UNITED STATES ARMY WAR COLLEGE PRESS
Carlisle Barracks, PA
STRENGTH and WISDOM

STRATEGIC LANDSCAPE, 2050: PREPARING THE U.S. MILITARY FOR NEW ERA DYNAMICS

Roman Muzalevsky

U.S. ARMY WAR COLLEGE
SSI
STRATEGIC STUDIES INSTITUTE

The United States Army War College

The United States Army War College educates and develops leaders for service at the strategic level while advancing knowledge in the global application of Landpower.

The purpose of the United States Army War College is to produce graduates who are skilled critical thinkers and complex problem solvers. Concurrently, it is our duty to the U.S. Army to also act as a "think factory" for commanders and civilian leaders at the strategic level worldwide and routinely engage in discourse and debate concerning the role of ground forces in achieving national security objectives.

The Strategic Studies Institute publishes national security and strategic research and analysis to influence policy debate and bridge the gap between military and academia.

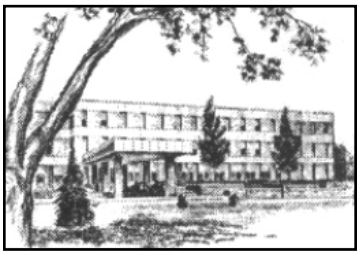
The Center for Strategic Leadership contributes to the education of world class senior leaders, develops expert knowledge, and provides solutions to strategic Army issues affecting the national security community.

The Peacekeeping and Stability Operations Institute provides subject matter expertise, technical review, and writing expertise to agencies that develop stability operations concepts and doctrines.

The School of Strategic Landpower develops strategic leaders by providing a strong foundation of wisdom grounded in mastery of the profession of arms, and by serving as a crucible for educating future leaders in the analysis, evaluation, and refinement of professional expertise in war, strategy, operations, national security, resource management, and responsible command.

The U.S. Army Heritage and Education Center acquires, conserves, and exhibits historical materials for use to support the U.S. Army, educate an international audience, and honor Soldiers—past and present.

STRATEGIC STUDIES INSTITUTE



The Strategic Studies Institute (SSI) is part of the U.S. Army War College and is the strategic-level study agent for issues related to national security and military strategy with emphasis on geostrategic analysis.

The mission of SSI is to use independent analysis to conduct strategic studies that develop policy recommendations on:

- Strategy, planning, and policy for joint and combined employment of military forces;
- Regional strategic appraisals;
- The nature of land warfare;
- Matters affecting the Army's future;
- The concepts, philosophy, and theory of strategy; and,
- Other issues of importance to the leadership of the Army.

Studies produced by civilian and military analysts concern topics having strategic implications for the Army, the Department of Defense, and the larger national security community.

In addition to its studies, SSI publishes special reports on topics of special or immediate interest. These include edited proceedings of conferences and topically oriented roundtables, expanded trip reports, and quick-reaction responses to senior Army leaders.

The Institute provides a valuable analytical capability within the Army to address strategic and other issues in support of Army participation in national security policy formulation.

Strategic Studies Institute
and
U.S. Army War College Press

STRATEGIC LANDSCAPE, 2050: PREPARING THE U.S. MILITARY FOR NEW ERA DYNAMICS

Roman Muzalevsky

September 2017

The views expressed in this report are those of the author and do not necessarily reflect the official policy or position of the Department of the Army, the Department of Defense, or the U.S. Government. Authors of Strategic Studies Institute (SSI) and U.S. Army War College (USAWC) Press publications enjoy full academic freedom, provided they do not disclose classified information, jeopardize operations security, or misrepresent official U.S. policy. Such academic freedom empowers them to offer new and sometimes controversial perspectives in the interest of furthering debate on key issues. This report is cleared for public release; distribution is unlimited.

*****

This publication is subject to Title 17, United States Code, Sections 101 and 105. It is in the public domain and may not be copyrighted.

*****

Comments pertaining to this report are invited and should be forwarded to: Director, Strategic Studies Institute and U.S. Army War College Press, U.S. Army War College, 47 Ashburn Drive, Carlisle, PA 17013-5010.

*****

This manuscript was funded by the U.S. Army War College External Research Associates Program. Information on this program is available on our website, *ssi.armywarcollege.edu*, at the Opportunities tab.

*****

All Strategic Studies Institute (SSI) and U.S. Army War College (USAWC) Press publications may be downloaded free of charge from the SSI website. Hard copies of certain reports may also be obtained free of charge while supplies last by placing an order on the SSI website. Check the website for availability. SSI publications may be quoted or reprinted in part or in full with permission and appropriate credit given to the U.S. Army Strategic Studies Institute and U.S. Army War College Press, U.S. Army War College, Carlisle, PA. Contact SSI by visiting our website at the following address: *ssi.armywarcollege.edu*.

*****

The Strategic Studies Institute and U.S. Army War College Press publishes a quarterly email newsletter to update the national security community on the research of our analysts, recent and forthcoming publications, and upcoming conferences sponsored by the Institute. Each newsletter also provides a strategic commentary by one of our research analysts. If you are interested in receiving this newsletter, please subscribe on the SSI website at the following address: *ssi.armywarcollege.edu /newsletter/*.

ISBN 1-58487-767-7

CONTENTS

Foreword xi

About the Author xv

Summary xvii

Strategic Landscape, 2050: Preparing the U.S. Military for New Era Dynamics 1

A New National Security and Strategic Landscape 1

Megatrends and the Global Operational Threat Environment 9

Demographic Dividends and Liabilities 9

Future State 9

Implications for the Global Operational Threat Environment and the U.S. Military 14

Recommendations for the U.S. Department of Defense, Department of State, and the Military 16

Wild Card: Raging Youth Bulges of the Greater Middle East 17

Environmental Risks and Breakthroughs 18

Future State 18

Implications for the Global Operational Threat Environment and the U.S. Military 21

Recommendations for the U.S. Department of Defense, Department of State, and the Military 24

Wild Card: Flooded Coastlines, Submerged Cities 25

Uneven Socio-Economic and Political Transitions 26

Future State 26

Implications for the Global Operational Threat Environment and the U.S. Military 34

Recommendations for the U.S. Department of Defense, Department of State, and the Military 36

Wild Card—The Death of China's Experiment 37

Technological Disruptions and Solutions 38

Future State 38

Implications for the Global Operational Threat Environment and the U.S. Military 41

Recommendations for the U.S. Department of Defense, Department of State, and the Military 43

Wild Card—From Cyber Monday to Mega Blackout 44

Military Revolution and Counter-Revolution 45

Future State 45

Implications for the Global Operational Threat Environment and the U.S. Military.....53

Recommendations for the U.S. Department of Defense, Department of State, and the Military 57

Wild Card: Self-aware Armed Robotics—Wither the Human Control.....59

Regional Economic, Technological, and Military Races 60

Future State 60

Implications for the Global Operational Threat Environment and the U.S. Military.....71

Recommendations for the U.S. Department of Defense, Department of State, and the Military 73

Wild Card—From "Cold" to "Hot"—The Coming War over the Arctic 75

Toward A Stand-Ready, Post-Modern Military 76

Endnotes 82

Appendix.....99

Climate Change, Water, and Resource Scarcity 99

Military and Conflict Trends 100

Economic Development Trends.....101

Population and Aging Trends.....102

Endnotes - Appendix.....104

FOREWORD

Assessing longer term trends may seem like a manageable task. But in the world of rapid technological innovations and growing complexity, it turns into a more difficult enterprise. Yet this is what Mr. Roman Muzalevsky, a strategic affairs analyst, achieves in his visionary assessment of a strategic landscape and operational threat environment likely to emerge by 2050.

Muzalevsky contends that, absent major policy failures, the U.S. military will remain the strongest in the coming decades, although a series of functional and regional megatrends will prove a monumental challenge, exposing the United States to "crises and opportunities on the battlefield and in the market." The U.S. military, he continues, will need to adapt to and shape these dynamics to retain its edge. Among other developments, the author especially highlights the emerging military revolution, which will feature transformations across multiple domains and face a counter-revolution in the form of responses by societies and select state and nonstate actors. Muzalevsky further points to the growing military and the strategic importance of the Arctic, in addition to assessing the emergence of China and India as major economic and military rivals.

Assessing each megatrend's trajectories and implications for the strategic landscape and operational threat environment, the author presents a series of wild cards—low probability but high-impact events challenging the U.S. military as well as global and regional economic and security orders. Specifically, Muzalevsky walks us through a possible outsized unrest by the unemployed youth in the Middle East; increased sea levels and floods submerging megacities in Southeast

Asia; the collapse of the economic and political system in China; a mega cyberattack and a breakdown of the Internet; an unauthorized use of force by fully autonomous weapons systems; and a military conflict in the Arctic potentially involving nuclear-armed powers.

Analyzing the variety of linkages between the megatrends and their implications for the strategic landscape and operational threat environment, the author points to what he terms as increased complexity, speed, and intensity (CSI) of developments in the modern era and ways they are likely to impact the international system of 2050. As he argues:

> the international system will become more unpredictable, exposed to 'circular causality' featuring more 'wild cards' than in the previous century, despite technologies that will help us create better risk management systems against their own effects. Significant and rapid changes across interconnected technological, economic, and social domains will usher in the Era of Multiple Transformations.

In his analysis, the author relies on a clear content structure, comprehensive overview of the megatrends, detailed assessment of related implications, and a forward-looking and provoking scenario-making that provides a nuanced perspective on a complex world of 2050. As Muzalevsky admits, the work relies "on relative simplicity to deal with absolute complexity," providing policy recommendations for the U.S. military as it responds to emerging challenges. It is with great pleasure that the Strategic Studies Institute presents this work to the research and policy community exploring strategic trends and the U.S. military transformation as

they unfold and shape the operational threat environment and strategic landscape of the coming decades.

DOUGLAS C. LOVELACE, JR.
Director
Strategic Studies Institute and
U.S. Army War College Press

ABOUT THE AUTHOR

ROMAN MUZALEVSKY's career includes work for Star-Hawk Solutions, Exovera/SOS International, Stratfor, the World Bank's Global Security Operations Center/iJet International, Hudson Institute's Center for Political and Military Analysis, Jamestown Foundation, NDI and DFID projects, and Central Asia-Caucasus Institute, among others. Mr. Muzalevsky is the author of more than 100 articles, 1 book, and 4 policy monographs on international affairs, geopolitics, global security, strategic trends, and foreign and military policy: *Central Asia's Shrinking Connectivity Gap: Implications for U.S. Strategy* (2014); *From Frozen Ties to Strategic Engagement: U.S.-Iranian Relations in 2030* (2015); *China's Rise and Reconfiguration of Central Asia's Geopolitics: A Case for U.S. Pivot to Eurasia* (2015); *Unlocking India's Strategic Potential in Central Asia* (2015); and *Strategic Landscape, 2050: Adapting the U.S. Military to New Era Dynamics* (2017). Mr. Muzalevsky is a recipient of the George F. Jewett Foundation Fellowship Award for Projects on the Study and Practice of Grand Strategies and Fellowship of the Eurasia Foundation's Professionals Network program for Eurasia specialists. He received his M.A. in international affairs with a concentration in security and strategy studies from Yale University.

SUMMARY

Barring major policy failures, the U.S. military will still enjoy unrivaled capabilities in the coming decades. But a series of megatrends and region-specific dynamics will challenge the U.S military and economic leadership, exposing the United States to crises and opportunities on the battlefield and in the market. These megatrends will define the evolving multicentric system of interaction among actors, facilitating further dispersion of influence that will undermine the U.S. position as the most influential actor while enabling its rivals to move up the ranks fast.

This system is expected to have neither the place nor the tolerance for unipolarity, as once ascribed to the United States in the 1990s. Instead, it will have plenty of room for numerous actors exercising considerable influence in different domains. The U.S. military will need to adapt to these megatrends to retain its strategic edge. Otherwise, protecting U.S. interests in a continuously evolving world will be a fruitless enterprise, one that will hasten the perceived U.S. decline as the greatest military power the world has ever known.

This monograph helps explore and prepare for the possible and the probable in a transformed world of 2050. Relying on forecasting, scenarios, and wild cards, it envisions the evolution of these megatrends and an emerging operational threat environment and strategic landscape for the U.S. military.

STRATEGIC LANDSCAPE, 2050: PREPARING THE U.S. MILITARY FOR NEW ERA DYNAMICS

A NEW NATIONAL SECURITY AND STRATEGIC LANDSCAPE

> Prediction is very difficult, especially about the future.[1]
>
> – *Niels Bohr*

> We must ask whether we are becoming so dependent on communications links and electronic microprocessors that a determined adversary or terrorist could possibly shut down federal operations or damage the economy simply by attacking our computers.[2]
>
> – *Senator Fred Thompson*

Barring any major policy failures, the U.S. military will continue to enjoy unrivaled capabilities in the coming decades. But a series of megatrends—demographic, environmental, cultural, socio-economic, political, technological, and military, as well as region-specific dynamics—will challenge U.S. global leadership and its status as the strongest military, exposing it to crises and opportunities on the battlefield and in the market. These megatrends will solidify an already evolving multicentric system of interaction among actors, facilitating further dispersion of influence that will undermine the U.S. position as the most influential actor while enabling its rivals to move up the ranks quickly. This system is expected to have neither the place nor the tolerance for unipolarity, as once ascribed to the United States in the 1900s. Instead, it will have plenty of room for numerous actors exercising considerable influence in different domains. China and India will be emerging as peer rivals, certainly in

the economic and, increasingly, the military area. The U.S. military will need to adapt to and shape these megatrends in order to better navigate the new strategic landscape and retain its strategic edge in the coming decades.

The demographic megatrend especially will entail major economic, political, and military challenges. The global population is projected to reach nine billion by 2050. Demand for food, land, water, and energy resources will increase drastically, straining production and supply networks and enhancing the risk of intra- and interstate rivalries and conflicts. Technological advances will mitigate related pressures, but not significantly or evenly across all regions. Coal and hydrocarbons will likely remain the major sources of energy overall. But the share of renewable and nuclear energy in energy mixes will grow considerably, particularly in the industrialized countries. Renewables will offer major operational advantages for militaries, while the growing use of nuclear energy will likely contribute to nuclear and ballistic missile proliferation. As the United States rebalances to Asia and reaps the fruits of its energy revolution at home, its strategic commitment to the oil and gas-rich Middle East will decline significantly. Other states such as China and India will increasingly play a greater role in providing for security in the region.

Meanwhile, youth bulges in the Middle East, sub-Saharan Africa, and Central Asia will be a source of instability if regional governments fail to improve the lives of local populations. Alternatively, they could be a source of dynamic growth if the governments leverage the labor pools effectively and pursue good governance, inviting more investment funds rather than troops and bullets. Increased urbanization will,

in turn, prompt closer coordination between domestic and overseas civilian and military agencies in protecting civilian populations in urban settings.

Environmental impacts will become more pronounced and harder to control. Extreme weather events, such as flooding and droughts, will increase in frequency and intensity in a number of regions. Degraded and threatened environments will lead to population displacements and refugee flows, exacerbating social tensions and prompting intra- or interstate conflicts in select areas. The U.S. and other militaries will be engaged in humanitarian and disaster relief operations more frequently and extensively. This will be especially true for coastal zones, where projected sea level increases herald more frequent and particularly destructive natural disasters.

Meanwhile, continued advancements in information and communication technologies (ICTs) will lead to increased efficiencies in civilian and military sectors while producing more risks of cyber and terrorist attacks targeting civilian and military infrastructure. The informatization and robotization of armed forces and war will grow in speed and scale in what is already becoming the hallmark of an emerging military revolution. Entities of all types and sizes will use unmanned systems on a wider scale to compensate for labor shortages due to aging trends and promised efficiencies, leading to mass unemployment and unrest absent better governance. The U.S. military will rely on cyber and ICTs even more substantially. As a result, it will be more vulnerable to information and cyber operations and will need a capability to operate off the grid.

While humans will still control the decision-making regarding the initiation of war and use of military force, the likely emergence of truly autonomous systems will

create substantial risks of accidents, unauthorized decisions, and ethical controversies that will define the political landscapes of high-tech countries and militaries. The embedding of sensors into human bodies will be increasingly likely, providing situational awareness, health, and human performance advantages, certainly for the militaries that will be keen to get their hands on such technologies. Mind-controlled machinery will become more sophisticated, with brain-to-brain communication possible. Hostile actors will increasingly use previously unavailable technologies, such as 3-D and 4-D, cyber, robotics, and drones, among others. The United States will remain the leading user of precision strike and autonomous weapons, as well as lead-developer of related defense capabilities. But the proliferation and development of such technologies by adversaries will undermine its position.[3]

This will apply to the U.S. space capabilities as well. Many more actors will exploit space for military and civilian purposes because of reduced costs of space vehicle manufacturing and launching. Enhanced space capabilities will bring advantages to civilian economic sectors. But the risk of orbital collisions and attacks against space assets will increase. The U.S. military could lose major advantages if others challenged its space capabilities by degrading its command and control, remotely piloted and early warning systems, precision strike capabilities, battle damage assessment, logistics and navigation, weather forecasting, and military planning functions. The militarization of space emphasizing space control will accelerate in the coming decades, challenging governance frameworks, while fueling calls for space de-weaponization.[4] The emerging military revolution will, in turn, prompt a counter-revolution marked by the development of

asymmetric military capabilities, various legal regimes, and societal responses.

As far as regional dynamics, stronger nationalism, enhanced disagreements, conflicts over disputed territories, increased economic competition, and accelerating arms races will redefine the geopolitics of most regions. The Indo-Asia-Pacific, the Global Commons, and the Arctic will be areas of especially sharp interstate rivalries. Asia will once again become the center of gravity, producing half of the global gross domestic product (GDP) and becoming the largest defense-spending region. The United States will have the strongest and most advanced military, but China, Russia, and India will trail close behind. China's defense expenditures are on track to match the U.S. by 2050, with both states accounting for almost half of the total global defense spending. India and Russia will follow suit. The European Union (EU) states will increase their defense expenditures as fears of U.S. strategic retrenchment ebb and flow. But other primarily emerging powers might well outdo them.[5]

Meanwhile, the exploitation and militarization of the Arctic will grow, as melting ice caps clear the passage for companies, ships, coast guards, and navies. Increased business opportunities will go hand-in-hand with enhanced risks of harassments of coast guards and civilian ships, potentially leading to armed conflicts. The Middle East and North Africa, Central and South Asia, and parts of Central and Latin America will struggle to overcome demographic, social, environmental, and economic challenges. But success stories and geopolitical realignments will dot the world map as well. More industrialized and knowledgeable economies will emerge in the Middle East and Asia, which will also see major geopolitical reconfigurations

centered on China, Japan, India, Iran, Saudi Arabia, and Turkey. These and the previously mentioned regional and functional developments will require a recalibration of the U.S. military posture. This new posture will increasingly and substantially focus on the Indo-Asia-Pacific region, the Arctic, Latin America, and the Global Commons (especially in the space and cyber domains).

But rapid changes across the functional and geographic areas might also contribute to wild cards—low probability events causing systemic perturbations. Such events help envision and prepare policies to prevent or mitigate the impact of such developments. Examples of such wild cards include: a cross-regional unrest by unemployed youth tearing apart the greater Middle East; increased sea levels and floods submerging megacities along the coastlines of Southeast Asia and overwhelming global relief efforts; the collapse of the Chinese economic and political systems leading to massive socio-economic dislocations and sending the global economy into a tailspin; a mega cyberattack resulting in the breakdown of the Internet and full or partial collapse of a national economic infrastructure; the initiation of conflict or substantial increase in the number of fatal incidents as a result of an unauthorized use of force by the truly autonomous weapons systems and self-aware robotics capable of challenging human control; and military skirmishes, proxy conflicts, or war in the Arctic potentially involving nuclear-armed powers.

The strategic landscape and global operational threat environment of 2050 will be more complex fundamentally. The diffusion of power fueled by the previously mentioned megatrends will result in a more pronounced shift in influence from the Western to

non-Western countries and a drastic shift of influence from state to nonstate actors. Coalition-making rather than alliance-making, as well as situational responses and ad hoc bargaining, increasingly will define actors' interactions. The state will remain the dominant unit. But nonstate entities will occupy a much larger position in the global system of relations, making their voice significantly louder and their ability to affect governance frameworks more pronounced and effective. Economic institutions, such as the International Money Fund (IMF) and the World Bank, will be revamped, made less relevant, or supplanted by non-Western ones.

Following Brexit and potential Grexit amid the rising tide of populism, protectionalism, and strained economic policymaking of its members, the EU will face two outcomes—be redone or undone. Global security frameworks, especially the United Nations (UN), will remain weak. Alliances will be hard to come by due to the situational nature of interactions. If it survives, the North Atlantic Treaty Organization (NATO) will remain the most successful alliance, likely boasting new members and pursuing new missions. But its members will have to provide more funding and commitment, given fiscal constraints and feared isolationism of its largest contributor—the United States. Moreover, NATO members increasingly will seek deeper ties with select nonmembers, given the situational nature of global interactions.

Complexity, speed, and intensity (CSI) will define the global operational threat environment and strategic landscape in the coming decades. The international system will become more unpredictable, exposed to "circular causality"[6] featuring more wild cards[7] than in the previous century, despite technologies that will help us create better risk management systems against

their own effects. Significant and rapid changes across interconnected technological, economic, and social domains will usher in the Era of Multiple Transformations.[8] Understanding this era and its complexity will differentiate a good forecast from a bad one. Already back in 1933, Professor A. M. Low suggested that Britain have a Minister for the Future:

> It will be the duty of the Minister to collect data from all over the world, to tabulate, correlate, compare and calculate. He will be like a spider sitting in a Web, drawing towards him all knowledge, and working out, on scientific lines, the effect that the latest developments and discoveries will have.[9]

All actors will need this role for the 21st century, given the growing number of developments across centuries.[10]

The U.S. military should be flexible in such a fast-changing operational threat environment and strategic landscape, and should have the political backing to harness related dynamics to face and exploit them. It should identify early on and be prepared to navigate the above megatrends, assess the related impact on its interests and capabilities, and design policies enhancing its strategic edge. It should also consider the potential wild cards and prepare for related contingencies. As it pursues these goals, it should retain and cultivate new allies, secure new basing and logistical arrangements, define new strategic and tactical objectives, and streamline processes, as well as identify, develop, and leverage new technologies to enhance logistics and military operations.

Not a deterministic enterprise, this monograph aims to help the effort by exploring and preparing for the possible and the probable in the transformed world of 2050. It relies on elements of forecasting,

scenarios, and wild cards, seeking not to predict but to envision the evolution and outcomes of the megatrends impacting the operational threat environment and strategic landscape for the U.S. military. It uses linear and nonlinear analysis to plot trajectories and assess implications and possibilities. In doing so, it seeks a position in the middle of the spectrum defined by determinism on the one extreme and free will on the other. It also takes a holistic perspective to produce a more informed analysis, employing deduction and induction to decode and encode linkages between and among the trends, impacts, and the resulting strategic landscape. Finally, the monograph points to increased CSI of developments across geographic and functional areas, forcing it to rely on relative simplicity to deal with absolute complexity.

MEGATRENDS AND THE GLOBAL OPERATIONAL THREAT ENVIRONMENT

> There is no national science, just as there is no national multiplication table.[11]
>
> – *Anton Chekhov*

> There are known knowns and known unknowns, but what we should be worried about most is the unknown unknowns.[12]
>
> – *Gary Marcus*

Demographic Dividends and Liabilities

Future State

Six major trends will define the demographic conditions by 2050, when the global population will reach

nine billion before declining thereafter: (1) the slowing or reversing population growth in the industrialized states; (2) the concentration of large and youthful populations in Africa, the Middle East, and Southeast Asia; (3) the rapid aging in North America, Europe, and East Asia; (4) substantially increased migration flows; (5) the growing urbanization, especially in China, India, and parts of Africa; and (5) the population growth in poor countries susceptible to climate change.[13]

Slowing and reversing population growth in the industrialized world. More than 86 percent of the global population will live in the developing world by 2050, as industrialized countries will continue to exhibit falling birth rates.[14] Asia will remain the most populous, with more than half the planet living there. Africa will account for half of the projected 2.3 billion increase in the global population, equivalent to populations of 3 Europes. Eastern Europe and western parts of Europe will see little difference in their population levels.[15] This trend is in line with a global demographic transition, whereby Asia and Africa become a greater source of the global population growth during this century due to medical advances and falling death rates, as opposed to Europe and North America with their significant declines in fertility rates.[16] There are exceptions, though, as some African and Latin American countries are projected to exhibit rapidly falling fertility rates. Japan, most of Europe, Russia, and former Soviet states will have populations below replacement levels.[17] The United States will retain one of the largest populations until 2050, due to relatively higher birth rates and immigration.[18]

Concentration of large and young populations in the industrializing world. Nine out of 10 children under 15 will grow up in the developing world.[19] A lot

of the projected increase in the global population will occur in Africa, the Middle East, and Southeast Asia, while 70 percent will occur in low-income countries, such as Afghanistan, Pakistan, Democratic Republic of the Congo, Ethiopia, and Nigeria.[20] The populations of Afghanistan, Iran, Iraq, Pakistan, Somalia, and Yemen will double, growing by 280 million total.[21] Somalia, Afghanistan, Yemen, the West Bank and Gaza, Ethiopia, and much of sub-Saharan Africa will have especially high fertility rates.[22] Meanwhile, dependency ratios will continue declining in India, sub-Saharan Africa, and select countries in the Middle East and North Africa, featuring the median age of less than 40 and serving as a source of larger and cheaper labor force.[23] Turkey, Iran, Morocco, Algeria, Tunis, Colombia, Costa Rica, Chile, Vietnam, Indonesia, and Malaysia will have youthful populations.[24] If harnessed effectively, the demographic potential of these countries might be a source of dynamic economic growth.[25]

The rapid aging of the old and new worlds. By 2050, one-third of the developed world's population will be more than 60 years old. Most developed countries will see a 50 percent increase in their populations aged more than 60, comprising 35 to 45 percent of the population in Europe, Japan, and South Korea; and 16 percent and 30 percent in the United States and Canada, respectively.[26] South Korea, Japan, and most European countries are projected to see their prime labor force dwindle by anywhere from 25 to 33 percent, and China by 17 percent. China's median age of about 35 will increase to 49, India's population aged 60 to 80 will increase 326 percent, and Brazil's elderly population will grow from the current 7 percent to 25 percent by 2050.[27] Iran, Singapore, and Korea will see their dependency ratios increase four times; those of

China, Mexico, Brazil, Cuba, Turkey, Algeria, Thailand, Vietnam, Indonesia, and Saudi Arabia by three times.[28] The aging trend will encourage much larger labor participation by women, especially in the Middle East and Southeast Asia.[29] At the same time, medical advances could increase lifespans significantly, contributing to the overall aging trend worldwide.[30]

Increased internal and external migration flows. More than 230 million migrants will roam the earth by 2050.[31] These migrant flows will occur within and between countries, with the old and the newly developed countries attracting an ever-larger portion of migrants from the developing world. Income inequalities, conflicts, ethnic and religious tensions, as well as more directly manifesting environmental stresses will increase "the number of people on the move."[32] Some flows will benefit countries in the migration chain, providing them with badly needed sources of economic growth. Others will strain or, in select cases, overwhelm the governance and economic systems, possibly leading to unrest or conflict.

Increasing urbanization. The share of the global urban population will increase from 42.7 percent in 2005 to almost 70 percent by 2050—roughly a 50 percent increase, or the size of the global population in 2005. This would require an 11-fold increase in consumption requirements—a level equivalent to the population growth from 7 to 72 billion.[33] City residents will comprise 85 percent of the population in the more developed world and 65 percent in the less developed world.[34] The less-developed world will add 3 billion urban residents, more than twice as it had in 2005.[35] The pace of urbanization has already been so rapid that the world has seen an annual addition of seven New York cities over the last four decades.[36] Growing

urbanization will especially apply to China, India, and Africa. Sub-Saharan Africa will feature fast-growing cities, where slums and inequality will threaten already weak governance and economic systems. Urban air pollution, exclusion from health care, and poor housing conditions and their communicable diseases will define urban landscapes, with especially deleterious effects on rural migrant populations looking for work in megacities.[37]

Concentration of population growth in poorer countries susceptible to climate change. Select countries in Africa, the Middle East, and Southeast Asia will see concentrated population growth. Many will have fragile governance systems, struggling to absorb the projected population growth.[38] Africa will be almost 3 times the size of Europe, accounting for about half of the 2.3 billion increase in the global population.[39] Many of the sub-Saharan countries will experience major development challenges. Because many cities will be located near the coast, the risks and impact of sea level rise and flooding will grow considerably. Population growth in Pakistan and Nigeria will pressure the Sahel, the waters of Niger, and the Indus valley. To illustrate, the water table in Punjab, Pakistan's major farming area, is disappearing rapidly due to the local population growth (Pakistan's population is projected to rise from 175 million in 2010 to 275 million by 2050, according to some estimates). This will likely trigger resources conflicts due to migration and refugee flows pressuring the already strained support systems. While a larger population might not be associated with more violence as before,[40] the scale and pace of population growth and income disparities will cause counter-pressures.[41]

Implications for the Global Operational Threat Environment and the U.S. Military

As the population growth in industrialized countries slows, NATO members will find it harder to recruit and field their armed forces and, by implication, initiate, sustain, and complete operations overseas.[42] Meanwhile, large developing states will upgrade their military capabilities significantly, drawing on larger populations and increased economic potential. Militaries increasingly will compete with industrial sectors for labor. Not to be outdone, the industrialized states and select large developing states will rely on technological solutions to deal with their shallower labor pools. Military sectors of these states thus will see a more profound transition, whereby capital in the form of technology will substitute labor on a much larger scale and in a pattern similar to the economic transition centuries ago when technology started widely replacing labor in industrial sectors. As they do, they will rely on autonomous technologies, the participation of women in full combat roles, and lenient immigration policies to staff their armed forces.[43]

Meanwhile, managing national or regional orders will become very costly, especially in the case of crises in countries with weaker governments, poor economies, and large young populations. Imagine managing conflicts in Iraq, Afghanistan, and Pakistan in a decade's time! Iraq's population is projected to grow from approximately 31 to 44 million, Afghanistan's from 28 to 45 million, and Pakistan's from 181 to 246 million.[44] Burdened by financial and demographic stresses of its own, the United States increasingly will turn to allies to manage regional crises and orders—a task that will be difficult to pursue for the allies who

will face even more severe challenges associated with their demographic conditions and potentially slower growing economies. To put things in perspective, Germany's population aged 15-24 will decline by one-fourth in the next 20 years, Japan's by one-fifth. The United States and its allies will need to restructure international institutions to advance stability and prevent or mitigate regional economic and security crises.[45]

The combination of rapid development, urbanization, and population growth in fragile states will contribute to or cause systemic and non-systemic disorders in the form of conflicts or more frequent and large-scale terrorist attacks affecting urban infrastructures. Cities will become more frequent targets for large-scale attacks, making the 2008 Mumbai attacks pale in comparison.[46] As security risks increasingly impact cities, the divisions between "soldiers and civilians, combatants and criminals" will become fuzzy. The protection of urban populations will assume a prominent role, with success of government responses depending on the pace, scale, and particularities of local urbanization trends.[47] Authorities increasingly will rely on the collaboration between domestic and external security and military agencies to protect cities.[48]

Aging trends and population increase will contribute to more lasting labor pools and potentially less violent societies. But youth bulges in countries with poor governance and economies will cause economic stresses, likely leading to unrest or conflicts. Meanwhile, the substantial increase in migrant flows amid the rapid urbanization will increase related risks.[49] Moreover, an intercontinental biological attack or spread of diseases may reverse the trend in a way

similar to the Black Death, which claimed about a third of Europe's population between 1347 and 1351.[50]

Recommendations for the U.S. Department of Defense, Department of State, and the Military

- Strengthen existing and develop new alliances for peacekeeping and crises management operations tailored for fragile states with youth bulges. Focus on Brazil, China, India, Mexico, and Turkey as partners—relatively large economies with large militaries positioned in key regions and more capable of undertaking larger missions.
- Enhance existing and create new coordination mechanisms involving domestic and external security and military agencies regarding the management of urban threats.
- Identify countries that could serve as sources of soldier recruits in the future and develop targeted campaigns across the immigration, foreign, and military policy spectrums.
- Develop and integrate technologies that could substitute labor within the armed forces on a much larger scale, but with safeguards in place so as not to undermine command and control.

Wild Card: Raging Youth Bulges of the Greater Middle East

The world of 2050 is one of an aged and pacified old core, represented by North America, Europe, and parts of East Asia, and one of a young and restless greater Middle East, represented by still poor Afghanistan, Pakistan, Iraq, Somalia, and Yemen whose populations double in size, as projected. Still reeling from instability as a result of previous wars and regional conflicts, these countries fail to take advantage of their demographic dividend to boost economic growth and development. The demographic liability presented by their youth bulges instead turns them into a source of significant instability, as the unemployed and restless youth take to the streets en masse. The deprived coordinate their anti-government actions using proliferating social media and information communication technologies, which accentuate the intra- and international income and wealth disparities. Mass protests eventually unseat the powers-that-be, causing a systemic collapse of the already ineffective and, in some cases, failing institutions, and leading to protracted civil wars that increasingly suck in outside powers. Pacification strategies—from within or without—fail to contain the situation. The countries now become full-fledged hotbeds of terrorist networks, with those in Pakistan on the verge of acquiring nuclear weapons. The youth bulges now inflame the greater region and grab non-stop headlines, with internal and external forces failing to tame them.

Environmental Risks and Breakthroughs

Future State

Resource consumption and depletion, climate change effects, and water scarcity challenges will become much more pronounced, rapid, and large-scale, affecting many more people worldwide by 2050. Environmental stresses will be much more severe due to human activity. But the tipping point will be avoided, in large part because of technological, and resource and environmental management advances that will prevent new and mitigate existing deleterious impacts of climate change.[51] Yet, the progress will be uneven, with some regions being more prone to conflict.

Rapid resource consumption and depletion. The pace of resources consumption and depletion is already very rapid, large-scale, and in some cases alarming. An average Westerner, for instance, consumes more within 2 years than an average Kenyan in his entire life. Of the seven billion global population, only one-seventh enjoys such consumption rate.[52] However, the projected population and consumption growth in the already environmentally stressed areas will strain resource systems considerably. Food, resources, and fresh water requirements alone are projected to almost double by 2050.[53] More than a third of the Earth's soil, producing 95 percent of food supply, is already degraded.[54]

Meanwhile, known oil reserves are on track for depletion by 2050, requiring the world of 2030 as many as 9 agreeable Saudi Arabias to meet the demand of 106 million barrels of oil per day. While resources and food will be available to make the fight against hunger

easier, the resource distribution and consumption patterns will still be uneven. Infrastructure issues, environmental concerns, and geopolitics will stand in the way. As for oil, opportunities will emerge to develop new fields in the Caucasus and Africa,[55] while projected technological advancements might lead to a more hydrogen-based and renewables-fueled global economy.[56]

Climate change. Changes in climate patterns, largely attributed to increased levels of atmospheric carbon dioxide due to fossil fuels use, will become more apparent in the coming decades, as population and consumption levels rise. The global population growth, nearly all of it in the developing world and mostly in water-stressed areas, will strain the environment, causing more severe climate change-induced natural disasters and conflicts.[57] The UN projects outdoor air pollution to be the top cause of environmentally related deaths globally by 2035, when half of the world's population will also face water shortages.[58] The floods, droughts, and intense heat waves of the last few decades have already resulted in approximately 300,000 deaths annually.[59]

By 2050, humans will have all corners of the world under their control, with the exception of parts of Antarctica; the northern forests and tundra; the rainforest cores of the Congo and Amazon basins; and select deserts of Africa, Australia, and Tibet.[60] Expect more desertification and changes to rainfall distribution within the monsoon belt of the Arabian Sea and South Asia, higher frequency and intensity of extreme weather events with a potentially severe impact on low-lying coastal regions, more rapid glacier melting in Central Asia and the Himalayas, and disputes

involving Central and South Asian states stemming from the environmental changes.[61]

As urbanization increases and climate change becomes more apparent, expect a major increase in sea levels, storm surges, and inland flooding—all affecting coastal cities more profoundly. More than 6 billion people already live in urban areas, most of these near the coasts.[62]

By 2035, roughly 50 percent more people than in the year 2000 will live in low-elevation coastal zones worldwide, with the number in Asia increasing by more than 150 million and Africa increasing by 60 million. Many megacities, such as Bangkok, Ho Chi Minh City, Jakarta, and Manila, will continue to sink because of excessive groundwater extraction and natural geologic activity.[63]

The United States already suffers from annual flood damages, which will worsen unless countermeasures are in place—something most U.S. cities should be able to pull off. But other world regions will not boast the same readiness and will contend with more severe impacts, requiring international efforts and approaches to deal with flood prevention and relief operations.[64] The World Bank estimates that addressing climate change will cost USD$400 billion by 2050. This is when the global GDP may reach USD$280 trillion—surely enough if countries commit to the task.[65]

Water scarcity. Water scarcity will emerge a major challenge by the mid-century. Demand for water will rise drastically due to population growth. Access to fresh water sources will become more limited due to climate change. Conflict will become more likely between upstream and downstream countries absent resolution mechanisms and water-sharing agreements.[66] Up to 4 billion people will face water shortages and reduced

agricultural production, primarily in Africa, the Middle East, South Asia, and northern China.[67] This is when only 3 percent of the surface's water constitutes fresh water, with 2 percent concentrated in ice caps and glaciers, and 1 percent directly accessible.[68]

The projected population and resource consumption growth mean that two out of three people might live in water-stressed conditions by 2030. To compare, the global population tripled and the use of water increased six times in the 20th century; by 2030, the demand for water will increase by 40 times.[69] More than 30 countries, of which almost half are in the Middle East, brace for extreme high water stress by 2035.[70] Parts of Africa, Australia, the Middle East, and North America are already consuming more water than nature can replenish, while water pollution, mismanagement, and inequitable distribution exacerbate the challenge.[71] China, for instance, is planning 59 new reservoirs in Xingjian to retain water from glacier-fed rivers, while the United States announced USD$1 billion in new water projects across its western regions.[72]

Implications for the Global Operational Threat Environment and the U.S. Military

Climate change-induced risks will include hurricanes, storms, ozone layer damage, ocean acidification, and rising sea levels, with conflicts over water, land, and food resources becoming more frequent and linked more directly to climate change.[73] Floods, droughts, cyclones, and hurricanes have already caused more damage to millions of people in the last decade than in the same period of the late 20th century. Expect those numbers to increase significantly, especially in poorly governed countries. Floods in Pakistan, for instance,

affected 20 million people in 2011, while the increasing variability of rain in parts of Africa caused localized conflicts and refugee flows. Climate change-induced refugee flows will swell the ranks of the already outsized global demographic waves and add to the tens of millions displaced worldwide.[74]

Yet, it is the projected rise in sea levels by one meter by the end of the century that will present an especially serious challenge. The coastlines of the Indian Ocean, Indonesia, the Philippines, and southern China are all increasingly at risk of major flooding and population displacement, which will strain or overwhelm local support systems. Thus, climate change and risk management frameworks increasingly will assume a central stage in global politics, while shelter, communication, transport, and medicine will play an even larger role as mitigating factors.[75] But interstate tensions over managing climate change should not be ruled out, especially in the case of geoengineering technologies that can also be used as a weapon to affect climate conditions.[76]

The combination of the security risks associated with or caused by climate change and the projected population growth will strain civilian and military capabilities of countries.[77] The military forces of the United States and its allies increasingly will be involved in humanitarian operations overseas to help with environmental devastation, conflict prevention, or rebuilding of collapsed environmental systems to contain their distribution and to pursue geopolitical objectives.[78]

Meanwhile, oil will retain its appeal as a magnet of foreign intervention.[79] But its significance as a strategic resource will decline, as other sources of energy will be utilized on a wide scale. However, the need

for uninterrupted access to other strategic resources, such as rare earth minerals, will prompt interventions. These minerals are concentered in few parts of the world, and only a handful of countries control their production and export. Demand for them in the technologically developed yet resource-strained world of 2050 will increase drastically, making them much more strategic, and interventions aimed at securing them likely and frequent.

Another strategic resource likely to invite intervention or cause resource wars is water. Fortunately for water-stressed regions, the expanded virtual water trade flows will help them address water scarcity. Many countries in Europe, the Middle East, North Africa, Japan, and Mexico are already major net water importers, with the global virtual water trade representing about 40 percent of all human water consumption.[80] For instance, water independence ended in Israel, Jordan, and Egypt in the 1950s, 1960s, and 1970s, respectively. But these countries have relied on technology and virtual trade to avoid water conflicts. Not all states will have adequate mechanisms to obtain, sustain, and expand their reliance on the virtual water trade, exposing themselves to potential conflict.

By 2050, most water-stressed areas will remain the same, even if they will face bigger water scarcity challenges, such areas include: the Mediterranean, southwestern North America, Africa, the Middle East, Central Asia and India, northern China, Australia, Chile, and eastern Brazil. Even the disappearance of the Jordan River and the Fertile Crescent is in the cards. Meanwhile, the Nile, Jordan, Tigris-Euphrates, and Indus river basins will likely trigger water tensions or conflicts between rival nations with a history of interstate wars. Populations that depend on these

river basins will grow from 70 to 150 percent by 2050, with water demand exceeding water supply levels and impacting conflict trends in North Africa, the Middle East, and South Asia.[81]

Recommendations for the U.S. Department of Defense, Department of State, and the Military

- Identify areas with the highest potential for partial or full systemic collapse due to environmentally induced security risks, stresses, and conflicts, and formulate related military responses involving the participation of host nations and other actors.
- Develop and propagate the use of climate change risk management frameworks featuring a more expanded involvement of military forces and military-civilian partnerships.
- Define more clearly the legal and operational roles of the U.S. military in responding to humanitarian disasters caused by environmental factors, domestically and globally.
- Advance climate change-related security and military cooperation frameworks.
- Identify areas of strategic resources and related dependencies likely to emerge by 2050 and develop operational scenarios for overseas involvement in securing access to such resources in the case of supply interruptions due to conflicts, interventions, or sabotage.

Wild Card: Flooded Coastlines, Submerged Cities

The world is severely water-stressed by 2050. But coastlines have more than plenty of water. Floods due to the rise in sea levels are now more frequent and large-scale, impacting hundreds of thousands of people in the rural and urban areas scattered along the sprawling coastlines of major regions. The now globally accepted and expected risk of localized flooding suddenly turns into a nightmare of severe magnitude when a tsunami of unprecedented force in the Asia-Pacific engulfs a host of coastal megacities in Indonesia and the Philippines. The catastrophe overwhelms national disaster response frameworks, destroying entire economic systems of urban environments and causing extraordinarily high numbers of deaths, population displacements, and migrant flows. Inland cities of both countries become recipients of staggering flows of displaced migrants, straining some and overwhelming other local socio-economic infrastructure and support networks. Countries worldwide rush to provide humanitarian aid and commit reconstruction efforts. Military personnel of outside powers are now seen as a welcome presence. The global support notwithstanding, the damage to the economies and environment is so severe that the reconstruction of some areas is no longer feasible, while the rebuilding of other ones will require a generation-long commitment by the now bankrupt, overburdened, and exhausted governments. The deluge serves as a wake-up call, with the military and civilian agencies of countries worldwide committing to substantially enhanced climate change mitigation measures and disaster relief and humanitarian response agreements and mechanisms.

Uneven Socio-Economic and Political Transitions

Future State

The following socio-economic and political trends will define the strategic landscape in the coming decades: the rebalancing of the global order and power hierarchy marking the advance of Asian powers in the pecking order; the accelerating global economic convergence, as well as faster modernization and democratization impeded by economic regionalization and political centralization; and the "reweaving" of a global energy fabric reflecting a much wider and extensive use of renewables in the industrialized and, increasingly, industrializing societies.

Reshuffling of global order and power hierarchy. The growing economic and military capabilities of non-Western powers will define the ongoing rebalancing of the global order. Systemic changes in the form of state disintegration (Libya, Syria, Yemen, and Iraq) or territorial state expansion (Russia plus Crimea) will still be a part of the process.[82] But a recalibrated global order will be the most notable change. While the United States and its select Western allies will possess the strongest, most efficient, competent, technologically enhanced, and globally deployable forces, their relative economic and military capabilities and influence will decline drastically. Many more other powers will inch closer to the status of kings.

Asian countries, especially India and China, will occupy the front seats across most negotiation tables. The United States, the EU, and Japan are on track to produce 60 percent of the global GDP by 2030, but Asia will account for 50 percent of the global GDP.

China and India will become the world's largest economies—a status both enjoyed in prior centuries. Goldman Sachs, for instance, projects that China's GDP will reach USD$70 trillion—80 percent more than the U.S. economy, projected to be the only G-7 economy by size (China, the United States, India, Brazil, Russia, Indonesia, and Mexico).[83]

No single power will be as dominant in all areas as the United States had been during its 20 year-long unipolar moment after the Soviet Union collapsed;[84] certainly not across all domains simultaneously, although the United States and China will come closer than any other power. In a three- or four-tiered influence structure, the United States and its Western allies will still represent the first position, given their predominant military capabilities. China and India—with their already substantial and capable military arsenals and immense economic sway—will represent a close second. Russia, Brazil, South Africa, Indonesia, and Mexico will represent the third, followed by major corporations, of which technology-focused ones will dominate the global economic landscape.

Depending on their relative weight, all these actors will be influencing major trends and outcomes differently. New sets of relations and institutions will emerge across traditional and increasingly new sectors, such as the cyber, space, robotics, nano- and biotechnology, among other areas. Institutions and regimes, such as the EU, NATO, the UN, the World Trade Organization (WTO), and the Nonproliferation Treaty (NPT), will either disintegrate or be forced to adapt to the new demands and conditions.[85]

The U.S. grand strategic goal of advancing global connectivity as a pillar of national security will remain

the same. Retired Vice Admiral Arthur K. Cebrowski put it best:

> Security is our nation's largest single public sector export, and it's booming . . . If you are fighting globalization, if you reject the rules, if you reject connectivity, you are probably going to be of interest to the United States Department of Defense.[86]

But this is where it gets complicated. China and India will favor the global connectivity, which has already made them wealthier. Yet, they will want the process to unfold on their terms or with them at the table as full-fledged co-managers of this connectivity. Provided current dynamics hold, the United States might benefit from having the two powers as co-managers of the global order in return for their acceptance of the common rules.

As these and other countries become wealthier, they increasingly will shape new narratives, discourses, and tastes for global consumption, sidelining Western discourses and offering other ways of looking at and shaping an individual and social life.[87] Western development models will still be attractive, even to China and India or their select elites. Along with rapidly proliferating information technologies, they will even promote political modernization and democratization worldwide. Yet, a potential success of China's and India's development models might tilt the scales and advance development concepts that do not reflect Western values, either fully or partially.[88] In this case, a lot will depend not just on the success of other models, but also on the ability of Western countries to address their own numerous economic and political imperfections.

Economic and political convergence and divergence. The world of 2050 will still feature developing countries, at times stagnant and failing, despite all the projected accumulation of wealth by old and new club members. Almost 70 percent of 5.3 billion workers, many representing global consumers, will live in emerging economies.[89] Yet, many more countries will leap forward in terms of development, as the global economic convergence accelerates. North American and Western Europe's share of real GDP will fall from 40 percent in 2010 to 21 percent in 2050. Asia's will double. China's will rise from 13.6 percent in 2010 to 20 percent. The fastest-growing regions per capita GDP will be Asia (4.7 percent), sub-Saharan Africa (4.4 percent), the Middle East and North Africa (3 percent), Latin America (3.3 percent), and Eastern Europe (3.2 percent). Western countries will grow slower unless they harness new discoveries and revolutions—a quite likely scenario. China and India will grow faster, though their growth will decline as they move up the value chain. They will also remain poorer than many Western countries on a per capita basis.[90]

Current income disparities will stabilize or narrow significantly, as more countries will have reached standards of living comparable to, equal to, or exceeding those of the developed world today. But the perception of inequality will remain, and might even intensify, as the ICTs and enhanced global interaction will make the awareness of inequality more obvious. (Pointedly, companies are developing virtual "empathy engines" as a way to mitigate the perception of inequality.[91]) Meanwhile, more countries, especially in Africa and Asia, will be urbanizing rapidly during the economic transition, causing wider intrastate inequality.[92] Middle-skill occupations will be disappearing in the

developed and, increasingly, the developing world. The professions prioritizing information, knowledge, and technology will proliferate.[93] Countries in sub-Saharan Africa, Asia, and Latin America, for instance, are already seeking to expand their services and knowledge economic sectors. As far as the agricultural sector, a potential spread of animal and plant diseases and emerging shift in agricultural patterns could disrupt global and local food production chains. But advances in irrigation and crop strains will boost agricultural production efficiency,[94] alleviating the socio-economic dislocations.

As they develop their knowledge and services economies, the developing countries of today will become major sources of innovation for tomorrow across a variety of fields, in select cases inching closer to the status of Western countries. The Western world will still occupy a leading position, but it will no longer be dominant, certainly not across all innovation areas.[95] The United States, Germany, Canada, South Korea, Japan, Australia, and Israel will master the entire spectrum of the innovation cycle. A rank down, but with a potential to move up rapidly, will be China, India, Russia, and Poland, which will master most key technological areas. Brazil, Chile, Colombia, Mexico, Turkey, Indonesia, and South Africa will follow third. Egypt, Kenya, Cameroon, Chad, Nepal, the Dominican Republic, Pakistan, Iran, Jordan, and Georgia will occupy the fourth tier.[96] China's high-tech products already account for 22 percent of global exports, and its share will only grow to overtake the total share of Western countries unless the latter make qualitative breakthroughs. Meanwhile, technology proliferation will shrink the technological development gap as the global economy recalibrates to become more

knowledge-based, marked by wider information flows and their integration for development purposes.[97]

Yet, the development and proliferation of new technologies and economic linkages behind the global economic convergence will confront the forces of nationalism, protectionism, economic regionalization and localization. The latter will intensify because of more frictions in the rebalancing global economy. After all, globalization has lifted millions out of poverty, but it has also increased competition and fueled anti-establishment, populist sentiment in both the developed and developing countries. Meanwhile, the projected proliferation of independent manufacturers serving global markets due to 3-D and 4-D printing and related technologies will disrupt trade flows in what might be the biggest revolution in manufacturing since mass production.[98] (Of course, 3-D and 4-D manufacturers will still need access to raw materials, property rights, and global markets.[99]) Trade and economic projects, such as the EU, Association of South East Asian Nations, and the Commonwealth of Independent States, will in turn need to change to survive or face collapse. Others, such as the Trans-Pacific Partnership (or its version given the Trump administration's U-turn on the issue), One Belt, One Road, or the proposed Transatlantic Trade and Investment Partnership might flourish if pursued right.[100] But regionalization and localization forces will surely hold them back.

The global economic convergence fueled by the ICTs and the Internet will advance the democratization and openness of the political and economic systems. But this will not bring the end of the world, Fukuyama-style. Authoritarian states will still be with us, and the democratic ones will deal with their own authoritarian impulses under global economic pressures and constrained economic opportunities at home. Indeed,

while the general trend will likely be one of wider and deeper democratization globally, select countries—including current democracies—will see their related prospects diminished or doomed.[101]

Populism and protectionism will undermine liberalism and free market principles, while strong nationalism in some countries will intensify interstate frictions in the geo-economic and geopolitical arenas. This would especially be the case as the developing countries catch up with the developed ones and take their share of global markets. Populism is on the rise in the United States, Europe (France, Greece, and the Netherlands), and Asia (the Philippines and Thailand), while "political decay" is no longer a far-fetched characterization of the political system in the United States.

Notably, the number of states with elements of authoritarian systems is growing,[102] though it could represent a transition stage whereby democratic systems try to cope with increased demands for more effective governance due to globalization, urbanization, and climate change. On balance, more countries are likely to move toward more transparent, accountable, and democratic systems, with less citizenry and heavy-handed deals with poor government performers. This would be welcome news for those trying to quell religious conflicts, extremism, and terrorism.

Reshaping of the global energy fabric. The global population and economic growth will require 75 percent more energy by 2050,[103] likely to be available but subject to technological advances on the acceleration side and environmental concerns on the deceleration side.[104] A post-industrial energy fabric will start emerging in the advanced economies, based on a much wider and extensive use of alternative energy sources and technologies, decentralization of energy sources and consumers, and efficient use of energy systems. This

will reshape the global and regional energy flows once dominated by fossil fuels, contributing to an unprecedented global economic transition for the world.[105]

Biomass consumption now contributes less than 1 percent to the global electricity production, but it is projected to grow by 50 to 300 percent. Biofuels might provide about a quarter of all liquid transport fuels. Hydrogen may serve as an alternative to oil and gas, meeting 35 percent of energy needs by 2035 alone and heralding "a full-blown hydrogen economy."[106] The shares of wind, solar, and hydro will grow considerably, making them viable choices for development. Global energy costs will face downward pressures, making the global energy system more resilient.[107]

But the uneven access to energy resources and variable consumption patterns will persist.[108] Technologically advanced societies will make renewables a larger share of their energy systems due to environmental concerns, likely at the expense of higher economic growth rates, at least until the new energy sectors generate economies of scale.[109] Fortunately, new energy technologies and more salient environmental concerns will spread far and wide.[110] The tech economies of the West and Asia will do the heavy lifting here, benefiting the developing world exponentially rather than incrementally, as had been the case in the previous century. With time, the technological advances and a larger "renewable source potential" in the developing world will facilitate a more dramatic expansion of the local renewables markets compared to the developed world.[111] As the global energy fabric is rewoven, the developing countries will be able to "electrify" their economies rapidly and increase the speed of renewables' deployment.[112]

Implications for the Global Operational Threat Environment and the U.S. Military

The past half-century has seen a significant reduction in the rate of battle deaths in wars of all kinds, linked as it has been to increased development and economic linkages, among other factors.[113] The emerging global economic convergence, while not a panacea, will continue to reduce the prospects of interstate wars and the war death rates in the coming decades. Economic growth will not be as much about supporting military spending—a goal that used to orient the economic activity in previous centuries.[114] Instead, it will be more about competition in the economic arena, increasingly across new sectors. Though not without a struggle, states of all stripes and colors already are building tech-based economies.[115] A new global energy landscape is emerging, one that is being born in conflict and peace as dependencies in terms of access to resources, technologies, supply links, and markets break, and form anew.

In such a world, expect a shift to a more functional approach to interstate ties and national strategic planning. Systems and subsystems of relations will still be important building blocks. The construction and management of regional orders will still be important, though increasingly harder for the United States and its allies, as more capable regional managers emerge:[116] China in Asia and Central Asia, India in South Asia, Brazil in South America, and Iran and Turkey in the Middle East. Meanwhile, the new managers also will contend with the growing influence of other actors. But the development and proliferation of new technologies and sectors, as well as the growing importance of select resources and potentially accelerating

(re)evolution of cyber and space technologies and operations, will create new functional dependences. This will elevate the importance and reliance on the functional approach to strategic planning, especially as the global economy converges and national capabilities tend to equalize in the coming decades.

With more factors and increased CSI of developments at play, the prospects for an effective policy planning look dim, despite the shift to a functional view of strategic planning that only select powers will harness. No clear compass, or the organizing principle, of planning will emerge. As the Princeton Project on National Security concluded, "containment, enlargement, balancing or democracy promotion" in this century is not a viable organizing principle for strategic planning due to multiple threats.[117] This complicates the already fractured U.S. strategic planning process, suffering from turf wars, time constraints, and tensions between "thinkers" and "doers."[118] On balance, the U.S. military will have a diminished ability to navigate the global operational threat environment, and to address the increased number of threats to U.S. national security.

But "crisis, change, and uncertainty" will offer an opportunity for strategic planning, prompting the development of more sophisticated planning tools in the future.[119] Moreover, the United States will still be the only state capable of shaping most extensively the global order in military terms.[120] Even if other states were an inch closer to that capacity by 2050, the United States would have an earlier start to self-organize. This is crucial, given the pace and scale of transitions in the coming decades and the importance of forward-looking adaptation for the United States and its "military machine." That adaptation will entail an expanded reliance on the civilian capacity,[121] integrated within

the military and/or working alongside it. It will also entail a shift of the burden to allies to manage regional orders.[122] The changing nature of war and rules of war, in turn, will require new military and legal regimes to shape related norms, practices, and institutions.[123] This will be key, as broader and deeper democratization highlights the need for more individual and national accountability, transparency, and higher intolerance for casualties, however seemingly minor.

Recommendations for the U.S. Department of Defense, Department of State, and the Military

- Create an interagency strategic planning unit, including directors and deputy assistants from the Department of Defense (DoD), Joint Chiefs of Staff, National Intelligence Council, and the Treasury, emphasizing functional dimensions during the strategic planning and execution.
- Increase funding for policy research/development related to issues of strategic planning.
- Strengthen the civilian policy component within and outside the purview of the military focused on the security, diplomacy, development, and civilian-military partnerships.
- Design and propagate military and legal regimes shaping norms, practices, and institutions related to the evolving definitions and practice of war and rules of war.
- Accelerate the shift to the development and use of renewable energy sources and technologies within the military, enhancing mission efficiency and autonomy.

Wild Card – The Death of China's Experiment

In the world of 2050, China is king. Increasingly, the entire global economy, and not just the immediate regional suburbs, are spinning around it, attracted by its outsized consumption glut and using renminbi as the global and, importantly, preferred choice of currency. Everything revolves around China: from politics and economics to culture and entertainment. But the Middle Kingdom suddenly experiences a fall from grace once again. Only this time, the death comes from internal rather than external pressures. China's political decay and inability to ensure a smooth transition to the world of more democratic politics comes to coalesce with a similarly rotten financial and economic system, overburdened by debt, supported by fake statistics, awash in corruption, and resistant to calls of the more informed citizenry for change. If Chinese leaders of a generation ago thought they outsmarted "The End of History" and fared better than the Soviet Union, they are wrong: the China of 2050 fails to save itself from the weight of its heavy military spending and broken financial system. Its development model is dead, its communist party is disintegrated, and its economy is shattered. Call it the death of China's experiment! If you think the U.S. subprime mortgage crisis or the collapse of the Soviet Union were too grave and systemic, think again, because the collapse of China produces ramifications of a much larger scale and more lasting duration. While in the 19th century China's "plague" was contained, in the global economy of 2050 it produces truly global consequences—ones that plunge the world's economic system into a tailspin to an extent far greater than we experienced with the U.S. financial crisis. Fortunately, for China, nobody will be in the position to carve it up old style. But the transition to a new development model is painful, for China and the world. Besides undermining the global economy and trade as well as production, supply, and consumption patterns, the end of China's experiment ushers in the era of radical ideologies and movements threatening to push back the "The End of History" worldwide.

Technological Disruptions and Solutions

Future State

ICTs, biotechnology, genetic engineering, nanomaterials and nanotechnology, robotics, and applied cognitive science will advance in a major way in the coming decades. A kind of a mutated technology revolution will unfold, comparable to and potentially exceeding in its impact and scale similar to the agricultural, industrial, and information revolutions.[124] Technology revolutions will unfold simultaneously and within much shorter timeframes. Barring a global catastrophe, humanity will be going through constantly emerging and faster transitions—a major departure from the earlier, more linear progressions. As one author put it, imagine shopping for deoxyribonucleic acid (DNA) online; taking grandkids for a space tour; shopping entirely online; driving a hydrogen-powered car; relying on robots at home; printing goods from your printer; and enhancing your health and mental capacity at a whim![125] That is just the starting point of good and bad to come in the global technology economy, in which the pace and impact of technological advances threaten humanity with the technological "singularity" that could "rupture the very fabric of human history."[126]

Information and communication technologies (ICTs). ICTs will make even more dramatic leaps, exposing more people to more risks and benefits. Take information storage and knowledge. Powerful search engines continue accumulating the memory of civilization.[127] The quantity of stored information doubles every 2 years, reaching 1.8 zettabytes in 2011

(1 followed by 20 zeros). To put things in perspective, it took Europe 50 years to double its knowledge base, but a society today can pull off a 50-fold increase in about 10 years! Information overload, not lack of it, appears to be the challenge. Superfast computers are already proliferating. The United States no longer holds the monopoly on the production of superfast computers—China does, after it showcased the fastest supercomputer in 2010.[128] Expect greater efficiencies across the board and more surveillance opportunities; but also more Internet fraud, identity and information theft, cyberattacks, and intrusions,[129] as the "Internet of Things" (i.e., the linking of numerous devices) generates both efficiencies and vulnerabilities.[130]

Biotechnology and genetic engineering. Advances in biotechnology and genetic engineering could potentially outdo the information revolution in both impact and scale. Similar to computer power, DNA manipulations are getting faster.[131] Enhancing the physical, mental, and emotional capabilities of humans is within reach. Extending people's life and making brain manipulations is increasingly possible.[132] These and other advancements will raise ethical and religious considerations for individuals and societies,[133] reshaping the old and forming new rules and expectations. While advancements in biotechnology and genetic engineering will remain the prerogative of wealthy societies, the poorer ones also will enjoy the fruits of such technologies as related applications spread.

Nanomaterials and nanotechnology. Nanomaterials and nanotechnology will advance to a whole new level—the atomic one! Both promise revolutionary changes to sectors as diverse as energy, medicine, and transport. A new, abundant, and transformational energy source may emerge thanks to advances

in nanotechnology.[134] What is more, the intersection of nanotechnology, biology, and cybernetics promises radical changes across numerous sectors, with the military and civilian entities increasingly interested in nanotechnology as a force multiplier or solution to numerous challenges. The global nanotechnology market in various applications already has expanded by half in recent years and is projected to grow at a rapid pace because of ongoing advancements.[135] Developed countries will be up front when it comes to the development and integration of nanomaterials and nanotechnologies. But the global technology diffusion also will accelerate developing countries, some of which may emerge as innovation leaders in the field. That said, related advancements would raise a host of socio-economic and environmental challenges.

Robotics and applied cognitive science. Advances in applied cognitive science and biotechnology will contribute to advanced robotics, linking living and nonliving systems. Increasingly autonomous robot systems entering and modifying different walks of life are emerging.[136] Implanting brainwave sensors and enabling computer operations by thought will become a widespread practice. Already, Intel is developing a chip enabling just that. Other companies are working on installing miniature mobile phones into people's heads or improving battery storage so your phones will not die on you.[137] Synergies from biology and information technologies will, in turn, make new brain scanning techniques and the construction of artificial brains and other artificial systems a reality. Computers could attain superhuman intelligence if computing power grows exponentially.[138] Nature, of course, will stand in the way—the computational power of all computers in 2010, for instance, equaled what the brain processed only every 5 minutes.[139] Self-aware systems could be

further off than expected, but related advancements are bringing humanity closer to the truly autonomous systems.[140] The diffusion of artificial intelligence and automation technologies would create new and disrupt old industries, resulting in new sources of economic growth and socio-economic dislocations.

Implications for the Global Operational Threat Environment and the U.S. Military

The speed with which technologies proliferate today has increased 10-fold over the previous century and will continue to grow.[141] Countries on the fringe of the Information Age will witness increased information flows.[142] Increased capacities of and access to technologies will bring its own risks and challenges. The democratization of technology and digital connectivity will allow more individuals to access more weapons as well as utilize communication and control systems with far greater range and precision.[143] Mobile phones and social media will become more popular and effective means of command and control on both sides of the law.[144] More automated systems and cyber technologies will make war business increasingly a home-based experience while making one's own turf more vulnerable. Hence, populations will be easier to attack, while governments will be easier to blackmail.[145] Boundaries between the military and civilian domains will be blurred.[146] The risk of cyber and bio attacks will grow significantly.[147] DNA warfare will be an option.[148] Meanwhile, the exposed global inequality will facilitate popular mobilization, in some cases sweeping the powers-that-be from their "gold thrones."

Cyber operations will grow in number and scope, influencing the will of populations and enemies, manipulating information, and taking control of and

destroying computer-controlled economic sectors.[149] The networking and interaction between humans and machines will impact force structure and operations. Some estimates suggest that the U.S. military will likely need to increase its cyber forces from one-ninth to about one-third to ensure its readiness and effectiveness.[150]

Expanded cognitive processing power will enhance pattern recognition, making technological systems more autonomous. Select countries are already developing autonomous armed robotics. South Korea previously deployed two robotic snipers to lraq.[151] More countries and nonstate actors will also acquire and use armed drones, given their cheaper costs,[152] instead of investing in bigger weapons systems, such as U.S. F-35s.[153] As of 2013, only the United States, United Kingdom, and Israel used armed drones against enemies. But the next big users in line are China, which is already working to expand its fleet of drones, and the likes of Hezbollah, which employed crude drone technology in the past.[154] Fully autonomous drone strikes may become possible, though a human likely will remain a part of the kill chain, given cultural and technical reasons. As drones and armed robotics proliferate, new legal requirements will arise to regulate their use. Already, companies are developing software for autonomous systems to ensure they adhere to the laws of war.[155]

As new technologies proliferate, a scientific and technological potential and ability to integrate advancements in the civilian domain increasingly will determine a country's military strength. Competition over scientific and technological advances in both civilian and military areas will increase significantly, pitting state and nonstate actors (including individuals) against one another. That is bad news for the United

States, whose share of global research and development (R&D) spending is projected to decline from about 33 percent today to 18 percent by 2050. As other countries invest more in R&D, the United States and its military will find it harder to compete. The U.S. DoD's Science and Technology program already is struggling to keep up with the growing pace and diminishing costs of global defense technologies development.[156] Given the importance of technological advances for its military and economic competitiveness, losing out in the technology arena will undermine the current U.S. dominant technological, research, and economic position.

Recommendations for the U.S. Department of Defense, Department of State, and the Military

- Create and enforce global rule sets regulating the development, use, and integration of potentially disruptive novel technologies in both civilian and military domains.
- Develop news rules of regulating conflict, wars, and special operations missions by factoring in the emerging data-driven warfare and autonomous weapons systems.
- Institute a program under the DoD to monitor the latest, emerging, and prospective technological advancements, with military applications being pursued worldwide.
- Foster interstate, state-to-nonstate, public-private, and military-civilian partnerships to research, develop, test, and propagate technologies with potential military applications.
- Create a network supporting an emergency operation mode if the Internet breaks down.

Wild Card – From Cyber Monday to Mega Blackout

The global economy of 2050 is as much virtual as it is real. Billions of shoppers, increasingly in emerging countries, spend trillions on goods and services online. Entire economic sectors and economies are interconnected on an unprecedented scale, with the Internet gluing it all into one complex organism feeding on virtual and real trade flows. Cyber Monday is now a truly global phenomenon, 360 days a year, linking billions of producers, suppliers, and consumers. From civilians to soldiers, this lifeline supports activities of societies and militaries alike. But hacktivists, criminals, states, and terrorist networks increasingly exploit the generally enhanced reliance on the Internet. An extremist group opposing a technologically enhanced world does just that by utilizing the very latest technological tools it despises to cause a Mega Blackout of the World Wide Web. The result? The Internet is offline. But so are trade flows and entire economic sectors. Military systems are no longer networked, operations are compromised and undermined. The global economy is in ruins, not with a launch of a hydrogen bomb but with a click of a mouse. Civilian and military cyber warriors rush to resuscitate it. But the damage is done—the world is disconnected, aloof, and unrecognizable to a mid-21st century consumer.

Military Revolution and Counter-Revolution

Future State

Advanced militaries, and areas of future military intervention, will get a taste of yet another military revolution in the coming decades, which will bring enhanced capabilities and vulnerabilities. Harnessing it will entail the integration of and adaptation to rapid and profound cultural, socio-economic, political, and technological changes. Key trends in this regard will involve a more rapid informatization and robotization of forces and war, increased reliance on the space and cyber domains, the refinement of the revolutionary precision and autonomous systems, the emergence of fundamentally new weapons systems and military tactics and doctrines, and significantly enhanced risks of weapons of mass destruction (WMD) and missile proliferation. Meanwhile, counter-revolution will emerge in the form of asymmetric military solutions developed by militaries as well as ethical and legal challenges mounted by societies worldwide.

The dawn of another military revolution. Ongoing and projected changes in military technologies, conflict, civilian systems, and military operations and culture herald the coming of another military revolution extending beyond this century.[157] Military revolutions are products of significant social, political, and technological changes that reshape societies, states, individuals, and the conduct of war, making adaptation an imperative yet difficult enterprise.[158] They also take the time to emerge as they go through "innovation, diffusion, and refinement."[159] We won't know how it will look exactly until we do, but given the pace

of change, this process will be much shorter. Already, it manifests itself as part of a 4th-generation warfare in the use of precision, intelligence, surveillance, and reconnaissance (ISR) systems, which will proliferate and improve in the coming decades.[160]

Objectives and types of military missions will evolve, focusing on Special and Cyber Operations designed to achieve limited objectives rather than pursuing large-scale reconstruction of societies. That said, culturally aware teams working alongside civilian counterparts will become more important. The United States and other militaries increasingly will coordinate with home- and foreign-based civilian agencies to conduct security, stability, development, and reconstruction operations. A seized territory will be even less of a prized possession. Borderlines between civilians and troops will be blurred. New conflict domains—cyber, space, and the media—will take center stage.[161] Asymmetric warfare featuring cyberattacks increasingly will be in demand.[162] Collateral damage will emerge as a major issue in a media-saturated environment. Meanwhile, enhanced precision systems will reduce casualties even more.

Information will play a much more pronounced role in this context, explaining the U.S. military's reliance on defense transformation to transition from a platform to a network-centric warfare that allows for integrated theater operations.[163] The United States and other advanced militaries are already pursuing networked operations, synchronization, and the compatibility of forces and systems. This approach will enable a selective, precise, stealthy, collaborative, adaptable, more lethal, and less costly application of power in diverse theaters against a diverse set of targets.

However, given the evolving strategic landscape, the U.S. defense transformation will be a process, not an outcome. After all, older weapons are getting an upgrade, news ones are emerging, and newer ones are yet to appear.[164] The culture of armed forces, societies, and the rules of war will be changing, with "warring . . . less and less confined to the battlefield, and more aimed at disrupting societies." More actors will utilize an ever-growing arsenal of tools challenging traditional concepts of "offense/defense" and "deterrence," increasingly along such domains as the cyber, "electromagnetic, social media, outer space, and the environment."[165]

It will take time for the U.S. military to adapt to these changes.[166] But the end game is clear, if not assured. As Cebrowski, the chief architect of force transformation, put it:

> We want all of our enemies, current and future to look at us and say, 'Wow. How do they do that? We see it unfold before our very eyes, but we don't understand what's really happening and we can't stop it.' That's the power of transformation.[167]

Informatization of military forces and war. The growing informatization of armed forces and war is a vivid manifestation of the Information Age and the emerging military revolution. This process mirrors a societal transition from the industrialization of economies featuring industrialized warfare to the informatization of economies featuring the informatization of warfare. Future wars will still be bloody and messy, but increasingly less so, if required. A military officer's characterization of information technology as "America's gift to warfare" may yet find its validity in this context.[168]

The future armed forces will feature "information corps," just as those of the past had an air corps a century earlier, while a new concept of warrior, an "information warrior," will emerge.[169] Enhanced integration of information technologies will provide gains, range, and scalability in military operations on levels comparable or exceeding those of blitzkrieg and aircraft carriers during World War II. Full-spectrum dominance and dominant battlespace awareness will no longer be just the buzz words, getting closer to "eliminating the Clausewitzian friction of war" in conflicts between superior and inferior militaries.[170] Sun Tzu's Art of War, written centuries ago and emphasizing deception, manipulation, and information operations, will not just live but thrive in the 21st century. Depending on the opponent, select high-tech and digitized forces might display Sun Tzu's "acme of skill" and win without fighting—an aspiration of today's militaries. While the U.S. military will be the most digitized, other peer competitors will also be digitizing their forces, denying it the sought-after full-spectrum dominance and dominant battlespace awareness.

Space and cyber domain adaptation and exploitation. The militarization of space and cyber domains is a major component of the emerging military revolution. Both will become more critical for ballistic missile defense; nuclear policies; communications; navigation; command, control, communications, computers, intelligence, surveillance, and reconnaissance; precision; and global strike capabilities and regimes. The United States, Russia, EU members, and Japan—and increasingly China, India, and South Korea—are all pursuing military space and cyber capabilities.[171] China, for instance, wants to build a space station and is preparing for unmanned and manned missions to the moon

in 2017 and 2025.[172] Of some 70 governmental space agencies, at least 13 already have launch capabilities. A growing number of nonstate actors (Space-X, Blue Origin, Virgin Galactic, Bigelow Aerospace, Planetary Resources, etc.) seek to bring men to space, create space habitats, or mine asteroids.[173]

By 2050, China and Russia's space capabilities will be far more menacing, and their current opposition to space militarization[174] (strike fighting systems, anti-satellite systems, space-based ballistic missile defenses) will be a guide of future warfare. The continued development of global navigation satellite systems by major actors and the use of highly sensitive remote sensors will have important military and commercial applications. While its space and cyber capabilities will be unrivaled,[175] the United States (and others for that matter) will face challenges weaponizing the domains, given constraints of spacepower and cyberpower theorization, let alone integration.

All space powers will seek strategic outcomes on Earth and in space through the integration and utilization of space, cyber, land, air, sea, nuclear, and special operations. While surprise reconnaissance and bombings from orbit will take the time to materialize, the need for a unified theory of air, space, and cyber power in joint operations will become more pronounced.[176]

Transformation of weapons systems. The development and integration of new weapon systems, tactics, and strategies will define the weapons transformation process with an emphasis on networking. As Secretary of Defense Donald Rumsfeld said, "Possibly the single-most transforming thing in our force will not be a weapon system, but a set of interconnections and a substantially enhanced capability."[177]

Precision systems (which have separated humans from the act of direct killing)[178] and faster, more lethal, and highly maneuverable hypersonic missiles capable of penetrating the strongest missile defense shields will play an expanded role. During the Gulf War, guided bombs accounted for 10 percent of the ordnance used; in recent conflicts, this has risen to 90 percent. This number is expected to increase, potentially substituting for low-yield nuclear weapons and targeting larger missile, aircraft, ship, and submarine forces.[179] Enhanced wide-area airborne surveillance and remotely piloted air systems capabilities providing high-resolution views and helping expose enemy operations will grow in use. The U.S. military is already testing long endurance multi-intelligence vehicles—developing an even larger Defense Advanced Research Projects Agency large unmanned airship system—and is making rapid advances in electro-optical infrared camera systems. For example, Gorgon Stare and ARGUS have been designated to design a nearly full-motion video of 12 independently steered spots and to transmit that video directly to the warfighter.[180]

New military technologies, upgrades, and applications will include physical, mental, and emotional enhancements to soldiers; smart improvised technology and micro robotics; bioagents; space weaponry; directed energy weapons; direct-ascent satellite weapons; satellite jammers; cyber-measures; and anti-access strategies.[181] An Active Denial System using intolerable heat waves to deter enemies and the Airborne Laser using an aircraft-mounted laser to target ballistic missiles will likely become a reality. Operational projects, such as a littoral combat ship to support the U.S. Sea Shield Concept, F-22A Raptor to support the U.S. Global Strike Concept of Operations, and the Quick

Kill Active Protection System to destroy rocket propelled grenades and anti-tank guided missiles will see major upgrades. Processes will evolve, too. The U.S. Army's Future Force Capstone Concept, Modular Force, and Force Generation will bring enhancements across processes, organization, and people, enhancing its battlespace awareness, expeditionary and joint capabilities. Meanwhile, low-observable traits and electronics functions will grow in importance to offset other countries' capabilities, increasingly denying the United States a fully permissive airspace.[182]

Truly autonomous weapons systems will start emerging, with unmanned aerial vehicles (UAVs) likely replacing manned aircraft for most missions as part of the robotization of warfare.[183] Autonomous aerial refueling and airborne communication relay will emerge as new roles, streamlining operations.[184] The development of artificial intelligence will make self-directing of select systems a widespread development,[185] heralding socio-economic shifts. As Vassily Leontief, an economist, stated:

> Computers and robots replace humans in the exercise of mental functions in the same way as mechanical power replaced them in the performance of physical tasks. As time goes on, more and more complex mental functions will be replaced by machines. . . . This means that the role of humans as the most important factor of production is bound to diminish in the same way that the role of horses in agricultural production was first diminished and then eliminated by the introduction of tractors.[186] As of 2013, at least 88 nations were either developing, purchasing or deploying military robotics.[187] But organizational and technological barriers will stand in the way, as the case of the U.S. Low-Cost Autonomous Attack System development has shown.[188]

WMD and missile proliferation. A more increased risk of WMD and missile proliferation awaits the world of 2050. Technological advances in the military and their proliferation and integration within civilian sectors will enable a larger number of actors to develop, acquire, and use WMD. The civilian infrastructure will become a more vulnerable and popular target for state and nonstate entities. Think of an intentional or inadvertent nuclear exchange between India and Pakistan, or a nuclear attack by North Korea against a likely nuclear weapons-capable South Korea. Consider the probability of biological attacks, with a killing trail extending from one corner of the world to another through a series of layovers along the way. As societies depend more on cyber networks and automation, a cyberattack will become a preferred and designated WMD, capable of wiping out entire economic sectors in the highly interconnected global cyber grid.

Meanwhile, the risk of authoritarian regimes and terrorists acquiring WMD capability will increase, especially in the area of biological agents because of reduced technical barriers and manufacturing costs.[189] The number of nuclear weapons-capable states will grow. In 2011, at least 35 states had plans to build nuclear reactors by 2030.[190] Unlike Russia and the United States, they will lack the experience or "strategic space" featuring a second-strike capability, big arsenals, and low-vulnerability launch platforms.[191] The missile development and proliferation, "decoupling" from WMD proliferation, will speed up considerably:

> as the growing availability of 'increasingly powerful conventional munitions and more accurate missiles' allows missile arsenals to serve the more traditional airpower roles.[192]

China is a candidate for both and could produce up to 800 nuclear warheads in the near future, a key factor for the "global nuclear balance of power."[193] Meanwhile, competition in hypersonic missile development will intensify, marking a continuous military race involving offensive and defense systems.

Implications for the Global Operational Threat Environment and the U.S. Military

Big interstate wars will become less appealing and more rare, but not impossible (think nuclear-armed India and Pakistan).[194] Weapons systems using computer-brain interfaces will remove humans from the line of fire and reduce casualties. But they could also prompt more conflicts, as the perceived operational benefits could outweigh costs in opponents' human lives.[195] The role of conventional forces will diminish, as new types of conflicts and missions emerge focusing on the urban, space, cyber, and civilian protection operations. Special operations will play a more prominent role serving advisory, diplomatic, and civilian functions, as the appetite for larger missions fades and the number and potency of unconventional threats increases.[196]

These factors will force cuts within the U.S. military in some areas and increases in budgets for other areas mentioned above.[197] The United States will rely on technology to compensate for labor resources. But increased technological dependency will make it impossible, as the Army's Capstone Concept underlines, for the U.S. military to operate with all systems intact.[198] The U.S. military's challenge, therefore, will lie in integrating new technologies without being

"institutionally undone by them"—all while meeting the needs of a transformed society.[199]

This will entail understanding the growing informatization of military forces and war, featuring the growing role of information and automated systems required to process it. As the data-driven warfare expands, more granular and wider mass surveillance capabilities will define a security state, challenging domestic and international legal frameworks.[200] Information technology will enable dispersed forces to better synchronize operations and even take over an opponent's "operational level system" in what could be described as the "New American Way of War."[201]

But while the new skillset could approach Sun Tzu's "acme of skill,"[202] related capabilities of other countries will advance significantly, undermining the U.S. current "technological overmatch" across all military domains. Such capabilities today and in the future will include communications and encryption software, precision-guided missiles and mortars, advanced mobile and man-portable air defenses, anti-satellite systems, anti-ship missiles, and long-range ballistic missiles.[203] The United States will be prompted to develop counter capabilities: offensive and defensive cyber measures; long-range strike capability; munitions for underground targets; anti-guided weapons systems; resilient ISR platforms; and systems to suppress enemy defenses.[204]

Adapting and exploiting space and cyber domains will be crucial. Military space missions increasingly will shift from support as defined by management of on-orbit assets, to force enhancement designed to enhance the effectiveness of operations on Earth, to space control involving kinetic and non-kinetic effects. U.S. satellites will become more vulnerable to attack

as other countries acquire satellites and anti-satellite capabilities. Select powers, such as the United States, China, and Russia, might attempt to place independent kinetic kill vehicles in launch and early orbit to deny space entry or transit to any other state. Meanwhile, decoupling "hard" and "soft" space power will prove difficult, increasing the risk of conflict on Earth as well as in and over space.

Electronic jamming or destruction of satellite uplinks and downlinks will be accompanied by the development and deployment of space-based non-nuclear, hyperkinetic weapons against fixed high-value and heavily defended targets on earth.[205] The United States is now deploying a space-based infrared system with revolutionary early warning system components for missile defense that it intends to utilize to create the theater event system against growing ballistic missile threats.[206] But given space conditions, achieving the disruption rather than the control of space is easier: a USD$1 bag of marbles can easily destroy a USD$1 billion satellite. Lack of direct threats to U.S. on-orbit assets and consensus on the space militarization will continue to impede space weaponization, just as the growing space capabilities of actors will push the trend forward.[207]

The space and cyber domain adaptation will involve the development and deployment of enhanced old and transformational, along with new weapons systems, especially precision and directed energy systems. This will prompt an adoption of countermeasures to ensure survivability of one's weapons systems. Short-range precision strike systems will become more popular, and an intercontinental precision strike capability could become a potentially widespread reality. The U.S. military is already developing a conventional

prompt global strike system.[208] China and Russia are seeking it, though little information is available about related programs in open sources. Meanwhile, all three, plus India, are developing hypersonic missiles and defenses against them.

Long-range precision strike systems will expose military and civilian infrastructure, reminding us of the threat of strategic bombings and coercion during the Cold War era. Keeping another state's civilian infrastructure at risk will be a popular way to achieve limited objectives. Meanwhile, broader stability will depend on each side possessing an assured survivable retaliatory capability, this time likely based on precision strike systems, not just nuclear weapons. The U.S. military strategies relying on forward-based assets will become more vulnerable.[209] States or terrorists capable of deploying an electromagnetic pulse with strength equivalent to a nuclear weapon explosion will become a real concern in the coming decades.[210]

As with precision-guided systems, advances in missile technologies and strategies will undercut WMD nonproliferation efforts. The global proliferation of short- and medium-range ballistic and ground-launched cruise missiles will undermine the Intermediate Nuclear Force Treaty. Actors will continue to develop and upgrade their anti-missile defense systems, focusing on directed energy systems.[211] China will rely on its nuclear arsenal and new technologies, presenting the largest threat to U.S. military capabilities. Already, China is modernizing its nuclear forces to ensure a second-strike capability, increasing the number of warheads, solid-fueled, road-mobile ballistic missiles, and nuclear-powered ballistic missile submarines.[212]

Other nuclear weapons states, not just China, will be upgrading their arsenals as part of an arms race featuring a larger number of actors and more menacing capabilities. The risk of nuclear exchange will grow as nuclear-armed states will perceive increased reliance on space for operations in space and on Earth as an effort to undermine their nuclear deterrence. The United States, Russia, Israel, China, India, Pakistan, North Korea, and Iran will remain the focus of nuclear weapons developments. India, Pakistan, and China are on track to nuclearize the Indian Ocean with at sea-deployments of nuclear weapons.[213] Meanwhile, Israel's and Iran's suspected nuclear weapons capabilities create incentives for other states in the region, namely Turkey, Egypt, and Saudi Arabia, to develop their own. This is a dangerous development given the lack of risk management frameworks in the two fast-militarizing and conflict-prone regions, respectively.

Overall, autonomous and precision systems, armed robotics, and other technologies will challenge the international law, prompting the development of "ethics" software[214] and entirely new rules and treaties regulating their development and use. This is critical, as advances in self-directed and artificial intelligence technologies could undermine human control.[215]

Recommendations for the U.S. Department of Defense, Department of State, and the Military

- Develop and upgrade a unified theory of joint operations across all domains emphasizing decentralization, experimentation, and autonomous approach to military operations.
- Identify best practices of organizational and technological change integration within other

domains in order to enhance the space and cyber domain adaptation and exploitation.

- Create an interagency body to advance the enhancement and integration of space and cyber power and a taskforce to monitor foreign space and cyber assets and capabilities.
- Enhance the survivability of critical bases, space and cyber systems, as well as develop low-tech solutions to address vulnerabilities stemming from cyber and electronic threats.
- Advance space de-weaponization and rules regarding collisions and interference with space assets as well as the use of lasers and conduct of regular and crisis communications.
- Enhance the experimentation of disruptive technologies, especially autonomous weapons and artificial intelligence technologies, in their interoperable and integrated mission mode, while employing proper safeguards in order to minimize unintended outcomes.
- Focus the WMD nonproliferation campaign on the emerging nuclear-weapons capable states and actors pursuing advanced missile capabilities, in part by revisiting treaties.
- Pursue a distributed sensor and interceptor architecture to defend dispersed targets in what should be a layered security system to protect both civilian and military assets.
- Conduct more wargaming, simulations, and scenario planning involving multiple nuclear powers and featuring conventional and/or nuclear exchanges by allies and partners.

Wild Card: Self-aware Armed Robotics – Wither the Human Control

The development and use of fundamentally new weapon systems, military technologies, and operational concepts drive the military revolution, now in its full swing. Armed robotics and autonomous systems are deployed for different missions and across all military domains. The sophistication of such systems leaves little room for human errors and a country's own casualties, reflecting a strong view within a high-tech U.S. society that technology is a panacea for challenges of human and non-human origin. Artificial intelligence machines become an accepted phenomenon and component in the civilian and military sectors—one that is cost-effective and efficient. Relying on armed robotics and artificial intelligence, the U.S. military wins more wars, and with fewer casualties and errors. But this increased technological reliance now leaves matters of control to the machine. Cases of the systems overriding human-programmed tasks become more frequent until they undermine human control, initiating coordinated yet unsanctioned strikes that cause unintended conflicts and numerous casualties abroad. Humans eventually restore control over the machines. But the growing number of such incidents and the continued development of the autonomous and robotic systems has now made possible, for the first time in human history, for an intelligent machine to decide the fate of the humankind.

Regional Economic, Technological, and Military Races

Future State

Some regions will achieve unprecedented levels of development in the coming decades. Others will see their economies slow considerably. A reformatted economic architecture will emerge, featuring a significantly diminished U.S. influence and enhanced capabilities of powers previously on the sidelines of global geopolitics. More states will use the enhanced capabilities to advance their interests. But the established powers will mount stiff resistance, with competition intensifying over new strategic resources and markets. Of all the regions, Asia is projected to account for the largest share of global GDP. This will mark the reversal of domination of Western economies, the return of China and India to the center of global economic gravity, and the emergence of other economic powerhouses in Asia, such as Indonesia.

This global economic configuration will feature China as the largest economy by GDP, likely followed by the United States and India. European and the U.S. shares of global GDP are expected to decline to a mere 23 percent.[216] The U.S. GDP is projected to increase to USD$35.1 trillion; Japan's, USD$6.7 trillion; and Germany's, USD$3.6 trillion. China is expected to hit a USD$44.4 trillion mark; India, USD$27.8 trillion; Brazil, USD$6.11 trillion; and Russia, USD$5.9 trillion.[217] The Chinese worker will earn USD$31,000 per year; Italian, USD$41,000; German, USD$49,000; French, USD$52,000; the United Kingdom, USD$59,000; Japanese, USD$67,000; and the United States, USD$83,000.[218]

North America. Absent major strategic failures, including extended foreign policy (mis)adventures, the United States will retain its absolute position as the global technological and military leader. It will also enjoy favorable demographic and immigration conditions as well as a robust technological and R&D infrastructure feeding its economic and military dynamism. It will continue to boast the largest share of global management resources. However, its relative position across all areas will decline compared to ascending powers, primarily in Asia. It increasingly will have to share the "pie" and work with state and nonstate actors to achieve more limited goals using more limited means.[219]

Canada and Mexico will elevate their status in world affairs. But it will be Mexico that will see a more accelerating change, starting from a lower base yet enjoying a rapid growth and deepening links with countries of Central and South America and farther ashore. While it will still be a key economic partner to the United States, it might see a mild decoupling from its northern partner as it shifts its gaze south. It has already pushed for the creation of an economic alliance with Columbia, Peru, and Chile, a market of 206 million consumers that accounts for 36 percent of the Latin American GDP.[220] Canada, in turn, will see its role grow in the Arctic, where competition will ramp up as ice melts and clears the area for transit development, trade, and resource exploitation.

South and Latin America. South America might see its status as a dormant region shattered, coming out of the periphery of global affairs as a counterweight to other regions on economic and security issues. Leveraging its resource and demographic potential, it might outdo select Asian countries in terms of economic

growth.[221] The region's middle class grew from 21 to 35 percent of the population between 2003 and 2013 and is expected to increase significantly by 2050. As in other areas, a number of powers will emerge in the region with a far stronger voice and ability to shape regional and, importantly, global outcomes. Meanwhile, a face-down in the political arena will continue between "the left" and "the right," with the appeal of "market-friendly ideas concerning rule of law and economic and social management" increasing, if recent successes are an indication.[222]

While major development challenges could prevent it from becoming a great global power in the 21st century, Brazil stands a chance of attaining at least a status of a major, second power center in the Western hemisphere. The growing economic and political ties between Brazil and major powers demonstrates the country's and the region's rising and hefty geopolitical profile, even if it also reflects the growing competition between major powers worldwide. China's engagement in the region stands out especially in this regard. It is driving the region's integration from within and without, enhancing the geopolitical roles of Brazil, Argentina, Venezuela, Bolivia, Chile, and Peru.[223] Time is not too far off when the United States will be forced to invoke assertively the Monroe Doctrine to fight off China's growing geopolitical encroachment in the region.

Europe and Eurasia. Europe will grow older and less dynamic, with countries of eastern and central Europe still catching up but inching closer to the economic status of their Western neighbors. Following the coming Brexit and given the concerns of Grexit, the EU is unlikely to survive in the current format. The dynamic states will include Germany and Poland.

The United Kingdom will continue trailing the United States, with its global influence eroding decade after decade. Germany and France will likely be more assertive in regional and global affairs, as U.S. interventionism declines, and allies pick up the slack in providing for the security of the global commons and regional orders. Meanwhile, increased migration pressures from the Middle East and North Africa, as well as increased terrorism risks, will challenge the security and vision of a liberal Europe. Russia could emerge as a major global economic power if it addresses widespread corruption, invests and scales the development of high-tech sectors, and concentrates on economic development rather than overseas adventures. The alternative is a depopulated, authoritarian, and undiversified Russia engaged in imperial expansion rather than much-needed country-wide development.

Central Asia and the South Caucasus might see their fortunes reverse, as China, India, Russia, the United States, EU, and Iran facilitate economic linkages within Eurasia (sometimes working at cross-purposes).[224] Major developments to watch will be a generational transition of rulers and governance systems, as well as the regional strategic rivalry involving China and Russia, and later India. Depending on how Russia fares in the coming decades, Beijing could sideline Moscow in Central Asia again, this time militarily, while India, and less so Iran and Turkey, could come closer to doing so in the economic arena.[225] Barring those dynamics, change in the regions largely will be evolutionary, in large part subject to twists and turns in Russia, China, Turkey, India, and Iran. The relatively open Kazakhstan, Kyrgyzstan, Georgia, and Azerbaijan will be on track to modernize their governance systems. The more insulated countries like Uzbekistan,

Tajikistan, Turkmenistan, and, less so, Armenia will open up or be forced to become more transparent and integrated within their regions if they want to accelerate their development.[226]

The future of Afghanistan will be critical for a transformed Central-South Asia. The rise of India, China, and potentially Iran will offer Kabul and the region a shot at accelerated development. Alas, it will take more than China and India to turn the proclaimed Silk Road interconnector into a viable entity not dependent on internal conflict, outside assistance, and external military presence. While becoming a more reliable and integrated link in the Eurasian chain of trade, energy, and transit connectivity, Afghanistan might have an opportunity to become a middle-income economy, provided good and stable governance takes hold in this war-torn country.[227]

Africa. Ethnic conflicts, resource wars, civil wars, state failures, and terrorist enclaves will still plot the geopolitical fabric of the continent, occasionally drawing interventions, increasingly by non-Western states. But from among many diverse countries, stars will likely emerge. South Africa and Nigeria, boasting more advanced political and economic resources and mobilization potential, might turn into economic heavyweights and increasingly set the continent's agenda. As information technologies continue to spread and global connectivity engulfs even the most remote areas, a larger number of African countries will open up. Poverty levels and health epidemics will decrease dramatically thanks to new technological and agricultural advances available to and, in some cases, developed by countries in Africa. Along with the Middle East, Africa will have plenty of opportunities to do the catching up, and do it faster. Meanwhile, an enhanced

economic and military presence of Asian powers on the continent will reflect a reformatted global influence structure, with Western powers ceding some of their positions to the emerged and rising powers of the East. China and India will become major political and military players, building and using a string of military bases scattered along the continent's major coastlines.

Urbanization dynamics will accelerate on the continent. Lagos, home to 14 million people, and Kinshasa, home to 12 million, are expected to outgrow Cairo in territorial and population size by 2020 alone. Trading centers in many African countries will become cities. Nigeria is on track to soon have 100 cities boasting more than 200,000 residents. Demographic and resource use pressures, droughts, and floods due to climate change will diminish soil fertility and vegetation. Desertification, for instance, already threatens sub-Saharan Africa more than any other area, with deforestation in the region occurring at twice the global rate. Meanwhile, water stress is projected to impact some 75 to 250 million people in Africa, with expected impact on internal and external migration affecting numerous regions within Africa and beyond. Dealing with urbanization and climate change pressures will be a major challenge for African countries in the coming decades as they rely on a mix of political centralization and decentralization tools to navigate the "technology- and development-induced changes" and "ethnic divisions."[228]

The Middle East. The Middle East will feature its stars and losers as well, with the former successfully leveraging their youth bulges to accelerate economic development. Saudi Arabia increasingly will attempt to position itself as a major regional geopolitical power. Turkey and Iran will emerge as the most dynamic states. Iran's potential larger-scale integration into

the global economic system and likely transformation of its political system will reformat the geopolitics of the region. Iran might again become an anchor of the U.S. regional foreign policy and achieve a détente with Israel.

The competition will intensify between Persian Gulf states, especially Saudi Arabia, Iran, and Turkey for the dominant geopolitical role.[229] Already, military rivalries are in full swing, with proxy wars ongoing in various theaters. Libya, Iraq, Syria, and Yemen will still be the battlegrounds of such rivalry, with their political systems struggling to consolidate. The Middle East, therefore, will remain the region with a high potential for state disintegration and formation.

Meanwhile, the region's oil-rich states will seek to diversify their economies because of depleting oil and gas reserves,[230] and because of reduced demand from external economies that will be undergoing their own transitions from predominantly fossil fuel-based to more diversified and more renewables-based economic systems. Nuclear power development will play a more prominent role. Nuclear proliferation potentially will result in the emergence of new nuclear weapons-capable states in the face of Iran, Saudi Arabia, Turkey, and Egypt.[231]

Southeast Asia. Asia will again emerge as an economic success story, but with a major twist in the Part II series. The geopolitics and military arms races, not just the geo-economics and business opportunities, increasingly will define it. Another group of Asian tigers will be born in the face of Malaysia, the Philippines, Thailand, Indonesia, and Vietnam. As the National Intelligence Council put it, China will become more assertive, India will be more economically significant, Japan will return to a normal state, and Indonesia

will emerge as a major economy in what will be a redefined geo-economic order.[232] China and India will have become truly global giants, returning to their status of having the large economies they once enjoyed when they commanded almost half of the global output in previous centuries, only if they manage to avoid the middle-income traps.[233]

Their rise will intensify the economic and military competition, making the conflict over disputed territories more frequent, and not just within their sub-regions. Regional arms races and nationalism will unfold in full swing. The Indian, Pacific, and the Arctic oceans, like the Trans-Atlantic one before them, will emerge as the area of growing global geostrategic rivalry[234] featuring China, India, and the United States as prominent actors. Instability in Asia will flare in the South China Sea and parts of Central and Southeast Asia,[235] reshaping the traditional Asian security and economic orders. The United States, China, and India will agree on a tri-pillar regional management or face instability, as other states become pawns or puppeteers in the game of bandwagoning, counterbalance, cooperation, confrontation, and proxy wars in the once Zen Asia.

Beijing and Delhi will be far more capable of challenging their rivals in areas outside their regions, both on the side of stabilization and destabilization.[236] Their outsized military capabilities and intentions will now determine the prospects for global stability. China's military budget is now on track to overshadow the U.S. one. China will have more advanced aircraft, submarines, and ballistic and cruise missiles, likely undermining U.S. "overwhelming superiority" by 2050.[237] China already is rapidly growing its aerospace, maritime surveillance, high-powered microwave electronics weapons, high-performance radars, and cyber capabilities.

Meanwhile, India is investing in laser weapons, its air force, theater missiles, and missile defense systems. It is developing a layered, hardened air defense relying on reconnaissance satellites, early warning radars, UAVs, and Airborne Warning and Control Systems.[238]

China and India's military rise will have reawakened Japan as a military state. Japan is already deploying a space-based intelligence network, integrating into the U.S. ballistic missile defense shield, and upgrading maritime security capabilities of China's uneasy partners.[239] As China and India's military capabilities and roles expand, Japan will be forced to develop itself into a major power capable of defending itself and its partners militarily. But the development of China's and India's overall capabilities is not assured. After all, they suffer from inequality, uneven growth, rapid urbanization, gender imbalances, water scarcity, environmental degradation, social unrest, terrorism, and insurgencies—enough potentially to derail their trajectories.[240]

Meanwhile, climate change will present a major challenge for the region, as its heavily populated coastal zones will face a major risk of flooding and destruction due to storm surges and sea level rises in the coming decades. Societies in China, Malaysia, and the Philippines already view climate change as their top threat. Those in Indonesia, Japan, and South Korea put it in their top three. Air population is another challenge. Of the 25 most polluted cities, 15 are in South Asia, and more than 20 cities in India "enjoy" air quality worse than the "suffocating" Beijing.[241] Expect this to worsen in the medium term as the rest of China, India, and Southeast Asia urbanize, and time passes before relevant policies and technologies start mitigating the impact.

The Arctic and Antarctica. By 2035-2050, parts of the Arctic may have ice-free summers, allowing for seasonal maritime and trade activities in and through the region.[242] Passage through the ocean will offer the shortest shipping distance between Asia and the West, facilitating trade, transit, and development of carbon and other resources. Nikolai Patrushev, a secretary of the Russian Security Council, asserted that Russia must turn the Arctic into its "main strategic resource base," admitting the possibility of military conflict over the area as the regional military competition and territorial disputes grow. Russia considers the Arctic key to its military strategy to ensure a second-strike capability, especially as hypersonic missiles, lasers, and missile defense systems continue to receive the attention of major powers. In the coming decades, expect more military deployments as part of yet another period of the region's militarization, once marked by rocket launch warning systems, nuclear submarines, spy planes, and strategic aviation bases during the Cold War.[243]

Russia, Canada, Denmark, and Norway will treat parts of the Arctic as their territorial or internal waters. This is in opposition to the United States, Sweden, Iceland, and Finland that will view the area as a free navigation space. An already revived conflict over the status of the North Pole will grow. In 2007, while Denmark was contesting Canada's claim, Russia planted its flag under the North Pole.[244] Russia, the United States, Canada, Denmark, Iceland, Norway, Finland, and Sweden will continue upgrading their military and coast guard capabilities in the region.[245] But it is the growing involvement of non-Arctic powers that will mark a major departure in the region. Of the likely candidates, China will stand out as the global trading power playing a key commercial and geopolitical role.

After all, the region's deposits reportedly contain more than 90 billion barrels of oil, 1,700 trillion cubic feet of natural gas, and 44 billion barrels of liquid natural gas.[246]

The geopolitical importance of Antarctica will also grow, manifesting in increased interest from Russia, China, and claimant states (Australia, New Zealand, Norway) amid climate change.[247]

The Global Commons. Climate change, resource scarcity, enhanced global interactions, and military and technological advances will increasingly prompt countries to venture into the Global Commons—the high seas, the atmosphere, Antarctica, cyber, and outer space. The last decades already have witnessed an accelerating development, use, and exploitation of the Global Commons.[248] This trend will only accelerate, as many more countries leverage their larger economic and military capabilities to pursue wealth and status beyond their borders. Coastal and increasingly offshore development will be wider and deeper in scale, whether in the field of ocean farming,[249] carbons development, or territorial enlargement. Meanwhile, piracy and terrorism will prompt further militarization of the high seas,[250] while growing trade flows will make the freedom of navigation an even more important pillar of global security, one that China and India, not just the United States, will defend. As a result, all the Global Commons will see new rule sets emerge regulating activities of state and nonstate actors. Cyber, space, and the high seas will exhibit a larger potential for militarization and, by implication, interstate frictions or wars in the coming decades.

Implications for the Global Operational Threat Environment and the U.S. Military

Parts of the Middle East, Africa, and Eurasia will continue to have fragile or broken governance systems, marked by civil wars, proxy conflicts, resource wars, climate change-induced stresses, and terrorist activities. This means we are in for another century of occasional interventions, increasingly of humanitarian nature and led by non-Western powers. The Indo-Asia-Pacific will see an unprecedented level of interstate tensions, nationalism, and conflicts.[251] Now a major global power, India will be a key actor in the strategic rivalry unfolding in the area and involving the United States and Japan on the one hand, and China on the other. Meanwhile, smaller states will seek security reassurances from the former without upsetting the latter—an increasingly difficult act.

In addition to geographic areas, an especially intense rivalry will play out in cyber, space, and the Global Commons, as countries leverage enhanced economic and military capabilities to advance their objectives and jostle over markets, resources, opportunities, and sources of influence. While the U.S. position will decline in all geographic and functional areas, the United States will retain a more comprehensive suite of capabilities positioning it as the ultimate global leader, one that nevertheless will share and compromise more than ever before. The U.S. military will be prompted to develop and rely more on its capabilities in cyber, space, the Arctic, and the Global Commons, while paying greater attention to the Indo-Asia-Pacific.

Despite concerns about Russia's adventures on the EU's doorstep, the U.S. military posture in Europe will dwindle, partly because it will have a tightened purse and partly because it will be forced to use the freed-up

resources to manage the evolving security order in the Indo-Asia-Pacific. In the Middle East, its posture will become lighter, as the U.S. military downgrades the status and decreases the number of permanent military facilities. In Central Asia, rotational forces and prepositioned equipment and supplies will define its posture, but Russia's and, increasingly, China's presence will deny it a robust military role. In Africa and Latin America, small and specialized forces will continue to be the hallmarks of the U.S. presence.[252] But China's growing military partnerships with Latin American states will prompt a shift to a more scaled U.S. regional military presence. Meanwhile, European and Asian partners and rivals will increasingly seek military bases and pursue interventions in parts of Africa and the Middle East.

As it recalibrates its military posture, the United States will increasingly rely on its allies to manage regional orders, especially in the Indo-Asia-Pacific where it will welcome more dynamic security and geopolitical roles by Japan, India, and potentially Indonesia and Malaysia. Meanwhile, a new global operational threat environment and strategic landscape will force the reshaping of NATO. The 21st century's geopolitical dynamics will make it or break it. The alliance might remain the strongest security bloc, but in a different format and with a different set of missions, certainly in the age of fiscal constraints and calls for rejuvenation and agreed burden-sharing to address the emerging threats. If it does, it might even have new members from Southeast Asia.

At a minimum, expect NATO members to pursue situational relations with non-members on a case-by-case basis, with such flexibility at times harming the standing of the alliance and at times helping it achieve better outcomes through missions increasingly

emphasizing urban, humanitarian, rule of law, reconstruction, cyber, space, and special operations. The U.S. military will be building its distributed sensor and interceptor architecture, linking its capabilities with allies and partners within and outside NATO's framework.[253] It will also seek to strengthen the allies militarily and cultivate new friends while developing a global ballistic missile defense (BMD) architecture, directed energy systems, cyber, and space measures to offset adversaries' capabilities.[254]

Recommendations for the U.S. Department of Defense, Department of State, and the Military

- Identify the rising stars and underperformers, and concentrate resources on helping shape the foreign policy conduct of the former and internal policy conduct of the latter.
- Enhance ties with Mexico, Brazil, Canada, Iran, India, and Japan to shape geopolitical dynamics in the Middle East, South America, the Arctic, and the Indo-Asia-Pacific.
- Support the economic and security integration initiatives/institutions in Europe and Asia.
- Work with China, India, Pakistan, and Iran to promote trans-Eurasian economic connectivity by supporting the development of Afghanistan and Central Asian states.
- In coordination with partners and allies, advance trade, transit, and resources exploration rules while addressing the risks of militarization and lingering disputes in/over the Arctic.
- Promote WMD and ballistic missile non-proliferation and slow down the militarization of the

Middle East, the Arctic, the Indo-Asia-Pacific, and the Global Commons.

- Recalibrate the military posture by developing and deploying enhanced assets and capabilities in the Arctic, the Indo-Asia-Pacific, cyber, space, and the Global Commons.
- Encourage allies to play a more autonomous security role in respective regions while deconflicting relations between Iran and Saudi Arabia; Turkey and Iran, India, and China.
- Shape the rules of conduct/expectations regarding state interventions by non-Western powers, creating deployable culturally-aware teams for reconstruction/rule of law tasks.

Wild Card – From "Cold" to "Hot" – The Coming War over the Arctic

If you thought that space and cyber were the only new areas requiring national resources to exploit and leverage them in pursuit of geopolitical objectives, think again. The Arctic increasingly is drawing in major powers, as climate change opens a new globally significant trade and transit artery via the Arctic Ocean, enabling resource exploration and exploitation. Anticipating this monumental shift, major regional and, importantly, outside powers start pursuing political, economic, military, and security mechanisms to stake their claims and solidify their positions before competition denies them the anticipated fruits of climate change. Increasingly, new legal regimes emerge, national economic and military activities intensify, and economic and military alliances and partnerships become more pronounced. But while laws are established and rules start regulating the local areas of economic activity, latent disputes over territory occasionally erupt like a volcano, turning the "cold" into "hot." Russia and China find themselves up against the United States, Japan, and some EU members, with military collisions and harassment of civilian and military vessels turning the Arctic into yet another South China Sea. Either by a miscalculation or design, a military encounter in the Arctic waters between a Russian and a Canadian ship results in a brief military exchange. As a NATO member, the United States wishes to assist, but going up against nuclear-armed Russia is a no-go. A great war is averted eventually, but skirmishes and economic and legal scrambles continue to flare up, threatening to erupt into a major war.

TOWARD A STAND-READY, POST-MODERN MILITARY

> We are made wise not by the recollection of the past but by the responsibility for the future. . .[255]
>
> – *ZOO*

> . . . plans are useless, but planning is indispensable.[256]
>
> – *President Dwight D. Eisenhower*

The U.S. military of 2050 should be flexible and resilient, capable of navigating rapidly changing dynamics across functional and regional spectrums defining the global operational threat environment and strategic landscape. Otherwise, protecting U.S. interests in a reformatted and continuously evolving world will be a fruitless enterprise, one that will hasten the perceived decline of the United States as the greatest military power the world has ever known. The U.S. military should thus understand, adapt, and prepare for the implications from the demographic, environmental, socio-economic, political, technological, military, and region-specific dynamics.

As far as the demographic trends, the population growth in the industrialized states will reverse or slow down. Parts of Africa, the Middle East, and Southeast Asia will have large and youthful populations. In North America, Europe, and East Asia, populations will grow even older. Internal and external migration flows will increase, just as the population growth in poor countries will be susceptible to climate change. Urbanization will reach unprecedented levels. Local governance systems will be under considerable pressure: some will collapse and invite interventions, others will have to be more inventive to make it through. Aging could bring more peace at the expense of economic

dynamism, while youth bulges could be a blessing or a curse subject to the performance of local polities. The protection of cities will rise in importance, as local and overseas civilian and military agencies join forces to protect civilian targets. The U.S. and other militaries will rely more on technologies, recruitment of women, and lenient immigration rules to field their forces as recruitment pools shallow due to aging populations. The U.S. military will need to foster new alliances for peacekeeping operations in countries with weak governance and youth bulges, as well as enhance civilian and military protection systems for cities at home.

In terms of the environmental trends, climate change effects, resource consumption and depletion, and water scarcity will become more profound and widespread, despite new environmental management solutions. Some areas will experience more conflict, population displacement, and refugees' migration due to food supply disruptions, hurricanes, storms, and rising sea levels. Taken together, these factors might overwhelm the capabilities of military and security institutions in select countries, certainly in the case of a major flooding impacting megacities in Southeast Asia, straining the response capacities of more prepared ones.

Humanitarian operations will grow in numbers, just as interventions to access strategic resources, especially water and rare earth minerals. Virtual water trade will help some, but not all countries. The U.S. military will need to develop climate change risk management frameworks involving closer coordination between domestic and overseas military and civilian agencies; pinpoint areas with the highest potential for systemic collapse and formulate related responses; identify areas of strategic resources and develop operational

scenarios for overseas involvement to secure them; define more clearly the legal and operational roles of the U.S. military in responding to humanitarian disasters; and advance climate change-related security and military cooperation.

Regarding the cultural, socio-economic, and political trends, the rebalancing of the global order and power hierarchy will continue (especially as Asian powers advance up the ranks), featuring the converging global economy, democratization, and related counter-pressures. The global energy infrastructure will rely on a wider use of renewables. More powers will assume the role of regional managers, with the United States struggling to shape global agendas. These powers, especially China and India, will propagate their cultures, systems, and tastes. However, "wild cards," such as the collapse of China, should not be ruled out. The complexity of the world will make strategic planning a harder enterprise, with the functional approach to strategic planning becoming more significant due to new technologies, economic sectors, and associated risks.

In these conditions, the United States will still boast the largest arsenal of world management resources, but it will need to create an interagency strategic policy planning unit and increase funding for related research; strengthen the civilian components of military policy as it relates to security, diplomacy, development, and civilian-military partnerships; create culturally-aware teams with expertise in reconstruction and rule of law; and propagate legal regimes on the evolving definition and practice of war and rules of war as part of military-to-military exchanges.

Concerning the technological trends, advances in ICTs, biotechnology, genetic engineering, nano-

technology, robotics, and applied cognitive science will produce a mutated technology revolution that may outdo in impact and extent the agricultural, industrial, and information revolutions. With "singularity" on the cards, nonlinear and disruptive technologies will force rapid transitions of not only the technological, but also cultural and socio-economic systems. Information age and technology proliferation will touch many more corners of the world, enabling more individuals and groups to access more powerful, precise, and long-range weapons and mobilize against government regimes. Meanwhile, the proliferation of autonomous systems, cyber, space, and biotechnologies will expose the military and civilian economies to blackmail and attacks. A global Internet meltdown will be closer to reality. The U.S. military should be able to operate in an emergency network mode if the Internet breaks down; design or refine global rules on disruptive technologies, wars, and special operations missions by factoring in the emerging data-driven warfare and the growing use of autonomous weapons systems; and monitor global technological advancements while fostering R&D collaboration with allies and partners.

Speaking of the military trends, the United States is on the cusp of another military revolution that feeds on revolutions in military affairs and monumental socio-economic, technological, cultural, and political shifts. Expect a more rapid informatization and robotization of forces and war, advances and increased reliance on space and cyber operations and precision and autonomous systems, as well as the emergence of new weapons and enhanced risks of WMD and missile proliferation.

Big interstate wars will become less appealing, and new conflicts and missions will emerge, focusing on

the urban, cyber, space, and civilian protection operations involving smaller and more mobile forces. Information technology will enable the "New American way of War." However, advances in related enemy capabilities will undermine the U.S. "technological overmatch." The militarization and exploitation of space and cyber will increase. Truly autonomous systems will undermine human control and international law, especially given unauthorized and deadly strikes by such systems. Nuclear arms races will intensify due to the increased reliance on space, the nuclearization of civilian economies, and a larger number of actors seeking nuclear capabilities. Increased military capabilities and security risks will prompt a counter-revolution, accompanied by the development of asymmetric military capabilities, legal regimes, and societal responses.

To prepare for these dynamics, the U.S. military should enhance the space and cyber domain adaptation and exploitation; develop a unified theory and practice of joint cross-domain operations; advance decentralization, experimentation, and autonomous approach to military operations; develop low-tech solutions for space and cyber vulnerabilities; increase the experimentation of disruptive technologies (with safeguards); stem the WMD and ballistic missile proliferation; and pursue an advanced global BMD program linking allied capabilities.

As far as the regional trends are concerned, a reformatted and converging global economic architecture will emerge, featuring new winners and losers. More actors will use enhanced economic capabilities to advance their interests, with the United States exercising far less influence. Asia, with China and India as its core, will return to primacy, producing the largest share of the global GDP. Arms races, nationalism, and

disputes over territories, technologies, and access to resources will intensify. China, India, and the United States will be performing a complicated strategic "dance" in the Indo-Asia-Pacific, while global rivalry will intensify in cyber, space, and the Global Commons over new markets, resources, and status. Elsewhere, select countries in the Middle East, Africa, and Eurasia will emerge as success stories. Others will still be prone to civil wars, proxy conflicts, resource wars, climate change-induced stresses, and terrorist activity. Foreign interventions will continue, but non-Western powers will increasingly lead them.

The United States will rely more substantially on its capabilities in the Arctic, cyber, space, and the Global Commons. Its military posture will expand in the Indo-Asia-Pacific and Latin America regions, but will dwindle in Europe and the Middle East. To manage regional security orders better, it will need to invest more in strategic planning resting on regional and functional blocks, while identifying the rising "stars" in all regions early on and enhancing cooperation with old and new partners and allies. It also should support ally and partner integration institutions in Europe and Asia, while promoting Eurasian economic connectivity. It should advance WMD and missile nonproliferation efforts while slowing down the militarization in the Middle East, the Arctic, the Indo-Asia-Pacific, and the Global Commons. Finally, it should deconflict relations between: Iran and Saudi Arabia; Turkey and Iran; India and China; and continue investing in its military capabilities—and those of its allies—to offset military advantages sought by adversaries.

Taking these steps across these major megatrends will position the U.S. military for another run—this

time as a transformed, post-modern, flexible, super expeditionary, and effective force.

ENDNOTES

1. Niels Bohr, quoted in Laurence Smith, *The World in 2050: Four Forces Shaping Civilization's Northern Future*, New York: Dutton, 2010, p. 3.

2. Senator Fred Thompson, quoted in Zalmay Khalilzad and John White, *Strategic Appraisal: The Changing Role of Information in Warfare*, Santa Monica, CA: RAND, p. 7.

3. For in depth discussion, see Peter Bergen and Daniel Rothenberg, eds., *Drone Wars: Transforming Conflict, Law, and Policy,* New York: Cambridge University Press, 2015.

4. For in depth discussion, see Charles D. Lutes and Peter L. Hays, eds., *Toward a Theory of Spacepower: Selected Essays*, Washington, DC: National Defense University Press, 2011.

5. For in depth discussion, see Richmond Lloyd, ed., "Defense Strategy and Forces: Setting Future Directions," William Ruger Chair of National Security Economics Papers, No. 3, Newport, RI: Naval War College, 2007.

6. Sean Lawson, *Nonlinear Science and Warfare: Chaos, Complexity and the U.S. Military in the Information Age*, New York: Routledge, 2014, p. 43.

7. Edward Cornish, *Futuring: The Exploration of the Future*, Bethesda, MD: World Future Society, 2004, p. 121.

8. For more, see *Ibid*.

9. James Canton, *The Extreme Future: The Top Trends That Will Reshape the World for the Next 5, 10, and 20 Years*, New York: Dutton, 2006, pp. 15, 184.

10. T. A. Shakleina and A. A. Baikov eds., *Megatrendy: Osnovnye traektorii evolutsii mirovogo poriyadka v XXI veke (Megatrends: Main Trajectories of the World Order's Evolution in the 21st Century)*, Moscow, Russia: Aspent Press, 2013, p. 20.

11. Anton Chekhov, *Notebook of Anton Chekhov*, New York: B. W. Huebsch, Incorporated, 1921, p. 18.

12. Gary Marcus, professor of psychology and director at the New York University Center for Language and Music, quoted in John Brockman, *What Should We Be Worried About? Real Scenarios That Keep Scientists Up at Night*, New York: Harper Collins, 2014, p. 447.

13. Jack Goldstone, "Demographics and Migration," in Bertelsmann Foundation, *Megatrends in Global Interaction*, Gutersloh, Germany: Verlag Bertelsmann Stiftung, 2012, p. 15. Also, see Kevin Kelly, "The Underpopulation Bomb," in Brockman, p. 117.

14. Shakleina and Baikov, p. 127.

15. John Parker, "Not quite destiny," in Daniel Franklin and John Andrews, eds., *Megachange: The World in 2050*, Hoboken, NJ: John Wiley & Sons, Inc., 2012, p. 18.

16. Smith, pp. 12-13.

17. Kelly, p. 118.

18. Shakleina and Baikov, p. 127.

19. Parker, p. 17.

20. Per Norheim-Martinsen and Tore Nyhamar, "Introduction: Trends and Scenarios in International Military Operations," in Per Norheim-Martinsen and Tore Nyhamar, eds., *International Military Operations in the 21st Century: Global Trends and the Future of Intervention*, New York: Routledge, 2015, p. 7.

21. Goldstone, p. 43.

22. Smith, pp. 40, 49.

23. *Ibid*.

24. Norheim-Martinsen and Nyhamar.

25. Parker.

26. Goldstone, p. 25.

27. Kate Jeffery, "The Loss of Death," in Brockman, p. 230.

28. Smith, p. 48.

29. *Ibid*., p. 49.

30. For more, see Jeffery.

31. Edward Lucas, "Freedom's ragged march," in Franklin and Andrews, p. 129.

32. U.S. National Intelligence Council, *Global Trends: Paradox of Progress*, Washington, DC: National Intelligence Council, Office of the Director of National Intelligence, 2017, p. 10.

33. Smith, pp. 17, 43.

34. Gulbenkian Think Tank on Water and the Future of Humanity, *Water and the Future of Humanity: Revisiting Water Security*, New York: Springer, 2014, p. 210.

35. Goldstone, p. 35.

36. Walter Grayman, Daniel Loucks, and Laurel Saito, eds., *Toward a Sustainable Water Future: Visions for 2050*, Reston, VA: Emerging and Innovative Technology Committee, Environmental and Water Resources Institute of the American Society of Civil Engineers, 2012, p. 371.

37. Gulbenkian Think Tank on Water and the Future of Humanity, p. 210.

38. Goldstone, p. 15.

39. For more, see Franklin and Andrews.

40. Parker, pp. 8-9.

41. Goldstone, p. 16.

42. *Ibid*., p. 20.

43. Brad Allenby, "How to Manage Drones: Transformative Technologies, the Evolving Nature of Conflict, and the Inadequacy of Current Systems of Law," in Bergen and Rothenberg, p. 428.

44. Goldstone, p. 23.

45. *Ibid*., p. 21.

46. *Ibid*., p. 36.

47. Per Norheim-Martinsen, "The New Urban Operations," in Norheim-Martinsen and Nyhamar, p. 150. Also see Alexander William Beadle, "Protection of Civilians as a New Objective in Military Operations," in Norheim-Martinsen and Nyhamar, p. 195.

48. *Ibid*., p. 36.

49. Gulbenkian Think Tank on Water and the Future of Humanity, p. 210.

50. Cornish, p. 46.

51. Grayman *et al*., p. 365.

52. Smith, p. 16.

53. Shakleina, p. 95.

54. U.S. National Intelligence Council, p. 24.

55. Smith, pp. 58-59.

56. *Ibid*., p. 54.

57. *Ibid*., p. 94.

58. U.S. National Intelligence Council, p. 24.

59. Shakleina and Baikov, p. 97.

60. Smith, p. 14.

61. Steve Aiken, "Asian Futures 2030: Global Strategic Trends – Alternative Scenarios," in Ajey Lele and Namrata Goswami, eds., *Imagining Asia in 2030: Trends, Scenarios, and Alternatives*, New Delhi, India: Academic Foundation and Institute for Defence Studies and Analyses, 2011, p. 566.

62. Grayman *et al*., p. 371.

63. U.S. National Intelligence Council, 2017, p. 10.

64. *Ibid*., pp. 126, 137-138.

65. Stephen Brown and Joel Darmstadter, "Energy and Natural Resources," in Bertelsmann Foundation, p. 166.

66. Grayman *et al*., p. 46.

67. Shakleina and Baikov, p. 97.

68. Uttam Kumar Sinha, "Water Security in Asia 2030: A Look at Indus and Ganga-Brahmaputra-Meghna River Basins," in Ajey Lele and Namrata Goswami, eds., *Imagining Asia in 2030: Trends, Scenarios, and Alternatives*, New Delhi, India: Academic Foundation and Institute for Defence Studies and Analyses, 2011, p. 28.

69. *Ibid.*

70. U.S. National Intelligence Council, p. 24.

71. Gulbenkian Think Tank on Water and the Future of Humanity, p. 207.

72. Smith, p. 112.

73. Robert Shiller, "The Risks of the Next Century and Their Management," in Ignacio Palacios-Huerta, ed., *In 100 Years: Leading Economists Predict the Future*, Cambridge, MA: The MIT Press, 2013, p. 131. Also see Wolfgang Cramer and Katrin Vohland, "Biodiversity and Climate Change," in Bertelsmann Foundation, p. 122.

74. Goldstone, p. 41. Also, see Cramer and Vohland, p. 121.

75. Goldstone, p. 43. Also see Matt Ridley, "Of predictions and progress: more for less," in Franklin and Andrews, p. 268.

76. U.S. National Intelligence Council, pp. 23-24.

77. For more, see Lele and Goswami.

78. Michael O'Hanlon and David Petraeus, "America's Awesome Military and How to Make It Even Better," *Foreign Affairs*, September/October 2016, available from *https://www.foreignaffairs.com/articles/americas/2016-07-22/america-s-awesome-military*, accessed August 19, 2016.

79. Lawrence Freedman, "The Counterrevolution in Strategic Affairs," in David Kennedy, ed., *The Modern American Military*, New York: Oxford University Press, 2013, p. 37.

80. Smith, p. 99.

81. *Ibid.,* pp. 97, 119.

82. Shakleina and Baikov, p. 69.

83. Simon Cox, "The age of emerging markets," in Franklin and Andrews, p. 157. Also see Zanny Minton Beddoes, "The great levelling," in Franklin and Andrews, p. 182.

84. Shakleina and Baikov, p. 289.

85. Jeffrey Legro, "A 'Return to Normalcy'? The Future of America's Internationalism," in Daniel Drezner, ed., *Avoiding Trivia: The Role of Strategic Planning in American Foreign Policy*, Washington, DC: Brookings Institution Press, 2009, p. 60.

86. Lawson, p. 7.

87. Charles Burton, "Scenarios for China's Role in a Post-American World," in Sean Clark and Sabrina Hoque, eds., *Debating a Post-American World: What Lies Ahead?* New York: Routledge, 2012, pp. 99-104.

88. Aiken, p. 567.

89. Cox, p. 157. Also see Laza Kekic, "Globalisation, growth, and the Asian century," in Franklin and Andrews, pp. 169, 179.

90. Cox, p. 157. Also, see Kekic, pp. 176-179.

91. U.S. National Intelligence Council, p. 177.

92. Beddoes, pp. 182-186. Also, see Cornish, p. 24.

93. Daron Acemoglu, "The World Our Grandchildren Will Inherit," in Palacios-Huerta, p. 27.

94. Aiken, p. 566.

95. Adrian Wooldridge, "Schumpeter Inc," in Kekic, p. 197.

96. Brown and Darmstadter, p. 159.

97. Shakleina and Baikov, pp. 91, 258.

98. Wooldridge, p. 196.

99. U.S. National Intelligence Council, pp. 180-181.

100. Shakleina and Baikov, p. 251.

101. For more, see Lucas.

102. U.S. National Intelligence Council, pp. 18-19.

103. Gulbenkian Think Tank on Water and the Future of Humanity, p. 209.

104. International Energy Agency, *Energy to 2050: Scenarios for a Sustainable Future,* Paris: OECD, 2003, p. 62.

105. Shakleina and Baikov, pp. 61, 265. Also see Matthew Symonds, "The future of war: the weak become strong," in Franklin and Andrews, p. 116.

106. Canton, pp. 39-40. Also see Smith, pp. 63, 67.

107. See U.S. National Intelligence Council, p. 16.

108. Aiken, p. 566.

109. International Energy Agency, p. 76.

110. *Ibid*., p. 90.

111. *Ibid*., p. 74.

112. *Ibid*., p. 63.

113. Symonds, p. 113.

114. Gary Shilling, "The Dollar Will Remain on First," in Sara Eisen, ed., *Currencies After the Crash: The Uncertain Future of the Global Paper Currency System*, New York: The McGraw-Hill Companies, 2013, p. 21.

115. Shakleina and Baikov, p. 260.

116. *Ibid*., p. 61.

117. Daniel Drezner, "The Challenging Future of Strategic Planning in Foreign Policy," in Drezner, p. 6. Also, see Richard Haass, "Planning for Policy Planning," in Drezner, pp. 25-27.

118. Drezner, p. 16. Also, see Bruce Jentleson, "An integrating Executive Branch Strategy for Policy Planning," in Drezner, p. 69. Also, see Aaron Friedberg, "Strengthening U.S. Strategic Planning," in Drezner, p. 84.

119. Drezner, p. 13.

120. Shakleina and Baikov, p. 77.

121. For more, see Roy Godson and Richard Shultz, *Adapting America's Security Paradigm and Security Agenda*, Washington, DC: National Strategy Information Center, 2011.

122. Henrik Friman and Susan Higgins, "The Influence of the Information Age," in Scott Jasper, ed., *Transforming Defense Capabilities: New Approaches for International Security*, London, UK: Lynne Rienner Publishers, 2009, p. 45. Also, see Shakleina and Baikov, p. 288.

123. Samuel Issacharoff and Richard Pildes, "Drones and the Dilemma of Modern Warfare," in Bergen and Rothenberg, p. 410. Also, see Allenby, pp. 428-429.

124. Cornish, pp. 15-20.

125. Canton, p. 51. Also, see Benjamin Wittes, "Global Security," in Bertelsmann Foundation, p. 61.

126. Cornish, p. 12.

127. Allenby, pp. 426-427.

128. Symonds, p. 117. Also, see Kenneth Cukier, "The web of knowledge," in Franklin and Andrews, pp. 243-246.

129. Wittes, p. 64.

130. See U.S. National Intelligence Council, p. 15.

131. Shakleina and Baikov, p. 235.

132. Geoffrey Carr, "What and (where) next for science," in Franklin and Andrews, p. 222.

133. Cornish, p. 30.

134. Canton, p. 43.

135. U.S. National Intelligence Council, p. 16.

136. Allenby, pp. 426-427.

137. Ludwig Siegele, "Distance is dead, long live location," in Franklin and Andrews, pp. 260-261.

138. Carr, p. 221. Also see Cukier, p. 251; and Max Tegmark, "Will There Be a Singularity within Our Lifetime?" in Brockman, p. 32.

139. Cukier, p. 253.

140. Tegmark, p. 32.

141. Shakleina and Baikov, p. 404.

142. Friman and Higgins, p. 43.

143. S.T. Johnsen, "Cyber Operations," in Norheim-Martinsen and Nyhamar, p. 185.

144. Norheim-Martinsen and Nyhamar, p. 12.

145. Johnsen, p. 184.

146. P. W. Singer, "The Five Deadly Flaws of Talking About Emerging Military Technologies and the Need for New Approaches to Law, Ethics, and War," in Bergen and Rothenberg, p. 224.

147. Wittes, p. 55.

148. William Doll, "The Future and the Army After Next: A Contextual Framework for the Future," in Earl Tilford, Jr., ed., *World View: The 1998 Strategic Assessment from the Strategic Studies Institute*, Carlisle, PA: Strategic Studies Institute, U.S. Army War College, 1998, p. 10.

149. Johnsen, pp. 190-191.

150. *Ibid*., p. 71.

151. Singer, pp. 215-216, p. 222. Also, see Allenby, p. 428.

152. Peter Bergen and Jennifer Rowland, "World of Drones: The Global proliferation of Drone Technology," in Bergen and Rothenberg, p. 302.

153. Scott Barrett, "Economic Globalization," in Bertelsmann Foundation, p. 203.

154. *Ibid*., p. 300. Also see Werner Dahm, "'Drones': Now and What to Expect over the Next Ten Years," in Bergen and Rothenberg, p. 349.

155. Singer, p. 219. Also, see Dahm, p. 349.

156. Committee on Globalization of Science and Technology: Opportunities and Challenges for the Department of Defense, *Strategic Engagement in Global S&T: Opportunities for Defense*

Research, Washington, DC: The National Academies Press, 2014, pp. 1, 23.

157. Allenby, p. 431.

158. Williamson Murray and MacGregor Knox, "Conclusion: The Future Behind Us," in MacGregor Knox and Williamson Murray, eds., *The Dynamics of Military Revolution: 1300-2050*, Cambridge, MA: Cambridge University Press, 2001, pp. 176-179.

159. Daniel Moran, "On Military Revolution," in Jasper, p. 29. Also see Thomas Mahnken, "Weapons: The Growth and Spread of the Precision-Strike Regime," in Freedman, p. 60.

160. O'Hanlon and Petraeus.

161. Allenby, p. 430.

162. Jasper, pp. 11-5.

163. Lawson, pp. 12, 44-46.

164. Friman and Higgins, pp. 44, 51. Also, see Scott Jasper, "Measuring Progress," in Jasper, pp. 210-211.

165. U.S. National Intelligence Council, pp. 7, 221.

166. Murray and Knox, pp. 181-191.

167. Quoted in Lawson, p. 1.

168. Martin Libicki and Jeremy Shapiro, "Conclusion: The Changing Role of Information in Warfare," in Khalilzad and White, p. 439.

169. Carl Builder, "The American Military Enterprise in the Information Age," in Khalilzad and White, p. 21.

170. *Ibid*., p. 20.

171. Robert Pfaltzgraff, Jr., "International Relations Theory and Spacepower," in Lutes and Hays, p. 40. Also see Henry Hertzfeld, "Commercial Space and Spacepower," in Lutes and Hays,

p. 215. Also see Simon Worden, "Future Strategy and Professional Development: A Roadmap," in Lutes and Hays, pp. 319-340.

172. Carr, pp. 222-230.

173. U.S. National Intelligence Council, p. 157.

174. Shakleina and Baikov, p. 405. Also, see Michael O'Hanlon, "Balancing U.S. Security Interests in Space," in Lutes and Hays, p. 142.

175. O'Hanlon, p. 143.

176. John Sheldon and Colin Gray, "Theory Ascendant? Spacepower and the Challenge of Strategic Theory," in Lutes and Hays, p. 6. Also, see Carr, p. 235. Also, see Lutes and Hays, p. xvii.

177. Friman and Higgins, p. 41.

178. Mahnken, p. 73.

179. O'Hanlon and Petraeus. Also, see Stephen Lukasik, "To What Extent Can Precision Conventional Technologies Substitute for Nuclear Weapons?" in Henry Sokolski, ed., *The Next Arms Race*, Carlisle, PA: Strategic Studies Institute, U.S. Army War College, 2012, pp. 387-388.

180. Dahm, pp. 354-355.

181. Singer, pp. 215-216. Also, see Jasper, "Measuring Progress," p. 210.

182. Dahm, p. 353; Also see Jasper, "Measuring Progress," p. 217.

183. Symond, p. 121.

184. Dahm, pp. 352-353.

185. Alvin Roth, "In 100 Years," in Palacios-Huerta, p. 117.

186. Shiller, p. 134.

187. Singer, p. 223.

188. Mahnken, p. 74.

189. U.S. National Intelligence Council, p. 219.

190. Henry Sokolski, "A Hardheaded Guide to Nuclear Controls," in Sokolski, p. 469.

191. Symond, p. 124.

192. Jeff Kueter, "Missile Defense and Arms Control," in Sokolski, p. 427.

193. Thomas Graham, "Nuclear Weapons Stability or Anarchy in the 21st Century: China, India, and Pakistan," in Sokolski, p. 277.

194. Freedman, p. 28.

195. Allenby, p. 427.

196. Norheim-Martinsen, p. 17. Also, see Iver Johansen, "Special Operations Forces," in Norheim-Martinsen and Nyhamar, pp. 105, 113.

197. O'Hanlon and Petraeus.

198. Norheim-Martinsen and Nyhamar, p. 13.

199. Builder, pp. 21, 42.

200. Daniel Rothenberg, "Drones and the Emergence of Data-Driven Warfare," in Bergen and Rothenberg, pp. 444-446, 458.

201. Brian McAllister Linn, "The U.S. Armed Forces' View of War," in Freedman, p. 46.

202. Zalmay Khalilzad and John White, "Introduction," in Khalilzad and White, p. 12.

203. Symonds, p. 117.

204. *Ibid*., pp. 120-121.

205. Everett Dolman and Henry Cooper, "Increasing the Military Uses of Space," in Lutes and Hays, pp. 104-105. Also see

Michael Krepon, Theresa Hitchens, and Michael Katz-Hyman, "Preserving Freedom of Action in Space: Realizing the Potential and Limits of U.S. Spacepower," in Lutes and Hays, p. 120. Also, see O'Hanlon, p. 145. Also see Benjamin Lambeth, "Airpower, Spacepower, and Cyberpower," in Lutes and Hays, pp. 162-163.

206. Mark Stokes and Ian Easton, "China and the Emerging Strategic Competition in Aerospace Power," in Sokolski, p. 151.

207. Krepon, Hitchens, and Katz-Hyman, p. 124. Also, see Lambeth, 163.

208. Graham, pp. 273, 280.

209. Mahnken, pp. 65-75.

210. Pfaltzgraff, p. 46.

211. Henry Sokolski, "Overview," in Sokolski, p. 1. Also, see Stokes and Easton, pp. 162-163. Also, see Kueter, p. 447.

212. Michael Mazza and Dan Blumenthal, "China's Strategic Forces in the 21st Century: The People's Liberation Army's Changing Nuclear Doctrine and Force Posture," in Sokolski, pp. 84-85.

213. See U.S. National Intelligence Council, p. 41.

214. Singer, pp. 215-219.

215. Libicki and Shapiro, p. 442.

216. Goldstone, p. 20.

217. Smith, p. 41.

218. *Ibid*., p. 43.

219. Shakleina and Baikov, p. 273.

220. *Ibid*., p. 329.

221. *Ibid*., p. 364.

222. U.S. National Intelligence Council, p. 145.

223. *Ibid*., pp. 316, 358.

224. For more, see Roman Muzalevsky, *Central Asia's Shrinking Connectivity Gap: Implications for U.S. Strategy*, Carlisle, PA: Strategic Studies Institute, U.S. Army War College, November 2014.

225. Roman Muzalevsky, "China's Long March into Central Asia," *Stratfor*, April 27, 2016.

226. For more on Russia's Central Asia strategy, see Roman Muzalevsky, "Russia's Strategy in Central Asia: Analysis of Key Trends," *Yale Journal of International Affairs*, 2009. For more on India's Central Asia strategy, see Roman Muzalevsky, "India's 'Connect Central Asia' Policy Seeks to Compensate for Lost Time," *Eurasia Daily Monitor*, September 27, 2012. For more on the U.S. Central Asia strategy, see "U.S. Central Asian Relations: Going Beyond Afghanistan," *Eurasia Daily Monitor*, January 20, 2010.

227. For more on the roles of China and India in advancing connectivity in and through Afghanistan, see Roman Muzalevsky, *Unlocking India's Strategic Potential in Central Asia*, Carlisle, PA: Strategic Studies Institute, U.S. Army War College, October 2015; Roman Muzalevsky, "China's Security Ambitions in South and Central Asia," *Stratfor*, March 18, 2016; Roman Muzalevsky, "The Economic Underpinnings of China's Regional Security Strategy in Afghanistan," *Eurasia Daily Monitor*, April 19, 2010; and Roman Muzalevsky, "India Seeks To Project Power In and Out of Central Asia," *Eurasia Daily Monitor*, October 17, 2011.

228. U.S. National Intelligence Council, p. 119.

229. For more on Iran, see Roman Muzalevsky, *From Frozen Ties to Strategic Engagement: U.S.-Iranian Relations in 2030*, Carlisle, PA: Strategic Studies Institute, U.S. Army War College, November 2014. For more on Turkey, see Roman Muzalevsky, "Turkey's New Foreign Policy in the New World," *The American Diplomacy*, Duke University: Durham, NC: Triangle Institute for Security Studies, April 2012.

230. Richard Russell, "The Middle East's Nuclear Future," in Sokolski, p. 179.

231. *Ibid*., p. 180. Also, see Graham, p. 266.

232. See U.S. National Intelligence Council.

233. For more, see Liu Mingfu, *The China Dream: Great Power Thinking and Strategic Posture in the Post-American Era*, New York: CN Times Books, Inc., 2015, p. 94.

234. Namrata Goswami, "Is Conflict Inevitable between the Great Power in Asia in 2030?" in Lele and Goswami, pp. 540. Also, see Aiken, pp. 570-577.

235. Aiken, pp. 570-577.

236. For more on China, see Roman Muzalevsky, *China's Rise and Reconfiguration of Central Asia's Geopolitics: A Case for U.S. "Pivot" to Eurasia*, Carlisle, PA: Strategic Studies Institute, U.S. Army War College, 2015. For more on India, see Roman Muzalevsky, *Unlocking India's Strategic Potential in Central Asia*, Carlisle, PA: Strategic Studies Institute, U.S. Army War College, 2015. Also, see Namrata Goswami, p. 540; and Aiken, pp. 570-577.

237. O'Hanlon and Petraeus.

238. Stokes and Easton, pp. 142-146, 158-160.

239. *Ibid*., pp. 155-157.

240. Aiken, pp. 570-577.

241. U.S. National Intelligence Council.

242. Smith, p. 157. Also, see Cramer and Vohland, p. 97.

243. Smith, pp. 148, 156. Also, see Shakleina and Baikov, p. 394.

244. Shakleina and Baikov, p. 395.

245. Smith, p. 149.

246. U.S. National Intelligence Council, p. 151.

247. *Ibid*., p. 152.

248. Shakleina and Baikov, p. 367.

249. Cornish, p. 35.

250. Shakleina and Baikov, p. 365.

251. Freedman, p. 37.

252. Michael Lostumbo, Michael McNerney, Eric Peltz, Derek Eaton, David Frelinger, Victoria Greenfield, John Halliday, Patrick Mills, Bruce Nardulli, Stacie Pettyjohn, Jerry Sollinger, and Stephen Worman, *Overseas Basing of U.S. Military Forces, An Assessment of Relative Costs and Strategic Benefits,* prepared for the Office of the Secretary of Defense, Santa Monica, CA: RAND, 2013, p. 288.

253. Symonds, p. 123. Also, see Avinash Dixit, "The Cone of Uncertainty of the 21st Century's Economic Hurricane," in Palacios-Huerta, p. 51.

254. Stokes and Easton, p. 152.

255. Quote of ZOO, in George Bernard Shaw, Act I, "Tragedy of an Elderly Man, Act I," *Back to Methuselah: A Metabiological Pentateuch*, Part IV, 1921, available from *www.gutenberg.org/ebooks/13084*.

256. President Dwight D. Eisenhower, as quoted in Friedberg, p. 85.

APPENDIX

CLIMATE CHANGE, WATER, AND RESOURCE SCARCITY

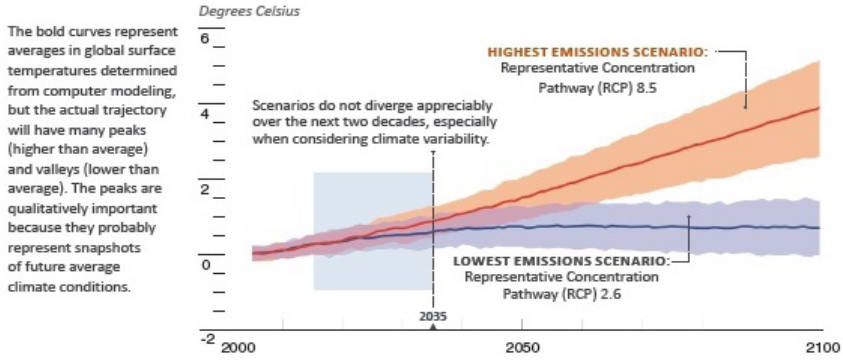


Figure A-1. Projected Average Surface Temperature Change.[1]

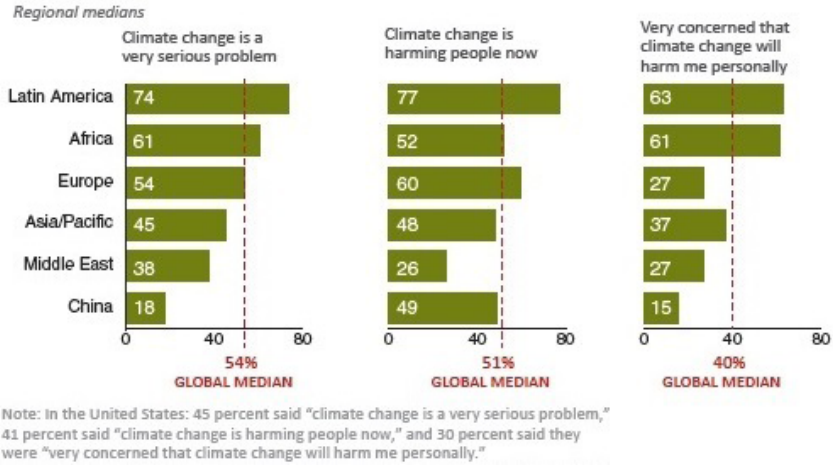


Figure A-2. Latin America and Africa are More Concerned about Climate Change Compared with Other Regions.[2]

MILITARY AND CONFLICT TRENDS

TRADITIONAL FORMS OF WARFARE	EMERGING FORMS OF WARFARE
Use of military force	Increasing use of nonmilitary and covert means
Targeting of enemy forces	Targeting of enemy perceptions, society
Direct clash of militaries	Remote strikes using standoff precision weapons, robotic systems, and information attacks
Destruction of military personnel and weaponry	Destruction of critically important military and civilian infrastucture
Deterrence by fear of retaliation	Deterrence by fear of escalation
Winning by defeating the enemy on the battlefield	Winning by distrupting the support systems (political, economic, information, etc.) on which the enemy military depends

Figure A-3. The Changing Character of Warfare.[3]

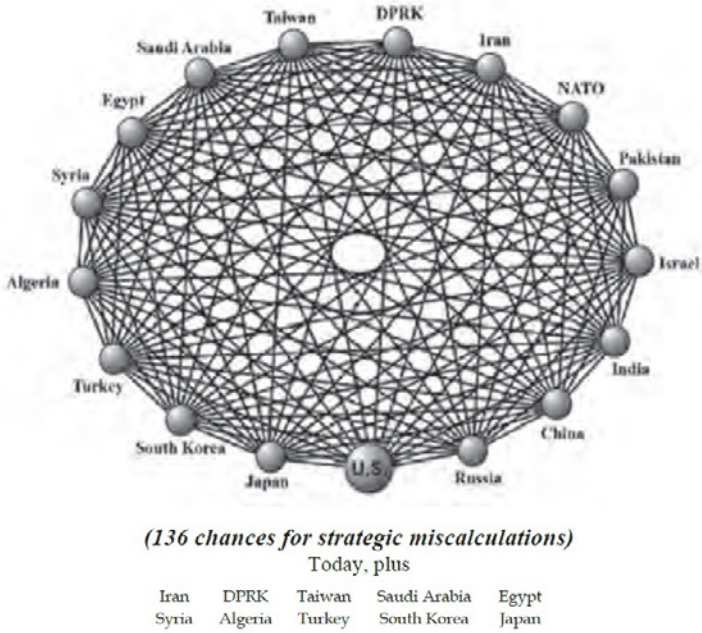


Figure A-4. Possible Proliferated Future.[4]

ECONOMIC DEVELOPMENT TRENDS

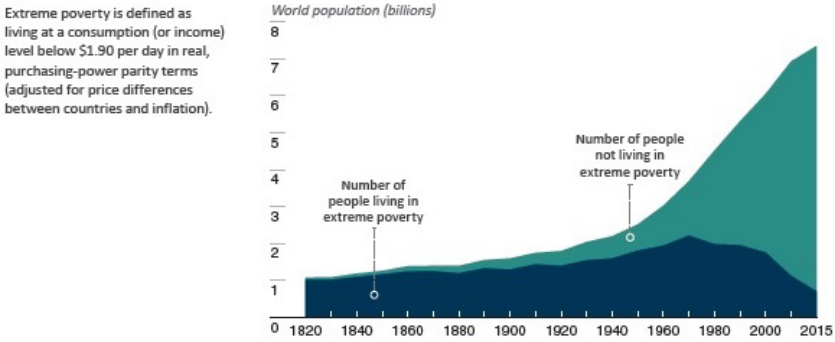


Figure A-5. World Population Living in Extreme Poverty, 1820-2015.[5]

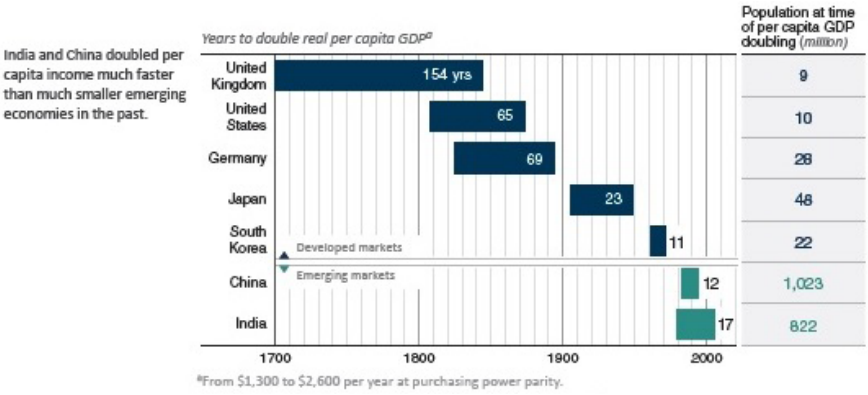


Figure A-6. In Emerging Economies, Incomes Are Rising Faster, and at a Greater Scale, than at Any Point in History.[6]

Research and Development (R&D) Investment—by Country or Region	USD Billion
The United States	403.7
EU-27	294.2
Japan	148.7
South Korea	43.9
China	120.8

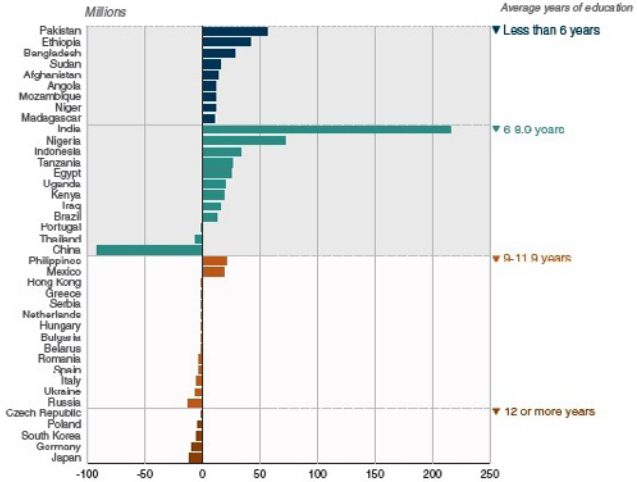
Table A-1. Investments by Country or Region in Research and Development (R&D).[7]

POPULATION AND AGING TRENDS

The world's working-age population will grow the most in South Asian and African countries, where education levels are among the lowest—putting them at a disadvantage in the evolving global economy, which will favor higher-skilled workers.

The biggest working-age decreases will be in China and in Europe, where employment opportunities will probably be greatest for skilled laborers and service-sector workers.

Worldwide, low-value-added manufacturing—historically the steppingstone to economic development for poor countries, and a pathway to prosperity for aspiring workers—will tend toward needing ever-fewer unskilled workers as automation, artificial intelligence, and other manufacturing advances take effect.



Note: The 40 countries highlighted in this chart are the countries with the largest increases and largest decreases of working-age population, in absolute numbers.

Figure A-7. Estimated Change in the Working Age (15-64) Population 2015-2035, Selected Countries.[8]

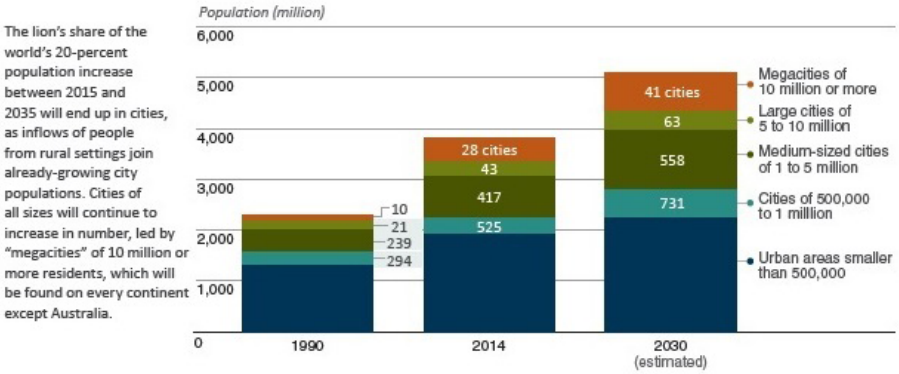


Figure A-8. Global Urban Population Growth is Propelled by the Growth of Cities of All Sizes.[9]

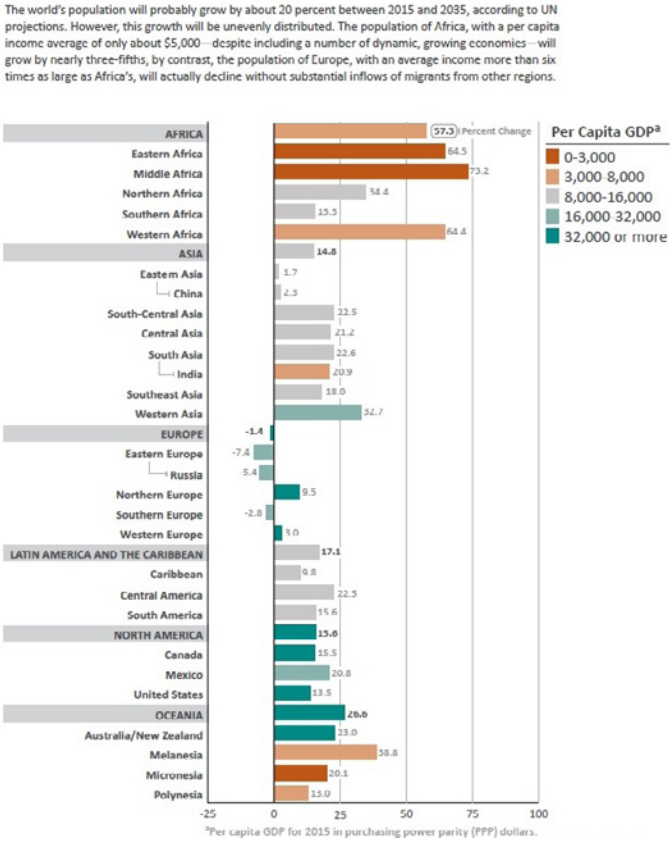


Figure A-9. Population Change by Region, 2015-2035.[10]

ENDNOTES - APPENDIX

1. Image sourced from U.S. National Intelligence Council, *Global Trends: Paradox of Progress*, Washington, DC: National Intelligence Council, Office of the Director of National Intelligence, 2017, p. 22.

2. Image sourced from *Ibid*., p. 23.

3. Image sourced from *Ibid*., p. 221.

4. Image sourced from Henry Sokolski, "Chapter 1: Overview," in Henry Sokolski, ed., *The Next Arms Race*, Carlisle, PA: Strategic Studies Institute, U.S. Army War College, 2012, p. 8.

5. Image sourced from U.S. National Intelligence Council, p. 11.

6. Image sourced from *Ibid*., p. 41.

7. Table data sourced from Nation Science Board, *Science and Engineering Indicators 2012*, Arlington VA: National Science Foundation, 2012; See T. A. Shakleina and A. A. Baikov eds., *Megatrendy: Osnovnye traektorii evolutsii mirovogo poriyadka v XXI veke (Megatrends: Main Trajectories of the World Order's Evolution in the 21st Century)*, Moscow, Russia: Aspent Press, 2013, p. 254.

8. Image sourced from U.S. National Intelligence Council, p. 9.

9. Image sourced from *Ibid*., p. 10.

10. Image sourced from *Ibid*., p. 160.

U.S. ARMY WAR COLLEGE

Major General John S. Kem
Commandant

*****

STRATEGIC STUDIES INSTITUTE
AND
U.S. ARMY WAR COLLEGE PRESS

Director
Professor Douglas C. Lovelace, Jr.

Director of Research
Dr. Steven K. Metz

Author
Mr. Roman Muzalevsky

Editor for Production
Dr. James G. Pierce

Publications Assistant
Ms. Denise J. Kersting

*****

Composition
Mrs. Jennifer E. Nevil

U.S.ARMY

THE UNITED STATES ARMY WAR COLLEGE

STRENGTH and WISDOM

FOR THIS AND OTHER PUBLICATIONS, VISIT US AT

armywarcollege.edu

ISBN 1-58487-767-7

9 781584 877677 90000>

This Publication

SSI Website

USAWC Website