maybe three—lay mangled on either side of this individual, not moving. Smith spoke now to his team leader: “Two-man machine gun team in a sandbagged position, lone enemy 5 meters up the trench with a rifle and grenade launcher. I’ll drop the drone and you all push through. Ready?” He was

answered with a squeeze on his shoulder, and as he pressed the icon on his forearm tablet, the tiny drone dove for the machine gun position, erupting into a fireball as the squad closed on the trench.

Several minutes later, as his soldiers finished clearing the Russian positions, Captain Graves found Lieutenant James and was ready to talk next steps. “After you’ve pushed through to the A4, do a quick sweep of the west side and set up a hasty 180 on the north end of the airfield. First will be right behind you; they’ll put their tanks in once you’re consolidated. Charlie Company isn’t far behind; they’ll be pushing through and taking advance guard.” It was important, he thought, to actually talk to the young officer in the midst of his first fight, rather than relying on a computer to do it for him.

“Roger, sir. Thank you.” James hopped into his waiting XM and sped off after his platoon.

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In the company’s rear, the company XO and supply sergeant were now fully focused on rapidly reconstituting the company’s combat power. The battalion and brigade support units, with real time access to the company’s damage and loss reporting, had already began to push dozens of UASs and a handful of UGVs, manned and unmanned maintenance and recovery capabilities, fuel, and ammunition to Alpha. Lieutenant Parker confirmed the link-up locations and began to coordinate with the platoon sergeants on how the company would distribute to the platoons. The supply sergeant was fully engaged with his tablet, refining consumption and damage statistics to ensure that they would be reflected in PACT in time for the CAB to adjust support to Charlie Company.

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As his M1E3 approached the hasty 180-degree defensive positions that the first tank platoon and mechanized infantry platoon had established on the north end of the airfield, Captain Graves reflected on what had just happened. The Russians weren’t nearly as well equipped, hadn’t had long to set up a defensive position, and were outmanned and outgunned from the start. But they were creative, finding ways to mask their signatures well enough for Alpha to get in close before they could engage and concentrating what capabilities they did have on hurting second platoon at the obvious crossing site. Nobody was killed, thank goodness, but there were nine soldiers, including a young lieutenant, already on their way out of the war almost as soon as they had entered it. The company had lost half a platoon of tanks, several UGVs, and most of its UASs, although Parker was already working to replace many of these. Alpha had fulfilled its mission, at a price.

Alpha had seen and learned much in one of the first engagements of NATO’s drive on Vilnius. Graves knew that in just minutes, the information in his after-action report would be plugged into a half-dozen AI-enabled tools, informing the decisions of the unknown numbers of commanders yet to experience what he and his soldiers just had. He turned to Specialist Rodriguez, who was already pulling up an automatically generated after-action report on the

tank's ISCOP. On an adjacent screen, he saw that the lead tanks of Charlie Company were just about to conduct their passage through Alpha's position.

"Double-check to make sure that report is thorough, Rodriguez," Graves says. "Charlie is going to need all the information they can get."

Chapter 3. Attack in Urban Terrain

According to the United Nations, by 2050, the proportion of the global population dwelling in urban areas is expected to reach two-thirds.[10] Cities and urban areas are usually home to what can be key operational objectives of control and, consequently, of war—central leadership and key infrastructure, such as transportation, political centers, and financial hubs, are often found in urban areas. In a conflict, the loss of a city can be seen a turning point or unofficial marker of progress in a conflict scenario, especially when this entails the adversary gaining control of key infrastructure.[11] With the increasing number of urban areas and the value they carry, future conflicts and decisive battles may end up in dense urban environments more often.

Urban environments provide unique challenges for combat. Close-knit buildings mean many opportunities for obscuring movements and hiding traps. There may be noncombatants present and incentives to change maneuvers and operations to avoid risk of civilian injuries or damage to civilian infrastructure. AI systems and autonomous vehicles can decrease uncertainty in this environment by providing greater reconnaissance abilities at faster speeds, as well as providing first contact to minimize risk to soldiers' lives.

This chapter presents a hypothetical vignette in which Russian forces take the Baltic city of Vilnius, Lithuania, and U.S., allied, and NATO forces move to recapture it.

In this vignette, the end state for the U.S. and NATO forces would be to recapture the southern portion of Vilnius that was taken by Russian and Belarusian forces and return control to the democratically elected leadership of Lithuania.

About three weeks prior to the start of the scenario, intelligence indicated a large-scale buildup of Russian forces in Kaliningrad and Belarus. In the week prior to the invasion, Russia and Belarus announced a "joint exercise focused on defending against threats to sovereignty." During this time, Lithuanian officials announced an evacuation of Vilnius and other cities near the border of Belarus and Kaliningrad. Roughly 200,000 civilians remained in Vilnius at the time of the invasion, where "little green men" forces, determined to be unmarked Russian and Belarusian units, surged across the borders and quickly pushed to Vilnius to "support the existing resistance to pro-NATO leadership."

[10] United Nations Population Division, "Urbanization," webpage, undated.

[11] For example, the Allies retaking Rome in the final months of World War II was viewed as a massive psychological defeat for Germans, which they attempted to avoid by creating the Gustav Line south of Rome. The structure of the Gustav Line and Allied advance collided in the Battle of Ortona, another urban fight where the Allied victory opened the road to retaking Rome with no resistance. See Liam Collins and John Spencer, *Understanding Urban Warfare*, Howgate Publishing Limited, 2022.

This is a terrain-based objective of capturing and holding a particular chunk of terrain that is currently held by opposing forces.[12]

The company's level would be a subset of the terrain-based objective. In this case, the company in this vignette will move to capture a key landmark in Vilnius—Cathedral Square and the buildings surrounding the square—to provide a hub from which units could regroup and begin pushing toward the southern side of the Neris River.

In considering this objective, the company would have to be mindful of the implications across the political, military, economic, social, information, infrastructure, physical environment, and time (PMESII-PT) spectrum of their objective relative to the end state and the area as a potential "center of gravity" for both the adversary and allied populations.[13] Some of these considerations include the political and social significance of Cathedral Square as a landmark in the city—the company will likely need to be cautious about the use of force to avoid unnecessary destruction of a center of political and historical significance. Additionally, this area is a visible landmark and representative of Vilnius, so there will likely be a positive psychological impact on morale and will to fight of Vilnius resistance if this area is captured by U.S. and NATO forces.

The company of focus in the vignette would support the mission of capturing Cathedral Square by taking control of the Grand Hotel Kempinski, a large hotel that is one of many buildings that frame the square. Given that this hotel is 269 rooms spread across many floors, a larger force would be tasked to clear and seize the building.

Part 1: Backache

Captain Bradshaw crouches over the ISCOP screen, aiming to relieve the perpetual ache at the spot between his shoulder blades. They've been standing here, debating and compromising and adjusting to a constant barrage of new info, for so long now that his neglected physical therapy finally caught up with him, and now he gets to deal with the consequences.

He shrugs off the pain as best he can with a defective back and looks down again at the map that has, at this point, been burned straight into his retinas.

The Lithuanian city of Vilnius fills the screen beneath his fingers. The city stands in the middle of a lush landscape of foliage, a monument of stone-tiled streets and thick walkways and old brick buildings, cut through by the winding Neris River. The latest satellite imagery shows smoke and rubble, concrete barriers and small tanks, drones and barbed wire: the mark of three weeks of Russian occupation. Bright colors and tiny windows with small text graffiti the landscape like the massively multiplayer online role-playing games (MMORPGs) he played as a

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[12] Headquarters, Department of the Army, and Headquarters, United States Marine Corps, Army Techniques Publication 3-06, Marine Corps Tactical Publication 12-10B, *Urban Operations*, July 2022.

[13] Centers of gravity can be locations, people, or intangibles, such as information and social cohesion, that are a source of strength and power. For more information, see Joint Chiefs of Staff, Joint Publication 3-06, *Joint Urban Operations*, November 20, 2013, pp. III-14 and III-15.

teen. Obstacles are demarcated by orange highlights that make up the barriers layer of the COP. Red dots for the mines. Open alongside it are several other overlays, labeling likely ambush points, set and suggested resupply points, the current and projected locations of their comms towers, and even PMESII-PT blockouts around the World Heritage sites in Old Town. Most importantly for the moment, the route overlay: dozens of wonky blue trails leading down several routes from their location to halfway through the city. Only a few of them matter to him: the ones ending at his company's ultimate goal: the Grand Hotel Kempinski.

Poking through the intel-vomit is a small mass of pulsing white spots, just near enough to third platoon's route to worry him.

Lieutenant Gonzales sees it, too. He points at the white mass. "Didn't Civil Affairs evacuate this area?"

Lieutenant Kravitz sneers. "Sure, but clearly they didn't get everyone."

"Guess not."

"Or they wanted to stay behind and give us a nice greeting."

Unlikely. The Lithuanians seemed to be generally positive about their presence here, even if they weren't pleased with this disruption. Bradshaw doubts they've defected to the enemy's position, but he can't be sure. And if they are civilians, the last thing he wants is for them to get caught in this operation.

A ping issues from the tablet's speakers, and, in tandem, a notification appears on the top left of the screen: new data, coming in hot.

"What's the update?" Captain Bradshaw asks.

Sergeant Bennett, the company's systems operator, opens the notification. "New EO/IR from our sUAS two kilometers west of the hotel, respective ELINT from the Blackbirds.[14] Layers affected are mines, terrain, and ambush points."

"Mines?" Kravitz says. "More of them?"

Bennett, ignoring him, asks Bradshaw, "Shall we integrate, sir?"

Captain Bradshaw nods. Better to have new information to argue over than old information. Over the radio, he notifies his remaining platoon leader, Lieutenant "Beedy" Boyd-Diaz, who's stuck sorting out why half of his platoon's tablets failed to charge. "Integrating, over."

Over the radio, Beedy responds, "Copy." He might not be here in the room, but his shared ISCOP will update right along with theirs.

Bennett pulls the new data into the COP. Captain Bradshaw remembers that when this system was first introduced, the COP would update automatically. The level of annoyance associated with the random data dumps and respective automatic updates, happening right in the middle of planning and going unnoticed by half the team, creating new arguments on top of the old ones, was incalculable. Fortunately, their industry partners for the COP software took feedback graciously. Though that certainly couldn't be said for all of them.

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[14] ELINT = electronic intelligence.

The updated regions glow yellow for a few moments. Bennett toggles off some of the other layers, leaving the mines layer at the forefront of the imagery.

A half-dozen red dots are scattered at the intersection between two streets that second platoon was routed to cross. They'd look more intimidating, in their eye-piercing crimson, if not for the warning sign flashing above them.

"What's that mean?" Lieutenant Gonzales asks.

"Something's wrong with the data fusion," Bennett says. "Can I—"

Captain Bradshaw waves her along. Bennett is smart, but he wishes she would take some initiative once in a while.

Bennett turns to her own tablet to work on an ISCOP without disturbing the planning team's view. Captain Bradshaw lets her fuss over that. In the meantime—"Any assessment on those civs?" he asks.

First Sergeant Williamson speaks up. "Likely nonhostile," he says.

Bradshaw looks at his platoon leaders. Kravitz stares at him with a note of impatience in his thin, raised brow, egging him to move on from this topic, and Gonzales looks at the COP blankly, the entirety of it reflected in his watery brown eyes. If Beedy were here, he'd probably be knocking elbows with Kravitz. His platoon leaders are smart, but they're young. Bradshaw doesn't think they can see the big picture—the one beyond the COP.

The Lithuanians allowed their troops to be here; they fed and housed them and received them with, if not open arms, willing ones. Civil Affairs (CA) was responsible for much of that. Bradshaw would like to keep it that way. If these civilians along their route truly are nonhostile, he wants to make sure that an army marching past their door does them no harm. Does he trust these dinguses with that mission?

"Any of you talked with the civilians here?" he asks them.

Over the radio, Beedy says, "Sure, sir. If the ones in fatigues count."

Kravitz snickers.

The ache in his back flares red hot. "First Sergeant," he turns to Williamson. "Is there no one in this whole company who has experience in these delicate matters?"

First Sergeant Williamson holds up a finger. "One moment," he says. Out of the corner of his eye, he can see him typing on another application on his tablet, a natural language chat connected to their personnel database.

"Sir," Bennett says.

Bradshaw turns to her. "The mines?"

Bennett grins. "Not mines at all." She opens the warning label on the COP and throws the images from the Blackbirds. "Sharp Eagle 1's RF detectors confirm. There's definitely a signal coming from there. And ATR classifies them as mines."[15]

"When did those mines even get there?" Lieutenant Gonzales asks.

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[15] ATR = automatic target recognition.

"Two days ago. But there wasn't any signal before—" she leans over to reads the monitor, "—two minutes ago."

Lieutenant Kravitz says, "But you said there weren't any mines?"

"There aren't." She pulls up another image, this one from the open-source intelligence data stream. It's a social media post, geolocated right on that road. "A civ took picture of this street five minutes ago. Look—there's nothing there. It's just paint and emitters."

Sure enough, from the horizontal view of the camera, there's nothing on the ground.

Kravitz throws up his hands. "What a stupid tactic! How long did they spend painting those things? Waste of time."

Gonzales shrugs. "Nearly fooled us."

"Nearly?" Bennett says. "Even the machine caught it before we did."

Williamson waves him over. Bradshaw leaves the trio to bicker and steps up next to his first sergeant. "Zolyak in BEBs completed training for CA last year.[16] Never joined CA, though."

"Good enough for me," Bradshaw says. He says through the radio, "Beedy, take Zolyak from BEBs with you. He has CA training. If you run into civs, you listen to him, understand?"

"Yessir."

"Radio off," he tells First Sergeant Williamson. "Have a word with Zolyak before Beedy steals him. Tell him to make sure they don't do anything stupid."

Williamson nods. "Understood, sir."

Williamson leaves the tent. Bradshaw takes a moment to sit down and stretch his spine. They're due to deploy in half an hour. He hopes to God they don't get another data update before then.

Part 2: Jack Breacher

There it was, dumped between quaint, pastel buildings, an enormous pile of dirt stretching from one side of the narrow lane to the other: the berm.

No mind. Lieutenant Gonzales knew it would be here. The high-fidelity feed from the Dragonfly only confirms this. As does the aerial feed from the Sharp Eagle, and the dozens of black-and-white video recordings from the block of Blackbirds. No sensor spared for this hunk of earth—at least none that didn't have more pressing tasks. Thing 1, a CGCV, is backing up 3rd Platoon, and 1st Platoon has the whole BEB behind them, not to mention every other vehicle organic to their company, leaving 2nd Platoon with scraps.

But Lieutenant Gonzales is confident. He'd been right there with the combat engineers, just hours ago, inspecting the report on the berm, engineering recon collected by the Sharp Eagle and Blackbird's Autonomous Route Reconnaissance and Kill mode. The intel collection had cost them some half-dozen birds, downed by Russian cUAS jammers, automated turrets, and nets, but

[16] BEB = brigade engineer battalion.

it was well worth it. Urban warfare was unknown warfare, a battle against uncertainty, and those drones poked a lot of holes in the enemy's citywide defilade. The fist-sized drones flew down city streets like blood through veins, propelled down every crack and crevice with the vigor of a pounding heart, extracting EO and sound bites in a constant stream up to their satellites and back again. That data deluge (and whatever other fountains of knowledge poured out of the sensor tap) fed into dozens of AI apps at their disposal, including Jack Breacher, as he'd heard the engineers call it, though the logo in the left-hand corner just said "Breacher" in some mutated strain of Impact font.

Time is short for platoons to plan, a third of a third of whatever little time they'd started with. So, for three minutes, as his platoon sergeant, Eakins, shooed their guys into their gear, Lieutenant Gonzales sat with the engineers doing the esteemed job of relaying administration personal identification numbers and codes so the engineers could pull his platoon's information into Jack Breacher's smoking gun of a database, right alongside the sensor feeds from route reconnaissance sensors. Everything was so connected these days, Gonzales assumed that Breacher talked with all their databases, everything from DEDS to PACT, more aware of the enemy's past and current movements and TTPs than any one person could ever be.

One engineer with fingers galloping like a stallion whipped the question into the keyboard: "Given these capabilities, what is the best way to breach the obstacle?"

The system replied:

"The obstacle in the pathway of 2nd Platoon's planned route is a berm. This berm is composed of soil and grass. There are no other substances detected within the berm. In this instance, bypassing the obstacle will not meet the commander's intent. This obstacle must be breached. Given 2nd Platoon's combat power, the best way to breach this obstacle is to use a plow attachment on Alpha Company's CGCV. Upon approach, the CGCV can provide a smoke cover for a team, who can then provide cover for the CGCV while it completes its task of clearing a portion of the berm. This breaching tactic will be quick and will not require the use of any explosives or additional personnel, thereby maintaining combat power. Would you like to explore more breaching options?"

The engineers looked to him. Behind him, a familiar spike of nervous laughter went off like a flare. His decision was instant. "Looks sound to me. Where's the plow?"

The attachment was as heavy as it looked. It was designed for mines, so moving dirt will be a stroll in the park. Thing 2, the CGCV directly supporting them for this mission, wears it proudly but awkwardly, like an elaborate dress on a debutante. Bright afternoon sunlight bounces off it in a powerful beam, a beacon heading their formation as they approach the bend in the street.

Beneath him, Gonzales feels the Humvee begin to move. First squad signals it forward with the wave of their hand, the vehicle's cameras interpreting their movement. He can see them through the Humvee's camera, one of several video feeds currently displayed on his Augmented Reality Integrated Display (ARID).

“Sir.” Eakins, seated next to him in the back of the Humvee, nods at his display. “Dragonfly found something.”

Position and movement noted, Gonzales directs his attention back to the Dragonfly’s feed.

The new notification appears: The Dragonfly is fixated on a spot on the ground, where a handful of felled Blackbirds lie motionless, waiting for his say-so on what to do next, as it’s meant to do when conducting scouting missions. With the Dragonfly’s superior fidelity, he can make out the slight gouges on their matte plastic bodies where they hit the ground, probably after power jammers took them out. The Dragonfly keeps its distance, even though it’s more robust against cUAS than the birds, which are designed to be cheap and attritable. Ten years ago, a single bird would have cost tens of thousands. Now they’re only a fraction of that; the company could lose hundreds of them without feeling a dent in their pockets.

Gonzales dismisses the notification and instructs the Dragonfly to finish its mission. In no time it reconfirms what the early Sharp Eagle recon had already confirmed: There’s nothing waiting for them behind the berm. The street behind it is clear; no people or bots are tucked behind the berm. No heat signatures detected in the surrounding buildings either. Not one thing to suppress. Briefly, Gonzales wonders what purpose a soft, undefended barrier like this is meant to serve, but the plan and materials are in place. Breacher would have accounted for that anyway. Doubt won’t serve him now.

The infantry brigade combat team was deployed to approach Cathedral Square from the west, through winding streets more appropriate for light infantry than the heavy wheels of armored vehicles. With drones conducting constant intelligence, surveillance, and reconnaissance (ISR) and the CGCVs taking first fire, 2nd Platoon was able to identify and disable booby traps, avoid pockets of lingering civilians, and take down hostile drones and bots that met their end at the end of Thing 2’s automated turret.

The trek through the streets of Vilnius had been uniquely harrowing: The persistent buzz of drones, shouts, and explosions of their fellow companies was dulled by distance; the acrid air, thick with smoke and debris, caught in their throats, weighed down by packed vests and the heavy AR headsets on their crowns. All before they even arrived at the hotel.

Lieutenant Gonzales nods to Eakins. “Rein it in,” he says. Eakins pulls out a tablet strapped to his side and brings up the controls for the Dragonfly, dismissing it from its scouting mission and letting it wander, its autonomy its own.

The whole squad needs to be focused on getting down the last few streets in one piece. Controlling drones to any degree would only be distracting now.

He messages Specialist Lauchert to ready his team. At NTC, Lauchert’s team, armed with rifles, grenades, and cUAS jammers, had adopted the role of last line of defense for their robot assistants.

Immediately, Gonzales gets a response back in the form of a message in green text in his peripherals reading “Affirmative.” Lauchert stands behind Thing 2, the privates lined up in a neat row behind him, the shadow of the machine covering them like a protective mother duck.

Thing 2 leads the way around the turn.

Lieutenant Gonzales watches it happen through three perspectives: the discerning eyes of the Dragonfly, the flickering cameras of the Blackbirds, and the feed directly from Lauchert's ARID.

Thing 2 peeks out from around the corner, a glint off the plow. No shots are fired, so it snakes around the corner, keeping close to the wall. A plume of smoke exudes over it, draping the street behind it in a veil of opaque gray.

On Specialist Lauchert's feed, dense smoke is rendered negligent by a short-wavelength infrared filter. His field of vision is further augmented by Thing 2 erasing itself from his view: Thing 2's front-facing camera feed seamlessly embeds itself into Lauchert's heads-up display (HUD), illuminating the battlefield in front of him.

The approach is slow. The team sticks to the wall, obscured in a thick smokescreen, not even the tips of their rifles poking through. Gonzales's heart beats in his throat. He always thought that the phrase "calm before the storm" was a misnomer—there was never any calm; his heart took off thundering the moment he touched down in Lithuania, electric from thrill and nerves, though he was careful not to let the latter show. He steels his face now, even as he keeps an ear out, prepared for the worst scenario even though Breacher thought it unlikely.

Twenty feet away, the team comes to a halt, ready to defend Thing 2 from a distance. The smokescreen holds, for now.

Thing 2 approaches. The birds hang in the sky above it, watching.

Ten feet away, then five, then two—

The plow, a metallic weapon in its own right, lowers itself to the ground. The whir of its internal motors as it supports the metal hunk shrills so loudly that Lieutenant Gonzales can hear it from a block away.

A pause, shorter than an inhale, and then—

A rainbow of lights burst like fireworks. Before he can read and disentangle all the warnings, Lieutenant Gonzales swipes his hand in front of his face, dismissing the graphics. He holds a hand to over the headphone covering his ear. "Pull up the Dragonfly feed," he tells his ARID.

A new screen fills the left half of his vision: Smoke and detritus fly through the air as the Dragonfly seeks to escape the debris.

Eakins shouts at him, "What just—"

This time Gonzales sees it: A rocket-propelled grenade (RPG) zips though the air for a split second before Thing 2's second autonomous turret blasts it to pieces. Through his other ear he hears the sudden crack of the impact. "Lauchert, get back—"

His radio sings. "We are authorizing the mortar platoon to assist."

Two more RPGs stream toward Thing 2, prompting its turret to fire again. Both RPGs are rendered limp, chunks of their flaming cartilage scattered over the soil berm. The counter-RPG munitions that Thing 2 carries are large and expensive, and it can only carry five at once. The resupply point is just ahead—but they have to make it there first.

Lauchert and his team come stumbling around the corner, taking cover from the chaos happening a street over.

His men out of the immediate line of fire, Lieutenant Gonzales watches the feed where the robots battle it out; it happens nearly too fast for him decipher. An alarm for an incoming drone blinks on his HUD. The enemy drone, a bulky octocopter, flies across the aerial map on his HUD, its trajectory following a fifth RPG that barrels across the screen. Thing 2's munition slams into the RPG, another smoke cloud obscuring Thing 2's view of the sky, where the enemy drone approaches. A flock of birds flies toward the enemy drone, cued by Thing 2's distress signal, attempting sabotage, but they're slow and small, and Lauchert's team with their drone jammers and net are even slower. In an instant, the enemy drone swoops down over Thing 2. Its payload, a big, black mass of something, drops directly onto Thing 2, exploding in a deafening boom.

The enemy drone shoots out of the building overhead. The moment it emerges from cover, its rotors halt in place and it falls from the sky, downed by Lauchert's team's cUAS. A blade snaps off as the drone lands with a crack on the street next to them.

Beyond them, a few blocks down where the RPGs originated, the deep crack of a crumbling building thrums through the earth: The mortar team had done its job.

Before there's imagery confirming the hit, warnings in critical crimson flash across the screen. All of Thing 2's internal sensors are offline, its maintenance condition catastrophic.

Thing 2 is as good as dead.

--

Gonzales has always had a talent for keeping calm in a crisis, and through training and experience over the course of his enlistment, he has been forced to sharpen that skill into an exacting blade. With it, he scoops all of the tumultuous, useless emotions he's feeling into a sandbox, tightly closing the door on any connection to his conscious mind.

In the aftermath of the loss of Thing 2, Captain Bradshaw puts 2nd Platoon on a new route, one created by RAR mere moments after Thing 2 met its end. The route writes itself in red across his HUD, and his platoon moves forward. Gonzales regroups his men, altering their formation for the trek they'll make to the resupply point, only their rifles to defend them, the mortar platoon to watch their backs, and the eyes of the remaining sensors to guide them.

Bots before blood. Now that Thing 2 is a smoldering hunk of metal, it's time for blood.

As 2nd Platoon approaches from the other street, a green identification flickers on the Dragonfly's feed. Within it, the glint of a miniscule camera peeks through the sliver between the drapes of a window just across from the steaming carcass of Thing 2 and above the handful of downed birds.

A feeling leaks out of Gonzales's carefully curated sandbox: the sickening nausea of hindsight. Only now, after everything, does it click. The clues were all there: a berm so simple to breach, the birds downed in one spot, the ease with which they arrived at that point, as if they

were meant to get there. The purpose of the barrier was to take out Thing 2, and that purpose was fulfilled. And it nearly cost his platoon's blood.

Without Thing 2, their approach will be slow, which will screw with the rhythm of this battle, and they are down a powerful ally that would have been an immense aid during the hotel breach. A flicker of rage that the Breacher program didn't foresee this strikes him, so powerful he feels his face heating from it.

Gonzales tucks that emotion inside the sandbox, alongside the other emotions that won't serve him now. Because right now, he has one mission, and that's to move forward.

Lieutenant Gonzales buttons the sandbox up tight and leads his platoon toward the hotel.

Part 3: Andante—Allegro

Hunched over three different displays in the back of a Humvee, four blocks from the Grand Hotel Kempinski, Systems Operator Bennett conducts an orchestra. Like any conductor of skilled musicians, she guides, rather than commands, keeping a steady beat and only stepping in when strategy demands. Two CGCVs lie in wait behind strategic corners, a third left behind after losing the beat. Fifty-six Blackbirds remain to flap about the hotel's exterior. A half-dozen bulky Payload-Bearing Unmanned Autonomous Vehicles (PBUAVs) rest nearby after making the long trek from base camp to the resupply point. Three Sharp Eagles circle high above, equally devoted to capturing ground imagery and to avoiding the cUAS emanating from the Grand Hotel Kempinski. For now, she lets them fly free to conduct ISR as they see fit and provide cover when necessary. Their notes fill the scores on the screens around her, covering each wall of the Humvee: COP on one, status feeds from various sensors scattered across the second displaying fuel levels and maintenance states, and a complex analytics dashboard on the other.

Something isn't right.

The DEDS window displays a 3D plot of the hotel, constructed days ago by feeding floorplans into an AI application programming interface that spoke Blender. It rotates slowly in the center right of the screen. The filter is set to IR, illuminating dozens of bright orange blobs scattered throughout the hotel. No, not dozens—hundreds, hundreds of human-shaped blobs lined up as neat as pieces on a checkerboard. A deception, surely.

The XO, Lieutenant Whiskey, elbows her. He's sitting beside her, double-checking the ARCS reports on his tablet. "What're you playing to today?" he asks.

"Shostakovich, symphony number ten, fourth movement," she says. "Haunting and dissonant during the first half . . . " and explosive in the second half. She'd played the trumpet through high school, had even thought about becoming a real musician. Maybe join Pershing's Own. But few people paid for real musicians anymore—machines were just as good, and cheaper. So, she had learned machines instead.

"Shostakovich? You can pronounce his name but not mine?" Whiskey says. She's almost surprised that he'd totally missed the opportunity to mock her for naming a Soviet composer on

this of all missions, but then she remembers Whiskey prefers classic pop: Beyoncé, Taylor Swift, Drake, and the like.

Bennett pulls up the controls for the Blackbirds and selects a soloist. Assuming remote control and relying on the bot's obstacle-avoidance programming to avoid its own destruction, she leads it around the building, observing the windows. "I can pronounce both your names. I just choose not to say yours," she says.

Whiskey laughs. "Rude."

There are other ways to estimate an enemy's movement inside a building when thermal readings are compromised. She searches for shattered windows. Small units stationed throughout the hotel to make holes in the windows to shoot through—and, sure enough, she finds them. In fact, every single window she sees is meticulously shattered through the bottom left corner. Tiny holes, no larger than two inches across. Can't see beyond them, either. The only thing visible through the windowpanes are wine-colored drapes or blackout paint.

On the Blackbirds' chat interface, she types, "Check all windows on the Grand Hotel Kempinski for shattering. If all windows are shattered, reply AFFIRMATIVE."

The task is distributed between the birds. She gets a response moments later. "AFFIRMATIVE."

"Whiskey," she says.

"Your instruments out of tune?"

She rolls her eyes. "Shut it. I'm serious—I can't see inside."

Bennett explains the problem to Whiskey. At this news, he cringes. "Can't you send a few birds inside?" he asks.

She watches as the bird-count ticker ticks down two points. "Maybe. They're too big to fit through the holes as they are, though. We'd need to find a way to make the holes bigger without tipping off anyone inside. And Kravitz will kill me if I take away his precious birds. Gonzales isn't even here yet, he needs them. And—"

"Jeez, I get it, I get it."

Another blast goes off. Absorbed in her screens, hunkered within the protected hull of the Humvee, she could almost forget she's in the middle of a battle.

Captain Bradshaw calls for Lieutenant Whiskey. As he scoots out of the seat, he says, "Figure it out quick, Bennett. 2nd Platoon's almost here; we're breaching the moment they arrive. We need to know what we're up against." With that, he leaps out of the Humvee.

Bright light floods inside as Whiskey exits, the glare momentarily blinding Bennett's screens. In the sliver of outside, she sees dozens of soldiers hurrying around chunks of concrete and drone husks, like a cloud of rubble had rained debris over the city. Drones will enter the hotel first, but people will follow them if needed.

She checks the COP—2nd Platoon is nearly here. She has a few minutes, tops. If she doesn't figure this out, their platoons will continue to take fire until she does, or they'll go into the hotel blind.

Screw this—Bennett can't think straight, so she'll rely on her orchestra to think for her.

On the screen to her left, she opens a new window for the application Devil's Advocate. It's a simple chat interface. She types her problem into it.

A response is generated quickly. The suggestion is so basic she feels stupid for not thinking of it immediately.

She pulls up her radio. Captain Bradshaw may be just outside, but she can't look away from her orchestra, not in the middle of this movement. "Captain Bradshaw, requesting permission to deploy DAGRs for greater visibility inside the hotel. Over."[17]

"Denied. Why on God's green earth would we use those antiquated things?"

"Sir—"

"Whiskey already explained. Don't tell me there isn't another way, Bennett. Why can't you just write an algo to root out the dirty data?"

Bennett does not have the time or patience to explain that, no, they cannot write an algorithm to detect false targets, because they'd need data on which targets are false. Which they obviously don't have. Instead, she says, "Not my idea, sir. This is Devil's Advocate's suggestion. Over."

For a moment, nothing. She's not sure what Bradshaw's problem with her is, but he's always trusted in AI more than her, and Bennett was never one to turn down another tool in her belt, even if she shouldn't have to need it.

Finally, the company commander responds. "Fine. Do it. Over."

Before she radios 3rd Platoon to notify them to outfit the cargo UAVs with the DAGRs stocked in their CGCV's belly, just for a single breath between notes, Bennett basks in the small victory.

Part 4: Patch 029 DAGR-Miniature v3.1

Securing the lobby had taken every infantry man and bot in the company. Things 1 and 3 led the charge with heavy metal plows that smashed the feeble barrier of upturned velvet chairs and polished oak tables like breadsticks. Hordes of sUASs dropped from spider holes punched through the milk-smooth ceiling, shattering themselves against the soldiers' helmets while bullets showered through after them. They left behind chandeliers with shattered lanterns, marble tiles scarred with skid marks, two squads of injured compatriots waiting for the casualty evacuation assets to arrive, thick white columns pocked with bullet holes. A layer of smoking casings. And a whole lot of bullets.

Focus, Specialist Tyler tells himself, pressing against the quilted wall of the hallway. He just needs to get his team through the next hour. He wills his heart to stop beating so fast, shakes his muscles out to shrug off the residual thrill from the scuffle in the lobby. A deep-rooted tremble remains.

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[17] DAGRs = Durable Autonomous Ground Robots.

Tyler's team's task is, in the grand scheme of operation to retake Cathedral Square, small: Clear the third floor of the southern wing. It will be just like the exercises at NTC, only extended through . . . 20-some rooms.

The obvious difference is that those exercises didn't have real enemies with real ammo who really wanted to kill them, and pre-infiltration recon by the DAGRs sensed a handful of them set up somewhere around there. Snipers, three of them.

That is, if its sensors were to be believed. If. *If* with emphasis.

Tyler has no idea why they're using those decrepit things. DAGRs—these ones miniature, shorter in length than a finger, fitted with EO, LIDAR, and a microphone—had failed him and his team before when they needed them most. Mair, Schachner, and Barton, he's been with them through thick and thin, grueling runs that turned your gut into a Celtic knot, long hours cleaning their rifles, and that was before their deployment to Daugavpils. But what he wouldn't give to have Liu with him right now. Tyler imagines where his friend is right now: probably asleep in a hospital bed, on the other side of the globe, awaiting prep for his third surgery. If Tyler makes it out of this, and if his request for time off is approved, Liu's his first stop. Tyler had promised he'd toast to Liu's 21st birthday—like hell he'll miss it.

"Ty."

He jumps at the sound of his teammate's voice. "Schachner."

She gestures to his ARID. "What're you seeing?"

The notification from the DAGR's recon run down the hallway was in. Tyler gestures in front of his face, pulling up the report on his HUD with the flick of his hand. "Three unique breath prints picked up in the last room on the right," he relays to his team.

Specialist Tyler knows he should be delegating this to Mair. His focus should be leading the team. But he can't help but grasp at any sense of control at his disposal.

"That's all?" Barton whispers harshly.

Mair shakes his head. "Doesn't feel right."

"It's what it says," Schachner says.

"And we're supposed to trust what it says?" Tyler feels a dormant rage sneak into his tone. He clears his throat, as if that will fix the problem. "It's missed breath prints before. You know that."

Schachner frowns. "Elessar Labs updated that algo."

Tyler feels his lip curl, poised to retort something like, "That doesn't make a difference," but Tyler didn't even know there was a system patch.

Maybe the DAGR is right; maybe there are only three snipers at the end of the hall, and they should get there as quickly as they can to take them out. But maybe there are more of them in that room and his team is walking into an ambush. Maybe there are more Russians in the rooms in the middle of the hall who've learned how to breathe so softly the DAGR can't pick it up. Tyler can see it so clearly: Mair in the lead, stalking down the hallway with the elegance and

deadliness of a tiger, ripped apart by bullets tearing through a door of a room they thought was empty.

"We can't rely on it," he says in as steady a tone as he can manage. "We're mouse-holing."

"Where?"

Tyler points at the end of the hallway, where the snipers are supposedly lying in wait. "The whole way down."

--

Halfway down the hallway, Tyler begins to regret his decision.

Behind them, a neat row of perfectly round holes, almost comical, like a cartoon bowling ball thrown straight through the walls. Before each breach, Tyler's heart jumps into his throat, sure that this time there'll be someone there lying in wait, and this time he'll be prepared to shoot first. But each and every room has been empty.

The cycle begins again. Mair pulls another explosive line from his fatigues. He waves it at Tyler. Tyler knows what he's conveying, because his ARID already notified him of his team's supply levels: They're going to run out of lines soon. Mair gives him one more look and, with Barton watching his back, sets up the device.

Not 30 seconds later, Mair shoos them back. They line up perpendicular to the door, a few meters away to avoid the blast: Mair at the front, Barton behind him, then Schachner, and Tyler in the back.

BAM!

Smoke shrouds the room in a thick plume. Mair heads inside, rifle raised. Barton follows right behind him, Schachner third. The first three haven't fired yet after entering the room, so when Tyler follows them inside, he holds his shot.

This room looks like all the others. A big bed in the middle of it; expensive white sheets and a wine-colored duvet with a lacquered wooden backboard; two squat, red velvet armchairs with a dark wood side table between them. He jumps as a pinch of pain zings through his thigh. He'd just bumped into the heavy granite desk, like an idiot, used to the leeway of training in virtual reality with virtual desks. There is a wide TV mounted to the wall, a TV stand that matches the wood of the side table and headboard. To his right, Schachner opens the closet, which is empty, aside from a few hangers and an ironing board.

Mair, positioned in the left-hand corner, moves along the wall and round the corner, pointed at the other side of the bed, the one blind spot in the room. That must be where they're hiding—Tyler holds his breath.

But Mair doesn't fire.

After a moment, he lowers his rifle. "Clear," Mair says.

There are no snipers in this room, no one at all.

Tyler checks the DAGR's feed again. He checks his team's supply levels—they're low on lines, unsurprisingly, but when they run out of lines they can use grenades.

Right then, his radio buzzes to life. "What the hell are you doing, soldier? — "

The line goes dead. Immediately, their rifles are up. They're being jammed.

"Cover me," he nods at Schachner. On his HUD, he pulls up the feed from the DAGR—it's dead, too. He tries to access its past data. No luck—it was uploading to their satellite before the satellite beamed its data back to them. And they can't access the satellite. "I'm switching to another frequency," Specialist Tyler says, failing to mask the tremble in his voice.

"Ty, behind—"

BLAM!

All the feeds on his ARID drop, leaving his vision clear. BLAM! Tyler ducks down toward the wall, tucks himself low against the bed. Mair crouches next to him, pops up, and shoots. Then Tyler sees them: the snipers, or their guns, at least, peeking through the mouse-holes he'd so helpfully created for them.

God, isn't he the biggest idiot in the world. DAGR had been right after all: three snipers, holed up at the end of the hall. Or at least they *were* at the end of the hall, right up until Tyler created a better point of entry for them. The snipers must have snuck through the main hallway, the loud blasts from the explosive lines no doubt creating the perfect cover for them to sneak along the other side of the wall, right past Tyler's team, completely undetected.

"Ty," Mair says. He envies how calm Mair sounds, after he'd gotten them into this mess. "What's the plan?"

Specialist Tyler hangs onto his voice, the press of his pack against Mair's arm. Without connection, enemies shooting at them, he feels like prey, helplessness and fear choking him. At this rate, he might get to visit Liu sooner than he'd planned.

Chapter 4. Conclusion

The development of the narratives revealed multiple themes that we analyzed through an anthropological method of pile sorting.[18] In this process, our research team members (a different group than the ones who wrote the narratives) reviewed the narratives and identified key observations or themes from the text. These observations or themes were then written down on slips of paper; themes that were most like each other were sorted into piles. Our team examined each pile and described the overarching theme of each. Six themes were evident and are described below.

The Army Hopes That Human-Machine Integration Will Reduce Risk and Improve Awareness

The most prominent theme in our exploration was in understanding that there are three main benefits the Army sees in the integration of humans and machines. The first benefit is that machines can reduce risk to soldiers by taking on some tasks that are dangerous for humans to do on the battlefield. Many of those tasks need to be conducted while under fire—casualty evacuation, for example. The task can be accomplished with less risk to the force overall and may also free human soldiers to take on other tasks.

A second benefit is in increasing human awareness and aiding in deliberate decisionmaking on staffs and in tactical operations centers (TOCs). Here, AI-enabled ISR platforms allow for more-proliferated and finer-grained situational awareness on the battlefield. In the TOC, AI applications help fuse data into a more complete and coherent COP to aid staffs and the commanders they serve in making decisions. The Army envisions that these machines will aid in planning and might actually be necessary to keep up with the speed of operations in the future. An important distinction of this type of benefit is that decisions are still left up to humans; the machines merely present information to assist.

Finally, the Army also sees benefits in using machines to increase awareness and aid human decisionmaking for operators on the leading edge of the battlefield. Experience that is often gained through painful firsthand experience could be replicated through the use of AI-enabled decision aids for small unit leaders faced with discrete tactical problems during the course of operations.

[18] Hung-Wen Yeh, Byron J. Gajewski, David G. Perdue, Angel Cully, Lance Cully, K. Allen Greiner, Won S. Choi, and Christine Makosy Daley, "Sorting It Out: Pile Sorting as a Mixed Methodology for Exploring Barriers to Cancer Screening," *Quality & Quantity: International Journal of Methodology*, Vol. 48, September 2014.

Human-Machine Integration Will Take Several Forms

Literature is dominated by three types of systems that will instantiate human-machine integration: AI applications that support deliberate decisionmaking, applications that will support tactical decisionmaking, and machines that work with humans on the battlefield. We examined a range of sources, including Army documents, leader statements, trade press, and examples provided by the sponsor, to synthesize a list of machines and applications; Table 4.1 describes the ones used in the vignettes.

Table 4.1. Autonomous Machines and AI Applications Considered in Vignettes

Warfighting Functions	Type	Full Name	Description
Intelligence	AI application	Depiction of Enemy Disposition and Strength (DEDS)	This AI tool provides a predictive representation of enemy positions and capabilities based on several inputs: enemy doctrine, terrain analysis, sensor data (infrared, thermal, EO, audio), and contact reports from units.
Mission command, intelligence	AI application	Decision Support Tool	This is an AI-enabled application that takes in information from DEDS, runs simulations on potential courses of action (COAs), and uses the results to suggest COAs to commanders.
Mission command, intelligence, protection	AI application	Improved Small Unit Common Operational Picture (ISCOP)	This is a suite of visual tools incorporated among multiple displays: screens within the unit's vehicles, on soldiers' goggles, and/or on forearm tablets. Various overlays can be incorporated to visualize terrain, friendly and enemy positions, movement and capability, routes, fires planning, control measures, battlespace geometries, etc.
Mission command	AI application	Automated Report Consolidation System (ARCS)	This AI tool is like a large language model—it takes contact reports, situation reports, or other forms of reports from lower echelons and combines them into a report for the receiving unit to transmit to higher-ups.
Movement and maneuver, mission command	AI application	Automated Precision Deconfliction Tool (APDT)	This is a suite of tools that automates deconfliction of UASs to avoid collisions. It is an AI application that maps the environment using sensor data from UASs, then deploys an algorithm that instantly identifies and selects routes for each UAS to follow.

Warfighting Functions	Type	Full Name	Description
Movement and maneuver, intelligence, protection	AI application	Red Teaming of Operations Orders (RTO2)	This AI-enabled model and simulation tool, available at the company level, would run simulations of a company's scheme of maneuver against a range of enemy courses of action and offer suggested refinements based on the commander's desired end state.
Movement and maneuver, intelligence, sustainment, protection	AI application	Route Analysis and Reconnaissance (RAR)	This AI-enabled route-planning tool takes routes of movement from an operations order and draws from available sources of information to analyze route conditions for route trafficability. The tool identifies and/or recommends alternate routes to meet stated end objectives—e.g., "Get to X location within four hours." The tool can also analyze known/suspected enemy positions, weapon capabilities, and doctrine to represent the likelihood of threats from weapons or nonkinetic effects. The tool presents this information to a commander via display.
Movement and maneuver	AI application	Breacher (colloquially known as "Jack Breacher")	This AI system is designed to recommend breaching techniques given a scenario. It networks with other AI applications (RAR, PACT, and DEDS) but is poorly designed.
Protection, movement and maneuver, intelligence	AI application	Autonomous Counter Air Tool (ACAT)	This small EO/IR sensor on all vehicles autonomously senses for UAS threats, orient-and-employ EW, and directed energy weapons. These sensors are networked within a unit, are able to share threat information automatically, and deconflict targeting either autonomously or in response to an order. These systems can also engage air threats without human approval.
Sustainment	AI application	Projected Ammunition Consumption Tool (PACT)	This AI-enabled tool assists in sustainment planning. It takes mission timelines as given in an operations order and determines the amount of ammunition needed, down to the fire team and single-crew-served weapons levels. The tool provides recommendations to the command team for ammunition supply requests and how to distribute ammunition.

Warfighting Functions	Type	Full Name	Description
Sustainment	AI application	Rapid Support Tool (RST)	This AI tool is available at the company level, identifies battalion- and brigade-level assets that could be useful to support a mission, and automatically links commanders and controlling units across units to rapidly establish new support relationships.
Mission command, movement and maneuver	Other	Augmented Reality Integrated Display (ARID)	These augmented reality goggles, similar to the Integrated Visual Augmentation System, display overlays of different AI applications to the user.
Intelligence, movement and maneuver, protection	UAS	Group 1 UAS	Group 1 UASs are organic to the company level (we allocated 90 total systems to the armored company in the movement to contact scenario). They are unarmed but have EO/IR and thermal sensors. These UASs can be networked with one another and with other systems at higher echelons to conduct reconnaissance, providing targeting data.
Intelligence, movement and maneuver, protection	UAS	Group 2 UAS	Group 2 UASs are organic to a battalion. The characteristics are similar to existing group 2 UASs in use but with more capable sensors and swarming ability.
Sustainment	Uncrewed ground vehicle	Payload-Bearing Unmanned Autonomous Vehicle (PBUAV)	These are large UAVs designed to carry a payload. They are used for resupply.
Intelligence, movement and maneuver, protection	Uncrewed ground vehicle	Durable Autonomous Ground Robot (DAGR)	These are small ground vehicles that are capable of being thrown with EO and LIDAR sensors.
Movement and maneuver	Uncrewed ground vehicle	Optionally Manned Fighting Vehicle (XM-30)	This is a future version of the XM-30 (previously called the optionally manned fighting vehicle), which is currently under development. This system fulfills the enduring role of an infantry fighting vehicle, providing transportation and fire support for dismounted infantry.

Warfighting Functions	Type	Full Name	Description
Movement and maneuver, intelligence, sustainment	Uncrewed ground vehicle	Company Ground Combat Vehicle (CGCV)	These are tracked vehicles with a modular design that allows them to be tailored to a variety of different roles, including logistics, reconnaissance, hazard clearance, direct fire, and air defense. They are autonomous, with the ability to connect to and receive tasking from the units' manned vehicles.

The Army's Main Concern Is Around Cognitive Burden and Trust

The benefits of human-machine integration do not come without challenges. We identified two main challenges that the Army perceives as it considers the integration of humans and machines for operations across all types of human-machine integration. The first challenge is that integration comes with a degree of cognitive burden. This burden might land on a staff officer in a TOC trying to understand why an algorithm is recommending a particular course of action. It might also instantiate itself on the battlefield with a small unit leader trying to manage a balky autonomous system while leading his or her unit. In any case, there is a concern that the machine will require an inordinate amount of attention from the human, making it a liability more than a benefit.

The second main challenge the Army is concerned about is trusting the machine to perform as expected more generally. Trust might potentially be eroded by the machine failing under adverse conditions posed by the enemy (e.g., communications-denied or -degraded environments that hinder machines that require connectivity) or hallucinating an obviously incorrect tactical choice. It might also be that working with the machine will require the human to calibrate his or her trust in the machine's behaviors such that the human is not unduly surprised during operations. Finally, there is a general concern that the machine might behave or come to a decision in a way that is not easily explainable, not intuitively correct, or some combination of both.

The Predominant Mitigation Is to Make AI Work Better for the Army Through Human-Centered Design and Explainability

To mitigate some of the challenges noted above, the Army has predominantly focused on changing the machine to work better with the human. The current thinking is to design machines and algorithms around the soldier. This might be accomplished by making algorithmic decisions explainable to the soldier. It might be to make the interface and outputs look and feel more like interfaces and outputs that soldiers are used to interacting with. Another mitigation the Army is considering is making the level of autonomy adjustable such that the human can modify it to fit

the level of risk tolerance that he or she is comfortable with in a given situation. In any case, the general thrust of these mitigations is to seek design solutions in the algorithm or machine itself.

Less Attention Is Paid to Redesigning the Army for AI

Conversely, our exploration of the narratives also revealed a less dominant theme of making the humans work better with the machine. This is usually explored through changes in formations that happen over time, as has been the case when the Army transitioned to mechanized forces or introduced helicopters for vertical lift. For instance, the inclusion of a human who tends to the machines in small units was a commonly discussed idea. Finally, there is also the recognition that experimentation and iteration will be essential to creating optimal human-machine integration. This will require more changes to the way the Army develops, acquires, and sustains machines such that it facilitates iteration and experimentation in a more fluid way across different institutional and tactical echelons.

War Is Fundamentally Human

Finally, we consider one last theme: War is an inescapably human endeavor. Aside from the fact that DoD policy emphasizes the role of human control over autonomous systems, the role of humans is clearly evident in our analysis of the narratives.[19] Planning and executing combat operations without humans as the predominant actors renders these operations meaningless; without humans in decisive roles, the links between the strategic and geopolitical purposes of combat are severed, and the foundation of the Army's doctrine and understanding of its strategic roles dissolves.[20]

[19] DoD policy states that "autonomous and semi-autonomous weapon systems will be designed to allow commanders and operators to exercise appropriate levels of human judgment over the use of force." See Office of the Under Secretary of Defense for Policy, Department of Defense Directive 3000.09, *Autonomy in Weapon Systems*, January 25, 2023.

[20] For a foundational view of the Army's role in war, see Headquarters, Department of the Army, Army Doctrinal Publication 1, *The Army*, July 2019.

Abbreviations

ACAT	Autonomous Counter Air Tool
AI	artificial intelligence
APDT	Automated Precision Deconfliction Tool
ARCS	Automated Report Consolidation System
ARID	Augmented Reality Integrated Display
ATGM	anti-tank guided missile
ATR	automatic target recognition
BEB	brigade engineer battalion
CA	Civil Affairs
CAB	combined arms battalion
CGCV	Company Ground Combat Vehicle
CO	commanding officer
COP	common operational picture
cUAS	counter–unmanned aerial system
DAGR	Durable Autonomous Ground Robot
DEDS	Depiction of Enemy Disposition and Strength
DoD	U.S. Department of Defense
EO	electro-optical
EO/IR	electro-optical/infrared
EW	electronic warfare
HUD	heads-up display
ISCOP	Improved Small Unit Common Operational Picture
ISR	intelligence, surveillance, and reconnaissance
LIDAR	light detection and ranging
NATO	North Atlantic Treaty Organization
NTC	National Training Center
PACT	Projected Ammunition Consumption Tool
PMESII-PT	political, military, economic, social, information, infrastructure, physical environment, and time
RAR	Route Analysis and Reconnaissance
RF	radio frequency
RPG	rocket-propelled grenade
RST	Rapid Support Tool
RTO2	Red Teaming of Operations Orders
sUAS	small unmanned aerial system

TOC	tactical operations center
TTPs	tactics, techniques, and procedures
UAS	unmanned aerial system
UAV	unmanned aerial vehicle
UGV	unmanned ground vehicle
XO	executive officer

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Recent advances in artificial intelligence (AI), machine learning, and robotics have raised the possibility that the profession of arms will soon include integrating human soldiers with thinking machines as part of the collective whole. Machines and software applications enabled by AI are starting to demonstrate an ability to move autonomously through complex urban traffic and create startlingly human-like and interesting derivative works through large language models.

This does not mean, however, that such developments can be implemented in military settings smoothly. The practice of building cohesive small units is no easy endeavor. The best small units cohere to such an extent that one soldier recognizes the silhouette and gait of another in the dark of a patrol base in an instant. The best staffs internalize their commander's style and specific needs over time. Integrating humans and machines in military contexts will likely draw from civilian parallels, but it will also require substantial contextualization.

The authors investigated the kinds of difficulties the U.S. Army could encounter as it attempts to pair humans with AI algorithms to accomplish specific warfighting tasks and wrote fictional narratives to illustrate these potential difficulties. A companion report (*One Team, One Fight: Volume I, Insights on Human-Machine Integration for the U.S. Army*) contains recommendations for overcoming these obstacles.

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