



Potomac Institute for Policy Studies

Science for Policy, Policy for Science

ELEMENTS OF GLOBAL COMPETITION

The Potomac Institute Global Competition Project Compendium

With a Foreword by the Honorable William M. (Mac) Thornberry

Edited by Tim Welter, PhD and Bob Hummel, PhD

With contributions from Potomac Institute for Policy Studies

Board of Regents members, Senior Fellows, and staff

With special acknowledgment to

Global Competition Project event participants

901 N. Stuart Street, Suite 1200
Arlington, Virginia 22203
Phone: (703) 525-0770
Fax: (703) 525-0299
www.potomac institute.org

Disclaimers: The Potomac Institute or Policy Studies cannot be held responsible for errors or any consequences arising from the use of information contained in this publication. The views and opinions expressed do not necessarily reflect those of the Potomac Institute for Policy Studies. The Potomac Institute is non-partisan and does not take part in partisan political agendas.

Copyright 2023, Potomac Institute for Policy Studies

All rights reserved.

The Potomac Institute for Policy Studies is an independent, 501(c)(3), not-for-profit public policy research institute. The Institute identifies and aggressively shepherds discussion on key science and technology issues facing our society. From these discussions and forums, we develop meaningful science and technology policy options and ensure their implementation at the intersection of business and government.

TABLE OF CONTENTS

FOREWORD	III
Meeting Americas Globally Competitive Challenges	iii
<i>The Honorable William M. (Mac) Thornberry</i>	
PREFACE	V
EDITORS	VI
CONTRIBUTING AUTHORS	VII
GCP EVENT PANELISTS/SPEAKERS	VIII
CHAPTER 1: THE POTOMAC INSTITUTE GLOBAL COMPETITION PROJECT (GCP)	1
CHAPTER 2: THE ECONOMIC CONNECTION	4
GCP Event: What is Competition?	4
Maintaining the Competitive Economic and Military Posture of the United States in a Turbulent Era	5
<i>Paper by: The Honorable Alan R. Shaffer</i>	
CHAPTER 3: ECONOMICS AND THE SPECTRUM OF CONFLICT	18
GCP Event: Economics and The Spectrum of Conflict—Is DOD Prepared?	18
US National Security in a New Era of Intense Global Competition	19
<i>Paper by: The Honorable Zachary J. Lemnios</i>	
CHAPTER 4: SUPPLY CHAIN FRAGILITY AND MICROELECTRONICS	30
GCP Event: Us Microelectronics Supply Chains and Competitive Advantage	30
Microelectronics: Supply Chain Challenges With “The New Oil”	31
<i>Paper by: Michael Fritze, PhD</i>	
CHAPTER 5: STRATEGIC COMMUNICATIONS	39
GCP Event: Strategic Communications and Information in Competition	39
Reclaiming the Narrative: The US and International Communications	40
<i>Paper by: Curtis Pearson, Jody Moxham, and Jeffrey “Skunk” Baxter</i>	
CHAPTER 6: THE COMPETITION FOR AN EDUCATED POPULACE	49
GCP Event: Education, 20-Somethings, and Competition	49
Education Of Americans Across Various Generations as a Preparation for Global Competitions	50
<i>Paper by: The Honorable Alan R Shaffer and Trevor Huffard</i>	
CHAPTER 7: SPACE	63
GCP Event: Envisioning Competitive Advantage in the Space Domain	63
A New Vision for Space	64
<i>Paper by: Jerry Krassner, PhD</i>	
The Space Race to Develop New Technologies	68
<i>Paper by: Thomas Messegee and Jessica Kirkpatrick</i>	
CHAPTER 8: COMPETITION FOR ENERGY RESOURCES	72
GCP Event: Energy Advantage—The Cornerstone of 21st Century Security and Prosperity	72
Prospects for US Sources of Energy	73
<i>Paper by: Bob Hummel, PhD and Moriah Locklear, PhD</i>	
CHAPTER 9: AN OPERATIONAL APPROACH TO ADDRESS ADVERSARIAL ECONOMIC ACTIVITIES	81
GCP EWOC Discussions	81
The Concept of an Economic Warfare Operations Capability (EWOC)	82
<i>Paper by: Potomac Institute for Policy Studies Staff</i>	
CHAPTER 10: AMERICAN VALUES	94
The Overarching Goal	94
Values, Strategy, and America’s Competitive Posture	95
<i>Paper by: The Honorable Alan R. Shaffer; Moriah Locklear, PhD; and Tim Welter, PhD</i>	
CHAPTER 11: LOOKING BACK AND LOOKING FORWARD	104
TABLE OF ABBREVIATIONS	111

FOREWORD

MEETING AMERICAS GLOBALLY COMPETITIVE CHALLENGES*

The Honorable William M. (Mac) Thornberry

“The more things change, the more they stay the same,” wrote the French journalist and novelist, Jean-Baptiste Karr more than a century and a half ago. That statement is profoundly true when applied to the many challenges faced by the United States since our founding. Our past trials have included wars, economic depressions, and social upheavals. Through them all, however, a defining characteristic of the United States has been adaptability, which has given us the resiliency needed to withstand the storms of history.

Our ability to adapt is grounded in our Constitution and in our free-market system. The freedoms and practical, innovative problem-solving abilities that they have unleashed in the American people enabled us to persevere and, since the end of World War II, to lead the world in its greatest period of human flourishing ever.

Today, America is again facing a plethora of challenges, and there are doubts about whether we are up to the moment. Some argue that decline is inevitable. But that American spirit of adaptability that has played such a central role in our past success is even more necessary today if we are to remain a globally competitive country and economy. The players, the location, the technology, and the circumstances are different, but the qualities needed to surmount them are largely the same. While uncertainty abounds, four things seem relatively clear.

First, we know that the **world will not get any calmer or quieter anytime soon**. China presents a more significant challenge than any we have met before. Yet, we still must be able to deter or, if necessary, defeat the belligerence of Russia, as well as the threats posed by Iran and North Korea and terrorist organizations. While many are quick to dismiss the possibility of a new Cold War, a process of separation into opposing camps—one of authoritarianism and one of democracy—may well be occurring around the world. Only the US can provide the leadership necessary for democracies to succeed.

Second, the **central battle in this world-wide struggle may well be in the cognitive space**. Technology now allows for instant communication, not only with one’s own citizens but with populations around the world. Authoritarian regimes are quick to use technology to block outside voices, as well as inside voices of dissent. Democracies have to tread carefully to remain consistent with our laws and values. There is ample evidence to show, however, that Russia, China, and others use their resources to create and exploit political differences within the United States and Europe. They also promote messages that support their policies and criticize those which run counter to their interests. Of course, a nation and economy subject to a relentless barrage of falsehoods cannot make good decisions. Even more significantly, if authoritarians can undermine the will of democratic populations to resist, they may triumph without ever firing a shot.

Third, the **infrastructure on which we all depend, both domestically and globally, is at increasing risk**. At home, we are still playing catchup for decades of neglect in building and modernizing infrastructure. Both neglect and malicious cyberattacks reveal vulnerabilities in everything from the electric grid and fuel pipelines to air traffic control and water treatment. And global economic integration has meant we are dependent on those outside our borders for much, as became evident during the COVID pandemic. Our economic competitiveness, as well as our safety and security, depend on a crash effort to understand our exposure and place safeguards and reduce exposures where necessary.

Finally, **the rise of protectionism and populist nationalism risks isolationism in both the economic and political spheres.** When it comes to the economy, history has proven isolationism as one of the biggest impediments to economic development, innovation, productivity and ultimately a country's competitive status. Isolationism also contributes to rising extremism and reduced trust in a nation's political institutions. We too easily forget our own history in which isolationist sentiment after World War I helped bring about the greatest calamity in human history measured by total deaths, namely World War II.

Taking meaningful action to address these and other conditions requires a serious commitment by the United States. Clearly, we should not seek to imitate China but should build upon our own considerable strengths. So while China pursues a 21st century version of mercantilism, an approach with a deep history of failures, our free-market economic system and democratic institutions remain the envy of the world and give us a significant advantage. While we must defend our companies and industries from unfair practices, especially from our adversaries, we must resist excessive government intervention repeating the past errors of others. Those approaches to industrial policy only weaken our ability to adapt. We must strongly counter the forces—domestic or international—that strive to weaken trust in our government and ourselves. And we must resist the temptations of nativism with an immigration policy that works and contributes to our national strength and wellbeing.

We must also shore up our weaknesses. Our educational system lags behind many other countries, both allies and adversaries. Our short-term focus in both government and financial systems undermine our ability to invest for the long run. National leaders who focus more on attacking political adversaries than on offering a positive, hopeful vision for the future fuel our domestic tensions. The siloed nature of our government, lack of leadership, and short-term focus combine to create an aversion to innovation, out-of-the-box thinking, and compromise. On the other hand, partnerships, whether between government and business or among allied nations, offer enormous potential.

Global competition in all domains is as heated as it has ever been. Whether from our adversaries or from our friends, the competition for resources, human and physical, will only get tougher over the coming years. America's historic resiliency stemming from our adaptability in a challenging and ever-changing world must remain strong if we are to meet our obligations at home and abroad and provide the leadership necessary for future success.

*Reprinted here with permission from *Breaking Defense* on March 8, 2023

PREFACE

The Potomac Institute for Policy Studies established the Global Competition Project (GCP) in 2021 to help identify, elevate, and address some of the most vexing societal-level challenges facing the US today. Throughout 2021 and 2022, the Potomac Institute conducted a series of symposia and studies titled the Global Competition Project, which aims to leverage the lens of the global competitive environment to bring contextual relevance to the Institute’s unique science and policy-focused mission and contributions to the nation. The Institute’s work is especially influential at the intersection of prosperity and security by helping to ensure the adoption of the right policies and processes to enable the nation to flourish when faced with the complexities of the dynamic contemporary global landscape.

Events

September 29, 2021	What is Competition?
February 24, 2022	Economics and the Spectrum of Conflict—Is DOD prepared?
November 3, 2021	US Microelectronics Supply Chains and Competitive Advantage
December 1, 2021	Strategic Communications and Information in Competition
January 26, 2022	Education, 20-Somethings, and Competition
March 30, 2022	Envisioning Competitive Advantage in the Space Domain
April 26, 2022	Energy Advantage—The Cornerstone of 21st Century Security and Prosperity
November 30, 2022	Advancing American Competitiveness: Challenges and Opportunities in the Decades Ahead

Compendium

This compendium reviews the GCP’s analyses and results to date and presents a collection of published writings on global competition from the Potomac Institute for Policy Studies’ publication *STEPS: Science, Technology, Engineering, and Policy Studies*, and some original articles that have not previously appeared in Potomac Institute publications. The foreword by the Honorable William “Mac” Thornberry was derived from his keynote address at the November 30, 2022 project event and subsequent publication in *Breaking Defense*.

Acknowledgments

We thank the many participants in the Global Competition Project (GCP), authors who contributed papers, and staff and attendees to Potomac Institute for Policy Studies GCP events. This compendium represents a compilation of discussions and writings by many people. We thank Potomac Institute Chairman of the Board, General Al Gray, USMC (retired); Potomac Institute CEO Jen Buss, PhD; Potomac Institute intern Jessica Kirkpatrick; and Potomac Institute staff Trevor Hufford, Joe Parrish, and Michael Montgomery for editing; Potomac Institute Director of Communications Abby Gillett; and Alex Taliesen of Potomac Institute Press and Sherry Loveless of Catsworth Studios for production.

EDITORS

Tim Welter, PhD is a Senior Fellow at the Potomac Institute for Policy Studies. He conceived and led the Potomac Institute's Global Competition Project (GCP). Having worked in the private sector, the military, and on Capitol Hill, Tim Welter brings valuable experience in national security and defense policy to the Institute. After serving on active duty in the Air Force for several years, he worked on Capitol Hill as Legislative Director for two different Members of Congress and later as a Professional Staff Member with the House Veterans Affairs Committee. Upon leaving the Hill, Tim worked with the foreign and defense policy research team at the American Enterprise Institute. He later completed a research fellowship at the National War College during which he finished his PhD dissertation in Political Science with the University of Missouri, writing about the political nature of defense policy in Congress. A US Air Force Academy graduate, Tim holds Master's degrees in political science, national security strategy, and management. Just prior to joining the Institute, Tim served at the Pentagon where he helped stand up an organization dedicated to future force design and the development of capabilities and concepts required to meet emerging national security challenges.

Bob Hummel, PhD is the Chief Scientist of the Potomac Institute for Policy Studies. He is editor in chief of the Institute's journal/magazine *STEPS (Science Technology, Engineering, and Policy Studies)*. Dr. Hummel has served in government positions in the Research Division of the National Geospatial-Intelligence Agency and as a program manager at DARPA, managing and initiating projects in information exploitation, computer science, and sensor design. Prior to joining DARPA, he was a tenured faculty member at NYU's Courant Institute of Mathematical Sciences in the Computer Science Department, where he did research in computer vision and artificial intelligence. Dr. Hummel's PhD is from the University of Minnesota in mathematics, and he holds a B.A. from the University of Chicago, also in mathematics.

CONTRIBUTING AUTHORS

Jeff “Skunk” Baxter

*Board of Regents Member and Senior Fellow,
Potomac Institute for Policy Studies
Chairman of the Civilian Advisory Board for Ballistic
Missile Defense*

Michael Fritze, PhD

Senior Fellow, Potomac Institute for Policy Studies

Trevor Huffard

*Research Assistant, Potomac Institute for Policy
Studies*

Bob Hummel, PhD

Chief Scientist, Potomac Institute for Policy Studies

Jessica Kirkpatrick, MSci (2023)

2022 Intern, Potomac Institute for Policy Studies

Jerry Krassner, PhD

*Board of Regents Member, Potomac Institute for
Policy Studies
Co-founder and former National Chairman of the
MASINT Association [now ATIA]
Former Chief Scientist in several offices at the Office
of the Secretary of Defense and the Defense
Intelligence Agency*

The Honorable Zachary J. Lemnios

*Board of Regents Member, Potomac Institute for
Policy Studies
Former Vice President of Research Strategy and
Worldwide Operations; Physical Sciences; and
Government Programs for IBM Research
Former Chief Technology Officer for Department of
Defense*

Moriah Locklear, PhD

*Federal Research Engagement Manager, Arizona
State University and Former Research Fellow,
Potomac Institute for Policy Studies*

Thomas R. Messegee

*Board of Regents Member, Potomac Institute for
Policy Studies
Spacecraft Design Consultant*

Michael Montgomery

Research Analyst, Potomac Institute for Policy Studies

Jody Moxham

Senior Fellow, Potomac Institute for Policy Studies

Curtis Pearson

Vice President, Potomac Institute for Policy Studies

Joseph Parrish

*Research Assistant, Potomac Institute for Policy
Studies*

The Honorable Alan R. Shaffer

*Board of Regents Member, Potomac Institute for
Policy Studies
Former Deputy Under Secretary of Defense for
Acquisition and Sustainment*

The Honorable William M. (Mac) Thornberry

*Board of Regents Member, Potomac Institute for
Policy Studies
Former Representative to Congress from the Texas
13th Congressional District
Former Chairman, US Congress House of
Representatives Armed Services Committee*

Timothy M. Welter, PhD

Senior Fellow, Potomac Institute for Policy Studies

GCP EVENT

PANELISTS/SPEAKERS

Jeff “Skunk” Baxter

*Board of Regents Member and Senior Fellow,
Potomac Institute for Policy Studies
Chairman of the Civilian Advisory Board for Ballistic
Missile Defense*

Colonel Ben Bishop

*US Air Force Operational Liaison to the Defense
Advanced Research Projects Agency (DARPA) and
Adjunct Assistant Professor, Georgetown University*

Dean Cheng

*Senior Fellow, Potomac Institute for Policy Studies
and Senior Advisor, United States Institute for
Peace*

Jaymie Duran

*Assistant to the Director for Strategic Initiatives,
MIT Lincoln Laboratory
Chairman and Co-Founder of the Andrew W.
Marshall Foundation*

Patricia Falcone, PhD

*Deputy Director for Science and Technology,
Lawrence Livermore National Laboratory*

Melissa Flagg, PhD

*Founder, Flagg Consulting LLC
Former Senior Fellow and Adjunct Professor,
Georgetown University*

Michael Fritze, PhD

Senior Fellow, Potomac Institute for Policy Studies

Laurie Giandomenico, PhD

*Vice President and Chief Acceleration Officer at
MITRE*

Daniel Hastings, PhD

*Head of Department of Aeronautics and Astronautics
and Associate Dean for Diversity, Equity, and
Inclusion of the School of Engineering at
Massachusetts Institute of Technology)*

Trevor Huffard

*Research Assistant and Science and Technology
Policy Internship Program Coordinator,
Potomac Institute for Policy Studies*

The Honorable Zachary J. Lemnios

*Board of Regents Member, Potomac Institute for
Policy Studies
Former Vice President of Research Strategy and
Worldwide Operations; Physical Sciences; and
Government Programs for IBM Research
Former Chief Technology Officer for Department of
Defense*

Jay Lewis

Partner, Silicon Projects at Microsoft

Mark Lewis, PhD

*Executive Director, Emerging Technologies Institute,
NDIA*

Christina Manning

*Director of Strategy, Northrop Grumman Defense
Systems*

Professor Charles McLaughlin

Professor of Practice, National Defense University

Ardavan Mobasheri

*Senior Research Fellow, Potomac Institute for Policy
Studies*

Jody Moxham

Senior Fellow, Potomac Institute for Policy Studies

Sarah Mineiro

*Senior Fellow, Potomac Institute for Policy Studies
and CEO, Tanagra Enterprises*

Jeremy Muldavin, PhD

DMTS Program Management, GlobalFoundries

Lois Nicholson

*Counsellor Defence Acquisition and Technology at
the British Embassy in Washington, DC*

Curtis Pearson

Vice President, Potomac Institute for Policy Studies

Heather Richman

Founder, Defense Investor Network

Will Roper, PhD

*Former Assistant Secretary of the US Air Force for
Acquisition, Technology, and Logistics and CEO at
Volsani*

The Honorable Alan R. Shaffer

*Board of Regents Member, Potomac Institute for
Policy Studies*

*Deputy Under Secretary of Defense for Acquisition
and Sustainment*

Joy Shanaberger

*CEO and Founding Partner of the Boone Group and
Former Special Assistant for the Office of the
Under Secretary of Defense for Acquisition,
Technology, and Logistics*

Alex Vacca, PhD

Corporate Director, Strategy at Northrop Grumman

Rand Waltzman, PhD

*Adjunct Senior Information Scientist, RAND
Corporation*

*Board of Regents Member, Potomac Institute for
Policy Studies*

Timothy M. Welter, PhD

Senior Fellow, Potomac Institute for Policy Studies

CHAPTER 1: THE POTOMAC INSTITUTE GLOBAL COMPETITION PROJECT (GCP)

THE US MEETS GLOBAL COMPETITION

Military might has long been a primary virtue of competition among nations. Armies, missiles, and territorial occupation have settled disagreements. While a strong military's importance has not faded, the modern world offers new avenues for competition.

The Information Age has collapsed distances between nations. Effectively, all nations and all peoples are neighbors. Globalization has brought the benefits of trade and diversity to massive numbers of people on a scale never experienced before in human history. Yet, the same sense of proximity has brought a new landscape for competition.

The contemporary environment for competition includes new aspects of economic and political domains. One needs to look no further than the war in Ukraine to conclude that the flow and access to information plays a critical role in competing for influence in all sectors, whether military, economic, or political. The wellbeing of society within a nation depends on factors that cut across all aspects of governance and services. In the past, the government's primary role was to maintain national defense and security through a strong military, but these objectives now require much more than military might.

Today, a nation must provide for education, health care, senior care, economic opportunities, and distribution of resources, housing, energy, food, and transportation facilities. These used to be the province of local domestic responsibilities. Increasingly, central governments assume levels of responsibility not just for their populace but also for the wellbeing of allies and friends as a shared responsibility. This centralization of responsibility has many causes, but it is partially driven by competition (or a sense of competition) both within a nation and across nations.

Competition, in turn, can be driven by resource limitation, such that demand is greater than supply. In this case, governments attempt to satisfy their populations' expectations by increasing their supply at the expense of others' supplies. However, competition can also occur even when supplies are essentially unlimited. For example, a nation might want to be the unrivaled superpower. A competition to be the best sets up an infinite game of one-upmanship. There is an infinite resource of possible improvement, but the demand can never be permanently satisfied. Indeed, such a competition can be beneficial by providing societal benefits to all sides. But it can also be costly by diverting resources from other needs.

The chapters that follow provide examples of varied kinds of competition with impacts at the societal level. In many cases, it is unclear if the competition is over limited resources or if dominance is sought in a constant cycle of measure and countermeasures and/or continual upgrades. Often, it is a perception of fairness or loss—or a need to maintain the status quo—that drives a competition. These perceptions, however, are real—they can be based on true hardships or backsliding that represent a loss for society. No one wants to accept a degradation of society's quality of life, nor should they. Our study of global competition is aimed at policies that will improve society's lot, with the emphasis on the interests of the US. We seek American leadership in the global arena, competing successfully to benefit society.

AMERICA AS A GLOBAL LEADER

The new landscape has developed over a long period of time. Economic competition among nations has been around for centuries. But the world's interconnectedness by virtue of the Information Age has

accelerated the globalization of supply chains and cognizance of imbalances, which has heightened opportunities for competition and added to the pressure of economic inequalities.

A couple of decades ago, the US enjoyed status as the sole superpower. Even during the Cold War, when the United States and the Soviet Union were in potential military competition, other major powers barely competed with the US in any dimension. Today, there are multiple near peers militarily, economically, and politically. Indeed, the world has become a complex patchwork of global competitions.

While global competition is hardly a new phenomenon, the pressures of international competition are increasingly becoming a reality for the United States. The issue is a multifaceted, multigenerational challenge, just in its infancy of recognition and attention. For decades, America has led the liberal world order. However, if the United States expects to continue to thrive as a global leader—economically and otherwise—government leaders must find a way to work better across their strict jurisdictional stovepipes, and the private and public sectors will have to cooperate. These strategies must invigorate a societal-level understanding and approach to great power competition.

While the United States has competed effectively at a societal level before, the stakes and players were different. We did not depend on the Soviet Union, economically or otherwise, during the Cold War, nor did we similarly depend on Germany or Japan during World War II. There were times when the United States worried that others might overtake US dominance in fields, for example, with the Japanese “fifth generation” computer program. The perception, however, was one of potential loss dominance and not a competition on a level playing field.

Today, however, we are economic codependents with China, and China is deliberately competing with the United States at the societal level. The Chinese government is in it for the long haul, leveraging an enduring patience built over several millennia. The United States does not employ a ruthless autocracy to align all aspects of society toward strategic goals. Instead, American-style democracy and free enterprise have proven themselves repeatedly to be the essential spark for unbridled ingenuity—the key to unrivaled flourishing among the world’s nations.

Nonetheless, to continue to thrive as a global leader, the United States must address a societal-level understanding and approach to competition. The current era—the Information Age—is dominated by unprecedented global interconnectedness and economic interdependence, intensifying competition for US leaders. State and other global actors have developed cost-effective means of political and economic manipulation and coercion, including impacting long-held US influence in international institutions. America’s domestic institutions are also starting to grapple with these new dynamics in global competition, but the response is far from synchronized. Ensuring our future security and economic vibrancy will require careful coordination of the public square and private enterprise.

UNIFYING THEMES

In the following chapters, six themes stand out as important factors that the United States must address to successfully navigate the global competitive environment. These themes are:

1. **Restored faith in base societal institutions**, including trust in the media, academia, and government that is necessary for success in competition with other nations.
2. **Commitment to a set of shared national values** that invokes a unifying vision supporting democratic ideals and human dignity.
3. **Recognition of the interdependence of global human needs**, including food, water, energy, and natural resources.

4. **Dominance in science and technology**, which is a competitive advantage derived from superior investments in education, the workforce, and a culture of innovation.
5. **Economic soundness** based on free markets and accessible, accurate information that underpins the ability to compete in global markets.
6. **Appreciation of the proliferation and ubiquity of information and its facile distribution**, which have radically altered the competitive economic and political landscapes.

These six themes weave throughout this compendium. Not all themes are in each chapter, and no chapter involves a single theme. We do not purport that this compendium is comprehensive. Additional topics and themes may be addressed through future Potomac Institute activities or publications. The themes provided in this publication are intended as guideposts for prioritizing and focusing future recommendations to policymakers and to promote a dialogue on how the United States might establish and maintain US competitive advantages.

CHAPTER 2: THE ECONOMIC CONNECTION

GCP EVENT: WHAT IS COMPETITION?

The Potomac Institute for Policy Studies hosted a GCP event titled “What is Competition?” on September 29, 2021. The panel of experts at this inaugural GCP event included The Honorable Alan Shaffer (former Undersecretary of Defense and Potomac Institute Board of Regents member); Melissa Flagg, PhD (founder of Flagg Consulting LLC and a former Senior Fellow and Adjunct Professor at Georgetown University); Jaymie Durnan (Assistant to the Director for Strategic Initiatives at MIT Lincoln Laboratory and Chairman and Co-Founder of the Andrew W. Marshall foundation); and Laurie Giandomenico, PhD (Vice President and Chief Acceleration Officer at MITRE). This chapter includes reflections from these discussions and an article by The Honorable Alan Shaffer titled “Standing Tall: Maintaining US Economic and Military Competitive Posture During Turbulent Times.”

INTRODUCTION

Today, the focus of the US competitive position is primarily evaluated in relation to Asia—particularly China. As a manufacturing powerhouse, China has established an economic position that seems favorable in comparison to the United States. Indeed, China has targeted sectors of commodities and goods production to enhance its capability to dominate markets while also modernizing its military. In multiple areas of commercial and defense products, China has made great strides and competes favorably against the US—much to the chagrin of the US Departments of Commerce and Defense. When we think of global competition, we naturally think of China and economic competition.

The well-understood concept that national security encompasses a strong economy is nonetheless controversial. The US Department of Defense (DOD) is supposed to focus on the military capabilities of the nation for the purpose of defense. However, they can only do their job well if they have sufficient monetary and non-monetary resources. It is the responsibility of other areas of government to ensure that the economy is strong, which allows for these appropriations. The new environment, discussed in chapter 1, increasingly looks to economic factors as a domain of global competition.

The DOD’s “pivot to Asia” and the US government’s focus on competition with China in economic sectors highlight this change. The interest in successfully competing in economic markets is thus part of national security and a collective responsibility of society and the government. The interplay between the national economic state and the resources that can be afforded to the military is the backdrop for our first contributed article. As The Honorable Alan Shaffer points out—in turbulent times, economic strength is a prerequisite for a competitive national security position.

MAINTAINING THE COMPETITIVE ECONOMIC AND MILITARY POSTURE OF THE UNITED STATES IN A TURBULENT ERA¹

Paper by: *The Honorable Alan R. Shaffer*

Paul Kennedy's 1987 book, *The Rise and Fall of Great Powers* demonstrated that throughout history, great powers fell into decline when their economic power failed to support their military and political ambitions. Ways, ends, and means fell out of balance. This paper contends that Paul Kennedy's basic premise applies to the United States in 2023.

The 2017 National Security Strategy used the phrase "great power competition"—a phrase that has been used widely since. Recently, the terminology has been refined to "strategic competition with China and any other nation."² No matter the label, it is clear that America has reentered a period of competition. Thus, we should ask, "what is the current competitive posture of the United States?" This competition is becoming increasingly tense. At the January 2022 Davos World Economic Forum, China's President Xi pointedly said that there would be grave consequences for any nation that attempted to shift the economic balance by interfering with China's global supply chains, its Belt and Road initiative, etc.

National power traditionally consists of three elements, as taught at the United States War Colleges: economic, military, and political power. This paper examines the current economic and military competitive posture of the United States. Our contention is that *America is living beyond its means* and that both economic and military elements are in decline from a competitive standpoint. We will not attempt to assess our standing in political competition with potential adversaries, but clearly challenges exist in that realm, as well.

Addressing the economic and military competitive status of the United States will require some reprioritization—and concessions—by Americans. Fixes may occur through new technologies and better strategies, and our purpose here is to foster such discussions and developments.

Measuring national power is not exact. We investigate specific areas of concern for both economic and military competition, using available data. Although we examine them individually, they are strongly interrelated, and assessment of the overall competitive position is qualitative.

ECONOMIC

The current US competitive economic trajectory is going in the wrong direction as America becomes more deeply in debt, with a record high in both actual debt and debt as a percentage of Gross Domestic Product (GDP). Simultaneously, mandatory federal spending has surpassed discretionary spending. Finally, there is growing income inequality, which, left unchecked, can lead to increased social unrest.³ Any of these items by themselves are cause for concern. But, if not addressed together, the United States will be challenged in its global competitiveness.

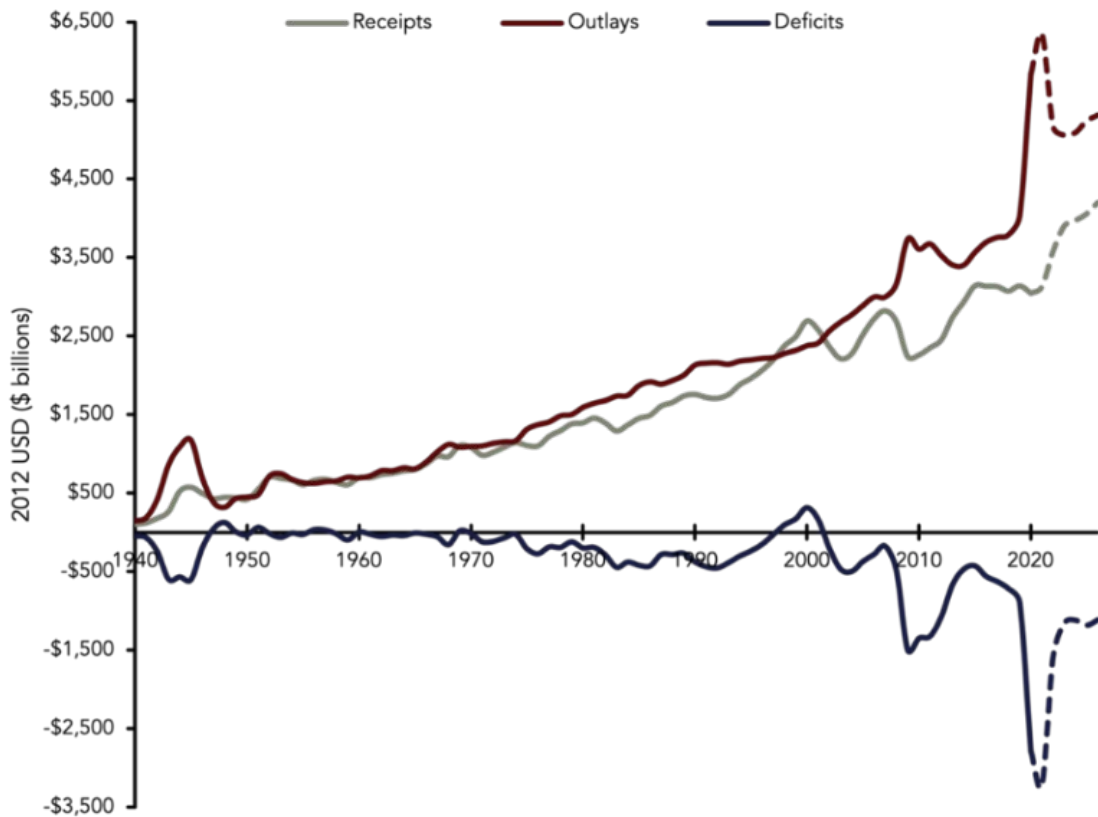
1 A version of this paper appears in *STEPS*, (*Science Technology Engineering and Policy Studies*), Issue 6, 2022, page 20, as "Standing Tall: Maintaining US Economic and Military Competitive Posture in Turbulent Times." 2022STEPSIssue6.pdf (potomac institute.org).

2 Lipman, Daniel, et al. "Biden's Era of Strategic Competition," *Politico*, October 5, 2021.

3 Gayle, Helene D. "Top 10 Trends of 2014: 2. Widening Income Disparities," *Outlook on the Global Agenda 2014*, <https://reports.weforum.org/outlook-14/top-ten-trends-category-page/2-widening-income-disparities/>.

Figure 2.1 shows the federal outlays (spending), receipts (income from taxes and other sources), and deficits from 1940 to 2025, in constant year 2012 dollars.⁴ Note that America has been in a severe deficit status since the early 2000s. The 2021 to 2025 figures are Office of Management and Budget estimates, which tend to be optimistic. Since population growth could explain the growth in spending, Figure 2.2 is included to show federal spending per person from 1950 to 2021 in constant year dollars (2012). If federal spending aligned with population growth, the value would be constant. It is not. In fact, the federal government today spends three to four times what it spent per person in 1950.

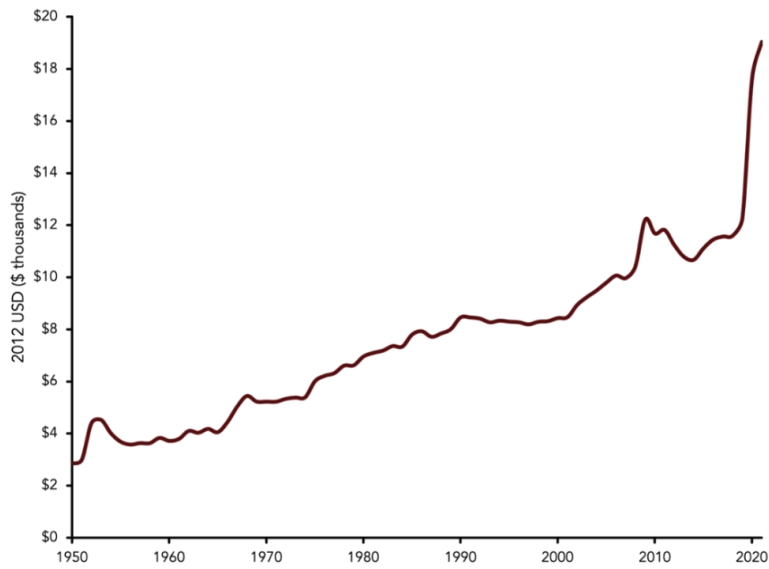
Figure 2.1. US Budget Snapshot Outlays, Receipts, and Deficit (1940–2025).



Data Source: Office of Management and Budget Historical Tables (The White House).
 The latest OMB Data uses 2012 data for constant year dollars.
 To convert to 2021 dollars, figures would need to be multiplied by 1.19.

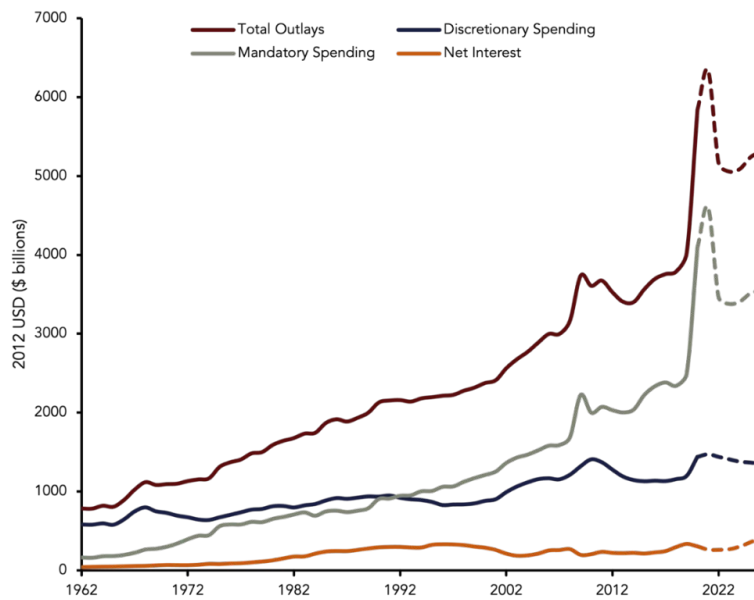
4 The latest OMB Data uses 2012 data for constant year dollars. To convert to 2021 dollars, each figure would need to be multiplied by 1.19.

Figure 2.2. US Budget Snapshot Federal Spending per Person (\$K).



Data Sources: Office of Management and Budget Historical Tables (The White House) and Population of the United States (United States Census Bureau). The latest OMB Data uses 2012 data for constant year dollars. To convert to 2021 dollars, figures would need to be multiplied by 1.19.

Figure 2.3. US Budget Snapshot Mandatory/Discretionary Spending (1962-2025).

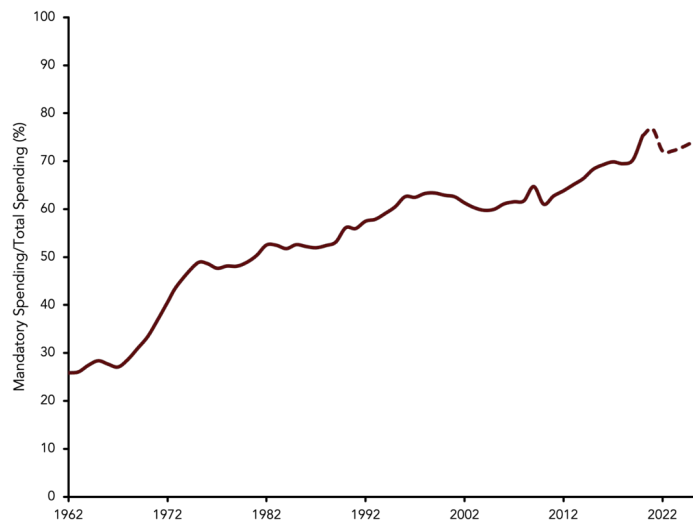


Data Sources: Office of Management and Budget Historical Tables (The White House) and Population of the United States (United States Census Bureau). The latest OMB Data uses 2012 data for constant year dollars. To convert to 2021 dollars, figures would need to be multiplied by 1.19.

Moreover, in constant year dollars, total federal spending is approximately six times greater than post–World War II spending, while federal spending per person has increased four times. One reason for this change is the nature of government outlays over the past 50 years. Figure 2.3 shows the evolution of mandatory and discretionary programs over time. Figure 2.4 shows the continued growth of the mandatory portion of the budget as a percentage of total outlays. In 1962, about 25% of federal outlays were “mandatory” (Social Security, Medicare Medicaid, interest on the debt, etc.). The best estimate is that by 2025, the mandatory spending will account for well over 70% of federal outlays.⁵

While the mandatory outlays have been growing, so has the national debt, both in constant year dollars and as a percentage of GDP. As of January 22, 2022, the United States debt is \$29.8 trillion, which is the largest in American history.⁶ Further, the ratio of debt to GDP is also the highest in American history, is at 127.55%.^{7,8} This is even 10% greater than the end of World War II. A September 2020 report by the Congressional Budget Office⁹ projects that the debt will continue to grow for the next 30 years, reaching 200% of GDP by 2050. A recent report by the World Bank states that a country that has a debt to GDP ratio greater than 77% over an extended period of time will experience reduced economic growth.¹⁰ The United States is well beyond 77%.

Figure 2.4. US Budget Snapshot Mandatory Spending as a Percent of Federal Outlay.



Data Sources: Office of Management and Budget Historical Tables
(The White House and Population of the United States and the United States Census Bureau).

-
- 5 Levit, Mindy, D. Andrew Austin, and Jeffrey M. Stupak. “Mandatory Spending Since 1962, Congressional Research Service,” March 18, 2015, <https://sgp.fas.org/crs/misc/RL33074.pdf>.
 - 6 National debt consists of “public debt,” i.e., debts that the US Government and state governments owes to the public, and intergovernmental debts. The latter is around \$6 trillion by the end of 2021.
 - 7 Data valid as of January 20, 2022.
 - 8 Agresti, James D. “National Debt Breaks All-Time Record for Highest Portion of Economy,” June 10, 2020, https://www.justfacts.com/news_national_debt_breaks_record_highest_portion_economy.
 - 9 “The 2020 Long-Term Budget Outlook,” Congressional Budget Office, 21 Sept 2021 <https://www.cbo.gov/publication/56598>.
 - 10 Grennes, Thomas, Mehmet Caner, and Fritzi Koehler-Geib. “Finding the Tipping Point -- When Sovereign Debt Turns Bad,” World Bank Group eLibrary, <https://elibrary.worldbank.org/doi/abs/10.1596/1813-9450-5391>.

Figure 2.5. United States National Debt to GDP.



Congressional Budget Office and Federal Reserve Bank of St. Louis.

Methods to address the debt are limited because 70% of the federal outlays are mandatory. A change in mandatory spending will require a change in the law, which means the “easiest” lever is discretionary spending. Defense makes up half of the discretionary budget. Unfortunately, since 2008, there have only been three years (2008, 2014, and 2015) where the United States budget deficit for the year was smaller than the entire defense budget. Said another way, Congress could zero out the defense budget, and America would still have an increase in debt. Therefore, America will not be able to address this debt without changes to the mandatory spending programs, which is not a path that will be popular with most Americans.

Why does debt matter? There are several factors, but consider these two—servicing the US debt and loss of US ability to receive loans. The cost to “service” the debt continues to rise. In 2020, the cost was \$522 billion—at minimal interest rates (2.4% in 2019 and 1.3% in 2020).¹¹ A 2019 study projected the cost to service the debt will be larger than the defense budget by 2025.¹² This projection was based on estimates before the COVID-19 pandemic; since the start of 2020, the nation has added \$6 trillion to the debt, which increases the cost to service the debt. With the size of the actual and relative debt, it is very possible there will be restrictions on the United States’ ability to receive loans. Loan restrictions will limit US capacity to participate freely in the global economy, thereby putting America at a competitive disadvantage.

11 From US Treasury Direct, Government–Interest Expense on the Debt Outstanding. August 20, 2021, https://www.treasurydirect.gov/govt/reports/ir/ir_expense.htm.

12 From US Treasury Direct.

Debt held by private citizens is also rising; it has more than tripled as a percent of GDP since the middle of the 1950s—from about 50% of GDP to over 150% of GDP.¹³ There are multiple causes for this, but one contributor has been the cost of higher education. Long-term student loans contribute to economic trends affecting competitiveness of the United States, including income inequality. In short, Americans, like America, are living beyond its means.

In a healthy economy, the gap between the very rich and very poor tends to decrease—a solid economy raises all boats. As measured by the Gini Index, an index that measures income inequality in a nation,¹⁴ the US is going in the wrong direction. The 2020 Census Bureau reports that the Gini Index of the US has grown from 0.36 in the late 1960s to 0.46 today. Worldwide, the Gini coefficient is strongly correlated with community violence and social unrest.¹⁵ The United States had the 27th highest Gini coefficient of 143 largest nations; and no NATO nation had a higher Gini coefficient.¹⁶

The United States income inequality now is more like a third world nation than an advanced liberal democracy. If this trend is not reversed, social unrest will likely grow. Simply, a nation at war with itself is not likely to stay competitive globally.

We have shown that the US national debt is growing rapidly, mandatory expenditures have taken over federal spending, and income inequality weakens our competitive posture. Economic deficiencies of this sort might not matter if we can produce what we need on our own. But when we are beholden to others, who might hold our debt, for essential goods and/or services, then national security can be jeopardized. We give two examples.

NATIONAL SECURITY SUPPLY CHAIN FRAGILITY

Microelectronic Supply Chain Vulnerability

Currently, the United States only produces 12% of the world supply of microelectronics, and very little at state-of-the-art (SOTA)¹⁷ This is critical, because modern military systems depend upon a large set of microelectronics—they are the brains and eyes of modern systems. By 2030, the Semiconductor Industry Association predicts that the United States share of global production will decrease to 10%, while China and Taiwan will produce 50% of global microelectronics. Together with South Korea, over 70% of the world supply will be concentrated in one area of the world. Since the US consumes about 48% of the world semiconductor market, the United States is dependent on non-domestically produced chips. Potential adversaries could withhold access or insert “bugs” (e.g., Trojan horses, corrupted software, remote triggers, and so forth), that could conceivably allow an adversary to turn systems on or off remotely or alter the performance in some way. Even without inserted triggers, a monopolistic supplier base puts other nations at an economic disadvantage. This is especially true in an industry that requires expensive and

13 Vague, Richard. “The Private Debt Crisis,” *Democracy Journal* Fall 2016, No. 42, <https://democracyjournal.org/magazine/42/the-private-debt-crisis/>.

14 There are typically 10 or 20% Gini’s, which measures the gap between the 10 and 20% rich and poor, respectively. A Gini index of zero represents complete income equality (everyone makes the same); a Gini of 1 means that one person has all the money in a country.

15 Luther, David. “New FBI Data Correlates City Crime to Income Inequality,” October 9, 2017, <https://www.zippia.com/advice/crime-income-inequality/>.

16 Central Intelligence Agency. “CIA World FactBook,” (New York, NY: Skyhorse Publishing) 2020.

17 Generally, 14nm is considered SOTA, although with some exotic materials, SOTA exists at 45nm. Currently, the United States has very little SOTA production.

lengthy investment periods before production capacity actually increases.¹⁸ If the supply chain moves to a monopoly, competitive balance is eroded.

The recent shutdown of the Colonial Pipeline in the Eastern United States occurred when Russian hackers took control of the pipeline operating systems. Suppose that this were not a hacker group, but a group enabled by nondomestic chips with embedded backdoors. Similarly, the auto industry found itself at the mercy of a product monopoly foreign supply chain, as a shortage of chips caused a global automotive industry contraction in the amount of \$210 billion.¹⁹ When national security is dependent upon a product, there is really no choice but to spend as needed to ensure economic and security self-sufficiency.

Rare Earth Elements

The American Geophysical Institute estimates that China currently controls 97% of the global supply of rare earth elements (REEs).²⁰ Many high-end defense systems use REEs and are essential for night vision, SONAR and RADAR systems, satellite communications, heads-up displays in fighter jets, laser systems such as guided weapons and laser targeting systems, and fiber optic cables. Even nuclear threat detection systems use REEs (lanthanum) to detect gamma radiation.²¹ The automotive industry is also highly dependent on REEs. Currently, most systems relying on REEs do not have a suitable substitute. This is not an acceptable position for the United States, as REEs provide real capabilities needed by the DOD, and society in general.

The challenges with a lack of REEs could be remedied by stockpiling (which could be expensive), restarting refinement or production domestically, or by finding a suitable substitute. Starting domestic processing has inherent risks because of the toxicity of processing the elements. It seems that the most logical approach would be a combination of stockpile coupled with a robust research program to find suitable substitutes. The nation does not have such a significant research effort at present.

Our nation is highly dependent on foreign sources for many other supplies and services. For example, pharmaceuticals are important to the health of the nation's population. The COVID pandemic highlighted the pharmaceutical supply chain vulnerability in the US (and the West). The key point is that in cases where the United States has critical dependencies that threaten national security, the nation must increase access from domestic or most favored nation sources.

MILITARY

In August 2021, Admiral Chris Aulino, Commander United States Indo-Pacific Command stated at the Aspen Security Conference that the United States still has the finest military in the world. The United States continues to spend more on defense than any other nation by a wide margin. Resulting capabilities of the military cover a wide range of mission sets.

18 Typically, \$20 billion or more for SOTA facilities with a four- to five-year lead time.

19 Isodore, Chris. "Automakers' Problems Are Much Worse Than We Thought," CNN Business, September 28, 2021 <https://www.cnn.com/2021/09/28/business/auto-industry-supply-chain-problems/index.html>.

20 Dreyer, Jane. "China's Monopoly on Rare Earth Elements, and Why We Should Care," Foreign Policy Research Institute October 7, 2020, <https://www.fpri.org/article/2020/10/chinas-monopoly-on-rare-earth-elements-and-why-we-should-care/>.

21 Montgomery, Michael. "Rare Earth Elements in Defense Systems," Investing News Network, April 18, 2011, <https://investingnews.com/daily/resource-investing/critical-metals-investing/rare-earth-investing/rare-earth-elements-in-defense-systems/>.

The capabilities required for successful future warfighting, however, will be different from those of the past, yet the DOD is still largely focused on platforms that may not be relevant in that future fight. People talk of a 355 ship Navy, up from fewer than 300, now.²² In 2019, the Center for Strategic and Budget Analysis presented a study indicating that the Air Force needed to grow to 386 squadrons—an increase of about 50 squadrons. Instead of talking in terms of numbers of platforms, the discussion should identify what the nation needs the DOD to accomplish and then, given that mission set, determine how the budget can be realigned to meet those needs.

The Strategic Air Command of the 1950 through the 1980s had the motto “Peace is our Profession.” In fact, a primary role of the military in an era of great competition is to be strong enough to deter conflict. In any discussion of military competitive posture, it is an unstated goal to have the strength to deter major conflict. Unfortunately, the United States military is delinquent in modernization of capabilities in long-term competition with adversaries.

The bedrock of national security is the nuclear triad. Currently, the DOD is modernizing all three legs of the triad, with the “Ground Based Strategic Deterrent” replacing Minuteman-III; the Columbia class submarine replacing the Ohio class; and the B-21 Raider and Long-Range Strike Option replacing the B-2 and Air Launched Cruise Missile. The Air Force first fielded Minuteman-III in 1970 with an expected missile life of 10 years. Through several “Service Life Extension Programs,” the missile has remained viable, but there is no more viable extension available, according to Admiral Chas Richard, the Commander of the United States Strategic Command.²³ The Ohio class submarine was first fielded in 1981; the first will be replaced in 2031. A similar situation exists with the Air Launched Cruise Missile, which was commissioned in the early 1980s with a 10-year life expectancy.

In May 2021, the Congressional Budget Office (CBO) estimated the cost of nuclear modernization over the period 2021 to 2030 will be \$634 billion. Since the overall average total DOD RDT&E and Procurement Budget Request is about \$250 billion per year, nuclear modernization will consume over 25% of the research and procurement budget for the next decade. This does not include the cost of modernizing nuclear command and control, another multi-hundred-billion-dollar bill over the coming decade. Subsequent costs after 2030 will be even greater.

Simultaneously, many other systems are entering the high-cost phase, to include full rate production of the F-35, the KC-46, and Next Generation Air Dominance fighter, Virginia class submarines, Ford class aircraft carrier, and missile defense systems. We have multiple aging and expensive platforms that need to be replaced simultaneously. Much of this “bow wave” came about because of decisions that individually were logical, but in the aggregate, deferred a lot of modernization by 30 years. This started with the “Peace Dividend” following the fall of the Berlin Wall, to a post-9/11 focus on counterinsurgency, to the “Budget Control Act” of 2011. The cumulative effect places the United States competitive advantage at risk.

Assuming that these are the modernization platforms that align to future mission sets, the costs will nonetheless be staggering.²⁴ The sustainment costs alone will squeeze out any other research and

22 “Active US Navy Ships” June 23, 2021, <https://www.military.com/navy/us-navy-ships.html>.

23 Everstine, Brian. “STRATCOM Welcomes Nuke Review, but Says Minuteman III Life Extension Should Not be Considered,” *Air Force Magazine* January 5, 2021, <https://www.airforcemag.com/stratcom-welcomes-nuke-review-but-minuteman-iii-life-extension-should-not-be-considered/>.

24 “The 2020s Tri-Service Modernization Crunch,” American Enterprise Institute, <https://www.aei.org/research-products/report/2020s-tri-service-modernization-crunch/>.

modernization efforts. If these are not the platforms needed for future missions, then the issue is: How should the Department redirect funding, and what investments are required?

Figure 2.6 shows the historical trends of the DOD budget in constant year dollars, from an Oct 2021 Congressional Budget Office Study.²⁵ Figure 2.7 shows the historical DOD budget as a percentage of GDP.²⁶ The budget includes all aspects of defense spending, from personnel costs, including (rising) health care, to acquisition and sustainment, operations, jet fuel, training, retiree pension payments, and when necessary, wartime operations. The DOD budget must address continued increases in “entitlements” (retiree pay, health costs for retirees, etc.). For instance, from 2020 to 2021, the cost of pay, housing and benefits grew by 5%, while force size only grew 1%.²⁷ Major General Arnold Punaro (Ret) recently pointed out that the fully burdened cost of a mid-career person has ballooned from \$80K to \$400K per servicemember in the last 20 years.²⁸ Others have stated the defense budget will need a 3 to 5% real increase (above inflation) annually for the next decade to field systems in the pipeline.²⁹ Given other national priorities, this does not seem likely, and in October 2021, the CBO published an option for a \$1 trillion reduction over a decade, resulting in a \$600 billion budget in 2031.³⁰ As seen from Figures 2.6 and 2.7, the United States is spending more on defense in constant year dollars, but with a slowly decreasing percentage of GDP. It is time to readdress what the nation expects of the DOD. If the nation expects a defense against all potential threats, the nation will need to spend appropriately to achieve these goals. The goals must address the overall strategic balance of the defense of the homeland, defense of ideals, and defense of allies.

To compound the challenge, the Department does not have a coherent strategy for cyber, electronic warfare, maneuverable reentry missile defense, information operations defense, etc. The Joint Chiefs of Staff have issued a “Joint Warfighting Concept” for a vision of future combat, with four “strategic directives,” which are: contested logistics, joint fires, joint all domain command and control, and information advantage.

Note that these are not platforms, but rather concepts. The DOD continues investing in platforms based on legacy systems and outdated concepts of warfare without prioritizing for future critical capabilities.

The nation has arrived at the position where the physical systems it is buying may not be affordable, let alone relevant to counter the threats we face. The defense budget focuses on platforms, but not the “enablers” that will allow the force of the future to fight more effectively. The United States may be living beyond its means in what it spends on defense. Yet defense of the population is one of the primary functions of government.

25 Data Source: Congressional Budget Office. Long-Term Implications of the 2021 Future Years Defense Program September 2020. Congressional Budget Office, Illustrative Options for National Defense Under a Smaller Defense Budget October 2021, Figure 1-1, p.6. <https://www.cbo.gov/system/files/2021-10/57128-defense-cuts.pdf>.

26 This can be obtained from the CIA World Info book, but other sources may exist. See “Military Expenditure (% of GDP) - United States,” The World Bank, <https://data.worldbank.org/indicator/MS.MIL.XPND.GD.ZS?end=2020&locations=US&start=1960>.

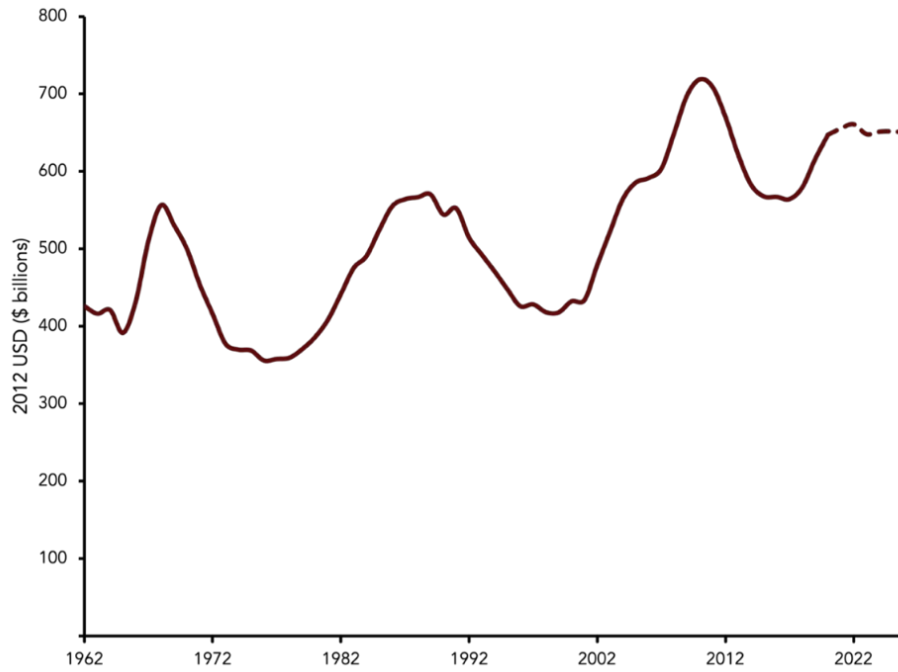
27 Shine, Leo III. “Rising Military Personnel Costs May Mean Future Personnel Reductions,” *Military Times* August 25, 2020 <https://www.militarytimes.com/news/pentagon-congress/2020/08/25/rising-military-personnel-costs-may-mean-future-cuts-in-troop-numbers/>.

28 Punaro, Arnold Maj Gen (Ret). “The Ever Shrinking Fighting Force,” (Virginia: Punaro Press, LLC) 2021.

29 Mackenzie, Eaglen and Hallie Coyle. “The 2020s Tri Service Modernization Crunch,” American Enterprise Institute, March 23, 2021 <https://www.aei.org/research-products/report/2020s-tri-service-modernization-crunch/>.

30 “Illustrative Options for National Defense Under a Smaller Defense Budget,” CBO Reduction Analysis, <https://www.cbo.gov/publication/57128>.

Figure 2.6. Historical Trends of the DOD Budget in Constant Year Dollars.



Adapted from CBO, Oct 2021 Illustrative Options for National Defense Under a Smaller Defense Budget.

Figure 2.7. Historical DOD Budget as a Percentage of GDP.



Data Source: Information from the Stockholm International Peace Research Institute (SIPRI), <https://www.sipri.org/databases/milex>.

There are two more fundamental changes that are needed to increase the competitive posture of the US military—both are needed to enhance agility and ability to respond more quickly and adapt systems. The first involves how the DOD buys systems—simply, all systems bought should conform to open systems architecture standards using digital engineering. The model that has served the United States well is being surpassed in commercial practices, which allows for easy upgradability. By adopting open systems, it will be possible to swap a microelectronic board, not a total subsystem. Use of digital engineering will likewise allow rapid adaptation. Both open systems and digital engineering will reduce sustainment costs and enhance downstream capabilities.

The other change is about how the DOD budgets. This change will require congressional action. Currently, the Department must define how it will spend all its money to Congress, with a budget that is built 18 months or more before the money arrives. There has to be a way, working within the constrict that provides Congress the power of the purse, to allow the Department a sum of funds that can be allocated when needed, not when scheduled.

THE ISSUES GOING FORWARD

Integrating our assessments of the economic and military positions of the United States in today's competitive environment, we pose a sequence of salient questions:

- What does the nation expect from its defense enterprise?
- Given that defense spending is a proportion of GDP, and thus incurs opportunity costs that must be balanced against social spending and entitlement costs, what percentage of GDP should be devoted to defense?
- What capabilities and systems need to be procured and on what timetables, prioritized according to missions that answer threats of the future as determined by a strategic review?
- How can the nation efficiently procure those capabilities and systems with sufficient agility and responsiveness in a competitive environment?
- What proportion of defense spending should be devoted to research and development (R&D)? What R&D is needed?
- How do we incentivize allies to assist in common aspects of defense?

The issues reflect certain structural problems in current practices. The last time the DOD executed a joint bottom-up review was in 1993.³¹ In any given year, DOD completes 95% of its budget build for a fiscal year that does not start until 15 months later, thwarting agility and responsiveness. The requirements process of the acquisition system needs overhauling. The US should also expand mutual reliance on allies, such as in the NATO alliance.

Answers must happen at the national level. Taken individually, each of these issues is difficult. In the aggregate, they are daunting. However, other nations are also facing significant challenges, and if America

31 Aspin, Les. Report on the Bottom-up Review, October 1993, https://history.defense.gov/Portals/70/Documents/dod_reforms/Bottom-upReview.pdf.

begins to address these issues it is likely that the outcome will be one where America and American allies will not be disadvantaged. America has faced difficult positions in the past and has risen to the challenge.

WHAT NEEDS TO BE DONE

The DOD should conduct a complete bottom-up review of force structure and platforms and capabilities that are needed to meet a prioritized set of missions for a future defense of the nation. This could be done by a bipartisan panel of national security experts who are given a year or less to complete the review. The Marine Corps did this in their 2022 budget request, realigning their budget to the 2018 National Defense Strategy and great power competition—and in so doing, retired several systems (to include all main battle tanks). A joint review, considering expectations of what national security of the future should include, should be convened.

To improve agility and responsiveness, the structure of the defense budget, and the way the DOD buys systems needs to change. Current budgets are granular and relatively inflexible, overly prescriptive, and not flexible enough for the fluid nature of the globally competitive environment. The DOD must be able to adjust funding as opportunities and necessities arise. In addition, the defense acquisition process has to adopt both open systems engineering and digital engineering as the foundation for future systems.

Ongoing reforms that add agility to the acquisitions system must be accelerated. Fixing acquisition starts with overhauling the requirements process, something the Joint Chiefs of Staff are trying to do. The DOD must step up efforts to prototype for production, not just prototype for technology. Finally, the DOD needs to implement both digital engineering and open systems architecture for all acquisitions. The services are moving in these directions. They need to accelerate.

America must incentivize expansion of defense spending by our allies and of those with whom we share similar values to assure our mutual competitive advantage in the future. NATO has been a successful alliance. While recent events have led to an increase in defense spending across NATO, in 2021, greater focus is needed on expanding mutual reliance, incentivizing fielding of capabilities that assure our mutual security and prosperity.

IMPLICATIONS

Some of the steps the nation may need to undertake will not be easy, or easily accepted by the American populace.

First, economically, America must begin to live within its means. Inevitably, this means incremental tax increases coupled with reduced spending. Reducing spending will require some reduction to mandatory spending.

At the same time, overall income inequality must be addressed. If America does not address the growing economic (and hence societal) gap in our nation, America will continue to bicker internally; a nation at war with itself will not be competitive on a global stage.

The nation must have a serious review of expectations regarding national security, and then allocate sufficient resources, both human and monetary. The review should provide a set of realistic options, and the nation will need to develop a consensus to commit to a long-term strategy. A serious bottom-up review of all platforms and capabilities in the acquisition pipeline will result in some systems being canceled.

Finally, the acquisition needs to be more agile, which will require legislative changes, including revising the planning, programming, budgeting, and execution (PPBE) process.

SUMMARY

The recommendations are easy to write down, but difficult to implement. Addressing these problems in earnest will require balancing overall outlays with the goals and means of the nation. If we do not address these challenges, US economic and military posture will erode. The nation is in an economic situation where servicing the debt is exceeding the current budget for the defense, and the ability to borrow may become jeopardized. This supports Paul Kennedy's thesis that economically, the United States is having a hard time meeting both military and political aspirations, because it is living beyond its means.

Additionally, the nation risks an increased level of social unrest due, in part, to income inequality and an erosion of confidence in the political and economic systems to take care of the American people.

Thus, to remain competitive, America must define the expectations of common defense, and fund that expectation while rebalancing economic priorities, balancing mandatory and discretionary budgets, and addressing the growing inequality in America. Without doing so, the underlying premise of what America stands for will continue to erode, the United States will cease to be a world leader, and will lose its global competitive standing.

ACKNOWLEDGMENTS

I would like to thank my colleagues for providing critical feedback on this paper. Thanks to Dr. Bob Hummel for consistently challenging my thinking and taking the time to improve this paper. Thanks to Mr. Jaymie Durnan, who asks "why," not "why not." Thanks to Dr. Tim Welter for pulling together a serious review of America's competitive status.

CHAPTER 3: ECONOMICS AND THE SPECTRUM OF CONFLICT

GCP EVENT: ECONOMICS AND THE SPECTRUM OF CONFLICT—IS DOD PREPARED?

On February 24, 2022, the Potomac Institute for Policy Studies hosted a GCP hybrid seminar titled *Economics and the Spectrum of Conflict—Is DOD prepared?*. The panel of experts at this event included Tim Welter, PhD; The Honorable Zach Lemnios (Former Vice President at IBM Research, Former Assistant Secretary of Defense [Research and Engineering], and Member of the Board of Regents at Potomac Institute); Will Roper, PhD (Former Assistant Secretary of the US Air Force for Acquisition, Technology, and Logistics and CEO at Volsani); and Lois Nicholson (Counsellor Defence Acquisition and Technology at the British Embassy in Washington, DC). This chapter summarizes the discussions and analyses and provides a reprint of a *STEPS* paper that also addresses important aspects of economics related to national security “US National Security in a New Era of Intense Global Competition” by The Honorable Zachary J. Lemnios.

INTRODUCTION

The global economic environment is a lever of influence in a global competitive environment. What is an optimal strategy for the nation’s defense in a world where the economic and political spheres of influence are as important as military might? From an economic and information standpoint, the United States and its allies are currently economically codependent with China, with both opportunities and vulnerabilities that would reverberate in the context of conflict.

Economics and information are being operationalized for advantages in the global competitive environment. The US has imposed trade restrictions and economic sanctions, for example on Russia, and China has targeted sectors of commerce for domination. Both Russia and China, have increased their application of “gray zone” activities, including the use of propaganda, mass media misinformation and disinformation, predatory investment practices, and economic manipulation and coercion. Thus, it is important to question the preparedness and current evolution of the US defense construct for dealing with these 21st century realities.

The 2018 National Defense Strategy in fact shifted America’s focus to great power competition and inspired a push for top-down organizational re-focus. To that end, the 2022 NDAA mandated the creation of a Planning, Programming, Budget and Execution Reform Commission and the DOD established the Office of Strategic Capital. Other initiatives seek to drive new collaborations among business, research, academia, and government. However, we are just in the initial stages of truly viewing economics, politics, and military strength as essential elements of a nation’s defense in a contemporary sense.

The paper in this chapter, by the Honorable Zachary Lemnios, posits that it is a new era that requires not just an economic competition, but a strategy for national defense that addresses the interconnected economic, military, and political vectors that constitute all forms of conflict and warfare. While calling for another commission, the paper calls for the kind of commission that restructured the national defense strategy, as was the case in the early 1950s with the Solarium study and Project Charles.

US NATIONAL SECURITY IN A NEW ERA OF INTENSE GLOBAL COMPETITION¹

Paper by: The Honorable Zachary J. Lemnios

A NEW ERA

The United States and China are in a great power competition that will have profound impact on the national security and economic security of both countries for decades.^{2,3} This competition aligns across interdependent economic, military, and political vectors. At the core, this is a competition of ideals and governance. But unlike the 20th century Cold War competition with the Soviet Union, the competition with China involves new challenges. The resulting tension between the US and China has opened a new era requiring a new national security framework.^{4,5}

In the past, the United States has confronted the need for a complete transformation in the national security environment. For example, after World War II and the proliferation of nuclear weapons capabilities, the nation undertook Project Solarium and the Project Charles Air Defense Study to define a new national security operating model to contain the Soviet Union.⁶ The competition with China poses an equally significant challenge now.



- 1 A version of this paper appears in *STEPS*, (*Science Technology Engineering and Policy Studies*), Issue 6, 2022, pg 8, as "US National Security in a New Era of Intense Global Competition" 2022STEPSIssue6.pdf (potomacinstitute.org).
- 2 Cordesman, Anthony H. "Chinese Strategy and Military Forces in 2021," *Center for Strategic International Studies*. June 7, 2021. https://csis-website-prod.s3.amazonaws.com/s3fs-public/publication/210607_Cordesman_Chinese_Strategy.pdf?FG7hUZdWUVJgaJzyC4E9Qj1m3w13SfjQ.
- 3 National Defense University Press. *PRISM* 8(4) June 2020, https://ndupress.ndu.edu/Portals/68/Documents/prism/prism_8-4/prism_8-4.pdf.
- 4 The Policy Planning Staff. "The Elements of the China Challenge," Office of the Secretary of State. December 2020, <https://www.state.gov/wp-content/uploads/2020/11/20-02832-Elements-of-China-Challenge-508.pdf>.
- 5 Loomis, F.W. "Problems of Air Defense: Final Report of Project Charles," Contract Number DA36-0039sc-5450, August 1, 1951, http://www.bitsavers.org/pdf/mit/lincolnLaboratory/project_charles/A800165_Final_Report_of_Project_Charles_Vol_1_Aug1951.pdf.
- 6 Department of State Office of the Historian. "Foreign Relations of the United States, 1952-1954," National Security Affairs, Volume II, Part 1, "Paper Prepared by the Directing Panel of Project Solarium."

© 2023, Potomac Institute for Policy Studies

ECONOMIC COMPETITION

The United States and China are in a fierce rivalry spanning a broad range of global markets and complex global supply chains. In 2020, US goods imports of \$435 billion and exports of \$125 billion reflect a trade imbalance with China. Persistent trade imbalances of this magnitude are unsustainable. This is caused by a complex competition in which the playing field is skewed and can lead to global market instability. Our companies and supply chains are interrelated. We depend upon each other's markets and host each other's companies.

The "Made in China 2025" plan, published in 2015, is China's ten-year plan to reduce China's dependence on foreign technology and to promote China's technology position in the global marketplace.⁷ China is focused on leading ten key high-tech industries (see the "Made in China 2025" figure). Particular technology areas of competition with the US include information technology, robotics, new materials, and aerospace equipment. This plan is structured to raise the Chinese domestic content of core components and materials to 70 percent by 2025. The plan is the foundation of China's economic competition.

The initial salvo for strategic industry leadership began with 5G wireless-telecommunications, as part of the "new information technology" sector. This is the entry point to the global digital and cyber-physical infrastructure with the opportunity to control the network infrastructure. This is also the path to position China as a "first mover" in training artificial intelligence (AI) algorithms on massive global data, driving AI to the network edge and accelerating digital transformation across many industries.⁸

As a result, China is driving the development of technologies in the 5G telecommunications sector, led by its private sector companies Baidu, Alibaba, Tencent, Huawei and ZTE (Zhongxing Telecommunications Company Ltd.). While there are over 200 Chinese companies listed on US stock exchanges with a total market capitalization in excess of \$2.2 trillion, Huawei and ZTE have been the subject of special scrutiny.⁹ In late 2019, the *Wall Street Journal* reported that Huawei had access to as much as \$75 billion in support from the China State Government.¹⁰ In July 2020, the US government officially designated Huawei and ZTE as threats to US national security, because of their close ties to the Chinese Communist Party and China's military apparatus and their legal obligation to cooperate with China's intelligence services. More



7 The People's Republic of China State Council. "Made in China 2025 Plan." May 19, 2015, http://english.www.gov.cn/policies/latest_releases/2015/05/19/content_281475110703534.htm.

8 Council Notice on the Issuance of the New Generation Artificial Intelligence Development Plan. "A New Generation Artificial Intelligence Development Plan," July 20, 2017.

9 China Economic and Security Review Commission. "Chinese Companies Listed on Major Stock Exchanges." <https://www.uscc.gov/research/chinese-companies-listed-major-us-stock-exchanges>.

10 Yap, Chuin-Wei. "State Support Helped Fuel Huawei's Global Rise," *Wall Street Journal* December 25, 2019.

recently, White House Executive Order 13959 identified 59 Chinese entities for which US investments are banned by the Treasury Department.¹¹

The “new information technology” sector of the “Made in China 2025” plan also depends on advanced semiconductor technology. State-of-the-art (SOTA) -microelectronics requires a complex supply chain with specialized technical talent and massive capital investments. Manufacturing facilities (fabs) are benchmarked by semiconductor wafer size (measured in millimeter in diameter), manufacturing volume (wafers/month) and smallest printed geometric feature (nanometers). Today’s SOTA products are manufactured on 300mm wafers at 5nm geometries. At the end of 2018 there were 112 production-class fabs globally utilizing 300mm wafers.¹² The global industry is projected to add at least 38 new 300mm fabs by 2024. Of these, Taiwan is expected to add 11 large-volume fabs, and China will add 8 to account for half of the global 300mm large-volume fabs by 2024. To support this, the China State Government has established an investment fund of \$150 billion to finance mergers and acquisitions for companies and technologies in the semiconductor industry.¹³

As a result, China is poised to successfully compete in the semiconductor sector. China is making significant investments and now has 13% of the global fabless market, up from 5% in 2010.¹⁴ The Chinese semiconductor manufacturing sector has seen an average compound growth rate of nearly 25 percent since 2014.¹⁵ Design of semiconductors is also making significant progress in China. In 2019, China’s semiconductor design sector reached a level that surpassed Taiwan, making China the second-largest design industry cluster after the United States globally. China’s share of semiconductor design grew from 3.6 percent in 2004 to nearly 43 percent in 2019.¹⁶ Leadership in semiconductor design and manufacturing implies leadership in new information technology, which is but one sector of emphasis of the “Made in China 2025” plan for economic competition.

The US has begun to recognize the criticality of America’s supply chains and the economic security and national security challenge posed by foreign disruption. The recent White House review on this topic launched a comprehensive whole-of-government effort to strengthen domestic competitiveness and supply chain resilience across four critical sectors: (1) semiconductor manufacturing and advanced packaging, (2) large capacity batteries, (3) critical minerals and materials, and (4) pharmaceuticals and active pharmaceutical ingredients.¹⁷

To answer the challenge of economic competition, the US will need to greatly improve its ability to understand the national security implications of foreign economic developments and to provide better

-
- 11 US Department of the Treasury. “Issuance of Executive Order Addressing the Threat from Securities Investments that Finance Certain Companies of the People’s Republic of China & Related FAQs; Introduction of Non-SDN Chinese Military-Industrial Complex Companies List,” <https://home.treasury.gov/policy-issues/financial-sanctions/recent-actions/20210603>.
 - 12 Semi. “300mm Fab Spending to Boom through 2023 with Two Record Highs,” November 3, 2020, <https://www.semi.org/en/news-media-press/semi-press-releases/300mm-fab-outlook>.
 - 13 Chamber of Commerce. “Made in China 2025: Global Ambitions Built on Local Projections, 2017.” https://www.uschamber.com/assets/archived/images/final_made_in_china_2025_report_full.pdf.
 - 14 Varas, Antonio and Raj Varadatajan. “How Restrictions to Trade with China Could End US Leadership in Semiconductors,” Boston Consulting Group, March 2020, <https://www.bcg.com/en-us/publications/2020/restricting-trade-with-china-could-end-united-states-semiconductor-leadership>.
 - 15 Triolo, Paul. “The Future of China’s Semiconductor Industry,” *American Affairs* Spring 2021 5 (1), <https://americanaffairsjournal.org/2021/02/the-future-of-chinas-semiconductor-industry>.
 - 16 US Department of the Treasury. “Threat from Securities Investments,” <https://home.treasury.gov/policy-issues/financial-sanctions/recent-actions/20210603>.
 - 17 The White House. “100-Day Reviews under Executive Order 14017,” June 2021, <https://www.whitehouse.gov/wp-content/uploads/2021/06/100-day-supply-chain-review-report.pdf>.

security for its own developments. New technologies can assist in addressing the national security implications of economic competition. Pursuit and integration of these directions into a comprehensive national defense apparatus might require new agencies and resources. Technology concepts, adapted from the commercial sector, could open new approaches to respond to economic challenges. These include the following.

- *Development and utilization of real-time national financial models to provide early warning indicators of critical supply chain disruptions, on both sides, thereby playing long-term offense and defense.* Statistical models applied to open-source financial and industry data are being used today by companies to optimize global supply chain efficiencies and costs. With additional data, these could be used at a national level to preemptively forecast supply chain risks and economic impact and to make decisions to secure critical supplies for national needs.
- *Development and utilization of macroeconomic models to forecast foreign government involvements across global markets, and to provide early indicators of potential disruptive activities.* For example, modeling mainland China’s potential economic futures with Taiwan would help to better understand and shape the region to thwart conflicts. Monte Carlo simulation techniques exist today to model thousands of scenarios and alert on early warnings and emerging scenarios, and to game threats and optimize responses. Analysts today monitor military threats; future analysts will use tools to analyze economic threats.
- *Utilization of blockchain, watermarking, design partitioning, and hardware obfuscation security approaches.* Such approaches, emerging for use in commercial venues, can mitigate risks of counterfeiting, intellectual property theft, and tampering. A national approach is needed to integrate in-line data from millions of sensors across complex global supply chains with comprehensive analysis of the data to model and deploy strategies to defend the economic homeland.

MILITARY COMPETITION

Military strength and resiliency comprise a second element of competition. China’s strategy of “Military-Civil Fusion” poses significant challenges for the US and our allies. China’s Military-Civil Fusion development strategy has leveraged a whole-of-government approach to achieving parity with the United States in several military areas, including air defense systems, land-based conventional ballistic and cruise missiles, and shipbuilding.¹⁸ The prospect of China developing and fielding advanced military capabilities by integrating research across its commercial sector with its military and defense industrial sectors, is a key element of this great power competition.

The Communist Party of China (CPC) Central Committee has established the goal of building a “fully modern military” by 2027, with the capability to defend national sovereignty, safeguard against security threats in the western pacific region, and protect overseas development interests as China’s global economic presence grows.¹⁹ These plans include accelerating its integrated development in

18 Office of the Secretary of Defense. “Military and Security Developments involving the People’s Republic of China 2020,” *Annual Report to Congress*. August 21, 2020, <https://media.defense.gov/2020/Sep/01/2002488689/-1/-1/1/2020-DOD-CHINA-MILITARY-POWER-REPORT-FINAL.PDF>.

19 The State Council of the People’s Republic of China. Communiqué of the Fifth Plenary Session of the 19th CPC Central Committee. October 30, 2020, http://english.www.gov.cn/news/topnews/202010/30/content_WS5f9b6f64c6d0f7257693ea0a.html.

“mechanization,” “informatization,” and “intelligentization,” comprehensively strengthening military training and preparation. A recent report outlines the pace and impact of China’s military modernization, with a focus on the People’s Liberation Army’s (PLA’s) strategy to use science and technology for military purposes.²⁰

Over the past decade, China has made significant progress in key technical areas including radio frequency systems, electronic warfare, hypersonics, and more recently quantum computing. As an example, Chinese researchers recently published an approach to network hypersonic weapons into a smart swarm for coordinated attacks.²¹ The concept opens the alarming prospect of a saturation attack that would be difficult to counter, even with future air defense systems. Particularly alarming are the references that the Beijing Institute of Technology authors cited, including the Raytheon Tomahawk Cruise Missile (RGM/UGM-109) Technical Manual and System Description.

In the field of quantum technologies, the Intelligent Perception Technology Laboratory of the 14th Institute of China Electronics Technology Group Corporation (CETC) announced China’s first quantum radar system in 2016 and displayed a mockup at the Zhuhai Airshow in 2018.²² ²³ More recently, China opened the world’s largest quantum research center to push the frontier of quantum computing. The National Laboratory for Quantum Information Sciences, a \$10 billion four-million square foot facility, has programs in quantum sensing, self-contained navigation, quantum computing, and quantum communications.

The United States has relied upon US technology leadership, unmatched engineering talent, and highly trained military personnel to build, deploy, and operate the world’s most technologically advanced military. With the development and availability of key advanced technologies from the commercial sector, nation state competitors and non-state actors now have equivalent access, eroding the technology overmatch to which our nation has grown accustomed. To recover and maintain technology superiority for military systems, new emphasis needs to be placed on defense technologies, involving new R&D agencies and approaches. Some concepts that should be explored prior to establishing such centers include the following.

- *Faster movement toward reinvigorating US technology development demonstrating and fielding advanced technology in key areas.* The DOD can do so by expanding its federally funded research and development centers (FFRDCs) and Department Laboratories, or instituting new ones, in partnership with US industry. By using new partnership models to engage in a campaign of continuous development with field testing and integration, the US can match and exceed the efficiency of China’s Military-Civil Fusion model for military systems development.
- *Tools and techniques for persistent gray zone operations in competition with China.* New approaches are needed to comprehend the long-term regional environment—economically, politically, and militarily. Long-duration campaign planning tools must employ tailorable and reversible effects at the most effective points in a regional campaign. Machine learning and dynamic planning could be adapted from the commercial sector and tailored with appropriate

20 The National Institute for Defense Studies. “NIDS China Security Report 2021: China’s Military Strategy in the New Era,” Nov 2020, http://www.nids.mod.go.jp/publication/chinareport/pdf/china_report_EN_web_2021_A01.pdf.

21 Luo, Shixun, Zhongshan Zhang, Shuai Wang, et al. “Network for Hypersonic UCAV Swarms,” *Science China Information Sciences* Issue 63, Article Number 140311 (2020), <https://doi.org/10.1007/s11432-019-2765-7>.

22 CETC 14th Research Institute. <https://www.globalsecurity.org/military/world/china/cetc-14.htm>.

23 “China Shows off First Quantum Radar Prototype,” Aviation Week Network. November 5, 2018, <https://aviationweek.com/defense-space/china-shows-first-quantum-radar-prototype>.

sensor data and modeling to preemptively plan for emerging scenarios. Emerging tools and techniques are beginning to provide military planners a “look ahead” into incipient scenarios and the opportunity to plan accordingly.²⁴

- *A new deterrence strategy to address a combined Nuclear, Chemical, Biological, Cyber (NCBC) threat, expanding the range of highest priority threats requiring national capabilities.* New deterrence, detection, and countermeasure techniques are needed considering that any combination of NCBC employment could present an existential threat to the United States. Natural or man-made, the COVID-19 pandemic resulted in millions of deaths and crippled the world’s economy for many months. Fielding a global NCBC early warning capability is essential as engineered pathogens could have a similar impact. Deploying such a capability globally with allies and partner nations requires US global leadership.

POLITICAL COMPETITION

Political strength is the third, and perhaps most challenging, element of the great power competition between the United States and China. China has harnessed its political and military strength in the South China Sea on a gray zone strategy. This has become an operational domain characterized by a long campaign of low threshold actions to achieve long-term strategic objectives without crossing the threshold of military confrontation.²⁵ It includes elements of Hybrid Warfare²⁶ and Soft Power.²⁷

China and Russia are increasingly using gray zone means to achieve their objectives without direct military engagement and below the level of war.²⁸ The gray zone is growing rapidly in the South China Sea, where China is using coercion, intimidation, propaganda, and manipulation to expand its position in the region.²⁹ China has built an artificial island chain, reclaimed disputed land, militarized islands, and is using legal arguments and diplomatic influence to expand its position.

In early 2020, China’s State Council established two new districts in Sansha City, a prefecture-level city headquartered on Woody Island which governs the bulk of China’s territorial claims in the South China Sea. This development will expand China’s control over the region and further complicate political and diplomatic dynamics.

While military deterrence is essential, the United States and our allies need a set of new technical and operational capabilities to operate in a persistent and multi-domain gray zone.^{30 31}

24 Nott, Chris, Stephen Gordon, and Leendert van Bochoven. “IBM Defense Simulation Analytical Service,” December 10, 2021, <https://www.ibm.com/blogs/think/uk-en/defense-simulation-analytical-service/>.

25 Popp, George and Sarah Cana. “The Characterization and Conditions of the Gray Zone: A Virtual Think Tank Analysis,” *NSI Inc* Winter 2016.

26 Hoffman, Frank. “Examining Complex Forms of Conflict: Gray Zone and Hybrid Challenges,” National Defense University. *PRISM* 7(4) November 2018.

27 Nye, Joseph. “Soft Power,” *Foreign Policy* No. 80, Twentieth Anniversary (Autumn, 1990), 153-171.

28 Morris, Lyle J., et al. “Gaining Competitive Advantage in the Gray Zone: Response Options for Coercive Aggression Below the Threshold of Major War,” RAND Corporation. 2019, https://www.rand.org/pubs/research_reports/RR2942.html.

29 Mastro, Oriana Skylar. “Military Confrontation in the South China Sea,” *Council on Foreign Relations* May 21, 2020, <https://www.cfr.org/report/military-confrontation-south-china-sea>.

30 Defense Science Board. “Summer Study on Capabilities for Constrained Military Operations,” December 28, 2016, https://dsb.cto.mil/reports/2010s/DSBSS16_CMO.pdf.

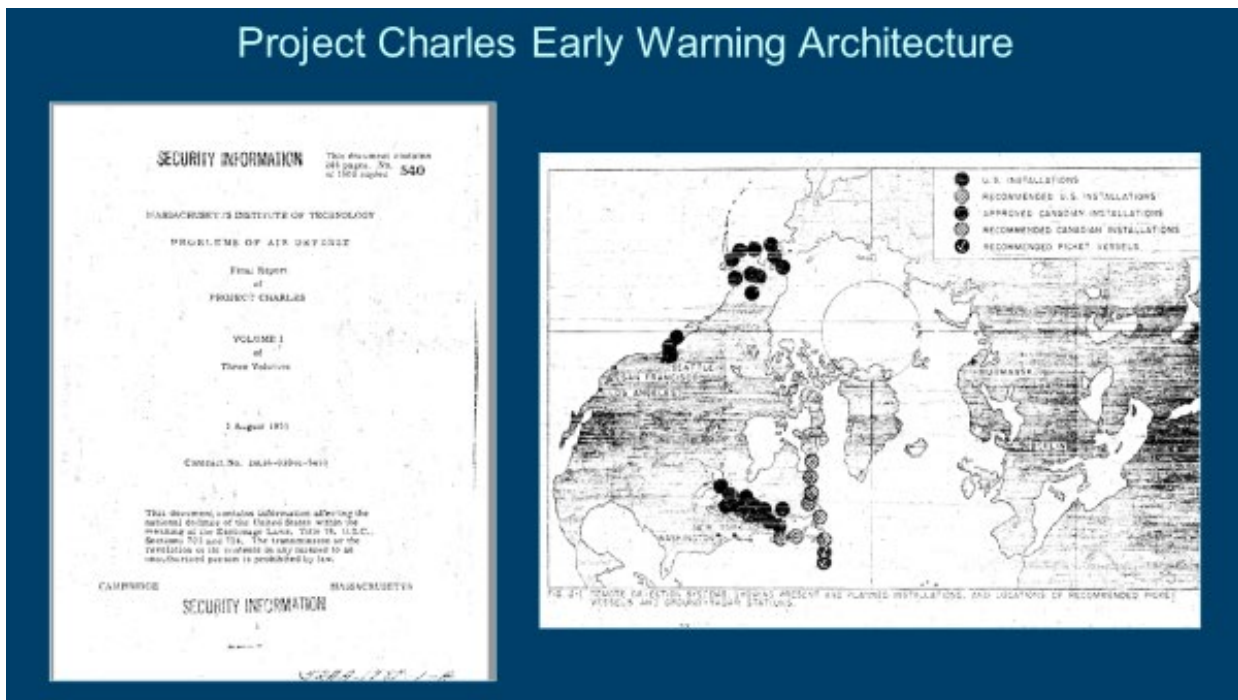
31 Defense Science Board. “Task Force on 21st Century Multi-Domain Effects,” September 2020, <https://dsb.cto.mil/reports/2020s/FINALMDEExecutiveSummary.pdf>.

Prevailing in a prolonged political competition with China requires the United States to develop and implement a whole-of-government approach to integrate economic, political, and military signatures, indications, and warnings. The following technical approaches should be explored and deployed.

- *Intelligence, advanced forecasting, and decision support capabilities to detect, tailor, and preemptively plan economic, political, and military actions.* Political actions can involve influence operations, marketing, competitive assistance, as well as tariffs and sanctions. Techniques can be adapted from the commercial sector to process live-stream data and alert on emergent behavior.
- *Whole-of-government synchronous strategic messaging and information operations using approaches from the commercial sector.* Social media has opened a new strategic communication channel for enabling red teaming against a range of simulated actions and responses from China. The development of multi-domain models could open the prospects of predictive risk assessment to extend our economic, political, and military options.
- *New technical approaches to detect and protect government, enterprise, and private information that are increasingly entangled and increasingly vulnerable.* Developing an effective layered information defense system is a daunting challenge. In addition to protecting critical infrastructure, effective capabilities would position the United States as a leader in information security, countering China's cybersecurity laws that permit the government to obtain any information that they deem has an impact on Chinese security.

PEER-LEVEL CHALLENGES OF THE PAST

The US has faced peer-level national challenges in the past. Our peer-level competition with China on the economic, military, and political levels is no less daunting than the confrontation with the Soviet Union some 70 years ago.



The Soviet Union detonated its first atomic bomb in September 1949, and by 1951, the Korean War had begun as a proxy war with the Soviet Union. With growing geopolitical tension between the United States and the Soviet Union, the US confronted the possibility of a devastating surprise attack.

In response, the US completely revamped the defense system in the 1950s and beyond. A strategy of containing the Soviet Union was devised, and more importantly, enacted. For example, the Project Charles Air Defense Study, begun in 1951, was more than a study, but a four-month effort to design short- and long-term development of an early warning system for attacks that might emanate from the Soviet Union.³² It led to the formation of MIT Lincoln Laboratory,³³ and engaged scientists and engineers from across industry and academia, and military liaisons, to outline many of the principles of today's air defense systems. They focused on early warning target detection and discrimination, threat interception, and command and control. Project Charles working groups were briefed on Soviet strategic capabilities and visited military operational field sites. They evaluated approaches to detect a small number of threat aircraft buried in a large constellation of commercial aircraft, and the importance of field testing a prototype system comprised of a network of small radars connected to a central computer at a command center.

With urgency to quickly counter the Soviet threat, the Project Charles Study outlined a development program that included short-term extensions of current technologies and longer-term plans to leverage an "electronic high-speed digital computer...and the revolution that the transistor will bring about in electronics to open up quite new possibilities in aircraft and weapon control."³⁴ These options were available because the United States led the world in radar, electronic warfare, communications, electronics, display, and other key technologies needed to deploy an initial early warning system.³⁵

Resulting contracts and development, called "Project Lincoln," led to the Semi-Automatic Ground Environment (SAGE) system and the Distant Early Warning system. RAND Corporation, another Federal Contract Research Center, was involved in developing the programming for the sophisticated mainframe computer, and MITRE was founded in 1958 to operate and expand the system.³⁶ SAGE protected the United States into the 1980s.^{37 38}

The use of FFRDCs was established for challenges that cannot be met solely through the commercial sector. As national security threats evolved from bombers to intercontinental ballistic missiles, FFRDCs focused their efforts on a major initiative in ballistic missile defense. This began in the late 1950s, expanded in the 1960s, and grew significantly in the 1980s with President Reagan's establishment of the Strategic Defense Initiative.³⁹ This work was critical to US national security and led to software and hardware

32 Loomis, F.W. "Problems of Air Defense: Final Report of Project Charles," Contract Number DA36-0039sc-5450, August 1, 1951, http://www.bitsavers.org/pdf/mit/lincolnLaboratory/project_charles/A800165_Final_Report_of_Project_Charles_Vol_1_Aug1951.pdf.

33 Grometstein, Alan A. "MIT Lincoln Laboratory: Technology in Support of National Security," *Lincoln Laboratory MIT*. 2011, http://www.ll.mit.edu/sites/default/files/other/doc/2018-04/MIT_Lincoln_Laboratory_history_book.pdf.

34 IBM. "SAGE: The First National Air Defense Network, IBM100 Icons of Progress." <https://www.ibm.com/ibm/history/ibm100/us/en/icons/sage/>.

35 "SAGE: The First National Air Defense Network."

36 Sage MITRE. "SAGE: Semi-Automatic Ground Environment," <https://sage.mitre.org/>.

37 Shield, Kenneth. "The Emerging Shield: The Air Force and the Evolution of Continental Air Defense, 1945–1960," Office of the Air Force History. 1991, <https://archive.org/details/TheEmergingShield/page/n23/mode/2up>.

38 Ekstedt, G.O. "The DEW Line Story (Western Electric Company)." <https://www.beatriceco.com/bti/porticus/bell/pdf/dewline.pdf>.

39 Ronald Reagan Presidential Library & Museum. "Address to the Nation on Defense and National Security," March 23, 1983, <https://www.reaganlibrary.gov/archives/speech/address-nation-defense-and-national-security>.

concepts which are in use today, including collection and analysis of test data, high fidelity simulations, critical discrimination techniques, and design of new radar and infrared sensors.

LESSONS LEARNED FROM THE COLD WAR COMPETITION

We can learn from the competition between the United States and the Soviet Union in the second half of the 20th century. The Cold War was a competition between liberal democracies and communism, just as we now confront a competition with a different form of government. The Soviet Union's self-proclaimed world power centered on its massive number of ballistic missiles with nuclear munitions. Without its ballistic missiles, the Soviet Union could not project power very far beyond its regional boundaries.

In our current confrontation, the protagonists are, as before, very careful not to engage with each other in direct military confrontation. Just as the Cold War lasted about 40 years, the current competition is likely to last for multiple decades. The United States, with superior technology, won the Cold War. The US competed with the Soviet Union in a technology race to directly challenge their missile force with developments such as the Strategic Defense Initiative. The Soviet Union was in no position to engage and thus, conceded defeat when President Yeltsin dissolved the Soviet Union on December 8, 1991.⁴⁰

INTERDEPENDENT ELEMENTS OF THIS GREAT POWER COMPETITION

While military, economic, and political interdependencies are not new, we are now in competition with a peer nation where military strength alone is not sufficient to succeed.

In a similar manner, new technical capabilities and operational concepts are needed to prevail in a long-term great power competition with China, which may also last for decades. In each element of great power competition, there are possible solutions, involving technology, policies, and investments in R&D.

But in developing solutions, we must recognize the interdependencies and interoperability of these capabilities. Responses in one area will affect other areas, and to prevail, we must respond in all areas. Each of these domains—economic, military, and political—have unique signatures and can be competitively modeled. But it is the interplay among domains that is critical. The challenge is to decompose this into a cross-domain model, fed by live-stream data to provide insight for preemptive courses of action. This is a messy, loosely structured, data-rich environment with a host of potential threats and ambiguities. It is also the environment we must understand and in which we must prevail.

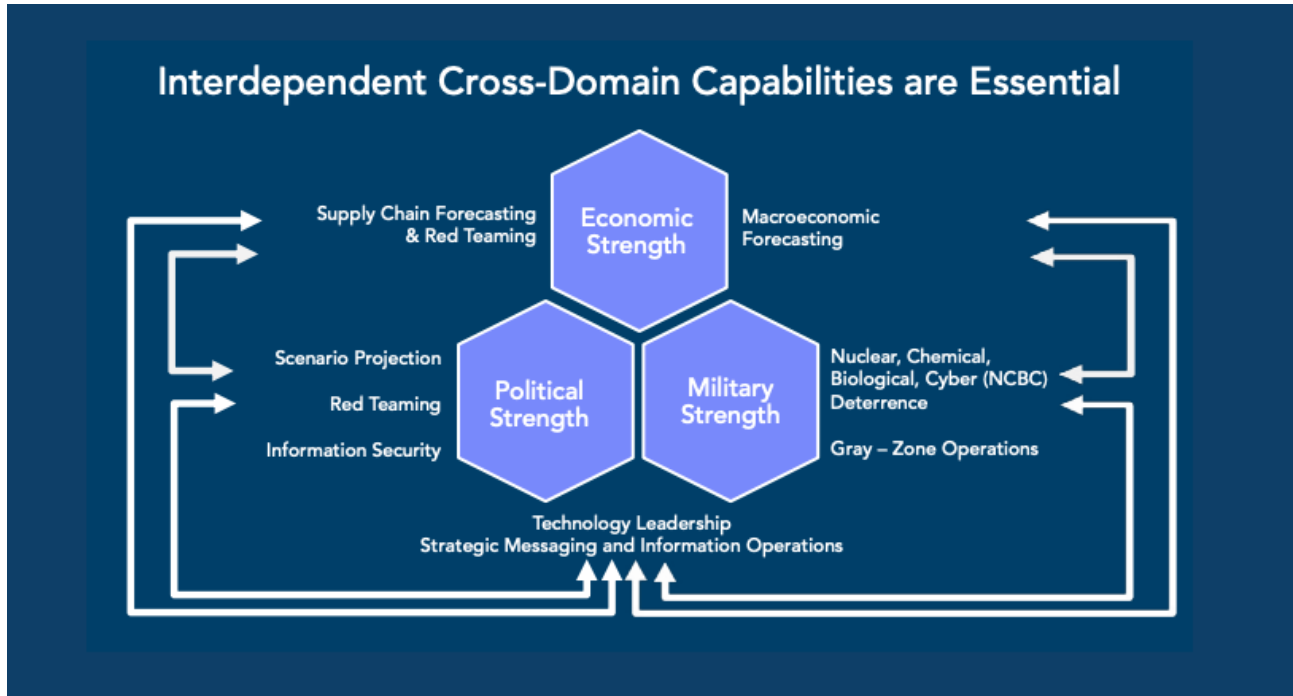
A CALL TO ACTION

The United States and China are in a protracted great power competition that will have profound impact on the national security and economic security of both countries for decades. The complex and interdependent economic, military, and diplomatic tension between the US and China has opened a new era of national security challenges. Just as superior technology allowed the United States to prevail against the Soviet Union, technology solutions will be the deciding factor in our current competition.

Yet, our current structures for acquiring and applying technologies are inadequate for the challenges posed by the new great power competition. The defense industrial base designs and builds weapon

40 Dobbs, Michael. "Slavic Republics Declare Soviet Union Liquidated," *Washington Post Foreign Service* December 9, 1991, Page A01, <https://www.washingtonpost.com/archive/politics/1991/12/09/slavic-republics-declare-soviet-union-liquidated/c15d0d5d-7e03-42c6-b1a1-6eb0568a8c80/>.

systems with advanced technology. The commercial sector is remarkably effective at developing high technology commercial goods. Private industry, often with government help, invests in technologies for health care, transportation, energy, space, materials, and manufacturing. Basic research capabilities and advancements are strong. What is lacking, however, is an integrated approach to addressing the interlocking economic, military, and political competition with those who have developed their own capabilities and technological progress.



A focused executive commission is urgently needed to frame this multi-domain challenge, to include talent from across industry, academia, government, and the military. Like Project Solarium and Project Charles, the study needs to involve the most senior, trusted, and intellectual experts in the nation. The study's "Terms of Reference" should be succinct and blunt: How can the United States prevail in the great power competition with China? What new capabilities do we need? What are the operational models and how are these integrated across whole-of-government? Bold ideas merit exploration.

This will not be a study typically conducted by agencies today. This commission needs to have an impact. Both short-term and long-term recommendations must lead to action, both executive and legislative.

The results are certain to support a restructuring of our technology development enterprise. Near-term fixes will be proposed to leverage novel technologies. But long-term developments will also be needed. New long-term institutions are likely to be proposed, including new FFRDCs and new government laboratories. These might be carved from existing institutions, but they also might require new centers to support evolving needs. A pipeline of human capital and infrastructure resources will be necessary. Support to the military's combatant command at United States Indo-Pacific Command (USINDIOPACOM) will be critical to develop and validate cohesive econometric/military/political models that can be integrated through operations. Other combatant commands and collaboration with allies will be equally important. New weapon systems for deterrence will be but one aspect of fortifying a great power competition in the economic, military, and political domains.

The United States has risen to grand challenges in the past, but only by taking bold and decisive steps. Those actions served to prevail in the past, but only after commitments that lasted decades. Today's challenges require similar kinds of commitments. It is time to frame the problem, propose approaches, and make those commitments.

CHAPTER 4: SUPPLY CHAIN FRAGILITY AND MICROELECTRONICS

GCP EVENT: US MICROELECTRONICS SUPPLY CHAINS AND COMPETITIVE ADVANTAGE

The Potomac Institute for Policy Studies hosted a GCP hybrid seminar titled “US Microelectronics Supply Chains and Competitive Advantage” on November 3, 2021. The panel of experts at this event included The Honorable Alan Shaffer (Former Undersecretary of Defense for Acquisition and Sustainment and Member of the Board of Regents at Potomac Institute); Michael Fritze, PhD (Senior Fellow, Potomac Institute for Policy Studies); Mike McGlone (Senior Commodity Strategist, Bloomberg Intelligence); and Jay Lewis (Partner, Silicon Projects at Microsoft). This chapter includes the article “Microelectronics: Supply Chain Challenges with ‘the New Oil’.”

INTRODUCTION

Our nation’s security and prosperity rely on microelectronics. From a security standpoint, the DOD cannot solve its microelectronics needs on its own, as it only represents 1 percent of the market. Corporations control the business aspects involving the global supply chains of the microelectronics industry.

Reliable and resilient supply chains are key for prosperity. This means less reliance on risky sources subject to interruptions in a crisis. However, we are in an age of robust economic competitiveness. Adversaries employ aggressive means to gain an edge—such as large investments, subsidies, intellectual property (IP) theft, and the use of market leverage (legitimate and illegitimate) for access to IP. Microelectronics are not a limited resource. We could produce all the microelectronics we wanted, at a cost. It is the economics of the supplies and production that lead to a competition.

Recent world events like the COVID-19 pandemic have highlighted not only vulnerabilities but also the importance of supply chains for competing in the modern world. The US is in the process of understanding supply chains within the framework of the contemporary global competitive environment. This is crucial to provide sustainable access to the services and materials vital to American prosperity and security. Supplies of microelectronics are especially concerning because they are important constituents in virtually every modern device underpinning prosperity and security. The recent CHIPS and Science Act legislation is a start at addressing the concerns.

In this chapter’s contribution (written before the CHIPS and Science Act of 2022 passed), Dr. Michael Fritze unwraps some of the details associated with the relationship between the microelectronics supply chains and the resulting challenges that America may face while trying to maintain a competitive advantage on the global stage.

MICROELECTRONICS: SUPPLY CHAIN CHALLENGES WITH “THE NEW OIL”¹

Paper by: Michael Fritze, PhD

A SHORTAGE OF CHIPS

The COVID-19 global pandemic has revealed the fragility of global supply chains. Business practices such as “just-in-time” supply chain strategies, so efficient during normal times, became serious liabilities in the face of supply disruptions, irrespective of their origins. Shortages of semiconductors (“chips”) have been but one of the many disruptions to ripple through the US economy in the wake of COVID-19, but one that was both highly consequential and surprising.

The public quickly took note when in the summer of 2020 automobile inventory shrunk and prices rose sharply. Auto manufacturers, such as Ford, had to stop manufacturing new cars and trucks because they did not have the chips on which the vehicles now depend.² Automotive chip shortages persist and the auto industry reportedly took a hit of \$210 billion in 2021 alone as a result.³ These shortages were due neither to delays at port facilities, nor to chip production interruptions at foundries. Rather, just as with shortages of personal protective equipment (PPE) and other goods, a fundamental cause was a dependence on foreign supplies and a failure to maintain sufficient inventory with assured resupply lines in times of need.⁴

Early in the pandemic, the automobile industry made the mistake of canceling orders in anticipation of much lower demand. Other industries were impacted by the shortage of microelectronics and continue to experience disruptions.⁵ The risks of relying on fragile supply chains reveals the potential of getting cut off from critically needed supplies in times of crisis. The pandemic highlighted the critical importance of securing US supply chains in the key industry of semiconductors.

NATIONAL SECURITY IMPLICATIONS

The ramifications resulting from chip shortages go beyond commercial inconveniences. Microelectronics are the foundation of the information economy, the underpinning of all information technology, and a prerequisite for advanced data science and telecommunications, which are all essential to a well-functioning society. But microelectronics is also at the heart of the US nuclear deterrent and conventional weapons systems, critical infrastructure and utility management, and all elements of national defense.

1 A version of this paper appears in *STEPS*, (*Science Technology Engineering and Policy Studies*), Issue 6, 2022, pg 34, as “Microelectronics: Supply Chain Challenges with ‘The New Oil,’” 2022STEPSIssue6.pdf (potomacinstitute.org).

2 Metz, Justin. “Car Chip Shortage 2021: What’s Going On?” Erie Insurance, January 28, 2022, <https://www.erieinsurance.com/blog/car-chip-shortage-2021>.

3 Wayland, Michael. “Chip Shortage Expected to Cost Auto Industry \$210 Billion in 2021,” September 23, 2021, <https://www.cnbc.com/2021/09/23/chip-shortage-expected-to-cost-auto-industry-210-billion-in-2021.html>.

4 Maithel, Peter. “Global Microchip Shortage in Automotive Industry Reinforces Need for Better Supply Chain Planning,” November 8, 2021, <https://diginomica.com/global-microchip-shortage-automotive-industry-reinforces-need-better-supply-chain-planning>.

5 Whalen, Jeanne. “Semiconductor Shortage that has Hobbled Manufacturing Worldwide is Getting Worse.” *Washington Post*. September 23, 2021. <https://www.washingtonpost.com/us-policy/2021/09/23/chip-shortage-forecast-automakers/>.

Current supply chain disruptions have shown potential adversaries how serious damage could be inflicted on the US, as described in Al Shafer’s paper “The Canary in a Coal Mine.”⁶

To be clear, in times of war—whether it is military, economic, or political vectors of combat⁷ or whether it is a “gray zone” war or war of competition—dependence on foreign supplies can pose a major national security vulnerability. If supplies are cut off, as in the use of sanctions, manufacturers might be left using inferior parts. For weapon systems, inferior parts lead to inferior weapons. Adversaries might emplace kill switches into parts that are then incorporated into military equipment, giving attackers the power to defeat a system on command. Microelectronic parts, like software, are subject to cyberattacks. Malicious insertions into microelectronics can enable foreign espionage, which can lead to information theft. Critical infrastructure might be disrupted in times of conflict: electric power or gas distribution might become unavailable. Communications might be disabled to hobble effective national responses.

The national security dependencies on microelectronics change our risk calculus. It is no longer just the losses of the automobile or consumer electronics industries. The security and surety of our microelectronics supply chain is an existential issue of national security, necessary for the protection of the nation from foreign influence, manipulation, and potential defeat.

However, the US DOD is no longer the driving force in research and market factors in the microelectronics field.⁸ Commercial interests have displaced the ability of the DOD to control supply chains for defense interests, despite the important national security implications. The risks imposed by supply dependencies are a vulnerability to national security, as well as economic and commercial sector concerns.

ASSURED ACCESS

Any solution must solve two issues with respect to the microelectronics supply:

- Provide a sufficient supply of SOTA components upon demand, with guaranteed access even under adverse circumstances, such as a global pandemic or economic conflict; and
- Provide access to trusted parts free from counterfeits, defects, inferior parts, manipulations, or insertions.

The same issues apply to other sectors, but neither condition is currently satisfied for the microelectronics sector.

The US is highly dependent on overseas suppliers for key semiconductor manufacturing steps, particularly fabrication and packaging and test. The semiconductor industry is a highly globalized endeavor, wherein key supply chain elements are located around the world (see Figure 4.1). There are multiple steps required in the production and delivery of chips (see Figure 4.2), with the “chip build” as the crucial step for the fabrication of the actual product. As a result of consolidation within the fabrication sector, Asian companies have dominated chip manufacturing (see Figure 4.3). In particular, TSMC (based in Taiwan) holds a

6 Shaffer, Alan R. “A Microelectronic ‘Canary in a Coal Mine,’” *STEPS* Issue (5) 2021: 8-17.

<https://www.potomac institute.org/steps/featured-articles/september-2021/a-microelectronic-canary-in-a-coal-mine>.

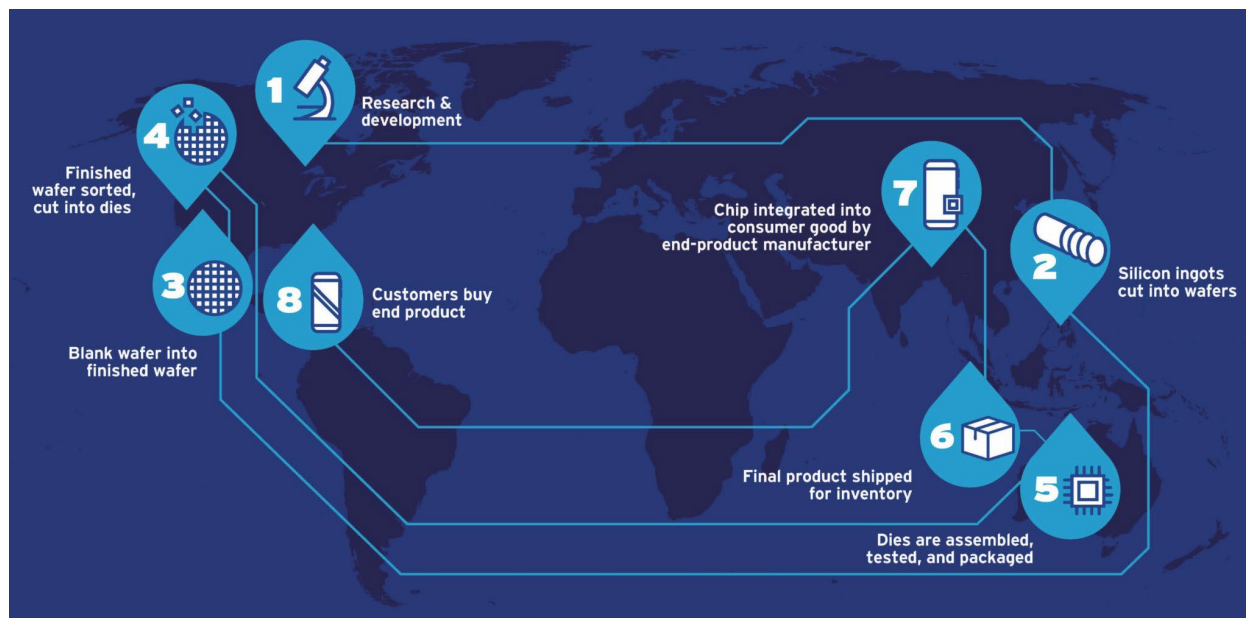
7 Lemnios, Zachary J. “US National Security in a New Era of Intense Global Competition,” *STEPS* Issue (6) 2022: 8-19, <https://potomac institute.org/featured/2503-us-national-security-in-a-new-era-of-intense-global-competition>.

8 Tadjdeh, Yasmin. “Microelectronics Industry at ‘Inflection Point,’” *National Defense Magazine* October 1, 2020, <https://www.nationaldefensemagazine.org/articles/2020/10/1/microelectronics-industry-at-inflection-point>.

commanding 58% market share in the “pure play” foundry market,⁹ where the company manufactures semiconductors primarily for outside customers and not internal consumption. Today, the US still dominates in design and verification, and possesses some foundries, but the SOTA components with the most recent developments are only manufactured in Asia.

Access to *trusted* microelectronics is even more challenging. Substitutions, insertions, or other tampering can occur at any point in the supply chain, and the fabrication step is particularly vulnerable. Historically, the US has used national security laws and classification authority to assure that the provenance and manufacturing of certain microelectronics parts was absolutely secure. However, with SOTA fabrication facilities (fabs) all offshore, that level of security is no longer available for the most desirable parts.

Figure 4.1. Complex Global Semiconductor Value Chain Map.



Source: Semiconductor Industry Association. Used with permission.

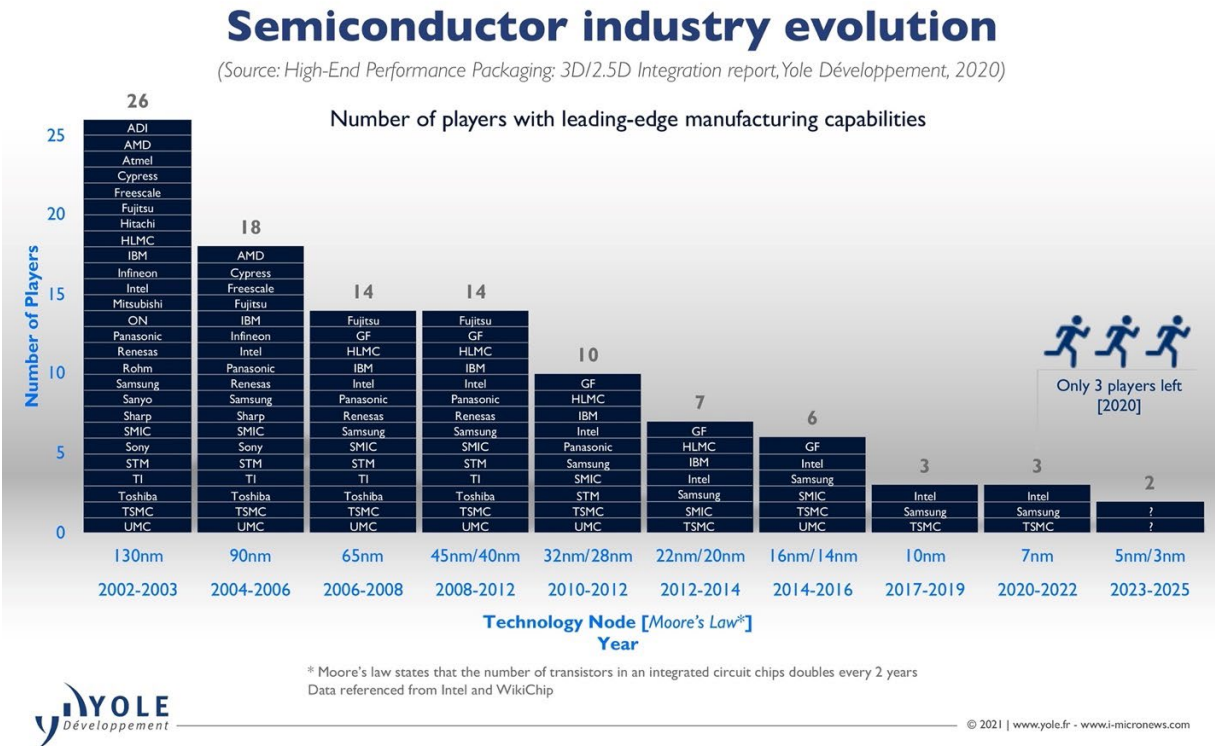
9 Park, Sin-Young. “Samsung Surprises Foundry Industry with Plan for 2 nm Chips,” *The Korea Economic Daily* October 10, 2021. <https://www.kedglobal.com/newsView/ked202110100002>.

Figure 4.2. Semiconductor Supply Chain for Digital Logic.



(Note the foreign dominance in fabrication and packaging and testing). Source: Potomac Institute for Policy Studies

Figure 4.3. Consolidation of Semiconductor SOTA Fabs.



Source: Yole Development. Used with permission.

CHINA AND MICROELECTRONICS

As part of the global competition in microelectronics, US adversaries are acutely aware of their own needs for assured access and trusted parts for use in their commercial, industrial, and military systems. China has been making very large investments to develop its own domestic semiconductor capabilities, as China is currently highly dependent on imports.^{10,11} China has recently established funds worth approximately \$150 billion and \$30 billion to support state-owned acquisition of foreign semiconductor production capabilities.¹² China continues to invest in its own fabs and stimulates the establishment of domestic fabless design companies. A modern fab facility run by TSMC has been established in Nanjing.¹³ China's State Council issued a *Notice on Several Policies to Promote the High-quality Development of the Integrated Circuit Industry and Software Industry in the New Era* and has been instituting incentives and subsidies to promote its domestic semiconductor industry.¹⁴

Such subsidies pose a major challenge to the competitiveness of the US semiconductor industry. More than guaranteeing its own assured access to microelectronics, China's large investments and acquisitions represent a plan to gain global economic competitive advantages in the microelectronics sector, as detailed in the "Made in China 2025" plan.¹⁵ As a result, China could, in the future, hold a monopoly position in the world's supply of advanced microelectronics.

POLICIES: CARROTS AND STICKS

The US needs a comprehensive national microelectronics strategy that responds to the changing geopolitical landscape. Policies need to be enacted that provide for assured access and trusted supplies. The same is true for other critical supply lines, but the characteristics of the semiconductor business are sufficiently different from other sectors that a unique approach is needed.

Typically, fabs take many years to build and require massive investments (tens of billions of dollars).¹⁶ Further, they are only economically viable if they maintain a large market share and have a sufficiently long lifespan over which to amortize their high costs. Accordingly, fixing the microelectronics supply chain problem requires a long-term approach that uses both carrots and sticks to steer the microelectronics industry. Separate proposals exist for each.

-
- 10 Sheng, Wei. "Where China is Investing in Semiconductors, in Charts," March 4, 2021. <https://technode.com/2021/03/04/where-china-is-investing-in-semiconductors-in-charts/>.
 - 11 Sheng, Wei. "China Spends More Importing Semiconductors than Oil," April 29, 2021. <https://technode.com/2021/04/29/china-spends-more-importing-semiconductors-than-oil/>.
 - 12 "China's New Semiconductor Policies: Issues for Congress," *Congressional Research Service* <https://efaidnbmnnnibpcajpcglclefindmkaj/viewer.html?pdfurl=https%3A%2F%2Fcrsreports.congress.gov%2Fproduct%2Fpdf%2FR%2FR46767>.
 - 13 Clarke, Peter. "TSMC, Nanjing sign to build Chinese Wafer Fab," March 28, 2016. <https://www.eenewsautomotive.com/news/tsmc-nanjing-sign-build-chinese-wafer-fab>.
 - 14 "The State Council Issued a New Era to Promote the Integrated Circuit Industry and Notice on Several Policies for High-Quality Development of Software Industry," August 4, 2020. http://www.gov.cn/zhengce/content/2020-08/04/content_5532370.htm.
 - 15 "'Made in China 2025' Plan Issued," May 19, 2015. http://english.www.gov.cn/policies/latest_releases/2015/05/19/content_281475110703534.htm.
 - 16 Gregg, Aaron. "Samsung Plans to Build \$17 Billion Chip Factory in Texas," *The Washington Post*. November 23, 2021. <https://www.washingtonpost.com/business/2021/11/23/samsung-chip-factory-taylor-texas/>.

The DOD has a requirement for a “Program Protection Plan” within all major defense acquisition programs.¹⁷ That plan should ensure that all microelectronics used in a weapon system are procured through secure channels. The Potomac Institute, many years ago, recommended that FPGAs (microelectronics that are post-fabrication programmable) be bought by those programs from sources manufactured domestically, thereby creating a compulsory demand signal (a version of a “Buy America Act”).¹⁸ At the time, there were no domestically produced FPGAs.¹⁹ A “Buy America Act” for all major DOD acquisitions would not provide a large enough market. Alan Shaffer, the former Deputy Under Secretary for Acquisition and Sustainment, has argued that domestically sourcing all microelectronics purchased for critical US systems—whether a weapon system, a US government desktop computer, or a node in the domestic electric grid—would constitute a much larger market that, if instituted over time, could create a sufficient demand for secure domestic microelectronics.²⁰ This regulation, which would be imposed as a “stick,” could be justified on national security grounds. The US government could be yet more aggressive, although sweeping “Buy America” acts are considered anti-competitive, inefficient, and in violation of World Trade Organization rules.²¹

In the realm of carrots, one concept is to meet foreign subsidies with our own. Such legislation has been proposed in the US Congress.

The CHIPS Act, “Creating Helpful Incentives to Produce Semiconductors,” proposes \$52 billion through 2026 “to stimulate advanced chip manufacturing, enable cutting-edge R&D, secure the supply chain and bring greater transparency to the microelectronics ecosystem, create American jobs, and ensure long-term national security.”²² The act passed the US Senate in June, 2021, as part of the US Innovation and Competition Act (USICA),²³ and includes funding for the formation of a public-private partnership (PPP) called the National Semiconductor Technology Center.²⁴ USICA also addresses other technology sectors, with an additional \$190 billion over several years. As of this writing, the proposed legislation has not passed the US House of Representatives. Other proposed legislation, such as the Facilitating American-

17 Merrill, Peter and Howard Harris. “Program Protection Plan,” Defense Acquisition University July 1, 2018. <https://www.dau.edu/library/defense-atl/blog/Program-Protection-Plan>.

18 Internal report and briefing at the Potomac Institute, briefed to senior DOD officials as FOUO pre-decisional reports, dated Feb 23, 2015, included the recommendation “Require that DOD FPGAs be purchased from Trusted sources for weapons and national security systems requiring Trust.”

19 Intel Corporation purchased Altera, an FPGA maker, in 2015, and so now there are some US fabs for FPGAs, despite the lack of a buy American policy.

20 Shaffer, Alan R. “A Microelectronic ‘Canary in a Coal Mine,’” *STEPS* Issue (5) 2021: 8-17, <https://www.potomac institute.org/steps/featured-articles/september-2021/a-microelectronic-canary-in-a-coal-mine>.

21 Fefer, Rachel F. and Ian F. Fergusson. “Trade Implications of the President’s Buy American Executive Order,” *CRS Insight* May 2, 2017. <https://sgp.fas.org/crs/misc/IN10697.pdf>.

22 Warner, Mark. “Bipartisan, Bicameral Bill Will Help Bring Production of Semiconductors, Critical to National Security,” June 20, 2021. <https://www.warner.senate.gov/public/index.cfm/2020/6/bipartisan-bicameral-bill-will-help-bring-production-of-semiconductors-critical-to-national-security-back-to-u-#:~:text=The%20CHIPS%20For%20America%20Act%3A%20Creates%20a%2040-percent,percent%20in%202026%2C%20and%20phases%20out%20in%202027>.

23 S.1260 - 117th Congress (2021-2022): United States Innovation and Competition Act of 2021, <https://www.congress.gov/bill/117th-congress/senate-bill/1260>.

24 “Schumer Brings Commerce Secretary Gina Raimondo to Meet with IBM & Other Albany Nanotech Complex Stakeholders & Discuss Cutting-Edge Semiconductor R&D Happening in Albany; Senator Says Albany Ideal for Future National Semiconductor Technology Center That Would Bring 1000+ Jobs to Capital Region,” July 22, 2021, https://www.schumer.senate.gov/newsroom/press-releases/schumer-brings-commerce-secretary-gina-raimondo-to-meet-with-ibm-and-other-albany-nanotech-complex-stakeholders_discuss-cutting-edge-semiconductor-rd-happening-in-albany-senator-says-albany-ideal-for-future-national-semiconductor-technology-center-that-would-bring-1000-jobs-to-capital-region.

Built Semiconductors (FABS) Act, would provide tax credits to incentivize American semiconductor manufacturing.²⁵ These legislative proposals are strongly supported by the Semiconductor Industry Association (SIA)²⁶ and have bipartisan support. They are nonetheless controversial,^{27,28} as they single out particular technologies as “worthy” of advantageous “industrial policy” that amounts to welfare for certain corporate sectors.²⁹ China opposes the acts.³⁰

The use of PPPs has historically been an effective method to help strengthen the economic competitiveness of the domestic semiconductor industry. In the 1980s and 1990s, the US government helped foster “Sematech,” a consortium of semiconductor industries that pooled R&D.³¹ The lessons learned from the Sematech experience should be incorporated into any new microelectronics focused PPP such as the National Semiconductor Technology Center (NSTC). An appropriate research focus is important, in this case post-Moore technologies such as advanced packaging and cost-effective custom chip fabrication. The governing structure is also crucial where the independence of the managing organization from individual member desires is essential for long-term success. A PPP such as the proposed NSTC should have clear commercial transition paths for new technologies.

Under a PPP program today, government engineers could work collaboratively with industry experts to develop tailored semiconductor products. Chips with added security would be an especially welcome product that would satisfy needs across the DOD and other security conscious markets. Many critical infrastructure sectors outside of government exist, including sectors such as banking, the power grid, water utilities, medical providers, special communications, and transportation. Taken together with the DOD, these areas could represent a major and viable new premium market for more secure semiconductor hardware. The National Defense Industry Association suggests that this approach could satisfy 20-25% of world demand for secure microelectronics.³²

US Air Force Research Lab scientists independently produced a government-owned design, and manufactured a chip for defense applications.³³ If such a program were scaled up with SOTA technology and produced in conjunction with domestic fabs, a PPP with US industry might create a sustainable business. The US government could then ensure its position as first-in-line for acquisition and distribution of products. We have emphasized the US government and US industry roles, but it would also be important

25 S.2107 - 117th Congress (2021-2022): The Facilitating American-Built Semiconductors (FABS) Act. <https://www.congress.gov/bill/117th-congress/senate-bill/2107?s=1&r=68>.

26 “CHIPS for America Act & FABS Act,” *Semiconductor Industry Association*. <https://www.semiconductors.org/chips/>.

27 Calhoun, George. “Semiconductors – The CHIPS Act: What It Is (Part 1),” *Forbes* Nov 23, 2021. <https://www.forbes.com/sites/georgecalhoun/2021/11/23/semiconductors--the-chips-act-why-it-is-what-it-is-part-1/?sh=52812bd64a8e>.

28 Calhoun, George. “The CHIPS Act: Good Questions, Bad Questions, Bad Bets? (Part 2),” *Forbes* Nov 27, 2021. <https://www.forbes.com/sites/georgecalhoun/2021/11/27/the-chips-act-good-questions-bad-questions-bad-bets-part-2/?sh=54d35cef6cc5>.

29 “Are Proposed US and EU “CHIPS Acts” Already Outmoded and Irrelevant?” *Lexology* <https://www.lexology.com/library/detail.aspx?g=9d876396-05ae-4cd4-bac5-699ce4b751d0>.

30 Shepardson, David. “Senate Passes Sweeping Bill to Address China Tech Threat,” *Reuters* June 9, 2021. <https://www.reuters.com/world/us/us-senate-set-pass-sweeping-bill-address-china-tech-threat-2021-06-08/>.

31 Hof, Robert D. “Lessons from Sematech,” *MIT Technology Review* July 25, 2011. <https://www.technologyreview.com/2011/07/25/192832/lessons-from-sematech/>.

32 “How to On-Shore Critical Semiconductor Production, Secure the Supply Chain, and Provide Access for the Industrial Base.” *NDIA: Electronics Division*. February 2021. <https://www.ndia.org/-/media/sites/ndia/divisions/electronics/images---resources/ndia-on-shore-semiconductor-products-supply-chain-and-industrial-base-white-paper-final.ashx>.

33 “AFRL Information Directorate Overview.” *AFRL*. <https://www.afrl.af.mil/Portals/90/Documents/RI/AFRL-RI%20Overview%2088ABW-2020-2625-200924.pdf?ver=KgbkHUDQPpTmag1mU-95RA%3d%3d>.

to work collaboratively with allies that have strong capabilities in the semiconductor fields (such as Taiwan and South Korea), encouraging them to locate facilities in the United States.

SUMMARY

The automobile industry and COVID-19 forced us to confront the fragility of the microelectronics supply chain. Whether for economic purposes or national security, guaranteed and secure access to advanced microelectronics is very important for the US. We hope that industry has learned the lesson of the vulnerability of “just-in-time” supply chain behavior for critical microelectronics. In the semiconductor industry, it is never wise to “lose one’s place in line” for critical parts, as this leads to long delays and shortages. But ultimately, this goes beyond commercial bottom lines and consumer satisfaction. America needs a comprehensive national strategy to ensure access to advanced and trusted microelectronics that can serve the needs of the government and industry, alike.

The semiconductor industry is highly globalized with key parts of the supply chain dominated by overseas players. Continued outsourcing threatens not only assured access, but also the nation’s place of relevance in a field we brought to fruition. The US is currently vulnerable to microelectronics supply chain disruptions, whether from a pandemic, sanctions, or conflicts. The US needs a comprehensive national strategy for microelectronics to ensure our security and economic prosperity.

CHAPTER 5: STRATEGIC COMMUNICATIONS

GCP EVENT: STRATEGIC COMMUNICATIONS AND INFORMATION IN COMPETITION

The Potomac Institute for Policy Studies hosted a GCP public event titled “Strategic Communications and Information in Competition” on December 1, 2021. The panel of experts at this event included Curtis Pearson (Vice President at Potomac Institute); Jeff “Skunk” Baxter (Board of Regents Member, Potomac Institute for Policy Studies); Jody Moxham (Founder, PhaseOne Communications and Strategic Advisor); Alex Vacca, PhD (Corporate Director, Strategy at Northrop Grumman); and Rand Waltzman, PhD (Adjunct Senior Information Scientist, RAND Corporation and Board of Regents Member, Potomac Institute for Policy Studies). This chapter features the *STEPS* paper “Reclaiming the Narrative: The US and International Communications” written by Curtis Pearson, Jody Moxham, and Jeffrey “Skunk” Baxter.

INTRODUCTION

The Information Age has widely benefited society by broadly enhancing the world’s communication abilities. Never has it been easier for a single person to communicate whatever they want with millions or even billions of people from virtually anywhere around the world. The implications of mass communication are still being explored and understood from the societal level in terms of policy and technology.

Our national narrative—how and what we are communicating at the strategic level and how it is perceived and processed by our competitors and allies— is an element of global competition. Developing a strategic messaging plan to construct and articulate a narrative that clearly and consistently relays US intent is crucial to success in a globally competitive environment, especially in today’s world of rapid and unconstrained communication.

Of course, information is not a limited resource. The competition is not for the production of information, but rather for the mind space of the recipients of the information, and the ability to influence those minds.

Evidence of the profound impacts of strategic communication abound. Social media companies in Silicon Valley are undergoing deep reflection of their role in the spread of information. Propaganda maintains support within Russia for their war in Ukraine. China tightly controls internal access to information sources.

US competitors across the globe are using thoughtful and deliberate narratives to drive their own policy agendas and strategies. The US used to have a US Information Agency, with outlets throughout the world. As explained in this chapter’s article, the agency has largely been abandoned and the US no longer has a coordinated messaging strategy. The authors suggest a way that the narrative could be reclaimed.

RECLAIMING THE NARRATIVE: THE US AND INTERNATIONAL COMMUNICATIONS¹

Paper by: Curtis Pearson, Jody Moxham, and Jeffrey "Skunk" Baxter

THE SHINING CITY UPON A HILL

Not long ago, the United States was universally perceived as that shining "city upon a hill"²—a modern nation founded solely on an idea and serving as a beacon of freedom for the whole world. For 40 years, an independent, federally funded organization had promoted the core values of the United States, broadcasted local and international news, and shared free and open information with the rest of the world. Today, that organization, the US Information Agency (USIA), has largely ceased to exist and the world has lost a trusted, independent voice.

THERE ONCE WAS AN AGENCY

The revolution in communications that connects people and nations online has placed the United States in a global competition of ideas and memes. The US is ill-prepared to compete successfully in this realm. We are losing because we are not communicating a clear, coherent narrative of our intentions and actions in ways understood and trusted by the world. We have no coordinated plan for communicating that narrative and no national strategy for communications.

Americans aspire to certain values articulated in the founding documents that provide the core constructs of the United States, namely: *justice, freedom, peace, and the duty to protect those values*. But today, our nation is no longer actively sharing the strong belief in those values with the rest of the world. The United States government, in particular, is no longer seen as a reliable source of truth. In 1999, the US State Department absorbed fractured parts of the USIA. It did not take long for decision makers to realize that relinquishing an independent voice was a bad idea. Two years after the State Department took over the USIA, then-Secretary of State Madeline Albright, who had overseen the plan, expressed concern that folding USIA into the State Department might have been a mistake.³ By 2001, the nation felt the loss of an independent and trusted voice telling our story.

The USIA's charter separated it from political bodies and provided governance that insured its independence, free from political influence. This independence, whether perceived or real, was lost when factions of USIA were absorbed into the US Department of State. Since then, the Broadcasting Board of Governors and other organizations have attempted to foster an independent voice on behalf of the United States. They have not maintained the level of trust previously held by USIA. The USIA was held in high regard and was generally believed to speak the truth concerning the United States—whether good, bad, or ugly.

1 A version of this paper appears in *STEPS, (Science Technology Engineering and Policy Studies) Issue 7, 2022, pg 8, as "Reclaiming the Narrative: The US and International Communications," Issue7STEPS.pdf (potomacinstitute.org)*

2 In his farewell address to the nation, Ronald Reagan quoted John Winthrop, a 17th century pilgrim who came to these shores in a wooden boat.

3 Cull, Nicholas J. "Henry E. Catto, Jr, 1989–91 in *The Embassy in Grosvenor Square: American Ambassadors to the United Kingdom.*" 1938-2008 eds. Alison R. Holmes and J. Simon Rofe (London: Palgrave Macmillan) 2012: (Kindle page 270), https://doi.org/10.1057/9781137295576_14.

Given this absence of authentic voice, we believe that our nation, and indeed the world, again needs to reconstitute an independent resource that can coordinate our messaging and relationships on the world stage, and in so doing, can earn back and maintain trust as a source of truth.

This new resource might be a new agency, like the USIA, or an independent function of an existing organization with authority and accountability to coordinate various agencies with tasking in public diplomacy and strategic messaging.

PROJECTING TRUTH AND COUNTERING PROPAGANDA—USIA HISTORY

The desirability of a national source of public information has been recognized since the days of World War I. Various administrations created organizations designed to spread a national message to support our allies and counter our adversaries' propaganda. The Smith-Mundt Act of 1948 established the "Voice of America" as a communication outlet for foreign populations, created the Fulbright Program, and in these ways, was designed to "combat weapons of false propaganda and misinformation."⁴

Dwight D. Eisenhower had long advocated the need to conduct "psychological warfare," by countering adversary propaganda with a strategic and trusted message.^{5,6} In a campaign speech in 1952,⁷ Eisenhower emphasized a whole-of-government approach to strategic messaging (primarily to counter communist oppression), and the need to inspire world respect of American ideals using peaceful tools. He differentiated these strategic messaging goals from propaganda by stating that the purpose of the former is to "help free people stay free," by "winning the struggle for...minds" through a message with "spiritual strength."⁸

In 1953, President Eisenhower's "Jackson Committee" recommended creation of a separate agency for these purposes, and Eisenhower's 1953 Executive Order 10477 established the USIA.⁹ Based on the now-declassified Jackson Committee report, the USIA was established for overt communications, while covert channels were established separately, with all communications coordinated through the National Security Council to the president.¹⁰ Initially, the USIA was engaged in campaigns to support the President's "Chance for Peace" and "Atoms for Peace" proposals, both internationally and domestically.¹¹ During the Kennedy Administration, famed newscaster Edward R. Murrow led the USIA, and tied the agency more closely to the CIA, to receive intelligence briefings, counter insurgency training, and advise local issues and culture, particularly in Southeast Asia. There were some indications of USIA involvement in covert operations during Murrow's tenure.¹² While there was connectivity between the overt side of public diplomacy and the covert aspects of propaganda after Murrow's departure, the USIA refused to work with

4 "The United States Information Agency." *American Security Project*. 2012, <https://www.americansecurityproject.org/ASP%20Reports/Ref%200097%20-%20The%20United%20States%20Information%20Agency.pdf>.

5 Osgood, Kenneth A. "Form Before Substance: Eisenhower's Commitment to Psychological Warfare and Negotiations with the Enemy." *Diplomatic History*. 24 (3) 2000: 405–33. <http://www.jstor.org/stable/24913835>.

6 Corke, Sarah-Jane. "The Eisenhower Administration and Psychological Warfare," *Intelligence and National Security* 24(2) 2009: 277–90. <https://doi.org/10.1080/02684520902826623>.

7 "Text of Gen. Eisenhower's Foreign Policy Speech in San Francisco," *New York Times* October 9, 1952.

8 "Text of Gen. Eisenhower's Foreign Policy Speech in San Francisco."

9 "Text of Gen. Eisenhower's Foreign Policy Speech in San Francisco."

10 Parry-Giles, Shawn J. "The Eisenhower Administration's Conceptualization of the USIA: The Development of Overt and Covert Propaganda Strategies," *Presidential Studies Quarterly* 24(2) 1994: 263–76. <http://www.jstor.org/stable/27551240>.

11 Parry-Giles, Shawn J. "The Eisenhower Administration's Conceptualization of the USIA."

12 Tomlin, Gregory M. "Murrow's Cold War: Public Diplomacy for the Kennedy Administration." *Potomac Books*. 2016.

the CIA in most cases, and would not release any information that did not have full and accurate attribution.¹³

Throughout the Cold War, the USIA opened libraries at embassies in closed countries, sponsored thousands of cultural exchanges, established over 200 public affairs offices throughout the world that fostered social media engagement, and provided access to world news through its Voice of America radio network; each with intent to bring truth and balance to even the most closed societies. By the end of the Cold War, the USIA had a well-connected global network of radio and television broadcasting, cultural and educational exchange programs, and open access libraries providing a wide array of knowledge—often serving as the only source of free information. The USIA adapted with changes taking place in communications technology; having a budget of around \$1 billion per year, offices and outlets throughout the world, and a staff of over 10,000 people.

However, the agency was not free of controversy, and concerns were raised that the agency could be used to promote polemical administration policies,¹⁴ despite its charter to exercise overt public diplomacy. In 1972 and in 1985, congressional action effectively prohibited USIA from domestic dissemination.¹⁵ This lack of transparency may have heightened fears that the USIA was engaged in propaganda, and prohibitions were removed in the Smith-Mundt Modernization Act of 2012.

The USIA began to lose favor—and funding—in the late 1980s and '90s. The fall of the Berlin Wall and the end of the Cold War seemed to lessen the need for psychological warfare. Communist ideology had seemingly been defeated, and the desire for a “peace dividend” inspired cost cutting across the US Departments of Defense and State. The USIA’s billion-dollar budget was an easy target. Infighting and budget cuts created dysfunction that hurt the organization, and the USIA was defunded and absorbed into the State Department in 1999.¹⁶

But, in this defrocking, valuable capabilities were lost. Many worldwide assets, such as free libraries, were shuttered. Perhaps most significantly, the US lost much of its ability to understand and influence real audiences within adversary and allied nations, alike.

The USIA was able to remain well-respected and trusted by demonstrating significant success in messaging, and helping to create and maintain the coalition during *Desert Storm* and *Desert Shield*. An argument can be made that the USIA was one of the organizations that helped the United States to prevail in the Cold War. The news provided by the USIA media organizations was largely of local interest to the nations where they were broadcasting, and US news was portrayed openly and honestly, inclusive of events such as civil rights issues in the '60s, Watergate in the '70s, and the political scandals of the '90s. Exchange programs, such as the Fulbright Program, created generations of scholars and world leaders who had been exposed to US culture and who were educated in US institutions. A 2008 survey of USIA alumni noted the difference between public diplomacy and propaganda, and largely credited USIA with creating international understanding and support for the US and its policies.¹⁷ The alumni pointed to values

13 “Murrow at The United States Information Agency (USIA), 1961-1964,” *The Life and Work of Edward R. Murrow*. 2008. <https://dca.lib.tufts.edu/features/murrow/exhibit/usia.html>

14 For example, *New York Times*, “I.A.: Controversy over its Mission,” Nov 30, 1969, Page 4 Sect E.

15 The Foreign Relations Authorization Act of 1973 and the “Zorinski Amendment” of 1985.

16 Cull, Nicholas John. “The Decline and Fall of the United States Information Agency: American Public Diplomacy, 1989–2001,” (London: Palgrave Macmillan) 2012.

17 Fitzpatrick, Kathy K. “The Collapse of American Public Diplomacy,” *Public Diplomacy Alumni Association*. 2008. <http://www.publicdiplomacy.org/Fitzpatrick2008.pdf>.

of credibility, respect, and truthfulness as the most important assets for public diplomacy professionals who are working in overseas regions. They rated public diplomacy efforts during the Cold War as having been “good” or “excellent,” yet a majority felt that by 2008, US public diplomacy was marginal or poor.

STRATEGIC COMMUNICATIONS ABHORS A VACUUM

The events of September 11, 2001 provide a harsh view of how much had been lost due to the demise of the USIA as it had been. The 9/11 Commission quoted the view of National Security Council (NSC) staff that by spring 2001, US public diplomacy was so diminished in the Middle East that “we have by and large ceded the court of public opinion” to Al Qaeda.¹⁸ This same lack of US public diplomacy was true in Europe, Latin America, and East Asia.¹⁹

Many USIA functions were absorbed into the Department of State’s “Board for International Broadcasting” and the “Global Engagement Center” (GEC). These agencies still exist, but they neither have the breadth and depth that the USIA had, nor operate independently from any given administration. The GEC’s mission, for example, embodies the mission of countering adversary propaganda—specifically, to “recognize, understand, expose, and counter foreign state and non-state propaganda and disinformation efforts aimed at undermining or influencing the policies, security, or stability of the United States, its allies, and partner nations.”²⁰ But, countering foreign propaganda requires a messaging strategy, coordination with multiple information sources, and, most importantly, a source that is trusted because it operates outside of political influence. With the loss of many overseas offices and resources, the remnants of USIA lack connectivity to regional influences and knowledge and, therefore, are relatively impotent.

While the US lacked an independent strategic coordinated messaging strategy, messaging by others grew exponentially. US communications lacked overarching guidance. One communications expert has stated: “One possible reason for the cacophony of discordant messages—in addition to the sheer volume of information—is the lack of a clear, articulate strategy from the national leadership. Without this, the leaders of each department, agency, and office are left to decide what is important. In most cases the answer is to use the organization’s communication efforts to advance its own interests.”²¹ With the proliferation of other nations’ information, voices, and channels, the situation continues to worsen.

Today, there is intense competition for cognitive influence. The Internet and its ability to spread messages globally enables any individual to communicate with almost the same force and breadth as a nation. People worldwide are bombarded with competing ideas that are promulgated as “truths.” The United States is not well-positioned in this competition. To regain and maintain leadership, the US should better diffuse ideas to attract populations to the ideals of democratic societies.

18 National Commission on Terrorist Attacks upon the United States. “The 9/11 Commission Report: Final Report of the National Commission on Terrorist Attacks upon the United States.” *National Commission on Terrorist Attacks upon the United States*, US Government Printing Office. 2004. <https://lccn.loc.gov/2004356401>.

19 Cull, Nicholas John. “The Decline and Fall of the United States Information Agency: American Public Diplomacy, 1989–2001,” (London: Palgrave Macmillan) 2012.

20 “Counter Foreign Propaganda and Disinformation,” Global Engagement Center, Department of State. January 20, 2022. <https://www.state.gov/bureaus-offices/under-secretary-for-public-diplomacy-and-public-affairs/global-engagement-center/#:~:text=The%20Department's%20Global%20Engagement%20Center,counter%20foreign%20propaganda%20and%20disinformation.>

21 Borg, Lindsey. “Communicating with Intent: The Department of Defense and Strategic Communication,” *Program on Information Resources Policy*. February 2008. http://pirp.harvard.edu/pubs_pdf/borg/borg-i08-1.pdf.

Both the US Department of State and Department of Defense acknowledge the need for strategic messaging. Still, responsibility for strategic communications remains fractured within these departments. In the State Department, the Undersecretary for Public Diplomacy, Public Affairs departments, as well as the Office of Congressional and Public Affairs each have responsibilities and processes for creating and executing strategic messaging within specific spheres of influence. The Defense Department has a detailed process for approving strategic messaging plans, but the substance of such messaging is left to individual departments and commands. These efforts have no unifying strategy, no executive level messaging plan, no guidance, and little evidence of coordination among them.

REGAINING THE NARRATIVE

In the absence of a coordinated strategic narrative, the United States is consistently placed in a reactive posture. Control of current narratives has been ceded to others.

The need to create a coordinated, effective strategic narrative was explored in a recent public forum of experts in the communications field.²² The forum discussion on strategic messaging and global competitiveness revealed that the US needs a coherent and consistent strategic messaging campaign to address global competition in the information space. Panelists emphasized that the lack of a stable strategic narrative puts the US at risk of alienating allies and driving competitors to more aggressive engagements. Uncoordinated messaging can be counter-productive. Reactions to misinformation promulgated by others and attempts to counter propaganda are not prime venues or vectors to fortify US messaging. Once one is reacting to misinformation promulgated by others, attempting to counter propaganda, it is too late to instill truth.

To illustrate the need for a national-level strategic messaging strategy, it is instructive to look at examples of messaging from the past decade.

Attempts at Persuasion. Through public and private communications, over a period of years, the United States attempted to persuade the Chinese not to weaponize space. According to a 2013 study for the DOD, the campaign had the exact opposite effect.²³ It pushed China into believing it needed to accelerate its programs, and prompted views of the United States as untrustworthy, in part because of what was perceived as contradictory messaging. US messaging did not consider the background and experiences of decision makers that they were trying to influence, or how the Chinese perspective would interpret and analyze the US statements and actions.

Messaging Through Actions. In the 1990s, the US sent China a message of support for Taiwan by running US war ships through the Taiwan Straits. On December 19, 1995, the USS *Nimitz* transited the Taiwan Straits at the same time that the Chinese government was conducting coercive diplomacy via military exercises to influence the Taiwanese elections. The United States asserted that this transit was unplanned, and was merely avoidance of weather. But direct links can be drawn between this event and the initiation of Chinese anti-ship missile programs, which have since matured and complicated the US' ability to operate freely in the Pacific. Again, US action incurred the opposite and undesired reaction.

Messaging Through Publications. Because the United States is an open society, messaging can occur through public review of official documents. Recently, the US government has taken a more aggressive

22 The Potomac Institute for Policy Studies Forum on Global Competition: Strategic Communications and Information in Competition. December 3, 2021. https://youtu.be/ROWxf9_Szlg.

23 "China's Space Program: Decision-Makers & Decision-Making," Phase One Communications Inc. 2012.

posture toward China in official publications. The 2018 US National Defense Strategy stated that China uses “predatory economic practices to intimidate its neighbors while militarizing features in the South China Sea.”²⁴ The 2021 Interim National Security Strategy Guidance speaks of our “growing rivalry with China” and calls China “the only competitor capable of potentially combining its economic, diplomatic, military, and technological power to mount a sustained challenge to a stable and open international system.”²⁵ Official publications are intended for US audiences, but Chinese government officials have equal access to them. Some official US documents treat China as a collaborator and other documents depict China as a competitor, while still others regard China a threat and adversary. It would take a cohesive narrative to reconcile these conflicting ideas so as not to foster negative reaction from China, while still making clear the US intent not to allow China to continue aggressive actions in regions that affect our allies and partners.

The current situation with Russia presents a different set of messaging challenges. Russia’s objectives and motivations differ from China’s. As we are seeing in events in the Ukraine, Russia has a more advanced disinformation and deception apparatus that requires that the US employ different approaches to convince the Russian populace—and the rest of the world—that democratic ideals are worthy values of governance. To be effective, a messaging strategy must incorporate understanding of history, culture, and the media environment of the target nation. In the case of Russia, the messaging strategy requires effective ways to undercut and displace false narratives promulgated by official Russian information agencies.

The United States faces mass propaganda designed to disrupt and divide societies. US efforts to counter the narratives that are controlled by others often fail because the US government lacks the global trust it once enjoyed. As a result, the United States is seen as internally conflicted and unable to control the operations of our own government.²⁶

COGNITIVE SECURITY—TRUTH FIGHTING ITS WAY ABOVE THE NOISE

A cornerstone of a new and independent US information agency would be a focus on improving cognitive security, worldwide. Cognitive security is a new and emerging field that addresses how information provided to individuals and groups can be used to influence their beliefs and cognition, preventing them from forming their own rational beliefs based on truth and factual information.

In today’s world, it is necessary to combat adversarial use of perception management, disinformation, and strategic deception. While there is nothing new about adversaries’ use of these tactics, they have become far more effective given globalization and the speed of communications. Disinformation can now be targeted based on profile information concerning the recipient, rather than simply indiscriminately broadcast.

24 United States Department of Defense. “Summary of the 2018 National Defense Strategy of the United States of America: Sharpening the American Military’s Competitive Edge,” November 2018, <https://dod.defense.gov/Portals/1/Documents/pubs/2018-National-Defense-Strategy-Summary.pdf>.

25 United States White House. “Interim National Security Strategic Guidance,” March 2021. <https://www.whitehouse.gov/wp-content/uploads/2021/03/NSC-1v2.pdf>.

26 “Americans’ Views of Government: Low Trust, but Some Positive Performance Ratings,” *Pew Research Center— Politics & Policy* May 25, 2021. <https://www.pewresearch.org/politics/2020/09/14/americans-views-of-government-low-trust-but-some-positive-performance-ratings/>.

Historically, China has made considerable use of strategic deception through perception management. A 2009 study notes that they call it “psychological warfare.”²⁷ The study states that “if China can discern its competitor’s thought process through intelligence and guide it through deception and perception management, then it stands to reap considerable benefits as it pursues its own goals on domestic and international fronts.” In 2013, the American computer security firm, Mandiant, revealed the extent of Chinese military cyber espionage efforts involving “Unit 61398” targeting US companies and individuals.²⁸

As well, Russia has been highly effective at strategic messaging, whether via disinformation campaigns during the Cold War, through the coordinated use of diplomatic language, and/or the use of cyberattacks. A warning was imparted to Estonia by cyber means in 2007.²⁹ Prior to the 2008 Russian incursion and occupation of portions of Georgia, a cyber messaging campaign was used.³⁰ Various financiers of the Russian Internet Research Agency and members of the Russian intelligence unit known as the GRU, are currently under US indictment for spreading cyber disinformation during the 2016 US election campaigns.³¹ The recent invasion of Ukraine has been accompanied by Russian strategic messaging,³² which reportedly continues to be quite effective in Russia as of this writing. Thus, we are seeing real-time experiments and engagements in countering disinformation through crowd-sourced intelligence and other messaging tactics.

The US has long been committed to the belief that people everywhere have the right to the truth, and to establish beliefs based on access to accurate information. Cognitive security includes practices, methodologies, tactics, and tools to defend against social engineering attempts—intentional and unintentional—to cause manipulations and disruptions to cognition and sensemaking.³³

A reconstituted independent force such as the USIA could help establish a higher degree of cognitive security. The challenge is greater than it was a couple of decades ago, as the world—and communication technologies—have changed. The new organization could seek to establish trust through independence and dissemination of accurate information, in languages and context appropriate to the recipients. We are not advocating, nor would the population tolerate, countering disinformation with disinformation. A consistent and uniform message based on a strategy that conveys accurate and balanced information,

27 Anderson, E.C. and J.G. Engstrom. “China’s Use of Perception Management and Strategic Deception Commission, US-China Economic and Security Review Commission,” November 2009.

28 McWhorter, Dan. “APT1: Exposing One of China’s Cyber Espionage Units,” *Mandiant* September 3, 2022. <https://www.mandiant.com/resources/apt1-exposing-one-of-chinas-cyber-espionage-units>.

29 Estonia planned to move a Soviet-era war memorial from central Tallinn to a military cemetery. Russia began sending angry diplomatic messages. When the work began, widespread cyber-attacks occurred all over Estonia, together with rioting by “ethnic Russians” living in Estonia. See <https://www.cnn.com/2021/06/18/tech/estonia-cyber-security-lessons-intl-cmd/index.html>.

30 Markoff, John. “Before the Gunfire, Cyberattacks,” *New York Times* August 12, 2008. <https://www.nytimes.com/2008/08/13/technology/13cyber.html>.

31 “Grand Jury Indicts 12 Russian Intelligence Officers for Hacking Offenses Related to the 2016 Election,” *The United States Department of Justice Office of Public Affairs*. August 10, 2021. <https://www.justice.gov/opa/pr/grand-jury-indicts-12-russian-intelligence-officers-hacking-offenses-related-2016-election>.

32 Messages are targeted separately to the Ukrainian population and Russian-speaking separatists. See Daniel Brown, “Russian-backed Separatists are Using Terrifying Text Messages to Shock Adversaries — And it’s Changing the Face of Warfare,” *Business Insider* August 14, 2018, <https://www.businessinsider.com/russians-use-creepy-text-messages-scare-ukrainians-changing-warfare-2018-8>.

33 “What Is Cognitive Security?” *Cognitive Security and Education Forum*. April 15, 2022. <https://www.cogsec.org/what-is-cognitive-security>.

worldwide, could replace a cacophony of uncoordinated ad hoc messages delivered by multiple agencies and multiple voices.

Such an independent function with the necessary authorities to create and manage information strategies would also require understanding the messages directed at US citizenry and proactively countering disinformation before it causes harm. Recently, in deterring Russian tactics in Ukraine, the United States pre-emptively released key intelligence information. With the increasing availability of open-source intelligence, such an approach might be effective, generally. Without stifling free speech, the agency could provide broader access to information, coordinate the messaging, and provide clarifications and access to the multiple views on events.

RECONSTITUTING AN INDEPENDENT STRATEGIC MESSAGING CAPACITY—SOMEONE HAS TO BE IN CHARGE

Reconstituting a capability similar to the USIA does not necessitate a new agency with direct control of all former USIA resources and functions, provided it has the authority and responsibility required to coordinate those functions across government agencies—it does not and cannot begin in a vacuum. USIA existed in the past, and it atrophied due to budget cuts and was absorbed into government. The Smith-Mundt Modernization Act of 2012 updated authorities in the Department of State and the Broadcasting Board of Governors (now known as the US Agency for Global Media [USAGM]) to globally disseminate information. The Voice of America still exists, albeit as a considerably reduced entity. Radio Free Europe and Radio Liberty (RFE/RL) exists as a private corporation with US government funding. The USAGM supervises the Voice of America, RFE/RL, and other media outlets. However, since 2017, the USAGM has been led by a presidentially appointed CEO rather than a bipartisan board. In forming a new organization or agency that can coordinate and guide these messaging functions, lessons learned from prior mistakes could inform existing and newly developed structures as a basis for reinvigorating US strategic messaging.

A new information agency would be different from prior iterations because the world has changed politically, economically, and technologically. Methods of effective strategic messaging are now more sophisticated, and messaging can be better tailored to the target audiences with consideration of history and culture, and not just language. The new agency would need to draw upon expertise in messaging and regional cultures, utilizing both staff and advisors.

Enabling legislation would require careful crafting. The charter would need to ensure the independence of the organization and maintain its continuity across administration and legislature boundaries—free from political influence. Messaging should conform exclusively to accurate information, while still reflecting American core values. It would need to develop the trust of world, without taint of propaganda, but also proactively counter misinformation and deception that might be perpetrated by other nations and/or groups. The organization would ultimately be responsible to the American public, through budget and law.

One of the great messaging challenges is to convey the uniqueness of the US concepts of “individual freedom” and “individual rights.” The US form of democratic government enables the individual to rank above the state in many instances (for example by directly voting for leaders at many levels of government, or in exercising certain constitutional rights). This idea rankles many foreign governments because it diminishes the importance of the party, castes, leaders, nobility, and government institutions. US democracy also motivates participation of individual citizens and serves as a beacon for much of the world’s population. It supports ideals that include opportunities for the individual to progress up the economic and social scale. The charter of the agency should support the use of effective messaging to demonstrably relate the ideals and aspirations that make the US form of government admired.

IF WE DON'T CONTROL OUR NARRATIVE, OTHERS WILL

The United States is in a global information competition, where messaging is used by adversaries as a weapon against US interests. With its messaging strategies widely distributed, the United States is not effectively communicating a coherent narrative of accurate and favorable support for American ideals. Without understanding competing narratives and without contacts and strategies for countering disinformation, the US will lose the information war.

For the United States to be successful in this fast-paced societal-level competition, it must promote narratives that best support the US position in the global commons. To establish trust, the narrative should be based on our founding core ideals and the information must be presented fully and accurately, devoid of political or marketing influence.

Techniques for effectively motivating attitudes and behaviors, inspiring loyalty, and drawing people closer together have been championed by US corporations in their marketing and branding campaigns. Their techniques include developing an understanding of the audience's experiences and culture. Similar techniques can and should be adopted for a US messaging strategy.

The entity must coordinate an uncomplicated narrative that supports true goals in a strictly nonpartisan way, such that they can endure across administration and congressional change. Expertise assuring that messaging is heard and understood according to its intended effect (by the intended audiences), can be drawn from decades of advanced research and experience in regional histories and cultures.

The US must be consistent in maintaining a narrative domestically and abroad, and must be prepared to combat disinformation spread through numerous communications pathways in today's digital world. Trusted independent sources are necessary to achieve this desired level of cognitive security. The USIA was largely trusted as a defense against foreign propaganda. Given that disinformation is so easily distributed, such a trusted resource is needed now more than ever.

CHAPTER 6: THE COMPETITION FOR AN EDUCATED POPULACE

GCP EVENT: EDUCATION, 20-SOMETHINGS, AND COMPETITION

The Potomac Institute for Policy Studies hosted a GCP hybrid seminar titled “Education, 20-Somethings, and Competition” on January 26, 2022. The panel of experts at this event included The Honorable Alan Shaffer; Patricia Falcone, PhD (Deputy Director for Science and Technology at Lawrence Livermore National Laboratory); Daniel Hastings, PhD (Head of Department of Aeronautics and Astronautics and Associate Dean for Diversity, Equity and Inclusion of the School of Engineering at Massachusetts Institute of Technology); Joy Shanaberger (CEO and Founding Partner of the Boone Group and Former Special Assistant for the Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics); and Trevor Huffard (Research Assistant and Science and Technology Policy Internship Program Coordinator at Potomac Institute for Policy Studies). This chapter features the *STEPS* paper: “Education of Americans Across Various Generations as a Preparation for Global Competitions” by The Honorable Alan R Shaffer and Trevor Huffard.

INTRODUCTION

Being competitive in any domain of the global competition requires an educated workforce. Moreover, the business of education is a competitive arena—one in which the US dominates at the university level.

People from all over the world come to study and learn in American schools. However, American students in elementary and secondary schools are falling behind in the basics, specifically science, math, and reading. Depending on the year and the survey, students in the United States tend to fall somewhere between 15th and 40th in the world compared to other nations in literacy and numeracy. This disconnect between the quality of the mainstream educational system and the elite university educational systems is a major source of societal friction.

The efficacy of a nation’s education system directly impacts a nation’s ability to compete on the global stage, at least over time. As the world becomes increasingly complex and competitive, each generation builds on the success of those preceding. Opportunities for education, however, are global, with many excellent educational systems and universities spread throughout the world. Much of the United States’ ascent as a modern superpower post–World War II was due to its pursuit of knowledge: knowledge largely based on research and technology. This landscape has shifted, and it is no longer clear that America is training its own to pursue the advances that maintain its competitive position in technology and the prosperity and strength that it creates.

How can US policymakers, along with business leaders and academia, leverage nascent talent to deliver an educated workforce to posture the US for an enduring competitive advantage? This chapter’s article, by The Honorable Alan Shaffer and Potomac Institute research assistant Trevor Huffard, suggest that the “braided river” model introduced by Jennifer Mathews offers an important idea for continuing education and maintenance of technical skills. The article’s authors offer other recommendations to address issues with the US educational system.

EDUCATION OF AMERICANS ACROSS VARIOUS GENERATIONS AS A PREPARATION FOR GLOBAL COMPETITIONS¹

Paper by: The Honorable Alan R Shaffer and Trevor Huffard

Since the end of World War II over 70 years ago, the United States has led the world in technology development. The US spearheaded the development of capabilities (in space and with semiconductors, computers, lasers, etc.) and the education of generations of new scientists and engineers. Today, this leadership is under threat. The US needs to seriously reconsider its educational system to include both the results (outputs) and the associated R&D investments that support and drive the system. Although the US maintains its global R&D leadership, US student performance in science, technology, engineering, and mathematics (STEM) may not be strong enough to sustain US educational leadership in the future technology competition on the world stage. The ongoing global competition for science and technology superiority has economic, military, and geopolitical consequences, and education and R&D investments are the most important levers of influence.²

“Since World War II, advancements in science and technology have driven much of our economic growth, underpinned our national security, and transformed nearly every aspect of Americans’ daily lives. New technologies built on federally funded discovery research have led to new businesses, revolutionized health care, and created the mobile, digital world.”

—Diane Souvaine, Chair of the National Science Board
before a Hearing of the House Committee on Science,
Space and Technology on January 29, 2020.

MEGA TRENDS IN GLOBAL R&D INVESTMENT

American preeminence in science and technology has not happened by chance. Sustained commitments to education and investments in basic research have played key roles in establishing and maintaining the knowledge ecosystem and innovation driving US partnerships among academia, government, and the private sector. To compete in the global economy going forward, the US needs to renew its commitment to strengthen these key components of our national infrastructure.

The US share of global investments in R&D has contracted in the post–World War II era, dropping from 70% of global R&D investments in 1960 to less than 30% in 2019. This occurred despite the fact that US federal R&D funding (in constant 2020 dollars) increased from \$81 billion in 1976 to over \$164 billion in 2020.³ During the same period, total US R&D funding, including corporate and non-federal funding, rose

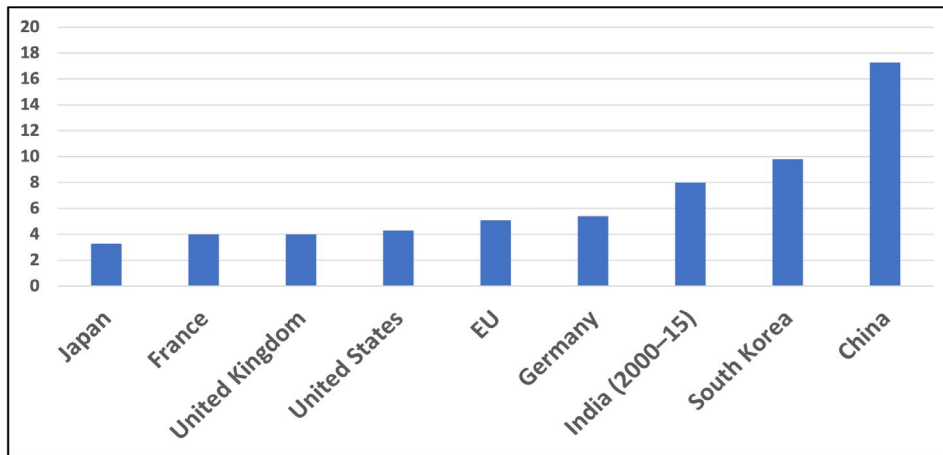
1 A version of this paper appears in *STEPS*, (*Science Technology Engineering and Policy Studies*), Issue 7, 2022, pg 18, as “Education of Americans Across Various Generations as a Preparation for Global Competitions,” Issue7STEPS.pdf (potomacinstitute.org)

2 Rogier Creemers, et al. “Translation: 14th Five-Year Plan for National Informatization,” DigiChina. Stanford University. January 24, 2022, <https://digichina.stanford.edu/work/translation-14th-five-year-plan-for-national-informatization-dec-2021/> .

3 American Association for the Advancement of Science. “Historical Trends in Federal R&D,” October 2020. <https://www.aaas.org/programs/r-d-budget-and-policy/historical-trends-federal-rd>.

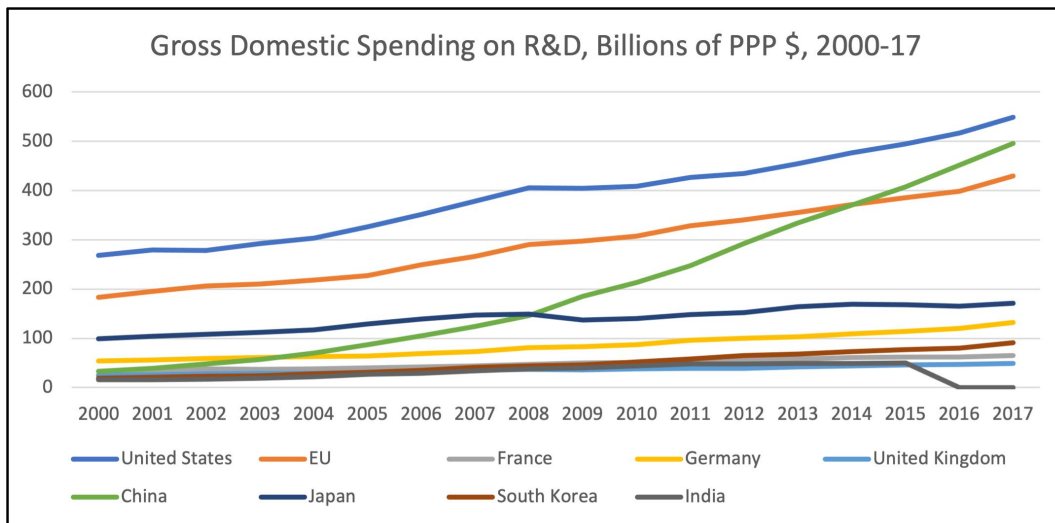
from under \$250 billion to almost \$500 billion.⁴ But, at the same time, the increase in total R&D investment in the rest of the world has dramatically surpassed the rate of increase in the United States (see Figure 6.1). For example, during 2000-2017, the Compound Annual Growth Rate (CAGR) in R&D was nearly 18% in China and about 10% in South Korea. This compares to a US CAGR of 4%. China is soon to overcome the United States in total R&D spending (see Figure 6.2).

Figure 6.1. Compound Average Growth Rate Percentage of Domestic R&D Expenditures, by Country/Region 2000-2017.



Source: NSF, National Science Board, Science and Engineering Indicators 2020, The State of US Science and Engineering 2020, Figure 13, data sourced from NCSES, National Patterns of R&D Resources; OECD, Main Science and Technology Indicators 2019/1; UNESCO Institute for Statistics, Research and Experimental Development data set.

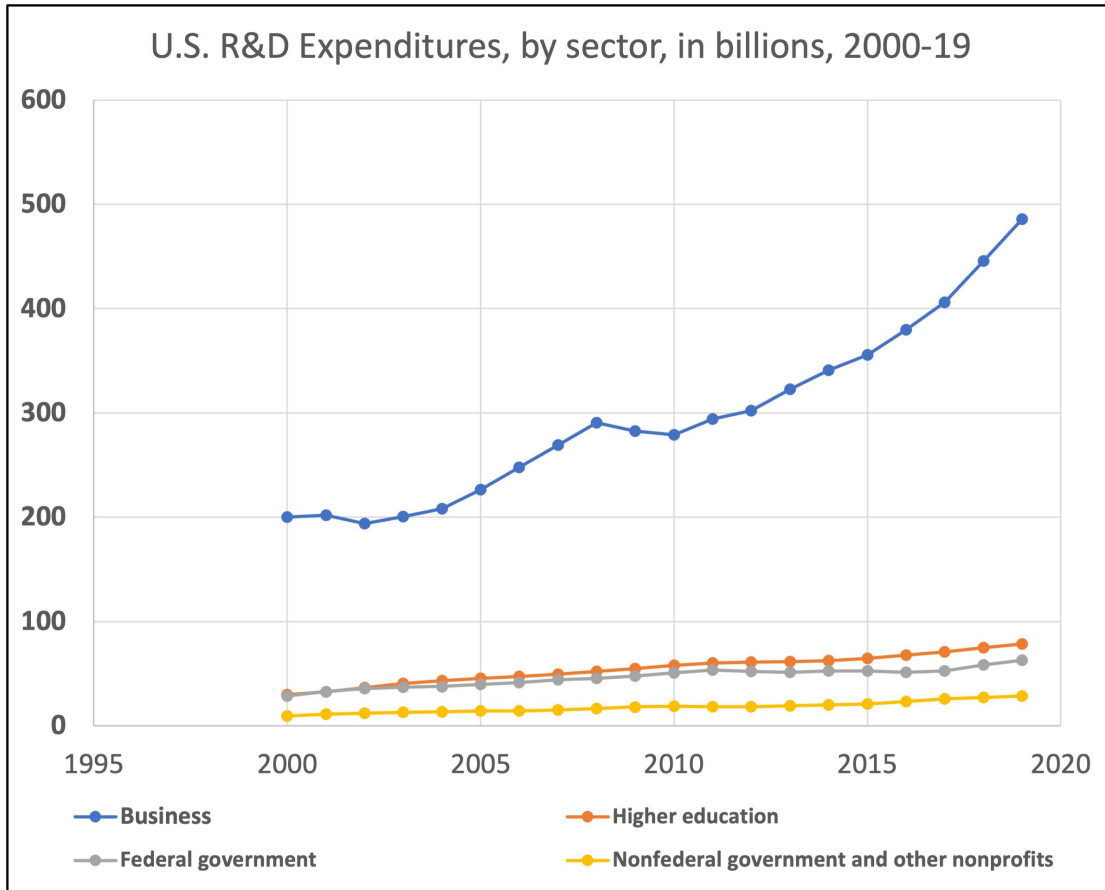
Figure 6.2. R&D Spending by Select Countries Over Time. Gross expenditures, not normalized as a percent of GDP.



Source: NSF, National Science Board, Science and Engineering Indicators 2020, The State of US Science and Engineering 2020, Figure 11. Data from NCSES, National Patterns of R&D Resources; OECD, Main Science and Technology Indicators 2019/1; UNESCO Institute for Statistics, Research and Experimental Development data set.

4 The National Science Foundation. "The State of Science and Engineering 2022," January 2022. <https://ncses.nsf.gov/pubs/nsb20221>.

Figure 6.3. US R&D Expenditures, by Performing Sector 2000-2017.



Source: NSF, National Science Board, Science and Engineering Indicators 2020, The State of US Science and Engineering 2020, Figure 16. Data from NCSES, National Patterns of R&D Resources.

It is not just total investment that has changed, but also the ratio of public to private investment in R&D. Today, public (government) investment has dropped to less than 30%; private sector (business, industry) investment continues to provide the growth in US R&D investment (see Figure 6.3). This shift changes the focus from scientific discovery to product development. To remain competitive, America needs to also invest in scientific discovery.

A strategy of fast-following is more profitable, but is not aligned with a national imperative of establishing an enduring competitive posture.

RECOMMENDATION 1: The United States must prioritize investment in basic science, R&D, and American people—particularly scientists and engineers—to remain competitive in a global environment. This means increasing the US federal investment and developing policies that favor industrial investment.

MEGA TRENDS IN STEM PERFORMANCE

Succeeding in a technological competition relies on people—scientists, mathematicians, data analysts, and engineers—in a workforce that drives the technology progress engine. Continuing signs indicate that the state of technological literacy in the US has been surpassed by other nations and is declining domestically. The impact of the shift in emphasis on R&D is manifest in student performance seen as early as middle school. The 2018 OECD Program for International Student Assessment (the PISA score) assessed the performance of 15-year-old students in math, science, and reading, and showed US deficiencies.⁵ In fact, the US students' performance fails to keep pace with results in such diverse nations as China, Estonia, Canada, and Poland in all three assessed categories. Moreover, the US students' performance shows continued erosion over time.

An Approach to "Experienced-based Learning"

US education needs new methods because US students are struggling with foundational studies and basic technological literacy. Dr. Freeman Hrabowski, from University of Maryland Baltimore County (UMBC) initiated a program that brings disadvantaged youth, who may not have had the appropriate preparation, to UMBC and takes the time needed to provide these students with necessary STEM skills, after which these students enter a standard engineering or STEM curriculum. This program uses "experienced-based" learning through internships and expanded lab time to bring the curriculum to life. His results have been phenomenal. Basically, Hrabowski turned the time-based 4-year college model into a skills-based approach. If it takes six years, does it matter if the United States gets a functioning engineer or scientist?⁶

How can a nation that birthed the information technology era, developed the semiconductor and computer industries, and landed the first man on the Moon—and that spends so much on education—be in a competitively disadvantageous position?

RECOMMENDATION 2: Fund the expansion of Dr. Hrabowski's University of Maryland Baltimore County model to other universities to expand the pool and diversity of domestic STEM students.

The economic incentives have not favored continued US dominance in basic (university) research in science and technology, and maintenance of US leadership in R&D globally. Culturally, we might contend that the United States has tended to value the accumulation of wealth, at least in the last few decades, over the accumulation of knowledge.

5 Organization for Economic Co-operation and Development. "PISA 2018 Results, Combined Executive Summaries," 2019. https://www.oecd.org/pisa/Combined_Executive_Summaries_PISA_2018.pdf.

6 Hrabowski, Freeman. "Hrabowski: An Educator Focused on Math and Science," Interview by Byron Pitts. 60 Minutes. November 13, 2011. <https://www.cbsnews.com/news/hrabowski-an-educator-focused-on-math-and-science-13-11-2011/>

Past examples of great US scientific and engineering achievements were often accomplished with the aid of foreign-born scientists working within the United States. The making of the atomic bomb (the Manhattan project), the Apollo program to land humans on the Moon, and human genome mapping leveraged basic science advances to make significant technological achievements. None of these would have been possible without non-US born scientists and engineers. The United States benefited from an influx of European physicists and mathematicians, German rocket scientists, Jewish immigrants, as well as many first- and second-generation scientists and engineers educated in the United States.

Cultural differences may be reflected in graduate student demographics. Forty years ago, most hard science and engineering students were US citizens. From 1980 to 2020, the number of international graduate students in US universities rose from about 90,000 to 350,000 today—most in the hard sciences.⁷ Over the same period, the total number of US university students rose by about 33%. Sources state that in 2017, 82% of electrical and petroleum engineering were international students, as were 72% of computer science, 71% of industrial engineering, and 70% of statistics graduate students in the US.⁸ Yet more US graduate students are foreign-born US residents. Fortunately, stay-rates of foreign graduate students (i.e., the percent that remain in the United States after graduation) have increased, in part because of the 3-year “Optional Practical Training” program, with over half employed in STEM fields.⁹

The suggestion is that foreign cultures might value STEM education more than Americans, and that STEM fields are difficult and less appealing to US students. In a recent panel, Professor Dan Hastings from MIT said “STEM is hard, that is ok. It can also be fun.” To get more US citizen students into the STEM pipeline, the United States may need to better encourage its young people to enjoy that hard work.

Cultural differences are accompanied by decreases in government funding support for R&D, which was reduced at the conclusion of the Cold War as part of the Peace Dividend. Government and military focus on global counterinsurgency after the 9/11 attacks stalled federal commitments to basic research in science and technology, in favor of more applied developments. These and other macroeconomic trends in US R&D investments were accompanied by large increases in R&D investments in science and technology by other nations, particularly China.

RECOMMENDATION 3: America has always been a nation built by bringing in the best from the world, which should remain a path forward today. The US government needs to examine how to enhance the number of H-1B visas given out to foreign students, and endeavor to bring them into US industry, academia, and select government positions.

-
- 7 Open Doors. “Academic Level,” Sponsored by the Department of State with Funding Provided by the Government and Supported in its Implementation by IIE. 2021. <https://opendoorsdata.org/data/international-students/academic-level-and-places-of-origin/>.
 - 8 Redden, Elizabeth. “Report Focuses on Graduate International Enrollment,” Inside Higher Education, August 19, 2021. <https://www.insidehighered.com/quicktakes/2021/08/19/report-focuses-graduate-international-enrollment>.
 - 9 Ruiz, Neil G. and Abby Budiman. “Number of Foreign College Students Staying and Working in after Graduation Surges,” Pew Research Center’s Global Attitudes Project. Pew Research Center, August 14, 2020. <https://www.pewresearch.org/global/2018/05/10/number-of-foreign-college-students-staying-and-working-in-u-s-after-graduation-surges/>.

THE ECONOMIC LANDSCAPE OF US EDUCATION—THE IMPACT OF INCOME INEQUALITY

Education is America’s key to establishing an enduring competitive advantage in science and technology. Before investments in R&D can be considered, the United States must reconsider how it invests in young people and how it funds education.

Public schools in the United States for kindergarten through 12th grade (K through 12) are largely funded by local sources: county and state. They are funded municipally by revenues gathered from property taxes (44% of total funding on average), and a portion of state tax revenues (income taxes and/or sales taxes) to account for another 48%, on average.¹⁰

Federal funding nationwide amounts to 8% of the sector. Public education is more likely to be well funded in districts with valuable properties and in richer states. Conversely, schools located in poorer neighborhoods tend to have less funding, and those students who may need the most financial help are less likely to receive it.

The model of local financing of schools introduces a feedback loop. In the United States, one of the significant contributors to property value is access to “good” schools. The National Bureau of Economic Research discovered on average that “for every \$1 spent on school funding, property values increased by around \$20.”¹¹ In this case, districts that have historically good schools see their funding increase, which leads to higher property values, which leads to more revenues to fund their schools. In Los Angeles, for example, homes in a “top-tier” school district sell for an average of 79% more than homes in an “average school district nearby.”¹² This relationship has stratified the quality of public education across the country.

New models of financing education may be needed. Sometimes municipalities attempt to innovate entirely new systems of public education (e.g., charter schools).¹³ Ultimately, the US needs a quality education system, which requires facilities and high-quality teachers. Education is costly, but it benefits the nation; the locality; and primarily, the educated person.

Private schools and private universities offer choice, but are largely funded by tuition.¹⁴ Elite universities also collect overhead on research, gifts, and endowments. State universities receive support from state resources to benefit the local population (employment, businesses, etc.). But, tuition payments (and room and board payments when appropriate) fund the administrative operations and education processes of private schools and universities.

The price of college in the United States has exploded over the last few decades. One analysis shows a constant dollar increase by a factor of 2:1 in average college costs from 1990 to 2021.¹⁵ In a recent survey, 37% American college applicants and 64% of parents, estimated that the costs of college are more than

10 Chen, Grace. “An Overview of the Funding of Public Schools,” *Public School Review*, March 31, 2022. <https://www.publicschoolreview.com/blog/an-overview-of-the-funding-of-public-schools>.

11 Barrow and Rouse. “Using Market Valuation to Assess Public School Spending.”

12 “Using Market Valuation to Assess Public School Spending.”

13 Ballotpedia: The Encyclopedia of American Politics. “Charter Schools in New York,” Ballotpedia. Accessed March 12, 2022. https://ballotpedia.org/Charter_schools_in_New_York#:~:text=In%20New%20York%2C%20charter%20schools,the%20districts%20where%20they%20reside.

14 Paulus, Nathan. “How to Pay for a Private School Education,” *MoneyGeek.com*. May 12, 2022. <https://www.moneygeek.com/financial-planning/paying-for-private-school/>.

15 Jennifer Ma and Matea Pender. “Trends in College Pricing and Student Aid 2021,” *New York College Board*. 2021: p. 12. <https://research.collegeboard.org/media/pdf/trends-college-pricing-student-aid-2021.pdf>.

\$100,000.¹⁶ Total costs of attending a 4-year college can vary widely, but students who do not pay full fare are expected to take on loans. The current average federal student loan debt balance is more than \$37,000, totaling over \$1.6 trillion across Americans.¹⁷ The amount of debt that a post-secondary student will incur depends greatly on the type of university, living arrangements, and the educational requirements of the program. If more than four years are required, as is often the case for STEM majors, the education will be more costly. The debt burden is not good for America,¹⁸ but that is a separate issue. Financing models that encourage those who are not extraordinarily wealthy to take on debt greatly impact the choices made by US students contemplating their post-secondary education, which can contribute to a decline in US STEM talent.

US funding for education and incentives that influence student choice are important issues that needs addressing. We also need to consider why college costs have risen so drastically.

One factor is the transition of higher education toward a competitive market landscape, where schools are incentivized to market themselves as something “more” than an educational institution. Athletics, amenities, and administrative support have broadly evolved into the leading factors in many students’ decision for enrollment—including the cultural artifact of the “college experience.” Given the choice between a school that offers a quality education and a school with an inferior quality but a “once in a lifetime social experience,” many students choose the latter. This trend is counter to the United States’ goal of cementing an enduring competitive advantage in STEM.

Another factor is that colleges and universities are incentivized to prioritize students that can pay full tuition. Today, the US can claim many world-class academic institutions that attract students from around the world who are able to pay full tuition. While most colleges state that they are “need-blind,” drawing on a worldwide pool of applicants reduces the need to offer discounting (through scholarships) to qualified applicants. Since foreign students do not always stay in the US,¹⁹ this also undermines the country’s competitive advantage in STEM fields.

State funding for public universities has declined in the past decade by roughly 13% per student,²⁰ motivating tuition increases. Ironically, the availability of student loans contributes to tuition increases by removing some pressure for cost containment.²¹ Increased access to higher education, in part due to the

16 The Princeton Review. “2022 College Hopes and Worries Survey Report,” 2022. <https://www.princetonreview.com/college-rankings/college-hopes-worries>.

17 Hanson, Melanie. “Student Loan Debt Statistics,” The Education Data Initiative. May 30, 2022. <https://educationdata.org/student-loan-debt-statistics>.

18 Hanson, Melanie. “Average Time to Repay Student Loans,” The Education Data Initiative. December 16, 2021. <https://educationdata.org/student-loan-debt-statistics>.

19 Han, Xueying, et al. “Will They Stay or Will They Go? International Graduate Students and Their Decisions to Stay or Leave in the upon Graduation,” PLoS One March 11, 2015. <https://doi.org/10.1371/journal.pone.0118183>.

20 Mitchell, Michael, Michael Leachman, and Matt Saenz. “State Higher Education Funding Cuts Have Pushed Costs to Students, Worsened Inequality,” Center on Budget and Policy Priorities. October 24, 2019. <https://www.cbpp.org/research/state-budget-and-tax/state-higher-education-funding-cuts-have-pushed-costs-to-students>.

21 Lucca, David O., et al. “Credit Supply and the Rise in College Tuition: Evidence from the Expansion in Federal Student Aid Programs,” Federal Reserve Bank of New York. July 2015, revised February 2017. https://www.newyorkfed.org/medialibrary/media/research/staff_reports/sr733.pdf.

availability of low interest loans,²² has increased demand on universities overall, which also results in higher tuition rates.

SCHOLARSHIP FOR SERVICE

A number of “scholarship for service” programs have funded the higher education of US students. In this model, the sponsor pays tuition, board, books, and even a stipend, in exchange for a guaranteed number of years of service to the sponsor following graduation (typically in a ratio between one or two years of service per year of sponsored education). In the US national security domain, the DOD has the Reserve Officer Training Corps program and the Science, Mathematics, and Research for Transformation (SMART) program.²³ These programs provide military officers and civilian scientists and engineers advanced education for future employment in the DOD. The FBI and the intelligence community have similar programs. These types of programs could be expanded to other government agencies and industry. In addition to student service commitments, tax incentives or credits could further motivate industry to adopt such programs. In so doing, the nation could reduce future debt burdens and produce more scientists and engineers.

THE CULTURAL LANDSCAPE OF US EDUCATION

The prevailing wisdom, historically, is that one must go to a university and obtain a degree to be “successful” in life. This perception is true, based on many studies of lifetime earnings.²⁴ As a hiring filter, employers increasingly require a bachelor’s degree.²⁵ The return on investment provided by a university degree is complex, and not universally accepted as a great deal; wage growth has been stagnant, and unemployment rates among recent graduates have been high.²⁶ Still, an undergraduate degree is undoubtedly a good deal—for both the student and the nation.

Whether due to perception or requirements, college enrollments increased rapidly from 1970 to present. In 1970, 7.4 million students were pursuing higher education in the US, and by 2010 this number had

22 Govind, Bhutada. “The Rising Cost of College in the US,” Visual Capitalist. February 3, 2021. Citing Bureau of Labor Statistics data. <https://www.visualcapitalist.com/rising-cost-of-college-in-u-s/#:~:text=The%20average%20cost%20of%20getting,has%20risen%20by%20only%2036%25>.

23 Smart Scholarship Program. “SMART Scholarship for Service Program,” <https://smartscholarshipprod.servicenowservices.com/smart>. May 2022; Today’s Military. “ROTC Programs – Today’s Military,” 2019. <https://www.todayismilitary.com/education-training/rotc-programs>.

24 Emmons, William R., et al. “The College Boost: Is the Return on a Degree Fading?” Federal Reserve Bank of St. Louis. July 17, 2018. <https://www.stlouisfed.org/on-the-economy/2018/july/college-boost-return-degree-fading>.

25 Fuller, Joseph. “Why Employers Must Stop Requiring College Degrees for Middle-Skill Jobs,” Harvard Business School Opinion. December 18, 2017. <https://hbswk.hbs.edu/item/why-employers-must-stop-requiring-college-degrees-for-middle-skill-jobs>.

26 Busted, Brandon. “The Convincing and Confusing Value of College Explained,” *Forbes Magazine* September 3, 2019. <https://www.forbes.com/sites/brandonbusted/2019/09/03/the-convincing-and-confusing-value-of-college-explained/>.

increased to 21 million.²⁷ (Interestingly, the number has plateaued since, with the pandemic causing further “great interruption” in enrollments.²⁸)

Motivations for higher education are changing. In one survey, over 86% of college first-years believed that “[being] able to get a better job” was “very important” in their decision to attend college, compared to the fewer than 60% that claimed “[preparing] myself for graduate or professional school” was equally as important.²⁹ Similarly, according to this same study from UCLA, the rate of respondents saying that “to make more money” was “very important” increased from 44.5% from 1971 to nearly 73% in 2014.³⁰ These trends in survey responses highlight a cultural shift toward an emphasis on financial rewards. Students may be highly motivated to pursue post-secondary education, but not to major in difficult STEM fields.

An education in STEM does not always translate to employment in STEM. The US Census Bureau states that out of the 50 million employed college graduates ages 25-64 in the US in 2019, “37% reported a bachelor’s degree in science or engineering, but only 14% worked in a STEM occupation.”³¹ Graduates in STEM fields are in high demand, but not necessarily for STEM occupations. Management consulting firms and financial institutions seek students from elite institutions, observing that the talent pool is small and competitive, and “STEM professionals have become an integral part of the workforce in the finance arena....”³² Exceptional pay and benefits tempt graduates away from a career in the sciences to pursue other more lucrative opportunities.

The situation is slightly different for international students in the US. For visa reasons, foreign graduate students must maintain full study loads during school and are less likely to be recruited to a non-STEM career if they stay in the US with a STEM degree. Perhaps as a result, over half of US engineering and computer science workers with a graduate degree are foreign-born (Figure 6.4).³³

The cultural milieu in the United States has evolved significantly over the last half-century. Against the backdrop of the numerous economic pressures facing students and young people in the US, there is cause for concern about the future of American competitiveness. Although rectifying the current situation is a monumental challenge, it is a challenge worth undertaking.

27 Hanson, Melanie. “College Enrollment & Student Demographic Statistics,” The Education Data Initiative. April 22, 2022. <https://educationdata.org/college-enrollment-statistics/>.

28 Conley, Bill and Robert Massa. “The Great Interruption,” *Inside Higher Education* February 28, 2022. <https://www.insidehighered.com/admissions/views/2022/02/28/enrollment-changes-colleges-are-feeling-are-much-more-covid-19#:~:text=Bill%20Conley%20and%20Robert%20Massa,patterns%20portend%20for%20higher%20education.&text=Much%20has%20been%20written%20about,second%20half%20of%202021%20alone>.

29 Rampell, Catherine. “Why Do Americans Go to College? First and Foremost, They Want Better Jobs,” *Washington Post* February 17, 2015. <https://www.washingtonpost.com/news/rampage/wp/2015/02/17/why-do-americans-go-to-college-first-and-foremost-they-want-better-jobs/>.

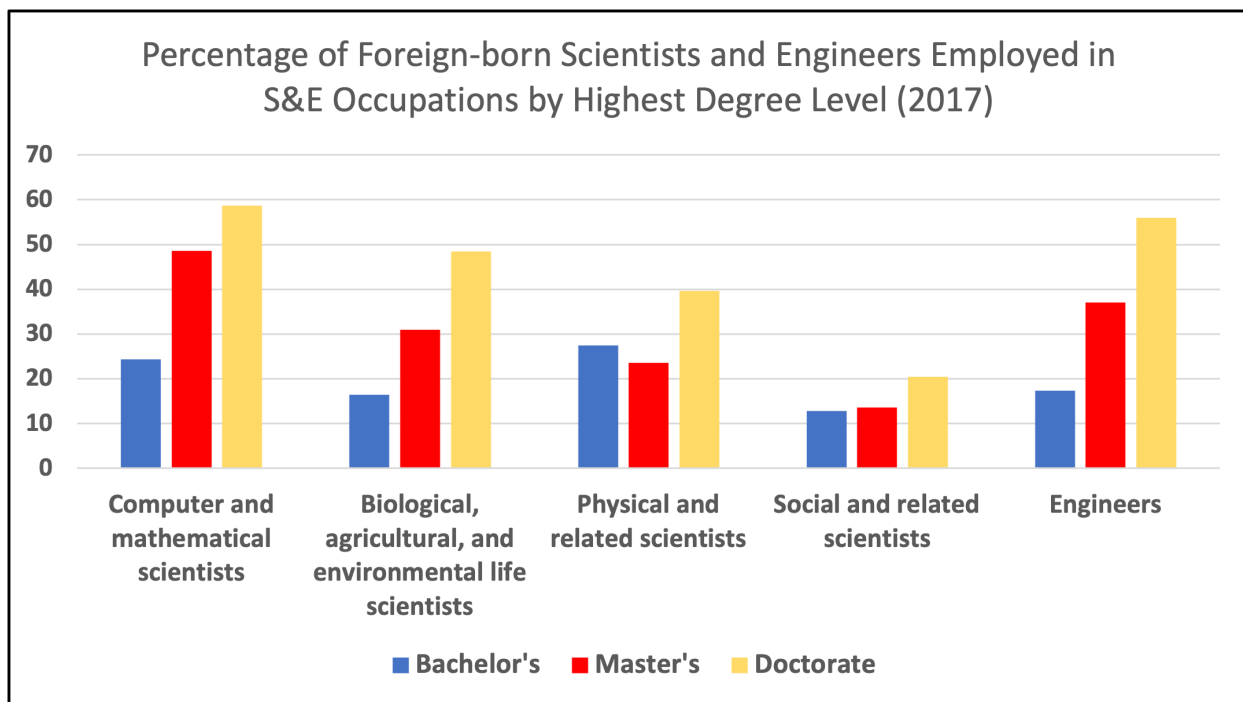
30 Rampell, Catherine. “Why Do Americans Go to College?”

31 Day, Jennifer Cheeseman and Anthony Martinez. “STEM Majors Earned More than Other STEM Workers,” United States Census Bureau. June 2, 2021. <https://www.census.gov/library/stories/2021/06/does-majoring-in-stem-lead-to-stem-job-after-graduation.html#:~:text=STEM%20workers%20who%20majored%20in,and%20physical%20and%20social%20scientists>.

32 Meadows, Amy. “A Sign of the Times – How the Finance Industry is Embracing STEM Professionals,” *Bloomberg*. August 28, 2017. <https://www.bloomberg.com/company/stories/sign-times-finance-industry-embracing-stem-professionals/>.

33 Burke, Amy, Abigail Okrent, and Katherine Hale. “The State of Science and Engineering 2022,” National Science Foundation, National Science Board. 2022. <https://ncses.nsf.gov/pubs/nsb20221>.

Figure 6.4. Foreign-born Individuals in Science and Engineering Occupations in US by Education Level.



Source: NSF, National Science Board, Science and Engineering Indicators 2019, Science and Engineering Labor Force, Figure 3-24. Data from National Center for Science and Engineering Statistics, National Science Foundation, National Survey of College Graduates, 2017.

THE FACTORS FOR MIGRATION AWAY FROM STEM FIELDS

In a recent forum of the Potomac Institute’s GCP, panelists suggested reasons as to what could be driving the migration of American students to non-STEM fields.

The overriding reason, as suggested, is financial. The overwhelming cost of attending college in the US incentivizes students to pursue degrees outside of STEM, or to drop from STEM programs after beginning them, because they “cannot afford to fail and retake courses.” Regardless of their talent or primary school experience, a STEM degree may be perceived as too risky given the burden of debt that will cripple them financially. They pivot their focus toward a subject area they believe is “easier” and less risky. One study in 2019 found that over 60% of college students dropped out of their STEM programs.³⁴ It is reasonable to suggest that students feel more likely to graduate with a degree in social sciences, humanities, and business.

Another factor for the migration away from STEM fields, brought up by the panelists, was the practice of introductory courses whose purpose is to “weed-out” weaker students. The suggestion is that STEM 101 courses are not designed to best prepare students for matriculation through their major but are designed

34 Student Research Foundation. “Why Do 60%+ of College Students Drop out of STEM Programs?” December 3, 2019. <https://www.studentresearchfoundation.org/blog/college-students-drop-out-of-stem/>.

to optimize the allocation of educational resources to a select few.³⁵ The selection process may be counter to the United States' goal of an enduring competitive advantage in STEM fields.

Class size may be another factor. In STEM disciplines, especially in introductory courses, large lecture-hall classes can be common, ranging in size from 100 to 500 students—with extremes of up to 1,000 students.³⁶ Quality and interactivity suffer, for efficiency. A 2021 study of the impact of class size on college students in the UK noted that large class sizes are “associated with significantly lower grades.”³⁷ Talent in STEM may be lost as students migrate to other fields with more social experiences.

Employment opportunities and starting salaries play a role. Today, the highest paying tech jobs (those positions that demand STEM degrees) are in advertising optimization, social networking, workplace efficiency, quantitative investment analysis, payments processing, and other data analytic applications.³⁸ These businesses generally do not contribute to the US' competitive advantage in STEM, but they attract investments from venture capital and, thus, recruit the best STEM graduates.³⁹

Today, many of the high-tech start-up companies that employ recent STEM graduates aim to be acquired by larger established companies. The start-up companies are not in the mold of large research enterprises of old, such as Bell Labs, Xerox Parc, Intel, or an early Apple. Instead, the startups focus on “quick wins” and demonstrations, and often do not persist at knowledge development after acquisition. STEM employees then migrate to other startups, or non-STEM endeavors.

To be competitive in the future economy of the world, the US cannot afford to have STEM students migrate to other fields and endeavors before their talent is discovered. The nation needs a larger cohort of students to matriculate through STEM education and to become gainfully employed in technology development for societal purposes to participate in the future economy.

A BRAIDED RIVER MODEL OF EDUCATION

Today, education and career development in the US can be represented as a pipeline, i.e., a linear progression through elementary, secondary, undergraduate, and graduate education into a career. This model has been under question for some time.

An *Economist* magazine special report from 2017 proposes a changed viewpoint in the educational model.⁴⁰ Contrary to time-based block learning, where a person attends programs for a fixed number of years, the changed viewpoint constitutes a more “continuous learning” model. Many career fields operate this way already, for example, medicine, law, engineering, and accounting. In these fields, more

35 Chawla, Dalmeet Singh. “Surviving Weed-Out Classes in Science May Be a State of Mind,” *New York Times* November 16, 2020. <https://www.nytimes.com/2020/11/16/science/weed-out-classes-stem.html>.

36 The University of California Berkeley, Office of the Vice Chancellor of Finance. Our Berkeley, “Class Size,” 2022. OPA – University of California Berkeley. <https://pages.github.berkeley.edu/OPA/our-berkeley/class-size.html>.

37 Kara, Elif, Mirco Tonin, and Michael Vlassopoulos. “Class Size Effects in Higher Education: Differences across STEM and Non-STEM Fields,” *Economics of Education Review* 82 (June) 2021, <https://doi.org/10.1016/j.econedurev.2021.102104>.

38 BuiltInSF.com. “50 Best Paying Companies in the Bay Area 2021,” 2021. https://www.builtinsf.com/awards/best-paying-companies-san_francisco-2021.

39 Statista Research Department. “Value of Venture Capital Investment in the 2021, by Industry,” Statista. April 13, 2022. <https://www.statista.com/statistics/277501/venture-capital-amount-invested-in-the-united-states-since-1995/>.

40 “Lifelong Learning is Becoming an Economic Imperative,” *The Economist* January 14, 2017. <https://www.economist.com/special-report/2017/01/12/lifelong-learning-is-becoming-an-economic-imperative>.

experiential learning occurs up front with frequent refreshers, updates, and certificate credentials throughout a career.

Figure 6.5. Illustration of the “Braided River Education Model for STEM.”

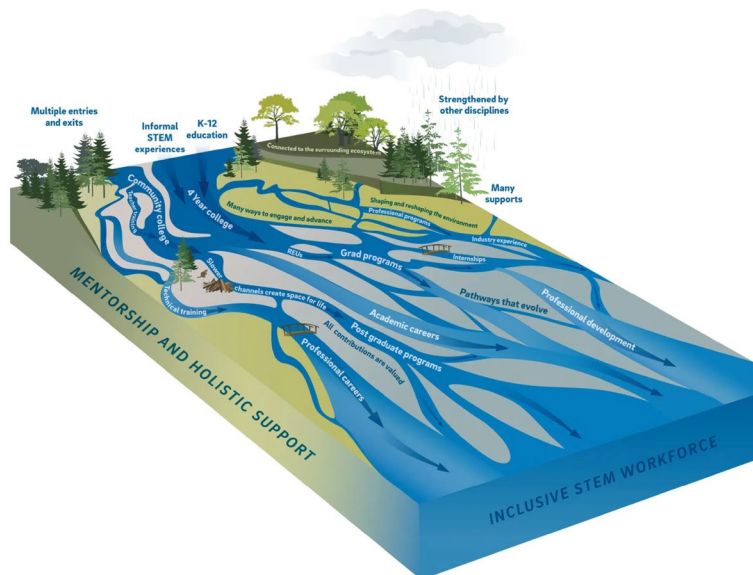


Image credit: Jennifer Matthews. With permission EOS, Reimagining STEM Workforce Development as a Braided River–EOS.

This new model may be thought of as a braided river model (Figure 6.5), as envisioned by authors of a recent article on STEM workforce development.⁴¹ Continuous learning serves as an analog for the way we can view a typical career, with an “inclusive, responsive, and modern career development” process. The concept is to allow individuals to move along and in between multiple entry points through a STEM career, in distinction to a time-dictated “pipeline” that has only one main entry point, namely higher education. Partnerships among academia, government, and industry could allow for multiple entry points into STEM at any readiness level.

The model implies a very different approach to educational investments and funding. Much of the advanced education becomes the shared responsibility of the student and employer. Employment models such as the Military Reserve Officer Training Program and SMART (see Scholarship for Service insert, page 8) make tuition payments for advanced education. The GI bill has supported numerous college educations. Other scholarship and tuition payment service programs might accompany careers outside of the military. Government service might include student loan payments in pre-tax dollars. Mentorships, training programs, academic courses, and deployment mobility could provide greater freedom for people of all ages and career stages to pursue lifelong STEM careers and to contribute to US competitiveness in the future economy. Removing current disincentives for STEM development and replacing them with

41 Batchelor, Rebecca L., et al. “Reimagining STEM Workforce Development as a Braided River,” EOS 102, April 19, 2021. <https://doi.org/10.1029/2021EO157277>.

motivations and opportunities would require a major shift in investments in education and the associated funding models.

CONCLUSION

The United States should strive to expand its leadership on the world stage in science and technology. In the past, its position as the eminent leader in these fields provided a historically unprecedented quality of life for the average citizen and has been the foundational building block in its provision of national security. Policy driven economic pressures should not be the reason that the United States loses its global competitive advantage. The US government needs to address the economic underpinnings of education to build a foundation for an enduring competitive advantage in STEM.

At the base of technological competition are people—the scientists, mathematicians, data analysts and engineers that drive the technological progress engine. If the US is to re-establish an enduring competitive advantage in STEM and technology, national education process reforms will be needed. Serious reconsideration of the federal government’s relationship with both the private sector and state and local education will be required. The United States has the talent, universities, laboratories, and infrastructure to succeed, and to lead the world in technology development through superior research and science. However, disincentives and barriers to effective career development through STEM education must be overcome. Investments in education and career development within US enterprises of the young, talented, and motivated are necessary to establishing an enduring competitive advantage in science and technology.

CHAPTER 7: SPACE

GCP EVENT: ENVISIONING COMPETITIVE ADVANTAGE IN THE SPACE DOMAIN

The Potomac Institute for Policy Studies hosted a GCP hybrid seminar titled “Envisioning Competitive Advantage in the Space Domain” on March 30, 2022. The panel of experts at this event included Jerry Krassner, PhD (Potomac Institute Board of Regents member, co-founder and former National Chairman of MASINT [now ATIA]; Former Chief Scientist in several offices at the Office of the Secretary of Defense and the Defense Intelligence Agency); Thomas Messegee (Spacecraft Design Consultant and Engineer); and Dr. Samantha Weeks, PhD (Mission Director, Science and Research, Polaris Dawn and Vice President, Corporate Transformation, Shift4 Payments). This chapter addresses topics discussed during the seminar and includes two original essays. The first essay, “A New Vision for Space,” by renowned aerospace R&D expert Jerry Krassner, is an impassioned argument for US leadership in space. The other essay, “The Space Race to Develop New Technologies,” written by space defense systems expert Tom Messegee and Air Force Officer and graduate student Jessica Kirkpatrick, addresses the space race as an opportunity and challenge to develop new technologies to enable US leadership in space.

THE CHALLENGES OF SPACE

The space domain, commonly referred to as the “Final Frontier,” is quickly becoming one of the most important areas for global competition. In the 1960s, the US engaged in a Space Race with the Soviet Union with a tangible goal of putting the first man on the Moon. Today, space competition has once again become a top priority for American leaders. The 2020 National Space Policy and 2018 National Space Strategy identified principles, goals, and guidelines for future US space activities.

In December 2019, the US Administration stood up the US Space Force as a new, separate military service under the Department of the Air Force. The months leading up to its establishment marked a shift in how US policymakers and national security professionals speak openly about space. In the past, it was taboo to openly discuss space as a warfighting domain. Our view of space today is explicitly one of military competition and deterrence, with implications for national economic, political, and military capabilities.

China and Russia have invested heavily in their civilian and military space programs, with efforts spanning intelligence, reconnaissance, surveillance, human space exploration, space-related R&D, and anti-satellite demonstrations. Meanwhile, commercial firms have expanded their space activities as NASA’s role in spaceflight decreases and federally funded space exploration has slowed.

As the essays in this chapter make clear, space offers substantial commercial opportunities and US leadership in space activities will facilitate capturing those commercial markets and benefiting from their use. But a leadership role is necessary to defend our interests in space because, as a warfighting domain, those commercial assets could become targets as a result of the convergence of military, economic, and political concerns within national security.

A NEW VISION FOR SPACE

Paper by: Jerry Krassner, PhD

Global competitions related to climate change, global pandemics, geopolitics, and military power can radically change the world. One of the great power competitions simmering in the background is the competition for preeminence and leadership in the space domain. This competition, based primarily (but not exclusively) in the technology sector, rarely breaks through to the front pages of the mainstream media. Even though this competition most visibly occurs in space, it holds the power to reshape the entire world.

If one believes a nation requires economic strength, military strength, or both to be a global power, then the emerging revolution in space should be considered a primary area of societal competition. This is not a competition for unilateral military control, but one to harvest the economic benefits of space primacy. Ultimately, the US is facing challenges to its historical leadership in space. US leadership in technology and innovation provides an opportunity to counter that challenge.

The United States can compete in several arenas, including: technical, policy, and operations. But foundational to the future success and advantage in space is an expanded pipeline of young workers to replace the growing cadre of “Sputnik-era” retirees and bringing new ideas and energy to the sector. An increased focus on early STEM education opportunities and public outreach by “space leader” role models, along with other similar initiatives, are needed to capture the imagination of young students. Also, the US government should consider expanding scholarship and fellowship programs such as the National Science Foundation graduate and young career funding opportunities that emerged in the 1960s and 1970s as a response to the Soviet Sputnik event,¹ and the current SMART program. We want the best and the brightest to see a space career offering excitement, stability, and societal contribution.

Since the start of the Space Age over 60 years ago, nations have produced increasingly capable launch vehicles, spacecraft, and associated infrastructure. Today’s rockets are larger and the spacecraft last longer, but a direct link remains between those earlier days and today’s space operations. To paraphrase: We still do things the old-fashioned way. And, while leading countries in the space field have benefited from the “old way” in terms of their national security, economic return, and international prestige, the “old way” comes with limitations.

For example, spacecraft are generally limited in size to the available volume in a single launch fairing. They are launched with their “lifetime” load of fuel and other consumables. They are launched into an orbit that they are restricted to for their entire operational lifetimes. In general, they cannot be repaired or updated with newer technology or changes in mission.

Limited counter examples exist, however. The ISS was assembled in space using multiple launches for its various components. The Hubble telescope was repaired several times, and its instruments upgraded as technology improved. Commercial re-fueling of satellites has been demonstrated in geosynchronous orbit. However, such examples were largely one-of-a-kind, bespoke designs not based on common infrastructure.

1 In-space Servicing, Assembly, and Manufacturing National Strategy, April 2022
https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwiYoPG6_8v4AhXvhYkEHfqSDs4QFnoECACQAQ&url=https%3A%2F%2Fwww.whitehouse.gov%2Fwp-content%2Fuploads%2F2022%2F04%2F04-2022-ISAM-National-Strategy-Final.pdf&usq=AOvVaw3WuQ4lFk58Y6_aQaPL0n7g

It is time to implement a new space infrastructure ecosystem that will unlock greater economic opportunity, enable more capable/cost-effective missions, and position the US to lead the world into the next generation of space activity. Societal benefits will come in the economic returns and international prestige that will enable continued US success in global competition, similar to the benefits achieved from earlier space missions such as Mercury, Apollo, and the Space Shuttle. But, this will not come without competition, both from peer competitors and from friendly space-faring nations, who see the same possibilities.

Technology now offers the ability to perform missions such as in-space assembly, repair and refueling, up/down/cross orbital transportation, on-orbit manufacturing/assembly, and similar functions that enhance mission effectiveness and reduce costs. International standards groups like the International Organization for Standardization (ISO) and the Defense Advanced Research Projects Agency (DARPA) Consortium for Execution of Rendezvous and Servicing Operations (CONFERS) provide a basis for global adoption that will further enhance the benefits of next-generation mission and platform designs. However, the US needs to lead this standards development in a manner that entices other space-faring nations to join in or risk alternative standards that result in a “bipolar standards world” with reduced cost effectiveness and interoperability that slows progress for all space-faring nations.

Recognizing the opportunities for in-space manufacturing/assembly, repair/refueling, and new transportation options, the US produced an initial roadmap document² to guide US investments in this area. Although a productive first step, effective and reliable funding is needed to ensure implementation and encourage private investment.

A vision for space-based infrastructure has direct parallels to the infrastructure that enables the terrestrial US economy today. Imagine the US without an interconnected transportation network of highways, rail, and air networks. Imagine a 21st century economy where all construction came from a single factory—limiting the size, shape, and function to what that one factory could provide (metaphorically analogous to launch fairing limitations). Imagine a country unable to service and maintain its infrastructure or critical assets; a country with no way to repair a water main break or that throws away a car after a single tank of gas; a country unable to update its technology over operational lifetimes. Such a nation would not likely be considered a global leader.

These limitations are analogous to the current state of on-orbit infrastructure, where spacecraft are just about the only component in any domain that is fielded, then never maintained, upgraded, refueled, or closely inspected.

It is now within our ability to develop a space infrastructure ecosystem that mirrors the advantages of the terrestrial infrastructure. This ecosystem would:

- Significantly reduce the cost and time to access space;
- Enable new functions and capabilities, either based on launched or in situ resources and space-based assembly;
- Set the standards for future trade and behavior worldwide;
- Expand the US industrial base, enabling space development to be performed by a wider set of companies at a lower cost;

2 In-Space Servicing, Assembly, and Manufacturing National Strategy, April 2022.

- Motivate the next generation of STEM students;
- Maintain US leadership of civil space exploration, commercial space applications, and national security space missions.

Such an infrastructure would provide the opportunity for enormous economic growth, greater security in the global commons of space, and motivation for commercial investment similar to past historical examples, such as the Erie Canal, the transcontinental railroad, and the interstate highway system. Each of these generated enormous long-term benefits across multiple sectors, using a variety of public and private funding mechanisms. Many of these benefits were not foreseen until much later.

The nation that implements this new vision most expeditiously will be recognized as a global leader in the future of space and will guide the development of new norms and standards for the rest of the world. Advanced implementation of the vision will render operational benefits leading to economic return on investment and growth. That nation will enjoy preference by the next generation of scientists and engineers as the place to pursue a career.

Regarding norms of behavior, it is critical the US lead this development—in conjunction with like-minded space-faring nations and private entities. The primacy of the rule of law has been a critical foundation for US development throughout its history. It is crucial that the American free enterprise system, bounded by applicable laws, be the basis for large-scale development of the space commons. Failure to lead will result in reduced private investment and increased risk of alternative, less law-based systems to set the rules for space operations.

The nation that fails to lead this “revolution in space affairs” will forfeit influence of the anticipated multi-trillion-dollar space economy. Without that economic strength, terrestrial global leadership will be severely inhibited.

In addition to the technology opportunities and challenges, it is equally important that the policy and regulatory environment keep pace. It is important that the US be seen as a reliable, low risk business environment for investment and operation. Rapid and transparent license processing will be important in cases where alternative countries can be seen as more responsive to innovation. Public/private partnerships, revenue sharing, and other innovative funding opportunities need to be available. In some cases, the US government may need to function as an “anchor tenant” to support initial, pre-competitive development, as has been the case in the past (in microelectronics development and vaccine development, etc.). Failure to do so will inhibit private sector involvement, which will force greater federal investment and assumption of risk when budget and political pressures will be significant.

Science and exploration have been key components of US space investment. Programs like Mercury/Gemini/Apollo, Space Shuttle, ISS, Hubble Space Telescope, and planetary probes have been riveting to average citizens, worldwide. As a result, the prestige, reputation, and soft power of the US have been long-standing and widespread. The US government, complemented by private efforts, should maintain a robust science/exploration activity to retain this soft power tool and to entice next-generation scientists and engineers, whether US- or foreign-borne, to pursue space careers.

This is not a call for unilateral US space dominance. Rather, it is a call for US leadership. The costs to realize the vision of a renewed space infrastructure ecosystem might be beyond the means of any one country. An attempt to “monopolize the market” might lead to alternative implementations by other countries, a competitive “Balkanization” of the space infrastructure resulting in reduced interoperability, differing technical standards, and similar complications largely negating the potential benefits outlined earlier.

In the global competition for leadership in space, the US can continue the incremental evolution of space activity, or we can disrupt and aggressively implement a vision of more capable, cost-effective missions. The latter will result in greater economic growth, enhanced national security, an improved workforce, and greater competitive advantage in a critical domain of international competition that will only continue to grow.

In short, the future of space leadership is a critical societal challenge. Continuing to do things the same old way reduces the barrier to entry for global competitors and risks others taking the lead, which compromises our future national prosperity and security. The future of global leadership is at stake.

THE SPACE RACE TO DEVELOP NEW TECHNOLOGIES

Paper by: Thomas Messegee and Jessica Kirkpatrick³

THE SPACE RACE OF THE PAST

The United States was the first and, after more than 50 years, is still the only nation to put a human on the Moon. This event had many impacts on humanity—some direct, many indirect, and most for good. Its significance in history for our nation and for most other countries has been the opening of space for free commercial and scientific use by anyone with the desire and technological ability to explore and advance their national goals. This great expansion into space started as a race between the two post-World War II superpowers: the former Soviet Union and the United States, vying to be the first nation to put humans on the Moon. It culminated with the Apollo 11 landing and the failure of all four of the Soviet's N1 rockets, the Soviet's version of the Saturn V, that were intended to take Cosmonauts to the Moon. Shortly after these events, the Soviets ended their lunar aspirations.

The first space race was over, and the US has maintained peaceful space dominance ever since. Neil Armstrong's famous words "One small step for man, one giant leap for mankind," had a broader meaning than just an astronaut demonstrating the advancement of technology: Armstrong claimed the Moon for the world and space as free for all of humanity.

New and old actors on the stage of space exploration have emerged to challenge that dominance. US dominance can be traced back to Robert Goddard's launch of the world's first liquid-fuel rocket on March 16, 1926, in Auburn, Massachusetts. The US has maintained dominance in a mostly non-hostile, exploratory space environment. The Information Age in space has delivered GPS global positioning, the entire telecommunications network, and other "things done in space" that are part of our daily lives.

Now, with the launch of Virgin Atlantic's VSS Unity space plane and Blue Origin's New Shepard rocket, the space tourism industry has been inaugurated. Commercial space is growing rapidly, and many countries are now capable of putting things on the Moon, launching rockets with complex satellites, or building space stations.

THE NEW RACE

Space is no longer a cooperative environment for commercialization and exploration—it is a battlespace. China and Russia wish to militarize it.

They have recently invested in space and developed some relatively sophisticated capabilities. The scale of the Chinese investment is especially large. They are the lead rocket-launch nation in the world and have begun launching satellites every other week. In 2020, they launched 35 satellites, compared to the US launch of 33. China and Russia are developing military capabilities, doctrine, and organizations—including anti-satellite weapons, ground-launch missiles, and directed-energy weapons. Additionally, they continue to launch experimental satellites that conduct on-orbit activities to advance counter-space capabilities. China sees space as the new South China Sea and does not intend to abide by treaties or respect our right to freely operate there.

3 Ms. Kirkpatrick's contributions in this publication are solely the author's and do not reflect the official stance of the us DOD or the US Air Force.

The United States still has a lead in space, but that might not last long, as Russia and China seek to asymmetrically undermine our space-based capabilities.

The loss of US dominance in space to either Russia or China would not only be a disaster for the United States both strategically and economically, but also for the entire free world. Space is intended to be a place for free enterprise and cooperative exploration. It is a vehicle for how we teach our children to be inquisitive about science and technology, and how we develop the technologies of the future. For the US, space is a vital national interest and is a foundation to our economy and way of life. It supports our academic, agricultural, banking, and travel sectors, among others. The rapidly growing commercial space sector offers enormous promise for the prosperity of Americans and our global partners. The economy of space is rapidly growing to be a multi-trillion-dollar industry.

TECHNOLOGIES FOR FUTURE SPACE ENDEAVORS

The DOD launched the US Space Force as a new service in the Department of the Air Force, elevated US Space Command as a unified command, and established a Space Development Agency—all part of DOD's efforts to move forward within this new reality. As of August 1, 2020, the US owned and operated 1,425 of the 2,787 satellites currently active in orbit.⁴ To protect these critical assets and expand our capabilities, these US organizations will need to make investments in key space infrastructure.

Our intellectual trust and our financial investments should be focused in three areas to advance our interests in space:

1. **Access:** Reducing the cost of launch systems and advancing space propulsion technologies.
2. **Autonomy:** Autonomous spacecraft operations through advancements in AI, deep learning, and machine learning.
3. **Information Technology:** Advanced on-orbit processing, data storage, and quantum computing.

The new second space race is underway. The winner this time is, in many ways, far more important than who won the first space race. The choices we make in the next five to ten years will determine the outcome, the results of which will impact our daily life directly.

ACCESS TECHNOLOGIES

The US is making significant gains in rocket technology. A SpaceX booster can return from space and land on a floating recovery platform. SpaceX has constructed the largest rocket ever built, with a height of 400 feet, nearly 40 feet taller than the next largest Saturn V rocket built by NASA.⁵ The Pegasus XL boosters deliver small and medium satellite payloads to low Earth orbit (LEO). The Space Force now operates on a 30-day launch cycle in which they can put a 900-pound payload into LEO. This contrasts with most DOD satellite programs of record that take, on average, ten years to field a new system.

But the US must further drive down the cost of launching satellites into LEO orbits. Moreover, there needs to be easier access to medium Earth orbit (MEO), geostationary (GEO), and cislunar orbits on launch schedules that are competitive with Russia and China.

4 https://rstudio-pubs-static.s3.amazonaws.com/703895_76b4a1afde894befb20f5976a87cc4a7.html.

5 UPI. SpaceX briefly puts together largest rocket in history at Texas base. August 6, 2021
https://www.upi.com/Science_News/2021/08/06/SpaceX-Starship-Super-Heavy-rocket/2161628271028/.

Beyond Earth's orbit, Russia may be ahead of the US in systems designed for interplanetary travel. A ground-breaking Russian nuclear propulsion system for human space travel began testing in 2017 and will power a ship capable of long-haul interplanetary missions by 2025. The nuclear drive will produce 100-150 kilowatts of energy for up to three years and use an electric ion propulsion system.⁶ NASA and SpaceX have both designed and utilized ion thrusters, albeit smaller, and have designed for larger ones for the future missions. Ion engines are likely essential for a manned trip to Mars, to reduce transit times and thus reduce astronaut exposure to cosmic rays. DARPA's Demonstration Rocket for Agile Cislunar Operations (DRACO) program is working on a nuclear thermal propulsion (NTP) system that will be tested in cislunar space.

The goal is to be able to transit to Mars in 30 days instead of 7 months to 1 year. For astronauts, fast transit is only part of the solution. To access Mars and beyond, astronauts will need greater protection. Improved shielding using water, which must be carried aloft in any case, could assist in shielding astronauts from high energy neutrons. In that it slows these particles down to thermal energies but does not produce sufficient back scatter. Steel, lead, and polymers can supplement the shielding, but add weight that must first be launched into LEO and then cislunar orbits before making their eventual journey to Mars. For human access to the surface of Europa, Jupiter's ice moon, would be yet more daunting, because Jupiter's magnetosphere traps and accelerates particles producing intense belts of radiation similar to Earth's Van Allen belts, but thousands of times stronger. Indeed, these will be difficult environments for both humans and computer hardware.

AUTONOMY TECHNOLOGIES

Today, we require large ground systems with communications and processing hardware and software to maintain the health and safety of our spacecraft, manage and direct their daily operations, and house the hundreds of employees tasked with keeping an eye on our valuable space assets. Our spacecraft and satellites are dumb and require constant attention from ground controllers.

The future will require spacecraft with continuous health status monitoring and decision-making, autonomous switching to redundant systems, making microsecond decisions on vehicle maintenance routines, such as orbit refinements to dump momentum or fire thrusters. Autonomous functions can greatly extend the life expectancy of a satellite, but is also essential as we expand our exploration of the outer solar system. Artificial intelligence is the key to making our space infrastructure here close to the Earth more resilient, and to enable the technologies to explore the outer solar system, the Kuiper belt and, one day, the stars.

INFORMATION TECHNOLOGY

Autonomy and more sensing and exploration imply advanced computer processing in space. We must push our processing to the edge of space. Vastly greater improvements in processing in space is the single most enabling technology for everything else.

When subjected to high radiation fields, a microprocessor with its millions of gates on a silicon substrate is prone to error and performance degradation. Space is filled with high energy ionizing radiation of

6 Plutonium to Pluto: Russian nuclear space travel breakthrough. April 3, 2012. <https://www.rt.com/news/space-nuclear-engine-propulsion-120/> and Business Insider, Russia Plans to Launch Nuclear Powered Spacecraft, May 25, 2021, Russia Plans to Launch Nuclear-Powered Spacecraft to Jupiter in 2030 (businessinsider.com).

protons and heavy atomic nuclei. Today, space qualified microprocessors require shielding, and operate with slower speeds and fewer transistor gates.

Computer science and mathematics offer alternatives, which can be explored to provide safe and reliable processing capabilities in space. Techniques include approaches such as parallel multiprocessors with co-correction comparison, advance error detection and correction codes, parity checking and cyclic redundancy check, and other approaches to accuracy checks. Quantum key distribution techniques might also be important for secure communications with spacecraft.

GOING FORWARD

We need to keep space commercially and economically free, driven by a free market, and available for exploration to satisfy our natural human curiosity. But, we are at a critical decision point as the world begins to view space as a battleground. The race is now to build our critical space infrastructure; develop, design, and build new propulsion systems; increase autonomy; and create advanced on-orbit processing capabilities.

We will need motivated and talented scientists and engineers in a pipeline of personnel to remain competitive in the space race. Our next Sputnik moment is overdue, to reinvigorate the allure of STEM education again, let alone technology development for space exploration.

How might we best incentivize and leverage commercial space endeavors to assure America's competitiveness in the future? FY 2022 saw a decrease in NASA funding, while US commercial investments in space continue to grow. Our return to the Moon in 2025 will inspire the next generation of future scientists, engineers, and explorers, and give commercial endeavors the opportunity to take part in a Moon-based infrastructure. To tackle the hard technological problems of deep space exploration, however, we must continue to cooperate with other countries such as China and Russia in exploring and opening up areas of inner-planetary research. We will have to overcome our differences to continue to make advancements in space-related sciences and Earth sciences.

DOD will also need to leverage commercial solutions in support of US national security interests. This will require more flexibility in our acquisition processes, to incorporate the "good ideas" from the commercial space industry. The commercial space industry has moved toward incorporating the automotive industry's standards for part manufacturing and testing and away from the traditional space qualified part qualification processes. The result allows companies like SpaceX to design and build a reusable launch vehicle in 12 months instead of the typical 12 to 18-year acquisition cycle for a DOD Program of Record (POR).

The United States has the opportunity to lead and work with partners across the globe into the next era of space exploration and commercialization. While maintaining national security capabilities and space asset defense, our goal should be to expand and lead in the commercial benefits of space, and to continue exploration for better understanding of our space environment, the solar system, and the universe.

CHAPTER 8: COMPETITION FOR ENERGY RESOURCES

GCP EVENT: ENERGY ADVANTAGE—THE CORNERSTONE OF 21ST CENTURY SECURITY AND PROSPERITY

The Potomac Institute for Policy Studies hosted a GCP seminar titled “Energy Advantage—The Cornerstone of 21st Century Security and Prosperity” on April 26, 2022. The panel of experts at this event included: Frank Fannon (Former Assistant Secretary of State (Energy Resources), Managing Director at Fannon Global Advisors, Non-Resident Senior Advisor at the Center for Strategic and International Studies (CSIS), and Non-Resident Senior Fellow at Atlantic Council); Ron Nussle Jr (Senior Advisor to the Under Secretary of State, and Founder and Partner at ICR Group); and Gentry Lane (CEO and Founder of ANOVA Intelligence and Potomac Institute Fellow). The event discussion centered on answering the questions: What is the path to enduring security, prosperity, and quality of life when it comes to energy policy, resource allocation, emerging technology, and international relationships? Is energy independence required or possible?

The exceptionally high quality of life that Americans and many of our partners and allies are accustomed to was founded on access to inexpensive energy resources. Energy is an essential component of the strategic global competition. Understanding the US public and private energy sector is necessary for illuminating the strengths, vulnerabilities, and opportunities in technologies, resources, infrastructure, policy, and security.

Fossil fuel energy sources are increasingly difficult to extract and unevenly distributed throughout the world.¹ These conditions set up a fierce competition for access. Alternative sources, such as nuclear and renewable energy, are not as easily developed. Global supply chains for resources and new technologies give rise to other competitions.

As the war in Ukraine has demonstrated, energy production during wartime can be both an instigator and a target of conflict. Nevertheless, energy is an essential commodity for heating, food production, transportation, manufacturing. Maintaining access to sufficient energy sources at affordable prices is a necessity for quality of life. The topic of energy is complex, carrying issues beyond global competition for resources. Global warming and greenhouse gas emissions further complicate the expansion of energy production and consumption.

Based on Potomac Institute discussions and research on energy, this chapter’s article presents the facts on US energy consumption, its mix, and prospects for continued access to abundant energy resources. Based on work by led by researchers at the Potomac Institute, the authors observe that dependence on fossil fuels is likely to continue for a long time. However, they offer hope that new energy technologies and sources might lead to a transformed landscape of worldwide energy supplies.

1 “Distribution of Fossil Fuels,” National Geographic Society. October 21, 2022.
<https://education.nationalgeographic.org/resource/distribution-fossil-fuels>

PROSPECTS FOR US SOURCES OF ENERGY

Paper by: Bob Hummel, PhD and Moriah Locklear, PhD

The US national security and economy depend on reliable and long-term access to abundant energy sources. Historically, the US has benefited from easy access to energy resources, including coal, oil, gas, wind, solar, and hydro power. Access to energy resources includes oil importation. Events in the 1970s demonstrated that a lack of self-reliance could lead to vulnerabilities. As a result, the US endeavored to achieve “energy independence,” to become a net exporter of energy resources. For the US, that goal was first achieved in 2020.

Energy independence is a noble goal, but it does not eliminate vulnerabilities. Malicious actors, cyberattacks on energy infrastructure, turbulence from climate change, an aging electrical grid, and unsecured supply chains pose threats to America’s competitive edge and economic wellbeing. Sudden increases in the price of energy could destabilize the population by making essential goods and services unaffordable. Residential heating and air conditioning, transportation, and commercial real estate rely on cheap energy sources. Industry depends on large supplies of energy, because, for example, manufacturing typically involves massive consumption of energy. The military requires prodigious supplies of energy in the form of jet fuel, gasoline, and nuclear power—for wartime and peacetime operations. The supply of energy resources is important, but its distribution is also essential to the population, the economy, and the military. Even when sources of energy are based on indigenous domestic supplies, disruptions can occur that put America’s national security and economy at risk.

Being a net exporter of energy resources does not mean that the US does not depend on imports. A major complication is that oil must be refined, and there are different types of oil for different kinds of refineries. The United States imports certain types of oil for which it has refinery capacity and capabilities and exports other types of oil for refining elsewhere. Should imports be disrupted, the US would confront supply deficiencies because current exports could not be converted quickly to domestic use. Moreover, domestic supplies of oil are limited.

Distribution requirements cause other vulnerabilities. Oil and gas pipelines can be sabotaged through physical and cyberattacks. Power grids for electricity distribution require maintenance and are vulnerable to weather or other disruptions.

In addition to threats from geopolitical adversaries, whether wartime or gray zone, there is also a competition for resources. Supply and demand are typically in a very delicate balance globally, and nations need and want access to sufficient energy resources. Any disruption can lead to a scramble and competition for resources globally. This scenario occurred in 2022 due to the reduction and redirection of supplies of oil and gas from Russia.

There are multiple other competitions that take place with respect to energy. In wartime, a typical target of an adversary’s infrastructure and warfighting capabilities involves local energy supplies. There is also a competition for affordable energy, as oil-rich states benefit from high oil prices, whereas major consuming nations benefit from low prices. Today, there is even competition for the installation of renewable energy resources, as there is increasing global interest in reducing atmospheric carbon emissions and thus reducing or eliminating the use of fossil fuels.

Because energy is so important to prosperity and security, the overarching requirement is for reliable access to energy resources. This necessitates sources of energy, production, and distribution, with reserve capacity in all areas. Even then, vigilance is required in recognizing potential threats, both natural and

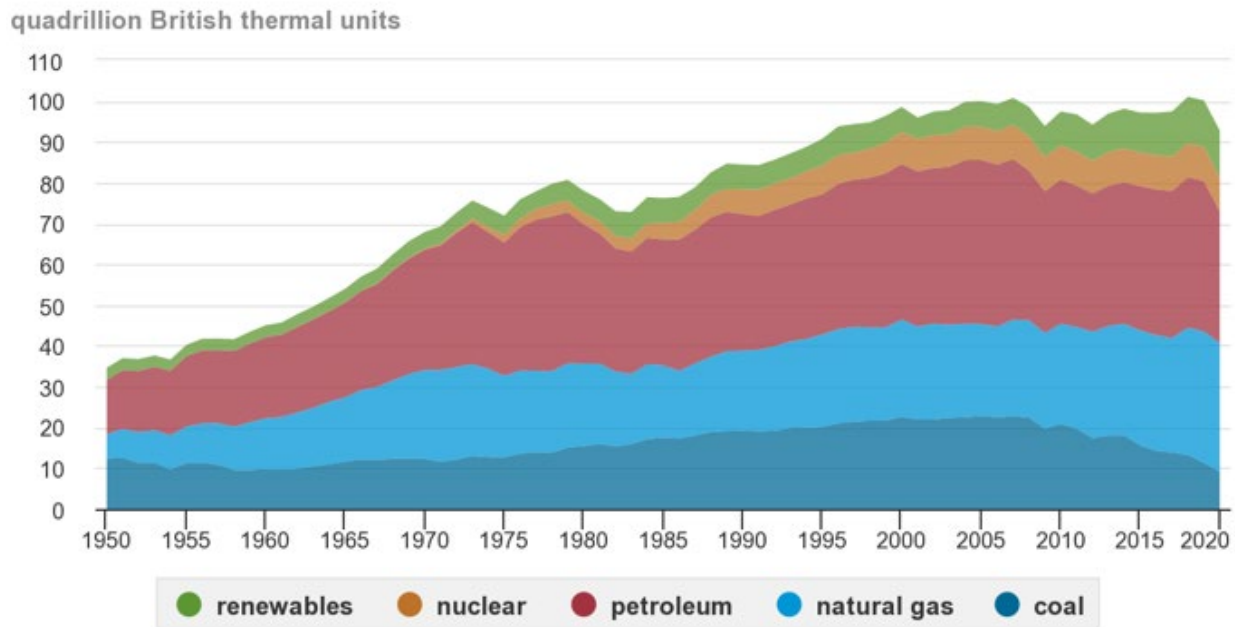
deliberate. This sets up a relentless pursuit of a competitive advantage in access to sources, production, and distribution of energy for the US population, industry, and military needs.

SOURCES OF ENERGY

To a limited extent, energy resources are fungible. Natural gas can be used in place of gasoline derived from oil; solar power can generate electricity in place of fossil fuel power plants. For resilient and stable access to energy resources, it is advisable to have a mix of available energy sources. We begin by considering the current mix of sources for US energy consumption.

Petroleum, natural gas, and coal (fossil fuels) provide for the majority of the US power needs 79%, as shown in Figure 8.1. Renewables account for 12% of US energy consumption, which includes wind, solar, hydroelectric, geothermal, and biomass sources. Nuclear energy comes in third after fossil fuels and renewables, contributing 8% to the total domestic energy portfolio.²

Figure 8.1. US Primary Energy Consumption by Major Sources, 1950-2020.



Source: U.S. Energy Information Administration, *Monthly Energy Review*, Table 1.3, April 2021, preliminary data for 2020



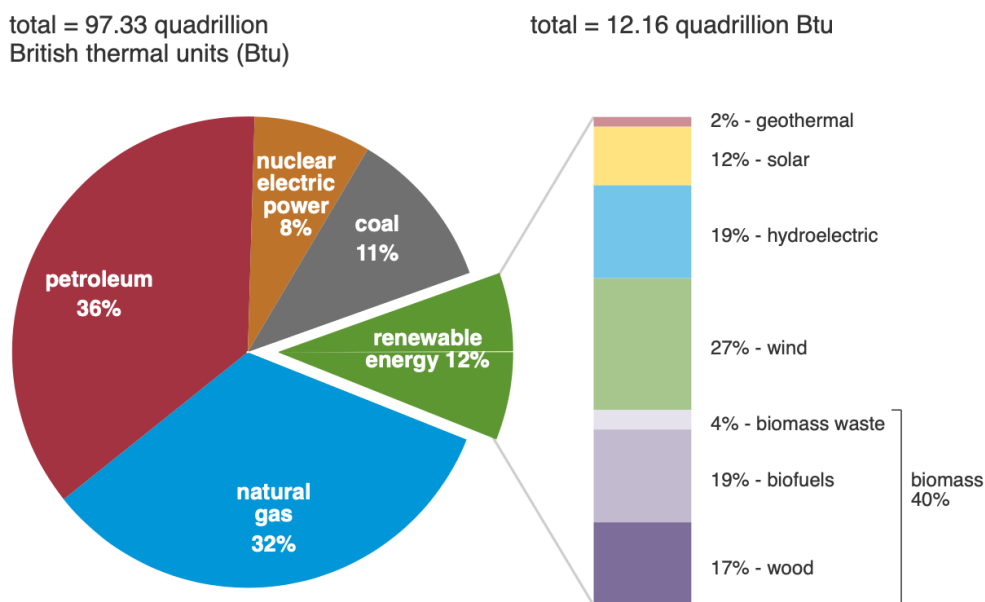
Note: Petroleum is petroleum products excluding biofuels, which are included in renewables.

Measured in “quads” representing the equivalent of a quadrillion British thermal units (Btu), total US consumption is a little less than 100 quads per year, which is roughly one-sixth of worldwide consumption. In the US, roughly a third comes from petroleum, a third from natural gas, and 11% of energy production

2 “Energy Facts Explained,” Energy Information Administration. 2022. <https://www.eia.gov/energyexplained/us-energy-facts>

from coal. Roughly 3.2 quads come from wind turbines, and 1.5 quads from solar.³ Biofuels (including ethanol from corn) contribute less than a quad.⁴ Thus, wind, solar, and biofuels are still relatively minor sources. The US continues to increase renewables while generally decreasing reliance on coal, although the use of coal in the US increased in 2021.

Figure 8.2. US Primary Energy Consumption by Energy Source, 2021.



Data source: U.S. Energy Information Administration, *Monthly Energy Review*, Table 1.3 and 10.1, April 2022, preliminary data



Note: Sum of components may not equal 100% because of independent rounding.

From <https://www.eia.gov/energyexplained/us-energy-facts/>.

Today, and for some years to come, oil and gas will remain the predominant sources of energy in the US. The US produces around 11 million barrels of crude oil per day, which is supplemented with hydrocarbon gas liquids and biofuels to effectively produce 18.6 million barrels per day in 2021. (Hydrocarbon gas liquids come from both natural gas and from the process of refining crude oil.) Consumption stood at around 19.9 million barrels per day in 2021, with the difference made up in imports.⁵ Oil consumption in 2021 accounted for 31.3 quads of energy in the US.

The US Strategic Petroleum Reserve (SPR) holds at maximum about 750 million barrels of oil,⁶ which is a roughly 40-day supply for the US, or 100 days of imports at current rates. It is useful for wartime supplies,

3 US energy facts explained - consumption and production - US Energy Information Administration (EIA).

4 "Biofuels Explained: Ethanol," U.S. Energy Information Administration. 2022. <https://www.eia.gov/energyexplained/biofuels/ethanol-supply.php>.

5 "Frequently Asked Questions," U.S. Energy Information Administration. 2022. <https://www.eia.gov/tools/faqs/faq.php?id=33&t=6#:~:text=In%202021%2C%20the%20United%20States,day%20over%20consumption%20in%202020>.

6 "U.S. Ending Stocks of Crude Oil in SPR," U.S. Energy Information Administration. 2022. <https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=MCSSTUS1&f=M>.

but also can be used to stabilize prices to absorb or make up for over- and under- capacity of the world's supplies. It is being drawn down in 2022 at a rate of a million barrels a day to make up for reduced Russian supplies of oil.

Natural gas production in the US in 2021 was a total of 34.5 trillion cubic feet (TCF),⁷ of which the US consumed 30.3 TCF⁸ and exported the remainder. Natural gas contributed 31.3 quads to US needs in 2021; coal contributed 10.5 quads.⁹

Petroleum products (which technically include both liquid oil products as well as natural gas) are uniquely important due to their high energy content per unit weight and volume. The military is vitally dependent on refined oil products and uses large quantities of natural gas. For certain military uses, it would be hard to replace petrochemicals with any other form of energy production. Aircraft, for example, need jet fuel for long-duration or high-velocity flights. Armored vehicles typically need diesel fuel to generate sufficient power. Many naval vessels rely on petrochemicals for propulsion.

Accordingly, for now and for the foreseeable future, the US requires a stable supply of petrochemicals. Our dependence arises both from common usage of oil and gas for residential, industrial, transportation, and other common uses, as well as from the military's need for large energy supplies. Total US consumption of energy is not expected to decrease, nor should it. This begs the question: to what extent should US energy supply be based on oil and gas, and are alternatives required?

The fact that the US is a net exporter of energy belies the observation that domestic oil and gas are increasingly difficult to extract. Today, oil and gas are found in abundance in the Middle East and other parts of the world but are highly concentrated in small pockets.

UNEVEN DISTRIBUTION

The fact that fossil fuels are not evenly distributed throughout the world makes for complicated marketplace with inequalities in competition. Moreover, production and demand are in close balance at any given time, mediated by prices. Excess production, or excess production capacity, requires excess infrastructure and is thus inefficient. Over production capacity suppresses prices which is not favored by the relatively few producers. The other problem is that as time goes on, oil and gas that is easy to recover has already been recovered. While there is plenty left, that which is left becomes more difficult to extract. New technologies enhance the ability to recover more difficult petrochemical sources, but also require significant investment.

Oil is concentrated into thousands of oil fields scattered throughout the world. Roughly 500 "giant" and 40 or so "super-giant" oil fields each contain over a half a billion barrels of ultimately recoverable liquid oil (5 billion, in the case of super-giant fields).¹⁰ The largest, the Ghawar field, is in Saudi Arabia, is said to have contained nearly 100 billion barrels of liquid oil when first tapped in 1951, now contains an estimated

7 "Where Our Natural Gas Comes From," U.S. Energy Information Administration. 2022. <https://www.eia.gov/energyexplained/natural-gas/where-our-natural-gas-comes-from.php>.

8 "Use of Natural Gas," U.S. Energy Information Administration. 2022. <https://www.eia.gov/energyexplained/natural-gas/use-of-natural-gas.php>.

9 OJG Editors. "Fossil Fuels Made Up 79% of 2021 US Primary Energy Consumption," *Oil & Gas Journal* July 1, 2022. <https://www.ogj.com/general-interest/economics-markets/article/14279046/fossil-fuel-sources-made-up-79-of-2021-us-primary-energy-consumption>.

10 Cohen, Gina. "Giant Oil Field; Super Giants," Hebrew English Energy Dictionary. 2022. <https://www.hebrewenergy.com/giant-oil-field-super-giants/>.

58 billion barrels equivalent, and continues to produce nearly four-million barrels of oil per day.¹¹ Most of the other giant fields, such as Prudhoe Bay in the north slope of Alaska, produce a few hundred thousand barrels per day. Thus, most fields produce a small fraction of the world's consumption of nearly 100 million barrels per day. The giant fields and super-giant fields provide for 60% of the world's total consumption.¹²

If one looks at "proven reserves," and divides by current consumption rates, the world will run out of oil and gas in 47 years. The same computation for US proven reserves versus US consumption results in about 5 years of oil and 15 years of natural gas remaining.^{13,14} In the US, the primary sources of oil and gas come from the north slope of Alaska containing the Prudhoe Bay fields, the East Texas Oil Field, and the West Texas "Permian Basin" fields. There are many other smaller sources, such as fracking in Pennsylvania and West Virginia, and many other potential sources, such as oil shale of western Colorado (which has seen multiple boom and bust cycles, due to the lack of profitability of oil extraction).

However, computations of years remaining are naive for multiple reasons: For one thing, proven reserves can rise or fall over time, depending on the price of oil and gas and the development of new recovery technologies. New discoveries are made all the time. Proven reserves do not fully account for abundant oil shale, tar sands, and other sources that can provide oil and gas using advanced technologies, and "unproven reserves." Fracking, when performed safely and responsibly, can free up natural gas supplies that are not envisioned in the simple computation. Natural gas can be used in place of oil for many purposes, but in many places is "flared" (i.e., burned on the spot) because it is not profitable to capture and distribute. These amounts are often not included in proven reserves.

Nonetheless, at this point, total oil and gas supplies are limited. For the US to maintain its rate of energy use, and continue to depend on oil and gas, there will need to be new supplies soon. There could be new domestic discoveries, but it is likely that much will have to come from imports. Most of the rest of the world's oil is in oil fields located in the Middle East, namely Saudi Arabia, Iran, Iraq, and United Arab Emirates. There are other super-giant and major fields in Mexico, Venezuela, Brazil, Russia, and Kazakhstan, as well as that which remains in the US. With more than 90% of the world's supply (along with the US), these nations have outsized influence due to the concentration of oil reserves and super-giant fields in their territorial borders. There will be a competition for access to these resources.

POSSIBLE FUTURE SOURCES

The issue becomes: Is there a way to reduce dependence on oil and gas, in whole or in part, to ensure that there are sufficient supplies for uses that require them? The concern over greenhouse gas emissions and global climate change only adds considerable additional pressure to the interest in new supplies (but only for renewables.)

11 "Largest Oil Fields in the World," Stacker. Updated November 2022. <https://stacker.com/stories/3860/largest-oil-fields-world>.

12 Op cit. Cohen, Gina. "Giant Oil Field; Super Giants," Hebrew English Energy Dictionary. 2022. <https://www.hebrewenergy.com/giant-oil-field-super-giants/>.

13 "United States Oil," Worldometer. 2022. <https://www.worldometers.info/oil/us-oil/>.

14 "U.S. Crude Oil and Natural Gas Proved Reserves, Year-end 2020," U.S. Energy Information Administration. January 13, 2022. <https://www.eia.gov/naturalgas/crudeoilreserves/>.

Significant headroom is available for expanding the use of solar production of electricity in the US. The current installed base is around 100 Gigawatts (GWs), which generates 1.5 quads per year.¹⁵ An optimistic Department of Energy study posits 1,000 GWs installed by 2035,¹⁶ which might generate 15 quads per year. However, many issues would need to be resolved, including storage and distribution.

Similarly, wind energy production offers enormous potential, from the current installed base of 135 GWs,¹⁷ which produced a little less than 10% of all electric power generated in the US in 2021.¹⁸ One vision predicts wind providing 35% of US electricity needs by 2050.¹⁹ Wind generators operate at night as well as day, which is a big advantage. However, they rely on a smart grid, as most of the US production is in the Midwest (and some offshore), and so must be distributed. As demand increases for electric power, it is possible that wind turbines could supply much of the increase. Storage is a problem for wind power as well as solar, as total electrical power generation becomes more dependent on sources that can be episodic. A robust distribution system with spare capacity can lessen storage needs.

Nuclear power accounts for about 20% of all electricity generation in the US. There are 93 reactors in 55 plants throughout the US, down from a peak of 104 reactors in 2012.²⁰ The reactors are old, and many are operating past their expected life span. Significant research is ongoing on the design and construction of new forms of nuclear power plants,²¹ which would provide greater safety and higher returns on investment (as nuclear power plants are very expensive and take a long time to build).

Perhaps the best prospects for increased nuclear power generation is through development of “small modular reactors” (SMRs).²² The Department of Energy sponsors an advanced R&D program on the development of SMRs, and considers them a key to the US energy future.²³ Each SMR would produce a few tens or hundreds of megawatts, and so hundreds or thousands would be envisioned to contribute to a percentage of the million megawatts of electricity generation capacity of the US. Although there is an aversion to the expansion of nuclear power, there are those who believe that the time for nuclear power dominance has come, especially for SMRs.²⁴

15 Frangoul, Anmar. “U.S. Solar Capacity Passes 100 Gigawatts After Strong First Quarter, but COVID Challenges Persist,” CNBC. June 17, 2021. <https://www.cnbc.com/2021/06/17/us-solar-capacity-passes-100-gigawatts-but-challenges-persist.html>.

16 Solar Energy Technologies Office. “Solar Futures Study,” U.S. Department of Energy Office of Energy Efficiency and Renewable Energy. 2022. <https://www.energy.gov/eere/solar/solar-futures-study>.

17 Wind Energy Technologies Office. “Wind Market Reports: 2022 Edition,” U.S. Department of Energy Office of Energy Efficiency and Renewable Energy. 2022. <https://www.energy.gov/eere/wind/wind-market-reports-2022-edition>.

18 “Electricity: Electric Power Monthly,” U.S. Energy Information Administration. 2022. <https://www.eia.gov/electricity/monthly/>.

19 “Wind Vision Detailed Roadmap Actions: 2017 Update,” U.S. Department of Energy Office of Energy Efficiency and Renewable Energy. 2017. https://www.energy.gov/sites/prod/files/2018/05/f51/WindVision-Update-052118-web_RMB.pdf.

20 “Nuclear Explained: What Is the Status of the U.S. Nuclear Industry?” U.S. Energy Information Administration. 2022. <https://www.eia.gov/energyexplained/nuclear/us-nuclear-industry.php>.

21 Cho, Renee. “The State of Nuclear Energy Today—and What Lies Ahead,” Columbia Climate School. November 23, 2020. <https://news.climate.columbia.edu/2020/11/23/nuclear-power-today-future/>.

22 “Small Nuclear Power Reactors.” World Nuclear. Updated May 2022. <https://www.world-nuclear.org/information-library/nuclear-fuel-cycle/nuclear-power-reactors/small-nuclear-power-reactors.aspx>.

23 Office of Nuclear Energy. “Advanced Small Modular Reactors (SMRs),” US Department of Energy Office of Nuclear Energy. 2022. <https://www.energy.gov/ne/advanced-small-modular-reactors-smrs>.

24 “Small Modular Reactors: Challenges and Opportunities,” OECD. 2021. https://www.oecd-ne.org/upload/docs/application/pdf/2021-03/7560_smr_report.pdf.

US road, rail, and boat transportation accounts for around 20 quads of annual energy consumption in the US (down from around 24 quads in 2015).²⁵ Air transportation consumes only around one quad. If all transportation other than air could be converted to electric vehicle power, then it would be easy to replace the power generation from non-fossil fuel sources (such as wind, solar, or nuclear, feeding into electrical grids for onboard storage or immediate consumption).

Notably, the military uses small nuclear power plants for energy production, particularly for aircraft carriers and submarines. We might ask whether the military could eliminate its dependence on petrochemicals by converting to all-nuclear power production. But concepts for nuclear-powered aircraft are distant dreams. Nuclear power plants for armored vehicles are undoubtedly a bad idea.

Each of these enhancements (wind, solar, nuclear) as well as any others will require significant investment, not just in the production infrastructure, but also in distribution and control systems, and eventually an electric storage infrastructure. Return on investment computations depend heavily on the future cost of energy, which in turn depends on the price of a barrel of oil.

EXOTIC SOURCES TO REDUCE COMPETITION FOR ENERGY

A variety of more exotic energy sources might become available in the future. Some involve oil and gas from new sources, which would nonetheless relieve pressure on the competition for resources by providing large new reservoirs of energy supplies. In all cases, the new sources envision near-infinite supplies that could supply energy globally.

Potentially abundant supplies of natural gas are available, albeit difficult to extract, and creating greenhouse gas emissions. The frozen methane hydrates in the deep ocean fuse ice and natural gas into formations that exist under high pressure, but with deep sea mining techniques could be used to extract gas.²⁶ Separately, there is concern that global warming could cause a tipping point with existing methane hydrates, causing the uncontrolled release of methane into the environment, over a period of centuries or millennia.²⁷ So it would behoove the world to secure the resource before they melt.

The other suggestion is that the mantle of the Earth, located below the Earth's crust and typically 100 kilometers below the surface, is replete with methane, according to models of chemical processes.²⁸ It might be possible to tap into these supplies, which might be viewed as essentially infinite, although bore holes have rarely descended beyond 10 kilometers. Locations where the crust is thin, however, might provide locations where large supplies of methane could be extracted. Whether this is advisable or feasible is problematic.

-
- 25 "Energy Consumption by Transportation Mode in the United States, 1960-2020," *Transport Geography*. 2021. <https://transportgeography.org/contents/chapter4/transportation-and-energy/energy-consumption-transportation-united-states/>.
- 26 Colman, Zack. "Should the World Tap Undersea Methane Hydrates for Energy?" *Scientific American* August 1, 2017. <https://www.scientificamerican.com/article/should-the-world-tap-undersea-methane-hydrates-for-energy/>.
- 27 David Archer, Bruce Buffett, and Victor Brovkin. "Ocean Methane Hydrates as a Slow Tipping Point in the Global Carbon Cycle," *Proceedings of the National Academy of Sciences of the United States of America*. December 8, 2009. <https://www.pnas.org/doi/10.1073/pnas.0800885105>.
- 28 Merali, Zeeya. "Earth's Mantle Can Generate Methane," *Nature* September 14, 2004. <https://www.nature.com/articles/news040913-5>.

Even more exotic is the idea of retrieving methane from outer planets and their moons, such as from Saturn's moon Titan. Note that bringing resources back to Earth is "downhill" relative to the sun's gravity well. We would also want to bring new supplies of oxygen to Earth.

Eventually, controlled fusion reactors might be able to supply power to electrical grids. International programs for the development of controlled fusion continue, and progress continues to be made. Practical power plants, however, remain many years, and perhaps decades, hence.

A less dangerous way to obtain energy might be to use giant solar cells in space, to beam energy to Earth. The concept of space-based solar power has been around for a long time, but only recently have practical experiments been conducted.²⁹ A major impediment is the cost of getting material into space from the Earth.

SUMMARY

Necessity might drive invention in one or more of these directions, or in other directions. The world has had the luxury, as well as the consequences, of abundant fossil fuel resources over the past couple centuries. This will continue, but extraction will be increasingly difficult and costly, and will likely still be competitive as resources are unevenly distributed. Further, dislocations due to global climate change may also force the more aggressive pursuit of alternatives.

Energy resources are so vital to national economies and security that the competition for energy may be central to most other competitions. International investments into resources may be driven by a need to secure future sources of energy. Resources that depend on energy include food from agriculture products, and industrial production capacity, and residential resources for heating and cooling.

In the near term, it is a safe prediction that oil and gas will remain the predominant sources, and that most supplies will come from a handful of countries that have remaining easily available resources. Thus, a competition for resources will continue, and success depends on either being one of the handful of countries, economic dominance, or military might.

The approach is not sustainable long term. Military conflicts are likely to occur in the interim over energy supplies, which could include kinetic wars as in Ukraine, and cyber wars to disrupt or divert supplies. They can also engender investment wars, as oil companies and nations vie for the rights to emplace infrastructure in territories that are not traditionally under their own control. Until inexhaustible supplies are found and secured, the competition for energy and especially for oil and gas will become an increasing driver of human activity.

So, what should the US do to prevail in the competition for energy resources? The answer is undoubtedly "all of the above." That is, the nation needs to be strong militarily, economically, and politically, to secure domestic sources and maintain access to foreign sources. The US needs a diversity of sources of energy, to include current fossil fuels and other energy sources derived from domestic supplies, supply chains from overseas sources, and future sources, all including wind, solar, nuclear, renewables, and more exotic sources. Reports of recent improvements in controlled fusion, and other potential inexhaustible supplies, provide for a hopeful future, but cannot be relied upon in the short term. One of the keys will be continued R&D and investments in demonstration and pilot plants. The US has the ability to lead in respect to R&D, and thus could control not only its own destiny, but the destiny of the world in access to energy sources.

29 David, Leonard. "Space-based Solar Power Getting Key Test aboard US Military's Mysterious X-37B Space Plane," Space.com. April 8, 2021. <https://www.space.com/x-37b-space-plane-solar-power-beaming>.

CHAPTER 9: AN OPERATIONAL APPROACH TO ADDRESS ADVERSARIAL ECONOMIC ACTIVITIES

GCP EWOC DISCUSSIONS

The staff of the Potomac Institute for Policy Studies, in conjunction with the GCP, led a series of informal discussions on concepts for a way to address the myriad issues brought up in the seminars.

As is evident from the information presented thus far, the United States confronts competition with other nation states on multiple fronts—some that are directly related to potential military conflicts and others that operate within the gray zone between national military power and economic strength. During the GCP events, it was frequently noted that although the US possesses a well-organized military defense and long-established military dominance, efforts involving international economic conflicts are disjointed—handled by many disparate government and national institutions. Further, each company that operates in the international space understands business as a competition for market, sales, and dominance across borders. Without eschewing the notion of a capitalist society that believes in free and fair competition, the Potomac Institute staff wondered if a better way exists, at least within government, that efforts that might better coordinate strategies when engaged in any form of economic warfare.

A concept that emerged is labeled the Economic Warfare Operations Capability (EWOC), which would be a body (potentially highly distributed) that would gather information, develop strategies, recommend actions, and elevate policy considerations to appropriate levels with appropriate authorities to act. All such activities already exist within the US as they stand but are not coordinated. In fact, one agency or one company can easily be engaged in activities that are at variance with other actions being taken by a different agency or company. Nor is the EWOC concept unique: others have certainly considered and proposed similar constructs.

The EWOC concept, described here, was initially formulated by the then-director of the Potomac Institute GCP, Dr. Timothy Welter. The EWOC description in the following article was written and edited by many different staff members, so authorship is not individually credited. However, special thanks are due to Jessica Kirkpatrick, Trevor Huffard, and Joseph Parrish for their contributions in compiling the article.

THE CONCEPT OF AN ECONOMIC WARFARE OPERATIONS CAPABILITY (EWOC)

Paper by: Potomac Institute for Policy Studies Staff

INTRODUCTION

The US enjoyed the benefits of a relatively unmatched monopolar position on the global stage in the immediate aftermath of the Cold War. That position has been challenged in recent years by rivals, such as China and Russia, working to shift the geopolitical and global economic environment in their favor.¹ To do so, both nations have employed asymmetric “gray zone” tactics, actions below the threshold of war, but which still vitally threaten the economic and security interests of the US and others.²

Gray zone operations include propaganda, media misinformation and disinformation, deliberate supply chain disruptions, and economic manipulation and coercion, along with other more traditional military equipping activities.³ Economic warfare activities are the most concerning, as such activities are focused on destabilizing and diminishing the vitality of the US economy⁴ and interfere directly with the United States’ ability to acquire, secure, and field capabilities required to defend the nation.

The industry and supply chains that the US government relies upon for weapons, technology, infrastructure support, and other factors of vital importance are at risk—highlighted recently by the PPE and other shortages experienced during the early days of the Coronavirus Disease 2019 (COVID-19) pandemic.⁵ Subsequently, factors limiting US access (deliberate or not) to critical technologies and other products and commodities vital to a healthy population and economy have become a growing concern for national leaders.

An emphasis of the 2022 National Security Strategy (NSS) was to invest in and partner with the commercial sector to strengthen the US national security posture—a societal-level approach to addressing the threats and realities of a dynamic global competitive environment. The approach carries over from the 2017 NSS and 2018 National Defense Strategy (NDS), which emphasized the need for a strong, resilient defense industrial base as an integral part of national security, as the former NSS stated, “...a vibrant domestic manufacturing sector, a solid defense industrial base, and resilient supply chains [are] a national priority.”⁶ The policy guidance across two administrations of opposing parties is an encouraging step in the right direction, but there is still much to be acted upon.

-
- 1 “Fact Sheet: The Biden-Harris Administration’s National Security Strategy,” The White House. October 12, 2022. <https://www.whitehouse.gov/briefing-room/statements-releases/2022/10/12/fact-sheet-the-biden-harris-administrations-national-security-strategy/>.
 - 2 Knefel, John. “The ‘Gray Zone’ Is the Future of War: Ongoing, Low-level, and Undeclared,” *Inverse* December 7, 2015. <https://www.inverse.com/article/8838-the-gray-zone-is-the-future-of-war-ongoing-low-level-and-undeclared>.
 - 3 Center for Strategic and International Studies. “Competing in the Gray Zone: Countering Competition in the Space between War and Peace,” CSIS. 2023. <https://www.csis.org/features/competing-gray-zone>.
 - 4 “How China’s Economic Aggression Threatens the Technologies and Intellectual Property of the United States and the World,” The White House. June 2018. <https://trumpwhitehouse.archives.gov/wp-content/uploads/2018/06/FINAL-China-Technology-Report-6.18.18-PDF>.
 - 5 Weissert, Will. “DHS Report: China Hid Virus’ Severity to Hoard Supplies,” *AP News* May 4, 2020. <https://apnews.com/article/us-news-ap-top-news-international-news-global-trade-virus-outbreak-bf685dcf52125be54e030834ab7062a8>.
 - 6 “National Security Strategy of the United States of America,” The White House. December 2017. <https://history.defense.gov/Portals/70/Documents/nss/NSS2017.pdf?ver=CnFwURrw09pJ0q5EogFpwg%3d%3d>

Prior to the COVID-19 pandemic, US government efforts to combat asymmetric “gray zone” attacks were reactive, fragmented, and siloed. The pandemic inspired the DOD and other US government departments and agencies to re-evaluate how to identify, support, and maintain industrial base elements vital for US national security. However, the nation still lacks the strategy (2022 NSS aside), workforce skillsets, and business operations to properly address the scope of the challenge at hand.

The US government’s approach to countering the infusion of adverse capital and other asymmetric economic activities that directly impact DOD missions has also been somewhat limited and disparate. While policymakers have acted,⁷ the challenge demands a fundamental shift in statecraft directed at the highest levels of government. Remedies will likely be constrained by the inertia of long-established institutional processes, cultures, and norms inside and outside the government and an evolution in thought and approaches to new threats come historically with a debate over the balance between liberty and security (e.g., post 9/11). Change, if effective, drives uncomfortable organizational and cultural shifts away from the status quo. In this case, a shift from 20-plus-years of the big “M” military as America’s primary lever of national power toward others in the “DIME”—diplomacy, information, military, and economy—is necessary.

Ultimately, a US government entity must be designated to “own the supply chain and industrial base problem,” responsible to orchestrate the development and employment of a suite of options to protect and defend the US industrial base from asymmetric economic attack. The Office of Economic Warfare and Competition (OEWC), as proposed by David Rader, former Deputy Director of the Office of Foreign Investment Review at the DOD, is a tenable conception of such an entity, as is the EWOC, a more operationally focused approach outlined in this chapter’s paper.⁸

Vulnerabilities resulting from conflict escalation, kinetic or otherwise, will be more manageable if an entity has the authority and tools to identify and address fundamental risks to the industrial base and supply chains. This would require strengthened partnerships between the US government and industrial base to expose and collaboratively examine threats to domestic and foreign companies. Moreover, this would require an exchange of information on risks, potential responses and mitigation, economic drivers—both political and economic—and their interdependencies with supply chains and national security. Ultimately, gray zone economic assaults must be addressed by the US government in collaboration with the private sector and partners and allies.

Until the problem is addressed, the US government’s ability to carry out its core duties to “insure domestic tranquility, provide for the common defense, promote the general Welfare, and secure the Blessings of Liberty,” is at risk. This paper provides a proposal to that end: The Economic Warfare Operations Capability (EWOC).

7 US Mission Japan. “Remarks by Secretary of Commerce Gina Raimondo on US Competitiveness and the China Challenge,” US Embassy and Consulates in Japan. November 30, 2022. <https://jp.usembassy.gov/commerce-secretary-raimondo-on-us-competitiveness-and-chinas-challenge/>.

8 Rader, David. “Dollars, Tanks, and Banks: Modernizing the Economic Warfighting Domain,” *The Hamiltonian* 2022. <https://hamiltonian.alexanderhamiltonsociety.org/security-and-strategy/dollars-tanks-and-banks/>.

BACKGROUND

Understanding the Problem

The US government is not organized for societal-level competition against adversaries, where “gray zone” tactics employed by global rivals like Russia and China operate below the threshold of open kinetic warfare, but still threaten US national security. This is an operational reality of the character of competition and conflict America is facing in the 21st century. Remedies require a societal-level response that actively fuse operational savvy with economic and business acumen; more transparent and farther reaching than the CIA-type covert operations sufficient for the Cold War. It will also require authorities at the highest level to swiftly decide, act on, and/or alert to threats and vulnerabilities across the US government and industry.

Industry and supply chains critical to America’s economy and national security are under routine attack and the government’s core responsibilities include protecting both. The US government needs an organizational approach to identify, monitor, prioritize, and coordinate (across US government and DOD entities) the mitigation of vulnerabilities to the industrial base. To accomplish this, trust and agility must be central to the working relationships between the public and private sectors. Currently, the government’s acquisition vehicles and practices are inadequate to rapidly address contemporary competitive challenges.

According to *Special Warfare*, “Gray zone security challenges, which are competitive interactions among and within state and non-state actors that fall between the traditional war and peace duality, are characterized by the ambiguity about the nature of the conflict, opacity of the parties involved, or uncertainty about the relevant policy and legal frameworks.”⁹

Gray zone warfare is thus a way to weaken a rival nation’s position outside the realm of conventional armed conflict and can be used to allow a competitor nation to achieve its political goals. It is a type of state aggression that is as old as warfare itself, with its practices and tactics articulated in the ancient Chinese military philosophy of Sun Tzu. The People’s Republic of China uses gray zone tactics to pursue the geopolitical goals of the Chinese Communist Party (CCP).¹⁰ Russia is also well-practiced in gray zone tactics¹¹ as demonstrated in Ukraine, starting with its initial invasion in 2014 and carried forward to the time of this paper’s writing.

Gray zone tactics are also delineated in China’s PLA doctrine of “Unrestricted Warfare.” The PLA emphasize combining all elements of national power to achieve national objectives, with tactics that reportedly include: “military intimidation, paramilitary activities [maritime militia and maritime law enforcement over disputed territories breaking norms of good seamanship], co-opting of state-affiliated businesses, manipulation of borders... lawfare and diplomacy, and economic coercion, and strategic investments in, and venture capital funding of, cutting-edge technology companies.”¹²

9 Kapusta, Philip. “The Gray Zone,” *Special Warfare*. October 2015. <https://www.proquest.com/trade-journals/gray-zone/docview/1750033789/se-2>.

10 Lin, Bonny, et al. “A New Framework for Understanding and Countering China’s Gray Zone Tactics,” (Santa Monica, CA: RAND Corporation) 2022. https://www.rand.org/pubs/research_briefs/RBA594-1.html.

11 Connable, Ben, et al. “Russia’s Hostile Measures: Combating Russian Gray Zone Aggression Against NATO in the Contact, Blunt, and Surge Layers of Competition,” (Santa Monica, CA: RAND Corporation) 2020. https://www.rand.org/pubs/research_reports/RR2539.html. Also available in print form.

12 Braw, Elisabeth. “The Defender’s Dilemma: Identifying and Deterring Gray Zone Aggression,” American Enterprise Institute. 2022. <https://www.aei.org/the-defenders-dilemma/>.

China and Russia have each been accused of destabilizing and diminishing the vitality of the US economy by using gray zone operations. Both have sought influence and advantage using adversarial economics. The defense industrial base has been a consistent target, through IP theft, infiltration of supply chains, and other gray zone activities.¹³

Gray zone economic activities are also referred to as predatory or asymmetric economics, adversarial investment, or as adversarial economics. They are designated in this chapter as “economic warfare.” To be clear, the US government is grappling to defend the nation against economic warfare. However, the US is not alone in this fight. A ripple in one nation’s markets can be consequential in another. Allies and partners can defend one another on both the security and economic fronts.

Economic Warfare

Beginning in 1953, China has used a series of “Five-Year Plans” to set strategic goals, focus government work, and guide the activities of market and non-market entities in China.¹⁴ In 2021, China started on its fourteenth Five-Year-Plan, which set an ambitious agenda to “promote high-quality development in all aspects, including the economy, environment, and people’s livelihood and wellbeing, and realize the rise of China’s economy in the global industrial chain and value chain.”¹⁵ To that end, the CCP has employed adversarial economic activities to undermine US economic and technological advantages to pursue its own strategic objectives on the global stage.¹⁶

China’s grand strategy of economic warfare is enhanced by state ownership of industries and businesses. State-Owned Enterprises (SOEs) receive significant investments from their owners (the Chinese government), allowing them to invest with less risk than those which investors in private commercial companies experience. In contrast, US businesses rarely receive government subsidies in the way and extent that Chinese SOEs receive government funding.¹⁷

China also uses their own venture capital¹⁸ funding to access innovative technologies in free-market economies. The Chinese government gains access to technologies (especially by investing in small and medium size Western enterprises) and then shares those technologies with their SOEs. China’s venture capitalists have been monitoring innovation hubs like Silicon Valley for investment opportunities in early-stage startups in fields deemed essential to its future military dominance (AI, Fintech etc.).¹⁹

13 Wray, Christopher. “Countering Threats Posed by the Chinese Government Inside the US,” Federal Bureau of Investigation. January 31, 2022. <https://www.fbi.gov/news/speeches/countering-threats-posed-by-the-chinese-government-inside-the-us-wray-013122>.

14 Per Covington, a firm providing legal and policy advice to those seeking to do business in China.

15 Ashwin Kaja, Sean Stein, and Ting Xiang. “China’s 14th Five-Year Plan (2021-2025): Signposts for Doing Business in China,” Global Policy Watch. April 6, 2021. <https://www.globalpolicywatch.com/2021/04/chinas-14th-five-year-plan-2021-2025-signposts-for-doing-business-in-china/>.

16 Remarks by U.S. Secretary of Commerce Gina Raimondo on the U.S. Competitiveness and the China Challenge, November 30, 2022, <https://www.commerce.gov/news/speeches/2022/11/remarks-us-secretary-commerce-gina-raimondo-us-competitiveness-and-china>.

17 Braw, Elisabeth. “The Defender’s Dilemma: Identifying and Deterring Gray Zone Aggression,” American Enterprise Institute. 2022. <https://www.aei.org/the-defenders-dilemma/>

18 “The Defender’s Dilemma: Identifying and Deterring Gray Zone Aggression.”

19 “The Defender’s Dilemma: Identifying and Deterring Gray Zone Aggression.”

Coercive loss of intellectual property (IP) can occur when a US company “partners” with a foreign company for “mutual benefit” in a joint venture or major stock purchase.²⁰ China, for example, can require a partnership for access to its market.²¹ IP-intensive industries account for over 45 million US jobs and the loss of IP erodes US technological supremacy, the cornerstone of its economic prosperity and military hegemony since World War II.

Intellectual property theft by China is said to cost the US between \$225 billion and \$600 billion annually.²² Mal-intended foreign direct investment and the use of cyber espionage to steal IP from US companies has resulted in the proliferation of technologies and capabilities once exclusive to the US military.²³ Chinese IP theft has allowed the PLA to fill gaps in its research programs, shortening R&D timelines for fielding advanced military platforms and identifying vulnerabilities in US systems for which countermeasures are presumably developed.^{24,25} It also allows China to bolster its own economy, in competition with the US.

Current Efforts to Combat Asymmetric Economic Activities?

While the US has laws to protect companies from predatory foreign direct investment (FDI), loopholes always exist in a proper free-market economy. The Committee on Foreign Investment in the United States (CFIUS) is supposed to prevent threats to national security from FDI in US businesses. The Foreign Investment Risk Review Modernization Act (FIRRMA), passed in 2018, attempted to provide more authority, scope, and latitude to CFIUS. However, CFIUS reported to Congress in 2022 that it only reviewed a “small percentage of the total number of... foreign direct investment flows into the United States.”²⁶ Given the scale and adaptability of investments throughout the US economy, the challenge to CFIUS is simply too great.

To counter asymmetric economic threats, including threats to national security, a different approach is needed. The 2022 NSS talks of an “integrated defense,” calling for the use of all instruments of national power to address subversive gray zone activities and other contemporary threats.²⁷

The CHIPS and Science Act in August 2022 represents an effort to combat certain economic threats. The law allots tens of billions of taxpayer dollars to invest across industry, government, and academia for R&D,

20 Wray, Christopher. “Countering Threats Posed by the Chinese Government Inside the US,” Federal Bureau of Investigation. January 31, 2022. <https://www.fbi.gov/news/speeches/countering-threats-posed-by-the-chinese-government-inside-the-us-wray-013122>.

21 Béraud-Sudreau, Lucie, et al. “Enabling a More Externally Focused and Operational PLA – 2020 PLA Conference Papers,” (Carlisle Barracks, PA: US Army War College Press) 2022, <https://press.armywarcollege.edu/monographs/951>.

22 “Executive Summary: China: The Risk to Corporate America,” Federal Bureau of Investigation. 2022. <https://www.fbi.gov/file-repository/china-exec-summary-risk-to-corporate-america-2019.pdf>.

23 Tiwari, Sakshi. “Chinese ‘Stealth’ Espionage! How Beijing-Backed Hackers ‘Acquired’ Sensitive US Tech Used In Its F-35 Fighter Jet?” February 3, 2022. <https://eurasianimes.com/chinese-stealth-espionage-us-tech-used-in-its-f-22-f-35-fighter/>.

24 Iones, Ellen. “China Steals US Designs for New Weapons, and It’s Getting Away with ‘The Greatest Intellectual Property Theft in Human History,’” *Business Insider* September 24, 2019. <https://www.businessinsider.com/esper-warning-china-intellectual-property-theft-greatest-in-history-2019-9#the-plas-j-20-looks-extremely-similar-to-the-us-air-forces-f-22-raptor-1>.

25 Jones, Jeff. “Confronting China’s Efforts to Steal Defense Information,” Harvard Kennedy School’s Belfer Center for Science and International Affairs. May 2020. <https://www.belfercenter.org/publication/confronting-chinas-efforts-steal-defense-information>.

26 “Annual Report to Congress: Report Period: CY 2021,” Committee on Foreign Investment in the United States. 2022. <https://home.treasury.gov/system/files/206/CFIUS-Public-AnnualReporttoCongressCY2021.pdf>.

27 Roaten, Meredith. “AFA News: ‘Integrated Deterrence’ to Drive National Defense Strategy,” *National Defense Magazine* September 22, 2021. <https://www.nationaldefensemagazine.org/articles/2021/9/22/integrated-deterrence-to-drive-national-defense-strategy>.

manufacturing, and workforce development critical to gaining (or recovering) an economic and security posture for the United States in certain high technology fields, and in particular in semiconductors.²⁸

The Office of Strategic Capital (OSC) was established in December 2022 within DOD's Office of the Undersecretary for Research and Engineering. The OSC is a turning point for DOD in publicly recognizing the need to counter the gray zone economic threats. Their mission is to "develop, integrate, and implement proven partnered capital strategies to shape and scale investment in critical technologies." Criticality, here, would refer to military needs.

At least two dozen other US government and nongovernmental organizations, including the FBI, and the Treasury, Commerce, and Defense Departments, have initiatives focused specifically on countering adversarial economics. However, these efforts are too disparate and tactical to adequately address or deter the comprehensive gray zone strategies currently deployed against the United States. No single US entity, public or private, is calling the shots overall (let alone has the authority to do so) to counter adversarial economics applicable to societal challenges. Subsequently, the government needs an orchestrated operational approach.

AN OPERATIONAL APPROACH: THE EWOC

What sort of organization could address a solution set informed by the global economic, political, and security environment?

Designated the *Economic Warfare Operations Capability (EWOC)*, the concept outlined in this section is a proposed means by which the US government can operationally address the threats and challenges posed by adversarial economic activity.²⁹ This capability is an imperative if the US expects to remain operationally relevant on the global stage. It is envisioned as agile and responsive to the dynamics of the global economic, political, and security environments to support the strategic posture of the United States.

The overall mission of EWOC is to ensure access to the industrial base and supply chains critical to preserving operational advantage across the full spectrum of conflict, to include economic warfare. As envisioned, the EWOC will help preserve the US government's ability to secure critical supply chains by building enduring partnerships and operational capacity to assure competitive advantage.

The EWOC will bring disparate efforts together, prioritized and orchestrated under one umbrella—a scalable operational approach for decision and action.

The EWOC approach operationalizes the concept of "integrated deterrence" (a key principle of the 2022 National Defense Strategy), providing coordination with the private sector, as well as with vetted allies and partners, to address economic threats across domains and instruments of national power. The EWOC helps prevent kinetic war by deterring potential adversaries by virtue of economic dependencies.

The EWOC has three core mission areas that fuse inputs from across the government, industry, and DOD:

28 "Fact Sheet: CHIPS and Science Act Will Lower Costs, Create Jobs, Strengthen Supply Chains, and Counter China," The White House. August 9, 2022. <https://www.whitehouse.gov/briefing-room/statements-releases/2022/08/09/fact-sheet-chips-and-science-act-will-lower-costs-create-jobs-strengthen-supply-chains-and-counter-china/>.

29 Distinct from, but not unrelated to the independently proposed Office of Economic Warfare and Competition (OEWC).

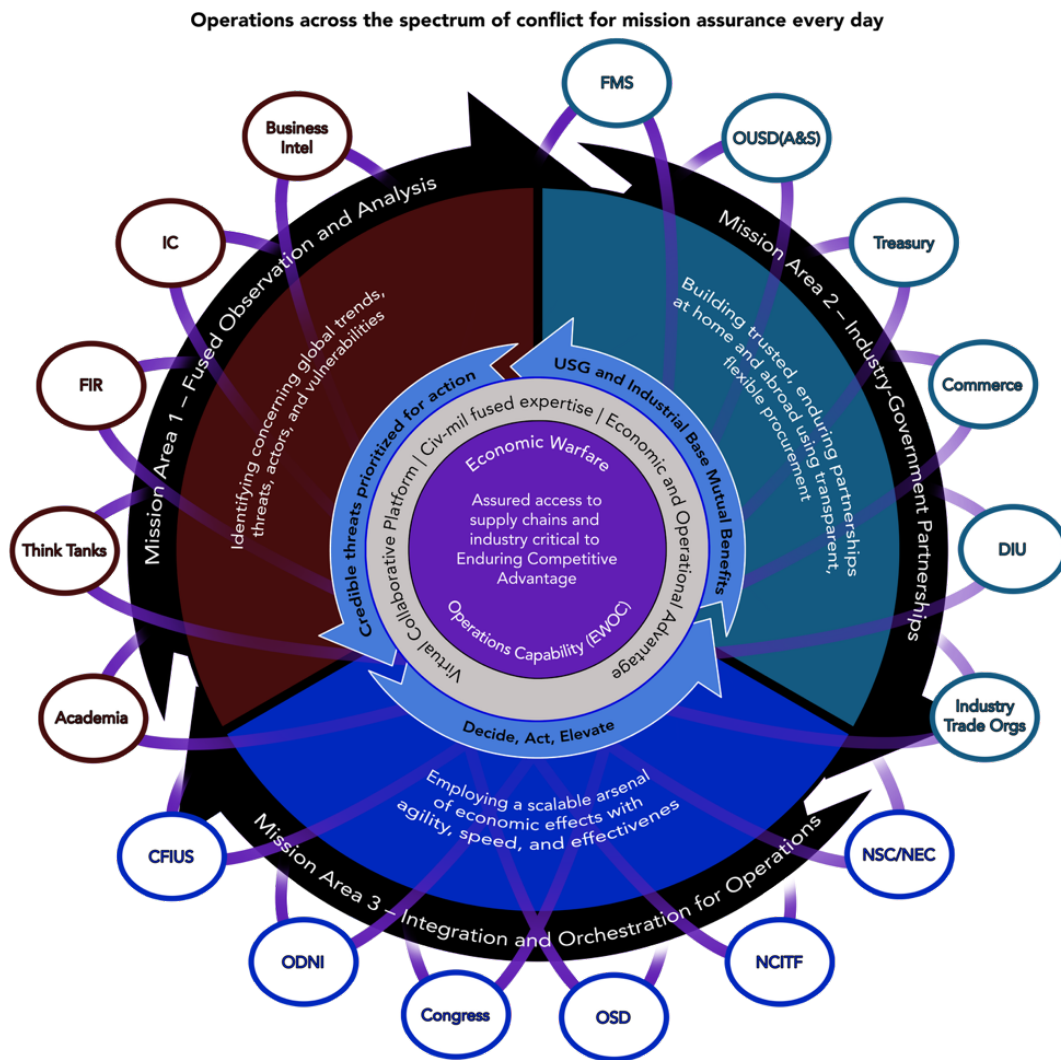
Mission Area 1: Prioritize and conduct observation and analysis of global markets, the industrial base, and supply chains critical to the US government.

Mission Area 2: Shepherd enduring, agile partnerships between industry and the government.

Mission Area 3: Provide options to decide and act or elevate action to address threats and risks.

The synchronization of the EWOC's three mission areas is key to addressing the primary challenge: Assurance the US government has enduring, secure access to the industrial products and supply chains vital for success across the spectrum of conflict while maintaining competitive advantage.

The diagram and following section describe each mission area in greater detail, to include explanations of how they work together.



MISSION AREA 1: FUSED OBSERVATION AND ANALYSIS—IDENTIFYING CONCERNING GLOBAL TRENDS, THREATS, ACTORS, AND VULNERABILITIES

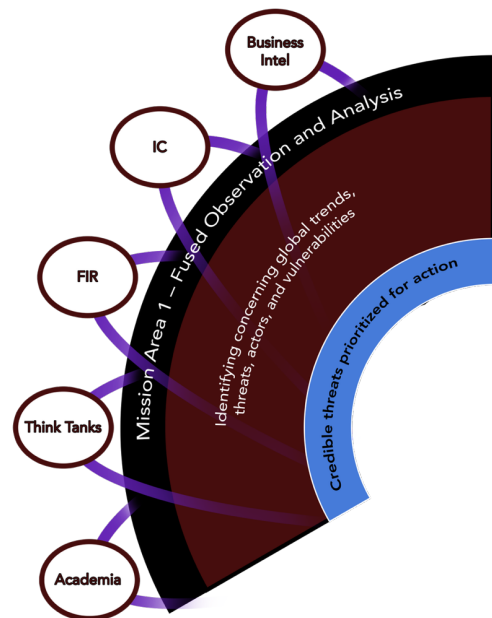
Mission Area 1 of the EWOC provides prioritized market intelligence and analysis for decisive operational action. The EWOC will identify and understand risks and vulnerabilities in supply chain networks impacting the US government.

Realization of that vision will require:

- Cultivation of a workforce uniquely steeped in both business intelligence and military operations.

Mission success will require continuous deep knowledge of global economic trends, investments, and markets and the identification of innovation and technologies vital to national security and US economic wellbeing.

The vision for this mission element is to identify and understand, for action, the vulnerabilities in supply chain networks and threats to industry sectors that could impact US interests. This knowledge and analysis will feed the other mission areas of the EWOC.



The EWOC will need to identify the sectors worth protecting. What are the innovations and technologies, specific to government interests, vital for national security and necessary for maintaining competitive advantage? These factors will need to be identified along with nodes of influence. Analysis of the resulting network will identify critical points of vulnerability and risks in supply chains, driving the focus for further intelligence collection.

Vulnerabilities in supply chains can happen due to logistical failures (natural or inadvertent causes) or by malintent by an adversary or bad actor. Both types need to be understood to remain competitive across the continuum of conflict. While competition will exist in many sectors, prioritization across national interests and capabilities will be important to drive the analysis. As part of Mission Area 1, that analysis will help define intelligence requirements and counterintelligence requirements in the context of business and industry sector interests, as well as national security concerns.

Information on adversary activities across economic markets is not generally centrally accessible to the US government. Instead, information is scattered across the private sector, trade publications and associations, various areas of the executive branch and military services, and the intelligence community. Often, the government's awareness of if or where useful information exists is limited. Further, there is no intelligence fusion capability lending to an analytical product to inform decision makers. **Therefore, an overarching role of the EWOC is to fuse disparate intelligence analysis together to provide prioritized, operational action options.**

The key to EWOC's Mission Area 1 is development of a workforce savvy in researching, analyzing, and using economic market-based intelligence. The workforce would mobilize personnel who have civilian and military experience across the financial services, intelligence, and operational national security realms. Expertise would be required in international finance and business, and global logistics coupled with national security. Operators must be able to identify and understand risks and vulnerabilities in supply chain networks impacting US government interests and readily leverage a deep knowledge of global

economic trends, investments, markets, innovations, and technologies vital to national security and enduring competitive advantage.

MISSION AREA 2: INDUSTRY-USAF PARTNERSHIPS—BUILDING TRUSTED, MUTUALLY BENEFICIAL ENDURING PARTNERSHIPS AT HOME AND ABROAD USING TRANSPARENT, FLEXIBLE PROCUREMENT

Mission Area 2 of the EWOC provides a platform for consistent engagement between industry and government—domestically and with allies and partners—rendering enduring partnerships built on countering common gray zone economic threats. This mission area is fueled by assuring that businesses are properly incentivized and sufficiently equipped to identify and share information about economic threats for assistance from the US government.

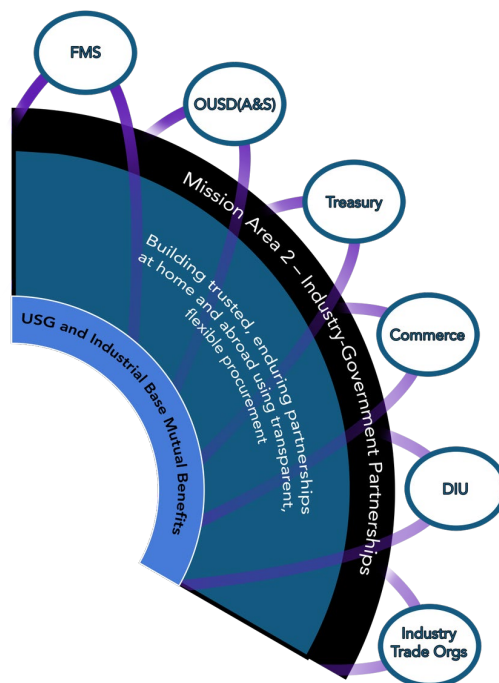
Adversarial economic activity negatively impacts both industry and US interests, generally, so the EWOC provides a unique mutually beneficial opportunity to strengthen relationships between industry and government by working together in countering threats. Government depends on industry, and the trust established by collaborating against adversarial economic activities will strengthen relationships on all fronts. Enduring partnerships are the goal—leading to less confrontational and more agile acquisitions and other processes, with continuous and open dialogue on emerging capabilities and business challenges.

Realization of the vision for Mission Area 2 will require:

- Establishment of incentives that provide a value proposition for industry to participate, to include more transparent and flexible acquisitions practices, sharing of business intelligence, and broader access to government needs and resources.
- Establishment and management of a human capital pipeline of savvy operators with business and national security acumen.

Mission Area 2 provides the connection between the intelligence analysis provided by EWOC’s Mission Area 1 and the decision and action to counter threats by Mission Area 3. Fusing the efforts of extant organizations, the EWOC will help orchestrate a cohort of invested parties from within the government and across industry to facilitate enduring partnerships that transcend transaction-focused relationships.

Central to that effort is the EWOC’s envisioned role as an information clearinghouse between the government and industry. The EWOC should be the venue for sharing information on emerging economic threats so nefarious actors or suspicious activity may be identified, deterred, and countered with decisive action. The outcome will be a protected and strengthened industrial base and supply chains critical to government interests. The goal is to address the pace and character of security challenges in the current global competitive environment.



The advantage of the EWOC's partnerships is that they provide a single unified storefront: a physical "Front Door" location for US government interactions with industry. The "Front Door" concept is similar to the Air Force's AFWERX, but on a larger scale. Where AFWERX focuses primarily on small business, the EWOC concept would serve companies of all sizes.

Technology can enable a secure virtual collaborative platform for both US and foreign industry to address emerging risks together, in real time. Controlled information sharing would be established for business intelligence, US government resources, insight to emerging requirements, financial incentives (such as tax incentives), and cyber and physical security. The greatest benefit, however, would likely be improved relationships between government and industry gained from countering common threats.

The virtual collaborative environment would also be used by the EWOC to establish the "big picture" for Mission Area 1, providing threat information and market and industry insights unavailable elsewhere for integration with currently disparate market intelligence and analysis. This would entail a fusion of products from multiple anonymized entities to inform operational decisions for action against adversarial economic activities.

Successful connections with industry will be predicated on a clear understanding of long-term objectives in global competition. The EWOC would define success for countering asymmetric economic assault, to include 1) defining thresholds for action based on risk analysis and 2) communicating with industry about shared benefits, mutual goals, and critical supply chain vulnerabilities.

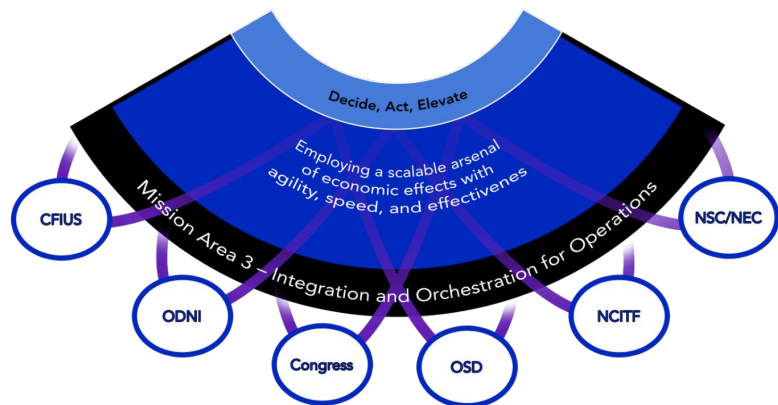
The collaborative environment can also serve as a baseline for cultivating a pipeline of future EWOC operators. It can provide resources for training in global markets, financial services, acquisitions processes and practices, and statecraft and military strategy. Talent must be developed from outside the government and recruited to the EWOC.

EWOC operators will collaborate extensively with partners and allies. This includes foreign entities with economic ties to the United States— not just military allies. Operators must be able to understand industry and national interests, and address supply chains critical to US government interests across the spectrum of conflict, regardless of origin.

Mission Area 2 is intended to foster industry partnerships that enable businesses to succeed in their endeavors, while also serving long-term national interests in providing for common defense and security, to include economic security. This goal is challenging because it requires that businesses are incentivized and trustful of government and other industrial partners in a common mission to counter threats. It also requires that government, in forming partnerships for the nation, deal fairly and transparently with industry.

MISSION AREA 3: DECIDE, ACT ELEVATE—EMPLOYING A SCALABLE ARSENAL OF ECONOMIC EFFECTS WITH AGILITY, SPEED, AND EFFECTIVENESS

Mission Area 3 of the EWOC is the operational arm. It is envisioned to develop and recommend the employment of an arsenal of economic levers to act on the market intelligence and fused analysis from Mission Area 1, in concert with the partnerships established by Mission Area 2. **Integration of these elements provide a means for government leaders to decide and act on looming threats in an orchestrated, operational manner.** Actions may be orchestrated



by other US government entities—driving a whole-of-government approach across domains and instruments of national power (i.e., integrated deterrence). Effects will be used to address threats with agility, speed, and effectiveness, ultimately assuring competitive and decision advantage across the spectrum of conflict—from competition to crisis.

The US government currently employs various levers to identify, analyze, and address mission critical industry and supply chain vulnerabilities. However, none currently takes an orchestrated operational approach, bringing disparate efforts together for decision and action. Mission Area 3 of the EWOC would enable orchestration at a speed and scale of relevance to day-to-day competition, while ensuring operational and decision advantages should hostilities commence.

Realization of that vision will require:

- Creating and assembling an arsenal of levers to counter economic assault by adversaries.
- Establishing a systematic, scalable, repeatable framework to employ these levers.
- Establishing interagency coordination to orchestrate desired effects.
- Establishing procedures to **enable decision and action on, and/or elevating the situation to** address, emerging and active threats.

An arsenal of gray zone economic levers will be required for this mission area. Some gray zone capabilities are regularly employed in this domain, such as trade controls. However, currently, the coordinated use of tools—if coordinated at all—only occurs clumsily at the highest levels of government.

To compete in an asymmetric (economic) war, one must be able to fight asymmetrically. As such, a gray zone arsenal of economic effects must be built along with the operational decision framework to employ them, to include integration into current strategies. Gray zone economic levers are not weapons in the traditional sense, but rather a suite of effects that create specific desired outcomes broken down into defensive and offensive operations.

Defensive measures might be designed to protect companies from malign foreign influence. Defensive Operations include changes to policy, regulations, and procedures that make it easier for industry partners to work with the US government, as opposed to working with entities beholden to the Chinese government. They might involve reducing hurdles for companies to accept US government funding (as

with the DOD's OSC). It could also be manifested in the creation of tax incentives for US companies to remain in the US or it could facilitate the availability of services that enable small companies to better compete.

Offensive operations generally involve asymmetric effects that negatively impact an adversary's global economic enterprise. For example, an alternative to rare earth elements (REEs) could disrupt China's 85% share of the world's processing capability, which they can use to threaten supply chains.

The development of a gray zone arsenal requires a framework to properly employ it. The following three step process outlines a high-order framework:

1. **DECIDE:** Based on EWOC's analysis (Mission Area 1), leaders must decide if there are national security concerns for the given scenario (i.e., "So what?"). The decision to act must be contextualized for operational impact to core government interests and guided by available concepts of operations and operational plans.
2. **ACT:** After a decision that action is appropriate, the desired outcome must be determined. Offensive or defensive options will be selected from an arsenal of levers and employed at the appropriate level of engagement.
3. **ELEVATE:** Actions require approval and authorities at the appropriate level. Some authorities might be granted to the EWOC, but other actions need to be elevated for consideration at higher levels. The recommended action should be referred to the appropriate government level, or levels, for interagency consideration. The existing construct used by the National Security Council provides a model. In many cases, allies and partners will need to be consulted through appropriate channels and their interests taken into consideration.

As with the example of stopping an inbound enemy missile, some operations will require a rapid interception, but other times it is more effective to disrupt a "kill chain." An arsenal of asymmetric economic tools can have graded effects ranging from effectively competing to intercepting an adversary's capacity to fight.

Development and employment of a scalable arsenal of economic effects that leverage market intelligence and analysis, as well as partnerships, will support the new reality of national security. Fusion of these elements provides a means for government leaders to decide and act on looming threats in an orchestrated, operational manner. The US needs an effective whole-of-government approach to countering adversarial economic activity across domains and instruments of national power.

SUMMARY

National interests are vulnerable to unchecked adversarial economic activities. While there are efforts underway to identify and analyze those threats, such information is not prioritized, fused and orchestrated across the entirety of the government for decision and action. When an action is taken it is usually at the tactical level, disconnected from a broader strategy and from industry partners. Here, we have outlined the concept of an Economic Warfare Operations Capability, an EWOC, to provide a unique but mutually beneficial opportunity for industry and government to strengthen their relationships and work together with partners to counter threats and serve the common good.

Development and fielding of an EWOC-type capability will help preserve the ability of the US government to carry out its core missions at the most basic level—by securing the industrial base and supply chains they depend upon—while providing the opportunity to build enduring partnerships and operational capability to assure competitive advantage on the global stage.

CHAPTER 10: AMERICAN VALUES

THE OVERARCHING GOAL

INTRODUCTION

The previous chapters have demonstrated that the US is engaged in many domains of global competition—prompting the question: What are competing for? What is the overarching goal?

There are individual answers in each of the areas of competition. We compete for superior military might, economic prosperity through market dominance, energy independence, supply chain assurance, superior messaging of the US brand. But taken together, we are competing for a preservation (and expansion) of the “American way of life.” But even that sentiment, the American way of life, belies a dynamic environment that can change and improve and be redefined in many ways. The immutable component is, and should be, the American values.

In the years following the Cold War, American democratic ideals, of life, liberty, and the pursuit of happiness, led the world order and established many of the global norms. Today’s changing global environment is challenging the understanding of these values, presenting a threat to the unifying vision of the American-led democratic world order. As a result, the nature of an increasingly competitive global environment is challenging the strength and validity of American national values.

The Honorable Alan R. Shaffer; Moriah Locklear, PhD; and Timothy Welter, PhD contributed this chapter’s paper, titled “Values, Strategy, and America’s Competitive Posture.” The authors address threats to the unifying vision of America’s values and democracy in the increasingly competitive global environment while considering the question: How can the US leverage historical ideals, as opposed to modern, skewed conceptions of American exceptionalism, to ensure its competitiveness in the future?

Beyond the international threats to democracy, the US has faced its own domestic challenges in maintaining a unifying vision and its democratic ideals in the pursuit of ideas. Political discourse and discord dates back to the establishment of the US itself, but they can interrupt understanding of the common purpose and coherent message that the nation conveys not only to the rest of the world, but to the participants in the great American experiment. The contribution that follows hopes to remind us of the common mission.

VALUES, STRATEGY, AND AMERICA'S COMPETITIVE POSTURE

Paper by: The Honorable Alan R. Shaffer; Moriah Locklear, PhD; and Tim Welter, PhD

"The supreme art of war is to subdue the enemy without fighting.... When you surround an army, leave an outlet free. Do not press a desperate foe too hard."

Sun Tzu—The Art of War

"One has to understand the Chinese intellectual game, which is what we call 'Go' [and] they call 'weiqi'. ... it's a game of strategic encirclement... our intellectual game is chess. Chess is about victory or defeat. Somebody wins."

Former Secretary of State Henry Kissinger—CNN, 2010

Across the 2021-2022 academic year, the Potomac Institute conducted the GCP as a foundation to identify, elevate, and examine some of the most consequential aspects of the globally competitive environment in the modern era. Among transitions that the US strategic community faces, maintaining a competitive advantage among peer rivals is arguably the most influential. While shifting from a focus on counterterrorism, which remains a vital concern, the US confronts a societal-level competition that challenges US dominance in military, economic, and political spheres.

The project's study makes clear the interdependency of these spheres and the complex nature of the competition. For example, a flourishing economy is essential for government funding of a strong national defense, which in turn is needed to deter attacks that could impact other important national interests.¹ Competition to lead in the development and employment of technology impacts businesses and thus the health of the nation's economy. Especially for the United States, technology is historically consequential to the fielding of military might that renders required deterrent effects and operational capabilities to keep the nation safe and prosperous. More broadly, a continuous supply of scientists and engineers is the critical enabler for technology leadership, which is driving the development of a more competitive environment across STEM education.² Competition in certain sectors, such as food, microelectronics, metals and minerals, pharmaceuticals, and petrochemicals, can have profound impacts when global supply chains are interrupted. Each area requires a strategy for the US to remain competitive, so that the US can remain dominant in the interlocking vectors of national power.

1 Shaffer, Alan R. "Standing Tall: Maintaining US Economic and Military Competitive Posture During Turbulent Times," *STEPS* Issue 6, April 2022, <https://potomac institute.org/steps/featured-articles/april-2022/standing-tall-maintaining-us-economic-and-military-competitive-posture-during-turbulent-times>.

2 Schwilcher, Andreas. "Programme for International Student Assessment 2018," OECD Press. 2020.

However, we pose the question: Is there a grand strategy to preserve the competitive posture of America in the “international order”? What are the goals and purposes of the strategies addressing individual competitive domains? What is a universal strategy on which the multi-dimensional competitions can unite in a common effective position?

We posit that to ensure a secure and prosperous future as a world leader, the US needs to adopt a grand strategy based on a contemporary conception of our shared American values. Such a strategy should be tied to the fundamental ideals that Americans have sought throughout US history; a continuous journey toward “life, liberty, and the pursuit of happiness” for all, as in the Declaration of Independence. Or, as codified in the preamble to the US Constitution, the ideals of the foundation of the nation still apply as doctrine that Americans can support: “To form a more perfect union, establish justice, ensure domestic tranquility, provide for the common defense, promote the general Welfare, and secure the Blessings of Liberty to ourselves and our posterity.”

The current global and domestic environments challenge our ability to realize a strategy based on shared values. Somewhere over the past several decades, the United States has seemingly lost its unity of purpose: the shared vision of what the country is and its role in the world. In the 1990s, the concept of “illiberal democracies” was discerned,³ with concern that democracies worldwide might willingly abandon the fundamentals of liberalism (not in the sense of liberal politics, but rather the norms of individual rights and freedoms and rule by laws and constitution). In September 2018, *The Economist* decried that champions of the liberal democratic ethos have turned their backs on the very tenets of liberalism they espoused (see excerpt). Those tenets (liberal democracies, not left or right political ideologies) had helped deliver immeasurably positive outcomes for the quality of life of an entire era of humanity.⁴ The forewarned potential for illiberal democracies to abandon those tenets seems to be an accelerating trend.⁵

The world, it seems, is turning away from liberal democratic values—the basis for the greatest improvement in quality of life in the history of humanity, experienced by billions across the globe. This adverse trend has been most notably embodied in the rise of populist political movements and increasingly autocratic governments. Less controversially, there is a global erosion of international norms and institutions that America helped establish in the post–World War II era—those norms and institutions that led to unbridled growth and prosperity, not to mention America’s posture as a global leader, in ensuing decades.

Excerpt from *The Economist*, “A manifesto for renewing liberalism,” Sept 13, 2018.

“LIBERALISM made the modern world, but the modern world is turning against it. Europe and America are in the throes of a popular rebellion against liberal elites, who are seen as self-serving and unable, or unwilling, to solve the problems of ordinary people. Elsewhere a 25-year shift towards freedom and open markets has gone into reverse, even as China, soon to be the world’s largest economy, shows that dictatorships can thrive.”

3 Zakaria, Fareed. “The Rise of Illiberal Democracy,” *Foreign Affairs* Nov/Dec 1997. <https://www.foreignaffairs.com/world/rise-illiberal-democracy>.

4 “A Manifesto for Renewing Liberalism,” *Economist* September 13, 2018. <https://www.economist.com/leaders/2018/09/13/a-manifesto-for-renewing-liberalism>.

5 Illing, Sean. “Fareed Zakaria Made a Scary Prediction About Democracy in 1997 — and It’s Coming True,” *VOX Magazine* July 4, 2017, <https://www.vox.com/conversations/2017/1/18/14250364/democracy-liberalism-donald-trump-populism-fareed-zakaria-europe-fascism>.

AMERICAN EXCEPTIONALISM

A review of the origins of American exceptionalism might elucidate the kind of shared values on which a contemporary strategy for ensuring our enduring security and prosperity should be rooted.

Immediately following victory in World War II, the US emerged as a beacon for liberal democracy. The United States guided the post-World War II international order by promoting free enterprise and democracy while adopting a strategy of containment to deal with the Soviet Union; ultimately providing a competitive edge that drove an arguably peaceful and prosperous era. American values were generally admired and often emulated during the Cold War when compared with those who empathized with the primary ideological rival of Western democratic values—communist dictatorships, as exemplified by Stalin’s Soviet Union.

The notion that the principles guiding American society were “unique” among the world’s nations dates back to 1835 when Alexis de Tocqueville wrote about America’s “exceptional” nature. Tocqueville defined American exceptionalism as “based on liberty, equality before the law, individual responsibility, republicanism, and laissez-faire economics.”⁶ Over the years, some have interpreted American exceptionalism to mean American superiority. This was never the intent. Rather, America was an exception to the general rule that nations throughout history were primarily established around things like shared ethnicity, religious beliefs, or natural geographic boundaries, and not on a set of principled ideals.

The revolutionary idea in the founding of the American democracy was that all should be viewed as equals under the law. The foundational ideals were unique and exceptional at their time, in prioritizing individual liberty and equality as the cornerstones for governance.

After the Great Depression and World War II, America was confident and optimistic, embracing an ethos of exceptionalism and liberal democratic values. The US was a hegemonic great power among the world’s nations, unified in sharing a common enemy in the Soviet Union. In establishing a “Strategy of Containment,”⁷ the US posited that Soviet demise was inevitable if they continued to elevate the communist state over individual liberty, fraternity, and free enterprise, as practiced in the US and free Europe. Containment meant that competition amounted to maintaining deterrence, for example through the creation of the North Atlantic Treaty Organization, and the Marshall Plan to rebuild Europe and create a strong economy across Europe to resist the spread of communism.

When the USSR was dissolved in 1991, it was widely recognized that the Soviets simply did not have a grand strategy that could compete with the West, economically or otherwise. Top-down, state-driven Soviet economics could not compete with the flourishing free-market approach of the West. The latter provided the means to field and sustain a long-term military buildup while the Soviets could not compete financially to sustain their military capabilities. Perhaps more importantly, the US embraced an approach of investing in technology that subsequently enabled that military superiority (the “offset strategy”⁸) while also vastly benefiting the growth of commercial markets.⁹ The US focus on R&D resulted in the US leading the world in development of the semiconductor, the computer, imaging sensors, the information technology revolution, the mapping of the human genome, and the development of quantum science

6 Lipset, Martin. “American Exceptionalism: A Double Edged Sword,” (New York: W.W. Norton & Co., Inc.) 1996.

7 X, (George Kennen), The Sources of Soviet Conduct, in *Foreign Affairs*, Jul 1947, <https://www.foreignaffairs.com/articles/russian-federation/1947-07-01/sources-soviet-conduct>.

8 Edward Keefer, “Harold Brown: Offsetting the Soviet Military Challenge 1977-1981,” Mar 2017, webHaroldBrownProgram2018.pdf (defense.gov).

9 Leavitt, Willian. “Toward New Horizons. Theodore von Karmen, A Memoria,” *Air Force Magazine* June 1963.

among other technology leaps. It was an approach that inherently reflected shared American values of the time and the weighty aspirations that influenced the nation's birth.

To the world, the United States exemplified freedom and possibilities. President Kennedy had proposed a set of challenges, including a lunar mission, that was a characterization of the nation's persona: "We choose to go to the Moon in this decade and do the other things, not because they are easy but because they are hard."¹⁰ Despite the strife in the US of the sixties, doing the "hard" things were embraced by Americans and envied by other nations. They transcended the fray of short-sighted political whims. Across administrations, they unified the country on shared principles that helped maintain competitiveness on the global stage both economically and militarily. In turn, they helped secure an enduring means for Americans to flourish and lead for decades thereafter.

THE COMPETITIVE LANDSCAPE TODAY

The competitive landscape has changed. Today, both Russia and China pose particular challenges to the US national wellbeing.

Russia has shown an ability to field sophisticated weapons, albeit a remarkable inability to dominantly utilize them in their Ukrainian conquest. However, Russia remains a challenge in their ability to divert supplies of oil and gas, meddling in and exploiting regional conflicts, and in manipulating information and emerging technologies for their exploits.

The US now perceives China as its greatest competitive challenge. Following in the footsteps of his immediate predecessors, President Xi of China has led a very focused effort to increase China's stature in specific areas that will advance their national interests, both domestically and abroad. China is using economic, military, and other levers of influence.¹¹ In rolling out China's 14th five-year plan covering 2021 to 2026, Xi cited the need for China to develop an independent means for innovation that drives economic growth and influence, with advanced technology at the center of the plan. A translation of a portion of Xi's remarks is in the accompanying box.¹²

"New-generation information technologies, represented by artificial intelligence, quantum information science, mobile telecommunications, the Internet of Things, and blockchain are accelerating breakthrough applications. The realm of life sciences, represented by synthetic biology, gene editing, brain science, and regenerative medicine, is giving birth to new changes. The new manufacturing technologies of integrated robotics, digitalization, and new materials are accelerating the manufacturing industry's shift toward intelligent systems, focusing on services, and eco-friendliness. The development of clean, high-efficiency, and sustainable energy technologies is accelerating and will usher in a global energy revolution. Space and maritime technologies are expanding the frontiers of where humans can live and work. In sum, creative breakthroughs in areas such as information technology, life sciences, manufacturing, energy, space, and maritime are supplying ever more wellsprings of innovation for cutting-edge and disruptive technologies."

President Xi Jinping, Peoples
Republic of China

10 John F. Kennedy, "Address at Rice University on the Nation's Space Efforts," Sept. 12, 1962, transcript available at <https://www.jfklibrary.org/learn/about-jfk/historic-speeches/address-at-rice-university-on-the-nations-space-effort>

11 Murphy, Ben, et al. Stanford Cyber Policy Center, "Xi Jinping: 'Strive to Become the World's Primary Center for Science and High Ground for Innovation,'" March 18, 2021.

12 Xi Jinping: 'Strive to Become the World's Primary Center for Science and High Ground for Innovation.'

Xi's observations present aspirations that could well have reflected continued US research goals. The Chinese plan further targets "New Generation AI, Quantum Information, Integrated Circuits, Brain Science and Brain-Inspired Research, Genetics and Biotechnology, Clinical Medicine and Health, and Deep Space, Deep Earth, Deep Sea, and Polar Exploration."¹³ It also pledges Chinese leadership to pursue basic research, talent development, and focused research for strengthened industrial output.

Previously, in 2018, President Xi had established a goal for China to become the dominant power in AI by 2030, documented in a speech to the Politburo: "*that China must develop, control and use artificial intelligence (AI) to secure the country's future in the next technological and industrial revolution.*"¹⁴ At the time, it was noted that China would invest more money in AI by 2030 than the value of the entire Australian economy.¹⁵ In 2014, China had established a goal to be the dominant producer of microelectronics by 2030. The goal was reiterated in 2016, when President Xi said "the fact that core technology is controlled by others is our greatest hidden danger."¹⁶ Vice Premier Ma Kai reinforced Xi at the 2018 National People's Congress by stating, "We cannot be reliant on foreign chips."¹⁷ Reflecting a competitive posture of technology development, the 14th five-year plan states that the People's Republic of China will "formulate an action agenda for becoming an S&T powerhouse...and successfully fight tough battles for key and core technologies." One hears echoes of Kennedy's "Moon in this decade" speech.

China has an established comprehensive vision for its future with tangible goals and strategies to achieve those goals. Portions of this plan are exemplified in the "Made in China 2025" document.¹⁸ While their success is not guaranteed, China has taken deliberate steps toward achieving those goals with measurable progress. In contrast, the United States pursues technologies ad hoc, driven by fads and competitive pressure, with little or no strategy. Some say that this is preferable, as it comports with the character of an open, liberal democratic, free-market society. Others say that technologically, the US is essentially standing still, if not regressing.

IMPEDIMENTS TO AMERICA SECURING ITS FUTURE

A secure and prosperous future will require America to rally behind a coherent, societal-level strategy that reflects our values and can address the challenges China and others present in a competitive global environment. The strategy must acknowledge impediments and provide a means to mitigate them while also capitalizing on our strengths across the most pertinent areas of the global competitive environment. Arguably, the recently released 2022 NSS opens a window to the complexities of that discussion.¹⁹

13 Taken from the translation of the 14th 5-year plan by the Center for Security and Emerging Technology.

14 South China Post: Develop and control: Xi Jinping urges China to use artificial intelligence in race for tech future. Oct 31, 2018.

15 Made in China 2025: Xi Jinping's plan to turn China into the AI world leader Made in China 2025: Xi Jinping's plan to turn China into the AI world leader - ABC News.

16 Speech at the Work Conference for Cybersecurity and Informatization <https://chinacopyrightandmedia.wordpress.com/2016/04/19/speech-at-the-work-conference-for-cybersecurity-and-informatization/>.

17 "China's Next Target: US Microchip Hegemony," *Wall Street Journal*, July 27, 2017, <https://www.wsj.com/articles/chinas-next-target-u-s-microchip-hegemony-1501168303>.

18 Made in China 2025 Archived 2018-12-29 at the Wayback Machine. CSIS, June 1, 2015, Made in China 2025 | Center for Strategic and International Studies (csis.org).

19 2022 US National Security Strategy, <https://www.whitehouse.gov/wp-content/uploads/2022/10/Biden-Harris-Administrations-National-Security-Strategy-10.2022.pdf>.

DRAGS ON ECONOMIC GROWTH

The US can remain competitive by investing resources, human and capital, in productive assets that create value for the populace. The value of such investments should be guided by the aspirations of the aforementioned preamble to the Constitution: to “provide for the common defense, [and] promote the general Welfare.” This is distinctive from business, wherein the bottom line is literally the bottom line in an accounting spreadsheet.²⁰ For society, the bottom line is found in its shared values.

The problem with the national debt, which for the US exceeds \$30 trillion, is that the interest paid on the debt can end up being invested in unproductive or less desirable assets, as opposed to those reflective of shared values. Arguably, much of the roughly \$400 billion spent on interest on the national public debt,²¹ and some of the \$1.7 trillion currently spent per year by the US government on social safety net programs, fails to wholly answer societal expectations (and really, its needs). Moreover, the US government deficit has increased steadily over the past 20 years with a sharp uptick during the COVID-19 pandemic.²² The last time the US had a budget surplus was 2001.²³ Total national debt as a percent of GDP is the highest in US history,²⁴ and carries the implication that deficit spending is the norm rather than a tool reserved for deliberate strategic stimulus. A strategy that helps the US realize and maintain a viable competitive posture and a leadership role on the international stage includes getting the government’s financial house in order.

Individuals and consumers have a role to play in determining investments made for prosperity. Economic theory says that demand will drive efficient investments, but such is less the case as income inequality rises. Income inequality in America has skyrocketed over the past four decades. As of this article’s writing in 2022, only 0.1% of Americans wielded 18% of the nation’s wealth.²⁵ The US ranks 98th of 169 countries in income inequality, as measured by the Gini Index,²⁶ which is worse than most peer nations.

Income inequality is correlated with decreased social cohesion, increased polarization, and overall depressed economic growth.²⁷ Worse than simply promoting unproductive investments, a nation will find it hard to be competitive on the global stage if it is at war with itself.

20 Krugman, Paul, “Competitiveness: A Dangerous Obsession,” *Foreign Affairs*, Mar/Apr 1994.

21 Fiscal Data Treasury.gov, “Interest Expense on the Public Debt Outstanding,” <https://fiscaldata.treasury.gov/datasets/interest-expense-debt-outstanding/interest-expense-on-the-public-debt-outstanding>.

22 Fiscal Data Treasury.gov, “What is the National Debt?” <https://datalab.usaspending.gov/americas-finance-guide/debt/trends/>.

23 Fiscal Data Treasury.gov, “What is the National Debt?”

24 National Debt in the United States in Relation to Gross Domestic Product from 2017 to 2020, with a Forecast to 2027.” Statista. 2023. <https://www.statista.com/statistics/269960/national-debt-in-the-us-in-relation-to-gross-domestic-product-gdp/>

25 Ember Smith and Richard V. Reeves. “Class Notes: Rising Income and Wealth Inequality, Parent Spending, and More.” Brookings. December 9, 2020. <https://www.brookings.edu/blog/up-front/2020/12/09/class-notes-rising-income-and-wealth-inequality-parent-spending-and-more/>.

26 Ventura, Luca. “World Inequality Ranking by Country 2022,” Global Finance. February 17, 2022. <https://www.gfmag.com/global-data/economic-data/world-inequality-ranking>.

27 “Introduction to Inequality,” International Monetary Fund. 2022. <https://www.imf.org/en/Topics/Inequality/introduction-to-inequality#What%20are%20Consequences%20of%20Inequality?>

POLARIZATION

Numerous studies show that America has become increasingly polarized, which presages a scenario that can reduce the country's competitiveness.^{28,29} In his 2004 book "The Paradox of Choice: Why Less is More," Barry Schwartz lays out a compelling hypothesis, supported by data, that anxiety and polarization increase as the number of available choices increase.³⁰ Consider Schwartz's hypothesis as it relates to the availability of news in the United States. In the 1970s, Walter Cronkite was hailed as "the most trusted man in America," and people got their news primarily from one of three networks (CBS News, Cronkite; NBC, Huntley and Brinkley; ABC News, Peter Jennings) supplemented by the local newspaper. Each were trusted to report professionally and objectively. Today, there are many more news channels and pathways for information,³¹ and there is no universal "trusted agent." Instead of a comfortable middle ground, America now has a thoroughly divided left and right. "News" channels (really "news commentators") compete by finding niches that allow consumers to reinforce their views by self-selection to sources motivated to sell their product. Politicians and political profiteers often pour gasoline on the fire by hyperbolizing and caricaturing minor policy differences for political and monetary gain. Elected leaders who compromise are all too frequently endangered.

Polarization ultimately detracts from the ability to define a common set of contemporary American values upon which to base a strategy to compete effectively on the global stage.

APPRECIATION OF US CIVICS

Yet another impediment to coalescing on shared values is a decline in knowledge of, and respect and appreciation for, US civics. A robust civics education helps motivate citizens to engage productively on the issues of the day, it broadens the base of those involved (and therefore invested) beyond the interests of a small political elite. Civics classes elucidate how government works while providing the opportunity to debate, understand, and work through all sides of challenging issues with civility and respect for the process.³² However, in 2016, only 26% of Americans could name the three branches of government.³³ Flatly, Americans no longer understand how government works, let alone feel an obligation or sense of duty to participate in traditional civic responsibilities. In the absence of a common external villain (e.g., the USSR), political debate and policy prescriptions are increasingly based on opinions of others who tend to reinforce personal views, as opposed to the collective wisdom of an educated society.

DEVISING THE NEXT GRAND STRATEGY (WHERE SHOULD WE GO NOW?)

It is not a stretch to say that "inherent American values"—individual rights, an open democratic society, and free enterprise—made the nation and the world a stronger place. People have enjoyed major improvements in living standards, growth in personal wealth, the ability to explore and communicate with

28 "Political Polarization in the American Public," Pew Research Center. June 12, 2014.

<https://www.pewresearch.org/politics/2014/06/12/political-polarization-in-the-american-public/>.

29 "Is Political Polarisation in America Really Rising?" Economist. October 5, 2021. <https://www.economist.com/the-economist-explains/2021/10/05/is-political-polarisation-in-america-really-rising>.

30 Schwartz, Barry. "The Paradox of Choice," New York: Harper Perennial. 2004.

31 Schwartz, Barry. "The Paradox of Choice."

32 Fiske, Edward. "With Old Values and New Titles, Civics Courses Make a Comeback," *New York Times* June 7, 1987.

33 Shapiro, Sharon and Catherine Brown. "A Look at Civics Education in the United States," Department of Education. 2018. <https://files.eric.ed.gov/fulltext/EJ1182087.pdf>.

the rest of the world more easily, and, in spite of internal squabbling, greater individual freedoms. Said another way, the principles of “American exceptionalism” remain a noble goal for the betterment of humanity. This is true for America, and for all who embrace liberal democratic ideals.

Despite daunting challenges, America can regain and enhance its competitive posture and rally around a strategy that unifies our engagement with the rest of the world by acting along three directions, presented here as recommendations.

RECOMMENDATION 1: Regain wide appreciation for government’s purpose and active civil discourse that strengthens our institutions and society.

A well-functioning government requires the active participation of citizens compromising and holding each other accountable via civil debate and tough deliberation on the formulation of policy. Mindless partisan brinkmanship is wholly destructive for all involved. Americans should be able to name the three branches of government, understand models of governance, and appreciate the value of checks and balances.

The federal government could start by providing incentives and policies to expand civics instruction at the local level. Objective curricula could be promulgated through trusted channels, possibly stood up for the purpose. Reinvigorating an understanding for how government works and establishing an appreciation of civic duties, is a first step in securing America’s competitive posture for the future.

RECOMMENDATION 2: Establish and enforce standards of accountability that ensure efficacy of information used in media and policy deliberations without abridging the freedom of speech and of the press.

The nation needs access to news based on authoritative, factual data. The Society of Professional Journalists have an agreed on a code of ethics, which begins:

“... public enlightenment is the forerunner of justice and the foundation of democracy. Ethical journalism strives to ensure the free exchange of information that is accurate, fair and thorough. An ethical journalist acts with integrity.”

These are sound principles. “News” networks need to be transparent about who has (or, has not) adopted such standards. As an analogy, the American Meteorological Society certifies weathercasters who meet similar professional standards. Most professions require lifelong learning with tests to hold them accountable. This is true of lawyers, doctors, professional engineers, accountants, and many others. Identification of who is and is not a professional journalist would be a step toward rooting out malfeasance. Radical views should not be suppressed, but viewers should have the right to know if the on-air person is a true journalist or an entertainer.

A further step would be to have a federally funded apolitical organization, an ombudsman, to conduct fact checking and provenance discovery, using authoritative sources, to illuminate those “news bits” that are really just conspiracy theory or memes not based on facts. Once again, the idea is not to suppress speech, but to illuminate truth from falsehood using verifiable data and contextual explanation. The US government collects mounds of data on countless issues and has done so since its earliest days. Leveraging that data as a foundation for accountability would help reinvigorate an appreciation for the value of our institutions while

also distinguishing truth from entertainment. Revitalizing an allegiance to data in policymaking will be a significant step in developing a coherent strategy for competition on the global stage.

RECOMMENDATION 3: Assess and divulge America’s contemporary values, and formally commit to them as a basis for a strategy to compete with near peers on military, economic, and political levels.

America’s competitive posture for the future requires us to identify a coherent set of values from which to develop a strategy. Too often, Americans get bogged down in the minutia of daily life or caught up in the passion of a politically charged debate. In doing so, they lose sight of the uniquely exceptional values Tocqueville first wrote about and are still accepted by most Americans. A joint panel, made of Executive and Legislative Branch members of varying age, race, experience, and regional origin should be appointed with that express mission. Once agreed upon, the panel should incorporate their findings into the basis of a draft strategy document.

It would be difficult to argue against continued dedication to life, liberty, and the pursuit of happiness and the ideals of the US Constitution. Modern economic analysis could justify capitalism and a market economy over a Stalinist command economy.

Such a panel was constituted in 1996 and listed American national interests of that day.³⁴ An update is needed and would have to be ratified as a representative statement of American values. While not written in stone, it would serve as the foundation of common contemporary principles and ideals in addressing the global competitive environment.

TO SUM UP

To assure a secure and prosperous future wherein America thrives as a world leader, the US must adopt a grand strategy based on a contemporary conception of our shared American values. Such a strategy should connect current day global and domestic challenges to the base ideals Americans have pursued since the dawn of our nation. To do so, Americans must act to regain a wide appreciation for government’s purpose and a dedication to active civil discourse that strengthens our societal institutions. We must also seek to develop and adopt the means to hold accountable efficacy in information used in media and policy deliberations while holding true to First Amendment principles. Finally, we should commission a diverse panel to assess and divulge America’s contemporary values, and formally commit to them as basis for a strategy to address the challenges of the globally competitive environment.

34 “America’s National Interests,” The Commission on America’s National Interests. July 1996. https://www.belfercenter.org/sites/default/files/legacy/files/americas_interests.pdf.

CHAPTER 11: LOOKING BACK AND LOOKING FORWARD

On May 25, 2022, Potomac Institute staff and Board of Regents members participated in a seminar titled “The Global Competition Project: Looking Back and Looking Forward” that was hosted by the Potomac Institute for Policy Studies’ Global Competition Project. This seminar, together with additional discussions at Potomac Institute, led to the documentation of observations from the study to date and the formulation of plans for continued work.

INTRODUCTION

Based on the material presented in the previous chapters and analysis of the topics, it is opportune at this point to look back across the events and extract major takeaways. Below, we summarize cross-cutting findings and offer key takeaways from GCP proceedings to date.

Key themes:

- Successful competition requires broad societal support.
- The US needs a long-term global competition strategy.
- Comprehensive intelligence goes beyond military capabilities.
- Multinational supply chains sustain basic human necessities.
- Importance of support for science and technology.

The following sections examine specific themes from previous chapters and consider issues that require further discussion and attention.

CROSS-CUTTING THEMES

Societal Support

The US is a diverse agglomeration of states, peoples, cultures, and preferences. This diversity often causes social and ideological fault lines that lead to political impasse and stagnation. If the US is to meaningfully compete with motivated, peer-adversary nations, broad societal support is necessary.

Global competition is today’s reality. In light of this, politicians, policymakers, and media outlets should set a common direction for the benefit of society. The challenges are to leverage core US values, disseminate factual information, rebuild trust in American institutions—such as the press, the education system, and the government—and generate societal consensus. The US has done this successfully before and can do it again.

Democracy is a raucous, messy process that some (like China) believe prevents the US from developing a unified vision or from carrying out a long-term strategy. However, this need not be so. It does mean, though, that society must use conflict resolution techniques to find major areas of agreement and to produce functional policy. Too often, factions focus on the minutia of disagreement while bickering and steering policy from one direction to another.

A Strategy for Global Competition

A recurring concept throughout the GCP activities was that China is a pacing threat for the US. For example, until 2022 National Security Strategy, the US did not have a comprehensive strategy to address the challenges arising from competition with China, let alone any other emergent competitor. China is

currently enacting a strategy that is over 50 years in the making. To compete, the US needs a long-term vision with a grand strategy incorporating a “whole of society” approach. This effort will demand stability in international relations and policy across changes in presidential administrations and congressional leadership. While the political environment often makes stability seem daunting, a professional corps of foreign service and international relations government representatives with sound authorities in law can enact an enduring strategy.

Comprehensive Intelligence Beyond Military Capabilities

Many discussions of global competition center on US shortcomings. Some bemoan the rise in adversaries’ military might, but many discussions also note limitations in competing in economic and political spheres. While it is useful to understand our own liabilities, a similar understanding of our adversaries’ shortcomings and vulnerabilities is essential. Repeatedly, GCP participants pointed out that China is not without its own difficulties. Much of our intelligence apparatus focuses on military threats. Making strategic decisions that benefit US competitive positions is difficult without an understanding of adversaries’ plans, intentions, and vulnerabilities—including in economic spheres.

Today’s global competition is distinct from that which defined the late 20th century, which endured the Cold War. The United States is now competing with codependent rivals. Interdependencies, such as economic ties with China, create a complicated patchwork of interests and collateral vulnerabilities. Potential societal and global economic consequences of a miscalculation are heightened by the complexity of these co- and inter-dependencies.

GCP discussions proposed methods to address this complexity—ranging from commissioning more study, engaging high-level panels, and mimicking business intelligence operations all the way to restructuring the intelligence community. “Red teaming” was suggested as a way to explore complex environments, although automated processes that explore “what-if” scenarios were also considered.

Multinational Supply Chains

Every human needs food, water, and shelter. In today’s world, we depend on technology, enabled by worldwide manufacturing and global supply chain delivery, for these necessities. Abundant and convenient energy sources are also vital to the provision of basic human needs. Essential energy sources are characterized by supply chains that traverse the oceans. The interrelated dependencies make for a complex competitive environment in which disruptions in any sector can disturb the availability of life’s necessities in multiple domains.

Energy provides heat to our homes and fuel in our cars, but it also powers factory lines and generates byproducts that become commodity chemicals feeding agricultural production and other areas of the economy. Food, water, clothing, building supplies, and many more industry sectors have equally complex and interdependent supply lines. International competition is not limited to military confrontations on a battlefield. Levers of influence involve goods, services, commodities, and supplies that are parts of a global network of exchange.

Importance of Support for Science and Technology

Another recurring theme during the GCP activities is the importance of science and technology as a solution to societal problems exacerbated by global competition. Domestic science and technology capabilities fortified US dominance in the 20th century. The advantages of scientific and technological progress not only contribute to military might, but to economic strength. Advanced technology can often find or develop alternatives that avert supply chain limitations and disruptions. However, US technological advantages are not guaranteed going forward. Technology domains are facing intense global

competition. Continued US dominance requires a workforce capable of supporting the development and use of those technologies. Both domestically and internationally, the US must compete to attract, educate, and retain talent.

The United States must continue supporting science and technology. Competitor nations—likely motivated by the US example of the 20th century—now devote resources through government financing and incentives to encourage science and technology expertise. In terms of S&T expenditures per GDP, the US percentages have declined, while China is on track to surpass US S&T spending.

REVIEW OF KEY TAKEAWAYS FROM POTOMAC INSTITUTE GCP EVENTS

While GCP events supported the development of the articles within this compendium, the events—and discussion that followed—also led to the generation of many observations and recommendations. Below, we review some of the key takeaways.

What is Competition?

September 29, 2021. The Honorable Alan Shaffer; Melissa Flagg, PhD; Jaymie Durnan; and Laurie Giandomenico, PhD. Key points of the event discussion included the following:

- The national debt is a burden on competitiveness, particularly as interest rates (will) rise.
- Despite the perception of an advanced military, the US has for the past two or three decades largely deferred fielding advanced weapons systems and new capabilities to confront a near-peer adversary.
- US investment in R&D has dropped from 2% of GDP to 0.7% over the last two decades. Furthermore, much of this investment is for short-term development in commercial markets.
- Societal balkanization inhibits success in the competition of ideologies. The US has lost sight of shared national values.

Economics and the Spectrum of Conflict: Is DOD Prepared?

February 24, 2022. Tim Welter, PhD; The Honorable Zach Lemnios; Will Roper, PhD; and Lois Nicholson. Key points of the event discussion included:

- The US lacks a comprehensive national strategy to address emerging threats like adversarial, subversive economic practices as exist in the gray zone of conflict.
- Greater alignment is required between industry and the military to confront societal-level challenges and to compete effectively with countries such as China that can otherwise take advantage of top-down control of the industrial sector.
- International cooperation with allies plays a pivotal role in capturing emerging technologies and industrial innovation.

US Microelectronics Supply Chains and Competitive Advantage

November 3, 2021. Michael Fritze, PhD; The Honorable Alan Shaffer, Jay Lewis, PhD; and Mike McGlone. Key points of the event discussion included:

- Supply chain shortages and disruptions stemming from the COVID-19 pandemic brought to light key vulnerabilities and dependencies of the US economy (which already existed), and if left unaddressed could be detrimental to American prosperity and security.

- The evolution of the microelectronics industry has placed the US at a competitive disadvantage as primary economic incentives for production shifted from a focus on domestic security to that of global commercial production efficiency.
- The security of critical national infrastructure (power grids, financial, healthcare, transportation, etc.) are also dependent on global supply chains.
- If data is the “new oil” of future economies, secure access to microelectronic technologies will play a critical role in gaining and maintaining an enduring competitive advantage in data-driven markets.
- Economics are central to gaining advantage in today’s globally competitive environment; China is competing with the US primarily in the economic and non-kinetic domains but grappling with internal economic challenges (some self-imposed).
- The adoption of a US central bank digital currency as a US crypto dollar (not to be confused with private crypto currencies that can be “mined”) providing an international reserve currency could cement a US dominant position in energy, agriculture, and other commodities in the global marketplace, providing a foundation for long-term US prosperity into the future.

Strategic Communications and Information in Competition

December 1, 2021. Curtis Pearson; Jeff “Skunk” Baxter; Rand Waltzman, PhD; Jody Moxham; and W Alex Vacca, PhD. The discussion included the following key points:

- Strategic messaging should always orient toward achieving strategic goals.
- Strategic messaging itself will not achieve a desired outcome—it must be paired with matching policy and planning.
- The US lacks a national agreed-upon narrative of who the US is and how we should convey that to the world.
- The lack of an agreed-upon national narrative leaves the US susceptible to strategic manipulation campaigns by our adversaries.
- Government and industry leaders need to better understand the vulnerabilities of our society to strategic manipulation by adversaries.
- Advancements in communications technology allow for the micro-targeting of individuals on a massive scale.
- The injection of chaos, delivered via strategic messaging, can change the international order. Short-term chaos injected into our society by adversarial manipulation may be serving long-term goals.
- The foundation for a national narrative may be derived from shared core principles, relayed in our nation’s founding documents (Constitution, Declaration of Independence, Bill of Rights, etc.).

Education, 20-somethings, and Competition

January 26, 2022. The Honorable Alan Shaffer; The Honorable Patricia Falcone, PhD; Daniel Hastings, PhD; Joy Shanaberger, and Trevor Huffard. Some main points from the discussion included the following:

- The US has lost focus on the investments required for the education of children. Are we providing the right tools and applying the best methods for the youngest Americans? Retaking the lead in primary and secondary education should be a focus of US investment and policy.
- The model of education is evolving. Increasingly, education is a lifetime endeavor. The “braided river” model versus a traditional pipeline through undergraduate and graduate education was discussed.
- Americans necessarily re-evaluate and re-establish their vision of the American Dream over time and from generation to generation, reconciling it with the reality of their times. The education system is viewed differently in 2022 than in the 1960s, and thus requires new methods.
- We need to better market STEM education: it can be hard, but fun! The emphasis should be on diversifying and broadening the STEM student and worker bases.

Envisioning Competitive Advantage In The Space Domain

March 30, 2022. Jerry Krassner, PhD; Thomas Messegee; and Samantha Weeks, PhD. Some major points of discussion included:

- The domain of space activities has entered an era of commercial, industry, and government access with affordable small satellites and new ground control systems, with global participation that requires the US to adapt.
- Situational awareness and management of space assets should be the top priority for US national security for space going forward.
- International cooperation is required for US success in space, even with geopolitical rivals.
- The commercialization of space has played a critical factor in making space launch and orbit more economically efficient, resulting in increased private investment in space ventures and a competition in commercial applications.
- Developing a national narrative for space that transcends politics and inspires the next generation of minds to join the US space mission will play a critical role in generating support for future investments.

Energy Advantage: The Cornerstone of 21st Century Security and Prosperity

April 26, 2022. Frank Fannon, Ron Nussle Jr, and Gentry Lane. Some of the main points included:

- The transition to renewable energy will be slow, depends on supply chains, and must be led by advancements in technology rather than policy edicts.
- Industry innovation is essential in pursuing a renewable energy transition and energy independence. The US has the opportunity of incentivizing R&D of renewable energy technologies. (As is done in the subsequent CHIPS Act.)
- Energy dependencies must be mitigated to lessen vulnerabilities, as seen in the Russo-Ukrainian war, even while pursuing clean energy goals.
- Too rapid a phase-out of hydrocarbon-based energy risks inflationary pressures that would limit the ability to pursue technologies and supplies essential to renewable energy development.

- Adversaries are employing a cyber strategy of incremental degradation (“salami tactics”) against our critical infrastructure, such as the energy infrastructure.

Advancing American Competitiveness: Challenges & Opportunities

November 30, 2022. The Honorable William “Mac” Thornberry; Tim Welter, PhD; Sarah Mineiro; Colonel Ben Bishop; Professor Charles McLaughlin; Bob Hummel, PhD; The Honorable Al Shaffer; Dean Cheng; Mark Lewis, PhD; Ardavan Mobasheri; Christina Manning; Jeremy Muldavin, PhD; and Heather Richman. Some of the primary points made across the three conference panels include:

- The government is ill-equipped to manage sustained challenges; it is siloed, positioning it to address singular issues efficiently, but struggles with complex interrelated issues, necessitating a new approach to policy.
- The US needs a long-term strategic vision to address competition with partners and allies, incorporating a whole-of-government approach that plays on our strengths while simultaneously rectifying areas of weakness.
- While there are other nations with which America will compete, China is the only competitor that currently has the ability to reshape the international order and that can compete with the US on a societal level.
- From an academic perspective, people, money, and vision are America’s primary contributions to the global competitive environment; the US must position itself to best utilize its people, invest in those people and their talents, and provide a vision of excellence that contributes to enduring advantage in competition.
- The US must understand competition from the perspective of competitors like Russia and China. The international order has operated under a US led vision of liberalism, free trade, and security for 30 years. There is not an institutionalized framing of how the US should tailor its strategies to its individual competitors.
- The private sector serves as the bridge between the development of US government policy and development of a talented workforce; a workforce that can interoperate between the government and the private sector is a competitive advantage.
- Government driven investments in certain industries will yield some buy-in from private business, but those investments are moot if the government does not position itself to leverage that cooperation.
- Globalization has been a miracle in providing the high standard of living Americans enjoy, but has also led to decentralized and fragile supply chains originating overseas that can compromise security and prosperity.

MOVING FORWARD

This study has elucidated a variety of domains of competition and brought together some unifying themes. But for the United States to continue to thrive as a global leader, a societal-level understanding and approach to competition must be invigorated, starting with our public institutions and how they intersect with the rest of society. While much has been written and discussed about global competition and the US position relative to competitors, so far there has been limited focus on the development of new legislation, policies, and processes that strike an acceptable balance between risk, oversight, and flexibility to pursue

competitive advantages in the face of rising threats. The CHIPS and Science Act, passed in August of 2022, is a notable exception, providing it is effectively implemented and funded.

Our new era—the Information Age—is dominated by unprecedented global interconnectedness and economic interdependence, complicating the world of competitions. We must therefore strive to better understand the implications of our ultra-interconnected world from an information, education, and economic standpoint. Policies and priorities need to be focused on assuring a friendly competitive advantage—flourishing with effective deterrence without provocation—moving forward. Accomplishing these tasks with the right balance, using effective and implementable strategies, may require study that includes detailed executable modeling, going beyond mere discussion.

The short history of the US has demonstrated that inventiveness, imagination, and the free flow of ideas—ingenuity—are core to the unprecedented success as a country. This has been especially true, when translated to the advance of impactful science, technology, and engineering on the economy, national security, and overall quality of life. The need for continuing ingenuity is at an all-time high.

The papers presented in previous chapters provided a platform for recommendations for specific domains of competition: economic security, supply chains, strategic communications, education, space, energy, and American values. However, addressing competition requires more. Moving forward, the US needs big picture recommendations for action, for both the private and public sector, to ensure US security and prosperity in the future.

In previous decades, US national security priorities focused on military might; the challenges in the modern era require that US national security priorities be realigned to a competitive US posture in all domains of societal import. Global competition, in the interconnected world, requires developing a societal-level approach to competition, ensuring mutually beneficial opportunities for all entities.

The implications of global competition in the modern era are becoming increasingly apparent across both the government and the private sector, yet there is still more that must be done. Current efforts, such as the CHIPS and Science Act and the 2022 NSS, have spearheaded efforts to improve the competitive posture of the US and increase connections between the private and public sector. However, the US government must continue to facilitate, build, and ensure a mutually beneficial relationship with the private sector at the societal level to ensure the US remains competitive in an interconnected and hostile world. This approach will need to develop through the bounds of US Governance norms, while establishing new legislative processes and policies ensuring the stability of these relationships in the long term.

TABLE OF ABBREVIATIONS

AI	Artificial Intelligence
Btu	British thermal unit
CAGR	Compound Annual Growth Rate
CBO	Congressional Budget Office
CCP	Chinese Communist Party
CETC	China Electronics Technology Group Corporation
CFIUS	Committee on Foreign Investment in the United States
CONFERS	Consortium for Execution of Rendezvous and Servicing Operations
CPC	Communist Party of China
DARPA	Defense Advanced Research Projects Agency
DOD	Department of Defense
DRACO	Demonstration Rocket for Agile Cislunar Operations
EWOC	Economic Warfare Operations Capability
FABS	Facilitating American-Built Semiconductors
FDI	Foreign Direct Investment
FFRDC	Federally Funded Research and Development Centers
FIRRMA	Foreign Investment Risk Review Modernization Act
FPGA	Field-programmable Gate Array
FY	Fiscal Year
GCP	Global Competition Project
GDP	Gross Domestic Product
GEC	Global Engagement Center
GEO	Geostationary
GW	Gigawatts
IP	Intellectual Property
ISS	International Space Station
LEO	Low Earth Orbit
MEO	Medium Earth Orbit
NCBC	Nuclear, Chemical, Biological, Cyber
NCSES	National Center for Science and Engineering Statistics
NDS	National Defense Strategy
NSC	National Security Council
NSF	National Science Foundation
NSTC	National Science and Technology Council
NSS	National Security Strategy
NTP	Nuclear thermal Propulsion
OEWC	Office of Economic Warfare and Competition
OMB	Office of Management and Budget
OSC	Office of Strategic Capital
PISA	Program for International Student Assessment
PLA	People's Liberation Army
POR	Program of Record
PPBE	Planning, Programming, Budgeting, and Execution

PPE	Personal Protective Equipment
PPP	Public-private Partnership
R&D	Research and Development
REE	Rare Earth Elements
RFE	Radio Free Europe
RL	Radio Liberty
S&T	Science and Technology
SAGE	Semi-Automatic Ground Environment
SIA	Semiconductor Industry Association
SIPRI	Stockholm International Peace Research Institute
SMART	Science, Mathematics, and Research for Transformation
SMR	Small Modular Reactors
SOE	State-Owned Enterprises
SOTA	State-of-the-art
SPR	Strategic Petroleum Reserve
STEM	Science, Technology, Engineering, and Mathematics
STEPS	Science, Technology, Engineering, and Policy Studies
TCF	Trillion Cubic Feet
UMBC	University of Maryland Baltimore County
US	United States
USAGM	US Agency for Global Media
USIA	US Information Agency
USICA	US Innovation and Competition Act
USS	United States Ship
ZTE	Zhongxing Telecommunications Company Ltd.