WEAPONS OF MASS DESTRUCTION: A PRIMER

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PURPOSE

This paper provides a brief introduction to the topic of Weapons of Mass Destruction (WMD). It is one element of the Comparative Strategic Cultures Curriculum, a resource developed by the Advanced Systems and Concepts Office of the Defense Threat Reduction Agency, with the support of numerous academic and policy experts. The Curriculum is available to academic and professional military education institutions, and is intended to explore connections between strategic culture and the WMD phenomenon, in particular the role of culture in the thinking, decision-making, and behavior of states (and even non-state actors) contemplating, pursuing, or possessing this class of weapons. This primer provides critical background and context for students and faculty who may not be familiar with the core issues that characterize the WMD problem. For purposes of this paper, weapons of mass destruction are defined as nuclear chemical, biological and radiological weapons, and their associated means of delivery. Proliferation refers to the processes by which weapons and the materials, technologies, and knowledge required to produce, acquire, and use them spread globally.[1]

OVERVIEW

Weapons of mass destruction are not a new phenomenon. There are precedents in warfare from ancient times through the medieval era and into the modern age. It was 20th century science and mass industrialization that transformed this phenomenon into the one we appreciate today as posing a uniquely dangerous and destructive threat. While the dangers manifest in the spread of weapons of mass destruction have been studied by theorists and practitioners for many decades now, it is only since the end of the Cold War that WMD have emerged as a dominant security concern. Largely subsumed in the Cold War superpower

[1] There are numerous official and semi-official definitions of WMD, a term that has a history in international diplomacy dating back nearly sixty years. For a detailed examination of definitional questions, see W. Seth Carus, *Defining "Weapons of Mass Destruction,"* National Defense University Center for the Study of Weapons of Mass Destruction Occasional Paper 4, January 2006.

competition, the problem of regional WMD proliferation is now "front and center" and increasingly tied as well to concerns about terrorism and violent extremism.

Regional states possessing or seeking WMD see them variously as a source of strategic leverage, international prestige, regional dominance, local deterrence, and as a means to counter U.S. and Western power in zones of potential conflict. Adversaries seeking to establish an effective framework for competition against established military powers can be expected to accelerate the development of capabilities seen as offering both a measure of deterrence as well as a potential equalizer that will compensate for weaknesses in traditional elements of military or strategic power. Among the asymmetric capabilities adversaries may pursue, WMD will remain of particular concern because of their potential to change the nature of a crisis or conflict, influence the political will of governments and coalitions, impose destruction (or disruption) on a large scale, and achieve other political-military effects. Terrorists see WMD as a means to inflict death and damage on the West on a scale far disproportionate to their resources and status.

The technologies and expertise required to develop and use WMD continue to spread as part of the larger dynamics of globalization. Knowledge that once was esoteric and the province of a small number of nations is now widely available – and not just to other nations. As events have demonstrated, highly destructive technologies can be acquired and mastered by small groups and even individuals. The proliferation of commercial dual-use technology is a driving force in this phenomenon, and can be expected to erode further the technical barriers to WMD proliferation while at the same time increasing the technical competencies of many state and non-state actors. The opportunities for WMD acquisition facilitated by dual-use technology diffusion may be difficult to detect and track. As acquiring WMD becomes more feasible for a wider range of actors, the prospects will grow for "proliferation surprise."

The international regime of nonproliferation treaties and technology controls has played an important role in managing the WMD problem, but it has been less effective in dealing with the most determined proliferators, who use the treaties as a cover for covert weapons development, seek special treaty rules for themselves, and/or choose to stand outside the treaty framework entirely. This is a principal concern today with states such as North Korea and Iran.

STATE PROLIFERATION

Which States?

States of concern range from rogue states to "near peers" and "status seekers," as well as friendly countries responding to proliferation pressures and "failing" states armed with WMD. While not all state-related proliferation developments will pose direct threats, many may be detrimental to U.S. or Western interests.

Rogue States

Rogue states today encompass a handful of determined nations whose intentions and WMD programs have been a source of concern for many years (in particular Iraq and Libya prior to 2003; and North Korea, Iran, and to a lesser extent Syria). In the future, other regional states with hostile or uncertain intent and a commitment to possessing WMD could emerge.[2]

These states present a number of challenges.

- Intelligence. The intentions and capabilities of rogue states seeking or possessing WMD will remain among the most difficult intelligence targets for the United States and its allies. These societies, decision-making circles, and WMD programs are difficult to penetrate. Lack of human intelligence combined with increasingly capable denial and deception efforts contribute to major knowledge gaps.
- Deterrence. Deterring rogue states seeking or possessing WMD may be problematic for a variety of reasons: lack of mutual understanding that increases the likelihood of miscalculation; a high propensity for risk taking; an asymmetry of stakes in regional conflict that may work against restraint; and the vulnerabilities of U.S. and coalition forces and societies.
- Military planning. In part because of the possibility of deterrence failure, armed forces in key regions must prepare for the operational threat posed by rogue states armed with WMD. The credible threat to use WMD (and their actual use) has the potential to negate some traditional military advantages and raise the costs and risks of prevailing. Coalition

[2] Iraq under Saddam Hussein was a prototypical rogue state and along with North Korea and Iran part of the "axis of evil." The principal justification for toppling this regime was its continued pursuit of WMD in defiance of the international community, though little WMD capability has been discovered. Libya, too, was for many years considered a rogue state pursuing WMD. In 2004, Libya agreed to abandon its WMD and missile activities.

building may be more complicated under the shadow of WMD threats. And fielding effective counters to adversary WMD and delivery means is costly and technologically challenging.

- Terror connections. Some rogue states may be prepared to sell or transfer weapons or materials to terror groups for political or economic reasons. States of proliferation concern include those with known or suspected ties to terror organizations. Individuals with access to state programs (e.g., sympathetic scientists) could also provide critical materials and know-how to terror groups with or without government sanction.
- Regional security. The mere possession of these weapons can be destabilizing by upsetting local balances of power, creating the potential for intimidation and coercion, raising the stakes of local crises, and creating additional proliferation pressures. The success of rogue states in acquiring WMD (especially nuclear weapons) could have a catalytic effect leading to an acceleration of proliferation in their respective regions. Success against near-term proliferation challenges (i.e., North Korea and Iran) is thus vitally important to avoiding the nuclearization of entire regions 10-20 years into the future.

"WMD Dominoes"

A major non-proliferation failure in a key region could lead to heightened proliferation pressures and the possibility of a proliferation "chain reaction," including among U.S. allies and friends. Regions today that are of particular concern are East Asia and the Greater Middle East, in response to North Korea's nuclear capability and Iran's nuclear ambitions. Failure to roll back or contain North Korea's nuclear capabilities could lead a number of East Asian states to reconsider their views on the need for an independent nuclear capability. Similarly, a nuclear Iran could be a catalyst for some states in the region in their thinking about nuclear weapons.

"Status Seekers"

A perception that WMD were becoming more prominent as a source of security or status could lead other regional states to consider acquiring WMD more seriously.[3] An important factor here may be the status accorded to nations such as India, which is pressing its claim to

[3] Nations such as Brazil, Argentina, South Africa, Indonesia and Singapore could fall into this category.

global power status based in part on its nuclear capability and, now, its emerging civilian nuclear cooperation program with the United States. States principally interested in the enhanced status associated with WMD may not become adversaries, but their capabilities could be a complicating factor in regional security that affects United States and Western interests and military planning.

"Near-Peers"

States with diverse WMD capabilities could pose different kinds of challenges. One such challenge would be a limited war against a major power with significant WMD capabilities, especially nuclear.[4] If there was a perceived asymmetry of interest in such a conflict, a near-peer or emerging global power could manipulate WMD threats in an effort to influence the U.S. or coalition assessment of costs, risks, and the chances of a rapid military resolution, and to undermine public support. A near-peer could even attempt to use such weapons in ways intended to avoid or limit nuclear retaliation. Nuclear-capable near-peers that also retain significant clandestine stockpiles of chemical or biological weapons could pursue such a strategy.[5]

"Failing States"

Lesser powers armed with WMD whose political stability is uncertain pose yet a different type of challenge. Here the concern is that the WMD of a state collapsing from within or falling to an insurgency could fall into the hands of extremist elements. At best, WMD in the hands of radical forces could confer legitimacy and bargaining leverage. At worst, they could become instruments of coercion and could be shared with affiliated terror organizations. Even absent the transfer of WMD, failed or weak states may serve as a base for training and operations for hostile non-state actors.

Regional States in Conflict with One Another

[4] An obvious example is a U.S.-China conflict over Taiwan. See "Asymmetric Conflict 2010," by Brad Roberts, November 2000 for a discussion of this scenario.

[5] Both Russia and China may be retaining the capability to develop and employ chemical and biological agents. See Annual Report to Congress: Worldwide Nuclear, Biological, and Chemical Weapons and Missile Threat, Department of Defense, January 2003, pp. 40-43.

As weapons of mass destruction continue to proliferate in volatile regions, it is possible that new WMD flashpoints could emerge, even between nations friendly to the West. While WMD conflicts between regional states may not engage the United States or Western powers militarily, their impact on regional and international security could be profound.

Which Weapons?

Nuclear Weapons

Nuclear weapons use fissile materials such as plutonium or highly enriched uranium to produce explosive blast, thermal radiation (extreme heat), direct nuclear radiation, and radioactive fallout. They can be more than a million times more powerful than an equivalent weight of conventional explosives and have the greatest mass destruction potential. The physics and engineering knowledge required to produce fissile material and manufacture weapons dates back to the World War II era; the first atomic weapon was created by the United States and exploded in July 1945. But even today, producing sufficient fissile material remains the key stumbling block to a state seeking to become a nuclear power. These are man-made materials that require a large industrial infrastructure to produce; creating that infrastructure and operating it efficiently takes significant resources, time, and talent. For this reason, the development timelines for some nuclear weapons states is measured in decades.[6]

Nuclear weapons will retain a special status for both those who seek them and those whose interests may be affected by their spread. There are a number of reasons why: their perceived value as an instrument of deterrence and coercion, greater status and prestige relative to other WMD, and threat perception. States facing chemical and biological threats may choose to "proliferate in kind" but also are likely to have other viable options (such as defensive countermeasures). But states facing a credible nuclear threat can be expected to seek access in some manner to nuclear capability as the preferred countervailing course of action. This could take the form of seeking a nuclear security guarantee from an established nuclear power, but could also involve acquiring an independent nuclear capability. In the future, the special status

[6] There are five legally recognized nuclear weapon states under the terms of the 1968 Nuclear Nonproliferation Treaty: the United States, Russia, the United Kingdom, France, and China. In addition, there are four de facto or self-declared nuclear weapon states: India, Pakistan, Israel and, based on its supposed October 2006 nuclear test, North Korea. The United States has not acknowledged North Korea as a nuclear power.

traditionally accorded nuclear weapons could change if nuclear weapons were to be used "in anger." Depending on the impact of such use, nuclear weapons could become more or less attractive as instruments of influence and warfare.[7]

Forty years ago, some serious observers foresaw a world of perhaps two dozen or more nuclear powers. These dire forecasts have not come to pass; overall there has been less nuclear proliferation than once feared, and we are not today facing "runaway proliferation." The technical barriers to developing nuclear weapons and fielding a militarily reliable capability remain significant for many nuclear aspirants, though they are not insurmountable. Historically, proliferation pressures in important regions have been contained through a combination of the nuclear Nonproliferation Treaty (NPT), alliance structures, and various types of security guarantees (some made by the United States, others by the nuclear powers as a group). Today, however, a number of observers believe the world is at a nuclear "tipping point" where traditional constraints and barriers are in danger of eroding significantly.

A number of factors contribute to this assessment and are seen as adding to proliferation pressures.

- Motivations. Some experts believe motivations are deepening, not only because of security considerations (e.g., "lessons learned" from the experiences with Iraq, Iran and North Korea that nuclear weapons provide enhanced leverage or deterrence), but also because many countries associate "nuclear" with modernity and see nuclear science and technology as a powerful means to join the community of advanced nations.
- Capacity. At the same time, nuclear capacity (knowledge, technology, and materials) is significant and growing among an increasing number of actors with increasingly ambitious goals. The expected expansion of nuclear energy in the coming decades will reinforce this. The technologies used to produce nuclear power are essentially the same as those needed to produce nuclear weapons.
- Stress on the nuclear nonproliferation regime. The regime and the norms it embodies are challenged principally by the progress of determined, hostile proliferators acting

[7] Not all experts believe that the continued spread of nuclear weapons will necessarily be destabilizing. The "more may be better" argument holds that new nuclear states will be responsible, cautious, and opt for stable deterrence relationships. The "more may be worse" argument foresees a major risk of miscalculation and accidental war. For an extensive discussion and debate, see Scott D. Sagan and Kenneth N. Waltz, *The Spread of Nuclear Weapons: A Debate Renewed* (New York: W.W. Norton & Company), 2003.

in violation of their treaty commitments. Failure to resolve these challenges could lead to a loss of faith in the ability of the regime to enhance security. Some observers also see the recent U.S.-India nuclear deal as placing added stress on the regime, as it appears to reward a state that is not a party to the NPT and could fuel a nuclear arms race on the subcontinent.

The traditional pathways to produce nuclear weapons are well understood, and encompass a number of methods to enrich uranium or reprocess plutonium to yield the material that comprises the core of a weapon. Typically, these are large, industrial scale enterprises centered around nuclear power production activities that operate under safeguards agreements with the International Atomic Energy Agency (IAEA). Monitoring and inspection systems are geared toward detecting illicit diversion of these activities to support weapons production. Determined concealment and deception efforts can undermine the effectiveness of monitoring and detection efforts. In the future, regional proliferants may have access to new or more advanced technologies that offer a pathway to a nuclear weapons capability that could be even more difficult to detect and track than today's technologies. One such possibility is uranium enrichment using laser technology. Laser enrichment facilities likely would be smaller, less energy-intensive, and more easily concealed – and therefore would be more likely to escape detection by both international inspectors and technical means of surveillance.[8] Also of concern would be a proliferation model in which the amount of fissile material required for entry-level weapons design is significantly reduced and the facilities and activities required to produce such material are correspondingly smaller and less observable.[9] Under these conditions, states may have the option to maintain a *latent* capability to produce some number of nuclear weapons in ways that could be difficult to detect. This model of latent proliferation may appeal to states that desire to retain some type of nuclear option without the burdens associated with maintaining a large production infrastructure or an operational stockpile. This would pose challenges to U.S. intelligence and traditional nonproliferation strategies focused on limiting or monitoring fissile material.

[8] See Jack Boureston and Charles Ferguson, "Laser Enrichment: Separation Anxiety," Bulletin of the Atomic Scientists, vol. 61, no. 2 (March/April 2005), pp. 14-18. Iran's laser research program was not detected by the International Atomic Energy Agency.

[9] See "Combating WMD: Challenges for the Next 10 Years," National Defense University, February 2005, p.13 for a more detailed discussion.

At the other end of the spectrum, major powers such as Russia and China could seek to develop new generations of nuclear weapons based on advanced nuclear energy sources such as subcritical and micro-fission devices, pure fusion weapons, nuclear isomers, positron energy conversion (anti-matter annihilation), and even low energy nuclear reactions ("cold fusion"). Weapons based on concepts like these have the potential to produce more powerful effects more "cleanly" and efficiently than the current generation of nuclear weapons. Numerous reports out of Russia indicate developments along some of these lines.

Radiological Dispersal Devices

A radiological dispersal device (RDD) poses a different type of radiation threat, one most closely associated with terrorists. A "dirty bomb" combines radioactive materials with conventional explosives to scatter radioactive particles into the environment. No nuclear fission reaction takes place as would occur with a nuclear weapon. Almost any radioactive material can be used to construct an RDD, including spent fuel from nuclear reactors and radioactive substances used for medical or industrial purposes, though only a handful of materials are considered optimal. Weapons grade materials (i.e., highly enriched uranium or plutonium) are not needed, but could be used. The RDD threat is fourfold: the blast and fragmentation effects from the conventional explosive, the radiation exposure from the radioactive material used, the fear and panic that would spread among he target group or population; and the economic dislocation and mitigation costs that could result. [10]

Virtually any state or non-state actor can build and detonate RDDs, as explosive material is widely available and radiological materials have become more plentiful throughout the world. Some terror groups are known to be interested in acquiring RDDs. However, not all terror groups are likely to be capable of building lethal RDDs. Acquiring a sufficient amount of material, constructing the device without overexposure to radiation in the process, effectively delivering the device on target, and achieving the necessary lethality are tasks that could present significant challenges. While the perception that all RDDs will have major physical effects is flawed, it is true that almost any use of an RDD could have great psychological and political impact. Thus, even crude RDDs might meet some adversary's objective to create panic, disrupt

[10] Passive, non-explosive sources can also be used to disperse radiation.

military operations or economic activity, or bring public pressure on political leaders to change a course of action.

Chemical and Biological Weapons

States continue to demonstrate an interest in retaining or acquiring chemical and biological weapons capabilities. Some states may view these weapons largely as a deterrent while others may see them as battlefield weapons and fully integrate them into doctrine, plans and training. Still others may see these weapons as most suitable for attacking strategic centers of gravity rather than more traditional military targets. Centers of gravity may be in a theater of operations or on the homeland of Western or coalition countries.

Chemical Weapons. Among WMD, chemical weapons proliferation has been most widespread, as the technical barriers to acquiring and deploying these weapons are significantly lower and they are widely viewed as a "force multiplier" that can be used on the battlefield to achieve military advantage (as during the Iran-Iraq war of the 1980s). Despite the entry into force in 1997 of the Chemical Weapons Convention, which prohibits the development, possession, and use of chemical agents, it is believed that a number of nations, including near peer and rogue states, possess chemical capabilities that could pose a serious threat.

Most covert stockpiles today are comprised of so-called traditional chemical agents, which are poisons that incapacitate, injure, or kill through toxic effects on the skin, eyes, blood, respiratory system, or nervous system. First generation agents, developed in the World War I era, deliver blister, choking and blood effects (e.g., mustard, cyanide, phosgene). Second generation agents, discovered in the World War II era, act against the nervous system (e.g., sarin, soman, tabun). Third generation agents, developed in the post-war period, are a more advanced and lethal form of nerve agent (e.g., VX). There is growing concern that some states are developing or may already possess even more advanced chemical agents that pose a challenge to existing countermeasures – so-called fourth generation agents (FGAs) and non-traditional agents (NTAs). FGAs were first developed by the Soviet Union to defeat U.S. and NATO countermeasures and are considered more lethal than VX, and may be relatively easy to produce in concealed facilities. NTAs operate against different aspects of human physiology and therefore blur the distinction between chemical and biological agents. They generally are

intended to disorient and incapacitate, but can be lethal.[11] Information on NTAs is becoming more available in open sources. Some of these agents are relatively easy to produce and weaponize and their production signature may be less than that associated with traditional chemical agents. Adversaries may view these agents as conferring important advantages.

Biological Weapons. Biological weapons have spread more slowly than chemical weapons, and while the scientific knowledge required to develop bioweapons has begun to diffuse on a global scale as a result of the biotechnology revolution, there are still technical challenges to weaponizing disease agents and delivering them effectively. It is only since the first Gulf War in the early 1990s that there has been a wider appreciation of biological weapons as a potentially serious and dynamic threat. Yet despite sharply intensified concerns about biological weapons, these programs remain the hardest to detect and track. The Biological Weapons Convention, which entered into force in 1975, has strengthened the norm against bioweapons, but contains no provisions for verification of treaty compliance.

Biological weapons are disease-causing microorganisms such as bacteria (e.g., anthrax, plague), viruses (e.g., smallpox), and rickettsiae (e.g., typhus, Q fever), as well toxins, which are non-living poisons produced in biological processes (e.g., ricin, botulin). Pound for pound, biological agents can be many times deadlier than chemical agents, and under conditions favorable to the attacker can cause mass casualties and death. The use of biological agents is considered to be plausible and is a factor in the military planning of some Western nations. States like the former Soviet Union and Iraq clearly believed in the utility of biological warfare (BW) and made major investments to achieve operational capability. But with little historical experience to draw on, there is uncertainty about the strategic and operational impact of BW in shaping the course of a major conflict. Wargaming and scenario-based analysis suggest that under some conditions adversary use of BW could have a significant military impact. Yet questions persist concerning the technical barriers to effective large-scale use, the risks of escalation, and other considerations affecting the strategic utility of BW. Regardless of how the probability of biological warfare attacks is viewed – whether to support specific military

[11] In October 2002, Russian security forces used a derivative of Fentanyl, a fast-acting inhalable opiate characterized as non-lethal and often referred to as a non-traditional agent, in an operation to rescue hostages from a Moscow theater. The gas killed 120 hostages, demonstrating that agents intended to incapacitate can have lethal effects depending upon conditions.

objectives, attack centers of gravity, or simply instill fear and panic – the consequences of such attacks are so potentially devastating that the protection of forces, essential personnel and, to the extent possible, civilians will remain a high priority.

Today, the vast majority of intelligence, operational planning, and countermeasures development focuses on traditional biological agents that have been validated as threats by the intelligence community. Looking ahead, advances in biotechnology that will be increasingly available worldwide create the possibility of qualitative leaps in the biological warfare threat that could outstrip the pace of countermeasures. The diffusion of advanced techniques in the biological sciences eventually will provide scientists everywhere the capability for genetic engineering. The parallel build up of biotechnology industrial infrastructures could help facilitate the translation of these scientific advances into potential weapons application. These applications could take the form of entirely unfamiliar threat agents that challenge existing countermeasures and which may require lengthy scientific investigation to fully understand. In an unclassified assessment prepared in 2003 for the Central Intelligence Agency, the National Academy of Sciences observed:

> …the biotechnology underlying the development of advanced biological agents is likely to advance very rapidly, causing a diverse and elusive threat spectrum. The resulting diversity of new BW agents could enable such a broad range of attack scenarios that it would be virtually impossible to anticipate and defend against…[A]s a result, there could be considerable lag time in developing effective biodefense measures.[12]

Delivery Means

Ballistic missiles will retain their political and strategic importance for regional states. The technical improvements underway in ballistic missiles will continue, leading incrementally to systems that are longer in range, more reliable, and more accurate. Short- and medium-range ballistic missiles already pose a significant threat to expeditionary forces and friendly regional populations. As the transition from short- to medium- to intermediate-range missiles unfolds, the risks facing U.S. and coalition interests will increase accordingly, especially as states make progress in developing WMD payloads for these missiles. Intercontinental-range ballistic

[12] "The Darker Bioweapons Future," Office of Transnational Issues, Central Intelligence Agency, 3 November 2003, p.2.

missiles, if they can be developed by hostile regional powers, would pose an even greater strategic threat.

In response to ballistic missile defenses, adversaries can be expected to consider a number of operational and technical countermeasures. At the same time, the value of ballistic missiles as instruments of coercion or aggression is likely to recede if ballistic missile defenses mature quickly into reliable operational capabilities. One consequence could be decisions by states to shift investment into other systems capable of delivering WMD. Of particular concern are long-range land attack cruise missiles (LACMs), which are an effective means to deliver chemical and biological payloads over a wide area. While few states possess LACMs today, the technologies supporting these cruise missiles are increasingly available and their diffusion can be expected to continue. Unmanned combat aerial vehicles (UCAVs) are also considered well suited for precision delivery of WMD payloads. Both LACMS and UCAVs in the future could possess stealthy characteristics.

At the other end of the spectrum, there is growing concern about the proliferation of increasingly sophisticated missiles and heavy rockets in the 40-200 kilometer range. Relatively inexpensive and easy to conceal and launch, these systems are capable of being fired in rapid-salvo operations to deliver significant firepower. Armed with chemical payloads, for instance, they can pose a strategic threat.

Other types of delivery means are widely available, to include tactical aircraft, unmanned aerial vehicles (UAVs), aerial sprayers, and artillery. Unconventional means of attack may have significant appeal to a state depending on its objectives in employing WMD (for example, if it is hoping to conceal the origins of the attack). Unconventional means include commercial or private aircraft, boats, trucks, automobiles, and other improvised devices.

What Objectives in Crisis or Conflict?

State adversaries may seek to leverage latent or operational WMD capabilities in a number of ways in an effort to shape the political, military, and psychological battlefield in a confrontation with the United States or a Western coalition. These objectives will vary with the phase of a crisis or war, the political and military situation, and the adversary's capabilities and risk calculus. Objectives may be strategic in nature, to include deterring U.S or Western involvement in a regional conflict, preventing coalition formation, fracturing an established

coalition, threatening escalation, and exacting revenge. Objectives also may be operational in nature, to include denying access to coalition forces, defeating operations, and advancing tactical objectives on the battlefield. In seeking to advance their objectives, adversaries may perceive a wide range of potentially lucrative targets, from the homeland of coalition members at one end of the spectrum to tactical forces at the other.

HOW PROLIFERATION IS OCCURRING

Dedicated national programs to develop WMD and delivery means will continue. As in the past, such programs are likely to be covert at least initially, and will take advantage of the growing diffusion of dual-use technologies and the opportunities for concealment inherent in legitimate civilian activities. Recent developments also suggest that proliferation networks are expanding and becoming more complex and sophisticated as states seek to further reduce the visibility of their programs and the risks associated with discovery. Important features of the proliferation process include the following.

Growing Self Sufficiency

Among some states there is increased emphasis on self-sufficiency through the development of indigenous research and production capabilities enabled by the global diffusion of science and technology. Greater self-reliance is seen as limiting opportunities for interdiction and disruption, even if it also limits access to the most advanced technologies. This is a tradeoff some proliferants will be prepared to make.

Secondary Proliferation

States with maturing WMD infrastructures are emerging as suppliers in their own right, and as a consequence there is a growing degree of mutual self-help among proliferants that exists outside international controls and is difficult to detect. This will serve to undermine the efficacy of international technology controls. Over time these relationships are likely to extend beyond supply to include other forms of sharing as well (e.g., WMD operations, logistics, and command and control).

Global Procurement Networks

The A.Q. Khan case demonstrates powerfully that proliferation networks are no longer limited to state-to-state cooperation. The success of the Khan enterprise over a period of many years makes it only prudent to assume that similar networks will arise in the future led by skilled "private" entrepreneurs with access to the materials, equipment, and expertise required to develop WMD, and adept at the systematic evasion of international controls. The emergence of sophisticated networks that are geographically dispersed and functionally diverse – spanning research and development, manufacturing, finances, and transport – presents a fundamental challenge to the system of international technology controls and will require an equally sophisticated response that targets networks as adaptive systems.

"Mobilization" Capability

Some states are likely to rely on a model of WMD surge production and deployment as a means to maintain ambiguity, deniability, and a degree of survivability in their WMD programs. For instance, the ability to rapidly produce and weaponize biological agents would afford a state the opportunity to field an operational capability in the run-up to a conflict while limiting the peacetime exposure of the program. There is evidence that Iraq adopted such a strategy in the aftermath of United Nations inspections in the 1990s (if so, the manifest failure of this strategy could give others pause in following it). Another variant of this approach is the so-called "basement bomb" in which a state chooses to avoid the presumed costs and risks of overtly deploying nuclear weapons in favor of maintaining components that can be assembled quickly to deliver operational capability.

Denial and Deception

Other forms of denial and deception can be expected as states seek to thwart intelligence efforts directed at their WMD programs and protect such programs from possible attack. By the year 2020, most militaries will be sophisticated in the adaptive use of camouflage, cover, concealment, denial, and deception. Of particular concern is the continued proliferation of deep underground facilities to provide sanctuary to WMD programs (as well as leadership and command and control). To cite a contemporary example, the main facility at Natanz, the principal site where Iran would enrich uranium on an industrial scale, is 75 feet below the

surface and protected by concrete walls 8 feet thick.[13] This is a facility constructed to be survivable against air bombardment.

WMD TERRORISM AND THE "CONVERGENCE CHALLENGE"

> *…powerful and readily obtainable capabilities provide contemporary extremist organizations with increasingly dangerous strategic tools. These tools include chemical and biological agents and radioactive materials.*[14]

While terrorists may prefer the innovative application of "low end" technology and proven conventional tactics in many circumstances, the WMD terror threat is believed to be real and growing, and terrorists are judged most likely to use WMD. Foreign terrorist, insurgent or extremist groups that have threatened or have the ability to attack the United States and other nations have expressed interest in nuclear, radiological, chemical and biological weapons. While there remain important gaps in what is known, there is an increasing search among terror groups for capabilities that could create significant casualties, destruction or social-economic disruption, and psychological effects – especially since the September 11, 2001 attacks and the subsequent anthrax incidents.

Materials, technology and information are being sought through commercial sources, the Internet, sympathizers associated with state programs, black markets and criminal organizations, and potential sources in the former Soviet Union. Emphasis is on materials that are relatively easy to acquire and handle and that can be employed surreptitiously. One focus is chemicals, ranging from "low end" applications such as cyanide (e.g., to contaminate food or water) and toxic industrial chemicals to traditional chemical warfare agents (e.g., blister and nerve agent).

Biological agents present a greater technical challenge to terrorists, but have strong appeal because of their potential lethality and the possibility of covert delivery. Al Qaeda made a significant investment in the acquisition of both chemical and biological capabilities for the purpose of mounting large-scale attacks. Al Qaeda's BW program in particular was considerably more robust than originally suspected. Senior intelligence officials publicly have described a sophisticated research program that acquired expertise and equipment needed to produce agents,

[13] Iranian officials have also acknowledged the construction of tunneled facilities to protect nuclear activities.
[14] The Military Strategic Plan for the War on Terrorism, Draft, 15 October 2004. p.5.

received assistance from sympathetic scientists, came close to developing a feasible production capability for anthrax, and may have investigated smallpox.

Al Qaeda's nuclear agenda has also been described as ambitious, focused on efforts beginning in the early 1990s to acquire materials, components and weapons, and to recruit foreign scientists for design and fabrication expertise. Al Qaeda may not have been successful to date in gaining possession of fissile material or a nuclear device, but is more likely to possess materials that could be used in a radioactive dispersal device (RDD). Fabricating and employing such a device is considered well within al Qaeda's capabilities if the materials can be acquired. For this reason, the RDD threat is considered to be highly credible.

Al Qaeda may remain the most serious and immediate threat with respect to WMD terrorism, and has certainly gone farthest to provide a religious, strategic, and practical justification for the use of WMD in the service of jihad.[15] But this threat is not monolithic. There are more than thirty designated foreign terrorist organizations and other non-state actors. It is unlikely that all these entities have comparably broad ambitions for acquiring and using WMD, or even see such weapons as a high payoff means to advance their specific objectives. This argues for a case-by-case approach built on a careful assessment of each group's intentions and capabilities. In thinking about the future character of the WMD terror threat, a fundamental question is whether this will become a routine and growing feature of the security landscape or remain a more or less isolated phenomenon.

In gauging the WMD terror threat, interest will remain focused most acutely on existing and emerging terror organizations that view WMD as weapons of choice to be used against the United States and its security partners for maximum impact. Such groups pose a particularly severe challenge. They are likely to be highly motivated, resourceful, insensitive to retribution, and not easily deterred. They are likely to operate as part of sophisticated, dispersed and adaptive networks. They may focus not simply on individual attacks, but on terror campaigns that involve multiple strikes over a period of time, possibly using different types of weapons. Their preferred means of delivery likely will be unconventional.

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[15] See Robert Wesley, *Al-Qaeda's WMD Strategy Prior to the U.S. Intervention in Afghanistan*, Terrorism Monitor, Vol.13, Issue 19 (7 October 2005), www.jamestown.org/terrorism/news/article and *Al-Qaeda's WMD Strategy After the U.S. Intervention in Afghanistan*, Terrorism Monitor, Vol.13, Issue 20 (21 October 2005), www.jamestown.org/terrorism/news/article

Because they are highly motivated and difficult to deter, terrorist groups intent on acquiring and using WMD are best countered by strategies that emphasize denying their access to WMD materials and technology from state programs, "loose WMD," and the global trade in WMD-related items. Strategic approaches to combat WMD must address the convergence of motivated terror groups, states with WMD, and the WMD proliferation process. This convergence has been characterized by senior government officials as one of the most critical security challenge facing the nation.

IMPLICATIONS

Plan for uncertainty. Gaps in knowledge and understanding will persist with respect to the motivations, capabilities, and intentions of those seeking or possessing WMD, reducing the prospect for specific warning of WMD developments or operational threats and creating the risk of substantial surprise. These knowledge gaps may close over time.

Expect adversaries to adapt. Adversaries are not standing still. They are refining concealment and deception efforts and pursuing technology-based or operational work-arounds intended to challenge or outpace countermeasures. Combating WMD will be characterized by a number of discrete "offense-defense" arms races.

Deterrence will remain an effective strategy against some states possessing WMD, but other states may not easily be deterred. Terrorists in possession of WMD will be most difficult to deter and most likely to use WMD. They will seek to target the United States and its allies.

Prepare for the long-haul. For some aspects of the WMD challenge, quick progress is needed (e.g., reducing the WMD terror threat). But systematically reducing the strategic and operational dangers posed by WMD is a mission for the long-haul that will require strategic patience and determination. Overall, success in countering WMD will be measured in years and decades. Planning, investment and measures of success should reflect this.

"Next use" of WMD will be an important event. The use of WMD may alter fundamentally the proliferation landscape, strategic planning assumptions, and military planning requirements. How dramatically will depend on the "who, what, when, where, why – and how successful" of the event. A number of outcomes is possible, and decision makers will wish to shape the post-use world in a way that advances and protects Western interests.

RESPONSES TO THE WMD PROLIFERATION CHALLENGE

The National Strategy to Combat Weapons of Mass Destruction (December 2002) establishes three pillars of strategy: nonproliferation, counterproliferation, and consequence management.

Nonproliferation

Historically, the response to the proliferation challenge has focused on prevention or what is commonly referred to as nonproliferation. Nonproliferation enterprise has been a political, legal, and diplomatic framework aimed at establishing a norm against WMD acquisition, reducing incentives to proliferate, and restricting access to critical technologies. The main elements of the nonproliferation regime include

- international treaties and supporting institutions (e.g., NPT and IAEA);
- technology control agreements (e.g., Nuclear Suppliers Group, Missile Technology Control Regime);
- national export control laws;
- weapons free-zones (e.g., nuclear weapons free zones in Latin America and Africa);
- security guarantees (e.g., Negative Security Assurances, provided by the legally recognized nuclear powers);
- alliance structures (e.g., NATO and the U.S. extended nuclear deterrent);
- threat reduction assistance (e.g., Cooperative Threat Reduction program to with Russia);
- a range of bi- and multilateral cooperative initiatives (e.g., Proliferation Security Initiative); and
- traditional arms control by the nuclear powers to meet their obligations under Article VI of the NPT (e.g., strategic arms treaties).

Counterproliferation

Counterproliferation emerged as a new type of response to the WMD threat in the United States in the aftermath of the first Gulf War. The premise of counterproliferation was that U.S. and allied forces could confront WMD on the modern battlefield, and needed to be capable of deterring and defeating such weapons – weapons, which the experience with Iraq had shown, could be developed despite the best efforts of nonproliferation strategies. In the United States,

counterproliferation became the rubric under which a range of military capabilities has been pursued, including improved passive defenses, missile defenses, and offensive capabilities to neutralize WMD before they can be used.[16] Counterproliferation also includes cooperation with security partners to improve indigenous capabilities and prepare for possible contingencies involving WMD-armed adversaries.

Consequence Management

Consequence management emphasizes the need to respond effectively to a WMD event at home or abroad, both to limit damage and to demonstrate resilience to adversaries. Consequence management measures seek to mitigate WMD effects, protect public health and safety, provide emergency relief, restore essential government and civilian services, and reconstitute military capabilities as needed. In the United States, the vision for emergency preparedness and response emphasizes an "all-hazards" national incident management plan to deal with any type of event, integrating all federal, state and local response organizations and capabilities. The U.S. Department of State coordinates all foreign consequence management activities.

CONCLUSION

Within this strategic framework, policies to address specific proliferation problems can vary widely and may follow no particular template. Consider recent efforts to deal with the rogue WMD threat. Following the first Gulf War, Iraq was subject to a regime of coercive disarmament through the United Nations. When this process could no longer be sustained, the United States pursued a policy of preventive war to confront what was described as a "gathering threat." By contrast, in Libya, the United States, working closely with the United Kingdom, persuaded the Qhadafi regime, through an extended and secret set of discussions, to disarm under cooperative terms. Here, a policy of "rollback" was achievable because the regime saw its strategic interests lying in a decision to disarm that would bring it tangible economic and political benefits. The six-party negotiations with North Korea represent a broader and more

[16] Other countries may use "counterproliferation" differently. In the United Kingdom, this terms refers to all efforts to address the WMD problem, including those traditionally referred to as nonproliferation. In the United States, the term "Combating WMD" has emerged as the overarching strategic and defense planning construct for all activities directed at managing the proliferation problem.

open diplomatic effort to roll back North Korea's nuclear program – though with a far more hostile and antagonistic regime whose true intentions remain uncertain. And with respect to Iran, the goal is to ensure the Islamic Republic does not achieve a nuclear weapons capability in the first place – prevention, as opposed to rollback. In looking at both North Korea and Iran, while diplomatic solutions are possible, they are not likely to follow the Libya model of highly cooperative rollback; at the same time, the preventive war model exemplified by the invasion of Iraq seems implausible as well. New proliferation challenges that emerge will also required tailored approaches.