



Blue Horizons II

Future Capabilities and Technologies for the Air Force in 2030

Executive Summary

John P. Geis II, PhD, Col, USAF
Christopher J. Kinnan, Col, USAF
Ted Hailes, Col, USAF (Retired)
Harry A. Foster, Col, USAF
David Blanks, Col, USAF

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by

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About the Authors

Col John P. Geis, PhD, is the Spaatz Center's director of the Center for Strategy and Technology at Maxwell Air Force Base (AFB), Alabama. He entered the Air Force in 1983 and has served as an instructor, weapons systems officer, navigator, and fire control officer on such aircraft as the F-111A, F-111E, T-37, AT-38B, T-43, and AC-130H. Operationally, he served as a planner for Operation Eldorado Canyon, flew combat missions over Bosnia-Herzegovina, and commanded a special operations task force in Korea. In 1996, Colonel Geis co-authored the alternate futures monograph for the chief of staff-directed Air Force 2025 study. Shortly thereafter, he served as chief, Strategic Planning, Doctrine, and Force Integration Branch at Headquarters Air Force Special Operations Command, leading all long-range planning, doctrine development, and joint force integration for all Air Force Special Forces. Colonel Geis graduated from the Air War College in 2001 and served as the director of the Center for Strategy and Technology until 2004. After earning his PhD from the University of Wisconsin, Colonel Geis returned to the Center for Strategy and Technology in 2007 and is again its director. In 2008, Colonel Geis co-authored a *Peer China in 2030* monograph for the USAF's *Blue Horizons II* (published May 2009) study. Colonel Geis has a bachelor of science degree in meteorology from the University of Wisconsin, a master of political science degree from Auburn University, a master of strategic studies degree from the Air War College, and both a master of arts and a doctor of philosophy degree in political science from the University of Wisconsin.

Col Christopher J. Kinnan is the Spaatz Center's deputy director of the Center for Strategy and Technology at Maxwell AFB. He entered the Air Force in 1987. A space and missile officer, Colonel Kinnan was previously assigned to the Air Staff as the deputy chief of Air Force Nuclear Operations. Colonel Kinnan has served as a crew commander, instructor, and operations officer on the Minuteman III (MMIII) Command Data Buffer, Peacekeeper, and the MMIII Rapid Execution and Combat Targeting systems; a crew commander, and instructor for missile warning, satellite operations, and spacelift systems; and as a space weapons officer. Operationally he has served as the space weapons officer for Joint Task Force (JTF)-Southwest Asia. During Operation Iraqi Freedom, he served as a planner for JTF-4 and as the deputy

chief of plans for both the Office of Reconstruction and Humanitarian Assistance, and the Coalition Provisional Authority in Baghdad, Iraq. He helped develop a Phase IV security and stability operations plan for Iraq, wrote and executed the plan establishing the Baghdad office of reconstruction and humanitarian assistance regional headquarters, and led the interagency team that planned and executed a complex and successful 30-day, \$450 million effort that paid salaries and provided emergency payments to three million Iraqis. From 2004–2006, he commanded the 45th Operations Support Squadron at Patrick AFB, Florida. In 2008, Colonel Kinnan co-authored the *Failed State monograph* for the USAF's *Blue Horizons II* study. Colonel Kinnan is a distinguished graduate of the Air Force Weapons School, an in-residence graduate of the Army Command and General Staff College, and graduated with distinction from the Air War College. He has a bachelor of arts in Russian/East European area studies from Auburn University, a master of management of information systems from Lesley College, a master of airpower arts and sciences from the School of Advanced Airpower Studies, and a master of strategic studies from the Air War College in 2008.

Col Theodore C. Hailes, USAF, Retired, is the Office of the Secretary of Defense chair for Force Transformation at Air University and a founding member of the Center for Strategy and Technology. In addition to his work in technology, he is also on the faculty of the Air War College, teaching courses on national security decision making, international security studies, and regional studies field seminars. He completed a 30-year career in the Air Force before retiring in 1996. He flew the F-4, O-2A, F-5, and the F-15, accumulating over 4,000 hours, of which 500 were in combat. He served in Vietnam as a forward air controller with the 2nd Brigade, 101st Airborne Division, and finished his fighter career as squadron commander of the 22nd Tactical Fighter Squadron, and then director of operations of the Northeast Air Defense Sector. He served at the Pentagon from 1979 to 1983, working in international programs and was executive officer for the Air Force chief of public affairs. Colonel Hailes has been on the Air War College faculty for 19 years, holding positions of department chairman, associate dean of the faculty, and as the office of force transformation chair. In this latter capacity, he has supervised a number of studies, both for the United States Air Force (USAF), and the Defense Advanced Research

Projects Agency. He has a bachelor of arts degree in history from Denison University and a master of science degree in international relations from Troy University.

Col Harry A. Foster is the chief of strategy for USAF Central at Al-Udeid, Air Base (AB), Qatar. While a student at the Air War College in 2008, Colonel Foster co-authored the executive summary for the *Blue Horizons II* study. A combat experienced instructor pilot in three aircraft (F-16, B-2, and B-1), he has commanded an operations support squadron and served in the Air Staff's Checkmate Division. He holds graduate degrees from Marine Command and Staff College at Quantico, where he was a distinguished graduate; the School of Advanced Air and Space Studies at Maxwell AFB; the Harvard Kennedy School at Cambridge; and the Air War College at Maxwell AFB, where he graduated magna cum laude.

Col David P. Blanks is the deputy director of the Air Force Research Lab's Propulsion Directorate at Edwards AFB, California. Colonel Blanks has had a variety of assignments in the acquisition, test, and evaluation career field. Additionally, he has served as an air officer commanding at the USAF Academy. He served as a basing and force structure staff officer with the USAF in Europe, Ramstein AB, Germany. He deployed to Afghanistan, working in the Office of Defense Cooperation and laying the groundwork for the emerging Afghan air force. His most recent assignment was as commander, 421st Air Base Squadron, RAF Menwith Hill, United Kingdom, a diverse unit of more than 300 personnel for whom he provided base support. While a student at the Air War College at Maxwell AFB in 2008, Colonel Blanks co-authored the *Resurgent Russia* monograph as part of the USAF's *Blue Horizons II* study. He has a bachelor of science degree in engineering mechanics from the USAF Academy, a master of operational art and science degree from the Air Command and Staff College, and a master of strategic studies from the Air War College.

Preface

In 1996 the Air Force initiated a major study effort under the direction of Gen Ronald R. Fogleman, the Air Force chief of staff. That study, *Air Force 2025*, looked 30 years into the future and made enormous contributions toward directing Air Force research and procurement.

In 2007 Gen T. Michael Mosley, Air Force chief of staff, directed a continuous series of future thinking and study efforts be undertaken, using Air University (AU) as the “Air Force’s think tank.” This study, *Blue Horizons*, was commissioned by the United States Air Force (USAF) chief of staff to provide “a new look at the future.” Specifically, the chief of staff asked the research team to provide “a common understanding of future strategic and technological trends for Air Force leaders to make better decisions.” The chief also sought to “confirm AU as [the Air Force’s] in-house think tank” and to improve the relevance of Air Force education to the decision-making processes in Washington.¹

The best and brightest officers from the Air Force and the sister services participated during their one-year AU courses of instruction, building four alternate scenarios to act as a foil to evaluate future systems and technologies, to determine the optimum path forward for Air Force investment. These senior officers each spent a year researching and traveling to their respective regions of concern. In the end, the team built four scenarios based on challenges found in the *National Security Strategy*.

These scenarios include a resurgent Russia, a peer China, a jihadist insurgency in the Middle East, and a failed-state scenario in West Africa. The authors then evaluated 58 potential future systems or concepts and 172 key enabling technologies to determine what capabilities the Air Force would need to maintain superiority in air, space, and cyberspace to the year 2030.

Executive Summary

This second iteration of the *Blue Horizons* study, commissioned by the USAF chief of staff, provides “a new look at the future.” Its original purpose was to develop a prioritized list of concepts and their key enabling technologies the USAF would need to maintain dominance in air, space, and cyberspace to the year 2030. In addition, the study examined whether the USAF could leverage a targeted investment today to position itself to address a broad set of possible challenges over the next 20–30 years.

The study has some built-in assumptions. It assumes exponential science and technology growth will continue. The research team determined that a series of disparate alternate futures provides the best tool to evaluate future challenges. Four alternate futures were built based on extensive academic and field research. While the scenarios are not intended to be read as predictions, each is plausible, and the future may see one or more of these scenarios unfold. Their purpose, however, is to act as a tool to assess how best to accomplish the core USAF missions, which are assumed to remain in the domains of air, space, and cyberspace for the foreseeable future.

The researchers discovered that regardless of the scenario, accelerating technological advances are interacting with a shifting strategic landscape to produce massive, dynamic change. This change acts as a catalyst, creating a very disturbing and *disruptive threat* to the United States and a serious challenge to the USAF’s future dominance in air, space, and cyberspace. Future enemies will be *motivated* by resources, fear, and hate; *empowered* through education; and *enabled* through technology and globalization to directly challenge the United States. The *enemy* will be different—the targets they present in 2030 will be more *difficult* to find, *harder* to hit, more widely *distributed*, and more *dangerous*.

Within the context of the 2008 *Blue Horizons II* study, researchers examined four separate possible alternate futures—a peer China, a resurgent Russia, a successful jihadist insurgent overthrow of a friendly state, and a failed state with a vital US interest.

Alternate Futures

The researchers used a forecasting technique known as “alternate futures” to help them envision worlds where the

United States must be able to survive and prosper in the future. The study team identified individual factors of change in the future.

Peer China

While the last 100 years have been called the American century, the world may be at the beginning of the Asian millennium. The ancient Middle Kingdom is again on the rise, and China's destiny, like its past, seems to be one of preeminence. Every indicator suggests in the next 30–50 years, China will be the world's single strongest state, both economically and militarily. While some strategists, historians, and scholars quibble about dates, few argue the outcome.

Although seeking a “harmonious society” in a “harmonious world”—words Chinese leaders use to describe their vision for domestic and foreign policy—China's rising power will present its leaders with an array of strategic options both regionally and internationally. Chinese leaders face several largely internal stressors that could threaten their “mandate from heaven” (a source of legitimacy in Chinese culture) and move it in a different direction from its stated goals of achieving a harmonious society in a harmonious world.

China also enjoys the advantages of interior lines within the region plus strategic depth within its own territory. A peer China will likely be a formidable nation militarily, with a range of advanced weapons and the ability to initially deny US penetration inside the second island chain. Thus, the USAF will need technologies to enhance capabilities in range; persistence; cyberspace; airlift; intelligence, surveillance, and reconnaissance (ISR); force protection; and space.

Resurgent Russia

Russia has a turbulent history. Traditions and cultural pressures have instilled in the Russian psyche a belief that strives for stability and seeks strong leadership. Russia values stability and strong leadership even when these traits conflict with democratic ideals. After each change in governance, Russia always returns to form and is now easy to follow in what is regarded as the Putin era.

Since the fall of communism in 1991, Russia has been in constant governmental transition. Perestroika brought about “openness,” but the first foray into democracy was

fraught with corruption and poor execution of national goals. Since assuming power in 1998, then-Pres. Vladimir Putin federalized power, restoring authority to the Kremlin and Moscow. Coupled with new wealth and a Russian psyche for a strong, autocratic leader, now-Prime Minister Putin maintains tremendous public support even while reducing civil liberties.

The consolidation of power in an authoritarian-style government is leading Russia back onto the world stage. The direction Russia will take over the next 20 years is uncertain, but its growing influence on the world scene, and the particular challenges it will present to the United States by 2030, indicate Russia may again become an adversary rather than a reliable friend. Thus, the USAF will likely require technologies to enhance its capabilities in space, cyberspace, directed energy, and ISR.

Failed State

Nations fail for a myriad of reasons including cultural and religious conflict, a broken social contract between the government and the governed, a catastrophic disaster, financial collapse, and war. Nigeria, like many nations in sub-Saharan Africa, the Middle East, Southwest Asia, and Southeast Asia, is a compelling candidate for failure. In its relatively short modern history, Nigeria has survived five military coups and separatist and religious wars. It is currently mired in an active armed insurgency over disastrous ecological conditions in the Niger Delta region and is fighting a difficult battle against one of the worst legacies of political and economic corruption in the modern world. Nigeria with its vast oil wealth, the largest population in Africa, and its strategic economic and geographical position could, if it fails, disproportionately impact the United States and the global economy.

Civil war is the most likely outcome of almost any state failure. To rapidly intervene in the event of state failure and prevent a full-scale civil war, the USAF will require enhanced capabilities to detect and understand what is happening on the ground, rapidly deploy a large and capable force to almost any location in the country, allow the deployed force to survive and sustain itself, and enable the deployed force to precisely engage only belligerents while protecting and assisting noncombatants. Unlike the previous scenarios, all of

this must be done while conducting a humanitarian relief operation of unprecedented scale.

Jihadist Insurgency

The United States is now actively immersed in counter-insurgency warfare in an array of locations around the globe. While the operations in Iraq and Afghanistan are foremost in the minds of observers, other operations, often with an air, space, and/or cyber orientation are being directed against insurgent and terrorist operators in many countries. Examples of such operations include recent air strikes against nonstate enemies in Pakistan and Somalia.² Martin van Creveld notes the trend is clear—insurgency has become the “warfare type of choice” of numerous nonstate enemies of the United States.³ Of all types of insurgencies, a jihadist insurgency provides numerous challenges for the United States and other nations dependent on the Middle East oil supply. The United States will likely retain significant interest in the future of most countries on the Arabian Peninsula not only for economic reasons but also because it is the location of the two holiest cities of Islam, Mecca and Medina. If these cities were to fall into the hands of radical Islamists, it could enable a charismatic radical leader to emerge as the new caliph who would then attempt to unite Muslims throughout the world under an extremist ideology. With Iraq becoming a Shi’a-dominated state, Saudi Arabia and other smaller states on the Arabian Peninsula serve as an important Sunni counterweight to Shi’a Iraq and Iran in maintaining a regional balance of power. Thus, the USAF must develop robust counterinsurgency capabilities that include information operations, unconventional warfare, ISR, mobility, precision engagement, and command and control.

Study Scope

The 2008 *Blue Horizons II* study does not specifically address new high explosive or nuclear weapons technology. While nanotechnology, biotechnology, and materials science were scored in the technology model,⁴ the study team is concerned these sciences may still be underrepresented. These technologies will be researched in greater detail in the 2009 study iteration—*Blue Horizons III*.

Study Findings

The study shows technological proliferation will continue providing groups and individuals access to new capabilities, some of which once exclusively belonged to nation-states. These new technologies are making distant and ideologically opposed countries “close neighbors,” as they are eliminating the traditional “sanctuary” of time and distance. This changing strategic landscape empowers more actors, which will create greater competition and new tensions between states, groups, and individuals.

... [For the United States Air Force] the concepts, systems, and technologies required to fight a peer competitor do cover, as a lesser included case, conflict against insurgencies and the types of operations in failed-state scenarios.

These technologically empowered groups and individuals will be agile, adaptable, and unencumbered by history. By 2030 their access to advanced technologies and lack of constraints will empower them to “out-ODA [observe, orient, decide, act] loop”⁵ even advanced nations hamstrung by bureaucratic thinking. Against this backdrop of alternate futures and the evolving future strategic environment, the USAF in 2030 must field a nimble and responsive force—masters of advanced technology—presenting the nation options against a multitude of future possibilities.

A surprise finding is that for the Air Force, the concepts, systems, and technologies required to fight a peer competitor do cover, as a lesser included case, conflict against insurgencies and the types of operations in failed-state scenarios. Despite developing different quantitative models for each alternate future, the rank order of both concepts and technologies does not significantly change between conflict types, except in the domain of space. The capabilities needed to fight a peer China include the capabilities needed for failed states and insurgencies.

... the Air Force **must invest in a broad range of enabling technologies** to bring the necessary capabilities and systems to fruition, or it will be unable to effectively maintain dominance in its core missions and domains.

The capabilities the Air Force will most need in the future include *increased range, greater persistence, better defensive capabilities* for systems in all three domains, a greater *variety of unmanned systems, better offensive capabilities in cyberspace*, and the need for a *much faster command and control* set of processes. Evaluation of the technology portfolio necessary to achieve these capabilities yields the conclusion that the Air Force must invest in a broad range of enabling technologies to bring the necessary capabilities and systems to fruition, or it will be unable to effectively maintain dominance in its core missions and domains. In short, any strategy which involves disinvestment in laboratory programs is assessed to be a strategy of very high risk.

Chapter 1

Introduction

In this study, the Air University (AU) Center for Strategy and Technology (CSAT) was asked to look 20–30 years into the future to provide a prioritized list of concepts and their key enabling technologies that the Air Force would need to maintain the dominant air, space, and cyberspace forces in the future. This study, *Blue Horizons II*, provides a new look at future capabilities and technologies through the lens of plausible alternate futures that could emerge in 2030. It is the first such study since *Air Force 2025*.⁶ This report examines the capabilities required across four plausible future scenarios, drawn from the 2008 *National Security Strategy*. These scenarios are as follows: a peer China, a resurgent Russia, a failed state of Nigeria, and a successful jihadist insurgency in the Middle East.

Methodology

The 2008 *Blue Horizons II* study is grounded in reputable scholarship. It includes extensive background research, interviews, and actual site visits to the locations in question. The researchers began with a literature search across international relations, political economy, and cultural and military studies literature. Each researcher conducted interviews with senior members of the Department of State, the national intelligence agencies⁷, the Department of Defense (DOD), and senior leaders of the governments in the affected states and regions.

The team engaged in a modified Delphi method⁸ of generating conclusions about both the present as well as each alternate future's direction. These conclusions were then revetted against a series of experts and against the fellow team members to adjust hypotheses and then reengage in additional research and interviews.

In these sessions, a formal Delphi method⁹ was used which included a broad cross section of 22 senior DOD civilian and military strategic thinkers. This scenario-based discussion involved several iterations wherein the researchers interacted with three opposing teams to generate a more complete picture of the challenges each alternate future might present by 2030.

Members of the Headquarters USAF Strategic Planning Directorate, AU students, and researchers from a variety of agencies developed a list of technologically feasible future concepts or systems the USAF either would have or could have in its inventory for the target year (2030) in question.¹⁰ The future concepts examined were vetted by scientists in the relevant disciplines to ensure these

systems were technologically feasible and could be procured, if needed, within the next 20 years.

The final aspect of this analysis involved using a value-focused-thinking quantitative model to formally evaluate the potential future concepts for utility across the range of alternate futures.¹¹ This model was developed and run under the direction of the AU CSAT, with the assistance of Innovative Decisions, Inc., whose members include some of those cited in the seminal works on this method in the endnotes.

Overview

This report begins by examining each of the four alternate futures: a peer China, a resurgent Russia, a failed-state scenario in Nigeria, and a jihadist insurgency in the heart of the Middle East. While each future was developed in great depth and published separately, this report provides a basic understanding of the nature of these futures and the challenges they could pose for the USAF.

Across these alternate futures, two value-focused-thinking models were estimated. This report examines the results of this modeling, and then discusses the patterns that are clearly evident in the results. This report concludes by offering some recommendations regarding the harsh realities that lie ahead. These recommendations are purposefully aimed at the study's target year of 2030, about two decades from when this report is being written.

Alternate Futures

- **Peer China**
- **Resurgent Russia**
- **Failed-State Nigeria**
- **Jihadist Insurgency**

Chapter 2

Alternate Futures

Using a forecasting technique known as “alternate futures,” the researchers envisioned worlds where the United States must be able to survive and prosper in the future. The study team identified individual factors of change in the future.

Peer China

In 2030 China is a peer to the United States.¹² Its culture remains fairly constant; its political system will be under the control of its sixth post-Mao generation leadership; its economy may be ahead of the United States, though per capita income is still lagging behind; and its military spending, while likely greater than the United States, has yet to produce a military fully equal to the United States.

China has long viewed itself as the “Middle Kingdom” or the center of civilization. With the largest population in the world and a fast-growing economy, China is well positioned to reinvent itself. In 2007 China’s economic growth was more than 11 percent. Even in the stressed global economy, its economy is expected to grow by 7.5 percent in 2009.¹³ This economic growth is critical to China’s internal harmony; it also provides the means for China to acquire and build the resources to project its power beyond the region.

A Path toward a Peer China

China’s president, Hu Jintao, calls his vision for leading China into the twenty-first century a harmonious society (“和谐社会”, he xié shè huì). This term harkens back to the Boxer Rebellion,¹⁴ where the Chinese revolted against United States and colonial/imperial powers’ interests. After roughly 100 years of foreign power exploitation and occupation, the Boxers, in their quest to expunge China of “foreign barbarians,” are hailed by today’s Chinese leaders as heroes of the state. The Chinese name for what the colonial powers called “Boxers,” was the “righteous and harmonious society”¹⁵ (“正义与和谐社会,” zhèng yì yǔ hé xié shè huì). Gaining deeper insights into President Hu’s harmonious society vision is possible when considering that his phrases’ historical connotation describes an attempt to defeat foreign humiliation and abuse.

Hu describes harmonious society as a scientific development concept,¹⁶ shifting China’s primary focus from a pure economic-growth model to a more balanced, Confucian-style approach aimed at maintaining growth while addressing social issues such as the gap between rich and poor, environmental degradation, and government and corporate corruption.¹⁷ Post-Mao Zedong China, beginning with Deng Xiaoping in 1978, remains authoritarian but

continues to build on policies promoting openness and integration with the international community.

The fundamental precept of this opening is China's 24-character strategy first articulated by Deng. The 24-character strategy refers to 24 Chinese characters which are and translate to the following:

“冷静观察，站稳脚跟，沉着应付，韬光养晦，善于守拙，绝不当头。”

“Observe calmly; secure our position; cope with affairs calmly; hide our capacities and bide our time; be good at maintaining a low profile; and never claim leadership.”¹⁸ It complements Hu's call to “hide brightness, nourish obscurity.”¹⁹ These ideas appear to guide China's modern leaders as they chart a course toward growth while avoiding conflict between global actors.

China's leadership understands a return to the Maoist economic policies would be a disaster, as the removal of market incentives under Mao demonstrated.²⁰ In contrast, for the past 30 years China has experienced unprecedented growth resulting from the macro-economic policy decisions beginning in 1978. The Central Intelligence Agency's *The World Fact Book 2007* ranked China as the world's second largest economy in 2006, based on purchasing power parity. The Economist Intelligence Unit reported China's real gross domestic product (GDP) growth for 2007 was 11.5 percent. China's exports have increased more than 650 percent over the past nine years, which is equally impressive.²¹

Goldman-Sach's most recent work, *BRICs and Beyond*, discusses a range of predictions for China's economy in 2030 ranging from a low of \$11,000 per capita GDP (\$16 trillion total) to as much as \$22,000 per capita GDP (\$32 trillion). Given this report estimates the United States per capita GDP at \$61,000, it implies that at any level above the low end of the forecast range, China's economy will pass the United States in the 2020s.²² The most optimistic forecast for China's economy comes from the International Monetary Fund, which predicts China's economy will dwarf the United States by a factor of at least three by 2030.²³ This level of economic growth, coupled with a government-stated objective of spending 5 percent of China's GDP on defense, may yield a very different military power in Asia within the next 20 years.

Through an aggressive program combining foreign purchases primarily Russian and indigenous programs, China has developed and will continue to develop significant capabilities for power projection, antiaccess, and area denial. China's modernization program is focused, for at least the next decade, on providing capabilities necessary to prevent Taiwanese independence. By 2030 China will likely have far more robust and new diverse capabilities.

China will have antiaccess capabilities, including “assassin's mace”²⁴ weapons, to deter or counter any adversary near Chinese territory. Specific aims of the antiaccess strategy will be to slow

deployment of adversary forces and compel these forces to operate from distances further than desired.²⁵ To achieve these aims, Chinese doctrinal writings propose a combination of conventional and asymmetric weapons. These include the use of medium-range ballistic and cruise missiles, aircraft, and covert operations to attack regional adversary bases. These same weapons, along with electronic jamming, antisatellite (ASAT) weapons, electromagnetic pulse (EMP)²⁶ weapons, and computer network attacks are being designed to degrade adversary command and control and early-warning capabilities. Finally, submarines, destroyers, aircraft, mines, cruise missiles, and conventional ballistic missiles may be used to attack aircraft carriers, forcing them to operate up to 1,500 kilometers away from China.²⁷

In parallel with producing antiaccess capabilities, China will have systems to project military power beyond the region.²⁸ New Chinese conventional theater ballistic missiles are already capable of projecting power beyond Taiwan.²⁹ Further, the People's Liberation Army (PLA) is seeking to purchase or develop over-the-horizon sensors and space-based ISR assets to track distant naval targets.³⁰ One-quarter of the PLA's current maneuver divisions and brigades focus on training for amphibious operations,³¹ and China will soon deploy a new amphibious assault vehicle while modernizing its existing ones.³²

Over the next 20 years, Chinese shipbuilders will likely produce very large ferries that can carry hundreds of troops with light armor, artillery, and supplies up to 1,000 nautical miles at speeds around 60 knots, allowing the PLA to quickly deploy large numbers of forces in the near abroad.³³ The Chinese air force will soon field its first-ever aerial refueling capability, extending the range of strike and bomber aircraft beyond the Taiwan Strait.³⁴ Finally, advanced destroyers and nuclear submarines, both Russian- and Chinese-made, will considerably advance China's naval power-projection abilities.

China will deploy approximately three aircraft carriers.³⁵ In October 2006 Lt Gen Wang Zhiyuan of the PLA's General Armament Department stated "The Chinese army will study how to manufacture aircraft carriers so that we can develop our own. . . . [A]ircraft carriers are indispensable if we want to protect our interests in oceans."³⁶ Such development is likely soon; *Jane's Defense Weekly* reported in late 2008 that China has begun training its first squadron of carrier-qualified pilots.

By 2030 China is expected to have a very modern military. Its navy will have at least a few, and possibly several carrier battle groups, as China will have all the elements necessary to deploy a carrier strike group well before 2030. In addition, China is on track to field state-of-the-art ballistic missile and fast-attack nuclear-powered submarines, probably much sooner than 2030.³⁷

A pillar of Chinese antiaccess strategy will continue to be ballistic and cruise missiles. China is expected to have hundreds of modern

land-attack cruise missiles by 2030,³⁸ and if current trends persist, several thousand submarine-launched missiles, many designed to penetrate carrier battle group defenses. The US Navy's sea-basing concept, if employed, will provide attractive targets for these systems. In addition, improved EMP warheads will specifically target naval computers and electronic command and control systems.

Technologically, Chinese air defense systems and aircraft are improving at a rapid pace. Modern SA-10/20 surface-to-air missiles, from both land and ships, provide coverage across the entire Taiwan Strait and make control of the air a serious challenge even today.³⁹ Also, China is developing at least one or two fifth-generation fighters, which will likely be fielded by 2030. The J-12, by Shenyang Aircraft Company, is similar in size, shape, and capability to the F-22.⁴⁰ In parallel, Chengdu Aircraft is developing the J-10A, possibly with Russian assistance. Chinese engineers have designed this canard aircraft to be larger than the J-12 but with many of the same features including plasma-stealth technology to provide stealth without significantly altering the fourth-generation fighter shape of the J-10.⁴¹ Achieving air superiority will almost certainly be difficult and costly for any future Chinese adversary operating in the South China Sea.

In addition to the conventional capabilities above, China is also developing emerging, unconventional forms of military power including space and counterspace systems, directed-energy (DE) weapons, and information operations. Chinese analysis of recent US military operations has convinced them that the United States is dependent on its network of space-based assets, and the vulnerability of these assets creates a substantial weakness that may be exploited.⁴² In the eyes of Chinese analysts, US dependence on space represents "the United States military's 'soft ribs' and strategic weaknesses."⁴³ In addition to the direct ascent ASAT, China is developing a family of ASAT options including ground attack, co-orbital "killer" satellites, DE weapons, and electronic attack.⁴⁴ China's goal is "information supremacy," thereby increasing battlefield transparency for Chinese commanders, while creating "fog" for their enemy.⁴⁵

By 2030 China will use asymmetric forces to confuse, weaken, and slow their adversaries. After decades of sustained growth and modernization, China will be a military peer of the United States, at least regionally, and a potential rival with limited blue-water naval capabilities.

Peer China 2030—Causality and Impact

Chinese leaders face several largely internal stressors that could threaten their mandate from heaven—a source of legitimacy in Chinese culture—and move it in a different direction from its stated goals of achieving a harmonious society in a harmonious world. These chal-

lenges include a sharp economic downturn, loss of domestic food production, or an inability to meet domestic energy needs.

A sharp economic downturn could foment instability. The rural areas expect coming prosperity as envisioned in *Harmonious Society*, and the developed urban areas expect continued prosperity. Both groups have internalized government rhetoric about more democracy. Further, the number of public demonstrations is increasing. While China has very substantial cash reserves, the societal response to an economic crash cannot be predicted.

China may have problems feeding its people. Today, only 10 percent of China's land mass is arable, and this figure is decreasing due to poor farming practices and climate change. Rising standards of living bring increased consumption of foodstuffs. Given the trend in its arable lands and population, at some point around 2015, China will transition from being a net food exporter to becoming a net food importer. Domestic instability may result should the national government be unable to meet the nutritional needs of its people on the open markets. If this should occur, a clash of interests between China and US allies becomes possible.

Similarly, China's already huge energy consumption will more than double by 2030. Like the food crisis, China is concerned about its future energy supplies. Thus, it has cultivated close relations with Middle East nations such as Iran. As world demand begins to exceed supply, China's need for energy to continue to build its economy could become unacceptably constrained. This too could be a *casus belli* for China.⁴⁶

Interestingly, this research concludes that conflict with Taiwan is probably not likely. China and Taiwan are both aware of the costs of going to war. As China continues to open its markets and its politics, the differences between them decrease. As a result, absent an all-out declaration of independence by Taiwan, conflict here seems unlikely.

Capabilities Needed to Respond to a Peer China Crisis

China enjoys the advantages of interior lines within the region plus strategic depth within its own territory. A peer China will likely be a formidable nation militarily, with a range of advanced weapons and the ability to initially deny US penetration inside the second island chain (i.e., the Marianas and Guam). The combination of these two factors places a large premium on several capabilities.

The USAF will need to both airlift supplies into and operate from areas near or perhaps even under the large Chinese integrated air defense system umbrella. This suggests a need for robust survivable basing infrastructure, and due to the vast distances of the Pacific, a large and fast survivable lift capability.

Any conflict with China will require the ability to attack strategically important targets from very long standoff ranges. Until the

Chinese air defense system is destroyed, it is possible that existing fighter aircraft would have to refuel well inside of the range of China's defenses, which may be able to reach and destroy aircraft at distances over 1,000 miles. Persistence and range, therefore, become valuable characteristics.

In cyberspace the ability to defend Air Force networks from major attacks while still being able to engage in warfare in the cyber domain is critical against an adversary as technologically advanced as the United States. Much has been written about China's potential cyberspace capabilities; by 2030 they will have advanced significantly. The Air Force must be ready.

In the area of space, China's already demonstrated capabilities indicate a need for the ability to rapidly reconstitute assets in space. Modular satellites that can be built to order and launched within very short periods of time (e.g., 48 hours) could prove quite valuable.

Lastly, China is developing DE (laser and microwave) capabilities. The USAF should develop and field protection against these types of weapons. Computer systems may be especially vulnerable to attack. Canvass, the most common building material for expeditionary bases, offers no protection as a barrier.

Resurgent Russia

Penned prior to the recent invasion of Abkhazia and South Ossetia, this alternate future scenario stresses the USAF in a state-on-state confrontation with a strong and modern competitor whose interests may conflict with US interests and those of its allies. This scenario is made plausible by recent changes in Russian governance, which appears to be on a path toward greater centralized control. This combined with Russia's historic paranoia and belief that it needs a buffer along its perimeter—a buffer now incompatible with the member states of the expanded North Atlantic Treaty Organization (NATO) alliance—validate and demonstrate the relevance of this scenario. Russia, the world's largest and most mineral-rich nation, may present a formidable challenge in the future as it taps its vast oil, natural gas, and mineral resources.⁴⁷

Russia has had a turbulent history as it moved from its Tsarist past, through the Soviet interregnum, to its brief flirtation with democracy. This history and its associated cultural pressures have instilled in the Russian psyche a desire for stability and strong leadership.⁴⁸ Furthermore, Russia tends to value stability and strong leadership even when these traits conflict with post-Renaissance democratic ideals.⁴⁹ After each change in governance, Russia has always returned to an authoritarian-style government that seeks to lead Russia back onto the world stage. Their history explains why Russia often displays the mentality of a paranoid nation.⁵⁰ As such, a resurgent Russia⁵¹ may become a challenge for the United States and its allies.

The Development of a Resurgent Russia

Russia is already reasserting itself as a world power in terms of its geography, politics, nationalism, and religion.⁵² Prime Minister Putin is acutely aware of Russian paranoia and is restoring a sense of nationalism and strength in the Russian people. The latest efforts to restore Russian pride include claims for the North Pole⁵³ and reviving the Russian space program in an attempt to be the first country to send a manned mission to Mars.⁵⁴ This “flexing” of international muscle and technological prowess is an effort to show Russian citizens they are part of a strong and resurgent Russia. This pursuit of security drives Russia to spend an increasingly larger share of its GDP on its military. In the interim, Russia uses its economic clout generated by oil and gas to wield power over its neighbors.⁵⁵

Three major factors appear to dictate Russia’s future. First is the paranoia and need for security along its borders, with the prospect for significant economic growth, enabled by Russia’s mineral wealth, second. Lastly, significant demographic changes are under way as Russia faces a continued decline in its overall population. Its dilemma is amplified by the disproportionate increase in the Muslim population, especially in its border regions near the Middle East and South Asia.

The economic forces at work, principally the revenue and power generated by its oil and gas sales, enable Russia’s resurgence. Russia’s mineral, coal, oil, and natural gas resources are the largest on Earth.⁵⁶ In addition, Russia has vast reserves of iron, platinum, uranium, nickel, cobalt, and a host of other key modern manufacturing minerals. Many of these lie in Siberian areas that have only recently become accessible and are now being tapped.⁵⁷ Recent government nationalization of industries involved in exploiting natural resources enables the government to focus its resources on the very priorities mentioned above, chief of which is national security.

Meanwhile, Russia is faced with a demographic challenge of population decline. Its population peaked in the early 1990s at around 148.5 million, whereas its current population is only 140.7 million.⁵⁸ Although there are many social factors contributing to this population slide, the nation’s dismal health care system is arguably the most direct cause. Russia has a staggering 40 percent preventable mortality rate—a direct result of poor preventive-medicine programs, substandard medical facilities, and limited health care accessibility.⁵⁹ This declining population trend is expected to last until 2050. Meanwhile, Russia’s Muslim population along its southern borders will increase. Should ethnic conflict come to these regions, as in Chechnya, this could create tensions in areas of vital interest to Europe and the United States. Thus, Russia is facing a period where its mineral wealth will likely result in economic growth, while its population is in decline. This produces a situation where the per capita income is likely to rise. At the same time, Russia will not have the people required for tradi-

tional manpower-intensive industries or for manning its military forces. This will force Russia to adopt a more US-like model for its military forces, where it uses advanced technology to compensate for reduced manpower.⁶⁰

Militarily, Russia will use technology to defend its interests, at a minimum in its near abroad. In this regard, Russia will certainly field a modern and robust homeland defense system, but it is unlikely to structure its forces for large expeditionary efforts at great distances from its borders. However, the Russians do and will possess unique asymmetric capabilities in the form of nuclear weapons, space access, and orbital systems that still give them superpower niches, ones they will seek to enhance. Putin has discussed “new spirals” in an arms race that could include nuclear space-based weapons,⁶¹ something the United States must recognize and defend against. *Strategic Forecasting, Inc.* summed up the Kremlin’s recent moves, saying, “Russia is back, and it no longer accepts its decline into obscurity.”⁶²

Russia has already made forays into advanced technologies like nanotechnology in order to improve its capabilities. Current Russian investments could lead to miniaturized control and power systems for inexpensive unmanned aerial vehicles capable of delivering bioengineered weapons. Recent Russian cyberattacks against Estonia and Georgia demonstrate the Kremlin is very interested in and capable of pursuing nontraditional approaches to warfare.⁶³ In short, Russia’s future capabilities may not appear as those of “Cold War–Fulda Gap” fame but may be just as lethal. Should international crises emerge over whether some states should join NATO, or over security and nationalistic concerns along Russia’s southern border, the United States and its allies may contend with a smaller but more modern and professional Russian military.

Capabilities to Defend against a Resurgent Russian State

In sum, the resurgent Russia of this alternate future is a major supplier of global energy resources not closely aligned with either the West or the East. As a result, it will be particularly concerned with defending its natural resources and supporting infrastructure. The military will be smaller but more capable, with professional soldiers and technologically advanced systems. They will have the ability to project the nation’s full combat power into their “near abroad,” including Eastern Europe, the Caucasuses, and Central Asia, but will have limited ability to deploy conventional forces beyond this region. In part to make up for the limitations in its conventional forces, Russia will develop significant strategic reach through its nuclear forces and develop advanced strategic technologies for space and cyberspace. In this alternate future, the Russian military will possess significant, advanced capabilities across all the Air Force war-fighting domains, including air, space, and cyberspace.

These capabilities imply that the United States will need capabilities relatively similar to those of the Chinese scenario. The study participants were concerned that this scenario, more so than the other three, offered the potential for major force-on-force combat. Land warfare on or near China's borders was seen unlikely due to the limited vital interests and the difficulties associated with distance in waging warfare on or near China's shores.

With Russia, however, and alongside US European partners, land warfare seems possible. This alternate future demands and stresses US conventional combat capabilities more than any of the others. These stresses are against a power that can fight on land, on the sea, in the littorals, in cyberspace, and in space. A wide range of systems and the ability to rapidly reconstitute what is lost will be required to prevail, should Russia's and America's interests collide, especially in Europe.

Failed State—Nigeria

Nigeria has been called the best example of the “paradox of plenty,” where tremendous natural resources create great wealth, which in turn creates “extravagant corruption, deep poverty, polarized income distributions, and poor economic performance.”⁶⁴ While the Department of State views Nigeria as relatively stable, increasing conflict is occurring along a religious fault line that bifurcates this African nation. What is worrisome is that the 2007 Failed State Index ranks Nigeria as the country 17th most likely to fail out of the 147 states they analyzed,⁶⁵ where failure implies the state cannot govern itself nor can it provide for internal security and the basic needs of its people. Further, when states fail, it is usually a long-term problem. A World Bank study shows that states listed as failed in 1980 are generally still failed today, and they estimate the average failed state will require 56 years to recover.⁶⁶

A Failure We Cannot Ignore

Of concern in this future is that few states have the potential to be as disruptive to the United States and the global economy as a failed Nigeria. Nigeria is one of the world's 20 largest economies and largest suppliers of light “sweet” crude oil, with a daily export of over 2.4 million barrels a day.⁶⁷ By 2030 roughly a quarter of US oil imports will likely be supplied by Nigeria.⁶⁸

While infrastructure investments in Nigeria are limited, they have yielded more reliable electricity for the cities and better roads in oil areas. Road improvements may allow for growth in the agricultural sector, especially in the north, and for natural resource development to diversify the economy. The top 1 percent of Nigeria's wealthiest families control over 80 percent of the oil profits, and they may seek to improve their personal portfolios by investing

in new technology areas overseas.⁶⁹ Should oil revenues not be invested in improving the north, or should corruption prove entrenched, this could spark greater animosity among regions, resurrecting issues of reduced government legitimacy.

Nigeria has the largest population in Africa, nearly 25 percent of the continent's total, and it is growing. Expected to surpass 225 million people before 2030, Nigeria could become the fifth most populous nation on earth.⁷⁰ Despite being a former British colony with English as its official language, Nigeria is diverse, with over 350 separate ethnic groups—more than any other country in Africa.⁷¹ Four main groups make up over three quarters of this population: Hausa and Fulani (29 percent), Yoruba (21 percent), and Igbo (18 percent). Eight other significant population groups, with their own languages that define them politically and culturally, make up the remainder.⁷²

These disparities and the trappings of Nigeria's colonial past have created tensions that make establishing an integrated, coherent, and legitimate government difficult.⁷³ By 2030 Nigeria's robust population will have an average age of 16.7 years and a life expectancy of 54 years. As such, Nigeria will likely have many disaffected and underemployed people.⁷⁴ It already has the sixth largest Muslim population in the world⁷⁵ and has a nearly equal balance of Muslims and Christians. This balance is currently at a potential tipping point because of the faster population growth in the Islamic north, which is ruled under Sharia law, unlike the Christian provinces in the south.⁷⁶ By 2030 Nigeria's Islamic population will likely comprise a majority of the electorate, which will fundamentally change the Nigerian domestic political situation.⁷⁷

With limited industrial development and oil production consigned mainly to the Christian south, 90 percent of funding to the states and localities is provided by the federal government, largely from oil export revenues.⁷⁸ A complex federal oil wealth sharing program provides each state with calculated shares. The formula includes population, level of development, and sources of oil revenues.⁷⁹ State governors budget and distribute this money, with much of the oil wealth flowing to the predominant political party.⁸⁰ While revenue sharing provides much needed government funding for the nonlucrative agrarian north, it also intensifies ethnic tension between the north and the oil-producing south. This ethnic tension combined with rampant corruption, whereby politicians frequently "skim" some of the earnings, has resulted in the federal government's loss of legitimacy. Losses of legitimacy in the past led to military coups d'état in 1966, 1975, 1983, 1985, and 1993. In most cases, military leaders delayed coup attempts until there was considerable public dissatisfaction with the elected government, thus ensuring the military, although often just as corrupt in their rule, would be "welcomed as redeemers."⁸¹

Nigeria's oil production may approach five million barrels a day between now and 2030, but this will likely decline in the out years due to domestic political instability, corruption, and the continued criminal insurgency by the Movement for the Emancipation of the Niger Delta (MEND). These conditions alone could reduce Nigerian oil flow by up to 25 percent.⁸²

Nigeria's military currently has four primary functions: preserving Nigeria's territorial integrity, contributing to national emergencies and security, promoting collective security in Africa while furthering Nigerian foreign policy, and contributing to global security.⁸³ The president of Nigeria is the commander in chief of Nigeria's military forces. He decides when and how to employ the armed forces, while day-to-day military operations are managed by the Ministry of Defense.

The Nigerian army, with almost 60,000 troops, commands the largest share of the military budget and resources.⁸⁴ The Nigerian navy and air force represent about 7,000 and 9,000 personnel respectively of the overall military strength of about 76,000.⁸⁵

Nigeria Shatters

The Nigerian army is fighting what the government terms an active insurgency by MEND. Their attacks on oil infrastructure and workers since 2005 have reduced oil production by 25 percent.⁸⁶ The group attacks to increase the price of oil in order to compel the world to force the Nigerian government to address the grievances of the indigenous people of the Niger Delta region. With all these structural problems, there exists the possibility for dissolution or full civil war within Nigeria.

As the Islamic population in the north grows, Nigeria is faced with a transfer of power from the Christian oil-rich south to the Islamic agrarian and less-well-off north. In this alternate future, a loss of financial support from outside investors triggers a collapse in the economy. This, in turn, forces the ruling and corrupt Christian government to hold early elections where a well-organized and united slate of Islamic candidates and parties win. The conflict between the two religious factions intensifies as the ruling party refuses to cede control of the oil wealth and its trappings, and refuses to hand off power to a newly elected Islamic government, which declares Nigeria an Islamic Republic. This situation triggers a national crisis and the failure of the Nigerian state.

With the loss of federal control and the revolt of MEND and the former leaders, Nigeria splits into lawless areas and criminal fiefdoms. With hundreds of ethnicities, Nigeria is ripe for fragmentation into a myriad of pieces. With no central authority, legitimate economic activity rapidly declines and is replaced by criminality. Oil workers flee the violence, abandoning their facilities in search of safety, which effectively halts oil production throughout the Niger Delta region and the Gulf of Guinea. The resultant global oil shock

is painful. The United States and the global economies are threatened, and the population of Nigeria—roughly one quarter of a billion strong, is faced with imminent pestilence, famine, and civil war.

Thus in this future, Nigeria succumbs to a variety of ills—corruption, weak government institutions, a failure to meet the social welfare needs of its people, unchecked criminality, crumbling infrastructure, a strong insurgency in the Niger Delta region, and a loss of confidence by international investors. By 2030 the Nigerian government loses its national support from its diverse people and, with the exception of the 12 Islamic-dominated states in the north, no longer functions as a nation-state. The collapse of central control and the eruption of violence in the wake of the elections halts oil production, destroys national governance, and threatens to plunge Nigeria and perhaps West Africa into civil war.

Capabilities Required for Intervention

With Nigeria on the brink of civil war, the global community, particularly the United States and the nations of West Africa, is faced with the difficult choices of *whether*, *how*, and *when* to intervene. If the president chooses intervention, then the United States will likely conduct a peace-enforcement operation.⁸⁷ The actions the United States would need to take must be designed to prevent full-scale civil war in Nigeria, contain the spread of conflict, and secure critical resources in order to limit damage to the United States and global economies. In short, protecting the oil fields and associated infrastructure, relieving human suffering throughout the country, creating conditions for a political solution between warring parties and national reconciliation, and eventually transitioning from a US-led peace enforcement operation to a United Nations (UN)-led national recovery and peace-building operation will be missions for the US military.

Quickly accomplishing these missions is essential. Historically, Nigeria has been the largest provider of peacekeeping forces on the continent and has had a disproportionate influence on regional stability. A failure within Nigeria, especially if it degenerates into religious conflict, has the capacity to ignite wars between and within neighboring countries. The US ability to act quickly may be central to preserving stability in West Africa, a region that by 2030 may be of vital interest to the United States and its allies.

Although securing the infrastructure quickly will be a key factor in stability, there is a second facet of this alternate future that may be even more daunting. A failed state engulfed in a multipartite civil conflict could easily degenerate into the greatest humanitarian crisis the world has ever known—a crisis potentially more than 100 times larger than the modern crisis in Darfur.⁸⁸ Extraordinary lift capacity will be required and will need to be fast. The ability to coordinate relief operations across a myriad of international govern-

mental and nongovernmental organizations will be critical, as a failure in this endeavor could result in the starvation of tens of millions. In short, the key capabilities required in this alternate future are speed of response (to keep the crisis from spiraling out of control in the first place), and the size of response (to ensure that Africa's most populous country does not become a homeland of famine, a breeding ground of pestilence, and a haven for transnational criminals and terrorists).

Specifically, the Air Force must be able to detect hostile intent and identify belligerents, understand and characterize the nature of the impending conflict, deploy forces into country with speed and quantity, survive in place and protect forces, and engage the right targets. The Air Force must attack only the belligerents through multiple means, while sustaining US forces and supplying those who are suffering because of the government collapse.

In order to do this, a few capabilities will need to be enhanced. The intelligence community will need to provide far more precise human and communications intelligence and be able to use network mapping systems to help establish operational and lifestyle patterns; defend operational networks; and discriminate between belligerents and noncombatants. The rapid airlift requirements needed in this future cannot be met with existing or planned systems, so new capabilities to rapidly airlift and deploy personnel and millions of pounds of materiel to austere locations, some without airfields and airdromes, are crucial.

Because of technological proliferation, the Air Force will need to protect and reconstitute critical cyber infrastructure and networks. The potential for a failed Nigeria to rapidly succumb to disease suggests new technologies or methods to rapidly eradicate disease vectors will be crucial to restoring stability in this scenario. Lastly, the ability to rapidly reconstitute, or in some cases build for the first time, electrical power generation, sewage and water treatment, fuel storage, and critical infrastructure is necessary to create a situation wherefrom UN or US forces will eventually be able to return home.

Jihadist Insurgency

The last alternate future scenario examines the possible challenges posed by a well-resourced and well-financed jihadist insurgency emanating from the heart of the Middle East. Today, insurgency is the conflict of choice for many of America's most ardent enemies. Jihadist insurgencies throughout the Middle East and Southwest Asia are directed at establishing theocracies with a strict interpretation and application of Islamic Sharia law. As with the Taliban, some of these insurgent groups are sufficiently well financed to destabilize and even exert control over territory or nations. They also export their ideology and practices, seeking greater influence, especially in the regions of the Middle East, Africa, and Southwest Asia.⁸⁹

Given the economic and geostrategic importance of many of these nations, successful jihadist insurgencies can cause significant global economic disruptions and challenge the security of nations around the world. Any economic disruption resulting from a successful jihadist insurgent takeover of a country in the Middle East or Southwest Asia would threaten US vital interests and require a response.

Roots of the Schism

Throughout the Middle East and Southwest Asia, several cultural factors create an environment in which insurgent warfare can flourish. There are conflicts within the region over religion to include schisms within the Muslim world, tribal loyalties often superseding national identity, and widespread poverty. All of these create conditions conducive to terrorist activities.

Religion is the single-most pervasive aspect of Middle Eastern society, with at least three distinct Islamic sects: Sunnism, Shiism, and Wahhabism/Salafism—all competing for dominance.⁹⁰ Sunnism recognizes the Quran and the Sunnah⁹¹ as the sources of faith, and the majority of Muslims in the world are Sunnis.⁹² The rift between the Sunnis and Shiites is rooted in a conflict over who should have taken the reigns as the leader of the Islamic people, or the “caliph,” after the religion’s founder and first caliph, the Prophet Muhammad, died. This difference in succession has implications for traditions central to the faith.⁹³

Wahhabism and Salafism are religious and political movements within Islam whose ideological bases lie in an attempt to recapture a pure, undistorted Islam.⁹⁴ Wahhabism is often traced to Muhammad ibn Abd al-Wahhab (1703–92) who taught on the Saudi Peninsula. Salafism is a stream of Islamic fundamentalism similar to Wahhabism, originating outside the Arabian Peninsula in part as a reaction to modern cultural influences. Both Wahhabist and Salafist movements reject all changes in Islam after its early period, often referring to Islamic variants accommodating modern culture as a form of unbelief and heresy.⁹⁵

The conflict between these Islamic sects is significant; a Sunni-Shi’a rift is surfacing as a result of the sectarian conflict in Iraq. The struggle for regional dominance between Arab-Sunni Saudi Arabia and Persian-Shi’a Iran is a critical geopolitical and religious force, and the decapitated state of Iraq is no longer a buffer between the two.⁹⁶ Both the modern Sunni and Shi’a movements are at odds with the Salafist/Wahhabist sects.

Al-Qaeda is a self-professed Salafist organization seeking to unite all Muslims under a new caliphate and remove all current “illegitimate” leaderships to restore the golden era of the Muslim nation.⁹⁷ In addition to representing a conservative form of Islam at odds with most of the Muslim world, al-Qaeda’s Salafist movement is, perhaps, the leading ideological threat to the monarchies in the

region. The geographic location of the two holy mosques of Islam—Mecca and Medina—within Saudi Arabia is a key reason al-Qaeda has sought to oust the Saudi regime, and a key reason the governments of nations in the region support the Saudi royal family.

After religion, the most significant source of cultural identity for most Middle Eastern people is their family or tribal membership. Two concepts of the tribal system—kinship and nobility—affect relationships and behavior in the region.⁹⁸ In this feudal system, the dominant tribes essentially run rackets and extort money and resources in exchange for protection from outside invaders. Tribes generally do not trust each other, thus arranged marriages to gain influence with rival tribal sheiks are still used to dampen the likelihood of conflict. This “mafia-like” type of social arrangement is a normal method of business payment between sheiks.

The population in most Middle Eastern and Southwest Asian nations is increasingly urban, young, approximately equal to that of the United States, and is growing rapidly. Today urban dwellers comprise over 75 percent of the population, and this concentration is increasing.⁹⁹ Providing education for the resulting number of urbanized youth is challenging for most of these governments. In 2002 the combined literacy rate among Middle Eastern nations was 52 percent and declining, with only a little more than half of all Middle Eastern children attending secondary schools. This poor quality of public education is responsible for a “low level of knowledge attainment and poor and deteriorating analytical and innovative capacity” among Arab children.¹⁰⁰ In the long term, this will create unemployment and underemployment of poorly educated young men, potentially fueling unrest. Many who do get an education get it through the madrasah system dedicated to Islamic studies, which often fosters extremist thinking.

The influx of petrodollars throughout the Middle East has helped ease tensions between the various groups and factions. Standards of living have risen, and in terms of per capita income, some nations of the region are now among the wealthiest on earth.¹⁰¹ Over time, however, the picture becomes bleaker. Peak oil production has likely passed and by 2030 will be markedly less than today.¹⁰² The rapidly rising population of the region means these decreasing revenues will be divided among an increasingly larger number of people, causing per capita income to decline and poverty to increase. This will place a significant strain on the social safety nets of most Middle Eastern nations.

The Insurgency

Given the already poor education level and low literacy rates in many Middle Eastern countries, most citizens are neither adequately educated nor well versed in hard science and technology fields, thus providing little chance of success in diversifying the economy. As eco-

conomic conditions worsen, an increasingly large segment of the unemployed will, as they have in the past, turn to their religion in hopes of finding a better tomorrow and bringing meaning to their lives.

The military capabilities of many Middle Eastern nations are often a mix of weapons from the former Soviet Union, the United States, France, China, and other nations. Most militaries in the region are organized and used to provide internal security and protect the ruling regime. The proficiency of military personnel and the war-fighting capabilities of each nation are often constrained by lack of funding, poor training, limited education, shifting tribal loyalties, religion, and trade restrictions. If jihadist elements are able to gain control of national resources, specifically the military, this presents an entirely new threat to Western interests.

To make matters worse, access to technologies may be changing. Recent trends in the proliferation of new technologies are now enabling groups and individuals to access new weapons with improved capabilities. As advanced technologies proliferate, these groups and individuals will eventually be able to access weapons capabilities previously held only by nation-states.

Therefore, this alternate future creates a stressing scenario by drawing upon the trends above. The challenges associated with controlling groups engaging in a global Islamic extremist jihad will be severe. By 2030 small groups with sufficient resources, and with some highly educated and trained members, will present a potential threat to the United States. Specifically, this alternate future posits that an extremist Islamic jihadist-oriented group will successfully influence the local population through its mosque-sponsored programs in order to exert control over a territory, a population, and over the regional resources of this territory. With the exception of international recognition, this insurgent force will acquire the resources and characteristics of a jihadist state and will be located in the heart of the Middle East.

This scenario further posits that the monarchies that make up the majority of governments in the oil-rich Arabian Peninsula will be directly or indirectly attacked by this insurgent territory, threatening global access to the region's oil and natural gas supplies. Further, the religious beliefs of these insurgents will drive them to use the mineral resources at their disposal, and the wealth those resources confer, to launch a sustained, high-tech, and well-financed terrorist campaign against the nations of the Arabian Peninsula and against states who would seek to defend the status quo.

While the United States will have considerable incentive to intervene, the US ability to involve itself directly in this scenario is constrained on several fronts. First, Islamist insurgents will have had decades of experience fighting the United States and will, by 2030, likely be the fittest of insurgent groups. Darwinian evolution will have eliminated those groups who are easy to defeat.

Second, while Middle Eastern nations may need assistance from the United States, they may be reluctant to accept uniformed American ground troops. Such a move could be perceived as “inviting infidels” into Islamic holy lands, further strengthening the arguments of the insurgents. This concern is exacerbated due to the American leadership’s past reluctance to quickly withdraw its forces when it perceives US interests are or might be threatened.

Lastly, in the wake of the wars in Afghanistan and Iraq, the American public is reluctant to commit troops and monetary resources to fight in any Middle Eastern nation with an active insurgency. All these factors may place an increased burden on the Air Force.

Capabilities Needed to Combat the Insurgency

This scenario provides a different set of challenges than the preceding four worlds. Here, the United States will need to defend its allies and interests but without a robust surface presence in country. In addition, the resources available to the insurgent groups will enable them to purchase virtually any weapons or munitions available on the world arms markets; by 2030 these weapons will be very advanced. In fact, given the proliferation of new systems based on nanotechnology, biotechnology, and potentially even nuclear weapons, a well-financed group may gain access to powerful old and new weapons with potentially incredible capabilities.

Insurgent’s access to classic weapons of mass destruction, such as nuclear weapons, will be a key concern. Such weapons not only could provide enormous destructive capability against ground targets but could be used to generate electromagnetic pulses that could destroy electrical systems and power grids, essentially taking the United States back to the 1800s.¹⁰³ The ability to deter, prevent, and survive in the wake of a nuclear device detonation in or above the United States is a required key capability in this world.

Technologically, this requires the reinvigoration of the US ability to produce hardened electronics that are impervious to electromagnetic pulses. It will require a domestic ability to contain and rapidly respond to disasters far larger than the failures seen by the Federal Emergency Management Agency in Hurricanes Andrew and Katrina. In the area of deterrence, the necessary actions are less clear, as the application of deterrence theory towards nontraditional actors is among the fields not yet well explored.

Traditional weapons of mass destruction are not the only problem. To protect both the United States and its allies, the Air Force and its sister services will need to defeat weapons based on nanotechnology or biotechnology, or a combination of both. Due to their extremely small size, these technologies may enable chemical or biological pathogens to penetrate even the most resistant of materials, allowing the insurgents to attack in unconventional ways. The ability to quickly detect the precursors of these weapons is a key capa-

bility needed to prevent their use. Once used, the ability to rapidly detect, identify, warn, and treat victims will be essential to containing an event before it kills large numbers of people or causes panic and/or the loss of governmental legitimacy of the targeted state.

As with the nation-state adversaries, a well-financed insurgent group may be able to grow or hire the necessary talent to engage in well-coordinated cyberattacks. Whether to disable critical national infrastructure in the territory of the Middle Eastern monarchies or in the United States, the ability to defend against these attacks and to protect the Internet is a key capability in this alternate future.

Again, one particularly daunting challenge to the US military is the reluctance by the Middle Eastern monarchies to allow “infidel” American troops to be stationed within their borders. This will require the United States to find capabilities to neutralize insurgent threats, while leaving little or no footprint, which suggests an increased importance for robotic combat equipment, unmanned vehicles, and covert special forces.

Operations Analysis Results

As mentioned, the researchers developed a quantitative model to evaluate 58 separate notional future systems for their potential utility across the four alternative futures. Each future scenario had its own separate model with its own internal weighting factors specific to the nature of the alternate future being explored. As a result, the expectation was that the types of systems required in each scenario would be quite distinct. For the USAF, two of this study’s findings are the types of systems needed for major state-on-state conflict cover and the types of systems and capabilities required for insurgent warfare and failed state scenarios (see figure 1). Notice that the

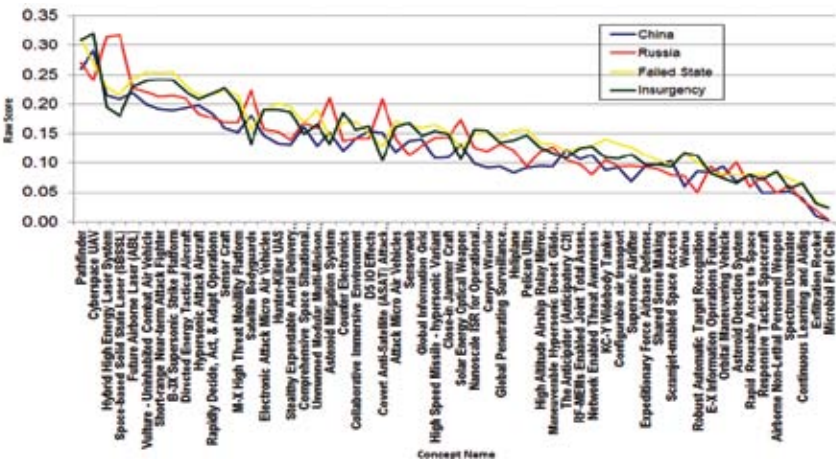


Figure 1. Scoring chart of all 58 systems across all alternate futures

four lines depicting the ratings of the 58 systems are nearly parallel across all four models, showing that little variation occurs in required capabilities, regardless of the type of warfare encountered.

As these capabilities were explored further, there was only one core Air Force capability that showed substantively or statistically significant variation across the four futures. This variation was in the area of space. The study does show that space-based capabilities are less relevant to insurgent and failed-state scenarios than they are in state-on-state warfare. This is highlighted further in figure 2, where this same capability list was plotted in a state-on-state versus a nonstate-actor scenario. All of the major spikes in the state-on-state chart line are systems that contain a significant space component. Again, other than these spikes, the parallelism in the rank ordering of these future systems between types of warfare is striking.

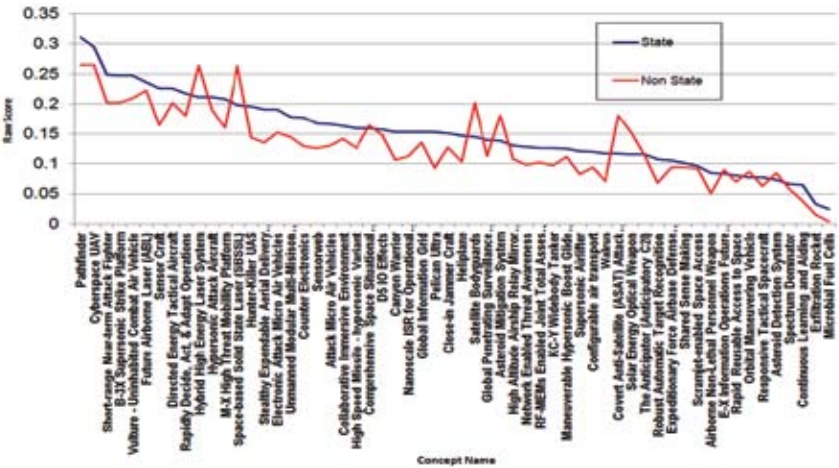


Figure 2. Scoring of all 58 systems in state-on-state versus nonstate warfare

The 58 future systems were mapped to a mutually exclusive and comprehensively exhaustive list of 172 key enabling technologies. A quantitative model evaluated the utility of each enabling technology based on the value of the systems to which it was essential. The expectation was that this model would generate a relatively short list of technologies which, if developed, would enable a significant number of potential future systems. There was also an expectation that the importance of the technologies would likely vary from alternate future to alternate future. Neither of these hypotheses proved true.

The key underlying technologies did not vary from scenario to scenario. In fact, the four technology scoring curves are even more closely clustered than they were in scoring the 58 conceptual systems (see figure 3).

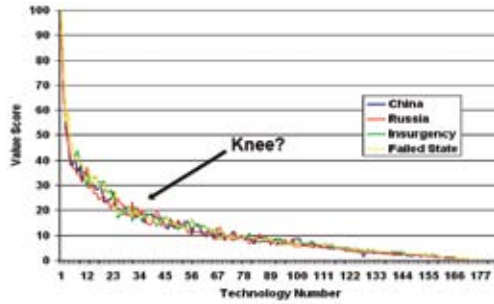


Figure 3. Score of enabling technologies by alternate future

Finding a short list of technologies which, if invested in, would enable development of a large number of concepts was among the study's goals. The actual findings were quite unexpected. In the end, the study concluded that 57 of the 58 future conceptual systems all have key enabling technologies ranking below 100. In other words, every concept but one has key technologies that scored in the tail of the graph. In fact, a detailed analysis of each technology and system shows that a disinvestment in the bottom 20 percent of technologies results in the inability to field systems that scored in the study's top 25 percent. The fundamental implication of this result is straightforward. Any budgetary strategy that disinvests in science and technology in the future is a very high-risk strategy that will foreclose a large number of future options.

... the Air Force **must invest in a broad range of enabling technologies** to bring the necessary capabilities and systems to fruition, or it will be unable to effectively maintain dominance in its core missions and domains.

Conclusions and Recommendations

Several trends became apparent as the research team began to synthesize the results of the operations analysis and the nature of the four alternate futures. At the top level, these insights form the conclusions and recommendations that are the principal product of this study.

As stated, the strategic environment in 2030 presents difficult challenges stemming from accelerating technological changes interacting with a shifting strategic landscape, producing massive and dynamic change. This change acts as a catalyst, creating a very disturbing and disruptive threat to the United States and a serious challenge to the USAF's future dominance in air, space, and cyberspace.

Future enemies will continue to be motivated by resources, fear, and hate.¹⁰⁴ What is changing is that these enemies will be empowered through education, and enabled through technology and globalization, to directly challenge states and attack places that heretofore they would never have been able to reach. As seen in Iraq and Afghanistan, future enemies will be more difficult to find, harder to hit, more widely distributed, and potentially more dangerous. Historically, as depicted in figure 4, the types of conflicts that were rare, such as World Wars I and II, were the conflicts of greatest impact. As we move toward 2030, single actors or small groups will have the capacity to create high-impact events, making future warfare more dangerous than past wars.

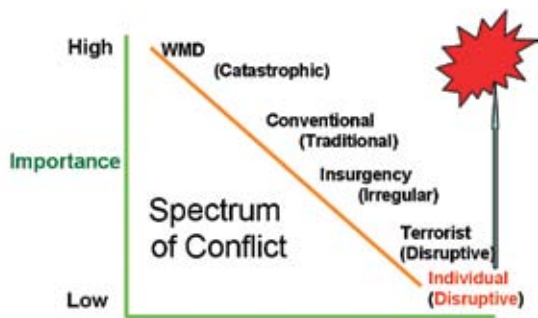


Figure 4. Spectrum of conflict versus impact

Also as a result of technological advances, the speed with which warfare occurs will increase. The observe-orient-decide-act cycle, often called the “OODA Loop” (see figure 5), will shrink toward an “OODA point.” Many warfare decisions will be executed at machine speeds by machines preprogrammed with the commander’s intent. The soldier, sailor, Airman, or marine will no longer be in the loop, but rather on the loop—able to stop the execution of the machine code as necessary, but unable to execute a decision cycle fast enough to remain ahead of a technologically savvy adversary.

Lest one believe this to be science fiction, this form of warfare is taking place today. In the Air Force cyberdomain, every computer within the department is armed with a program designed to execute the commander’s intent of keeping the hard drive free of viruses and



Figure 5. The observe-orient-decide-act cycle or “OODA Loop”

malware. The majority of computer owners have installed antivirus software on their personal systems, because the speed a virus can intrude into a computer system is faster than the speed with which a human can react. This dynamic will spread over time to other fields of warfare. Unmanned vehicles and missiles will be equipped with the ability to seek and destroy adversary targets. Air Force defense systems will need to react at these same machine speeds to keep air bases and the mainland United States safe from attack.

In 2030 targets will be more difficult to find and strike. Most targets will be mobile, distributed, dispersed, fleeting, deeply buried, nested within facilities protected by international law, and located in highly urbanized areas. As a result, the USAF must possess systems and technologies to rapidly locate and identify targets, attribute attacks, and respond to threats. Future kinetic weapons will need to be even more precise and may need to employ new kinds of energetic (e.g., DE) technologies. These will allow engagements to take place with forensic precision so only the target identified is harmed—the goal is no collateral damage.

The commonalities of the systems that rose to the top of the scoring process also cannot be ignored. The role for unmanned systems increases in the future, as five of the top 10 systems are unmanned, and several are based in the continental United States.

Wars are already being fought in cyberspace. Al-Qaeda's principal recruiting tool is and has been the Internet for some time. Presentations by scholars from Harvard, the Norwegian Defense Institute,¹⁰⁵ and others strongly suggest that al-Qaeda's ability to grow is intrinsically linked to its Web presence. Networks of sites reinforcing the conservative jihadist mentality of those who frequent them are within this realm, along with links necessary to join the al-Qaeda network. In fact, the Taliban's resurgence in Afghanistan appears to be nothing more than the manifestation in physical space of a lost war in cyberspace.¹⁰⁶ Pathologically, Internet restrictions by many federal agencies preclude access to these sites. The ironic result is that history may well record the current war against al-Qaeda and the Taliban in Afghanistan as the world's first cyberwar, and the United States, the world's most technologically advanced power, may become the loser.

As the study team looks further forward, the importance of the cyberspace domain increases even more. This domain is of concern; however, the Air Force combat capability is as reliant on the nation's civilian critical infrastructure as it is on infrastructure owned by the DOD. The USAF must be able to navigate, explore, defend, and attribute attack in this domain, and it must protect not only US government assets but have a system in place to defend other assets critical to national infrastructure. This is a domain where we must operate even while degraded, and in that regard, it is like other war-fighting domains. Disconnecting from this domain, even in the interests of enhancing security, is akin to uni-

lateral disarmament. The study team could find no instances in war-fighting history where unilateral disarmament from a war-fighting domain has ever led to victory.

Things will also happen at great speed in the future. In the top-scoring systems, only one item on the top 10 list operates at speeds below Mach 1. Five of the top 10 systems operate, either via cyberspace or DE, at warp speed.

Despite using the same basic methodology as in the *Air Force 2025* study, the importance of survivability of USAF systems is much higher today than it was 13 years ago. In *Air Force 2025*, survivability issues ranked so poorly as to not warrant mention in the final report. All of the top-scoring systems contained robust self-defense capability. Intuitively, this makes sense as the development time for defenses against aircraft (new missile systems, etc.) has historically been only a few years; yet the development cycle for new aircraft is often two decades. The greater speed which the threats are advancing makes survivability a more important component of future weapon systems than in the recent past. As the Air Force reconstitutes its forces after the Southwest Asian conflicts of this past decade, this is a consideration that needs to be taken into account.

Further, the eventual emergence of DE weapons on the battlefield has the potential to change existing operating paradigms. Pulsed microwave energy has the capability to destroy computers and their associated networks, if these systems are not hardened or located in hardened facilities.¹⁰⁷ Once these weapons proliferate, the current expeditionary methodology of deploying US forces will be rendered obsolete. Canvass is not a protective covering for electronics, and unless the command and control systems used on the battlefield are made impervious to DE attack, the expeditionary concept of operations cannot survive. The emergence of these weapons onto the battlefield is likely less than 15 years away.

The study also indicated that rank ordering of concepts and technologies does NOT vary significantly between state-on-state and irregular warfare. The researchers noted virtually identical results across all four alternate futures in:

- Air and surface attack
- Directed energy
- Communications, cyberspace, and sensing
- Attribution
- Data fusion technologies

One significant difference is that offensive and defensive space systems and technologies are more crucial in state-on-state warfare than in other types of conflict. Underlying enabling technologies that cross all conceptual boundaries, indicating their

ubiquitous nature in future conflict, are also important. Even more important, systems and technologies deemed significant in the peer-China and resurgent-Russia scenarios are operationally relevant in responding to both a jihadist insurgency and failed-state scenarios.

The study also reveals some harsh realities. Groups and individuals have the ability to morph and rapidly adapt new technology and use it in new ways. Their actions can force real changes in the strategic environment faster than nation-states with large bureaucracies and hierarchical structures can respond. Readily available advanced technologies in 2030 will create super empowered individuals known as “Bubba Einsteins.” In some cases, these individuals will be able to effect change through their ability to strike and significantly disrupt critical infrastructure and systems in nation-states.

Surprise will be the normal state of affairs; thus leaders who today are trained and prized for their ability to manage crises once they manifest will be less valuable in 2030 compared to leaders who can consistently anticipate surprises and take action in advance to mitigate their effects. It is clear that classical professional military education as practiced today must change now to prepare future Air Force leaders for this eventuality. Along with this change in how we prepare future leaders, the current Air Force effort to recapitalize its assigned capabilities must also adjust to incorporate emerging technologies that will be required to respond to the 2030 world.

Recommendations

The study team sifted through the findings to arrive at a set of concrete recommendations for the leadership of the Air Force. The Air Force should adhere to the following:

- Pursue concepts with increased range and persistence. The increased range of adversary defenses makes short-range fighter assets less useful in 2030 than they are today. The system currently being procured will not meet the needs of the Air Force in the future.
- Increase investments in unmanned architectures. Unmanned systems comprise five of the top 10 concepts.
- Develop counters to DE weapons, including laser and microwave attack systems. This can be achieved via countermeasures, defenses, or protecting systems from attack. While the avenues to accomplish this are numerous, suitable protection for military and critical civilian infrastructure needs to be in place in only a few years, because by 2030, DE threatens everything.
- Increase emphasis on defensive capabilities because technological proliferation is closing the capability gap between the

United States and its adversaries, including individuals and states. This is occurring in all three Air Force domains: air, cyber, and space.

- Improve the speed and effectiveness of the US government's acquisition processes since individuals and groups will adapt and even change the future strategic environment. We are entering a time when it can no longer take 20 years to produce a new aircraft or weapons system. Those who take this long are doomed to lose.
- Incorporate future conflict studies into intermediate and senior developmental education. The Air Force's new leaders must understand the emerging technologies and the strategic threats associated with them. At present, these curricula address cyberspace but do not address the myriad of other technologies that will present new and dangerous militarily relevant threats in the future.
- Include technologically savvy, super-empowered individuals in the future Air Force Title X wargames. The United States has already seen the chaos that can be created by a single disgruntled individual (Washington, DC, anthrax attack and the attack on the Murrow Building in Oklahoma City). How Air Force leaders view these attacks and differentiate them from ongoing conflicts is an issue with which the Air Force has yet to wrestle and is one that demands answers.

This study concludes that any disinvestment in the science and technology programs is a high-risk strategy that could disable a myriad of future options in a rapidly changing world. The entire Air Force science and technology budget is but 2 percent of its total budgetary authority. This is a small price to pay to be ready for future technological challenges; full funding of the laboratory and research budgets should be pursued. Indeed, a robust investment across all technologies is the only way to hedge against an uncertain future and retain "sovereign options."

At the same time, some technologies, such as space launch and battery sources, will be developed by other government agencies such as the National Aeronautics and Space Administration. The Air Force should ensure that its science and technology enterprises are well connected to other research organizations to efficiently leverage advances made by other agencies.

Finally, the study uncovered some unanswered questions that need further research. The dynamic strategic environment, with a myriad of new players, requires a closer examination of the nature of deterrence in a world with substate actors potentially possessing the power of today's nation-states. Not only must the Air Force examine how to apply the deterrence theory to nonstate actors, it must also explore how to deter nation-states from using highly

disruptive but nonnuclear technologies. Cyber-, nano-, bio-, and directed-energy technologies can also produce cascading and massive effects. How deterrence works in a world with these technologies is a question that needs to be answered.

Additionally, further exploration of concepts and technologies evaluated during the study is required to discern second- and third-order effects. Given the surge of interest and investment in nanotechnologies and biotechnologies, future research must better gauge their impact in future years. Lastly, of all the military services, the Air Force is the largest user of fuels and energy. Thus, there is a need to explore alternative energy sources and solutions.

The Way Ahead

The 2009 iteration of this ongoing study effort, *Blue Horizons III*, envisions and explores new future concepts in detail. It will crystallize the impact exponential technological change will have on the USAF in 2035, driving leadership to continue technological investment, reform professional military education, and revamp system acquisition processes.

Blue Horizons IV (2010) will examine future deterrence theory as it applies to nation-states, large groups (like al-Qaeda), and individuals. That theory will be applied to a list of emerging technologies to include synthetic biology and other potential weapons of mass effect.

These conclusions, and the concepts developed in *Blue Horizons III* (2009), will feed further efforts to evaluate the utility of new systems and concepts as they apply to national defense and deterrence in the year 2011 and beyond. Building on the legacy of *Air Force 2025*, *Blue Horizons'* ongoing charter remains providing "a new look at the future" as it endeavors to "provide a common understanding of future strategic and technological trends for Air Force leaders to make better decisions." Sound leadership decisions now will prepare the Air Force chief of staff and his or her team of senior leaders in 2030 to meet the challenges of their time and make good decisions for the next generation leading the USAF in 2055.

Notes

1. Gen John D. W. Corley, vice-chief of staff, US Air Force, "Strategic Studies (Blue Horizons) Special Interest Item," memorandum of agreement, 17 May 2006.
2. Eric Schmitt, "Senior Qaeda Commander Is Killed by United States Missile Strike in Pakistani Tribal Areas," *New York Times*, 1 February 2008, <http://query.nytimes.com/gst/fullpage.html?res=9E06EED81038F932A35751C0A96E9C8B63&scp=1&sq=air+strike+pakistan&st=nyt> (accessed 9 February 2009); Candace Rondeaux, "In Pakistan, Missile Strike Kills at Least 18," *Washington Post.com*, 17 March 2008, <http://www.nysun.com/foreign/in-pakistan-missile-strike-kills-at-least-18/73032> (accessed 31 March 2009); "United States Missile Strike in Somalia Kills 6," *Los Angeles Times*, 4 March 2008, <http://www.latimes.com/news/nationworld/world/la-fg-somalia4mar04,1,479766.story?track=rss> (accessed 9 February 2009).
3. Martin van Crevald, "Through a Glass, Darkly," *Naval War College Review* 53, no. 4 (Autumn 2000): 25.
4. The models and data sets used in this study were provided by a variety of sources within and outside the US government. Some of the sources seek to remain anonymous, and to respect those wishes, the origins of some data are not discussed in this paper.
5. OODA is the acronym first coined by Col John Boyd to describe the decision-making process—observe, orient, decide, and act. Based on his work on fighter tactics and energy management related to aircraft design, the OODA Loop has evolved over time to describe a methodology designed to get inside an adversary's decision process in order to induce psychological paralysis and ultimately defeat him.
6. The *Air Force 2025 Study* was an extensive effort with 286 researchers, with the results published in seven volumes. <http://csat.au.af.mil/2025/index.htm> (accessed 10 February 2009).
7. There is nothing in this work, nor any source used to compile this work, which is or draws upon classified material.
8. Norman Dalkey and Olaf Helmer, "An Experimental Application of the Delphi Method to the Use of Experts," *Management Science* 9, no. 3 (April 1963): 458–67. Dalkey and Helmer discuss the method in depth, as well as its origins in RAND's Project Delphi.
9. Ibid.
10. The term *concept* has a specific meaning in some parts of the budgetary community which is not intended here. In this study, concept refers to a notional future system that technologically can be built to meet the challenges of the world of 2030. Fifty-eight such concepts or systems are embedded in this study.
11. The methodology is described in full detail in a separate paper. John Geis, "Toward Blue Horizons: Air Force Requirements in 2030," (paper presented at the annual meeting of the International Studies Association's 50th Annual Convention "Exploring the Past, Anticipating the Future," New York City, NY, 15 February 2009). This methodology parallels that used in the *Air Force 2025* study. For details on the *Air Force 2025* model, see J. A. Jackson, G. S. Parnell, B. L. Jones, L. J. Lehmkuhl, H. Conley, and J. Andrew, "Air Force 2025 Operational Analysis," *Military Operations Research* 3, no. 4 (1997): 5–21. For more on value-focused-thinking methodology, see R. L. Keeney and H. Raiffa, *Decision Making with Multiple Objectives and Value Tradeoffs* (New York, NY: Wiley Press, 1976); R. L. Keeney, *Value-Focused Thinking: A Path to Creative Decisionmaking* (Cambridge, MA: Harvard University Press, 1992); C. W. Kirkwood, *Strategic Decision Making: Multiobjective Decision Analysis with Spreadsheets* (Belmont, CA: Duxbury Press, 1997); G. Parnell, H. Conley, J. Jackson, L. Lemkuhl, and J. Andrew, "Foundations 2025: A Framework for Evaluating Future Air and Space Forces," *Management Science* 44, no. 10 (1998): 1336–50.
12. Col John P. Geis II, Col Blaine D. Holt, Col Scott E. Caine, Col Edwin F. Donaldson, and Lt Col Ralph A. Sandfry, compiled in part from *Discord or Harmonious Society: China in 2030*, Center for Strategy and Technology Occasional Paper 67 (Maxwell AFB, AL: Air University Press, forthcoming).

13. Shamim Adam, "World Bank Cuts East Asia Economic Forecasts (Update 1)," *Bloomberg.com*, 10 December 2008, <http://www.bloomberg.com/apps/news?pid=20601068&refer=home&sid=aLUyRXjzHQbQ> (accessed 10 February 2009).

14. The Boxer Rebellion lasted from 1898 to 1901. The name "Boxers" was given to the Chinese by the eight-nation coalition of the United States, Great Britain, Russia, Germany, Italy, Austria-Hungary, France, and Japan. The coalition won the conflict.

15. Yu-tzung Chang and Chu Yun-han, *Confucianism and Democracy: Empirical Study of Mainland China, Taiwan, and Hong Kong*, Asian Barometer Working Paper no. 1 (Taipei, Taiwan: National Taiwan University, 2002), 11. Note: The term is originally drawn from Confucian analects.

16. Pres. Hu Jintao, "Scientific Outlook Development" (lecture, Yale University, New Haven, CT, 24 April 2006). Hu's definition is found in these quotes: "China will pursue a scientific outlook on development that makes economic and social development people-oriented, comprehensive, balanced and sustainable. We will work to strike a proper balance between urban and rural development, development among regions, economic and social development, development of man and nature, and domestic development and opening wider to the outside world. It is also rooted in the cultural heritages of the Chinese nation."

17. Arthur Waley, ed., *Analects of Confucius* (London, UK: George Allen & Unwin Ltd., 1949). Note: "Confucian-style" in this context refers to the long standing positive cultural orientation towards authority as benevolent. See also Judith A. Berling, "Confucianism," *Ask Asia.org*, 2007, <http://www.askasia.org/teachers/essays/essay.php?no=38>; and Robert E. Gamer, ed., *Understanding Contemporary China* (Boulder, CO: Lynne Rienner Publishers, Inc., 2003).

18. Office of the Secretary of Defense (OSD), *Annual Report to Congress from the Office of the Secretary of Defense, Military Power of the People's Republic of China*, 2007 (Washington, DC: OSD, 2007), 6.

19. K. C. Yeh, ed., "Economic Reform: An Overview," *China's Economic Reform* (San Francisco, CA: The 1990 Institute, 1993), 19. China's growth rate fell to only 1.8 percent, which was well below the growth rate of the population. This resulted in the people becoming gradually poorer in terms of available foodstuffs.

20. The phrase, 韬光养晦 pronounced "tiaoguang yanghui," translates into "hide brightness; nourish obscurity." While repeated often by Hu, the phrase was initially promulgated by Deng Xiaoping. Hu has modified this slightly as of late to incorporate the concept of a peaceful rise of China in the context of a harmonious world. This philosophy continues the following of the 24-character strategy to eschew global leadership. See John Lee, "China's Insecurity and Search for Power," *IssueAnalysis*, Center for Independent Studies, http://www.cis.org.au/issue_analysis/IA101/ia101.pdf (accessed 17 April 2009).

21. United States-China Business Council, "US-China Trade Statistics and China's World Trade Statistics," <http://www.uschina.org/statistics/tradetable.html> (accessed 29 April 2008).

22. Goldman Sachs, *BRICs and Beyond*, Goldman Sachs Report, February 2006, <http://www2.goldmansachs.com/ideas/brics/BRICs-and-Beyond.html> (accessed 5 March 2008). With a population estimated to be around 350 million, the US gross domestic product in this timeframe would be approximately \$21.35 trillion. It should be noted that the Chinese economy in 2006 and 2007 grew at a rate more than 3 percent faster each year than the Goldman Sachs upper estimate.

23. Jianwu He and Louis Kuijs, *Rebalancing China's Economy—Modeling a Policy Package*, World Bank China Research Paper no. 7 (New York, NY: World Bank, September 2007).

24. The Chinese word for "assassin's mace" is pronounced "shashoujian," which translates to "the inferior defeats the superior." Using an indirect strategy discussed by Sun Tzu, China seeks to counter US technology advantages with weapons designed to "leapfrog" current technology and counter US access to the China region.

25. Roger Cliff et al., *Entering the Dragon's Lair, Chinese Antiaccess Strategies and Their Implications for the United States* (Santa Monica, CA: RAND Corp., 2007), 11.

26. An electromagnetic pulse is a burst of electronic energy that propagates through space (or the atmosphere) that can damage computer equipment and electronic circuitry. These pulses can be generated by upper atmospheric nuclear weapons bursts or via high-powered microwave pulse emitters. This latter form of the phenomena is often referred to as HPM. For a primer on the effects of these weapons, see John P. Geis II, *Directed Energy Weapons on the Battlefield: A New Vision for 2025*, Center for Strategy and Technology Occasional Paper 32 (Maxwell AFB, AL: Air University, 2003), <http://www.au.af.mil/au/awc/awcgate/cst/csat32.pdf> (accessed 10 February 2009).

27. *Ibid.*, 111.

28. OSD, *Military Power of the People's Republic of China 2007*, 23.

29. *Ibid.*, 23.

30. *Ibid.*, 16.

31. *Ibid.*, 5.

32. *Ibid.*, 4.

33. Richard D. Fisher Jr., *The Impact of Foreign Weapons and Technology on the Modernization of China's People's Liberation Army* (Washington, DC, January 2006); US-China Economic and Security Review Commission, January 2004, 43.

34. *Ibid.*, 18.

35. Russell Hsiao, "China Navy Floats Three Carrier Plan," *Asia Times*, 8 January 2008, <http://www.atimes.com/atimes/China/JA08Ad01.html> (accessed 21 January 2009).

36. Fisher, *Impact of Foreign Weapons and Technology*, 24.

37. OSD, *Military Power of the People's Republic of China 2007*, 3.

38. Robert Wall, "Growing Threat Countries Increase Focus on Land-Attack Cruise Missiles," *Aviation Week & Space Technology* 159, no. 8 (25 August 2003): 38.

39. OSD, *Military Power of the People's Republic of China 2007*, 31.

40. Fisher, *Impact of Foreign Weapons*, 34.

41. *Ibid.*

42. Richard J. Adams and Martin E. France, "The Chinese Threat to US Space Superiority," *High Frontiers* 1, no. 3 (Winter 2005): 18-23.

43. Hucheng Wang, "The US Military's 'Soft Ribs' and Strategic Weaknesses," *Liaowang* 27 (5 July 2000; reprint *Xinhua Hong Kong Service*, 25 July 2000).

44. Ashley J. Tellis, "China's Military Space Strategy," *Survival* 49, no. 3, (Autumn 2007): 46.

45. *Ibid.*, 133.

46. Jack Levy, "The Causes of War: A Review of Theory and Evidence," *Behavior, Society and Nuclear War* 1 (Oxford: Oxford University Press, 1989): 258-60. Levy quotes from several studies by Choucri, North, and Holsti from 1975-76 wherein their results suggest that this has been a significant cause of interstate conflict.

47. *The 2008 World Factbook* (Washington, DC: Central Intelligence Agency, 2008), <https://www.cia.gov/library/publications/the-world-factbook> (accessed 29 January 2009). Russia's energy reserves rank first in the world in natural gas, ninth in oil, and second in coal.

48. Stuart D. Goldman, *Russian Political, Economic, and Security Issues and United States Interests* (Washington, DC: Congressional Research Service [CRS], 2007).

49. Aleksander Grigoryev, "Russia: The Media and Unfreedom of the Press," *International Communications: A Media Literacy Approach* (Armonk, NY: M. E. Sharpe Publishers, 2004). For example, the Russian people prefer internal stability to freedom of their media.

50. *Ibid.*

51. John Anderson, *Religious Liberty in Transitional Societies: The Politics of Religion* (New York, NY: Cambridge University Press, 2003), 118.

52. *Ibid.*

53. Yuri Zarakhovich, "Russia Claims the North Pole," *Time*, 12 July 2007, <http://www.time.com/time/world/article/0,8599,1642905,00.html> (accessed 23 January 2009).

54. "50 Years after Sputnik, Russia Revives Space Ambitions," *Space Daily*, 30 September 2007, http://www.spacedaily.com/reports/50_years_after_Sputnik_Russia_revives_space_ambitions_999.html (accessed 23 January 2009). *Space Daily* reports that Russia is not only investing billions of additional dollars into its space program, but it also intends to put a man on Mars not later than 2025.
55. Fred Weir, "Russia Intensifies Efforts to Rebuild Its Military Machine," *Christian Science Monitor*, 12 February 2007, <http://www.csmonitor.com/2007/0212/p04s01-woeu.html> (accessed 23 January 2009). Since Weir's commentary, Russia has again used its status as the principal natural gas supplier to Europe to demonstrate its international clout. Russia cut off gas supplies to Europe in order to negotiate not only higher prices for gas supplied to the Ukraine, but to suggest to Ukraine that Russia would "have to respond" if the Ukraine joined NATO. See "Wrap: Russia, Ukraine Agree on Gas; Discuss NATO," *Russian News and Information Agency*, 2 December 2008, <http://en.rian.ru/world/20080212/99058682.html> (accessed 24 January 2009).
56. Energy Information Administration, "Official Energy Statistics of the United States Government: Russia," http://www.eia.doe.gov/emeu/cabs/russia_pipelines.html (accessed 31 March 2009).
57. Russian Information Network, "Mineral Resources," *Russia the Great*, http://russia.rin.ru/guides_e/4319.html (accessed 24 January 2009). Internal Russian sources estimate their mineral wealth to be much greater than the value of their fuel reserves, possibly in excess of 30 trillion US dollars. The title of the Web site may strike some readers as comical, but it is evidence of the intense national pride which is ingrained in the Russian psyche. It is this pride which makes security and prominence in world affairs so vitally important to the Russian people and their culture.
58. Ward Kinkade, "International Brief: Population Trends—Russia" (Washington, DC: US Census Bureau, February 1997), 1990s population data only. Current population data: *The 2008 World Factbook*, <https://www.cia.gov/library/publications/the-world-factbook/print/rs.html> (accessed 24 January 2009).
59. Zvi Gitelman, Stephen White, and Richard Sakwa, *Developments in Russian Politics* (Durham, NC: Duke University Press, 2005), 216. Russia has a very high infant mortality rate, a high suicide rate, and a working-age population death rate that is 350 percent of the European average. For more information, see also *The 2008 World Factbook* and the World Health Organization, http://www.who.int/mental_health/prevention/suicide/suiciderates/en (accessed 29 January 2009).
60. This is in marked contrast to the Soviet military model of building large quantities of unsophisticated equipment because it had a surplus of manpower.
61. J. A. Tirpak, "Washington Watch: Now, A Russian Buildup?; Keep an Eye on China; Services to Lose Power," *Air Force Magazine* 89, no. 7 (July 2006): 12–29.
62. STRATFOR, "Putin's Most Recent Surprise Move," *Geopolitical Diary*, http://www.stratfor.com/geopolitical_diary_putins_most_recent_surprise_move (accessed 29 January 2009).
63. "A Cyber-Riot," *Economist* 383, no. 8528 (12 May 2007): 55.
64. Paul M. Lubeck, Michael J. Watts, and Ronnie Lipschutz, *Convergent Interests: United States Energy Security and the "Securing" of Nigerian Democracy* (Washington, DC: Center for International Policy, February 2007), 2.
65. "Failed States Index 2007," *The Fund for Peace and Foreign Policy*, July/August 2007.
66. Liana S. Wyler, *Weak and Failing States: Evolving Security Threats and United States Policy*, CRS Report RL34253 (Washington, DC: CRS, 15 November 2007), 8.
67. *The 2008 World Factbook*, <https://www.cia.gov/library/publications/the-world-factbook/geos/ni.html#People> (accessed 23 January 2009).
68. Lubeck, Watts, and Lipschutz, authors of *Convergent Interests: United States Energy Security and the "Securing" of Nigerian Democracy*, report that by 2015, 25 percent of US oil imports could come from Nigeria. Given that Nigeria's wells are not expected to run dry, this level of supply is expected throughout this timeline.
69. Bill Thompson, "Give Me Rice, But Give Me a Laptop Too," *BBC News*, 11 December 2007, <http://news.bbc.co.uk/2/hi/technology/7138061.stm> (accessed 17 April 2009).

70. Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, *World Population Prospects: The 2006 Revision and World Urbanization Prospects: The 2005 Revision*, <http://esa.un.org/unpp> (accessed 23 January 2009). United Nations (UN) Population Database projects Nigeria's population to reach 226,855,000 by 2030. The UN calculates Nigeria's population will double in 32 years based on the following formula: $\log(2) / \log(1 + r)$, where r = population growth rate.

71. David Levinson, *Ethnic Groups Worldwide: A Ready Reference Handbook* (Phoenix, AZ: Oryx Press, 1998), 156–57. As a note, *The 2008 World Factbook* lists the number of ethnic groups in Nigeria as being slightly smaller, at only around 250. However, whether Nigeria has 250 or 350 different ethnic groups is not crucial to the central point that Nigeria is an exceptionally diverse nation, and that this diversity is challenging to manage.

72. Failed States Index 2007, "Nigeria" (Washington, DC: Fund for Peace), 2007, http://www.fundforpeace.org/web/index.php?option=com_content&task=view&id=336&Itemid=497 (accessed 27 April 2009).

73. Library of Congress, Federal Research Division, *Country Profile: Nigeria*, June 2006, 1.

74. Stella A. J. Goings, MD, "Nigeria: Socio-Economic Factors 2007" (briefing, US Agency for International Development, Washington, DC), 18 September 2007. The youth population (under age 16) accounts for 41.7 percent of the total population according to *The 2008 World Factbook*. Given the average fertility rate of 5.6 children and the relatively low life expectancy of Nigerian men and women (less than 54 years of age), the percentage of young people will likely continue to increase.

75. *The 2008 World Factbook* shows Nigeria to have approximately 146,255,000 people, of which half, or 73 million, are Muslim. This places Nigeria at between fourth and sixth place in terms of states with Muslim population—very nearly tied with Egypt and Turkey. <https://www.cia.gov/library/publications/the-world-fact-book/geos/ni.html#People> (accessed 23 January 2009).

76. John Paden, "Brief to the National Intelligence Council's Seminar on Nigeria" (briefing, National Intelligence, Washington, DC), 19 September 2007.

77. This percentage is a colloquie synthesized from research reports from the UN Development Program, the UN Population Program, and the World Bank; Dr. Stella A. J. Goings, MD, "Nigeria: Socio-Economic Factors 2007"; and statistical information found in *The World Fact Book 2008*. These sources generally agree that Nigeria's population is currently more than 50 percent Muslim, although some Islamic publications claim higher figures. The last official recorded census taken in Nigeria was in 1991. In 2006 Nigeria's National Population Commission attempted a new census, but the results of this effort were widely dismissed because of flawed collection and calculation methodologies, and a failure to collect information about controversial demographics like religion. Charges of political corruption in the census process levied at Pres. Olusegun Obasanjo and his political party further tainted the results. As a result, the 2006 census was rejected by the 36 governors who are required to approve the results. Under Nigeria's constitution, state population statistics directly affect the proportional representation in the National Assembly and the federal allocation of funds to each state. Previous census attempts have led to conflict between the 12 Islamic states and the 24 non-Islamic states. The unofficial 2006 population statistics did show a 63 percent increase in the number of people over the 1991 census. The UN, World Bank, and the CIA population projections generally agree the overall population growth rate is approximately 2.025 percent annually. *The 2008 World Fact Book* states the voting-age population accounts for 55.3 percent of the Nigerian population. Population growth rates are higher in the 12 northern Muslim provinces, as men are allowed to marry up to four women (under the Sharia law practiced there), while the Christian provinces ban polygamy. Based on these data, it is expected that by 2030, the voting-age population of the 12 northern states will make up the majority of voters within the country.

78. Paden, "Brief to the National Intelligence Council's Seminar on Nigeria."

79. Ibid.

80. Ibid.

81. Karl Maier, *This House Has Fallen* (Boulder, CO: Westview Press, 2002), 59.

82. This is a projection only based on Lubeck, Watts, and Lipschutz' book, *Convergent Interests: United States Energy Security and the "Securing" of Nigerian Democracy*, and World Bank reports responding favorably to Pres. Umaru Musa Yar'Adua's proposed reforms. These reforms include efforts to curb corruption and make significant investments in critical oil and transportation infrastructure. Peak oil projections for Nigeria were inconsistent and thus were not factored into this projection.

83. Jimi Peters, *The Nigerian Military and the State* (New York City, NY: Tauris Academic Studies, 1997), 176.

84. US Department of State, *Background Note: Nigeria* (Washington, DC: Bureau of African Affairs, June 2007), 6, <http://www.state.gov/r/pa/ei/bgn/2836.htm> (accessed 16 December 2007).

85. Ibid.

86. Africa Masterweb, "Chronology of Nigeria Militants' Attacks," *Nigeria/Africa Masterweb News Report*, 25 June 2008, <http://www.africamasterweb.com/AdSense/NigerianMilitants07Chronology.html> (accessed 28 June 2008).

87. Joint Publication 1-02, *Department of Defense Dictionary of Military and Associated Terms*, 12 April 2001, <http://www.dtic.mil/doctrine/jel/doddict/index.html> (accessed 12 May 2008).

88. Alfred de Montesquiou, "African Union Force Ineffective, Complain Refugees in Darfur," *Washington Post*, 16 October 2006, <http://www.washingtonpost.com/wp-dyn/content/article/2006/10/15/AR2006101500655.html> (accessed 24 January 2009). The crisis in Darfur is widely called the greatest crisis in all of humanity. Darfur has seen more than 450,000 perish, with approximately 2.5 million dislocated. The scenario above in Nigeria has the capacity to decimate a population of 240 million, and dislocate nearly all of them, making it approximately 100 times worse.

89. John Mackinlay and Alison Al-Baddawy, *Rethinking Counterinsurgency: RAND Counterinsurgency Study 5* (Santa Monica, CA: RAND Corporation, 2007), 22. Muslims have used the theological construct that all Muslims are part of the Ummah (community of believers) for centuries. This implies that an attack on any part of the community is an attack upon all. Insurgents have used this argument to suggest that the West's creation of the Israeli state in 1948 is an ongoing attack on Islam, requiring a response by all faithful Muslims. With this rationale, jihadist insurgents are attempting to spread their version of Islam and their desire to attack the West to increasingly large segments of the Ummah.

90. Richard N. Haas, "The New Middle East," *Foreign Affairs* 85, no. 6 (November/December 2006), 2-11; and Matthew B. Stannard, "Analysis: Sunni-Shiite Rivalry Is a Constant Undercurrent of Tension," *San Francisco Chronicle*, 13 August 2006, <http://www.globalsecurity.org/org/news/2006/060813-islam-rivalry.htm> (accessed 25 January 2009). Tensions between the Sunnis and Shiites, especially in Iraq, have been written about widely.

91. The Sunnah translates into English as "trodden path" and essentially refers to the way the Prophet Muhammad lived his life.

92. Alexei Vassiliev, *The History of Saudi Arabia* (London: Saqi Books, 1998), 563.

93. Shiites believe the legitimate successor to the Prophet Muhammad was his son-in-law and closest confidant, Ali. Sunnis regard the first caliph as Abu Bakr. The difference between these faiths is based in part on the way the prophet lived his life, much of which was handed down by either word of mouth and general practice (the Sunnah) or via writings (the Haddith). Even the Sunnis came to recognize Ali as the fourth caliph, but by that time, a divergence in the interpretations of some of the prophet's actions had occurred across the two sects. This divergence in practices and beliefs persists today. This disparity impacts the more fundamentalist beliefs of Salafism and Wahhabism, as these sects believe that the proper practice of Islam was defined by the first three caliphs. The Wahhabi and Salafist followers ascribe to the Sunni version of succession. In the end, this pits the Wahhabi and Salafist

followers against the Sunnis because they believe in only a strict and ancient interpretation of traditions. This also pits them against the Shiites by virtue of their disparate beliefs in early succession.

94. Ibid., 564.

95. Stephen Schwartz, *The Two Faces of Islam: Saudi Fundamentalism and Its Role in Terrorism* (New York City, NY: Anchor Books, 2003), 138–40.

96. "International: The Widening Gulf; Shias and Sunnis," *Economist*, 3 February 2007, 45–50, <http://www.proquest.com> (accessed 4 October 2007).

97. Anthony H. Cordesman and Nawaf E. Obaid, National Security in Saudi Arabia (Washington, DC: Center for Strategic and International Studies, 30 September 2005), 14.

98. Christine Moss Helms, *The Cohesion of Saudi Arabia* (Baltimore, MD: Johns Hopkins University Press, 1981), 53.

99. Peter Wilson and Douglas F. Graham, *Saudi Arabia: The Coming Storm* (Armonk, NY: M. E. Sharpe Publishers, 1994), 234.

100. UN Human Development Program, *The Arab Human Development Report 2002* (New York City, NY: UN Human Development Program Regional Bureau for Arab States, 2002), 35.

101. For instance, Qatar's per capita income is over \$100,000 per year, ranking it second in the world just after the principality of Lichtenstein; and Kuwait is sixth. For comparison, the United States is 10th with a per capita income of around \$48,000 per year. See *The 2008 World Factbook*, <https://www.cia.gov/library/publications/the-world-factbook/rankorder/2004rank.html> (accessed 25 January 2009).

102. US Department of Energy, *Strategic Significance of America's Oil Shale Resource* (Washington, DC: US Department of Commerce, March 2004), 2, http://www.fossil.energy.gov/programs/reserves/npr/publications/npr_strategic_significancev1.pdf (accessed 29 January 2009).

103. John Keller, "Nuclear Proliferation Raises the Specter of an EMP Attack," *Military and Aerospace Electronics* 20, no. 2 (February 2009), http://mae.pennnet.com/display_article/352477/32/ARTCL/none/none/1/Nuclear-proliferation-raises-the-specter-of-EMP-attack. Keller quotes Bill Magee, a senior program manager of an electronics firm, as saying, "Explode a nuclear weapon 200 miles above Kansas City. . . . We're back to being hunter/gatherers."

104. These motivations for conflict have remained unchanged for as long as the history of warfare has been recorded. Thucydides, in *History of the Peloponnesian War*, argued that it was resources, fear, and hatred that frequently were at the root of conflict between Athens and her nearby fellow city-states.

105. Brynjar Lia, "Al Qaeda's Appeal: Understanding its Unique Selling Points" (lecture, Treating Terrorism Conference, Dubai, United Arab Emirates, 17 March 2008).

106. Wael Adhami, "The Strategic Importance of the Internet for Armed Insurgent Groups in Modern Warfare," *International Review of the Red Cross* 89 (December 2007): 857–78. A search of scholarly articles shows over 2,000 works already written on this topic. The Taliban's ability to recruit unopposed in cyberspace is the principle cause of its resurgence in Afghanistan and Pakistan.

107. Geis, *Directed Energy Weapons on the Battlefield: A New Vision for 2025*.

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