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On Not Confusing the Unfamiliar with the Improbable: Low-Technology Means of Delivering Weapons of Mass Destruction

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On Not Confusing the Unfamiliar with the Improbable: Low-Technology Means of Delivering Weapons of Mass Destruction

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By bestowing virtually exclusive attention to the threat of ballistic missile delivery of weapons of mass destruction (WMD), strategic planners and nonproliferation specialists alike may well have fallen prey to the danger of obsessing over familiar dangers at the cost of more likely ones.[1] Professor Thomas Schelling captured this inclination well in his foreword to Roberta Wohlstetter's classic treatment of surprise at Pearl Harbor. Referring to the U.S. government just before the Japanese attack of 6 December 1941, Schelling observed:

> "There is a tendency in our planning to confuse the unfamiliar with the improbable. The contingency we have not considered seriously looks strange; what looks strange is thought improbable; what is improbable need not be considered seriously.[2]

Al Qaeda's masterful plan of turning fuel-ladened jumbo jets into cruise missiles demonstrated that there are decidedly more low-tech means of achieving mass-casualty effects than planners might have wished to examine before September 11, 2001. But non-state actors are not the only perpetrators who might contemplate more prosaic means of WMD delivery. When the Central Intelligence Agency (CIA) released its National Intelligence Estimate (NIE) on the

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[1] In regard to strategic military planners, one need only examine the relative the extent to which defending against ballistic missiles has dominated U.S. missile defense expenditures over the last decade to the exclusion of so-called "other means" of attacking the U.S. homeland. See, for example, Dennis M. Gormley, "Enriching Expectations: 11 September's Lessons for Missile Defence," *Survival*, vol. 44, no. 2 (Summer 2002), pp. 19-35. Nonproliferation specialists are no less singular in their nearly exclusive focus on ballistic missiles within the Missile Technology Control Regime (MTCR), even though cruise missiles and unmanned air vehicles are subject to similar controls. See K. Scott McMahon and Dennis M. Gormley, *Controlling the Spread of Land-Attack Cruise Missiles*, The AISC Papers, No. 7 (American Institute for Strategic Cooperation: Marina del Rey, CA: 1995).

[2] Thomas C. Schelling, Foreword to Roberta Wohlstetter, *Pearl Harbor: Warning and Decision* (Stanford University Press, Stanford, CA, 1962), p. vii.

ballistic missile threat to the United States in January 2002, the likely seemed to clash with the familiar when the document concluded that U.S. territory is more likely to be attacked with WMD using "ships, trucks, airplanes or other means" than with an intercontinental ballistic missile.[3] These so-called other means of WMD attack include land-attack cruise missiles and armed unmanned air vehicles (UAVs). The NIE argued that cruise missiles offered a better alternative than ballistic missiles if launched from forward areas. Each of these low-tech alternatives compare more favorably with ballistic missiles because of their low cost, ease of acquisition, better reliability, and greater accuracy. The NIE did not distinguish between state and non-state actors, but could plausibly include both, as this paper will argue.

The obsessive focus on ballistic missile delivery of WMD has fostered a lopsided approach to missile nonproliferation policy. Existing nonproliferation mechanisms—the Missile Technology Control Regime (MTCR) and the Hague Code of Conduct (HCOC) against the proliferation of ballistic missiles—tilt conspicuously in favor of inhibiting the spread of ballistic missiles. Low-tech UAVs and cruise missiles are covered under the MTCR just like ballistic missiles, but they have enjoyed second-class treatment until very recently.[4] And no matter that the

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[3] For an unclassified version of the 2002 NIE, see http://www.cia.gov/nic/pubs/other_products/. For a press account, see Walter Pincus, "U.S. Alters Estimate of Threats, Non-Missile Attacks Likelier, CIA Says," *Washington Post*, 11 January 2002, p. A1.

[4] Until September 2002, the MTCR's effectiveness in dealing with cruise missile transfers suffered from a lack of consensus on determining the true range of these delivery systems. This contributed in part to France and United Kingdom, in 1997, agreeing to sell the *Black Shahine* stealthy cruise missile to the United Arab Emirates, in spite of protestations from Washington. At the 2002 MTCR plenary in Warsaw,

MTCR is the progenitor of the HCOC, the code ignores altogether cruise missiles and UAVs. In view of the Blix Commission's quest to present realistic and constructive ideas and proposals designed to reduce the danger of WMD, this paper has two goals: first, to examine why and how non-state and state actors may seek to employ low-tech WMD delivery means such as converted recreational aircraft or surplus anti-ship missiles; and second, to recommend ways of improving existing nonproliferation regimes to cope more effectively with controlling the spread of such low-tech means of WMD delivery.

Non-state Actors and Low-Tech Delivery of WMD

At first blush, the notion of non-state actors and WMD delivery by unmanned systems seems not only unfamiliar but also improbable.[5] The means of perpetrating terrorist harm, even for religiously motivated, apocalyptic groups like al Qaeda, continue to be decidedly jejune yet effective ones, usually involving a suicidal agent. Yet, Aum Shinrikyo, the perverse Japanese cult, pursued, admittedly without much success, chemical and biological agents as well as unmanned mini-helicopters for spraying such agents.[6] There

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Poland, the membership announced that it had tightened ground rules for defining the true range of cruise missiles and UAVs. However, several shortcomings remain in the way in which cruise missiles and UAVs are covered under the MTCR's guidelines and technical annex. For an accounting of these shortcomings, see Dennis M. Gormley and Richard Speier, "Controlling Unmanned Air Vehicles: New Challenges," *The Nonproliferation Review*, vol. 10, no. 2 (Summer 2003), pp. 66-79.

[5] For an earlier appraisal of non=state actor use of UAVs as terrorist weapons, see Dennis M. Gormley, "UAVs and Cruise Missiles as Possible Terrorist Weapons," in James Clay Moltz, ed., *New Challenges in Missile Proliferation, Missile Defense, and Space Security*, Occasional Paper No. 12 (Monterey, CA: Monterey Institute's Center for Nonproliferation Studies, 2003), pp. 3-9.

[6] Aum's 1995 sarin gas attack in a Tokyo subway took only 12 lives, but an important psychological line was crossed. The group's interest in

is substantial though largely inferential evidence that al Qaeda is seeking WMD. Besides Osama bin Laden's own assertion that it is a religious duty to acquire WMD, U.S. and coalition troops found compelling evidence of al Qaeda's interest in WMD in the aftermath of operations in Afghanistan. Sultan Bashiruddin Mahmoud, a former nuclear scientist at the Pakistan Atomic Energy Agency, testified to CIA interrogators that he met with bin Laden and other al Qaeda members for two to three days in August 2001 to discuss WMD. Bin Laden was interested in nuclear, biological, and chemical weapons and sought advice on building a "dirty bomb," or radiological device purportedly based on materials expected from the Islamic Movement of Uzbekistan. A search of Mahmoud's offices in Kabul disclosed a history of anthrax, documents on the U.S. military's immunization program, gas masks, and diagrams of an aerial balloon system for dispersing biological or chemical agents.[7]

Delivering biological agent by means of an aerial balloon shows that a pilot willing to commit suicide is not an essential requirement. However, using a balloon is a notoriously ineffective way to achieve mass-casualty effects.[8] Rather suicide is viewed as a means of enhancing

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unmanned helicopters for spraying agents never materialized. See the Nuclear Threat Initiative's Global Security Newswire, available at http://www.nti.org/d_newswire/issues/thisweek/2002_8_19_misd.html.

[7] For details on Mahmoud's testimony and activities, see Daniel Benjamin and Steven Simon, *The Age of Sacred Terror* (New York: Random House, 2002), pp. 203-205. For an appraisal of al Qaeda's potential WMD capabilities, see Jack Boureston, "Assessing Al Qaeda's WMD Capabilities," in Strategic Insights, Center for Contemporary Conflict, U.S. Naval Postgraduate School, available at http://www.ccc.nps.navy.mil/rsepResources/si/sept02/wmd.asp.

[8] Balloon delivery might be able to achieve great ranges if launched into the upper atmosphere, but the corresponding uncertainty of disseminating its payload with any terminal effectiveness is significant, as the U.S. found in its early investigations. Interview

the effectiveness of delivery. Thus, al Qaeda investigated employing a crop-dusting aircraft. The September 11 ringleader, Mohammed Atta, made several visits to a crop-dusting airfield in Florida asking for details about crop-dusting aircraft. While attempting to apply for a $650,000 loan to start a crop-dusting business, Atta told a Department of Agriculture official that he intended to use the money to purchase a six-seat, twin-engine crop duster, after which he planned to remove the seats to fit a large chemical tank, leaving space for the pilot alone. Crop dusters are notoriously difficult planes to fly without significant training, however.[9] Another increasingly attractive alternative not requiring a suicide agent is to rely on remote control or completely autonomous aircraft, which have become widely available within the recreational marketplace due to the quantum leap in dual-use navigation and guidance technologies over the last decade.[10]

Low-tech aircraft, unmanned and manned, have clearly come to the attention of terrorist groups. One terrorist expert has recorded 43 cases involving 14 terrorist groups where remote-control delivery systems were "either threatened, developed, or actually utilized," including al Qaeda plans to use unmanned airplanes ladened with plastic explosives to kill G-8 leaders at their 2001 summit in Genoa, Italy.[11]

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with a former biological weapons scientist in the U.S. program, 18 August 1999.

[9] Mark Steyn, "Mohammed Atta and his federal loan officer," *National Post* (Toronto), 1 June 2002, available at www.lex-nexus.com.

[10] Such navigation and guidance is a by-product of the commercialization of the Global Positioning System (GPS) and high-resolution satellite imagery and mapping tools. As for how these technologies might be adapted to unmanned systems, see Dennis M. Gormley, *Dealing with the Threat of Cruise Missiles*, Adelphi Paper 339 (Oxford: Oxford University Press for IISS, 2001), chapter 1.

[11] The expert is Louis Mizell, a former U.S. intelligence officer. See http://www.securitymanagement.com/library/001324.html.

A British national held at Camp Delta, Guantanamo Bay, reportedly confessed to being a part of an al Qaeda plot to acquire a drone (unmanned aircraft) to attack the House of Commons with anthrax.[12] The prisoner's British attorney argued that the charge lacked plausibility because UAVs were tightly controlled by the armed forces and cost at least $5M apiece. Yet, a terrorist group would not necessarily have to rely on acquiring a military UAV to achieve an unmanned delivery capability. A variety of recreational aircraft, called kit airplanes, which are home assembled, could be modified to fly either via remote control or autonomously, assuming in the latter case that a suitable flight management system could be installed. The cost would be at least 100 times less than the $5M cited by the al Qaeda prisoner's attorney.[13] What's more, it appears that even expensive military UAVs are not immune from being diverted by black marketers or terrorists. In late November 2003, a container with two UAVs normally used by intelligence agencies found its way into the hands of Sri Lankan Customs officials. The container included remote control electronic devices that enabled the UAVs to fly to a distance of 180km.[14]

What might motivate a terrorist group to pursue such low-tech means of delivery? Al Qaeda's religiously motivated quest to acquire WMD—most notably biological or chemical weapons—would be ably complemented by using a UAV. The

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[12] Severin Carrell, "British prisoner 'confesses' plot to poison-bomb Parliament," *London Independent*, 30 November 2003, p. 1.

[13] The average cost of a recreational kit airplane, including a small reciprocal engine, is about $20,000. At most, flight management and payload modifications might add another $15-20,000.

[14] "Customs seize spy planes," *Colombo Daily News* (Internet Version-WWW) in English, 20 November 2003 [FBIS Transcribed Text].

flight stability of these aerodynamic vehicles permits them to release and spray agents along a line of contamination.[15] Modeling of UAV agent delivery performance demonstrates that cruise missiles and UAVs enlarge the lethal area of biological agents, conservatively, by a factor of ten compared with ballistic missile delivery.[16] Radiological dispersal, an area of acknowledged interest to al Qaeda, also becomes conceivably more effective with a UAV over large urban areas, but only if the source material is cesium chloride—the one radiological source that comes in a powdered form.[17] Although such a "dirty bomb" dispersal would not truly measure up to the destructive damage that other WMD might produce, it would play on the public's fear of anything nuclear and cause long-term disruption. Finally, even non-WMD attacks become attractive against certain civilian and industrial targets even with a small airplane when one considers the fact that a gasoline payload, when mixed with air, releases 15 times the energy as an equal weight of TNT.[18]

Besides mass-casualty effectiveness, terrorists would also be likely to exploit the intended target's

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[15] Edward Eitzen, "Chapter 20—Use of Bio Weapons," in *Medical Aspects of Chemical and Biological Warfare* (Washington, D.C.: Walter Reed Army Medical Center, 1997), pp. 440-442.

[16] Private communication between the author and Dr. Eugene McClellan, Pacific-Sierra Research Corporation, 22 August 1997.

[17] The author is grateful to his CNS colleague, Dr. Charles Ferguson, for this point. Most other radioactive sources of concern, such as cobalt-60 and iridium-192, are solid materials. See Charles D. Ferguson, Tahseen Kazi, and Judith Perera, *Commercial Radioactive Sources: Surveying the Security Risks*, Occasional Paper No. 11 (Monterey, CA: Monterey Institute's Center for Nonproliferation Studies, 2003), available at www.cns.miis.edu/pubs/op11/index.htm.

[18] Richard A. Muller, "The Cropdusting Terrorist," *Technology Review*, 11 March 2002, available at http://www.technologyreview.com/articles/print_version/muller031102.asp .

vulnerabilities, as al Qaeda did on September 11, 2001, when it took advantage of America's lax airport security. Indeed, terrorists seem to be adjusting to September 11's positive effects on airport security. According to the director general of intelligence for Canada's armed forces, terrorist groups have already purchased ultra-light aircraft and hang-gliders to work around effective security precautions against highjacking large commercial airliners.[19]

From the perspective of terrorist planning, the virtue of any aircraft threat to domestic targets is the abysmal state of defenses against low-flying objects. Sadly, while the Bush administration is rushing headlong to declare an untested handful of ballistic-missile interceptors in Alaska operational against intercontinental-range ballistic missiles, America's capacity to defend against low-flying unmanned or manned aircraft remains virtually non-existent. A July 8, 2004 U.S. House of Representatives hearing drew grim attention to the lax state of America's defenses against low-flying airplanes by examining the near-catastrophic circumstances surrounding the June 9 funeral for President Ronald Reagan. As officials gathered in the nation's capitol, a combination of human error, onboard technical malfunction, and computer incompatibility between the Federal Aviation Administration (FAA) and the Transportation Security Administration caused U.S. security personnel to mistake the governor of Kentucky's official airplane—a 1972 King Air turboprop with a maximum capacity of 15 passengers—as a terrorist threat. This led to the evacuation of hundreds of officials and the dispatch of two

[19] David Pugliese, "Terrorists are training on hang-gliders, experts warn," *Calgary Herald*, 26 March 2004, p. 1.

F-15 interceptors, and circumstances that almost prompted the top general of the North American Aerospace Defense Command (NORAD) to order the governor's plane shot down.[20]

The near disaster of June 9 in Washington, D.C. points up the inadequacy of the nation's capacity to identify friend from foe. In the case of the governor's plane, this led to erring on the side of caution. But the fact that a disastrous mistake nearly ensued could produce an even more tragic result: inaction in the face of a genuine terrorist threat. In any event, the head of the U.S. Department of Homeland Security's directorate in charge of air defense has admitted that the current system may not be able to stop a determined adversary.[21] An intelligent and committed terrorist is unlikely to fly a small airplane, whether manned or unmanned, above an altitude of 3,000 feet, where the FAA's radars would be able to detect and query the aircraft's transponder to establish its intentions. Flying beneath the FAA's existing radar system, an attack targeting Washington would face detection and interdiction only by unarmed Immigration and Customs Enforcement helicopters operating within the highly restricted 15-mile radius around the city. Even assuming the helicopter crews were able to detect a low-flying threat and alert military authorities rapidly, the defense of the nation's capital would be left to modest anti-aircraft defense around a few high-profile sites. Other American, European, or Asian

[20] Spencer S. Hsu, "Plane That Caused Capitol Evacuation Nearly Shot Down," *Washington Post*, 8 July 2004, p. A1.
[21] *Ibid*.

cities are far less capable of dealing with such low-flying terrorist threats.[22]

How difficult would it be for a terrorist group with al Qaeda's resources to convert a small airplane into a UAV? It has increasingly become the general presumption that almost any person or small group with modest engineering knowledge and skills could build a simple, autonomous self-guided UAV or small cruise missile at minimal expense and based entirely on off-the-shelf component technologies. In order to demonstrate this point, a New Zealand engineer named Bruce Simpson created a website with the title "Do-It-Yourself Cruise Missile," where he documented his effort to build one in his garage for under $5,000.[23] Before having the opportunity to test his missile, the New Zealand government, under pressure from the United States, forced Simpson to shut down his efforts. Simpson told BBC News that he proved "that by using off-the-shelf technology in a suburban garage a terrorist can create a weapon against which there is no effective defense." Iran, which Simpson claims offered to purchase technical details of his project, was among several potential buyers.[24]

But before too much is made of do-it-yourself cruise missiles, it is not at all clear that Simpson's efforts would have proven successful. Just because individual

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[22] At present, no serious effort is underway to design and build the means of detecting airborne attack vehicles capable of flying below 3,000. Senior NORAD officials say that their mission is to detect threats from outside the country, not from within. The DHS and FAA have shown no indication to assume responsibility for this gap in radar coverage and probably will not until firm evidence of funding furnishes the necessary incentive to do so.

[23] Simpson's website is http://www.interestingprojects.com/cruisemissile/.

[24] "DIY cruise missile thwarted," BBC News Online, 9 December 2003, available at http://news.bbc.co.uk/go/pr/fr/-/1/hi/world/asia-pacific/3302763.stm.

component parts are available from commercial sources does not imply that they can be readily integrated to produce a reliable system. System engineering skills, particularly those required to integrate actuators and servo controls that are crucial for moving the UAV's control surfaces based on command from the flight management computer, represent the most significant integration challenge. Simpson's technical approach to flight management belies the ease with which this task can be accomplished.

An even simpler way to develop a rudimentary but nonetheless effective UAV would be for a terrorist group to purchase one of many recreational or kit airplanes and convert one into a unmanned system. Simpson's small cruise missile represented a proof-of-concept effort; thus, it involved only a few kilograms of payload. A converted kit airplane would deliver on average a payload of 200kg, amply more than enough for a biological or chemical payload, and even enough to accommodate a worrisome amount of gasoline for a non-WMD attack. The kit airplane market consists of nearly 100,000 copies of over 400 different systems from worldwide manufacturers.[25] On average, these airplanes have a cruising speed of roughly 75 knots, a 66-horsepower reciprocating engine, a one-way range of 500km, and a total weight of 400kg. They require only about 75 meters of flat grassy surface to take off. Beginner construction time is normally around 260 hours. Between the kit plane package and engine, which are purchased separately, the total average cost is less than $25,000.

[25] This accounting of the kit airplane marketplace was accomplished by Dr. Gregory DeSantis, a private consultant and colleague of the author, based on internet searches of the kit airplane literature, primarily Kitplanes Magazine's monthly issues during 2001.

Given the simplicity of design of these recreational aircraft, a kit airplane conversion would not present too daunting a challenge for appropriately skilled persons (meaning advanced mechanical, electrical, and computing skills). As much as two years of effort would be required, with the most challenging requirement being integrating and properly installing the various components of the flight management system. This task could be rendered substantially easier, however, by purchasing a complete flight management system, called a variable autonomy flight management system. These systems permit the rapid conversion of manned airplanes into UAVs. Variable autonomy furnishes the user with two flight mission choices: either remote control from the ground (limited by line of sight to the vehicle) or fully autonomous flight, which would depend on a series of way points embedded into the flight management system's computer. Several new small aerospace companies have emerged in the United States over the last five years to sell such fully integrated flight control systems as well as support services that greatly ease the task of converting a small airplane into a UAV. While these systems together with support services cost around $35,000, they would greatly enhance the prospects that the conversion would succeed. Remarkably, no existing export controls govern foreign sales of these conversion systems or services.[26]

[26] Of course, even with case-by-case review of foreign sales of these systems, domestic transactions could still take place. This may warrant close monitoring of the small number of aerospace firms involved in the manufacture and sales of these systems.

State Actors and Low-Tech Delivery of WMD

For the past four decades, ballistic missiles have dominated the missile proliferation scene. This came about largely as a legacy of the former Soviet Union's arms transfer habits with their many client states. As a result, the Scud ballistic missile is ubiquitously featured in scores of military arsenals around the globe. But recent missile proliferation trends suggest that cheaper cruise missiles and UAVs will gradually join many if not most state missile arsenals to present a toxic mix of offensive delivery capability. Indeed, this mix may be sufficiently potent to be beyond the defensive capacity of even the best U.S. missile defenses. Early signs of this trend surprised most analysts during the U.S. invasion of Iraq in March 2003.

During Operation Iraqi Freedom, American and Kuwaiti Patriot PAC-2 and –3 missile defense batteries performed surprisingly well against Iraq's ballistic missiles: all nine of Iraq's most threatening ballistic missiles were intercepted and destroyed. Equally surprising, however, was the failure of these same Patriot missile defense batteries, which are designed to detect and intercept both ballistic and cruise missiles, to detect or engage any of Iraq's five Seersucker cruise missiles launched during the campaign. One of these cruise missiles almost resulted in a direct hit on a Marine encampment on the opening day of the war, while another just missed a Kuwaiti shopping mall. Further north, two Iraqi ultralight aircraft, which U.S. intelligence officials feared might carry chemical or biological agents, were belatedly detected (but not

engaged) only after flying over thousands of U.S. troops, equipment, and command facilities prior to the division's advance on Baghdad. Iraq's use of low-flying cruise missiles and slow-flying ultralights also contributed to the Patriot's unfortunate series of friendly-fire incidents, two of which led to the loss of two aircraft and the deaths of three crew members.[27]

Countries interested in acquiring missiles capable of delivering WMD or even conventional payloads will undoubtedly draw important lessons from the performance of U.S. missile defenses in Iraq. As a senior U.S. Army missile defense officer commented in the aftermath of Iraq's use of cruise missiles, "this was a glimpse of future threats. It is a poor man's air force. A thinking enemy will use uncommon means such as cruise missiles and unmanned aerial vehicles on multiple fronts."[28] In fact, now that U.S. missile defenses have shown they can work effectively against at least shorter range ballistic missiles, missile-acquiring states will likely see the benefits of acquiring low-tech cruise missiles or UAVs to complicate such defenses. Even against greatly improved cruise missile defenses, low-tech, low-cost systems would

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[27] Dennis M. Gormley, "Missile Defence Myopia: Lessons from the Iraq War," *Survival*, vol. 45, no. 4 (Winter 2003/04), pp. 61-86. During the 1991 war with Iraq, coalition air forces avoided friendly-fire incidents because they first removed Iraq's air force as a threat, which permitted Patriot batteries to employ restricted rules of engagement. That is, Patriot radars were trained exclusively on the comparatively steep trajectories of Iraq's ballistic missiles, not on low-flying aircraft or cruise missiles. When Iraq surprised U.S. and Kuwaiti Patriot batteries with their cruise missiles on the first day of the war, Patriot radars had to drop their highly restrictive rules of engagement to focus on both low-flying and high-angle threats, leaving them more susceptible to friendly-fire errors. Simulated exercises in the U.S. suggest that attrition rates under these circumstances often produce rates of 10-20%. *Ibid.*, pp. 68-71.

[28] Michael R. Gordon, "A Poor Man's Air Force," *New York Times*, 19 June 2003, p. 1.

simply exhaust comparatively high-cost American interceptors. Whether a Patriot PAC-3 interceptor costs $5M or the desired $2M per copy, the figure is starkly higher than either a $200K cruise missile or $50K converted kit airplane.

The high cost of defending against both ballistic and cruise missiles is generating growing instability in regional settings. Recent developments in the missile competition between China and Taiwan illustrate how the addition of cruise missiles to an already unstable regional competition can greatly exacerbate tension. China has been deploying its M-series ballistic missiles in provinces within reach of Taiwan at a rate of 50 to 75 a year for several years. Current estimates suggest they will have 800 deployed by the end of 2006.

In response to the China ballistic missile buildup, Taiwan has purchased missile defenses, including U.S. Patriot PAC-2, while the latest hit-to-kill interceptors, called PAC-3, are scheduled for acquisition. As U.S. and Kuwaiti Patriot units proved in the last Iraq war, these missile defense systems can intercept ballistic missiles with considerable effectiveness. But severe complications arise against both ballistic and cruise missiles. Patriot missile defense systems have a nominal capability to intercept low-flying cruise missiles, but only if they have advanced (fire-control quality) information on the whereabouts of the incoming target. That information must come from airborne radars with advanced detection capabilities, which add to the already high price of defending against comparatively less costly ballistic missiles. Thus, recent reports that China has tested a land-attack cruise missile (Dong Hai-10) with a range of

1,500 km and accuracy of 10m, and has already deployed a shorter-range LACM (Ying Ji-63) with a range of 400-500km, as well as Harpy UAVs furnished by Israel, have sparked a more open debate in Taiwan about the futility of relying alone on costly missile defenses as a counter to these developments.[29] Instead, Taiwan is pursuing a LACM development program of its own that is believed to be within four years of completion. According to Britain's *Financial Times*, Taiwan's legislators and government officials are concerned about the long-term costs of missile defenses. As one Taiwanese government official said, "Relying on purely defensive systems to protect ourselves from China means we will have to outspend them 10 to one; we have to buy anti-missile missiles plus more early-warning and other detection equipment. That is impossible in the long run."[30]

A classic missile arms race is thus unfolding in Northeast Asia. Unlike the Cold War doctrine of mutual assured destruction, which involved the threat of nuclear retaliation, the one developing along the Taiwan straits involves, initially at least, conventionally armed missiles, which suggests a lower threshold surrounding the decision to commence hostilities. But given the inviting vulnerability of Taiwan's critically important air force, Taiwanese officials will be prone to strike first before suffering incalculable losses to its air force. Such logic

[29] For information on China's LACM test and other cruise missile and UAV programs, see Space Daily, "China Test-Firing New Cruise Missile Which Threatens Taiwan: Journal," 19 September 2004, available at www.spacedaily.com/**news**/**missile**s-04zzh.html.

[30] Kathrin Hille, "Taiwan speeds up race to match Beijing missiles," *Financial Times* (Asia Edition), 25 September 2004, p. 3.

compels officials to usurp control at the outset of conflict, which aptly describes the tyranny of preemption.

How might missile-acquiring countries go about building a poor man's air force of low-tech cruise missiles or UAVs? Converting small airplanes or recreational vehicles into weapons-carrying "missiles" offers a particularly attractive option, especially if variable autonomy flight management systems can be readily acquired to ease the task of conversion. But the option that Iraq sought of converting surplus anti-ship cruise missiles, like the Chinese Seersucker (HY-2), also makes compelling sense. Over six years ago, this author predicted that countries interested in cheaply acquiring a capability to use land-attack cruise missiles would turn to the Chinese Seersucker of the Silkworm family of anti-ship cruise missiles due to the ease of converting them into land-attack systems.[31] From a weapons-proliferation standpoint, the Seersucker/Silkworm cruise missile shares the Scud ballistic missile's ubiquity: they are available globally, including in countries like Bangladesh, the Democratic Republic of Congo, Dubai, Egypt, Iran, Iraq, North Korea and Pakistan. Given their age, many surplus Seersuckers are available for conversion.

Turning cruise missiles originally designed to attack ships at sea into one that attack targets on land is nothing new. The U.S. Navy has converted the Harpoon anti-ship missile, which is exported to 24 nations, into the Stand-off Land-Attack Missile (SLAM). Russia has done the same with its export family of Klub anti-ship missiles, one of which is being jointly produced by India and Russia

[31] Dennis M. Gormley, "Hedging Against the Cruise-Missile Threat," *Survival*, vol. 40, no. 1 (Spring 1998), pp. 92-111.

(called the Brahmos, a dual-mode cruise missile with both anti-ship and land-attack capabilities). Yet, converting these modern anti-ship missiles, which are densely packed with electronic components and are comparatively much smaller than the Seersucker/Silkworm cruise missile, offers little room for adding fuel to extend the range beyond 100km. Once the original autopilot and radar are removed from the Seersucker/Silkworm, there is significant additional space to permit range extension out to around 1,000km. The David Kay-led Iraqi Survey Group found that Iraq had not only converted ten Seersucker cruise missiles into land-attack systems, with a modest range extension, but had also begun work on a more ambitious program to extend the missile's range to 1,000km, using a Russian turbine engine.[32]

Two main barriers stand in the way of converting anti-ship cruise missiles into land-attack ones. The first, and less taxing, is the need for a turbojet engine to extend the system's limited anti-ship range. Only the latest version of the Silkworm—the Chinese HY-4—comes with such an engine. However, there is a significant marketplace for unrestricted civil turbojet engines, many of which would suffice. The second and more daunting barrier is providing a modern land-attack navigation to guide the missile over the more variegated terrain of the earth's surface, particularly while flying low to avoid defenses. State actors have sufficient technical skills to do this job, but it will take a few years of integration and testing to achieve reliable results, especially if no significant foreign assistance is involved. A palpable shortcut

[32] The Interim report of the Iraqi Survey Group, delivered on 1 October 2003. See http://www.cia.gov/cia/public_affairs/speeches/2003/.

entails purchasing variable autonomy flight management systems to ease the conversion task.

Iraq's conversion efforts are obviously no longer a matter of concern, but Iran, North Korea, and possibility Pakistan are converting Seersucker/Silkworm anti-ship missiles into land-attack versions.[33] Iran's development of cruise missiles appears directly related to their Shahab-3 ballistic missile development program as a means of complicating U.S. and Gulf Cooperation Council states who possess regional missile defenses.[34]

During the 2003 war in Iraq, U.S. military officials fell prey to confusing the unfamiliar with the improbable by misrepresenting the potential capability of Iraq's low-tech conversions of first-generation anti-ship missiles like the Seersucker. "The Seersucker is much, much smaller than a Scud and we don't think it can be converted to carry any significant NBC [nuclear, biological, or chemical] payload," said one officer after one such cruise missile nearly hit a Kuwaiti shopping mall. Missed in this assessment was the fact that the Seersucker's limited anti-ship range can be extended by ten times its distance after conversion to a land-attack system. Moreover, the Seersucker delivers a warhead with the same or greater payload weight (500kg) than most Iraqi ballistic missiles managed. Most important, however, the Seersucker and other such low-tech aerodynamic platforms are decidedly more suitable—by at least a factor of ten—for delivering biological and chemical payloads than any existing

[33] Douglas Barrie, "Iran Reveals Cruise Missile Based on Chinese Design," *Aviation Week & Space Technology*, 2 February 2004, p. 45.
[34] "Iran Seeks Cruise Missile to Support Shihab," *Middle East Newswire*, 10 June 2004.

ballistic missile system that threatens the U.S. and its friends and allies. And from the evidence accumulating in countries like Iran, North Korea, and Pakistan, the spread of these unfamiliar delivery systems is likely to keep pace or even exceed the more familiar proliferation of ballistic missiles.

Recommendations

Two principal recommendations flow from this paper's analysis:

- The MTCR membership should tighten export control reviews on variable autonomy flight management systems that make it conceivable that a terrorist group might convert a seemingly innocent recreational vehicle into an unmanned weapon.
- The Hague Code of Conduct against the proliferation of ballistic missiles should deepen its normative coverage to include cruise missiles and UAVs.

The MTCR—the only extant multilateral arrangement covering the transfer of missiles (ballistic, cruise, and UAVs), related equipment, material, and technology relevant to delivery of WMD—is flawed but has frequently been effective. It has achieved remarkable, though largely unsung, success in dampening the qualitative spread of ballistic missiles by curtailing the export of dual-use components, technologies and production capabilities relevant to making ballistic missiles. As a consequence, the spread of ballistic missiles to date has been limited largely to 50-year-old Scud technology. On the other hand, the MTCR has been too lax in regard to cruise missiles and

UAVs. For example, current MTCR coverage of flight management systems and technology (under Item 10, Category II of the MTCR technology annex) is too narrowly crafted to have any inhibiting effect on access to the flight control systems needed simply to convert manned airplanes into UAVs for weapons delivery. Moreover, even though the MTCR membership took the first step toward addressing possible terrorist use of UAVs and cruise missiles in September 2002 (when it committed to examining ways of limiting the risk that controlled items and their technologies could fall into terrorist hands), nearly two years later it has still not addressed the lax controls on flight management systems that enable simple planes to be converted in unmanned means of WMD delivery. No more effective way of fulfilling this commitment exists than to close existing MTCR loopholes affecting the spread of new flight management systems enabling such UAV conversions.[35] Implementing such controls on variable autonomy flight management systems would also make it harder for states to acquire such devices to convert anti0ship cruise missiles into land-attack systems.

The Hague Code of Conduct against the proliferation of ballistic missiles has striven to expand its membership

[35] In January 2003, the U.S. introduced an "antiterrorism" proposal to the Wassenaar Arrangement (WA), a group of 33 co-founding nations that strive to achieve transparency and greater responsibility in transfers of conventional arms and dual-sue good and technologies (including UAVs). Expressing concern about the possible terrorist use of kit airplanes and other manned civil aircraft as makeshift UAVs, the U.S. proposal sought export control reviews and international notifications for all equipment, systems, and specially designed components that would enable these airplanes to be converted into UAVs. The WA membership could not agree to cover this area largely because the language was not sufficiently descriptive of precisely what technologies or systems required review and notification. Even though improved language may be introduced in the future, because the WA does not incorporate the MTCR's strong denial rules and no-undercut provisions, the MTCR membership should act quickly to improve its own controls on variable autonomy flight management systems.

rather than to deepen its normative coverage by including cruise missiles and UAVs. This solidifies the second-class status of low-tech cruise missiles and UAVs precisely at a time when their proliferation has become inextricably linked to the spread not only of ballistic missiles but missile defenses as well. To the extent that the international community focuses missile nonproliferation policy on only one part of a complex set of offense-defense interactions, it will have fallen prey to confusing the unfamiliar with the improbable. Without a more comprehensive approach to such offense-defense interactions, more regional states threatened by ballistic and cruise missiles will surely turn to preemptive strike doctrines either instead of missile defenses or as a complementary remedy to offensive missile proliferation.[36]

[36] More research is desperately needed on the impact of ballistic and cruise missile proliferation in the context of missile defense deployments. Now that missile defenses have been deployed in the Middle East and Northeast Asia, a growing body of empirical evidence has become available to examine these offense-defense interactions with greater analytical rigor. At the same time, much more work needs to be done on the role and potential effectiveness of regional missile agreements, including both offensive and defensive systems.

List of published studies and papers
All papers and studies are available as pdf-files at the Commission's website: www.wmdcommission.org

No 1 "Review of Recent Literature on WMD Arms Control, Disarmament and Non-Proliferation" by Stockholm International Peace Research Institute May 2004

No 2 "Improvised Nuclear Devices and Nuclear Terrorism" by Charles D. Ferguson and William C. Potter June 2004

No 3 "The Nuclear Landscape in 2004: Past Present and Future" by John Simpson, June 2004

No 4 "Reviving the Non-Proliferation Regime" by Jonathan Dean, June 2004

No 5 "Article IV of the NPT: Background, Problems, Some Prospects" by Lawrence Scheinman, June 2004

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