In Ukraine, New American Technology Won the Day. Until It Was Overwhelmed.

Project Maven was meant to revolutionize modern warfare. But the conflict in Ukraine has underscored how difficult it is to get 21st-century data into 19th-century trenches.

Congress is about to provide billions more dollars to Kyiv, mostly in the form of ammunition and long-range artillery, but questions remain whether new artificial intelligence technology will be enough to help turn the tide of the war. Nicole Tung for The New York Times

By David E. Sanger
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The idea triggered a full-scale revolt on the Google campus.

Six years ago, the Silicon Valley giant signed a small, $9 million contract to put the skills of a few of its most innovative developers to the task of building an artificial intelligence tool that would help the military detect potential targets on the battlefield using drone footage.

Engineers and other Google employees argued that the company should have nothing to do with Project Maven, even if it was designed to help the military discern between civilians and militants.

The uproar forced the company to back out, but Project Maven didn't die — it just moved to other contractors. Now, it has grown into an ambitious experiment being tested on the front lines in Ukraine, forming a key component of the U.S. military's effort to funnel timely information to the soldiers fighting Russian invaders.

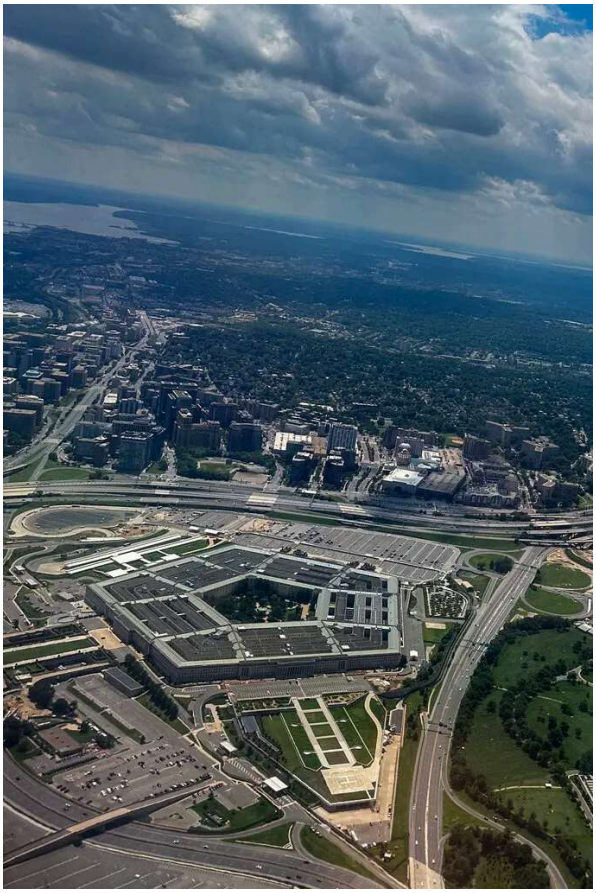
So far the results are mixed: Generals and commanders have a new way to put a full picture of Russia's movements and communications into one big, user-friendly picture, employing algorithms to predict where troops are moving and where attacks might happen.

But the American experience in Ukraine has underscored how difficult it is to get 21st-century data into 19th-century trenches. Even with Congress on the brink of providing tens of billions of dollars in aid to Kyiv, mostly in the form of ammunition and long-range artillery, the question remains whether the new technology will be enough to help turn the tide of the war at a moment when the Russians appear to have regained momentum.

'This Became Our Laboratory'

The war in Ukraine has, in the minds of many American officials, been a bonanza for the U.S. military, a testing ground for Project Maven and other rapidly evolving technologies. The American-made drones that were shipped into Ukraine last year were blown out of the sky with ease. And Pentagon officials now understand, in a way they never did before, that America's system of military satellites has to be built and set up entirely differently, with configurations that look more like Elon Musk's Starlink constellations of small satellites.

Meanwhile, American, British and Ukrainian officers, along with some of Silicon Valley's top military contractors, are exploring new ways of finding and exploiting Russian vulnerabilities, even while U.S. officials try to navigate legal restraints about how deeply they can become involved in targeting and killing Russian troops.



Project Maven quickly became the standout success among the Pentagon's many efforts to tiptoe into algorithmic warfare. Kenny Holston/The New York Times

"At the end of the day this became our laboratory," said Lt. Gen. Christopher T. Donahue, commander of the 18th Airborne Division, who is known as "the last man in Afghanistan" because he ran the evacuation of the airport in Kabul in August 2021, before resuming his work infusing the military with new technology.

And despite the early concerns at Google over participation in Project Maven, some of the industry's most prominent figures are at work on national security issues, underscoring how the United States is harnessing its competitive advantage in technology to maintain superiority over Russia and China in an era of renewed superpower rivalries.

Tellingly, those figures now include Eric Schmidt, who spent 16 years as Google's chief executive and is now drawing on lessons from Ukraine to develop a new generation of autonomous drones that could revolutionize warfare.

But if Russia's brutal assault on Ukraine has been a testing ground for the Pentagon's drive to embrace advanced technology, it has also been a bracing reminder of the limits of technology to turn the war.

Ukraine's ability to repel the invasion arguably hinges more on renewed deliveries of basic weapons and ammunition, especially artillery shells.

The first two years of the conflict have also shown that Russia is adapting, much more quickly than anticipated, to the technology that gave Ukraine an initial edge.

In the first year of the war, Russia barely used its electronic warfare capabilities. Today it has made full use of them, confusing the waves of drones the United States has helped provide. Even the fearsome HIMARS missiles that President Biden agonized over giving to Kyiv, which were supposed to make a huge difference on the battlefield, have been misdirected at times as the Russians learned how to interfere with guidance systems.

Not surprisingly, all these discoveries are pouring into a series of "lessons learned" studies, conducted at the Pentagon and NATO headquarters in Brussels, in case NATO troops ever find themselves in direct combat with President Vladimir V. Putin's forces. Among them is the discovery that when new technology meets the brutality of old-fashioned trench warfare, the results are rarely what Pentagon planners expected.

Starlink, the Elon Musk-provided mesh of satellites, was often the only thing connecting Ukrainian soldiers to headquarters, or to one another. Tyler Hicks/The New York Times

"For a while we thought this would be a cyberwar," Gen. Mark A. Milley, who retired last year as chairman of the Joint Chiefs of staff, said last summer. "Then we thought it was looking like an old-fashioned World War II tank war."

Then, he said, there were days when it seemed as though they were fighting World War I.

'The Pit'

More than a thousand miles west of Ukraine, deep inside an American base in the heart of Europe, is the intelligence-gathering center that has become the focal point of the effort to bring the allies and the new technology together to target Russian forces.

Visitors are discouraged in “the Pit,” as the center is known. American officials rarely discuss its existence, in part because of security concerns, but mostly because the operation raises questions about how deeply involved the United States is in the day-to-day business of finding and killing Russian troops.

The technology in use there evolved from Project Maven. But a version provided to Ukraine was designed in a way that does not rely on the input of the most sensitive American intelligence or advanced systems.

The goals have come a long way since the outcry at Google six years ago.

“In those early days, it was pretty simple,” said Lt. Gen. Jack Shanahan, who was the first director of the Pentagon’s Joint Artificial Intelligence Center. “It was as basic as you could get. Identifying vehicles, people, buildings, and then trying to work our way to something more sophisticated.”

Google’s exit, he said, may have slowed progress toward what the Pentagon now called “algorithmic warfare.” But “we just kept going.”

By the time the Ukraine war was brewing, Project Maven’s elements were being designed and built by nearly five dozen firms, from Virginia to California.

Yet there was one commercial company that proved most successful in putting it all together on what the Pentagon calls a “single pane of glass”: Palantir, a company co-founded in 2003 by Peter Thiel, the billionaire conservative-libertarian, and Alex Karp, its chief executive.

Palantir focuses on organizing, and visualizing, masses of data. But it has often found itself at the center of a swirling debate about when building a picture of the battlefield could contribute to overly automated decisions to kill.

Early versions of Project Maven, relying on Palantir’s technology, had been deployed by the U.S. government during the COVID-19 pandemic and the Kabul evacuation operation, to coordinate resources and track readiness. “We had this torrent of data but humans couldn’t process it all,” General Shanahan said.

From the start, the Ukrainians understood that to win, or even to stay in the game, they had to reinvent drone warfare. David Guttenfelder for The New York Times

Project Maven quickly became the standout success among the Pentagon's many efforts to tiptoe into algorithmic warfare, and soon incorporated feeds from nearly two dozen other Defense Department programs and commercial sources into an unprecedented common operating picture for the U.S. military.

But it had never been to war.

A Meeting on the Polish Border

Early one morning after the Russian invasion, a top American military official and one of Ukraine's most senior generals met on the Polish border to talk about a new technology that might help the Ukrainians repel the Russians.

The American had a computer tablet in his car, operating Project Maven through Palantir's software and connected to a Starlink terminal.

His tablet's display showed many of the same intelligence feeds that the operators in the Pit were seeing, including the movement of Russian armored units and the chatter among the Russian forces as they fumbled their way to Kyiv.

As the two men talked, it became evident that the Americans knew more about where Ukraine's own troops were than the Ukrainian general did. The Ukrainian was quite certain his forces had taken a city back from the Russians; the American intelligence suggested otherwise. When the American official suggested he call one of his field commanders, the Ukrainian general discovered that the American was right.

The Ukrainian was impressed — and angry. American forces should be fighting alongside the Ukrainians, he said.

"We can't do that," the American responded, explaining that Mr. Biden forbade it. What the United States can provide, he said, is an evolving picture of the battlefield.

Today a similar tension continues to play out inside the Pit, where each day a careful dance is underway. The military has taken seriously Mr. Biden's mandate that the United States should not directly target Russians. The president has said that Russia must not be allowed to win, but that the United States must also "avoid World War III."

So, the Americans point the Ukrainians in the right direction but stop short of giving them precise targeting data.

The Ukrainians quickly improved, and they built a sort of shadow Project Maven, using commercial satellite firms like Maxar and Planet Labs and data scraped from Twitter and Telegram channels.

Instagram shots, taken by Russians or nearby Ukrainians, often showed dug-in positions or camouflaged rocket launchers. Drone imagery soon became a crucial source of precise targeting data, as did geolocation data from Russian soldiers who did not have the discipline to turn off their cellphones.

This flow of information helped Ukraine target Russia's artillery. But the initial hope that the picture of the battlefield would flow to soldiers in the trenches, connected to phones or tablets, has never been realized, field commanders say.

One key to the system was Starlink, the Elon Musk-provided mesh of satellites, which was often the only thing connecting soldiers to headquarters, or to one another. That reinforced what was already becoming blindingly obvious: Starlink's network of 4,700 satellites proved nearly as good as — and sometimes better than — the United States' billion-dollar systems, one White House official said.

Dreams of Drone Fleets

For a while, it seemed as if this technological edge might allow Ukraine to push the Russians out of the country entirely.

In a suburb of Kyiv, Ukrainian high school students spent the summer of 2023 working in a long-neglected factory, soldering together Chinese-supplied components for small drones, which were then mounted onto carbon-fiber frames. The contraptions were light and cheap, costing about $350 each.

Soldiers on the front lines would then strap each one to a two-or-three pound explosive charge designed to immobilize an armored vehicle or kill the operators of a Russian artillery brigade. The drones were designed for what amounted to crewless kamikaze missions, intended for one-time use, like disposable razors.

Ukraine's ability to repel the invasion arguably hinges more on renewed deliveries of basic weapons and ammunition. Nicole Tung for The New York Times

The broken-down factory near Kyiv encapsulated all the complications and contradictions of the Ukraine war. From the start, the Ukrainians understood that to win, or even to stay in the game, they had to reinvent drone warfare. But they could barely keep enough parts coming in to sustain the effort.

The mission of remaking Ukraine's drone fleet has captivated Mr. Schmidt, the former chief executive of Google.

"Ukraine," he said in October, between trips to the country, "has become the laboratory in the world on drones." He described the sudden appearance of several hundred drone start-ups in Ukraine of "every conceivable kind."

But by the fall of 2023 he began to worry that Ukraine's innovative edge alone would not be enough. Russia's population was too big and too willing to sacrifice, oil prices remained high, China was still supplying the Russians with key technologies and parts — while they also sold to the Ukrainians.

And while Ukrainian pop-up factories churned out increasingly cheap drones, he feared they would quickly be outmatched.

So Mr. Schmidt began funding a different vision, one that is now, after the Ukraine experience, gaining adherents in the Pentagon: far more inexpensive, autonomous drones, which would launch in swarms and talk to each other even if they lost their connection to human operators on the ground. The idea is a generation of new weapons that would learn to evade Russian air defenses and reconfigure themselves if some drones in the swarm were shot down.

It is far from clear that the United States, accustomed to building exquisite, $10 million drones, can make the shift to disposable models. Or that it is ready to bring on the targeting questions that come with fleets driven by A.I.

"There's an awful lot of moral issues here," Mr. Schmidt acknowledged, noting that these systems would create another round of the long-running debates about targeting based on artificial intelligence, even as the Pentagon insists that it will maintain "appropriate levels of human judgment over the use of force."

He also came to a harsh conclusion: This new version of warfare would likely be awful.

"Ground troops, with drones circling overhead, know they're constantly under the watchful eyes of unseen pilots a few kilometers away," Mr. Schmidt wrote last year. "And those pilots know they are potentially in opposing cross hairs watching back. … This feeling of exposure and lethal voyeurism is everywhere in Ukraine."

David E. Sanger covers the Biden administration and national security. He has been a Times journalist for more than four decades and has written several books on challenges to American national security. More about David E. Sanger

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- The authorities in Poland and Germany have arrested at least five of their citizens and accused them of spying for Russia or of offering to help Moscow commit violence on European soil, including a "possible attack" on the president of Ukraine, Volodymyr Zelensky.
- The drone combat in Ukraine that is transforming modern warfare has begun taking a deadly toll on one of the most powerful symbols of American military might — the tank — and threatening to rewrite how it will be used in future conflicts.
- At least 17 people were killed and scores more injured when three Russian missiles struck a busy downtown district of Chernihiv, north of Kyiv, Ukrainian officials said.

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