On Landmines

Consider criminalizing the mining of another country's territory, and a prize competition for a truly automated approach for detection and destruction.

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POLICY PROPOSAL
14 AUGUST 2023

As the Ukrainian defense minister recently lamented, "Ukraine is the most heavily mined country in the world." While his not-quite 6,000 sappers are hard at work scratching paths through Russian lines, actually clearing the country of explosives could take twenty years at its present pace. Few systematic solutions have emerged "left-of-boom," beyond hand-held metal detectors and Bangalore torpedos, developed during the First World War. My research describes how matching better solutions to the problem requires providing policymakers with windows of opportunity for making the right decisions, which open lamentably infrequently. I offer two other ideas for advancing the cause against landmines: criminalizing the mining of another country's territory, and a prize competition for a truly automated approach for detection and destruction.

Contemplating the problem: "Ukraine is the most heavily mined country in the world"

Landmines seem the salient weapon in the Russian gambit to maintain hold of southern and eastern Ukraine. Without such extensive mining, the Ukrainian Armed Forces might be in Sevastopol, and Rostov, by now. As Ukrainian Defense Minister Oleksii Reznikov put it to *the Guardian's* Daniel Boffey, "today, Ukraine is the most heavily mined country in the world. Hundreds of kilometers of minefields, millions of explosive devices, in some parts of the frontline up to five mines per square meter." Boffey sourced an estimate from another expert:

> *Pete Smith, the Ukraine program manager of the mine-clearing NGO Halo, and formerly an officer in command of all of the British army's explosive ordnance disposal assets, said the level of mine contamination was "unrecognizable in modern history"… Smith suggested that even with 10,000 mine clearers it would take a decade to decontaminate the country. Halo has 900, largely locally sourced, working in Ukraine and plans to have 1,200 trained experts operating in the country by the end of the year.*

Thus, even with victory, the problem will persist, and hugely. Worldwide, landmines have killed and maimed several thousand people annually, worldwide, for decades. The casualties have been disproportionately civilians, of whom perhaps half have been children (see the 2022 edition of *Landmine Monitor*). Across Ukraine, from 2011 through 2021, landmines killed 3,108 people—and this was before the Russians' recent and still ongoing, massive mining effort. Extrapolate a bit, and one can imagine the count of the casualties to come. Might we actually do something about this?

Devising the solutions: African rats, or magneto-multi-copters?

Boffey estimates that the Ukrainian Armed Forces have well fewer than their established strength of 6,000 sappers cleaning mines and explosive remnants of war, with numbers dwindling as they lose limbs. It is easy to say that the Ukrainians were unprepared, but it may also be unhelpful. Eight years of skirmishing with Russians notwithstanding, their armed forces had never fought a big war, and none of their illustrious advisors from points west had either. All had under-appreciated the depths and densities of the minefields to come, and the need for breaching gear and troops.

Last month, Mick Ryan, current think-tanker and retired major general of the Australian Army, said that "Ukraine needs a Manhattan Project for mine-clearing" (see the article by Matthew Bigg). Nineteen years ago, nearly the same plea went out from another general, John Abizaid, in charge of US forces in Iraq and Afghanistan, to the Joint Chiefs of Staff at the Pentagon. In June 2004, Abizaid requested a "Manhattan-like project" against what he deemed his "number one threat," so-called *improvised explosive devices*—basically, landmines (see my doctoral dissertation and 2021 book). Two-and-a-half years later, large orders of Mine-Resistant, Ambush-Protected (MRAP) vehicles were underway in the United States. Notably, the Australians were way ahead, having brought their own domestically-manufactured Bushmaster MRAPs to Afghanistan in 2004. The Americans completely missed the example, even as their allies' vehicles drove past them.

Abizaid just wanted a solution. MRAPs worked strictly right-of-boom (after a landmine explosion), though they made and continue to make mine-clearance teams more secure in their work left-of-boom. General Ryan is probably thinking mostly left-of-boom. Manhattan Projects are not supposed to take twenty years. From here on, what more can actually be done to clear the mines?

A South African friend tells me that the best technology remains African rats. They may compete with dogs, which remain another common approach, despite all the money spent during the Iraq War, by the US Defense Department's Joint IED Defeat Organization, on electro-mechanical systems for explosives-sniffing. Dogs and rats do require lots of handlers. So what could automate and robotize the process, of both detection and destruction, for clearance on a global scale? A land mine is effectively an autonomous weapon, so it is best to have robots fight the robots.

Almost a year ago, a Ukrainian teenage refugee in Canada won a $100,000 prize, and admission to the University of Alberta, for cleverly kluging a magnetic detection coil onto a quadcopter for rapidly scanning farm fields from extremely low altitude. He explained his motivation thusly: “I am scared of going to the woods and to the fields near my house. We walk only on the roads.” (See reporting by Bev Betkowski and Margaret Osborne.) He is presumably still working on his concept, but with little further news feed. No dominant solution has emerged, so the field for investment is wide open.

Matching solutions to the problem: the right people at the right time

At issue is not just the development and production of better technology. Someone needs to decide to pay for all this. As I wrote in a recent working paper (“On Predicting Military Innovation,” 8 June 2023), Cohen, March, and Olsen’s classic (1972) model of the “organized anarchy” provides structure for thinking about the timing of military innovation. Solutions only get matched to problems when decision-makers find opportunities for actually making decisions. These “choice opportunities” may naturally arise with budgetary cycles, reorganizations, arms-control treaties, and postwar recoveries. Bureaucracies do not deal with them naturally, but only institutionally.

The decision-makers themselves may need to change to effect real change. Better mine-resistance in Iraq required a chain-reaction induced by “Mother of the MRAP” and field statistician Susan Alderson all the way to newly-installed Secretary of Defense Robert Gates. In the summer of 2006, Alderson stopped taking *no* for an answer from the military bureaucrats, and pushed the issue all the way to the Marine Corps commandant. In late 2006, at the commandant’s direction, the USMC’s Major General Emo Gardiner gathered up half a billion dollars in leftover military funding to jump-start the process. In early 2007, Gates short-circuited the straight-jacketing budget cycle with many more billions, helped along by a rousing floor speech from Senator Joe Biden of Delaware. Getting the right kit right-of-boom required the right people from the ground up to get the basics right.

Even then, lessons were left semi-learned. MRAPs were usefully stored after the war, but I have taken note over the past decade of how many senior military officials have treated MRAPs like a one-hit wonder, never to be used again. Yet we are seeing lots of them today on the Russo-Ukrainian front! Meanwhile, NATO’s training bureaucracy is trying to teach Ukrainians how to drink chai with a knife. As Isobel Koshiw reported recently for the Open Democracy project,

> *“I don’t want to say anything against our partners, but they don’t quite understand our situation and how we are fighting,” said a senior intelligence sergeant in the newly formed 41st Mechanised Brigade who goes by the name ‘Dutchman’… Members of the 41st Brigade said that their instructors often used examples of NATO operations in the Middle East, where the objective is to clear houses and identify potential insurgents among the local population, but “that’s not really relevant to us”… Yura [not her real name], one of the newly mobilised soldiers from the 41st, gave the example of minefields... “The [Western] training was good and interesting. But there was very little about de-mining,” Yura said.*

They showed us a minefield about two metres wide. The training lasted about two hours. But you get here and look at what's in front of you, it's just not comparable.

So we might say that not all the right people are actually in place.

Pursuing other pathways: criminalization, and a prize competition

The persistence of the economic devastation wrought by the Russians with this mining across Kherson, Zaporizhzhia, Donetsk, and Luhansk indicates the moral and mental bankruptcy of their aims in this war. Ukrainians cannot thrive in such heavily minded areas, but Russians cannot either. This points to why anti-personnel landmines have been banned, through the 1997 Ottawa Convention, by 165 countries. The convention itself is not binding on non-signatories, including Russia, China, and the United States. Perhaps, though, it is time to declare the large-scale mining, with active anti-personnel weapons, of the territory of another country, a *per se* criminal act, regardless of one's orders. This could encourage other countries to join the convention, without extending its jurisdiction over the defensive mine-belts on the territory, for example, of South Korea and Finland. It could also further isolate and vilify Vladimir Putin's regime. It might even work to encourage the financing of an international effort to mitigate this global humanitarian disaster.

To that point, time may be high for a prize competition for a truly automated approach for detecting and destroying landmines. The 2020 US National Defense Authorization Act called for an investigation into "alternative policy options to accelerate commercialization and innovation in dual-use technology, [including] prize competitions." At George Mason University's Baroni Center for Government Contracting, I led the research team that considered this (and other) questions in a formal report to the Defense Department in May 2022. Prize competitions offer an alternative in policy to patents for incentivizing innovation, by providing funding upfront in return for much of the intellectual property rights associated with the invention itself. Prize competitions can attract many entrants for concepts which have otherwise been unable to attract financing. The competition can be designed with funding for initial production start-up costs to field a minimally viable product or initial operating capability. The rollback of intellectual property rights then streamlines access to the technologies developed, so that multiple firms can work on improving the underlying ideas, and not just the ones receiving prizes. If financed with donor monies, the entire process could work outside military procurement cycles.

These are novel approaches, but the scale and persistence of the problem argue against convention.

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