
Forward Engagement III

**DEPUTY NATIONAL SECURITY ADVISOR:
CHRIS DEGNAN**

**STATE STABILITY AND GOVERNANCE PANEL:
DAVE HANCOCK, CHAIR
SHAWN DUNCAN
MALGORZATA GNOINSKA
E.J. MONSTER**

**SCIENCE AND TECHNOLOGY PANEL:
LELAND COGLIANI, CHAIR
MIKE GONZALEZ
MARINA PITSINO
CHRISTOPHER POTHOVEN**

**MILITARY AND SECURITY PANEL:
MARGARET KAMMEYER, CHAIR
DANIELLE DORFFELD
CARY MATTHEWS
JOHN NEUMANN**

**ECONOMICS PANEL:
ARIS YORTZIDIS, CHAIR
VALERIE BILGRI HOLM
LACEY YATES**

Spring 2002 Capstone
IAFF 206.18-LONG RANGE ISSUES IN NATIONAL SECURITY
PROFESSOR LEON FUERTH
25 April 2002

INTRODUCTION	3
<hr/>	
STATE STABILITY AND GOVERNANCE	5
<hr/>	
DOMESTIC CONTEXT	5
INTERNATIONAL CONTEXT	10
RECOMMENDATIONS	13
SCIENCE AND TECHNOLOGY	16
<hr/>	
NANOTECHNOLOGY	16
INFORMATION TECHNOLOGY	18
BIOTECHNOLOGY	20
RENEWABLE ENERGY SOURCES	22
SPACE	24
SOCIETAL IMPACT	26
RECOMMENDATIONS	27
MILITARY AND SECURITY	30
<hr/>	
TRADITIONAL GEOPOLITICAL THREATS	30
THREAT OF MILITANT NON-STATE ACTORS	32
INCREASED RESPONSIBILITIES AND ALTERNATIVE THREATS	34
EVOLUTION OF WEAPONRY	37
RECOMMENDATIONS	39
ECONOMICS AND FINANCE	41
<hr/>	
TECHNOLOGIES	41
DEVELOPMENT	43
ENVIRONMENT	45
FINANCE AND TRADE	47
RECOMMENDATIONS	50
CONTINUED FORWARD ENGAGEMENT	53
<hr/>	

INTRODUCTION

The president has believed, for well over a year, that the United States Government (USG) is neither well positioned to contemplate the future nor prepared to take effective action to respond to it. Two presidential panels have addressed these concerns, though not to the president's complete satisfaction. Responding to the president's request to form a third panel on "the subject of longer range issues of concern," the national security advisor assembled a team of 16 government experts. The president asked the panel to consider what must be preserved in order that liberal democracy, defined as "a system of representative government based on the individual person as the fundamental unit of social accountancy and on the sovereignty of the people as the basis for the legitimacy of government," can survive and thrive.

The key question that the panel tried to answer was, "What can the USG do now to prepare for the future and the impact of changes (gradual or discontinuous) on American liberal democracy?" The answer must make government more effective without depriving American citizens of the freedoms that USG officials are sworn to defend. Four crosscutting themes emerged in attempting to answer the key question. First, the world is being transformed by expanding networks, and changes happen faster than ever before. Second, the walls between public and private concerns are becoming porous and, in some cases, are coming down. This leads to a third consequence: power is concentrating in some cases and diffusing in others. Finally, people and governments will either have to make fundamental choices between freedom and security or find new ways to enjoy both.

The panel reviewed the two previous "Forward Engagement" studies commissioned by the president, attempting to find areas that warranted further investigation, then met with experts to determine methodologies for analyzing the long-range future. With these ideas in mind, the

panel studied four areas: state stability and governance, science and technology, military and security, and economics and finance. It reviewed the long-range analytic capabilities already existing in government, identified likely trends in each subject area, and formulated ideas on how to increase government's ability to predict, shape, and manage the future. The panel's findings and recommendations in each of those areas follow.

STATE STABILITY AND GOVERNANCE

The fundamental challenge to the USG in the year 2025 will be to contend with an increasingly network-centric world. Advances in communication and information technologies (IT) will continue to accelerate the flow of information, capital, goods, services, and people across national borders. Power on both the domestic and international levels will become more horizontal, interdependent, and increasingly concentrated around network “nodes” of variable size and importance. Although the concept of the United States as a nation-state will remain the predominant organizing unit of political, economic, and security affairs through 2025, the United States will confront fundamental tests of effective governance as it is forced to acknowledge and cooperate with various non-state entities to formulate effective policy. At the same time, the institutions of the USG will find themselves increasingly forced to appropriate the principles of network-centered organization if they are to retain their relevance.

Domestic Context

Individuals represent the most basic level of political power, but in a way they are the most mutable and nimble of the newly empowered network “nodes.” As movement of goods, people, and information continues to grow, by 2025 the power of government to control these movements will be considerably limited. Even today, individuals routinely interact with foreigners, foreign governments, business leaders, civil leaders, and institutions with ease unheard of a decade ago. Often, these individuals have better language skills, more regional expertise, and better understanding of problems confronting the United States than USG officials.

Increased higher education rates and global awareness will lead to greater participation of individuals in politics. Advanced information technology and instant communication capability will enable individuals to become influential players in both the national and international arena, prompting greater voter turnout in local and national elections, as well as the creation of numerous new political platforms reflecting previously unseen political and economic interests. These highly educated and informed individuals will not only demand greater transparency and communication in the decision-making process at state and federal levels but will also become more active participants in the process. This change will lead the government to a more direct and less bureaucratic relationship with the public.

Greater public participation in politics will shift domestic focus to public goods and services. Voters will seek better living conditions, safer neighborhoods, cleaner air and water, better roads, and improvements in the national education and health system, as well as preservation of their rights. Greater transparency and communication will allow taxpayers to monitor the government regulation and distribution of these revenues. Public awareness will lead to more efficient government spending and management, as well as reform of national education, health, and social security.

Immigration, retirement, and a decreased gender gap in the workforce will result in a significant shift in population demographics. As greater numbers of minority participants express their interests at the ballot box, the USG will have to pay more attention to labor, civil rights, and education reform. Restructuring educational curricula should include an emphasis on world history and foreign languages to accommodate the interconnected global world and the large immigrant population. As transparency and communication increase at the federal level, Americans with ties abroad will seek to influence the national decision-making process.

Advances in biomedicine and genetic research will lead to higher life expectancy in developed countries. The United States will face a population increase. Rising population will be accompanied by increasing environmental concerns. Although adequate food production is predicted, food distribution, water shortages, and megacity pollution will require national and transnational cooperation. Public demand for higher living standards will force the government to review and drastically alter current environmental policies. Alternative energy sources will contribute to more effective use of finite resources, cleaner air and water, and safer food.

Despite the rising influence of empowered individuals in shaping the national and transnational agenda, national priorities will continue to override personal interests. Individuals will fight for preservation of their rights and protection of their privacy, yet they will be willing to forfeit these rights and privileges for security and safety. Camera surveillance of public spaces, digital records, and improved face and fingerprint recognition technologies will become accepted facets of American life. Government cooperation with individuals, nongovernmental organizations (NGOs), and commercial interests will contribute to effective intelligence and crime control.

Increased “people power” is a growing trend that all nation-states will eventually encounter. Among these states, the United States will be best positioned for good governance because the USG will tend to empower legitimate non-state actors in both the for-profit and non-profit sectors, favor institutions and processes that accommodate divergent communal groups, press for transparency in government and the efficient delivery of public services, and maintain institutions to regulate for-profit and non-profit organizations and control illegitimate criminal groups.

Additional advances in IT made by the year 2025 will affect the organization and operational capacity of U.S. governmental institutions. The rapid diffusion and introduction of new information and telecommunications technology will increasingly provide average American citizens and USG agencies with new tools and methods to aid in transforming an old-fashioned representative, bureaucratic democracy into a stronger, more direct and deliberative form of democracy. American citizens will be loath to surrender their growing individual power to a monolithic and unresponsive bureaucracy. Government institutions will be challenged to become more nimble, yet more complex.

By 2025, government institutions must reflect fundamental changes in American society. These changes should be dominated by a shift from the traditional hierarchical model of bureaucratic organization to a network-centered organizational model. Actors need to be seen less as independent and more as part of a continuously adapting system. Making strategic choices to adapt or even survive in such changing environments must become paramount. Network-centered organization, or “horizontal integration,” of governmental institutions has its antecedent in the dynamics of growth and competition that already have emerged in the modern capitalist economy. Federal agencies of the USG need to evolve from a traditional vertical hierarchy (top-down) organizational model to a network-centered or horizontal (bottom-up) organizational style, much like that of entities in the private sector. These organizational changes would improve the performance of government agencies by placing more power and authority in the hands of employees with working-level expertise and limiting unnecessary bureaucratic hierarchy. The horizontal organizational model would ensure a more efficient and productive USG.

USG institutions must have the most advanced IT at their disposal and incorporate it into their daily activities. This would enable USG employees to locate and capture knowledge easily, both within and outside the government, and to make it available to employees throughout the USG. A federal government-wide Intranet, supporting both classified and unclassified material, could provide effective storage and retrieval of information, as well as a means of efficient communication between experts working on similar issues throughout the USG. This would enable government institutions to work collaboratively and give citizens the information they need to solve problems faster. Electronic government (e-government) should become the norm. To the American public, the government would appear smaller, smarter, and more effective. The capacity of the government to assess and react to ongoing trends should be institutionalized through a structured apparatus, the Office of Technological and Strategic Assessment (OTSA), whose general task would be to assess and improve the sophisticated operational capacity of the USG by providing a forward-looking mechanism to guide all USG policymakers. As an executive agency, OTSA would report directly to the president but would assess and advise all institutions of the USG. OTSA would provide the USG with a comprehensive oversight agency to encourage maximum potential and efficiency. Extensive liaisons should be established between OTSA and the House Government Reform, House Science, Senate Governmental Affairs, and Senate Commerce, Science and Transportation Committees. Although under the executive branch, OTSA's capabilities would be available upon request by Congress to analyze the evolution of the legislative branch.

International Context

The nation-state will not disappear in the foreseeable future, but by 2025 various non-state actors will increasingly challenge its sovereignty and authority at the international level. Economic and political power will be increasingly diffused along a global network transcending national borders. This will provide exceptional power to the non-state actors that can skillfully connect to and interact with this network.

This poses fundamental problems for some nation-states. The demands of technological and economic globalization will restrict the ability of many governments to address the negative effects of such integration on their societies. Non-state actors will jump into those gaps, effectively being entrusted with what were once nation-state duties and allegiances. For many societies, the inability or unwillingness of the nation-state to fulfill its social contract will fuel increasing demands for autonomy by various sub-national actors, such as local political elites, regional economic entities, or groups constructed around ethnic, religious, or other identities.¹

Each nation-state has a unique set of existing political, economic and cultural inequalities, and globalization will likely exacerbate such inequalities (especially economic ones) in the future. This challenge will be especially hard for developing countries to meet, as many will not have the economic or political resources to mitigate these inequalities. Greater resources, established rule of law, and coherent democracies will generally, but not always, enable Western states to resolve such sub-national demands peacefully.

Gaps in state coherence will also enhance the role of domestic and international NGOs. Transnational advocacy networks composed of NGOs will penetrate national and international institutions, disseminating political information faster and further than ever before. While this will be an alternative avenue of political action for many whose voices may not be heard, NGOs

will have their own agendas and will not necessarily operate as democratic entities. In many poorer countries, NGOs will increasingly take over former duties of the state without any clear form of political accountability, further degrading the coherence of national government.

Where global inequity and state breakup reach critical levels, the globalized criminal economy will often take root. This “shadow economy” thrives in areas inadequately connected to or even wholly disconnected from the legitimate world economy. In these areas, activities such as narcotics production and the trafficking of women and children are seen as the local population’s only economically viable alternative. If unchecked, this illicit economy can destabilize states to the point of total breakdown, especially if it rises in concert with separatist sub-national identities. Catastrophic state failure will produce innumerable security, environmental, trade, and refugee problems, which in turn can cause regional destabilization.²

Besides fueling growth of the “shadow economy,” global inequity in its many forms is also the driving force behind the current anti-globalization movement. Currently, this movement acts as an umbrella for all sorts of transnational issue groups. However, the sheer number of groups and their networked structure enable them to stage substantial protests against what they view as an unjust globalization process. States have failed to adequately explain the benefits of globalization to this movement and have fueled it through frequent, excessive police action.

If this anti-globalization movement continues to grow and unites around a specific agenda, it could coalesce by 2025 into a popular political party in a country essential to the world economy. If this country were to put up trade barriers and begin nationalizing industries, the shock waves would reverberate throughout the global economic network. Such an economic shock would not only severely affect the United States but would also gravely intensify the state degradation problems outlined earlier.

The anti-globalization movement can be seen as a manifestation of the empowerment of the individual at the global level. Similarly, the increasingly network-oriented domestic politics of the United States will have their own reflection in the evolving relationship between nation-states, NGOs and inter-governmental organizations (IGOs).

The last two decades of the 20th century were marked by the creation of numerous regional organizations such as the North Atlantic Free Trade Agreement (NAFTA), the Asia Pacific Economic Cooperation (APEC), and the South American Common Market (Mercosur). Current U.S. roles in most prominent IGOs are significant. The United States has veto power on the UN Security Council. At the World Bank and IMF, the United States commands roughly 17 percent of the votes on the boards of executive directors due to its considerable financial contribution. Furthermore, the United States dominates contributions to NATO.³

As 2025 approaches, economic IGOs will become essential tools for managing globalization. The establishment of formal, equitable, and effective rules and norms of trade will be essential in spreading globalization's prosperity while at the same time keeping the United States economically healthy. Regional economic entities may help solidify state stability, and the role of economic IGOs in efficiently collecting and disbursing development aid will grow.

However, in a world of empowered individuals and NGOs, the IGOs will have to submit to greater transparency and participation. Their marginal utility as network "nodes" will also vary and evolve over time. NATO, for instance, has outlived its original purpose—defense against the Soviet Union. Urgent leadership and extensive forward thinking will be needed if the good aspects of such IGOs (in this case, shared civil-military norms and the pooling of military resources) are to endure. Some IGOs may evolve, and some may simply disappear.

The nation-state will still be the predominant security apparatus in 2025, and international responses to security threats will continue to be characterized by ad hoc coalitions formed under various IGOs. Global security problems, and international terrorism in particular, have rarely been solved entirely through existing IGOs. This trend will most likely continue into 2025, though with frequent exceptions (e.g., varying involvement of the World Wildlife Fund in providing anti-poaching security for African national parks). Such exceptions could grow further beyond the 2025 time frame.

Recommendations

- Beginning in FY 2003, dramatically increase USG budget expenditures for procurement of IT equipment for all agencies of the USG.
- Establish a citizen commission, made up of government officials and private citizens, charged with assisting the USG in eliminating duplicated functions across federal agencies and creating a network structure.
- Create an Office of Technological and Strategic Assessment (OTSA), under the executive branch, with jurisdiction to assess and advise all USG agencies.
- Use OTSA to forecast future challenges to American governance. Domestic policy avenues that should be explored include:
 - Inclusive governance and greater collaboration between the USG and public and private organizations.
 - Greater utilization of talented individuals with specialized skills not commonly found in the USG, such as foreign language proficiency and advanced technical capability.

- Implementation of appropriate social structures to manage the imminent demographic shift.
- Give OTSA the authority to create periodically new panels of experts and citizens to review the direction of U.S. foreign policy based on changing demographics and gender roles. Allow these panels to suggest changes in, or the elimination of, U.S. participation in specific international organizations and multilateral regimes, as well as encourage suggestions for new cooperation mechanisms between nations.
- Diffuse foreign policy power out, where appropriate, to state, local, and non-governmental entities.
- Make managing globalization and mitigating its worst effects a top priority of USG agencies with an international role. Policy options following from this include:
 - Contributing more money for global economic development disbursed through IGOs and NGOs.
 - Reducing or eliminating of domestic subsidies and tariffs to promote free trade and set an international example.
 - Exploring the use of pension guaranties and trade adjustment assistance to help workers in the international context through institutions such as the World Bank.
- Bring governments and NGOs together to discuss the self-regulation of NGOs through an international code of conduct. Leverage the power of advocacy networks by making them co-creators of such regulation on a par with national governments.
- Resist international state disintegration by promoting regional economic organizations that encourage prosperity and stability on a collective basis. Designate a special aid fund specifically for states undergoing democratic transition.

- Continue participation in IGOs that promote economic development, trade, and investment, while at the same time encouraging transparency and accountability.
- Promote the evolution, and if necessary, the dissolution of IGOs whose original goals may no longer be relevant.

SCIENCE AND TECHNOLOGY

Science and technology hold a central position in preparing the U.S. government mechanism for dealing with future challenges, as well as creating some new ones. Innovation is happening at an increasingly rapid pace, challenging societal structures and the government's ability to cope with change. IT is weaving together individuals, institutions, and societies in ways barely conceivable as little as 30 years ago. Recent advances in genetic manipulation, vastly improved understanding of the human genome, and the current moral and ethical debate over human cloning portend developments in life sciences that could have enormous impacts on the ways people live and work, and nations compete and cooperate. Perhaps even more important will be the advances made over the next 20 to 30 years through the synergy of technologies, and, unlike the past 20 years, the private sector will be responsible for most of the technological innovation. To fully enjoy the benefits of developing and using these new technologies, it will become increasingly important to address the implications of these changes to national security, the economy, and the military.

Nanotechnology

Nanotechnology will have a pervasive and even revolutionary impact on many scientific and technological fields. It will have a particularly strong impact in materials and manufacturing, nanoelectronics and computer technology, medicine and health, aeronautics and space exploration, the environment and energy, and biotechnology and agriculture. Progress in computational nanotechnology, which will permit the modeling and simulation of complex nanometer-scale structures, will greatly reduce development time and will challenge the ability of society to adjust to new technologies and their implications.

The essence of nanotechnology is the ability to work at the molecular level, atom by atom, to make the building blocks for creating both microscopic and increasingly larger structures with fundamentally new molecular organizations. Nanostructure fabrication will involve the development of self-organizing and self-assembling sub-micron structures that can be used to create larger devices. In manufacturing, the ability to synthesize sub-micron building blocks to assemble larger structures offers the possibility for the design of materials previously unseen in nature. Lighter, stronger, and thermally resistant materials designed for planes and satellites will greatly lower costs associated with space exploration and improve capabilities of rockets and commercial and defense satellites. Nanotechnology will also permit advances in agriculture, including biosynthesis and bioprocessing of organic material, to develop new chemical and pharmaceutical products. As nanotechnology has a number of possible applications, it will likely influence, with unforeseen consequences, a variety of important industries.

The “eyes and fingers” of nanoscale engineering have seen rapid advances. Initial successes in the laboratory, utilizing techniques such as scanning tunneling microscopes (STMs) and scanning probe microscopes (SPMs), include “nanotubes,” miniature transistors composed of carbon atoms, and the construction of wires less than a dozen atoms thick. These advances have practical applications for the creation of quantum computers that may mark an information advance as radical as the invention of computers and the microelectronic revolution combined. The laboratory success of molecular manipulation has convinced many scientists that nanotechnology is no longer a question of if, but when.

Attempting to monitor these developments, the White House National Science and Technology Council (NSTC) created the Interagency Working Group on Nanoscience,

Engineering and Technology (IWGN) in 1998.⁴ This group drew members from eight federal agencies to interact closely with the academic and industrial community and was designed to formulate a national research and development plan. The IWGN published a report that called for the establishment of a National Nanotechnology Initiative (NNI), to be funded with \$495 million in the 2001 budget. Former President Clinton made the NNI a top priority, and it was endorsed strongly by the President's Committee of Advisers on Science and Technology, the Office of Science and Technology Policy, and the Office of Management and Budget. The Bush Administration has continued this strong support, pledging increased budgets along the lines advocated by the NNI. However, because the effect of nanotechnology on society is likely to be more influential than the IT revolution, which was confined solely to electronics, a mechanism to monitor not simply technological progress, but also its impact on society and governance structures, is needed.

This technology will proliferate as it matures and begins producing practical industrial applications. The speed and patterns of nanotechnology's spread among the countries of the world will be shaped largely by the existing patterns of technological and industrial development. In the next 15 to 20 years, therefore, nanotechnology will continue to be within the purview of only the most advanced industrialized nations. This will increasingly put pressure on existing international structures and exacerbate inequalities.

Information Technology

Information technology is an extremely broad field encompassing all aspects of managing, disseminating, and processing information. Advances in IT have dramatically

transformed the way in which society lives, works, learns, communicates, and does business. Moreover, IT is increasingly prevalent in matters of national and international security.

During the past 40 years, and over several different generations of technology, not only has the performance of IT increased, but the rate at which performance is increasing has accelerated as well. New technologies for extremely dense data storage, enormous bandwidth over optical fibers, and faster transistors are fueling much of this growth. Molecular manufacturing has made possible the development of nanotubes and atom thick “nanowires,” which may be used to develop microscopic semiconductors. In addition, communications systems with higher transmission frequencies will be able to provide 10 times more bandwidth, with positive consequences for business, education, and defense.

Quantum physics also could offer a new type of programming known as “quantum computing,” in which binary code processing would be replaced by quantum bit computing (qubits). These qubits could exist in multiple states simultaneously and would not be subject to the processes of binary code, allowing them to vastly outperform even the fastest modern computers. Quantum computers would have the capacity to process a number of operations simultaneously, making them ideal for cryptography, modeling, and very large database formation. This could in turn influence more scientific advances and facilitate the ability to develop artificial intelligence.

Like nanotechnology, the market for IT development continues to be concentrated primarily in advanced industrial nations. At the same time, IT is demolishing territorial boundaries and forging nations together into a single global community. Moreover, as physical, social, and cultural boundaries are eroding, increased and accelerated information sharing capabilities will empower state and non-state actors. As the world becomes increasingly

dependent on IT's informational and economic infrastructure, the world also will become more vulnerable to those that wish to disrupt IT capabilities.

Biotechnology

The next two decades will likely be referred to as the "Medical Age," with staggering developments in humankind's ability to cure disease, improve health and welfare, and ultimately prolong life. Biotechnology has already had a profoundly positive impact on the lives of many people, changing the landscapes of medicine and agriculture. The advent of these new technologies has also forced society to confront a variety of safety, security, and ethical issues, including new classes of biological weapons made possible through microbiological engineering and genomic sequencing.

The last 50 years have witnessed an explosion of research in the fields of genetic engineering and DNA manipulation. A key threshold was crossed in 2000 when the Human Genome Project, after first beginning research in 1990, completed the initial map of the human gene sequence. The final map should be completed in 2003, two years earlier than originally planned. This could open up a revolution in medicine's ability to treat and prevent a myriad of ailments; advances in stem cell research, vaccine development, cloning, and genetically modified (GM) foods could be just as revolutionary. All these will produce stronger and healthier U.S. citizens and ultimately help prolong human life spans. Additionally, many of these advances could have almost immediate effects on the health and average life spans of people in the developing world; however, delivery of new medicines and biotechnology will remain a major hurdle.

The biological sciences also will intersect with other fields—particularly nanotechnology, IT, and defense—in ways that will further stimulate innovation and advances. These are positive developments at face value, but the consequences of many of these advances have yet to be seen. Improved vaccines, for example, may trigger superstrains of drug-resistant diseases. GM crops could impact natural ecological systems and create new forms of biological pollution. Negative synergy between new drugs and genetic advances could create unforeseen side effects.

These advances also could generate major societal divisions that would tear apart the United States if not managed properly. Stem cell research and cloning could present ethical clashes that would dwarf the abortion debate. The costs of new medical advances may increase the divide between rich and poor Americans. Developing life-extending advances, which could cause major long-term demographic disruptions and affect numerous work and life issues, will demand forward-looking responses. The speed and magnitude of future developments could strain U.S. capacity and adaptability.

Internationally, if not managed correctly, these advances could widen the gap between the developed and developing worlds and worsen U.S. economic and diplomatic relations with the developing world. If left alone, many of these countries face significant health challenges—such as AIDS, tuberculosis, and malaria—that could weaken and destabilize them, potentially requiring a military response by the United States and/or its allies to protect interests and citizens. U.S. enemies may use these advances to develop new and terrifying forms of biological warfare. Conversely, the strategic use of bioscientific advances could indirectly increase U.S. security: GM crops may help solve major famine and migration problems, for example, and genetic and vaccine advances could augment the world’s ability to respond to disease threats.

The USG must continue to play a proactive, rather than a reactive, role in helping to map the future of the biological sciences. Presently, at least two factors are pushing the government into a reactive role: the commercial sector, driven by considerations of self-interest and profit; and the biological attacks following 11 September, which shifted the nation's focus to biological weapons (BW) defenses. Neither factor is in itself negative, but BW work may be driven more by capabilities assessments than by risk assessments. More importantly, there is a growing concern that the commercial impetus has dissuaded scientists from researching the dangers and unintended consequences of advances in the biosciences⁵ and may result in companies controlling access to important pieces of scientific information.⁶ Further, the United States does not exist in a vacuum. An Italian scientist's recent announcement that three cloned pregnancies are developing, although highly non-credible, nonetheless foreshadows the possibility that other, less-regulated countries could eclipse the United States in controversial biotechnology.⁷ Such an event could have significant economic and moral implications.

Renewable Energy Sources

Advances in the fields of energy and space applications will be no less revolutionary. Technological advances and economic development were once seen as the main causes of environmental degradation. Today, and through future developments, technological advances will decrease greenhouse gas emissions, reduce pollution, and eventually reverse global warming trends. Renewable energy can help provide for long-term, future energy needs while maintaining a commitment to environmental protection by harnessing abundant, naturally occurring sources of energy such as the sun, wind, geothermal heat, and biomass. Advancements in technology have and will continue to reduce the cost of renewable energy, making alternative

fuels as competitive as traditional energy sources, while increasing the abundance and diversity of the United States' energy resources.

Three of the most promising energy technologies that will have a serious impact on foreign policy and consumer behavior are multiple-product power plants, fuel cells, and solar technology.⁹ First, unlike today's single-purpose power plants that produce only electricity, new power plants will produce multiple products, perhaps electricity in combination with liquid fuels, chemicals, hydrogen, or industrial process heat, increasing industrial competitiveness. These plants will generate electricity at unprecedented efficiencies, while emitting little if no greenhouse gases.

Second, fuel cells, which require only hydrogen fuel to produce energy and produce only water as a by-product, and solar power have wide implications for space, transportation, consumer products, landfill/wastewater treatment, and energy conservation. Solar-electric, or photovoltaic, energy has routinely been used for decades to power spacecraft, space stations, and virtually all satellites. Improvements in this technology will enable spacecraft and space vehicles to travel longer distances and be self-sufficient. Solar-electric technology is being applied by major automakers to commercialize a fuel cell car. It will also change the telecommuting world, powering laptops and personal digital assistants hours longer than batteries. Combined with advances in nanotechnology, the implications are mind numbing.

Renewable energy will greatly enhance energy security. The United States is becoming increasingly economically and politically vulnerable as it relies on oil imports from places like the Persian Gulf. The price shocks from a serious disruption in oil supplies would course through every quarter of the U.S. economy. U.S. military forces have been assigned to protect foreign sources of oil, and considerable foreign aid is granted to nations largely because of oil.

Reducing dependency on oil will change U.S. foreign policy objectives. Protecting oil assets will no longer be imperative and the United States might become less willing to intervene. As oil prices fall, some instability in the Middle East and countries that rely primarily on oil exports may result. This repercussion must be considered, and foreign assistance should be structured to aid these countries in developing alternative exports and diversifying their economy.

Renewable energy sources will dramatically reduce urban air pollution, decrease oil imports, reduce the trade deficit, and produce American jobs. If a mere 10 percent of automobiles nationwide were powered by fuel cells, regulated air pollutants would be cut by one million tons per year, and 60 million tons of the greenhouse gas carbon dioxide would be eliminated. This would pave the way for the United States to join the Kyoto Protocol and take a leadership position in reducing greenhouse gases. Oil imports could be cut by 800,000 barrels a day—about 13 percent of total imports.¹⁰

Through improved technology, the United States can lead the world in the development of clean, natural, renewable, and alternative energy supplies. The renewable and alternative energy sectors are among the fastest-growing in the United States. American-made small-scale solar-electric devices are beginning to dominate the world market. The lower middle class in developing countries can afford these systems, and because they are nearly maintenance-free, the potential market in solar rural electrification is huge.

Space

Technological innovations in space, fueled by developments in solar energy and nanotechnology, will continue to proliferate. On one hand, space exploration will shift in focus, with more emphasis on issues such as colonizing outer space. The civil space sector is

approaching a long-standing goal of a permanent manned presence in space with astronauts deployed on the International Space Station¹¹ and of securing effective technological means to search for life on other planets.

On the other hand, issues such as privatization and militarization will increasingly become more contentious. An increasing number of countries are participating in manned flight programs. The fact that many more actors will be involved will pose a challenge to current U.S. supremacy in the field. In addition, unlike the government's domination of the initial era of space exploration, the current era is dominated by the commercial sector. An international space industry has developed, including private space launches and privately developed and operated satellites. Privatization is increasingly eroding government control of space applications. Despite this proliferation of actors, however, the divide between North and South in space technology, as in the other technological fields, is large, if not more pronounced.

Communication satellites and other space-based systems have been the technological cornerstone of globalization, integrating communities that are not just geographically distant but different culturally, politically, and economically. As nations and civil societies become increasingly dependent upon space-based assets, there is a need to protect those assets from attempts to disable them during a conflict. This need has led countries to look for ways to protect their satellite communication systems and military satellites. Nations will either try to create a multilateral framework governing the use of space, or nations will independently look for ways to protect their assets, which could eventually lead to the weaponization of space.

Societal Impact

Rapid, unprecedented technological change will have monumental effects on society. Fundamental questions about the nature of humanity will need to be addressed as genetic manipulation, cloning, molecular manufacturing, and sentient machines revolutionize human society. Novel cultural adaptations will likely arise to enable humanity to adjust to new conditions, just as it has to changes in the past. Whether these adaptations take the form of spiritual responses, manifestations in secular culture, or political reorganizations remains to be seen. It is highly unlikely, however, that faced with radical technological change, the responses of society would be any less radical. Social movements of diverse, forward-looking social thinkers, philosophers, and scientists are already advocating the concept of “transhumanism”: the idea that by utilizing machine/human interfaces, genetic manipulation, cloning, and nanotechnology, it is possible and even desirable for humans to move beyond perceived limitations and confines of the mortal form.

Many fear, however, that the speed and magnitude of these developments could significantly impact U.S. stability and security—perhaps producing deep rifts between religious and secular society, contributing to the growth of isolationist and/or militant segments, or even creating sub- and super-classes of humans. Other events related to science and technology—such as cataclysmic environmental change brought about by global warming, global biological warfare, or the discovery of extraterrestrial life—also could permanently alter the face of U.S. society.

Whether these changes will fundamentally alter human society is unclear, but the USG must assess the possibilities. At the very least, these technologies will create conditions in which the question of “What is human?” may no longer have a definitive answer.

Recommendations

- Increase cooperation and coordination between government and the private sector in matters of space, biotechnology, nanotechnology, IT, and renewable energy technology.
 - Make cooperation a priority, and develop it to include the active participation of all levels of government, the private sector, NGOs, and community-based organizations in decision-making, policy formulation, resource allocation, implementation, and evaluation.
 - Use the National Nanotechnology Initiative as a model for the confluence of private and public research institutions with those of the government.
- In matters of national security, emphasize the information flow between the scientific community and the military (e.g. intelligence sharing), which can be achieved under the umbrella of OTSA.
- Increase government investment in research and development for science and technology applications.
 - Congress should pass legislation to extend and expand tax credits for electricity produced by alternative energy sources.
 - Increase funding of critical and noncommercial research into the benefits and dangers of new products and technologies.
- Carefully assess whether an outright ban on research and funding in a certain field will be beneficial or result in a loss of governmental control.
- Promote public discussion and debate.

- Create “evaluation and societal impact” research teams composed of citizens who will provide valuable insight into potential societal implications of scientific research and suggest alternative innovation paths.
- The Ethical, Legal, and Social Issues Program of research attached to the Human Genome Project should be applied as a model to initiatives in nano- and information technology, space applications, and renewable energy.
- Increase funding in science education and training.
 - Encourage education about and discussion of the social and political implications of scientific research.
 - Increase funding for the National Science Foundation, allowing it to emphasize inquiry-based education at all levels while improving and creating better academic programs for science, such as integrating more research experience into undergraduate curriculums.
- Place an increased priority on intelligence information regarding scientific progress in other countries to ensure the United States does not lose its international edge.
- Lead internationally in developing and maintaining regimes and institutions regarding both the negative and positive aspects of scientific developments.
 - Make international cooperation through scientific exchange a policy goal that will help overcome threats to national security, such as the AIDS epidemic or the dual-use nature of certain technologies, that permeate borders.
 - Work to revise the UN Treaty on Outer Space to ensure that U.S. interests are protected.
 - Reaffirm U.S. support for the UN Office of Space Affairs, either directly or by paying U.S. dues to the UN, so that it may continue its important work in furthering knowledge and experience of space application.

- Advocate redesigning the mandate of the UN Office of Space Affairs to encompass a “forward engagement” component, establishing a body of forward-thinking scientists from developed and developing nations, corporations, and NGOs.
- Become actively involved in the Kyoto Protocol negotiations, shaping the treaty to U.S. specifications and protecting U.S. economic interests.
- As a signatory to a revised Kyoto Protocol, put pressure on developing countries to accept limitations on their greenhouse gas emissions.
- Lead a global effort to design a “Marshall Plan” for global health, utilizing advances in biotechnology and information technology, to aid developing nations and decrease their gap with the developed world.
- Make a conscious effort to bridge the North-South technological divide by providing training to local scientists and sharing commercial satellite imagery and use for nominal fees.
- Integrate the White House Office of Science and Technology Policy with OTSA to eliminate redundancy.

MILITARY AND SECURITY

Innovations in science and technology and alterations in the economy will each substantially affect the future security of the United States. Over the next 15 to 25 years, the United States will encounter a variety of security threats consisting of both familiar geopolitical threats and increasingly familiar asymmetrical threats. In order to counter these threats, the U.S. military must adapt to the upcoming reality both in terms of changing missions and evolving weaponry. While the threats evolve, the role of the government, particularly the military, will remain the same: to provide security to all citizens and interests of the United States.

Traditional Geopolitical Threats

There is a general consensus that attention to transnational security threats should play an increasingly central role in the United States' national security assessment and posture into the future. Issues such as terrorism, international criminal networks, and narcotics will continue to pose serious security challenges for the United States and its interests around the world. However, the nation's security foci and attendant security apparatus must remain balanced yet versatile, since threats will be varied, particularly between regions. It would be extremely risky to shift an unnecessarily high amount of resources to asymmetrical threat programs, which are by nature amorphous and diffuse, at the expense of traditional, state-centric military threat programs that require high-value equipment replacement and/or upgrades. Nevertheless, it is clear that the enemies of today and tomorrow will continue to exploit the traditional hierarchical nature of the United States' national defense structure. Accordingly, it is incumbent upon the military to move toward a more network-centric structure in order to meet these emerging challenges.

Overt threats from states that are antagonistic to the United States and its allies will continue to be a concern into the near future. While there is currently broad, although fragile, cooperation throughout the international community with American leadership in the war on terrorism, traditional security issues such as state territorial integrity/sovereignty, resource conflict, and military aggression have not disappeared. Moreover, states such as China, India, Iran, Iraq, and Russia will continue to maximize their power through traditional means to counter the preeminent military power of the United States. Accordingly, the U.S. military should focus on Asia and the Middle East as areas of probable military rivalry or conflict in the early decades of the 21st century. Since the distance from the United States or other bases of operation may preclude timely or sufficient aerial transport of troops, equipment, and logistical support teams to the region, the Navy will have to transport the bulk of troops and equipment to the areas in question.¹²

The U.S. Navy is especially important, providing U.S. policymakers with unparalleled offensive and defensive capabilities when bases for operations are unavailable due to political or logistical reasons. One need look no further than the current deployment of three U.S. Navy carrier groups in the Arabian Sea, and the speed with which they were dispatched to the region in the weeks following the September 11 attacks on the United States, to appreciate the value of a robust and responsive maritime force. While intense diplomatic efforts were necessary to ensure bases of operation for ground troops and air support in Central Asia, the Navy is virtually unrestricted in where it can conduct its current and future missions.¹³ Moreover, as evidenced in 1996 in the Straits of Taiwan and in the current war being waged from the Arabian Sea, U.S. carrier groups provide a menacing and tangible symbol of American power to those who would test the nation's resolve. Accordingly, the United States' ability to protect its interests around the

world while continuing to shape the international environment will rest, in large part, upon a strong, agile, and forwardly-deployed military.

Threat of Militant Non-State Actors

September 11, 2001 dramatically altered the way in which the United States must identify, monitor, and combat its enemies. The U.S. military and intelligence apparatus demonstrated a startling inability to detect and prevent the most destructive attacks ever recorded on U.S. soil. This is directly due to the fact that terrorists have become increasingly ingenious, capable, and covert in developing plans of attack, and this trend will likely continue in the next 15 to 25 years. Unfortunately, the United States is reacting to the events and aftermath of September 11 instead of looking ahead. Well-funded, proficient, and mobile terrorist organizations such as al Qaeda will avoid using the same strategies against an adversary, especially after that adversary is adequately prepared for another, similar attack. Although the United States is spending billions of dollars on homeland defense, an international web linking terrorists, organized crime, and narco-traffickers is forming. This underground syndicate will wage guerilla warfare on its enemies, disrupt the global trade infrastructure, exploit and destroy weaker states, and may ultimately remake portions of the world in its own image. If this network is allowed to expand unimpeded, it may prove to be one of the most devastating evolutions of criminality in modern history.

During the 1990s, a variety of criminal elements emerged in the former Soviet Union, taking advantage of the newly opened markets, fluid borders, and general governmental confusion. Russian mafia bosses established ties with warlords, dissidents, and al Qaeda sympathizers in the opium growing regions of Pakistan and Afghanistan to export opiate

derivatives. This relationship has proven to be mutually beneficial for the criminals and poses a serious future security threat to the United States. Afghani militants receive much needed funding, and the Russian mafia obtains opium—a highly prized money-producing commodity.¹⁴ These sales not only are responsible for dispersing weapons to states and terrorist organizations hostile to the United States but also pose further security challenges by fueling drug addiction and the HIV epidemic.¹⁵ Further cooperation between organized crime, terrorist groups, and drug traffickers will not be limited to relatively simple exchanges in the future. Of concern is that Russia’s nuclear arsenal is not well maintained or organized. When it becomes profitable and feasible, mafia cells may obtain nuclear material and sell it to the highest bidder. Interested parties may include Iraq, Iran, North Korea, China, former Soviet states lacking nuclear armaments, and any number of terrorist organizations.

Narco-traffickers and organized crime syndicates are also adept at money laundering and transfers. These skills will become important to terrorists as the United States and its allies continue freezing accounts and confiscating money. The disruption to the global economy will be significant, as increasing amounts of dirty money flow unhindered across borders and bank accounts. Further, the loss of tax revenue, investment, and legitimate business will hamper law enforcement capabilities, sap social programs, and dissuade legitimate investment within the states inhabited by these militants and criminals. As correspondence increases between rogue elements, increased cooperation in planning, funding, training, transportation, asylum, and chemical, biological, radiological, and nuclear (CBRN) weapons acquisition is inevitable.

Increased Responsibilities and Alternative Threats

Homeland defense is now a major component of defense strategy. Recent creations like the Office of Homeland Security and the planned Northern Command are the foundations for future homeland defense strategy. The Northern Command will be responsible for securing North America. The U.S. government must continue to maintain a clear line between domestic civilian and military activities. The Posse Comitatus Act, 18 U.S. Code, Section 1385, prohibits the military from taking part in domestic law enforcement activities. However, this law does not prevent close cooperation with and support of civilian agencies. A CBRN attack against U.S. citizens on U.S. territory is likely to occur in the future. Civilian and military responders should be prepared to deal with the consequences of such an attack. The U.S. military should continue to work with federal, state, and local agencies to prepare for CBRN attacks, natural disasters, and other emergencies. The Office of Homeland Security and the Northern Command should work together closely to coordinate homeland defense strategy. However, it is crucial to keep law enforcement a civilian responsibility, for without a clear distinction, democracy is endangered.

In addition to geopolitical threats and threats from militant non-state actors, U.S. security will be increasingly challenged by non-traditional security concerns. The number of civil wars and internal conflicts will continue to increase over the next 15 years as a result of changing demographics, resource scarcity, and disease. These conflicts will continue to be centered in the developing world, particularly Africa and South Asia, but may expand into the Middle East and Southeast Asia. The world population is expected to reach over 7.8 billion by 2025, with the majority of the population growth occurring in the developing world.¹⁶ Some African and Middle Eastern states will experience “youth bulges,” in which 20 percent or more of the population is aged between 15 and 24.¹⁷ If education and employment are unavailable, these

countries could destabilize. As the population increases, the trend of urbanization will continue. The CIA predicts that over half of the world's population will live in an urban environment by 2015.¹⁸ If governments and economies fail to accommodate the growing population, tensions and the possibility of internal conflict will increase. Many peacekeeping and humanitarian operations will likely be centered in urban areas in the future.

The growing world population is also straining the natural environment, producing not only the previously mentioned economic concerns, but also significant military challenges. Conflicts over water are probable by 2025 because there are no easy solutions and nations are not planning for the future. The International Water Management Institute predicts that 1.8 billion people will live in areas with absolute water scarcity.¹⁹ Water-stressed countries in geopolitically important regions like the Middle East will be especially susceptible to wartime coercive pressures from water-endowed adversaries. As conflict erupts between these states, water sources may become a major object of military strategy.

As mentioned briefly above, the AIDS epidemic is an additional destabilizing trend, one that will pose increasing security concerns for the United States in the next 15 to 25 years. U.S. military personnel (particularly peacekeepers) must be thoroughly trained in HIV/AIDS prevention. Sub-Saharan Africa, South Asia, and Southeast Asia are hardest hit by the epidemic. Beyond the tragic loss of life, the epidemic also inhibits economic growth and development while destroying social and family networks. The United Nations predicts that some heavily affected countries could lose more than 20 percent of their gross domestic product by 2020.²⁰ Millions of children have been orphaned and many must forgo education to care for sick relatives, adding to the destabilizing effects of "youth bulges." By 2025, the rate of infection

will have slowed because of better education, healthcare, and medical breakthroughs. However, the damage to the future has already been done.

Population increases, water shortages, and HIV/AIDS in the developing world will result in an increasing number of internal conflicts and humanitarian crises. These situations may spill over into other states, create refugee flows, cause a state to fail, or threaten U.S. citizens and interests in affected regions. The increasing importance of democracy and human rights will also compel the United States to be involved in peacekeeping operations. Opponents of such operations argue that they interfere with the soldier's main function as a war fighter. However, the dangerous environment of some peacekeeping operations and humanitarian interventions require combat skills. U.S. peacekeepers must also work closely with international organizations and local leaders. Peacekeeping operations and humanitarian interventions will continue to be pursued through the UN, regional organizations, and other multilateral coalitions over the next 15 years.

The Air Force, Navy, and Marines will also play a role in peacekeeping and humanitarian interventions. The Air Force will continue to provide air support, lift, and surveillance capabilities. Carrier battle groups will continue to be an important operational platform. Carriers can provide a base of operations (similar to the current situation in Afghanistan) in areas with little infrastructure. The Marines can assist in establishing bases of operations.

Another important component of peacekeeping operations and humanitarian interventions is intelligence. Human intelligence must increase in areas of internal conflicts. Intelligence officers, U.S. peacekeepers, aid workers, and community leaders will need to create intelligence networks to monitor the local community's mood and adversaries' movements. Better

intelligence and coordination will enable U.S. peacekeepers to predict and respond to small incidents before they become crises.

Evolution of Weaponry

The evolution of weaponry will depend largely on the future roles and missions the military chooses or is forced to undertake. Some argue because U.S. weapons are already decades ahead of potential adversaries, resources should be geared to develop weapons suited for low intensity conflicts such as peacekeeping and humanitarian missions. Others argue it is important for the U.S. to remain well ahead of the curve in developing all weapons types and promoting the possibility of using high-tech weapons in low intensity conflicts.²¹ Although low-intensity conflicts will likely increase, the United States should continue to develop systems effectively to combat all types of aggressors in all venues. In this matter, OTSA could be of importance to military planners by providing an improved ability for the USG in preparing weaponry best able to fulfill policy objectives.

Just as the information revolution has influenced the current generation of weapons, advancements in nanotechnology will shape the next generation of weapons. Although nanotechnology is seen primarily as a way to preserve U.S. information and communication dominance, other military applications are possible. These could include “nanotech uniforms” offering multi-threat protection against ballistics and chemical and biological agents, climate control, and biomedical monitoring. Other military uses for nanotechnology include enhanced automation of combat vehicles; lighter aircraft able to complete longer missions with heavier payloads; improvements in chemical, biological, and nuclear weapons sensing and casualty care; and improved systems for nonproliferation monitoring and management.

In 2002, the United States can control land, sea, and air. The future focus will be American dominance of space. According to the Pentagon, space has become the ultimate military high ground, and officials are concerned that other states and even corporations will challenge the United States in this venue.²² To counter this, there will be a 145 percent increase over the next five years in operations dedicated to strengthening U.S. presence in space.²³ By 2025, current earth-based surveillance capabilities could theoretically be moved into space, with satellites capable of locating tanks in densely populated urban areas and even able to locate and track movements of terrorists and other international criminals. Directed Enemy Technology, or hyper-spectral surveillance, may also be available to pinpoint battlefield targets for destruction and scramble enemy equipment in space.

Yet the future possibilities in space are not limited to intelligence gathering. With such advanced technology operating in space, the United States will have to devise methods to defend its space interests, leading to the precarious step of space militarization. Although in an advanced developmental stage, offensive weapons such as lasers or robotically operated spacecraft will not likely be operating in space by 2025. However, satellites with self-defensive measures are already being developed.²⁴ Consequently, the larger debate over the militarization of space will escalate as space weaponry and satellites advance.

Men on earth, not robots in space, will still wage war in 2025.²⁵ However, with Americans becoming increasingly intolerant of U.S. combat casualties, a sophisticated fleet of unmanned aerial and maritime vehicles will be developed to provide reconnaissance, surveillance, and targeting information, as well as having combat capability.²⁶ In addition, the U.S. Navy's stealth fleet should be operational by 2025. Also by this time a second or third generation Joint Strike Fighter able to serve the combat capabilities of the Air Force, Navy, and

Army should be in existence. Finally, many strategists view humans as the ultimate weapon, and there is increasing discussion of creating a genetically modified human structured for combat. While completion of such a project is not likely by 2025, advancements in gene technology will increase its feasibility. As scientists ponder the social implications of their new findings, so too must military planners decide if their decision to implement new weapons will detrimentally alter society.

Recommendations

- Maintain current carrier force at 12 and accelerate development of replacement carriers.
- Establish plans for expanded contingency military bases in the Western Pacific (Guam, Saipan, etc.) that could be activated quickly if political conditions in East Asia shift (e.g. Okinawa).
- Reduce army troop end strength and replace with smaller units of Special Forces trained in guerilla, counter-terrorist, and urban warfare.
- Move forward with Quadrennial Defense Review 01 recommendation to shift U.S. security focus to Asia.
- Deploy an international cadre of undercover agents mirroring the network structure of terrorist and criminal elements in order to collect intelligence, infiltrate the organizations, and ultimately destroy individual cells.
- Build, along with allies, multilateral crime fighting networks that parallel and counteract the activities of terrorists.

- The Department of Defense and the Office of Homeland Security should create more military-civilian training exercises, simulations, and education programs to prepare for attacks on national territory.
- Create offices with parallel organization structures and similar policies within each USG department to handle narco-traffickers, organized crime, and terrorism.
- Invest in security, prevention, contingency plan development, emergency response, vaccinations, medical facilities, and public education to prepare for a CBRN attack.
- Integrate National Missile Defense (NMD) and North American Aerospace Defense Command (NORAD) into the Northern Command.
- Fund more Army interim combat brigades and task them with peacekeeping and humanitarian operations. These brigades should be trained in urban combat, local culture, and foreign languages. American peacekeepers should interact with the local population through education, youth, and other local programs when possible.
- Upgrade relevant legacy systems and use them for peacekeeping and homeland defense.
- Reallocate military research funds to intelligence gathering, Special Forces, covert field deployments, current system maintenance, long term strategy planning, emergency response, multilateral training, and peacekeeping.
- Employ OTSA to monitor scientific developments that might have military applications.
- Appoint a commission to study the need for a service branch dedicated entirely to space. Current space programs are housed both under the Air Force and NASA, yet the thinking necessary to control an air force is different from the type necessary to control a space force. A separate branch would ensure U.S. space dominance and deter others from threatening the United States.

ECONOMICS AND FINANCE

Globalization, and the advances in technology associated with it, will fuel the U.S. economy while presenting challenges that are difficult, if not impossible to predict. Economic, and more importantly national, security will take on added importance as technologies become more advanced. Globalization has the power to help developed economies thrive as well as intensify problems, especially in the banking, trade, and finance sectors. The same is true for the already struggling developing world. Resource scarcities and environmental catastrophes are the most pressing concerns, as these developing economies are left to dwell in a technological deficit. The United States and other states will face fundamental challenges to their liberal democracies as a result of these economic changes; the USG will therefore need to consider a number of recommendations to mitigate negative consequences and enhance positive aspects.²⁷

Technologies

IT is vital to the global economic network and has flourished in the last decade. The emergence of new IT, especially computer circuits and chips, will pave the way for faster and more dynamic computers. IBM scientists have been working on computer circuits that are built from single strands of carbon and practical computer chips that can be manufactured from nanotubes.²⁸ This is significant because:

The processing power of computer chips has consistently doubled every year or two as the size of transistors continues to shrink. But current chip-making technology, which etches circuit into silicon, is expected to run up against fundamental physics in 10 to 15 years.²⁹

Not only will more enhanced computers and systems emerge (such as quantum computing), but also their use and availability will increase.³⁰ The CIA projects the decreasing costs of equipment, coupled with the increase in demand, will encourage economic development and

enhance many states' economic status.³¹ It is the negative aspects of these technologies that must be examined.

The most potent threat the United States will likely face with the emergence and diffusion of information technologies is the asymmetric threat posed by individuals exploiting these systems in cyberspace: cyber “hacktivists” and cyberterrorists. The United States will continue to be a net exporter of these technologies as well as the network hub for North America, making its computers and computer systems a valuable target for state and non-state adversaries. The last two U.S. administrations have actively tried to understand and deal with the potential for a “digital Pearl Harbor” that can significantly disrupt major networks.

Science also is advancing by leaps and bounds in biotechnology and in nanotechnology. These technologies will present the scientific community with unprecedented opportunities to enhance people’s overall quality of life. The National Institutes of Health (coordinator of the Human Genome Project) and private firms like Celera Genomics are at the cutting edge of biotechnology, transcribing the code that controls the creation of human life, learning the mysteries behind diseases and conditions, and, in turn, altering the economic landscape of the future.³² In addition, universities are investing heavily in nanotechnology research, as are other organizations such as the Foresight Institute and the USG (through the NNI).³³

These new technologies will create many stresses on the U.S. economic situation. With people living longer as a result of drug therapies and biomedical engineering, and as the sequencing of the human genome leads to cures for deadly diseases, the United States faces the challenge of ensuring that all Americans have the basic necessities in addition to education, employment, and retirement services. Paying for some of these services will be a major challenge. Education will become more costly and more difficult to manage, and unemployment

may grow to be an issue. In formulating economic policies, the USG will have to take into account these threats today if social and welfare services are to be maintained in the future.

Abuses and aberrations of new technologies could cause potential economic havoc. The cloning debate best illustrates this fact. The Roslin Institute, the entity that first cloned the now famous sheep “Dolly,” clearly understands the potential for catastrophe with cloning given that “success rates remain low in all species, with published data showing that on average only about one percent of 'reconstructed embryos' lead to live births.”³⁴ Similarly, as scientists move towards cloning organs, the possibility for incompatible organs is extremely high, with the potential of increasing medical costs to governments and private sector entities. If there is poor risk management, the United States and other states will incur high costs trying to remedy issues. Additionally, state and non-state actors who lack access to these technologies will pose a threat, especially as their ability to network anonymously through computer networks increases. More terrorism and other negative repercussions are highly plausible, potentially leading to significant economic ramifications.

Development

Biotechnologies will provide breakthroughs in development issues, including an increase in human life expectancy. This increase, coupled with falling fertility rates, will paradoxically contribute to harmful effects on the U.S. economy. Almost all population growth will occur in developing nations that until now have occupied places on the fringes of the global economy; however, these growth projections have recently been revised to reflect fertility rates falling below “replacement level,” which has already occurred in much of the developed world. More women in the developing world are gaining control over their reproductive lives instead of

waiting for rises in living standards or educational and employment opportunities. But low fertility rates will continue to affect the developed world. The industrialized world will experience an unprecedented crisis of aging. According to CIA statistics, by 2050, nearly 1.5 billion people (16.3 percent of the world's population) will be aged 65 or older, compared to about 420 million (6.9 percent) in 2000.³⁵

Consequently, labor force contraction in many of the world's leading economies will depress economic output, boost inflation, and curb investment, creating a ripple effect in the global economy. Demographic factors will heighten existing tensions and exacerbate other factors that precipitate conflict. These pressures will build in regions of the world, such as Sub-Saharan Africa, that have traditionally not been at the center of U.S. policy interests. The United States will be expected to assume a larger share of the burden for increased financial and humanitarian assistance in these regions. As births decline in the coming decades, so too will the number of consumers and producers in the industrialized world. The declining ratio of working people to retirees will strain social services, pensions, and health systems. Failure to respond to the aging challenge will destabilize the global economy, straining financial and political institutions around the world.³⁶

While aging will mostly affect the developed world, the young will help to exacerbate problems in the developing world. The world's poorest and often most politically unstable countries will have the largest youth populations, otherwise known as a youth bulge,³⁷ through 2020.³⁸ Most countries will lack the economic, institutional, or political resources to effectively integrate youth into society. The International Labor Organization estimates that the global labor force will increase by nearly one billion over the next decade (with most growth coming from the developing world), putting significant pressure on already weak economies to create hundreds of

millions of new jobs. Furthermore, with fertility rates remaining relatively high in developing countries, pressures will continue on education, health care, sanitation, and economic infrastructures.

The failure to adequately integrate large youth populations is likely to perpetuate the cycle of political instability that already affects many of these countries. In turn, political instability will make it even more difficult for poor countries with large youth populations to generate economic growth and encourage the foreign and domestic investment needed to generate new jobs. The emergence of high structural unemployment during a youth bulge will often result in many youths supporting radical political alternatives. The destructive impact of internal demographics is clear and can often lead to economic and international problems with alarming implications for U.S. national security.

Environment

The preceding population issues will contribute to global pressures on the environment. Some 7.2 billion people will populate the world in 2015, up from 6.1 billion in the year 2000.³⁹ These figures represent demographic challenges that are adversely affecting the environment. According to the World's Resources Institute, global water consumption is rising quickly, and water availability is likely to become one of the most pressing and contentious resource issues of the 21st century. By 2015, nearly half the world's population—more than three billion people—will live in “water-stressed” countries, mostly in Africa, the Middle East, South Asia, and northern China.⁴⁰ Surface water supplies will continue to shrink as the amount of water consumed by agriculture increases in order to meet world food demand. Globally, water supplies

are abundant, but they are unevenly distributed among and within countries. This will lead to instability and conflict that could produce a negative effect on the U.S. economy.

Rising populations will also lead to accelerating forest destruction. Increasing populations will continue to pressure all countries with remaining tropical forests, where about 60 percent of world population growth this decade will occur.⁴¹ Because many in developing countries depend on wood for cooking and heating and need to clear more land for crops, forests will continue to be destroyed at an alarming rate.

Deforestation has many adverse consequences, ranging from soil erosion to climate change. Soil erosion will lead to permanent impoverishment of huge land areas, causing its inhabitants to continually migrate, often leading to conflict. Perhaps the most serious consequence of deforestation is climate change due to tree loss. Deforestation prevents plant life from keeping carbon dioxide levels in check. Increased atmospheric carbon and other greenhouse gas levels lead to increased temperatures and, eventually, changes in climate and weather. These climate changes represent a possible discontinuity among environmental trends. A recent incident, involving the sudden break-up of an Antarctic ice shelf approximately the size of Rhode Island, provides a warning of what is likely to happen to the frozen continent over the next century if present trends in global warming continue.⁴² Climate change and other environmental effects will pose significant long-term threats to the environment and the U.S. economy.

Finance and Trade

Despite the rapid depletion of natural resources, international trade and finance networks will continue to grow into one global market by 2025. Concurrently, the United States will forge even closer economic ties within NAFTA and broaden the agreement to include Central America in an integrated trade and financial market stretching from Canada to Panama by 2025, accompanied by dollarization “south of the border” and completely integrated monetary policies. A common currency (U.S. dollar) and monetary policy will be essential for stabilizing the economies of Central America, encouraging investment, facilitating trade, and increasing efficiency and competitiveness in the regional bloc vis-à-vis a strengthening European Union competitor.

Technological advances, and the free flow of capital, information and free enterprise, will fuel the integration of financial and trade markets and have an enormous impact on trade, financial transactions, and business decisions, as they will be conducted in “real time.” Western markets, especially the United States, have relied heavily on foreign direct investment and on Americans' insatiable desire to consume. According to *The Economist*, the United States and other Western nations have continued to borrow to sustain spending, expecting economic growth to continue indefinitely, resulting in record corporate and private debt.⁴³

In order to continue the volume of capital inflow needed to finance this enormous debt, the United States must remain at the forefront of trade, finance, science, and technology, as well as continue to lower barriers to trade and create an extremely favorable environment for foreign investment. If investors feel domestic policy will adversely affect their short-term gains, they will instantly be able to withdraw capital, and the likelihood of economic collapse triggering a “contagion” reminiscent of the Asian financial crisis of 1998 will increase exponentially. The

next time a contagion happens, however, the effects will be more widespread, happen more quickly, and be more powerful because of the more highly integrated global markets and more easily moving capital. This means that governments will essentially have “two constituencies”: financial markets and national citizens.⁴⁴

This raises the question of who will be in charge of this new global financial system. This issue has already become a regulatory nightmare, as governments are unable to move as quickly as technological advancements; this lag will delay government’s ability to assess the social impact on citizens or to devise tools that can adequately assess real economic growth to make relevant policy. The intimate connection of economic policy with national governments has impeded the development of international institutions to monitor and regulate financial markets and has consequently impeded the effectiveness of existing institutions. Economists are already wondering if policymakers truly appreciate the interconnectivity of global markets or the potential damage these markets can do in a future age of instant information and financial transactions. For example, an election campaign that promises to raise tariffs in order to court the votes of certain domestic groups can have devastating effects on markets, leading to instant boycotts of American products and an outflow of capital from the United States.⁴⁵ This regulatory lag will also allow businesses to grow unencumbered, with antitrust laws unable to cope with transnational corporations and a further widening digital divide. More financial scandals and layoffs affecting U.S. workers and their savings à la Enron will decrease American trust in employers, government, and even capitalism, and Americans will object to more economic integration.⁴⁶ This will especially be true if the benefits of globalization continue to profit the select few in the globalization “club.” While global markets and the U.S. economy have survived the shocks of both recession and terrorist attacks remarkably well, development

and integration have continued to distribute disproportionate benefits, with “two billion people (living) in countries that have become less rather than more globalized.” In these countries, “trade has diminished in relation to national income, economic growth has been stagnant, and poverty has risen,” increasing asymmetrical threats to the United States and its interests.⁴⁷

The technological advances that make financial transactions so effortless also aid antagonists in acquiring damaging information and/or resources to harm the United States at home and abroad. Major disruptions to U.S. financial markets are extremely likely as a result of American dominance in finance, trade, and technology, ranging from terrorist attack (nuclear, conventional, or technological in nature) to a collapse of world financial markets and stock market crashes. Any attack on the information networks of U.S. markets and/or financial centers would ruin the economy. Unless the United States and its close trading partners can find a way to resume trade and banking within days, if not hours, after such an attack, the United States will spend years recovering from the collapse of its economy. Integrated markets will also make corruption more difficult to detect. This will allow criminal organizations to move laundered money more easily and anonymously, undermining the stability of financial markets as states and their financial institutions permit these acts of corruption for their own gain or because they have insufficient resources and policy with which to monitor these developments.⁴⁸ The more economically pressed the citizens and governments of underdeveloped countries feel, the more likely they will be to accept bribes and allow organized crime and terrorist groups to use their countries and resources for corrupt purposes, greatly multiplying the impact of asymmetrical threats on U.S. interests.

Additionally, the uneven benefits of globalization and financial market integration could frustrate emerging markets to the extent that national governments prevent the free flow of

capital in an attempt to protect domestic markets. This will undoubtedly lead to a halt of capital flow from the developing world to Western financial markets, and effectively cease the economic engine that has so far fueled Western success and consumption.

Recommendations

- Emphasize risk management and encourage greater networking and flexibility in working with the private sector, especially in IT, since the private sector owns the networks from which the world operates.
- Significantly alter the USG hierarchical structure and begin functioning more like the private sector to deal with the emergence of more knowledge-based technologies.
 - Streamline the government by cross-fertilizing people from various networks to handle problems.⁴⁹
- Produce self-sustaining entitlement programs to offset the aging challenge.
 - Encourage citizens to work and encourage those who are already employed to work more, increasing output through higher utilization of labor.
 - Consider increasing tax rates and retirement ages to ease pension issues and help offset the fiscal pressures from the aging population.
 - Develop new definitions of and requirements for retirement, as well as greater understanding of the burdens to be shouldered by coming generations.⁵⁰
 - Support reproductive enfranchisement in developing nations to stabilize fertility rates.
- Support migration to increase the availability of workers in aging populations and of jobs for unemployed youth in many developing countries. Migrants who choose to remain in host countries with aging populations will help to boost government revenues through taxes.

- Emphasize international networking dealing with the better management of water resources to mitigate scarcities in the future, avoid conflict, and avoid further damage to aquatic ecosystems.
 - Work with the UN Development Program (UNDP), which partners with other agencies, governments and NGOs, to help strengthen transboundary water initiatives.
 - Emphasize, with the UNDP, a focus on water-efficient technologies and pollution control as essential to dramatically expanding available resources and increasing water conservation.
 - Promote simple improvements in irrigation projects and planning to bring high short-term rewards in reduced water consumption and improved health.
 - Share sustainable technologies with water-stressed regions while adapting to their particular social contexts. Provide local communities needed financial support to develop their own processes.
- Use a multilateral approach, including networking with various programs at the UN, to improve forest management and conservation.
 - Promote efforts to reduce timber harvesting in natural forests, develop alternative sources of industrial wood, improve harvesting practices, reduce illegal forest activities, and increase community-based forest management.⁵¹
 - Focus on institutional and governance issues in order to achieve sustainable forest management. Illegal forest activities, including corruption, incur immense financial, environmental and social costs. Governments, the private sector, IGOs, and NGOs need to strengthen monitoring and enforcement systems, increase transparency in decision-making, enact simpler laws, and support more severe punishment.

- Provide economic incentives for industry to manage forests more sustainably. Promote independent organizations that have launched “good wood” programs to create markets for timber obtained from sustainable sources. Harnessing such positive economic forces offers more promise than fines and other punishments.
- Increase and strengthen networks with trading partners, IGOs, and NGOs to monitor the developments of global markets and business and develop a flexible response system *within* these established organizations to address these issues as they arise.
 - Increase the pace of developing new institutions to accommodate rapid changes in financial markets. Develop measures to ensure benefits to all countries that open their markets to foreign investors.
 - Increase trade, foreign direct investment and, most importantly, foreign aid to developing economies to assist with this process, decreasing the impact of asymmetrical threats.

CONTINUED FORWARD ENGAGEMENT

The overarching goal of this panel was to present a broad picture of the future in the areas of state stability and governance, science and technology, military and security, and economics and finance, and to provide some direction to policymakers to enable them to look beyond immediate concerns. While the range of issues covered and options suggested above are expansive, they are in no way all-inclusive. Change is occurring at an ever-increasing pace. Advisors can predict a number of events such as growing nanotechnology, spreading globalization, increasing terrorism, and emerging global non-state actors with reasonable certainty, yet humans still lack the capacity to forecast accurately all future events. In order to secure its place in the 21st century and beyond, the United States should no longer rely on short-term fixes to address long-term problems.

The panel's answer to the key question of how the USG can prepare now for 2025 and beyond is two-pronged. Forming OTSA would help the USG better predict future events and respond to them proactively. The new office could build upon the success of the U.S. military, which is already evolving toward a network-centric reality, and in return could help the military reap the fruits of civilian advances. In the realms of science and economics, the USG should aim, through OTSA and other structures, to facilitate, not regulate. Enabling information sharing among public and private entities would greatly multiply positive outcomes, but stifling scientific innovation and economic growth would threaten the leadership of the United States in these two vital areas.

The panel agreed that the U.S. Constitution must be preserved in order for liberal democracy to continue thriving. However, the USG, through OTSA and its authority to create citizen commissions, should study and anticipate the material and ethical issues that may cause

conflicts between the interests of American citizens and constitutional law. This function would not take constitutional interpretation away from the courts, but it would prepare the USG and the public to hold more thoughtful and reasoned debates. If future developments lead to constitutional amendments, or even a reconsideration of the entire document, the USG must prepare for that contingency in a way that will best ensure the American people's sovereignty.

In a world of demographic changes and diminishing resources, domestic or multinational networked actors may threaten liberal democracy's survival in the United States if the USG is not ahead of the curve. A forwardly engaged government, anticipating and promoting strategic and technological opportunities while allowing the private sector freedom to excel, is America's best defense for the next quarter century and beyond.

¹ Manuel Castells, *The Power of Identity* (Oxford: Blackwell Publishers Inc., 1997).

² "State Failure Task Force Report; Phase II Findings," July 31, 1998.

³ Tara Sheets, ed, *Encyclopedia of Associations. International Organizations: A Guide to More Than 19,000 International Nonprofit Membership Organizations Including Multinational and Binational Groups, and National Organizations Based Outside the United States, Concerned with All Subjects or Areas of Activity*, (Detroit, MI: Gale Research Inc., 2001).

⁴ For more information, see the National Science and Technology Council website at http://www.ostp.gov/NSTC/html/NSTC_Home.html.

⁵ Richard Louv, "Funding System for Scientific Research Filled with Pitfalls," *San Diego Union-Tribune*, 17 March 2002, A12.

⁶ For example, reports recently surfaced that the journal *Science* and a Swiss-based agrochemicals company, Sygenta, had reached an agreement that would enable the company to control who has access to the complete DNA sequence of the rice genome. Steve Connor, "Geneticists Protest at DNA of Rice Becoming a Trade Secret," *The Independent* (London), 18 March 2002, 5.

⁷ "Doctor: Three Women Pregnant with Cloned Babies," Reuters, 24 April 2002.

⁸ "Doctor: Three Women Pregnant with Cloned Babies," Reuters, 24 April 2002.

⁹ For detailed information on each of these applications, see the U.S. Department of Energy website at <http://www.energy.gov/future/sub/fueling.html>.

¹⁰ National Energy Policy Development Group, *Reliable, Affordable and Environmentally Sound Energy for America's Future*, 2001.

¹¹ Construction in orbit began in November 1998 with the launch of Zarya, the Functional Cargo Block, from Russia on a Russian Proton rocket. A total of 44 launches will be required to complete the facility in 2005. For more information, please refer to <http://spaceflight.nasa.gov/station/>.

¹² John Birkler et al., *The U.S. Aircraft Carrier Industrial Base: Force Structure, Cost, Schedule, and Technology for CVN 77* (Santa Monica, Calif.: RAND, 1998)

¹³ John Schank et al., *CVX Propulsion System Decision: Industrial Base Implications of Nuclear and Non-Nuclear Option* (Santa Monica, Calif.: RAND, 1999)

-
- ¹⁴ Sergei Karaganov, "Drug Addiction in Russia: A Threat to the Nation?" *The 'Whither Russia' Project: Strengthening Democratic Institutions Project*, John F. Kennedy School of Government, Harvard University, September 1998, 3.
- ¹⁵ Ibid.
- ¹⁶ "Total Midyear Population for the World: 1950-2050," US Census 2000, at <http://www.census.gov/www/worldpop.html>.
- ¹⁷ Michael Mazaar, *Global Trends 2005: An Owner's Manual for the Next Decade* (New York: Palgrave, 1999), 36.
- ¹⁸ *Global Trends 2015: A Dialogue About the Future With Nongovernment Experts*, Central Intelligence Agency, December 2000, 20.
- ¹⁹ "Projected Water Scarcity in 2025," International Water Management Institute, at <http://www.cgiar.org/iwmi/home/wsmmap.htm>.
- ²⁰ Ibid 7.
- ²¹ Martin van Creveld, *The Transformation of War*, (New York, 1991).
- ²² "Wolfowitz Says 2003 Defense Budget Driven By New Strategy," U.S. Department of State, at <http://usinfo.state.gov/topical/pol/terror/02021301.html>.
- ²³ Ibid.
- ²⁴ Jack Hitt, "Battlefield Space," *The New York Times*, 2 August 2001, section 6, p. 30.
- ²⁵ George Friedman, *The Future of War: Power, Technology, and American World Dominance in the 21st Century*, (New York: Crown Publishers, 1996).
- ²⁶ "Wolfowitz Says 2003 Defense Budget Driven By New Strategy." Institute of Peace, April 1997.
- ²⁷ Ellen L. Frost, "Globalization and National Security: A Strategic Agenda," in Richard L. Kugler and Ellen L. Frost eds., *The Global Century: Globalization and National Security* (Washington, DC: National Defense University Press, 2001), 35.
- ²⁸ Kenneth Chang, "I.B.M. Creates A Tiny Circuit Out of Carbon," *The New York Times*, 27 August 2001, 1.
- ²⁹ Ibid.
- ³⁰ Mark K. Anderson, "Liquid Logic," *Wired Magazine*, September 2001, 1.
- ³¹ *Global Trends 2015: A Dialogue About the Future With Non-Government Experts*.
- ³² Charles Platt, "Evolution Revolution," *Wired Magazine*, January 1997, 1.
- ³³ "Foresight FAQ General Nanotechnology Information," The Foresight Institute, at <http://www.foresight.org/NanoRev/FIFAQ1.html>.
- ³⁴ "Cloning," from the Roslin Institute, Edinburgh, Scotland, at <http://www.roslin.ac.uk/public/cloning.html>.
- ³⁵ *Long-Term Global Demographic Trends: Reshaping the Geopolitical Landscape*, Director of Central Intelligence, July 2001, 21.
- ³⁶ Peter G. Peterson, "Gray Dawn: The Global Aging Crisis," *Foreign Affairs*, January/February 1999.
- ³⁷ A youth bulge is a disproportionate concentration of population in the 15- to 29-year-old age range. Definition taken from: *Global Trends 2015: A Dialogue About the Future With Non-Government Experts*, 36.
- ³⁸ *Long-Term Global Demographic Trends*, 36.
- ³⁹ *Global Trends 2015*, 19.
- ⁴⁰ "Water-stressed" countries have less than 1,700 cubic meters of water per capita per year. Definition taken from: *Global Trends 2015*, 27.
- ⁴¹ *Long-Term Global Demographic Trends*, p.77
- ⁴² Mark Henderson, *The Times*, March 21, 2002, p. 8.
- ⁴³ "Ready for take-off?" *The Economist*, 26 January 2002, 9.
- ⁴⁴ David J. Rothkopf, "Foreign Policy in the Information Age," *The Global Century*, (Washington, DC: National Defense University Press, 2001), 219.
- ⁴⁵ Ibid., 220-222.
- ⁴⁶ Richard W. Stevenson, "Why a Scandal Become a Spectacle," *The New York Times*, 17 February 2002, Section 4.
- ⁴⁷ "Is it at Risk?" *The Economist*, 02 February 2002, 66.
- ⁴⁸ Dr. Kimberley Thachuk, "Corruption: The International Security Dimension," paper presented at 2002 Pacific Symposium, National Defense University, 20-21 February 2002.
- ⁴⁹ Frost, 36.
- ⁵⁰ Dennis Pirages, "Demographic Change and Ecological Security," *Environmental Change and Security Project*, The Woodrow Wilson Center, Spring 1997, Issue 3, p. 44.
- ⁵¹ *State of the World's Forests 2001*, Food and Agricultural Organization of the United Nations, Rome 2001. Available at: www.fao.org/forestry/FO/SOFO/SOFO2001/publ-e.stm.