SOCIOCULTURAL BEHAVIOR RESEARCH AND ENGINEERING IN THE DEPARTMENT OF DEFENSE CONTEXT

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14. ABSTRACT

Understanding and engaging foreign populations is not a novel concept for the United States military. Our Armed Forces have long recognized the operational value of understanding the mindset of opposing forces and securing the cooperation and support of local populations. However, the U.S. is now expected to engage foreign populations more routinely, at all operational phases, and across a broader range of mission types than ever before. Success requires being able to anticipate how factors such as culture, society, group identity, religion, and ideology influence the behavior of foes and others in foreign populations. This new reality demands a broader, deeper capability, realized at tactical, operational, and strategic levels, and founded on the social and behavioral sciences.

Mastery of the factors that optimize our forces' ability to forecast behaviors driven by social and cultural variables and take effective courses of action in the full range of military operations.

Realizing this vision—a DoD sociocultural behavior capability—is the focus of this paper. It details the strategic and operational drivers for a sociocultural behavior capability, explains the role and importance of research and engineering (R&E) for building that capability, highlights the exciting R&E progress that has been made across the Department, discusses major technical and other challenges, and outlines future directions for DoD sociocultural behavior R&E.

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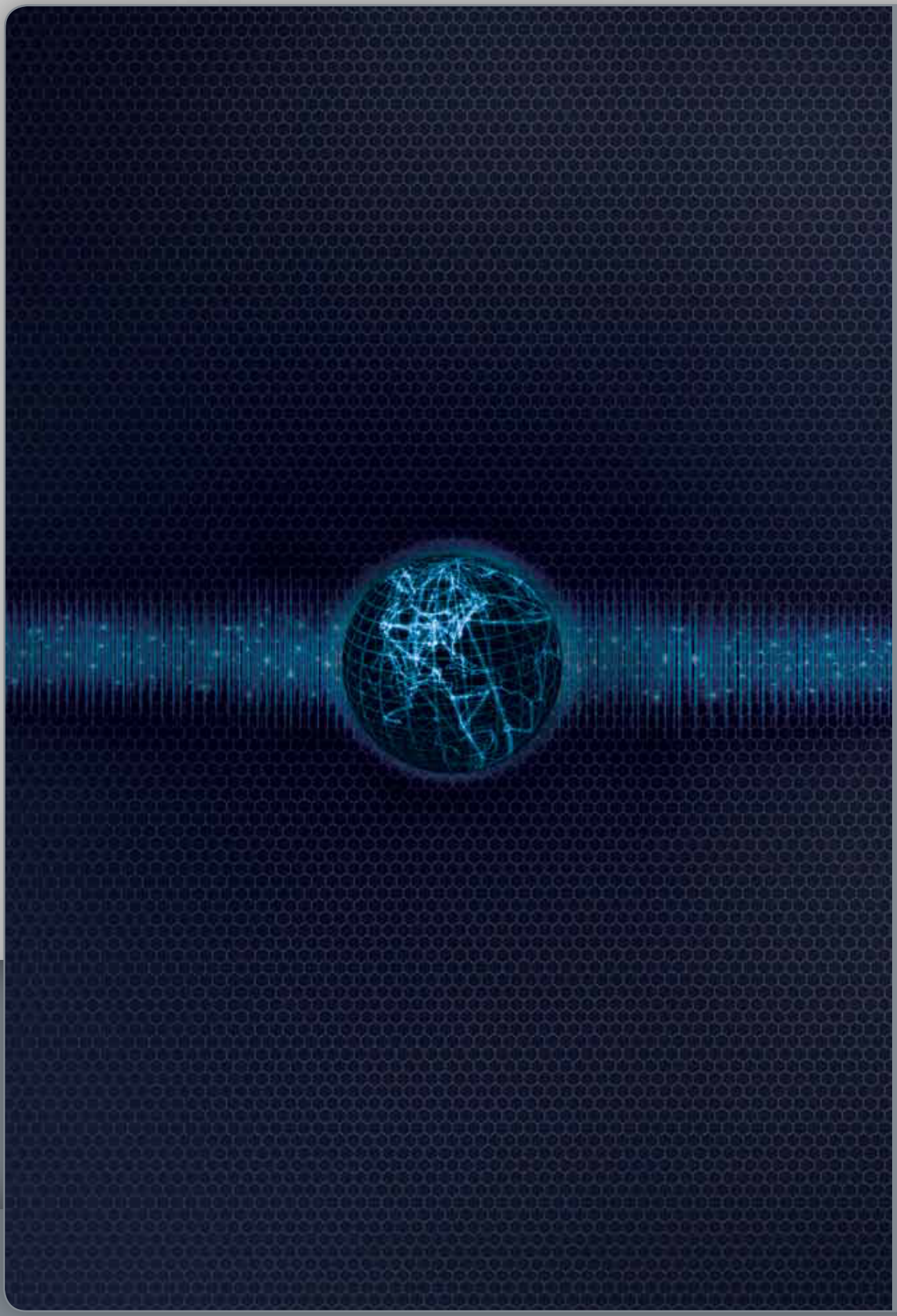

Foreword

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Understanding and engaging foreign populations is not a novel concept for the United States military. The U.S. Armed Forces have long recognized the operational value of understanding the mindset of opposing forces and securing the cooperation and support of local populations. However, the United States is now expected to engage foreign populations more routinely, at all operational phases, and across a broader range of mission types than ever before. Success requires the ability to anticipate how factors such as culture, society, group identity, religion, and ideology influence the behavior of foes and others in foreign populations. This new reality demands a broader, deeper capability at the tactical, operational, and strategic levels, and founded on the social and behavioral sciences:

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Realizing this vision—a DoD sociocultural behavior capability—is the focus of this paper. It details the strategic and operational drivers for a sociocultural behavior capability, explains the role and importance of research and engineering (R&E) for building that capability, highlights the exciting R&E progress that has been made across the Department, discusses major technical and other challenges, and outlines future directions for DoD sociocultural behavior R&E.

A number of individuals contributed to the ideas offered herein. Thanks go to Sean Biggerstaff, John Boiney, Barry Costa, Jill Egeth, Ivy Estabrooke, Bob Foster, Gary Klein, Lee Kollmorgen, Liz Lyon, Patrick Mason, Mark Maybury, Dave Moody, and George Solhan for their original contributions and comments.

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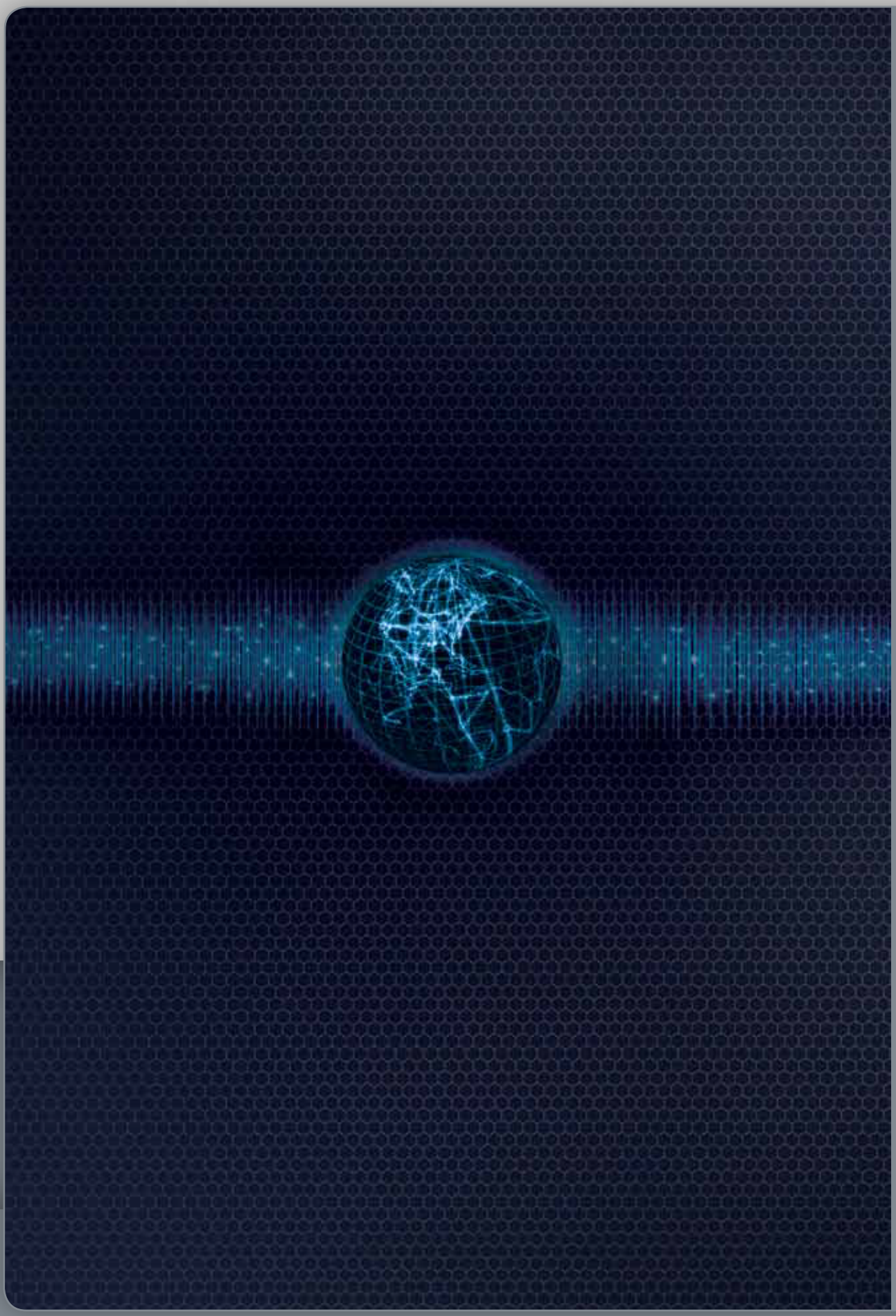

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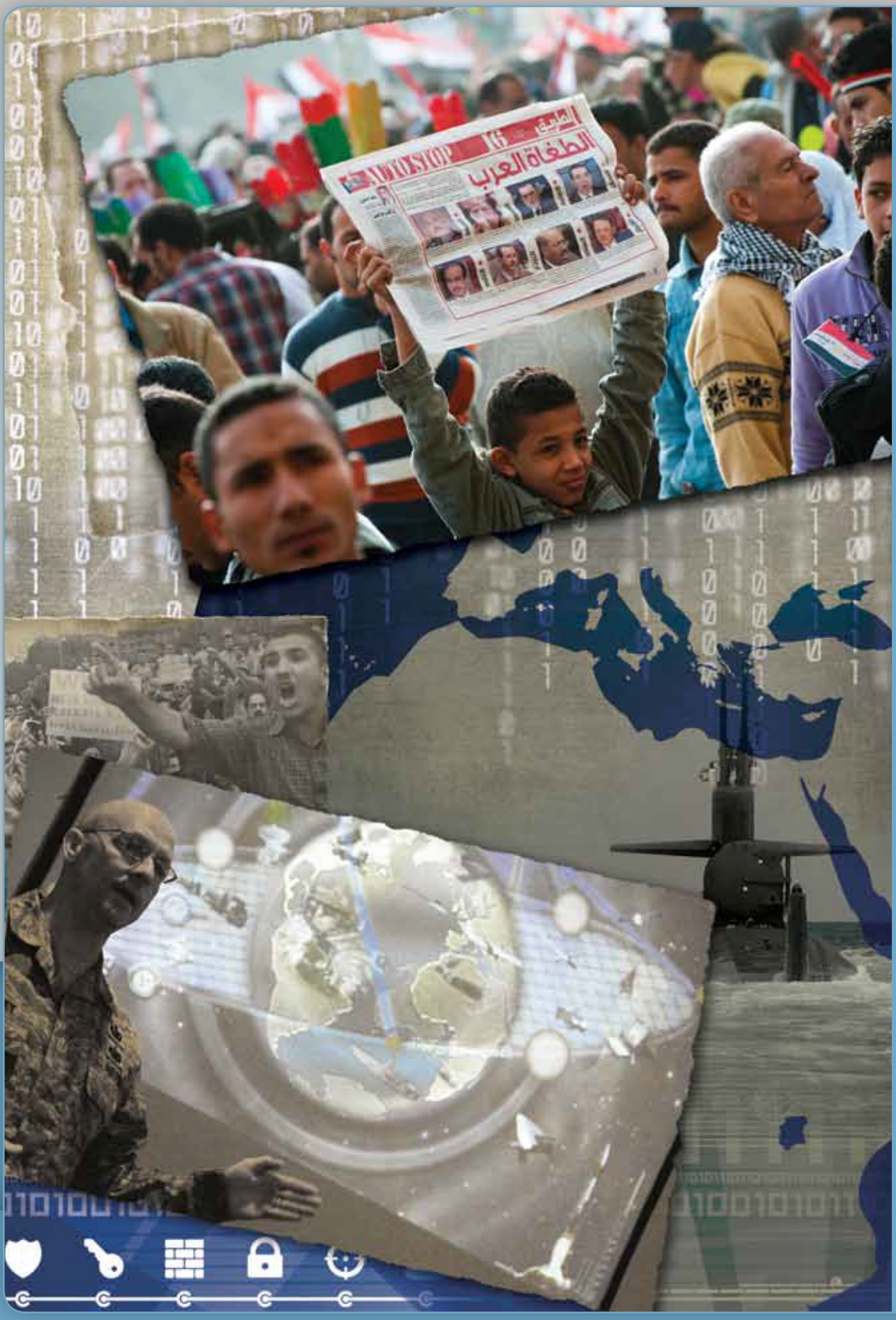


Executive Summary

On December 17, 2010, a Tunisian street vendor named Mohamed Bouazizi set himself on fire to protest repeated harassment and humiliation by the police and confiscation of the produce he was selling. The unrest that followed his act, facilitated by Facebook, quickly led to the resignation of the Tunisian president. More uprisings followed in nearby countries, including Egypt, where long-time president Hosni Mubarak was forced out of office. These revolutionary events took much of the Western world by surprise, and effects of the several uprisings and regime changes continue to ripple across the region.

Instability like that experienced in North Africa is one of several challenges that impact U.S. strategic interests—challenges that include violent extremism, growing access to weapons of mass destruction (WMD), and cyber threats. These widely disparate challenges seem increasingly likely to share certain features. Leading actors may well be small groups or even individuals, connected and perhaps driven primarily by cultural or social factors. In many cases, these actors will be geographically distributed, perhaps only loosely affiliated with one another, embedded in general populations, and will use local networks, economies, and sympathetic governments for cover and support. They will also exhibit agile, adaptive behavior, including an emphasis on influencing general popular sentiment through culturally anchored communication.

These shared features indicate that in order to develop effective strategies and courses of action (COAs) across this broad range of problem types, the U.S. military must be able to forecast behaviors of groups or perhaps key individuals in foreign operational contexts. Such forecasts depend upon the ability to detect relevant indicators amid the baseline noise, an ability that can only be acquired through a deep understanding of the extant culture, social structure, history, and language of a region of interest. Taken together, these represent a vision for desired Department of Defense (DoD) capability regarding sociocultural behavior:

> **Mastery of the factors that optimize our forces' ability to forecast behaviors driven by social and cultural variables and take effective courses of action in the full range of military operations.**

This ambitious vision calls for a capability with many difficult-to-achieve features. "Mastery" would mean that U.S. forces would have the data on indigenous populations and the training they need to move easily in those populations; could see the parameters of culture and society and integrate those with conventional mapping of the physical terrain; could detect often complex and dynamic networks, where adversaries and civilian populations are intermingled; and would possess non-kinetic tools as well as the ability to anticipate both the near-term and long-term impacts of applying those tools.

The DoD has recognized that this vision can best be realized and sustained through a coherent, innovative DoD-wide program of research and engineering (R&E), and has moved aggressively to meet this need. With leadership from the Assistant Secretary of Defense for Research and Engineering, and programs such as Minerva and the Human Social Culture Behavior (HSCB) Modeling Program, DoD has established a strong science foundation and successfully moved resources and tools into operational use. DoD's investment includes programs and initiatives from the armed services, the Defense Advanced Research Projects Agency, the Combatant Commands, and the defense intelligence community.

With all of the innovative work underway, the DoD sociocultural behavior R&E community now finds itself at a point of transition and great opportunity. To date, the community has accomplished some outstanding work on very difficult problems. Yet most of the individual projects have proceeded more or less discretely, each attacking some part (or parts) of a given problem. The field of sociocultural behavior R&E has matured to the point where it can now begin to bring those discrete elements together, pursuing integration in order to offer more end-to-end solutions.

Such integration would represent a significant step forward—a step that will be greatly aided by applying a framework for sociocultural behavior R&E that reflects end-to-end military operational needs. In addition to indicating technology transition paths, such a structure would help to uncover integration opportunities as well as gaps where further R&E is needed. This paper introduces the Sociocultural Behavior Capability Areas Framework. Derived from familiar and widely applied concepts for military operations, including the Observe, Orient, Decide, Act (OODA) loop,[1] the Joint Fires Targeting Cycle,[2] and the strategic communication process,[3] the framework comprises four sets of capabilities, each set feeding into the next and forming a cycle (see Figure 1).

- **Understand** ~ Capabilities to support thorough perception and comprehension, grounded in social and behavioral science, of the sociocultural features and dynamics in an operational environment.
- **Detect** ~ Capabilities to discover, distinguish, and locate operationally relevant sociocultural signatures through the collection, processing, and analysis of sociocultural behavior data.
- **Forecast** ~ Capabilities to track and forecast change in entities and phenomena of interest along multiple dimensions through persistent sensing and modeling of the environment.
- **Mitigate** ~ Capabilities to develop, prioritize, execute, and measure COAs grounded in the social and behavioral sciences.

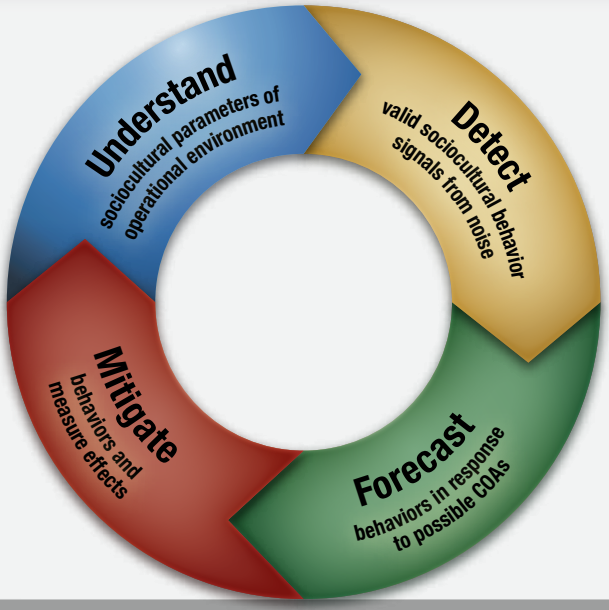


Figure 1. Sociocultural Behavior Capability Areas Framework

Each of the four capability areas has varying needs for all the sociocultural behavior R&E building blocks: validated multidisciplinary theory, proven data collection methods and robust systems for using the data, accessible and theory-based computational models, and sophisticated training and education.

Recommendations

Significant progress has been made toward building a DoD capability for understanding sociocultural behavior, and some solutions have been delivered to military end users. However, there is much work to be done. The complexity of human behavior defies easy understanding or reliable forecasting. In the context of irregular warfare, counter-insurgency, post-conflict recovery, or any other mission setting of the Armed Forces, technology—including computational models—is essential to support decision making. That technology must be rooted in well-validated, inter-disciplinary theory, and applied appropriately, with recognition of its strengths and limitations. Priorities for sociocultural behavior R&E must reflect needs across the full spectrum of operational missions, and must be linked to the U.S. military's strategic priorities and grand challenges:[4] Counter Violent Extremism, Deter and Defeat Aggression, Strengthen International and

Regional Security, and Shape the Future Force. Ultimately, the test of the knowledge products, technologies, and models produced through DoD sociocultural behavior R&E will be how they contribute to development of the future force. The following recommendations are designed to give analysts, warfighters, and leaders more time and opportunity to do what they do best: out-think and out-innovate adversaries by bringing all instruments of power to bear.

1. Increase interdisciplinary basic research that will build foundational understanding of sociocultural behavior in military contexts and enable applied research and development.

2. Build quantitative scientific underpinnings for a DoD sociocultural behavior capability, with the goal of achieving rigor on par with that of the physical sciences. This would include establishing and building consensus on methods for validating and verifying computational models of sociocultural behavior as they apply to military operations.

3. Establish and sustain a DoD-wide repository of sociocultural behavior data, along with the ontologies, standards, and systems necessary to ensure enterprise-wide access for military intelligence and operations analysis.

4. Develop new methodologies, tools, and training that will measurably increase the military's capacity to collect valid sociocultural behavior data in denied environments and those with low levels of literacy and/or information technology penetration.

5. Develop technologies that enable more comprehensive and higher fidelity semi-automated exploitation of open source material, with particular emphasis on social media and integration across multiple modalities (e.g., tweets versus newswire versus blogs).

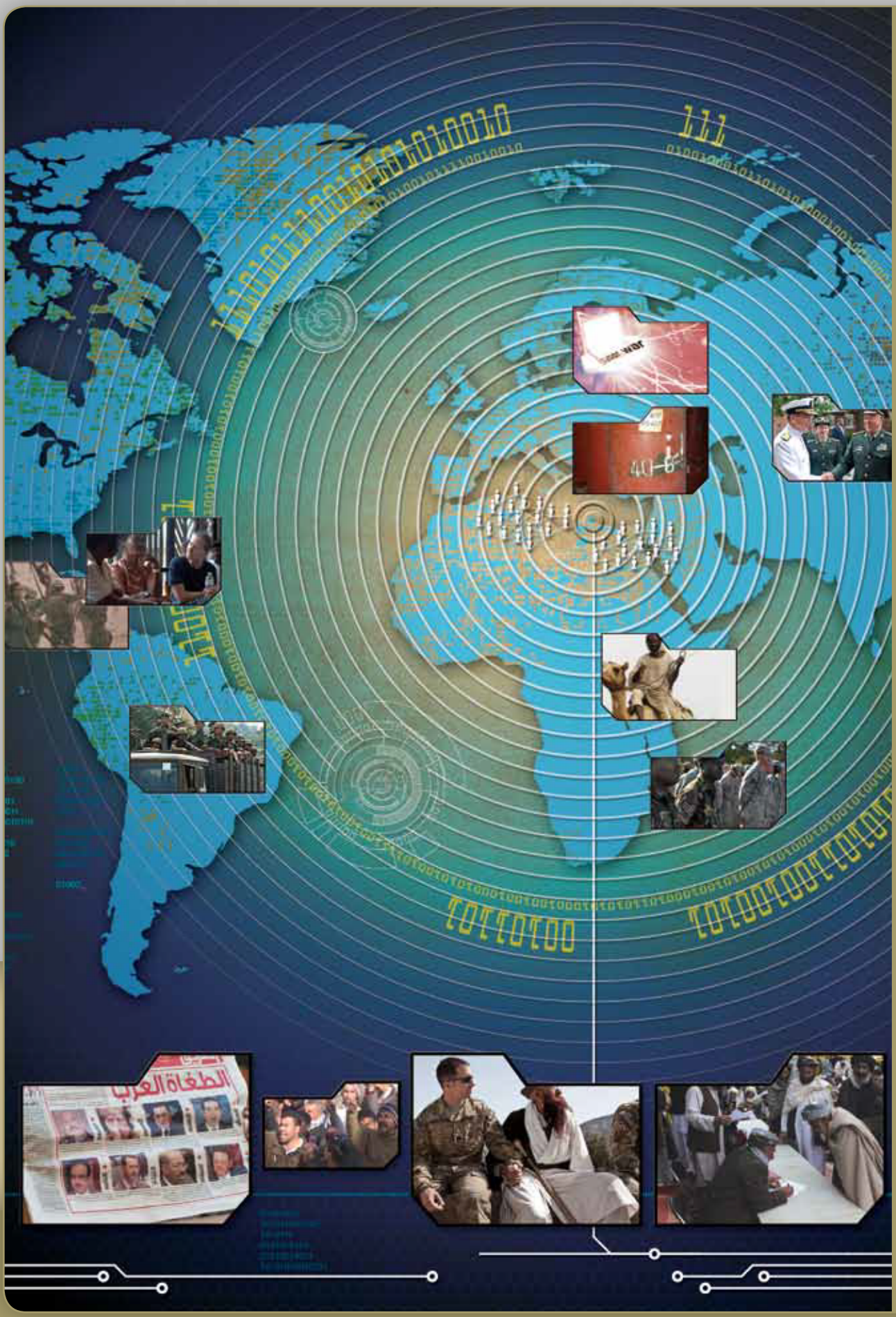
6. Research and engineer a "social radar"—a global and persistent indications and warnings capability consisting of integrated technologies for detecting and monitoring operationally relevant sociocultural behavior signatures. This capability would include data, resources, tools, and training that will enable rapid recognition, tracking, and countering of adversarial narratives. It will also serve as a framework for the integration of other capabilities.

7. Engineer hybrid modeling systems (integrating game-theoretic, system-dynamic, and agent-based modalities) that operational decision makers can use to forecast the emergence of instability and violent extremism and to explore alternative COAs for both types of challenges.

8. Develop and validate metrics for gauging the effects of non-kinetic COAs, along with tools and systems for planning integrated implementation of kinetic and non-kinetic COAs.

9. Design and engineer decision support system interfaces that provide visual analytics of sociocultural behavior integrated with conventional and geospatial data layers, and enable data drill-down.

10. Foster and support venues designed to share information, assess progress in the state of the art and, importantly, enable collaboration to enhance multidisciplinary approaches to problems and challenges.



Introduction

I. Introduction

Historically, U.S. defense-related research and engineering (R&E) has focused on solutions to challenges of the physical world, in keeping with the demands of conventional warfare. Given the nature of many current and projected future conflicts and engagements it is now equally important to detect, understand and develop courses of action (COAs) for social and cultural phenomena. Supplementing physical world sensors with systems that gather sociocultural behavior data will provide our Armed Forces a more complete, fused picture and enable more effective decisions. This paper assesses progress to date in sociocultural behavior R&E, discusses the challenges remaining, and offers thoughts on a way forward.

In January 2011, a leaderless movement evolved in Tunisia, aided by social networking systems including Facebook. It grew without drawing the attention of either the ruling party or its opposition, and became the catalyst for aggressive, but largely peaceful, protests that quickly toppled the regime. The rapid change of government in Tunisia presaged a virtual seismic shift in the political structure of much of the Islamic world. Unrest followed almost immediately in Egypt, where the autocrat who had been in power for thirty years was forced out of office—an action still accomplished with little loss of life. In the weeks that followed, popular pressure on entrenched regimes grew in other parts of the region, but here both the acts of citizens and the responses of the governments involved were often far less than peaceful.

The underlying impetus for these events has yet to be fully understood. However, the instability in North Africa has drivers and dynamics that also characterize major types of challenges important to U.S. interests, such as irregular warfare (IW), violent extremism, weapons of mass destruction (WMD), and cyber threats. In dealing with all of these types of challenges, the U.S. military would benefit from greater capacity to recognize the growth of networks that foster hostile or other acts. Similarly, the Department of Defense (DoD) could improve its ability to reliably discern and monitor the strategies, tactics, and actions of hostile organizations, and the impact they have on general populations. While DoD has some capacity to forecast behaviors of interest, insight is needed much earlier. Leading indicators undeniably exist, and DoD should have the capacity to detect them. Altogether, the U.S. military needs a deep, enduring capability to understand socioculturally-driven behavior of foreign groups and populations.

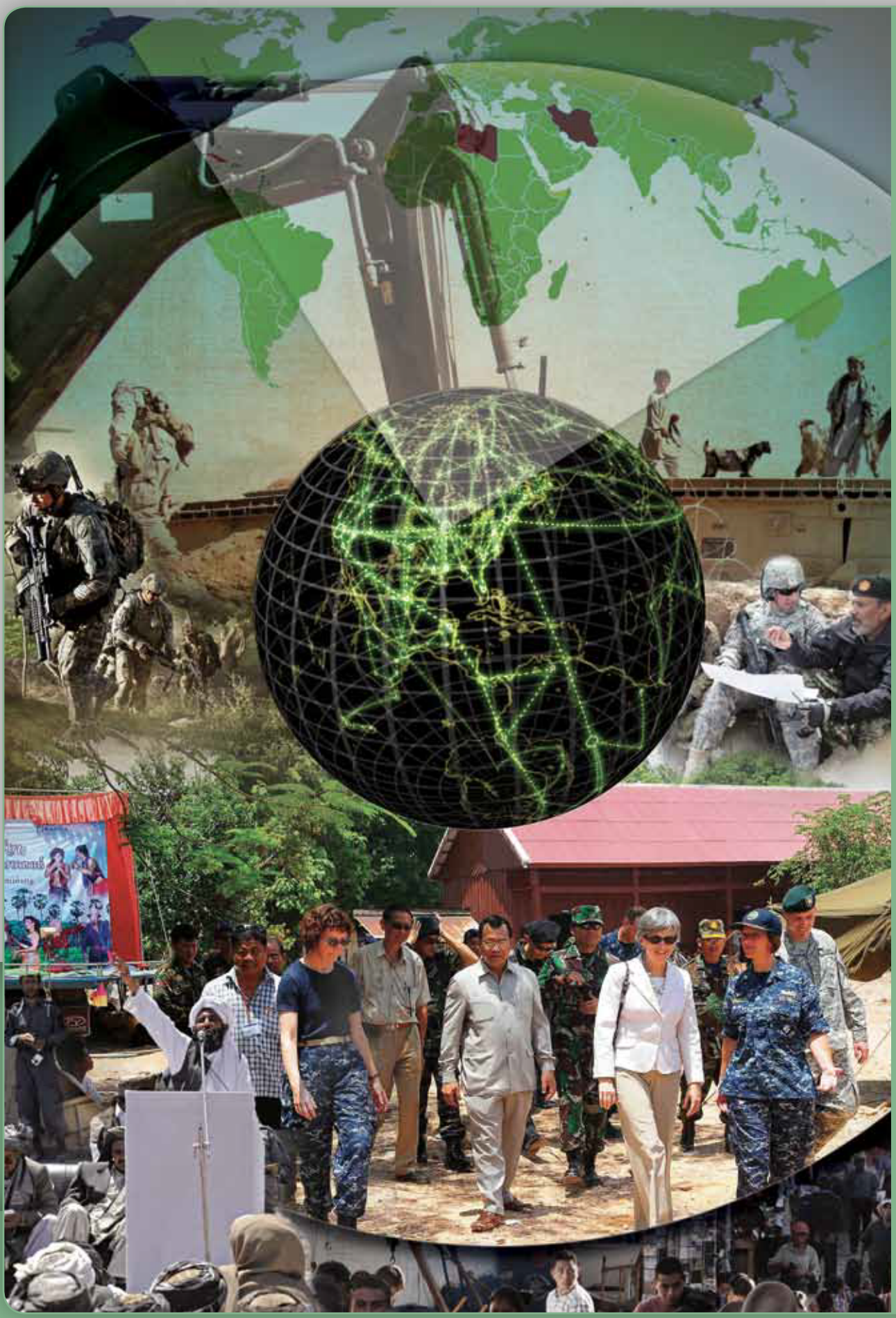
The impact and largely unanticipated nature of the uprisings in North Africa lend particular urgency to efforts that have been underway in DoD for roughly five years. DoD has recognized the need for improved capability regarding sociocultural behavior and outlined ways to achieve it in various strategic, doctrinal, and technical documents.[5]

Reports such as *Understanding Human Dynamics*, by the Defense Science Board (DSB) and *Behavioral Modeling and Simulation* from the National Research Council highlight and describe evolving needs in the human, social, cultural, and behavioral domains, laying out specific scientific challenges to meet emerging needs.[6] In 2006 the Director of Defense Research and Engineering (DDR&E) delivered a seminal study in response to tasking in *DoD Strategic Planning Guidance, Fiscal Years 2008–2013*.[7] The study identified major capability gaps in the modeling of sociocultural behavior and recommended increased investment in (a) science and technology and (b) product maturation and transition.[8]

Section II of this document—The Need for a DoD Sociocultural Behavior Capability—discusses critical features of the national security environment, and describes how national strategy and doctrine indicate the need for a DoD sociocultural behavior capability. Section III describes the rapidly growing DoD R&E community, highlighting major efforts such as the Office of the Secretary of Defense (OSD) Human Social Culture Behavior (HSCB) Modeling Program. This section includes statements from each of the armed services, summarizing their stake and activities in the area of sociocultural behavior R&E. The section concludes by presenting evidence that DoD is at an inflection point, poised to fully realize and demonstrate the value of sociocultural behavior R&E.

Since the DoD investment in R&E is both large and catholic in nature, DoD also faces the challenges of coordination and collaboration to achieve maximum return on investment. Section IV provides a set of principles and practices to ensure that DoD investments are cost effective and have high operational impact. Section V offers a framework for viewing the full scope of DoD R&E in the area of sociocultural behavior. This Sociocultural Behavior Capability Areas Framework can help show where discrete investments fit in an integrated set of operational needs. It also helps to indicate the highest priority needs going forward, and to highlight the most important technical challenges. Many of those needs are being addressed by the HSCB Program and other DoD efforts. In those cases, the challenge is to sustain and build on those efforts; in other cases, the challenge is to find ways to fill the gaps. Finally, Section VI offers a set of recommendations, concentrated on the highest priority R&E thrusts.

The Need for a DoD Sociocultural Behavior Capability



II. The Need for a DoD Sociocultural Behavior Capability

Section II describes critical features of the U.S. national security environment as presented in national strategy documents. The discussion gives particular attention to the challenges associated with IW, countering violent extremism, and mitigating instability, but also notes the persistent conventional challenges posed by nation-state threats. Certain guiding principles for national security follow from the strategic environment, including the need for whole-of-government approaches. U.S. success requires that DoD achieve a mature capability regarding sociocultural behavior, i.e., mastery of factors that will enable its forces to forecast behaviors driven by social and cultural variables, and select appropriate, effective COAs in the full range of military operations.

The strategic security environment is marked by rapidly increasing global interdependence, complexity, and focus on indigenous populations.

The environment in which U.S. forces operate has changed significantly in the past decade. U.S. interests are increasingly interdependent with those of both state and non-state actors, and the global environment has become ever more complex and dynamic. Effects follow quickly from causes, and can rapidly spread, adapting and modifying as they progress. For example, regional dynamics are increasingly troubled by population growth and urbanization. Pressure on natural resources and food supplies, along with global climate change, will cause severe disruption and conflict, often in areas of the world that are already experiencing the most rapid population growth and are plagued by significant economic inequities and political instability.[9] It is reasonable to expect that all of these dynamics will be "exacerbated and amplified by instantaneous information systems and the global economy's interconnectedness."[10]

"The United States finds itself in the midst of a rapidly changing strategic environment. The erosion of traditional boundaries between foreign and domestic, civilian and combatant, state and non-state actors, and war and peace is but one indication of this change. Today, geographic borders have diminished in importance as non-state actors have increased their role in globally diffuse terrorist networks and transnational activity."

U.S. Secretary of Defense Robert Gates in 2011 Memorandum on Strategic Communication and Information Operations (OSD 12401-101)

The National Military Strategy 2011 stresses that there has been an "evolution to a 'multi-nodal' world characterized more by shifting, interest-driven coalitions based on diplomatic, military, and economic power, than by rigid security competition between opposing blocs."[11] These "nodes" include not only traditional national powers, but also corporate interests, ethnic groups, terrorists, and criminal organizations, and a variety of other groups at the transnational, national, regional, and local levels.

Individuals in this globalized world do not replace their local identities with international identities, but retain their existing loyalties while also seeing themselves in the context of a global society. Both today and in the future, the sociocultural environment will contain nested identities, interrelated ideas, and quick transitions from one dominant perspective to another.

Given these features of the contemporary and future strategic environment, U.S. forces must be prepared to meet several grand challenges, guided by some key principles for long-term success in national security.

In the face of this complexity, the Intelligence Community projects four possible futures, based on two continua: the degree of state domination and the degree of global fragmentation.[12] These alternative futures present U.S. national security leaders and the Armed Forces with varying strategic and operational challenges. As noted in the 2010 Quadrennial Defense Review (QDR), DoD must be prepared to deter aggression on a global scale, prevail in existing armed conflicts, and succeed across a broad spectrum of operational contingencies that include counter insurgency (COIN), responding to disasters, supporting post-conflict recovery, countering proliferation of weapons of mass destruction, deterring or defending against cyberthreats, and stabilizing fragile states.[13] With contemporary and possible future conditions in mind, DoD has identified four grand challenges that the military must be prepared for and supported to address:[14]

- **Counter Violent Extremism**
  Violent extremism is rooted in culture and religion. Its proponents are a very small minority of any population, but they are ideologically driven, widely distributed, embedded within the general population, and adaptive. Key to undermining the efficacy of violent extremist groups is draining their support and weakening their sources of legitimacy. These groups may not respond to direct deterrence measures, but can be understood and perhaps affected through the networks upon which they depend.

- **Deter and Defeat Aggression**
  "Preventing wars is as important as winning them, and far less costly."[15] Aggression, whether state sponsored or initiated by non-state actors, represents a persistent threat. Non-state actors are more difficult to understand and identify than state adversaries, and the United States has fewer unambiguous means to counter their behaviors. But anticipating and preventing aggression is critical to ensuring a prosperous and interconnected world.

- **Strengthen International and Regional Security**
  A stable network of resilient partner nations provides one of the best hedges against conflict. Therefore, building the capacity of partner nations is imperative—a concept stressed in the 2010 QDR. Reliable access to resources and cyberspace is a necessary—though not always sufficient—precondition for stable markets. Thus, strengthening international and regional security requires not merely whole-of-government approaches, but truly comprehensive (government and non-government, international, defense, development, and diplomatic) approaches. Building the security capacity of partner nations will help ensure that they can manage their security needs and respond to threats within their own territory.

- **Shape the Future Force**
  To shape the future force, DoD must nurture leaders who can truly out-think and out-innovate adversaries while gaining trust, understanding, and cooperation from partners in an ever-more complex and dynamic environment. The enduring challenges and the whole-of-government approaches they require call for leaders who are open to new ideas, adapt rapidly to new situations, and can build unique teams of teams to accomplish missions.

A number of national strategic documents and analyses derive principles for meeting these grand challenges.

1. Prepare for the distinctive, still-emerging challenges of IW, while maintaining the capacity to engage in conventional conflict. In recent years, much attention has been given to IW. However, part of what makes the contemporary global environment complex is that at any time it encompasses the full array of operational challenges—including conventional war.[16] The United States must not only be prepared to engage in operations with non-state adversaries; it must also be positioned to combat the strategic influence of nation-state activities.

2. Apply the full range of U.S. power. If conflict becomes inevitable, the armed services must apply force only in a disciplined and carefully targeted manner. Rather than rely on strictly military solutions, U.S. foreign policy requires

the ability to solve problems through what the National Military Strategy describes as "an adaptive blend of diplomacy, development, and defense,"[17] and what Secretary Clinton and others refer to as "smart power."

"We must use what has been called 'smart power,' the full range of tools at our disposal—diplomatic, economic, military, political, legal, and cultural—picking the right tool, or combination of tools, for each situation."

Secretary of State Hillary Rodham Clinton, in Senate Confirmation Hearings, January 13, 2009

3. Place a higher priority than at present on non-kinetic means, especially strategic communication and information operations (IO). As stressed in the QDR, National Military Strategy, and elsewhere, preventing conflict is important for saving lives, conserving resources, and ensuring a level of stability conducive to productive economies. One of the keys to preventing conflict is effective non-kinetic engagement with foreign populations at all levels—tactical, operational, and strategic.[18] Consequently, political and military leaders stress the importance of persistent, culturally sophisticated communication. In a January 2011 memorandum, Secretary Gates stated explicitly that "…the President has heightened U.S. Government strategic emphasis on countering violent extremism through effective strategic communication and IO."[19]

4. Be proactive. No nation can compete with the United States on conventional terms. However, at least recently, the United States has not been equally successful in competing with other nations—and non-state actors—for hearts and minds. Part of the reason is insufficient understanding of other languages, cultures, and societies, which makes it difficult to develop the sensitivity needed to anticipate emerging trends and act before they can produce adverse outcomes. Too often, the United States puts itself in the position of moving comparatively slowly and simply responding to a competitor that has already adapted its tactics.

5. Seek enduring effects. The United States today confronts growing pressure to constrain spending in all areas, including national defense. DoD can improve its ability to manage competing demands if its COAs have long-lasting effects, which in turn will depend in part on understanding how those COAs affect all features of life on the ground—political, military, economic, and social. Taking integrated action with the long view in mind will increase the chances of solving a given problem permanently, rather than repeatedly fighting symptoms of that problem. This should help to ensure a more robust and efficient approach to military operations and planning.

6. Be prepared to take part in a comprehensive approach to complex operations. "The scope and complexity of stability operations, reconstruction, and

humanitarian efforts will require the U.S. military to operate in partnership with other organizations, both governmental and non-government."[20] Increasingly, U.S. forces will need to work with the people of other nations in coherent, coordinated, and constructive ways. The United States has a good, lengthy history of international operations, but the range of organizations involved is now much wider than ever before, as is the range of operational scenarios and demands. The North Atlantic Treaty Organization (NATO) and others are conducting research and analysis to understand what tools would support effective implementation of the comprehensive approach to operations.

Figure 2 summarizes key features of the strategic environment in which the U.S. military operates.

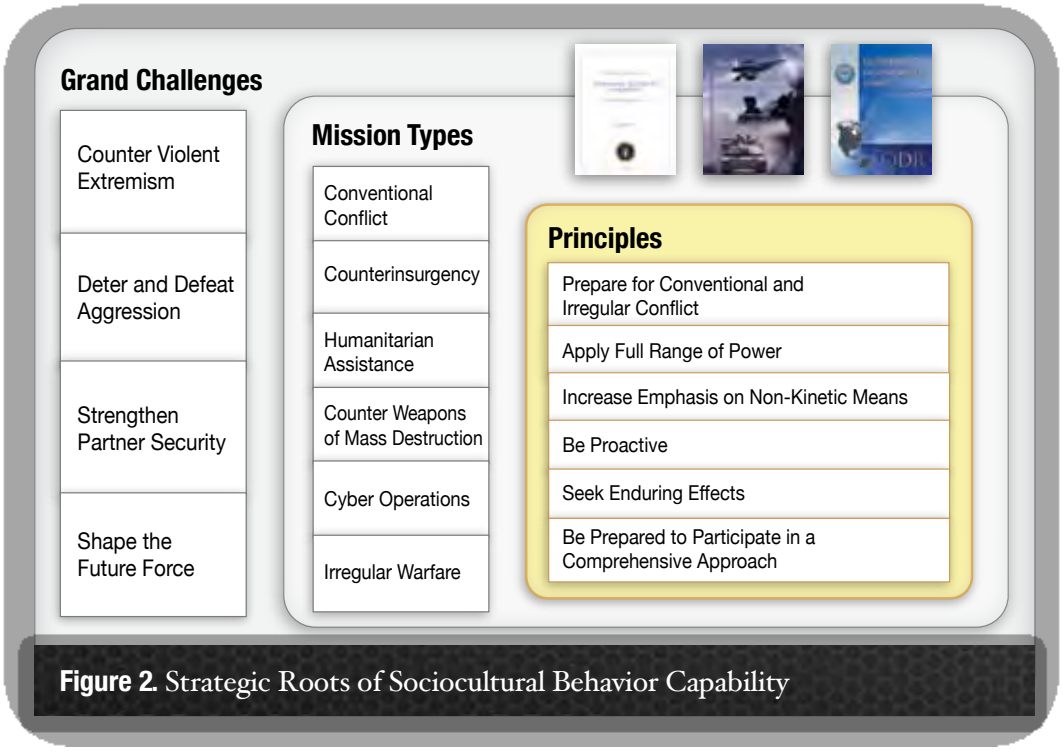


Figure 2. Strategic Roots of Sociocultural Behavior Capability

To meet its grand challenges, the U.S. military needs to effectively engage foreign populations, which requires capabilities for understanding the social and cultural drivers of behavior.

Common to the grand challenges, alternative possible futures, and principles for national security is DoD's need for a mature capability to understand behaviors driven

by social structure, language, and culture: concepts encompassed in the term "sociocultural behavior." The human dynamic has become a prominent feature across the full spectrum of operations—conventional conflict, COIN, humanitarian assistance and disaster relief (HADR), support to stability transition and reconstruction (SSTR), IW, countering WMD, and countering cyber threats. To counter violent extremism and deter aggressors, U.S. forces must understand the drivers of extremism and violence, have the capacity to forecast undesirable behaviors, and possess the tools needed to conceive and simulate COAs that will have lasting impacts. Meeting adversarial behaviors with an appropriate blend of "hard" and "soft" power requires familiarity with foreign populations and agile access to tools for engagement. To build the security capacity of partner nations, U.S. forces must be well prepared and supported to engage with other cultures. Having the appropriate linguistic and social knowledge will make the difference in building governance and security capacity that will ensure rapid, effective response to natural disasters or pandemics and to transnational threats such as trafficking, piracy, proliferation of WMD, terrorism, and cyber-aggression. Finally, DoD can only build the desired future force of leaders if those leaders possess the training and tools to understand and visualize complex interdependencies of behavior, along with some capacity to forecast mid- and long-term effects that alternative actions will have on the operational environment.

Advanced capabilities for understanding sociocultural behavior will have different aspects across the different functional areas of analysis, planning, operations, and training.

- **Intelligence and Analysis**
  Distinct data collection and analysis capacities must underlie the capability to understand sociocultural behavior. The intelligence necessary to build situation awareness will require data on factors that often will not be directly observable and will be difficult to validate, such as perceptions, attitudes, and opinions. Effective collection will be guided by social and behavioral science theory that provides context and parameters for analysis. Furthermore, the tools that analysts use to understand current activities and trends across time must be based on theoretical frameworks that have been validated in ways consistent with sociocultural analysis.

- **Operational Planning**
  Sociocultural behavior capability affects operational planning at all levels—strategic, operational (theater), and tactical. At the strategic level, the National Command Authority and Combatant Commands (COCOMs) monitor the health and welfare of areas of responsibility, discern and simulate the effects of nation-state strategies, and both implement U.S. policies and strategies and track their impacts on perceptions, attitudes, and behaviors of leaders and general populations. At the theater level planners must grapple with such factors as long-term economic and political stability, foreign influence on any nation or group of nations, and whether or not a change in

a pattern of international conflict indicates growing instability. Theater commanders also need to recognize if diplomatic contacts, military-to-military cooperation, material aid, or other means are most appropriate in a given situation. At the tactical level, language skills and understanding of sociocultural behavior will support the kind of situation awareness required for rapid, agile planning and re-planning.

- **Engagement with the Population**

  Nowhere is the need for accurate sociocultural information greater than in the area of direct engagement with the populace. The primary focus must be on individuals and their immediate societal groups, including their attitudes and behavior. The ability to forecast the likely effects of an action demands an understanding of how people in that culture communicate, their most trusted sources of information, who holds power and influence, how traditional and current power structures interact, and the society's cherished values. It is imperative to understand the language of a country of interest, not simply because this greatly facilitates interaction with foreign populations, but because it is a key to understanding the cultural lens through which individuals view the world around them.

As important as the physical terrain, in future full spectrum operations, commanders require the capability to understand and address the "human terrain," of social, cultural, historical, political, economic, and population and urban geography of the area of operations (AO).

U.S. Army Study of the Human Dimension in the Future: 2015–2024, p. 72

- **Training and Mission Rehearsal**

  A final area that stands to benefit from increased sociocultural understanding is training and mission rehearsal. Proficiency of the total force in sociocultural skills has become increasingly important. A tactical error in behavior by even a single soldier can create problems at the strategic level. Ill-defined or improperly applied rules of engagement (ROE) can also ruin otherwise sound operational plans and prevent the United States from meeting strategic goals. To decide on and apply appropriate ROE in an unfamiliar culture, planners need awareness of acceptable and expected behaviors as well as the taboos of the society. Furthermore, aside from understanding the enemy and "host nation," military planners must also understand how coalition partners and non-government organizations think, plan, and act.

Service and joint doctrine and requirements are beginning to specify the need for a DoD capability in sociocultural behavior.

DoD has placed an increasingly explicit emphasis on the need for all the Services to develop capabilities for understanding, analyzing, and forecasting sociocultural behavior. Much of that emphasis focuses on deriving more complete situation awareness by better balancing

attention to adversary characteristics with attention to the general population in an area of conflict. MG Michael Flynn is a forceful voice for such a balance. He has argued that the intelligence and operational communities engaged in the war in Afghanistan tend to "overemphasize detailed information about the enemy at the expense of the political, economic, and cultural environment that supports it."[21] A recent DSB report concluded that the U.S. government "is not investing adequately in the development of social and behavioral science information that is critically important for COIN."[22]

Service and joint doctrine provides widespread, though uneven, support for building a sociocultural behavior capability. U.S. Army Field Manual 3-0 ("Operations") discusses the need for "a broad understanding of the strategic and operational environment."[23] Success in full spectrum operations, with their simultaneous combinations of offensive, defensive, stability, and civil support operations, requires improved understanding of the social and cultural realm. Joint Publication 3-0 ("Joint Operations") and Joint Publication 2-0 ("Joint Intelligence") point to the need for greater understanding of the culture, perceptions, beliefs, and values of individuals—both allies and enemies—with whom warfighters engage in modern operations. In addition, the Irregular Warfare Joint Operating Concept contains guidelines that assist participants in joint operations to engage in IW as a cohesive whole. The authors state that when conducting IW "the joint force must understand the population and operating environment, including the complex historical, political, sociocultural, religious, economic and other causes of violent conflict," and must enhance their Foreign Area Officer numbers and training.[24]

Anticipating an increased need to conduct operations within urban littorals and other challenging environments, Marine Corps strategy calls for Marines to be "specifically trained and broadly educated to understand cultures and populations."[25] The Navy's Irregular Warfare Office lists one of the enduring areas of focus as "enhancing regional awareness, which enables better planning, decision making, and operational agility."[26] The Chief Naval Officer Guidance 2011 recognizes advances made in Language, Regional Expertise, and Cultural Experience (LREC) initiatives in support of operations in the Afghanistan-Pakistan area, as well as in Partnership Station missions in Africa and South America. Pursuant to establishing and improving international relationships, the document identifies the way ahead specifically as expanding "LREC skills enhancement opportunities for all operational forces, with special emphasis on General Purpose Forces' cross-cultural competency training and on pre-deployment operational LREC training for forces afloat and expeditionary units."[27]

Human and cultural behavior modeling is a component of six of the Potential Capability Areas (PCAs) outlined in the Air Force report *Technology Horizons: Visions for Air Force Science & Technology During 2010–2030*. These six PCAs are also directly associated with all twelve Air Force Service Core Functions (SCFs). In addition to discussing behavior

modeling, the Air Force report provides a vision for human sociocultural research and development that includes analysis of COA development and improvements in training that will allow for "entirely new methods for discovering cultural insights as well as innovative blue- and red-force concepts of employment long before they are evident by ordinary experience or in the far smaller statistical samples available by formal methods."[28] At the January 2011 Language and Culture Summit, as he announced a 28% increase in the ranks of Air Force Regional Affairs Strategists, Air Force Chief of Staff General Norton Schwartz noted, "Central to building partnerships and capacities is our ability to appreciate unfamiliar cultures, and communicate and relate with an ever-growing number of international partners."

Initiatives specified in the 2010 QDR and other strategic documents clearly indicate the need for greater capabilities in understanding sociocultural behavior to improve COAs development and decision making. However, DoD must still codify requirements, a process informed by studies of national capabilities in each of the QDR Key Mission Areas (KMAs). One of those studies, on Building the Security Capacity of Partner States (BSC), indicates clearly the integral part that R&E on sociocultural behavior plays in advancing the nation's long-term national security interests. For each of six core capability areas, the study identified up to ten enabling technologies, and then distilled the results to a top ten technologies for the entire KMA. Human sociocultural analytics for decision making was identified as one of six core capability areas. One of its seven enabling technologies—hybrid and federated modeling—was designated as one of the top ten technologies that should be the highest priorities for extended DoD investment.

DoD would benefit from having a broadly accepted vision for a Department-wide sociocultural behavior capability.

DoD would benefit from describing a capability vision that can be widely shared, and explicating what it entails. This paper proposes the following formulation of that vision:

> **Mastery of the factors that optimize our forces' ability to forecast behaviors driven by social and cultural variables and take effective courses of action in the full range of military operations.**

According to this admittedly ambitious vision, the national security community would have the ability to gather and process increasingly massive volumes of unstructured data, rapidly extract meaning and patterns, and make the processed data available on an appropriately wide scale to support agile decision making. U.S. strategists and Military

Information Support to Operations (MISO) personnel would be able to draw on theory and on databases of cultural narrative to anticipate what kind of messaging will spread quickly, and in what patterns, across dynamic social networks. U.S. forces would have the capability to adapt reliably and with agility to novel sociocultural environments, including some ability to understand and communicate in the native language, as well as cultural awareness and real-time access to essential sociocultural data. COA planners would have systems of integrated computational models to support simulations depicting first-, second- and third-order effects of kinetic and non-kinetic COAs with some reliability, and across a range of outcomes of interest.

In sum, "mastery" will mean that U.S. forces have the data they need on indigenous populations and the training to move easily in those populations; can discern the defining characteristics of culture and society and integrate those with conventional mapping of the physical terrain; can detect and take effective action regarding complex and dynamic networks, where adversaries and civilian populations are intermingled; and

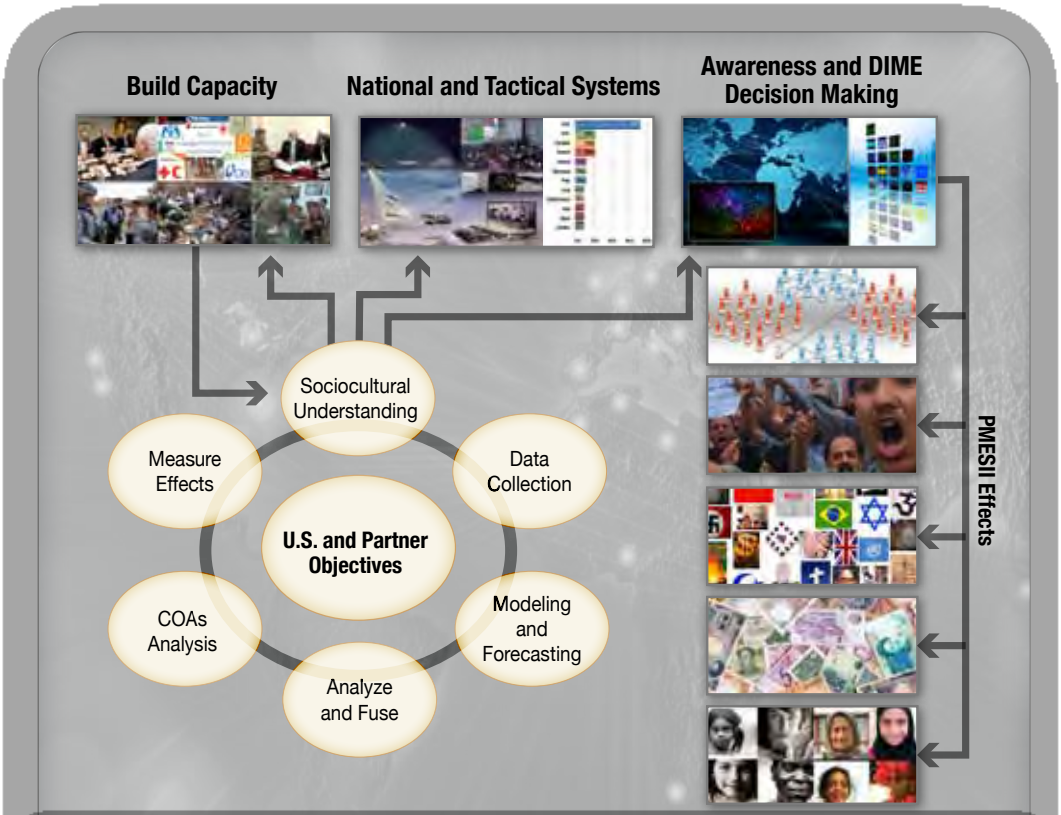


Figure 3. Sociocultural Behavior Operational View

have non-kinetic tools at their disposal, along with the ability to anticipate both near-term and long-term impacts of applying those tools. The Operational View presented in Figure 3—which was included in the report by the QDR's BSC study group—depicts the place of a sociocultural behavior capability in a broad operational context. Data collection, modeling, analysis, and measurable kinetic and non-kinetic COAs enable sociocultural understanding of the human terrain. That cycle in turn supports U.S. efforts to build partner capacity, provide data to support national systems, and affect warning, engagement, and decision making.

Success in realizing the vision for a DoD-wide sociocultural behavior capability depends on sustaining a coherent, innovative program of R&E strongly grounded in applied social and behavioral science and oriented to military operations.

Achieving the vision previously described requires meeting certain core needs, including needs for theory, data, knowledge products, models, and training. Only a broad, deep, and sustained program of R&E can meet such needs. That R&E must span multiple levels, to include basic research, applied research, advanced technology development, and demonstration and validation.

Conclusion

With leadership from the Assistant Secretary of Defense Research and Engineering (ASD(R&E)) and the armed services, DoD has quickly established a strong R&E foundation. Section III describes the elements of sociocultural behavior R&E, summarizes the major programs and initiatives across DoD, and highlights the considerable progress made on exceptionally difficult technical challenges.

Progressand Promise of Sociocultural Behavior Research and Engineering

III. Progress and Promise of Sociocultural Behavior Research and Engineering

This section first describes the main forms of sociocultural behavior R&E and notes some of the major technical challenges associated with each. A summary of the recent history of relevant R&E, noting the important progress made recently across the DoD, then showcases some of the work that has been conducted.

The building blocks of a mature sociocultural behavior capability are validated multidisciplinary theory, valid data collection methods and robust systems for using the data, accessible and theory-based computational models, and sophisticated training and education.

In the present context, *Validated Theory* refers to the research, development, and testing that must precede the application of theory-based approaches from the social and behavioral sciences to the wide range of military needs and contexts. Theory is the foundation of any rigorous application of social and behavioral science. For something as complex as human behavior, and for application in the military situation awareness and decision-making spaces, new and proven theoretical approaches must be considered and—ideally—synthesized. Truly interdisciplinary R&E on sociocultural behavior is imperative—perhaps most importantly at the basic research level. Too often, basic research is executed discipline by discipline, because this conforms to established funding processes and to academic incentives. The armed services, in particular, must lead the way to more effective R&E by making multidisciplinary applicability a standard, high-priority criterion when soliciting and selecting research.

Data Collection and Systems refers to research into determining what data is needed to support analytics and modeling, methods for improving the rigorous collection of valid data and the accuracy and efficiency of translating that data into computational models, and development of systems for supporting the appropriately integrated use of that data and modeling results across DoD communities. This data is difficult to manage because of its heterogeneity, multidimensionality, and multi-scale nature. The types of data needed

differ enormously, spanning demographic, economic, political, and social variables regarding knowledge, beliefs, intentions, and more. Furthermore, computational models rely on structured data, in which variables are properly identified and converted to a format usable by a particular piece of software. As most of the data used by these models was not collected specifically for the model in question, this data must be formatted properly before it can be input into a model. Sociocultural behavior data comes from a wide variety of sources, and may have been collected at varying levels of validity and granularity through various intelligence means (signals intelligence, human intelligence, etc.), through surveys conducted by either military or civilian organizations, or through open source collection and data mining. Although it is possible to limit the sources of data to increase uniformity among the data, experience has repeatedly shown that expanding the amount of data vastly improves a model's analytic capability.

Computational Models refers to research into the application of computation to discover and understand historical patterns that have led to success and failure, and the use of these patterns to forecast plausible futures. The complexity of the situations faced by the military and the responses needed has outpaced not only decision-theoretic approaches, but also the ability of even the greatest experts to master the many dimensions involved. The variety of interconnected events and entities and the density and speed of their interactions are all increasing. Without extensive computational support, relating a cause to an effect is difficult at best; predicting cascading effects is almost impossible.[29]

Models have proven their value as tools that can help decision makers process huge volumes of data, develop viable options for action, and make robust decisions that will lead to success across a broad range of possible futures. Properly designed, supported, and applied, models can help decision makers to gain heightened awareness of the sociocultural features of a landscape, estimate a set of possible futures, more completely and accurately compare and contrast the outcomes of various COAs, and discern the contributions of different sociocultural factors to a range of possible outcomes.

The output of computer models must be aligned to the operational needs of the user. Ideally, a model will produce an accessible and understandable output that can be seamlessly integrated into the planning process. Properly formatted model output can display the interactions among disparate actors and their influences. Graphical representations of complex data can provide planners and decision makers with a tool to quickly and easily determine the possible effects of planned actions, even second- and third-order effects. Furthermore, given the interconnected environment in which U.S. forces operate, tying simulation output to geospatial data can provide analysts with insight into the effects of actions not only in their own operational environment, but also in areas geographically or politically linked to that environment. This permits stronger integration between and across units.

Research on *Training and Education* develops and tests ways to improve the acquisition of both general cultural competencies and culture/region-specific characteristics. Part of the challenge here is specifying the knowledge, skills, and abilities that are to be trained, and doing so in ways appropriately tailored to the tasking of armed services personnel. Language skills are essential, and a core element of effective pre-deployment training. Ideally, methods will be adaptable enough to support rapid training for new cultural contexts, yet also innovative and interactive enough to provide a realistic, high-impact learning experience. Just as models can help decision makers to understand the sociocultural landscape and forecast effects of decisions, they can also assist trainers in designing and implementing scenarios that reflect the conditions on the ground and the most likely effects of trainee actions as accurately as possible.

Overall, the DoD challenge is to extend the applied science base for understanding human sociocultural behavior, develop computational models of operating environments from the tactical to strategic levels, integrate models into tools, and transition those tools to warfighters and programs of record (PORs). DoD can only achieve these objectives if it has data available to incorporate in developed models; valid social science theories that support operations; clear, quantifiable, and repeatable metrics to baseline and gauge progress; and rigorous systems engineering practices in a field where some still argue that data can only be qualitative. Table 1 describes the mature state of each form of R&E and how it would contribute to an overall DoD sociocultural behavior capability.

Table 1. Forms of Sociocultural Behavior Research and Engineering

Theory	Validated interdisciplinary theory of sociocultural behavior as applied to military needs across operational contexts, and tactical level access to resources that support rapid situation awareness and ongoing adaptability.
Data	Scientifically verified and valid methods for rapid generation and collection of data to support analysis and modeling of sociocultural behavior, and systems for cross-DoD access to support technology development and testing.
Modeling	Theory-driven and empirically validated methods, tools, and computational models of behavior that enable development of alternative courses of action, and forecasting of their primary and higher-order effects.
Training	Rapidly adaptable culture-general and culture-specific training systems, tailorable to the learner so that training time is minimized and retention increased.

Table 2. Signs of Progress in DoD Sociocultural Behavior Research and Engineering

Category	2006	2008–2009	2010–Present
Core Sociocultural Capability	Technical sociocultural behavior capability drawn from academia, labs, industry.	OSD and services have formalized R&E sociocultural-related investments. Some geographic COCOMs have investments to meet mission requirements.	Geographic Combatant Commands, SOCOM, RDECOM, and services and intelligence agencies have dedicated personnel for sociocultural research and analysis. Interagency agreements with USAID and U.S. Department of State foster whole of government exchange. International exchange with NATO and TTCP partners.
Data and Tools Transfer	No investment in resources to port or extend relevant data, knowledge and tools.	Increased DoD investments in data collection, storage, and transfer. Increased investment by HSCB Program focused on transitioning research capabilities to PORs and others.	HSCB has completed transition agreements with AFRICOM, EUCOM, SOCOM, ISPAN, Army-TRAC. Network analysis capability transitioned to ISAF. Other tools and resources being transferred to meet near-term operational demands.
Data and Collection Methods	No data and collection methods to support understanding, models, or tool development.	Data collection tools and methods emerging along with models and tools. Human Terrain Teams and Civil Affairs Teams collecting data to meet commander requirements.	Focus on mobile data collection, crowd-sourced data collection, remote data collection. Research and technology investments extending to capitalize on social media resources. TRADOC standing up Cultural Knowledge Consortium.
Models Scope and Scale	Models not broad enough to cover full range of military operations, nor detailed enough to forecast behaviors at scale.	Introduction of sociocultural hybrid modeling and integration of model outputs into decision-making process.	Increased DoD investment focus on hybrid models, from both HSCB and OSD-CAPE. ICEWS, NOEM, and PRISM projects all demonstrate model integration to support behavior forecasting.
Model Integration Across Levels	Limited capacity to support integrated modeling of strategic/ operational/tactical planning and operations.	Development and testing of architectures and infrastructure necessary to support integration of computational models.	The Social Network Analysis Reachback Capability (SNARC) integrates HSCB technologies to meet warfighter and analyst requirements. Mobile technology used as an integrating platform for decision support in the ISAAC tool.
Gap at Individual Soldier Level	No general-use S&T to achieve the "language agile cultural chameleon" warfighter.	Progress being made but general-use solutions for individual warfighters remain long term goals.	DoD focus on language and cultural training and retention. Formal strategy developed to actively encourage and reward warfighter sociocultural knowledge. S&T solutions for individual warfighters remain long term goals.
Governance of Sociocultural Behavior R&E	Sociocultural behavior R&E highly distributed with limited coordination and few DoD-wide solutions.	Collaboration and coordination through formal and informal mechanisms. IW M&S SCG selected as a Users Group for the HSCB Program. OSD sponsoring national meetings on state of the practice and art in sociocultural behavior R&E.	DoD directives and initiatives establish governance authorities for R&D, analysis, and training. USD(I), DISCCC, IW M&S SCG, and Human Systems Community of Interest each convene regularly. More than 600 participated in Focus 2010 and 2011, from industry, academia, NGOs, and government.

DoD has made noteworthy progress in defense-related sociocultural R&E. The Department must maintain momentum while increasing coherence, coordination, collaboration, and alignment with operational priorities.

In its 2006 report following the 2008–2013 Strategic Planning Guidance (SPG), the DDR&E identified several critical gaps: lack of a military technical sociocultural behavior core capability, limited "reuse" of data and software, lack of life-cycle management plans for products, absence of data and collection methods to support understanding, limitation of models in scope and scale, limited domain and inter-domain knowledge and experience, and a current shortfall in general use of science or technology to aid soldiers in gaining language skills and cultural awareness.

In the intervening five years, DoD has made significant progress in computational social science modeling and other types of sociocultural behavior R&E. This progress is summarized in Table 2. A broad research community now exists. The commercial market continues to make investments applicable to DoD needs, while Federally Funded Research and Development Centers (FFRDCs) and academia have substantially increased their engagement. Large integrators are now becoming involved in internal research and development and direct-funded projects. The U.S. Army Training and Doctrine Command (TRADOC) Analysis Center (TRAC), the Naval Postgraduate School (NPS), the OSD's Cost Assessment and Program Evaluation (CAPE), and others have emphasized applied computational social science and IW analytics. Several COCOMs have invested in major analytic cells, and there are dozens of Human Terrain Teams deployed in Iraq and Afghanistan. Figure 4 shows a summary representation of active organizations and major programs; Appendix A provides more detailed descriptions of each.

ASD(R&E) provides leadership in the sociocultural behavior R&E space across DoD, coordinating closely with the Under Secretary of Defense for Intelligence (USD(I)) and the Under Secretary of Defense for Policy (USD(P)). Most of the ASD(R&E) initiatives, including the HSCB Modeling Program and a number of Small Business Innovation Research (SBIR) projects, are managed through the Human Performance, Training and BioSystems Directorate.

Since its inception in 2008, the HSCB Modeling Program has provided technical leadership by funding innovative and rigorous applied research, advanced technology development, and prototypes. That research has had an impact on operations and

Figure 4. Sociocultural Behavior Research and Engineering Community

PORs. HSCB Modeling Program investments have supported International Security Assistance Force (ISAF) operations with reachback social network analysis, deployed personnel with enhanced visualization capabilities, and the COCOMs with toolsets for visualization, instability analysis, information support operations, and strategic communication. Within the program, multiple projects leverage existing investments to support training and mission rehearsal objectives, including commercial investments in Internet-based technologies and DoD investments in training technologies. Program achievements have also aided the development of data and infrastructure necessary to deploy computational models.

Since 2009, the HSCB Modeling Program has made a particular contribution by organizing and hosting a seminal series of annual conferences to forge collaborative ties and broad awareness of DoD's sociocultural behavior programs. Through the *Focus* series, the Program has provided thought leadership and helped to bring greater coherence to the many programs and initiatives underway across multiple R&E communities.[30]

Another element of ASD(R&E), the Defense Advanced Research Projects Agency (DARPA), invests heavily in fundamental science and innovation for R&E in sociocultural behavior, largely through its Information Innovation Office (I2O). The I2O supports development of U.S. technological superiority wherever information can provide a decisive military advantage, including emergent domains such as social science and human, social, cultural, and behavioral modeling. One example of an I2O effort is the Integrated Crisis Early Warning System (ICEWS), a system to monitor, assess, and forecast (in near-real time) movement toward or away from stability at the nation-state level.

The Services are increasing their investment in R&E focused on sociocultural behavior. The Air Force Research Laboratory (AFRL), Army Research Institute (ARI), and Office of Naval Research (ONR) have extensive programs, with particular emphasis on basic and applied research. For this paper, R&E leadership at each of the armed services were asked to provide a statement of each branch's activities and stake in the domain of sociocultural behavior R&E. Those statements are reproduced on the following pages.

The Armed Services' Stake in Sociocultural Behavior Research—Air Force

One of several goals established by the Human Effectiveness Directorate (RH) of the Air Force Research Laboratory (AFRL) is to enable the Air Force to understand and anticipate behavior for intelligence, surveillance, and reconnaissance (ISR) analysis decision dominance. Central to achieving that goal, and to enabling anticipatory sensing and analysis as well as improving analyst performance in the face of increasing complexity and data overload, is a research program focused on innovative discovery and development of human, social, cultural, and behavioral models and methods. This includes targeted cross-cultural data collection to develop an understanding of the inherent variability in cognitive processing, decision making, attitudes, motivations, and behaviors across cultures at different scales. Such an understanding will facilitate better ISR analysis and more precise targeting, not in a physical sense, but rather in the precise selection of COAs to bring about desired national objectives with minimal unforeseen effects.

The Air Force research encompasses new model development, model application (e.g., for forecasting instability or "phase changes," anticipating cascading effects on individuals, groups, and societies), model integration, methodology and tool development for model-driven analysis (e.g., discourse analysis for indications and warnings (I&W), or systematic organizational analysis for vulnerability assessment), as well as data collection and basic research. Both the basic and applied sociocultural research heavily leverages the investments of DARPA, OSD, U.S. Strategic Command (STRATCOM), and others. It also benefits significantly from partnerships, including international partnerships through NATO research groups and unilateral agreements.

Basic research is a critical element of the AFRL effort. That research includes exploring trust, answering if and how culture matters, as well as developing computational modeling approaches to study the behavior of groups and communities. AFRL is performing critical foundational work on interpersonal trust and trust in automation, focusing on trust and emotions, dispositions, and data manipulation. Ongoing data collection and analysis efforts center on trust and culture, culture and cognitive biases, and culture and precaution and vigilance mechanisms. The Collective Behavior and Socio-Cultural Modeling Program will explore fundamental constraints and limits of sociocultural prediction and create rigorous mathematical approaches for assessment, including development of basic science techniques to explore the structure of cultural knowledge, beliefs, and social norms; examination of cultural variations in decision-making, self-organization, and adaptation processes; and characterization of interacting dynamics at multiple scales, from individual to nation-state.

The Armed Services' Stake in Sociocultural Behavior Research—Army

The Army's investment in social and cultural research focuses on cross-cultural training; language translation; information extraction, collection, and dissemination; social network analysis; and attendant M&S approaches. The goals are to understand and develop training content and devices for the individual competencies each soldier must achieve across the diverse social and cultural space in which missions will be undertaken. Within that framework, the Army seeks to create training and technology that assist rapid cross-cultural understanding with in-the-field language translation devices; to understand and develop information displays that accommodate and support the cognitive implications of culture, both the implications of viewing information through one's own cultural lens and the displays used to portray pertinent social and cultural information; to understand and build support tools to help assess and manage population-level social and cultural responses; to use M&S to predict system performance with respect to social and cultural parameters; and to understand and predict the social and cultural network dynamics of blue and red forces.

The U.S. Army organizations executing this research agenda are the ARI, the Corps of Engineers (USACE) Engineer Research and Development Center (ERDC), the U.S. Army Research Laboratory Human Research and Engineering Directorate (ARL HRED), the ARL Computational and Information Sciences Directorate (ARL CISD), and the Army Research Office (ARO). Additionally, the Army has funded University Affiliated Research Centers (UARCs) and the Institute for Creative Technologies (ICT) to develop a variety of training simulations that support delivery of social and cultural training content.

ARI, ERDC, and ARL HRED are jointly developing methods and tools for incorporating sociocultural factors in planning, analysis, decision support, personnel, training, and leader development. ARL CISD researches machine language translation and machine-mediated human-to-human communication and has fielded several devices in support of recent war efforts. ARO oversees single investigator research and Multidisciplinary University Research Initiatives (MURIs) such as the Harvard University-led development of quantitative data analysis procedures to identify, characterize, and display covert social networks of asymmetric adversaries. Carnegie Mellon University and the University of Maryland-College Park have been funded to examine the effect of culture on collaboration and negotiation results to support the development of effective training. The Center for Language and Cultural Analysis and the Laboratory for Computational Cultural Dynamics at the University of Maryland are developing tools and methodologies to support the analysis, synthesis, and visualization of cultural data for use by analysts and soldiers.

The Armed Services' Stake in Sociocultural Behavior Research—Navy

The Office of Naval Research (ONR) funds and manages basic and applied research and advanced development efforts in the Human Social Cultural and Behavioral Sciences (HSCB) with the goal of developing a full understanding and mastery of the social, cultural, and cognitive factors that will optimize the warfighter's ability to influence human behavior across the full spectrum of military operations. This work addresses the Social Cultural Dynamics Analysis thrust of the Naval Science and Technology (S&T) Asymmetric and Irregular Warfare Focus Area within the Naval S&T Plan. Specifically, these programs seek technologies to provide military decision makers the knowledge and tools to understand the dynamics of regional populations through the development of data collection and analysis methods, computational social science models, and sociocultural training methods and tools. To accomplish these goals ONR funds multidisciplinary social and computational research in both the private and public sectors to improve the warfighter's understanding of the human terrain.

Multiple lines of inquiry exist within ONR, with an emphasis on ethnographic methods and field work, impact and utility of social media, network science, cross-cultural training, non-kinetic approaches to countering violent extremism, and methods for detecting and addressing regional instability. With a focus on the needs at the operational and tactical levels, data collection and analysis methods and social and culturally informed models of human behavior will enable the warfighter to forecast the potential effects of coalition actions, identify types of influences likely to be effective, and determine how those influences can be applied to shape the battlespace with a focus on the needs of the U.S. Marine Corps and U.S. Navy. HSCB research will improve tactical warfighter training by developing cross-cultural and sociocultural skills through the use of models and simulations.

Robust joint R&E activity is taking place as well, in particular at the COCOMs, most of which have made some investment in sociocultural analytic capabilities. The U.S. Special Operations Command (USSOCOM) has long been interested in the potential of R&E in sociocultural behavior to support enhanced understanding of foreign audiences and create better tools for tracking communications and developing and testing information support operations strategies. USSOCOM also focuses intently on the challenge of countering violent extremism. It is home to many specialized cells that provide high-quality intelligence derived from multiple sources and disciplines. The TRADOC Intelligence Support Activity (TRISA) is leading the effort to stand up a Cultural Knowledge Consortium (CKC) that would provide the availability, analysis, and storage of sociocultural data to satisfy the COCOMs' requirements for sociocultural information.

DoD researchers often coordinate or partner with other Federal Departments and Agencies that conduct research in sociocultural behavior. These organizations include the Intelligence Community, the National Laboratories, the Department of Homeland Security (DHS), and the National Science Foundation (NSF). A leading sponsor of relevant R&E is the Intelligence Advanced Research Projects Activity (IARPA), which supports cutting-edge research that has the potential to provide the United States with an intelligence advantage over adversaries. Much of IARPA's sociocultural behavior work comes out of the Incisive Analysis Office, which focuses on maximizing insights gained from data. This work includes developing tools and methods that incorporate sociocultural and linguistic factors into analyses. One significant program sponsored by the Incisive Analysis Office is Socio-cultural Content in Language (SCIL). SCIL explores and develops novel designs, algorithms, methods, techniques, and technologies to extend the discovery of the social goals of group members by correlating these goals with the terminology they use.

Conclusion

DoD has a strong, diverse community of R&E actors in place and has demonstrated significant technical progress on hard problems. In the long term, DoD must also ensure that it has a set of principles, processes, and standards in place to structure the entire enterprise and ensure continuing innovation, rigor, and responsiveness to operational needs. That is the subject of Section IV.

Principles and Practices to Consider

IV. Principles and Practices to Consider

To date, there has been effective coordination of efforts among the relevant R&E communities and reasonably effective engagement between the R&E and operations communities. This two-pronged approach has resulted in some noteworthy successes, particularly for transition efforts intended to meet relatively near-term operational needs. The continued success of sociocultural behavior R&E demands that DoD continue to invest strategically at the programmatic level and coordinate across the diverse sociocultural behavior communities. Section IV discusses organizational principles, structures, and processes that will help ensure that DoD builds on present success and realizes a coherent, innovative, and operationally relevant program of sociocultural behavior R&E.

As the sociocultural behavior R&E domain has expanded, the DoD has made good progress in balancing and managing programmatic challenges. The sociocultural behavior R&E communities can help meet DoD strategic objectives and ensure enduring impact by pairing wise programmatic investment strategies with rigorous research practices.

ASD(R&E) has dedicated its efforts to realizing four strategic imperatives. To fulfill these imperatives, the DoD's sociocultural behavior R&E communities must pair wise programmatic investment strategies with rigorous technical assessment standards and practices.

- Realign the science and technology (S&T) enterprise to work across the Department with purpose (basic research; labs; Science, Technology, Engineering, and Math (STEM) workforce development initiatives; and independent research and development (IR&D))
- Build core technical capabilities for the Department in each of the priority S&T areas
- Build an enduring rapid demonstration, assessment, and fielding model for the Department that invests in near-horizon concepts for aiding rapid transition to meet the COCOMs' urgent operational needs
- Build an enduring high-performance engineering culture across the Department in systems engineering and testing

Program managers across DoD, in a range of R&E domains, regularly confront a host of programmatic challenges that include determining and validating the appropriate technical direction for R&E efforts and programs; developing the appropriate balance among near-, mid-, and long-term needs, with that balance reflected in the R&E investment portfolio; determining the right mix of funding lines; developing effective methods of integrating across the different levels of R&E efforts; and developing methods to assess the return on investment in each program.

The sociocultural R&E domain has implemented approaches for confronting these programmatic challenges since the domain's inception, beginning with the identification of capability gaps for the modeling of sociocultural behavior by the 2006 SPG study. The DSB report *Understanding Human Dynamics* then laid out specific scientific challenges to meet emerging needs, and DoD doctrine subsequently codified these challenges and requirements. These documents shaped the initial structure and funding balance of the DoD's sociocultural R&E programs and also set the stage for continuous and ongoing investment review. The majority of these analyses and reviews involve collaborative processes that are internal to each research program and are also performed in conjunction with other sociocultural R&E programs, coordinating groups, and potential end-users of each program's research products. This ensures that the DoD's research program managers have a full understanding of the range of Service and COCOM requirements, existing programs, program gaps, and required resources.

Technical Direction of R&E Efforts

Determining the direction of a program's research efforts presents multiple challenges. Today's program managers cannot rely on static assessments whose conclusions can quickly become outdated. In addition to remaining cognizant of current gaps and needs, managers must anticipate future gaps and needs and maintain awareness of the technical direction of other programs in the sociocultural R&E domain so that each program can successfully meet its unique mission while avoiding technical duplication. Leveraging commercial and industry IR&D is one method of cost-effectively allocating resources targeted toward relevant problems. The OSD HSCB Modeling Program is using that approach to rapidly implement a baseline social media analysis and modeling system on which to base further research.

Balancing Needs

In the DoD Research, Development, Testing and Evaluation (RDT&E) environment, different funding lines exist to meet a range of research needs, spanning basic research (6.1), applied research (6.2), advanced technology development (6.3), and demonstration and validation (6.4). Moving from 6.1 to 6.4, the time horizons for delivery of an operationally usable product shorten. While basic research provides the fundamental building blocks of knowledge in a domain, that knowledge does not generally take the form of a product that can be deployed in an operational setting. A portfolio heavily skewed toward early-stage research can make a strong contribution to fundamental domain knowledge and satisfy long-term strategic needs, but rarely makes an immediately useful operational contribution. Conversely, a program heavily skewed toward delivering validated operational tools and methods can have an immediate impact on operational needs, but does not necessarily contribute to foundational domain knowledge.

Programs whose missions span a range of funding lines must develop an appropriate balance so that they meet near-, mid-, and long-term needs. Maintaining this balance requires that program managers maintain open lines of communication with other sociocultural domain

program managers, remain aware of scientific advances in the field, and coordinate with operational users who are attuned to strategic, operational, and tactical requirements. Stepping back from individual programs to look across DoD, it is essential to have a coordinated cross-service strategy for investments across the R&E spectrum. The current emphasis on "smart power" also suggests that DoD should coordinate its R&E closely with that of the Department of State (DoS) and U.S. Agency for International Development (USAID) in terms of economic and political research focuses.

Integrating Across Funding Lines

While achieving the proper balance across funding lines is important, program managers must also consider how each of the funding lines can influence the others. For example, the research foci of a 6.2 portfolio can be directly aligned with those of a 6.3 portfolio; as 6.2 projects make advances in applied research, those advances can inform and advance the 6.3 portfolio. Developing this sort of integration across a portfolio requires early-stage planning, close attention to project milestones, and coordination among project teams. To integrate activities successfully across funding lines, managers of sociocultural behavior R&E programs should closely coordinate and collaborate within and between their programs.

Importance of Establishing and Applying Metrics

A key element of effective program management is the ability to develop and systematically apply metrics in order to independently verify and validate ongoing efforts. These metrics must exist at both the project and programmatic levels. Each project and each program has different goals and objectives that must be appropriately assessed; therefore, developing a set of carefully tailored metrics is a programmatic investment in and of itself. Yet without these metrics, program managers cannot fully understand their program's successes, failures, challenges, and opportunity spaces.

No one set of metrics can meet all needs in the domain of sociocultural behavior R&E; instead, managers must develop and select a range of project- or program-specific criteria on the basis of their appropriateness for a particular project assessment. Likewise, each sociocultural behavior R&E program will have its own program-level goals and metrics. For maximum impact, these metrics should be applied at every step of the portfolio and program development process so they can inform and guide investments and planning.

To illustrate, the HSCB Modeling Program integrates rigorously developed and applied metrics into each stage of the project lifespan. This begins with awardee selection, which entails a careful process that stresses scientific rigor. Once awardees are selected, a set of assessment processes and events is put in place for tracking performance, project by project, not just against a given project plan, but against metrics that help managers fully understand the operational value of a given tool. Successful transition of HSCB-supported technologies and use of these technologies in the field represent perhaps the most important criteria by which to measure not only a given project's success, but also the success of the sponsoring program.

Effective programmatic and technical practices must be complemented by attention to issues associated with transition of resources and tools.

The final success of DoD sociocultural behavior R&E will be defined by its application to improve defense operations. Those who sponsor and conduct R&E can maximize chances of successful transition by managing certain issues associated with technology users and those responsible for acquiring tools and systems.

Considerations for Users

Introduction of sociocultural tools and data into the relevant user communities requires some indoctrination of those users into the nuances of producing sociocultural information. Broadly, these nuances fall into two categories: understanding social and behavioral science methods, and understanding models and modeling.

- **Social and Behavioral Science Methods**
  Compared to the physical, computer or mathematical sciences, the social sciences confront a significant challenge in isolating variables to indicate causation. Describing or forecasting human behaviors depends on analyzing an enormous number of considerations. It can be very difficult to conduct rigorous experimentation, especially at the scale of questions of interest to the federal government. Consequently, users place considerable reliance upon data generated from sources such as national census-taking, publicly observable behaviors, or qualitative data gathered for other purposes. All of this means that users of sociocultural models and data must be particularly attuned to considerations of potential biases, data limitations, and the limits of theory.

- **Models and Modeling**
  As has been argued elsewhere in this paper, computational models have great promise for helping warfighters, analysts, and decision makers manage operational complexity. Some users may think of models as equations where putting in values for (x), (y), and (z) will yield "the" answer. In fact, models are stylized representations of behavior or processes and must be understood as frameworks for deductively exploring various hypotheses. This means that users need to understand deductive (top-down) versus inductive (bottom-up) reasoning, how they are both necessary but not sufficient unto themselves, and how they interrelate. Additionally, users must understand that different types of models exist and have different strengths and weaknesses. Statistical and numerical models help users identify patterns among and between datasets; conceptual models are more abstract and qualitative, and can highlight areas for more study. Both have subsets that handle different data in different ways. Combining these model types and scaling from individual to group

to national behaviors are also very difficult problems that are still being researched, and should be topics of user education.

Given these observations, transition of sociocultural behavior R&E will succeed to the extent that:

- Transition agents provide a primer on the benefits and contra-indications for the model types being fielded
- Users are made aware of the challenges of scaling and model hybridization
- Sponsoring R&E offices educate transition partners in the methodological challenges inherent in the social sciences.

Considerations for Consumers

Consumers—those people who are responsible for acquiring sociocultural capabilities—must deal with another set of considerations that mirror their particular responsibilities. Transition agents should make consumers aware of the rough Total Cost of Ownership (TCO) calculations attached to any model being transitioned. After the initial prototyping, this may include a need for updating, enhancing, or adding models to the capability initially provided. These "mini-versions" of the computational software are likely to be lightweight and carry low integration risks, but consumers must be prepared for the dynamic nature of sociocultural capabilities and to consider tailored insertion processes, especially in the start-up phase of the domain.

In light of these observations, transition of sociocultural behavior R&E will succeed to the extent that:

- Transition agents deliver a rough TCO calculation with the initial prototype of a model
- TCO calculations include costs for piecemeal model enhancement/addition
- Transition agents are alerted to available opportunities for tailoring acquisition processes and discussing these with transition partners.

Significant coordination and collaboration are already taking place across the sociocultural behavior R&E landscape. By building on the strong foundation of existing processes and institutions, DoD can likely realize further gains in efficiency while preserving innovation.

A significant amount of coordination and collaboration is already taking place, much of which is described below. DoD should seize any opportunity to further minimize duplication and inefficiency while preserving innovation and keeping the needs and interests of operational end-users first and foremost.

Collaboration among R&E Programs

The DoD's sociocultural R&E efforts are not centrally organized around one program, although many of them are funded and managed by ASD(R&E). To succeed, these programs must coordinate both with each other and with the operationally oriented organizations for which they are developing tailored solutions to real-world needs by setting priorities, leveraging investments, and ensuring coordination.

At present, each program's efforts are coordinated and shared among the other sociocultural R&E programs through regular meetings, listserv emails, websites, and newsletter communications. Annually, the R&E programs sponsor collaborative symposia; other organizations are invited to report on progress and planning for their technical area. These efforts include program status overviews, project-level updates, reports on new technology demonstrations, future plans, and expert panel discussions with updates that describe intra- and inter-departmental coordination activities. Meeting participants include representatives from organizations and communities that will implement the new knowledge and technologies.

Scientific collaboration, rigorous scientific peer review processes, and information sharing within the sociocultural R&E enterprise play an important role in maintaining a well-organized DoD-wide sociocultural behavior R&E portfolio. Collaborative processes ensure that DoD's investments have integrated reviewing, decision-making, and program management procedures, and are primed to transition from one budget line to another. DoD's sociocultural R&E programs rely on established scientific collaboration practices to ensure cross-pollination of ideas and the development of scientifically distinct research portfolios that anticipate and align with emergent research developments. These practices include involving the sociocultural R&E community in Broad Agency Announcement (BAA) development, in the peer review project selection process, and in project and program evaluation.

R&E Participation in Coordinating Groups

In addition to efforts focused within and between each of the individual sociocultural R&E programs, program representatives also participate in groups focused on information sharing and coordination between R&E and operationally oriented organizations. Examples of collaboration include the following:

- The Human Systems Community of Interest (HS CoI) is a DoD Senior Executive Service (SES)-level coordination group formed under the auspices of the DoD Science and Technology Executive Committee (DoD S&T EXCOM). The HS CoI is composed of representatives of leading research areas oriented to Human Systems Integration. The HS CoI includes Human System Readiness, Human Centered Autonomy, Human Interface to Cyberspace, Human Resilience, Neuroscience, the Sociocultural Sciences and other related areas. The HS CoI serves as a key link to other DoD CoIs and supports increased outreach for international cooperation.

- The mission of the Irregular Warfare Modeling and Simulation Senior Coordinating Group (IW M&S SCG) is to enhance visibility, collaboration, and coordination of IW M&S across DoD. Activities include assessing IW M&S capabilities; identifying potential gaps, solutions, and metrics for IW M&S; producing reusable IW M&S that provides common solutions; and leveraging existing investments in M&S. The group holds monthly meetings attended by eighteen senior leaders at the General Officer and SES levels who represent potential end-users for the products developed by ASD(R&E) and USD(I).

- The Defense Intelligence Socio-Cultural Capabilities Council (DISCCC) is chartered and chaired by USD(I). This working group pursues the establishment of sociocultural capabilities that meet the requirements of commanders, staffs, and policy makers at all levels of DoD. This work supports the development, use, and institutionalization of sociocultural knowledge, concepts, methods, analysis, and tools throughout the Defense Intelligence Enterprise (DIE) and in support of the missions of DISCCC member organizations. DISCCC standing membership is composed of those organizations within the DIE responsible for the management or use of sociocultural capabilities that inform the decision making of senior leaders. Enabling objectives include coordination of capability development, operational collaboration, and institutionalization of sociocultural capabilities. Meeting participants include groups whose R&E activities are directly tied to the requirements of DISCCC member organizations.

- The Defense Language Steering Committee (DLSC), established through DoD Directive 5160.41E, consists of General Officer or SES representatives from USD Policy (USD(P)); USD(I); USD Comptroller; Under Secretary of Defense for Acquisition, Technology, and Logistics (USD(AT&L)); the Office of the Director, Program Analysis and Evaluation; the COCOMs; the Office of the Chairman of the Joint Chiefs of Staff; the Military Departments; the Defense Intelligence Agency (DIA); the Defense Security and Cooperation Agency; the Defense Threat Reduction Agency (DTRA); the National Security Agency (NSA); and the National Geospatial-Intelligence Agency (NGA). The DLSC recommends and coordinates language policy, needs, training, education, personnel, and financial requirements. USD(AT&L) oversees research, development, testing, evaluation, and acquisition of multi-language technology to be employed by the operating forces (except technology to be employed within the DoD Intelligence Components) and coordinates these efforts with USD(Personnel and Readiness (P&R)) and USD(I).

Other Venues for Information Sharing

In addition to participating in groups such as the IW M&S SCG and the DISCCC, members of the DoD sociocultural community often take part in informational and coordinating meetings across departments and offices. USD(I), USD(P), USD(AT&L), the Joint Staff, COCOMs, and members of the DIE hold both formal and ad hoc meetings with each other. These regular

interactions ensure that members of various socioculturally focused communities are apprised of evolving requirements, gaps, and investment strategies. Organizations such as ASD(R&E) involve other R&E funders and staff from the data and analysis and training/education communities, including end-users, in the R&E process. This includes discussions of requirements and gaps for incorporation into R&E strategy and BAAs and review of research proposals during the scientific peer review process, ensuring that end-user needs are identified and included in the DoD's R&E portfolio.

Conferences and workshops regularly issue invitations broadly across and beyond the DoD. Meetings such as the HSCB Modeling Program's series of "Focus" conferences and the COCOMs' S&T workshops are held annually. They provide venues for members of socioculturally oriented communities to formally present their perspectives, interact with each other, and gain insight into the needs, gaps, and strategic directions of the broader sociocultural community.

Governance Strategies

The DoD organizes the sociocultural activity domain within three broad categories: R&E, data collection and analysis, and training/education. Each of these three areas is guided by a lead oversight organization that has strategic investment, governance, and decision-making authority over its specified programs and related activities. Within USD(AT&L), ASD(R&E) leads research and development; USD(I) leads data collection and analysis; and the Defense Language Office (DLO) within USD(P&R) leads development of related training/education programs. Each lead organization has DoD Directives (DoDDs) and Instructions that align the authority and responsibilities to carry through with respective planning, budgeting, and programming objectives. Collectively, the three organizations comprise the oversight and decision-making body for the sociocultural area. Each of the lead organizations for DoD's sociocultural behavior activities has purview and authority over that specific organization's investments and programmatic foci. This gives domain experts and thought leaders an appropriate mandate to manage and guide.

For example, under DoDD 5134.3, ASD(R&E) is authorized to engage in activities that include, but are not limited to:

- Making recommendations and issuing guidance for DoD R&E plans and programs
- Recommending approval, modification, or disapproval of programs and projects of the Military Departments and other DoD Components in assigned fields to eliminate unpromising or unnecessarily duplicative programs, and initiating support of promising activities for R&E
- Promoting coordination, cooperation, and shared understanding of R&E within DoD and among DoD, other federal agencies, and the civilian community
- Developing and maintaining an R&E metrics program to measure and assess the quality and progress for DoD's R&E program[31]

In 2009, the DSB recognized a need for coordinated R&E in the domain of human dynamics (HD).[32] Subsequently DoD increased its HD investments and assigned internal coordination and staff specialists to oversee, coordinate, and support the fiscal and technical HD portfolios. Collaborative practices within DoD's HD enterprise ensure that those involved in the HD communities understand the range of Service and COCOM requirements, existing programs, program gaps, and required HD resources. Coordination, collaboration, investment planning, and guidance are facilitated by current working groups, steering committees, coordinating meetings, and collaboration best practices (e.g., cross-program scientific peer review practices). These DoD structures and processes provide appropriate levels of expert review and guidance while continuing to embrace opportunities for closer ties and enhanced collaborative mechanisms.

Much of the success of a DoD program of sociocultural behavior R&E depends on effective engagement with operational communities, and with others not only across the interagency but also out to the international communities.

Successful R&E requires collaboration and coordination among many different elements, from the developers and evaluators of different projects to all those who comprise the enormous and growing community described elsewhere in this paper. However, success in the sociocultural behavior domain depends on far more than conducting careful, thoughtful-research or engineering technically effective solutions. R&E must be informed by careful engagement with the operational communities.

That engagement starts with understanding needs and requirements by becoming familiar with end-user tasks and needs at all levels—tactical, operational, and strategic. Also critical is ongoing engagement with end users and with PORs that have the resources and infrastructure to integrate and maintain new technologies. The individual Service components are best positioned to develop solutions tailored to the needs of their respective user communities. Supporting DoD-wide needs and integrating as needed across the individual services is a shared challenge area in which ASD(R&E) and the COCOMs must play a leading role.

Beyond that basic relationship, DoD can derive important advantages by coordinating across the U.S. interagency and even internationally. No one part of the U.S. or any other government has a monopoly on great ideas. It is important to seek alternative solutions to the challenges DoD confronts, regardless of where those solutions were developed. Such coordination not only helps ensure technical innovation and impact, but also helps to leverage resources fully. For example, opportunities may exist to increase the robustness and affordability of data collection and analysis by engaging foreign subject matter experts—with appropriate attention to validation and security risks.

Figure 5 presents a conceptual view of relationships and interdependencies between the DoD R&E community and military operational communities, along with possible connections to the U.S. interagency and international spheres.

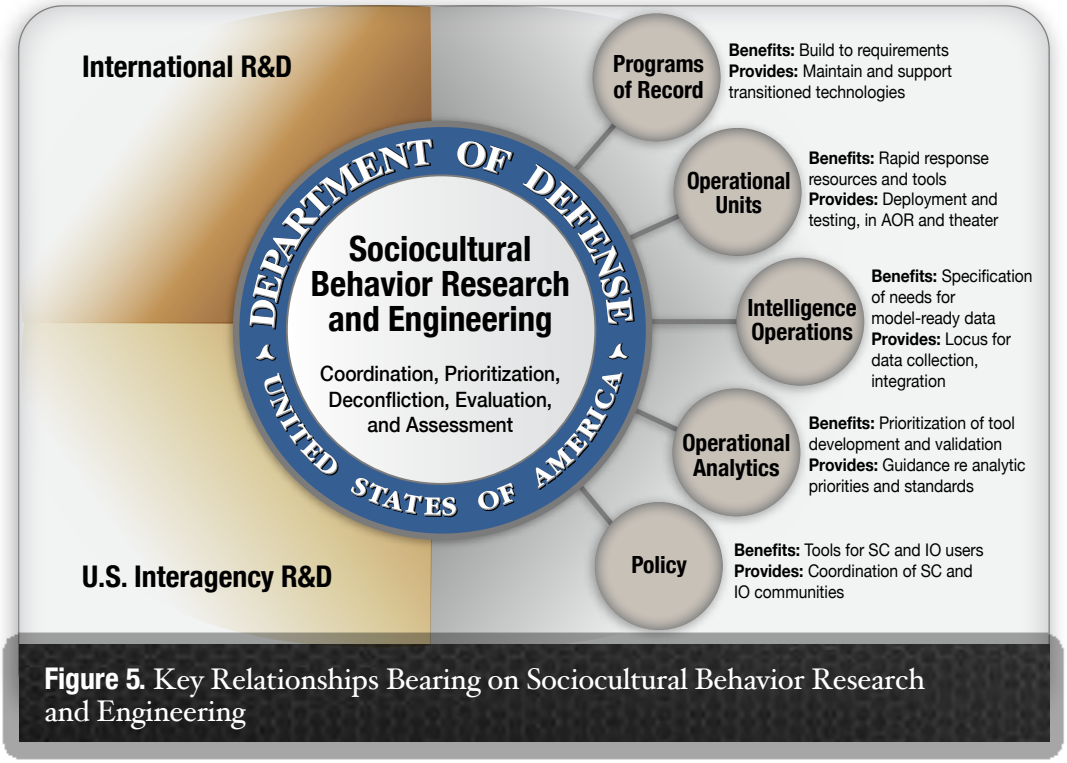


Figure 5. Key Relationships Bearing on Sociocultural Behavior Research and Engineering

Conclusion

Sections III and IV have shown that there is an extended DoD community pursuing innovative sociocultural behavior R&E, and that the community has a strong foundation of shared standards, practices, and coordination mechanisms in place. With all of the innovative work underway, the DoD sociocultural behavior R&E community now finds itself at a point of transition and great opportunity. The field of sociocultural behavior R&E has matured to the point where discrete efforts are being brought together, with the promise of more comprehensive integration and more end-to-end solutions. One strong model for how this can be done is SNARC—the Social Network Analysis Reachback Capability project, featured in the Spotlight below. This move toward integration represents a significant step forward—a step that will be greatly aided by the steady increase in requirements for R&E in this space. It will also be aided by viewing both existing work and remaining gaps in the context of a holistic framework, grounded in military operational priorities. Section V presents such a framework, derived from widely used operational concepts, along with a discussion of challenges and thoughts on a way forward for the long term.

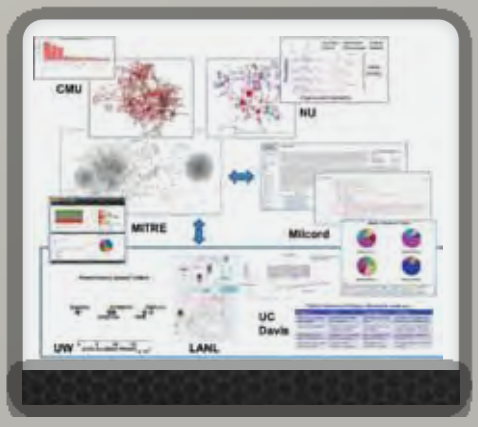
SPOTLIGHT ON THE SOCIAL NETWORK ANALYSIS REACHBACK CAPABILITY (SNARC)

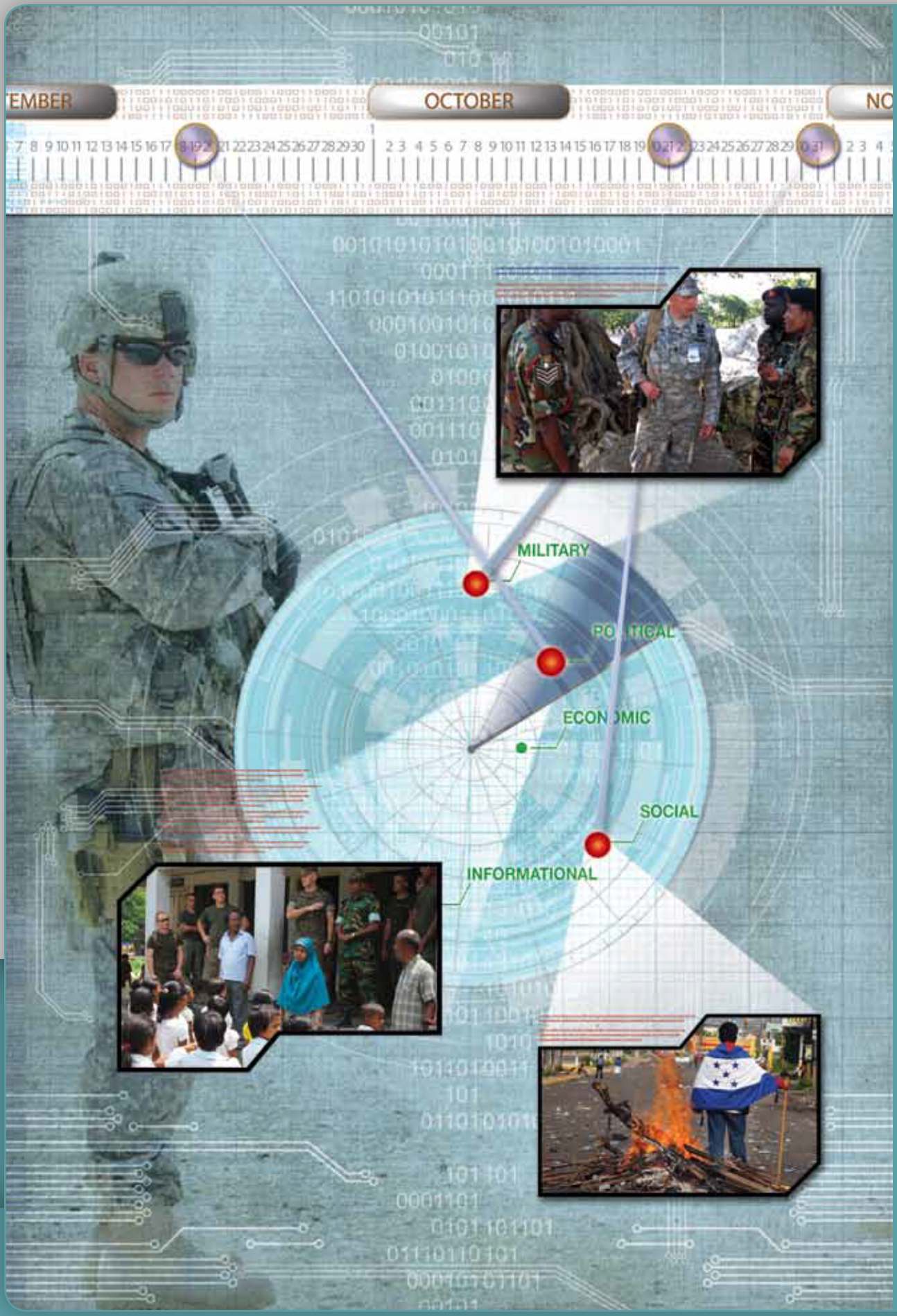
While there is a good deal of innovative sociocultural research and engineering underway, bringing disparate efforts together into a coherent capability package that can be integrated into current operations presents a significant challenge. One important success story is the Social Network Analysis Reachback Capability (SNARC), which integrates multiple sociocultural R&E projects and initiates earlier transition for these projects, providing developers with rapid feedback from warfighters in the field and allowing them to create more relevant tools.

SNARC was created to help the Information Dominance Center (IDC) Network Effects Cell (NEC) for the International Security Assistance Force (ISAF) Joint Command (IJC), collect, process, and analyze open source information on social networks in Afghanistan. Partners in the SNARC effort receive Requests for Information (RFIs) from the NEC. They collaborate to answer these RFIs, gaining insight into the needs of the warfighter and improving each individual project's performance by building on each other's work.

The team comprises six OSD HSCB Modeling Program awardees (Northeastern University, Milcord, Los Alamos National Laboratory, University of California Davis, University of Washington, and Carnegie Mellon University), supplemented by The MITRE Corporation's Internal Research and Development program. MITRE was asked to coordinate the project because it had been providing direct support to the IJC Headquarters in Kabul, and thus had extensive knowledge of the operational environment. This role also leveraged MITRE's status as a Federally Funded Research and Development Center (FFRDC), and Systems Engineer for the OSD HSCB Modeling Program.

By connecting developers and customers early in the development process, SNARC provides warfighters with tools to improve their analysis capability, and serves as a model for sustained transition, innovation, and responsiveness to researchers within the sociocultural R&E community. The project brings together researchers who are each tackling a different aspect of a shared problem, thereby making all of them parts of a larger, coherent whole. This makes the effort more effective technically, and has also proven gratifying and energizing for the participants. Similarly, the researchers are motivated and focused by working on problems of clear importance for a well-defined customer with urgent needs. The relatively rapid pace ensures quick feedback over multiple cycles, which also positively affects performance. In addition, the project demonstrates the potential for fully leveraging resources: SNARC is funded jointly by ASD(R&E), and MITRE, each building on hundreds of millions of dollars of existing investments made for other purposes.





Thoughts on the Way Ahead

V. Thoughts on the Way Ahead

As noted, DoD has made significant investments in R&E on sociocultural behavior, leading to clear advances in technical capabilities and some impact on operations. Section V presents a framework for building on DoD's success. The framework comprises four capability areas to guide DoD in prioritizing R&E initiatives: understand, detect, forecast, and mitigate.

There is now an opportunity to further coalesce the many exciting R&E efforts underway. This can be achieved by connecting disparate theories, tools, and technologies into coherent capability packages, oriented to cross-cutting operational challenges.

DoD has devoted considerable work to bringing the social and behavioral sciences to bear on some enormously challenging national security problems. Much of that work has been foundational, such as defining operational needs, activating the social and behavioral science research community, and developing the basic science upon which applied and other research must rest. The emerging field of computational social science has also wrestled with ways to instantiate social and behavioral science theory in computational models and to validate such models.

Meanwhile, as the research community has identified these building blocks, the warfighters and others who interface with foreign populations have called insistently for new sociocultural understanding and tools. The DoD R&E community has responded to that call, and is beginning to bring these tools and resources together to address operational needs as effectively as possible. Widespread integration will be facilitated to the extent that more PORs incorporate requirements that would support transition of sociocultural behavior technology. It will also be facilitated by establishment of a framework for sociocultural behavior R&E that reflects end-to-end military operational needs. In addition to indicating technology transition paths, such a structure would help reveal integration opportunities as well as gaps where further R&E is needed.

The HSCB Program has derived a relatively simple framework from familiar and widely applied concepts for military operations such as the OODA loop,[33] the Joint Fires Targeting Cycle,[34] and the strategic communication process.[35] The Sociocultural Behavior Capability Areas Framework comprises four sets of capabilities, each feeding into the next and forming a cycle (see Figure 6.).

Capability Area One: Understand

Capabilities to support thorough perception and comprehension, grounded in social and behavioral science, of the sociocultural features and dynamics in an operational environment.

The cycle begins with the need to frame the sociocultural structure and dynamics of behavior in a given operational context. To understand at this level means bringing sociocultural theory and concepts to bear to identify the sociocultural features of the terrain that are important to monitor. Understanding is not a single event, and users may constantly need to adapt the initially-applied theories, concepts, and consequent features based on the results of detecting, forecasting, and mitigation. This then initiates a new cycle. This step spans all levels—tactical, operational, and strategic. It requires applied social and behavioral science theory, access to baseline sociocultural data for any given region, descriptive models, and linguistic and sociocultural training.

Capability Area Two: Detect

Capabilities to discover, distinguish, and locate operationally relevant sociocultural signatures through the collection, processing, and analysis of sociocultural behavior data.

Once the defining features of the sociocultural setting are understood, the next steps are to develop a persistent capability to detect sociocultural behavior signals of interest amidst complexity and noise, and to harvest data for analysis. This entails capabilities for ISR in the area of sociocultural behavior (referred to here as a "social radar"), with particular focus on the challenges associated with open source data collection. It also requires robust systems for storing and managing that data, and tools enabling timely, dynamic analysis.

Figure 6. Sociocultural Behavior Capability Areas Framework

Capability Area Three: Forecast

Capabilities for tracking and forecasting change in entities and phenomena of interest along multiple dimensions (time, space, social networks, types of behavior, etc.) through persistent sensing and modeling of the environment.

Armed with historical and real-time data, users can take the next step: to forecast alternative plausible futures by extrapolating from the collected data. The goals are to identify the various paths that behaviors of interest could take, and to estimate the consequences of each for populations of interest. Among the most important needs in this step are large amounts of data, multidisciplinary theory, and hybrid modeling.

Capability Area Four: Mitigate

Capabilities to develop, prioritize, execute, and measure COAs grounded in the social and behavioral sciences.

The final step in the cycle is to develop and measure the effects of alternative COAs for achieving desired changes. This step builds on all the foregoing ones, and should assist in updating U.S. forces' understanding of the sociocultural behavior terrain, thus continuing the cycle. This step requires education in the use of models for robust decision making, strategic-level theory, integrated systems, decision space visualization, and agile data collection.

Each of the four sociocultural behavior capability areas has a number of long-term goals consistent with the overall capability vision. Reaching those goals will require DoD to meet a variety of technical challenges by both maintaining the momentum of existing projects and, as appropriate, initiating new ones.

The following paragraphs outline the desired future state for each capability area, then discuss the leading challenges to realizing that state, and finally identify R&E priorities. Existing programs that can be built on are noted.

Understand

A. **Goals**

A mature set of capabilities for understanding will be supported by interdisciplinary social and behavioral science theories that address universal and culture-specific factors, and are fundamentally grounded and validated against sociocultural and military principles. This will aid understanding of how the influence of sociocultural factors varies across regions, groups, and societal

conditions. An integrated framework will provide a basis for applying multiple concepts, theories, and models in a given operational context. Theory-driven models will improve situation awareness by helping to identify the crucial socio-cultural factors affecting an area and to distinguish between conditions that are favorable and unfavorable to U.S. objectives. DoD will have rapidly adaptable culture-general and culture-specific training systems, tailorable to the learner so that training time is minimized and retention increased. Users will have enterprise-scale access to validated sociocultural behavior data structured for military application.

B. Leading Challenges

Decades of social and behavioral science theories and methods could be applied to the U.S. military's needs in the sociocultural area. Thanks to programs such as the Minerva Research Initiative, MURIs, and OSD HSCB Modeling Program, DoD has a growing understanding of which theories apply under given conditions and which sociocultural factors should be considered in the military context. These and other programs are now leaning forward to promote theoretical integration that would bring about truly interdisciplinary application of the social and behavioral sciences. Realizing the goal of a comprehensive theoretical framework will be a major undertaking, given that sociocultural behavior is a highly complex domain with many levels of interactions and analysis. Empirical testing of integrated theories is essential, but is difficult in operational environments, especially in the early stages of operations when, ironically, the theories may be most urgently needed.

Computational models play an important role in facilitating understanding: they can provide insight into the key factors and relationships that will affect the success or failure of U.S. policies and actions. One current barrier to their effective use is transparency: models must be more accessible to analysts and decision makers than is currently possible through expert consultation. Access must include some understanding of the models' theoretical and logical underpinnings.

Building understanding in a new sociocultural context requires access to deep baseline data. Structuring that data to make it widely usable for modeling and other purposes is challenging, particularly given the difficulties of validating data that is likely to be qualitative, drawn from multiple sources, and not necessarily collected for military operational needs.

Developing training content for specific regions and cultures is currently time- and resource-intensive. Yet it is essential that DoD be quickly able to develop or adapt existing training that prepares the warfighter to act effectively in novel

sociocultural settings. Synthetic environments promise high-impact realism and adaptive training capacity, but only if cognitively realistic avatars can be engineered. There is also the challenge of demonstrating the benefits and appropriate use of the social and behavioral sciences to military end-users—many of whom are accustomed to the relative precision of the physical sciences.

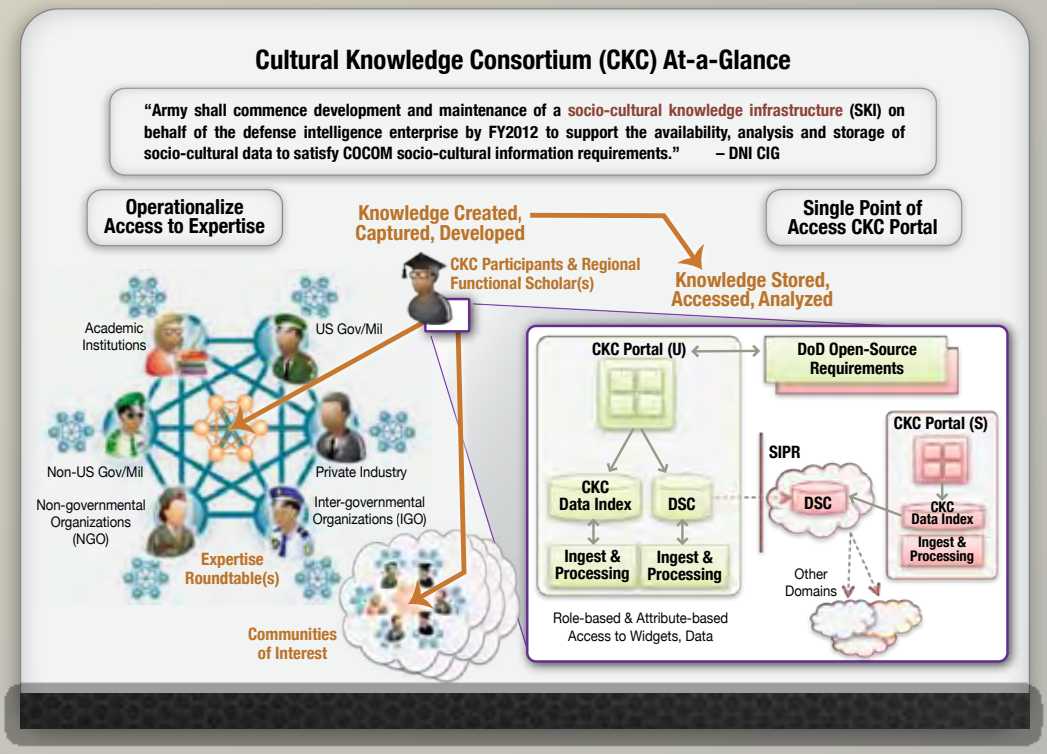
C. Priorities

DoD would certainly benefit from strong continued investment in interdisciplinary basic social and behavioral science research. Because the armed services execute much of basic research, they can facilitate this goal. Under the leadership of ASD(R&E), DoD will place increasing emphasis on cross-national and cross-group studies to determine military-addressable factors that may affect human behavior and on interdisciplinary approaches to developing a framework for integrating social science theories that will handle the dynamics of the military domain.

Ensuring access to deep baseline data at all levels—tactical, operational, and strategic—must remain a major element of DoD's sociocultural behavior R&E. ASD(R&E) is fostering development and demonstration of a functional architecture for managing and disseminating data, information, and analysis products across sociocultural and military domains. Data dissemination must be supported with taxonomies, ontologies, and metadata based on theories that will allow data transfers across these domains and facilitate creation of reusable data sets for the sociocultural research community. The CKC is among the most important initiatives for addressing these data-related needs (see Spotlight).

DoD has made noticeable progress in developing training methods and resources to meet the grand challenge of shaping the future force. DLO and programs such as IARPA's SCIL are important for addressing persisting gaps in foreign language skills. ONR and the OSD SBIR Program have sponsored leading-edge work using synthetic environments to support virtual training. That work should be strengthened further by pressing to improve culturally accurate training scenarios and theoretically valid instantiation of behavior in models. ONR and others are also focusing on how to maximize the impact of training by tailoring it appropriately, e.g., to a trainee's role with regard to cultural interactions and the trainee's level of current expertise or experience. Similarly, DoD could reap significant benefits from providing analysts with task-oriented training on how to use data-translation systems and sociocultural modeling and assessment tools to deliver finished products that clearly convey the sociocultural factors and conditions in the area of interest. Finally, DoD must continue research on how to assess and measure learning of non-kinetic and cultural skills.

SPOTLIGHT ON THE CULTURAL KNOWLEDGE CONSORTIUM



U.S. Army TRADOC is leading development of the Cultural Knowledge Consortium (CKC), which is to provide a Socio-cultural Knowledge Infrastructure (SKI) to operationalize access to and leverage multi-disciplinary worldwide social science expertise for collaborative engagement in support of Combatant Command (COCOM) socio-cultural analysis requirements. The Army initiated the CKC in response to a Director of National Intelligence (DNI) directive. The intent of the CKC is to enable collaboration across the breadth of sociocultural communities and individuals and provide maximum access to sociocultural data, information and knowledge. Initial deployment will be on the commercial Internet and DoD's unclassified NIPRNET. A CKC portal will serve as a single point of access for sociocultural data, information and knowledge. It will also leverage the advanced analytic capabilities of the Army Distributed Common Ground System Standard Cloud. This will include centralized acquisition and providing access to data sources and materials to increase synergies and leverage economies of scale.

Detect

A. Goals

Full realization of a detection capability will result in a "social radar": a global and persistent indications and warnings capability, consisting of technologies to detect sociocultural behavior signatures with operational or strategic relevance. These signatures will comprise distinctive patterns of expressed perceptions, sentiments and attitudes, along with actions among populations of interest. A social radar capability will localize and track these signatures temporally, geographically, and socially. This social radar will be supported by scientifically verified methods for rapid generation and collection of foundational data on factors such as the geographic, demographic, socioeconomic, political, and cultural environment. Multilingual, global, and real-time collected data will be appropriate and readily translatable for theory-driven modeling technologies used in analysis, decision making, and training. DoD will have methods for correlating social "signatures" with indicators at various levels of abstraction across domains (e.g., micro versus macroeconomics; individual versus group versus tribal versus national political models). Data collection methods will be objective and theoretically informed, based on ontologies to allow transfer of data across domains and communities. Rich, enterprise-scale data sets will allow for comparison of models and theories across disciplines.

Full realization of an adequate detection capability will result in a "social radar": a global and persistent indications and warnings capability consisting of technologies to detect sociocultural behavior signatures with operational or strategic relevance.

B. Leading Challenges

At the core of this capability area is the capacity to isolate signals of operational relevance amid the great wash of noisy irrelevance, and to do so early enough to prepare for or—if possible—prevent conflict. Thus, the linchpin of a robust detection capability is a capacity for continuous collection and rapid processing of large volumes of varying forms of data, especially from open sources—including social media. DoD has recently made progress in this area, but the COCOMs and others are still struggling to handle this material at the necessary scale, separate meaningful signals from background noise, and integrate data across media streams to form a coherent overall picture of the environment.

Developing methodologies for data collection that are grounded in social and behavioral science theory and also empirically validated presents a major challenge. The OSD HSCB Modeling Program and select others have addressed this hard problem and now some empirically and theoretically validated methods are available. A persistent problem is that much sociocultural behavior data is

qualitative, and requires interpretation to make it useful to analysts and decision makers. The quantification of unstructured text—for example, by applying numeric scores to expressions of emotion and attributing that score to people and groups—remains difficult and is the subject of research and prototype implementation today, but much more must be done. For example, if open source feeds indicate that Party A hates Party B "a lot," this qualitative data must be translated into a quantitative value (with appropriate uncertainty attached) before it can be used in a model.

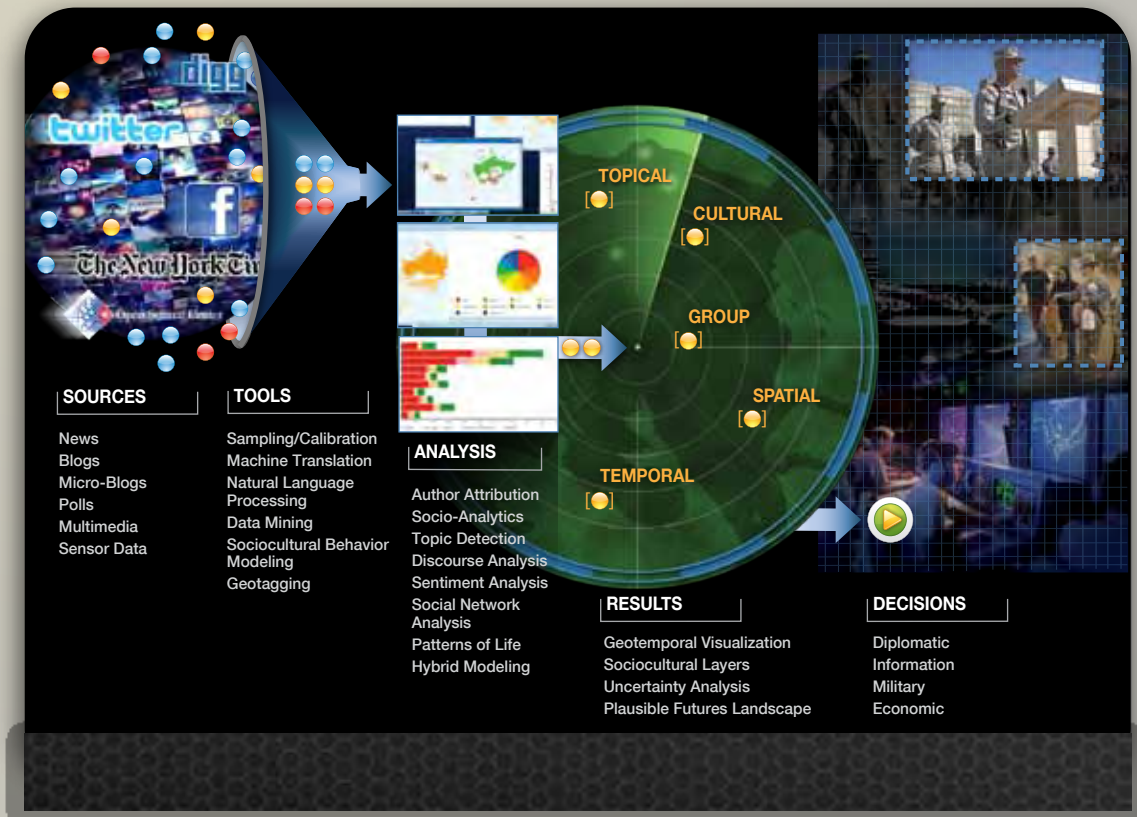
Another significant technical challenge is extracting value from the broad set of technologies that comprise the sociocultural behavior landscape (e.g., chat, blogs, micro-blogs such as Twitter, social networking sites such as Facebook, news). DoD needs such data to understand general population perceptions, attitudes, sentiments, and opinions. Open source material varies widely in structure, making it difficult to integrate across data streams. The current ability to extract information on low- and high-level entities, groups, and networks from unstructured text is very uneven. Beyond these comparatively straightforward language processing tasks lies the difficulty of detecting and attributing sentiments, and of understanding the links between sentiment, motivation, and behaviors. Sentiment analysis is of increasing interest to DoD users, but remains very much in the early stages of technological readiness. A non-technical challenge is ensuring that appropriate attention is given to privacy concerns as Detect technologies are developed and executed.

C. Priorities

The creation of a social radar requires new sensors, signatures, and methods to collect, extract, analyze, correlate, and, especially, visualize social and behavioral phenomena. Algorithms must mitigate noise arising from variations in the pertinent sociocultural signals or from the background environment, as well as filter out irrelevant, duplicative, or deceptive signals. The HSCB Modeling Program is currently supporting the integration of R&E that will provide a social radar capability (see Spotlight).

To leverage the rapidly expanding flow of open source data, the preparation, ingest, and analysis of that data must be supported by automated information processing systems. Automation is important to scalability, affordability, and accuracy of a detection capability. Ideally, U.S. Army TRISA, USSOCOM, DARPA, and others will continue to research and develop standards, methods, and technologies for identifying, collecting, extracting, and tagging sociocultural behavior data automatically.

SPOTLIGHT ON SOCIAL RADAR



The HSCB Modeling Program is currently supporting work to prototype a social radar capability for DoD. This effort leverages and integrates mature methods and technologies, as well as those currently in development. Participants are being drawn from all sectors: government, academic, industry, and FFRDC. The figure offers a notional representation of the social radar. Various tools are applied to multiple streams of source material (much of it open source) to prepare that material for analysis and ultimately for visualization to support situation awareness and decision making.

Continuing to improve the availability, validity, and sensitivity of leading indicators of violent extremism and nation-state instability will remain one of the most important thrusts for sociocultural behavior R&E. USSOCOM is a leader in this area, as are the ICEWS program and the HSCB Modeling Program. Such work should include a focus on "patterns of life"—i.e., understanding typical movement and migration patterns in sociocultural groups to better detect significant deviations from normal patterns. The U.S. Army Geospatial Center (AGC) has demonstrated expertise in this area, and likely has opportunities for collaborative research with DoS.

Improved detection of attitudes in areas of interest will require identification and empirical testing of novel models and methods for assessing sentiment and indicators of sentiment change. These will support detection of tipping points and warnings of instability. Many commercial products purport to perform these functions, but adapting them to military demands can be non-trivial. DARPA and the HSCB Modeling Program both support R&E on sentiment analysis.

Of course, not all sociocultural behavior data can simply be harvested from on-line or other electronic sources. As was emphasized in a recent BAA from ONR, DoD has a need for remote and passive data collection methodologies in denied areas, to include methodologies that can be used by non-experts and warfighters wherever possible. Innovation is also strongly needed in development of methods to collect data among populations where either literacy levels or information technology penetration are low—or where both conditions hold.

Data collection by non-experts and warfighters would be much more successful if it were backed by theory-driven training to counter Western cultural biases when identifying non-Western cultural artifacts. Non-experts and warfighters would also benefit from training on how to use new sociocultural data collection tools and handle the resulting data. In addition to improving tool use, training should focus on how to appropriately tag data for dissemination, and how to analyze it to develop better and stronger conclusions. Programs such as DARPA's "Good Stranger" and the recently established ARI Learning and Operating in Culturally Unfamiliar Settings (LOCUS) could be important contributors to meeting these training and education needs.

Developing new visual analytic techniques will be critical to assessing the data generated by the social radar sensors. These analytics would facilitate reasoning by providing visual interactive interfaces that enable the processing of such data. This task might otherwise be intractable due to the data's size and complexity, and to the need for closely coupled human and machine analysis.

Forecast

A. Goals

As part of a mature forecasting capability, data will be collected automatically to support regular, periodic model-based analyses. Exploratory modeling[36] with sociocultural models based on sound theory will raise the option awareness[37] of decision makers by simulating and visualizing a landscape of plausible futures. Once adapted for a particular situation, computational models will support forecasting of first and higher order effects and convey their results in a transparent, traceable fashion. Analysts and decision makers will have access to theory and models to forecast tipping points that indicate transition to violent extremist action or to instability. Further, they will have the ability to make forecasts earlier, and with greater reliability, than at present. Architectures will enable integration, whether by creating federated interoperable models or by incorporating modeling results into a comprehensive analysis. Such an analysis will help to identify robust options that will produce acceptable sociocultural outcomes across the broadest swath of conditions. Moreover, the models will enable decision makers to create novel socioculturally sensitive options, branches, and sequels that will more likely lead to desired outcomes.

B. Leading Challenges

The knowledge of subject matter experts drives much of the planning and analysis of non-kinetic COAs and the estimation of sociocultural effects. Programs such as Minerva have helped augment this expertise by building a foundation of interdisciplinary theory applicable to military needs, while the HSCB Modeling Program and other programs are working to make models grounded in such theory the norm. Building to that vision is important, because even when statistics-based forecasts can identify events of interest, they provide only limited insight for planning and may not suffice to determine causality.

Arguably the defining challenge of forecasting is the instantiation of human behavior in a single model. In contrast to the objective of prediction, where success is defined by placing specific events in space and time, forecasting embraces the probability of error. It attempts to incorporate as much of the variability of human behavior as possible. The problem is how to emulate that highly complex behavior in a limited set of underlying rules, and thereby accurately forecast not only the immediate effects of specific actions, but also higher order effects.

Another core challenge is accurately and efficiently translating data from its original format to one usable by a computational model. Even quantitative data

must be converted to fit the ontology of a specific model, and data from multiple sources must be reconciled when sources contradict each other. Technologies for automation-aided entity extraction and data translation that are now being developed can mitigate many of these issues. The challenge is to mature these technologies and move them from state of the art to state of the practice.

Timeliness of forecasting is also a central issue. Available models must be adapted to new areas of interest with enough speed and agility to support operational imperatives. At present, this process requires months or possibly longer; the ideal would be weeks or even days.

Finally, sociocultural behavior forecasting will often, perhaps even typically, involve multiple models. The situation is analogous to model usage in meteorology, where a repertoire of models is used to forecast hurricane paths. No one model performs best under all conditions, and it is not even possible to determine which one is best suited to a particular set of conditions. However, by integrating the results from multiple models meteorologists can forecast a window of plausible landfall, which is indeed valuable for decision making.

With increases in quality and coverage of sensors, the ability to forecast future outcomes increases. Two key challenges, therefore, are how to integrate multiple models (theoretically, computationally, and technically) and how to evolve military sensor capability (as discussed in the Detect capability area).

C. Priorities

The need to advance the state of the practice in forecasting of behaviors associated with violent extremism and nation-state instability has never been greater.

With effects of mass uprisings still being felt across the Middle East, and extremist sentiment growing in a number of regions globally, the need to advance the state of the practice in forecasting behaviors associated with violent extremism and nation-state instability has never been greater. This advance will require, among other things, sophisticated hybrid models as well as techniques for performing meta-analysis of data from different sources. Agility is a key criterion for a mature forecasting capability. DoD should place high priority on designing core generic models that can quickly be adapted for new geopolitical areas of interest, i.e., in one to two weeks. Similarly, a feasible goal is development of computational hardware, software, and architectures that enable models to provide decision support analysis in hours. DARPA's ICEWS has shown great promise in extending the lead time for forecasting instability (see Spotlight), and the HSCB Modeling Program is supporting development of a hybrid system for forecasting violent extremism. There has also been promising early research on cultural narratives and other drivers that may contribute to

extremism and instability. If that work continues, it could yield tools for tracking and forecasting the spread of narrative-driven communications.

The use of computational models involves expert translation of information from the real world into the models, and from the models into real-world implications. DoD needs either new technologies that capture translation expertise in automation for use by non-experts, or technologies to connect decision makers with the modeling process (through human experts, e.g., members of a reachback cell). Conscientious operational usage would best be supported through development of policies, procedures, and information systems to guide people in this endeavor and to ensure that their activities are audited and documented. In addition, decision makers would benefit from training and doctrine on the capabilities and limits of models for analysis and operational planning.

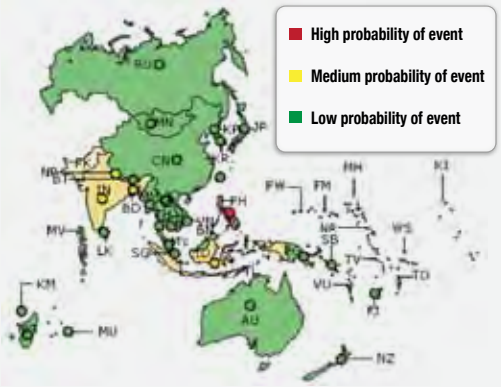
DoD must develop a regular process and supporting technology to empirically validate forecasting models. Recognizing that it will not always be possible to reproduce complex conditions in the real world and test alternative outcomes, it is important that DoD take advantage of the many historical examples that can be indexed and analyzed to perform controlled studies and counterfactual analysis.

Another promising line of research addresses ways of leveraging social media to "crowdsource" forecasting. A relatively new IARPA program, Aggregative Contingent Estimation (ACE), is developing and testing methods for generating accurate and timely probabilistic forecasts, leading indicators, and early warning of events by aggregating the judgments of many widely dispersed analysts. Research supported by the OSD HSCB Modeling Program is examining how to provide real-time support to military decision making in the aftermath of a disaster. The research uses social media to model the emergence of communities of interest and track the propagation of influence across highly dispersed and fragmented communities.

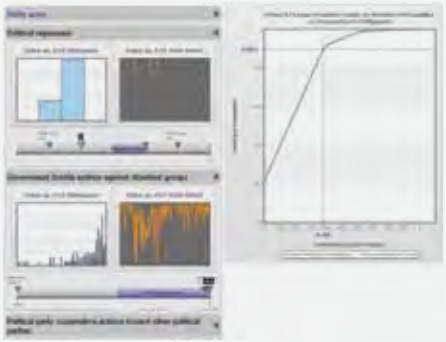
A final area of opportunity encompasses new or enhanced visual analytic display approaches and prototypes, as well as corresponding strategies and tactics, techniques, and procedures (TTPs). These would help convey understanding of the complex and uncertain interactions of sociocultural factors and conditions with military COAs. To these ends, the HSCB Modeling Program has supported development of visualization software toolsets and the integration of a common visualization architecture. The objective is a non-proprietary framework that permits interaction, exploration, and visualization of key elements of sociocultural behavior modeling information based on both user and task requirements.

SPOTLIGHT ON INTEGRATED CRISIS EARLY WARNING SYSTEM (ICEWS)

Insurgency (February 2011)



Variables of Interest Drilldown for Insurgency in Philippines
Initial values set to February 2011
(Performing variables in black text)



DARPA's ICEWS program seeks to develop a comprehensive, integrated, automated, generalizable, and validated system to monitor, assess, and forecast national, sub-national, and international crises in a way that supports decisions on how to allocate resources to mitigate them. ICEWS will provide key decision makers with a powerful, systematic capability to anticipate and respond to stability challenges in countries or regions of interest; allocate resources efficiently in accordance to the risks they are designed to mitigate; and track and measure the effectiveness of resource allocations toward end-state stability objectives, in near-real time.

ICEWS' mixed methods approach to instability forecasting combines heterogeneous statistical and agent-based models in an innovative model integration framework with an aggregate forecast accuracy of greater than 80 percent. These models are provisioned in near real-time from over 100 data sources, including 75 international and regional newsfeeds. The coded event data is presented to decision makers through an interactive, customizable, web-based portal featuring time series, map-based, and other views. Model forecasts are presented through a variety of visualizations supporting drilldown to foster trust in models through transparency.

(Approved for Public Release—Distribution Unlimited)

DARPA LOCKHEED MARTIN

Mitigate

A. Goals

Understanding of the battlefield and the ability to forecast the consequences of actions drive the development of COAs and choices among them. Currently, DoD handles the required transformation and reinterpretation of sociocultural behavior factors and conditions into options for COAs as a series of requests for information. This demands real-time human mediation between a decision maker's information needs and available sources of information, and calls for human-to-human iterations and mutual adjustment—all costly in time and resources.

A mature Mitigate capability will allow planners and commanders to use forecasting models in an exploratory fashion to identify those COAs that are more and less sensitive to various factors and conditions of sociocultural behavior. They will also be able to identify, simulate, forecast, and measure the interactive effects of kinetic and non-kinetic COAs. In general, COAs will be characterized by:

- Robustness: mission goals are achievable across a wide range of conditions
- Completeness: evaluated factors and conditions account for most of the known data
- Accuracy: model representations of factors and conditions address the known ranges of values and operationalize them in all plausible fashions
- Adaptability: early action stages of the COAs provide information useful for improving later stages
- Agility: COAs can be quickly adapted to changing environments
- Reliability: COAs produce repeatable successful outcomes from the same initial conditions

Different echelons and domains will interact through consistent computer-supported displays and interfaces that will still be tailored to each echelon's and domain's needs. Efficient transformation and reinterpretation of data will be aided by computer ontologies that enable interoperability among data collection systems, situation awareness systems supporting intelligence, and option awareness systems supporting operational planning and decision making. This will promote the completeness and accuracy of the data supporting the forecasting models that will drive decision making.

B. Leading Challenges

Complexity presents the defining challenge to a mature Mitigate capability. The range of plausible outcomes associated with alternative COAs is vast, with

each outcome fed by a multifaceted and highly variable set of factors. Human cognitive limits restrict decision makers' ability to consider the needed range of plausible outcomes. For similar reasons, it is difficult to track and verify the effects of the COAs implemented. Methods available for isolating sociocultural behavior signals of interest are evolving, but remain relatively limited.

Complicating the picture still further is that non-kinetic COAs are becoming more widely used in complex operations such as IW, COIN, and SSTR, where the primary objective is to create an impact on general populations rather than on armed forces. These COAs are less well understood and more difficult to simulate, and their effects have proven harder to measure and assess. The challenges are compounded because non-kinetic COAs are increasingly being planned and executed as part of what may be called the comprehensive approach to operations. The comprehensive approach means that the military must operate synchronously alongside other actors with widely divergent resources, organizational structures, missions, goals and objectives, methods, standards, and competencies.

Sociocultural behavior data, computational models, and improved decision support systems have already made a difference in DoD's ability to develop and track the effects of alternative COAs. Persistent challenges center on the instantiation of behavior in models at multiple levels of granularity (see the earlier discussion under Detect), the difficulty of translation between military COAs and social/behavioral science-based models, the need for collaboration and coordination in decision support, and the overall approach to COAs decision making.

Two of the crucial processes in applying sociocultural theory and models to support planning and decision making are translating viable COAs into the sociocultural theoretical or model framework, and then translating the results of the COAs analysis back into a military framework. The initial step is selecting the right models to help assess the situation at hand. This is critical, because the choice of a specific model affects the time horizon over which the forecasts from the model apply, the match between the model's level of detail and the questions being asked, and of course the relevance of the model's constructs to those questions. The subsequent translation steps are complicated by the fact that most of the sociocultural models available today come from a non-military frame of reference. DoD requires a synthesis of expert knowledge about the models, knowledge about the specific information requirements, and subject matter expertise about the area of operations.

The need for multiple forms of expertise likely means multiple experts—and thus collaboration and coordination become issues to manage. Determining the implications for an operational objective of a change in the attitude of software

agents in a model requires modeling expertise (to understand the difference between changes in one agent versus another), psychological expertise (to translate from the model to human constructs), and operations expertise (to translate from human constructs into possible COAs). Choreographing the requisite expertise and organizations has technical aspects. For instance, information systems must be able to capture the aspects of each translation (which COAs were translated into what values of what parameters), and then use that information to inform both the analysis of the modeling results and future translations.

The current emphasis on optimal decision making in the military—i.e., pursuing a COA that yields the best possible outcome—also presents a challenge. Under the kind of deep uncertainty[38] that characterizes sociocultural behavior, multiple plausible futures are possible, making it problematic to select an optimal strategy. In these circumstances, commanders and other decision makers would, ideally, shift from seeking optimality to seeking robustness—meaning the COA that has the greatest chance of success across multiple possible futures. This shift in approach is not trivial, and runs counter to conventional military practice. The core approach to decision making has significant implications for how to support that decision making, including the most appropriate data, methods, and tools to apply.

C. Priorities

A number of programs and organizations have helped build DoD capacity to efficiently generate alternative outcomes in the area of sociocultural behavior and measure the effects of COAs on those outcomes. AFRL continues to mature and evolve its National Operational Environment Model (NOEM), which includes a module for conducting what-if analysis of alternative COAs (see Spotlight). USACE has collaborated with the U.S. Institute of Peace and the U.S. Army Peacekeeping and Stability Operations Institute (PKSOI) to develop Measuring Progress in Conflict Environments (MPICE), a hierarchical metrics system that offers a comprehensive framework for measuring progress during stabilization and reconstruction operations. ARL HRED, ARI, and the U.S. Army Engineering Research and Development Center recently launched an applied research effort focused on understanding and modeling the cognitive aspects of sociocultural influences on soldier/commander decision making and communication.

Given the importance of collaboration to effective COA selection and measurement, DoD must have systems that support shared sensemaking and group decision making. This demands systems that support collaborative behaviors such as synchronization and establishing and preserving common ground.

SPOTLIGHT ON NATIONAL OPERATIONAL ENVIRONMENT MODEL (NOEM)

The NOEM is a strategic analysis/assessment tool that provides insight into the complex state space (as a system) that is today's modern operational environment. NOEM supports baseline forecasts by generating plausible futures based on the current state. It supports what-if analysis by forecasting ramifications of potential "Blue" actions on the environment. NOEM also supports sensitivity analysis by identifying possible leverage points in support of the Commander that resolves forecasted instabilities, and by ranking sensitivities in a list for each leverage point and response. NOEM can be used to assist decision makers, analysts and researchers with understanding the inner workings of a region or nation-state, the consequences of implementing specific policies, and the ability to plug in new operational environment theories and models as they mature. The architecture of NOEM consists of three major components:

- Model Development Environment (MDE)
- Baseline Forecaster
- Experiment Manager

The latter provides an analytical capability to exercise the model, permits what-if analysis, and provides a plug-in environment that allows for easy integration of future advanced analysis tools.

Hybrid models capable of forecasting sociocultural behavior at multiple levels of abstraction will be needed to drive improved understanding and robust planning.

The shift to robust adaptive planning will depend on tight coupling between sociocultural data analysis and modeling. One key to such coupling is new visualizations that enable decision makers to navigate the terrain of the plausible futures generated by models. A recent ONR BAA solicited new research on how visualization can deal with the most challenging issues of sociocultural behavior data—its sparseness, volatility, varying validity, complexity, and uncertainty. ASD(R&E) also supports new work in data mining that will help decision makers extract the crucial factors and relationships that drive better and worse outcomes.

DOD will need hybrid models that enable decision makers to conduct multiple "what if" simulations that drive improved understanding and robust planning. Through its PRISM project and other efforts, the HSCB Modeling Program is advancing the state of the practice in hybrid modeling. In the future, large-scale agent-based simulations should help elucidate social behavioral responses; these simulations would be most valuable if they include cognitively realistic agents. This is an emerging area of research, with the OSD SBIR Program supporting some important work.

Projects should emphasize research to build understanding of possible non-kinetic actions, indicators of impacts of those actions, methods for collecting data on those indicators, and techniques for analyzing the effects of COAs on the operational environment. OSD can build on its participation in The Technical Cooperation Program (TTCP), a research partnership among the United States, United Kingdom, Canada, Australia, and New Zealand. Included among TTCP efforts is an action group focused on the comprehensive approach to operations. DoD would also benefit from continued participation in various NATO Research and Technology Organization panels.

Clearly, the kinds of systems outlined here to support decision making must be designed to the best human factors standards, so that they are as easy as possible to learn and use. Even so, only complex tools can deal with complex planning and analysis and display complex information about complex situations. It will be important to extend the kinds of training required to prepare commanders to read and use displays and tools for decision making and monitoring the kinetic battlespace.

Figure 7 presents abbreviated versions of the technical areas of opportunity just discussed in the full Sociocultural Capability Areas framework.

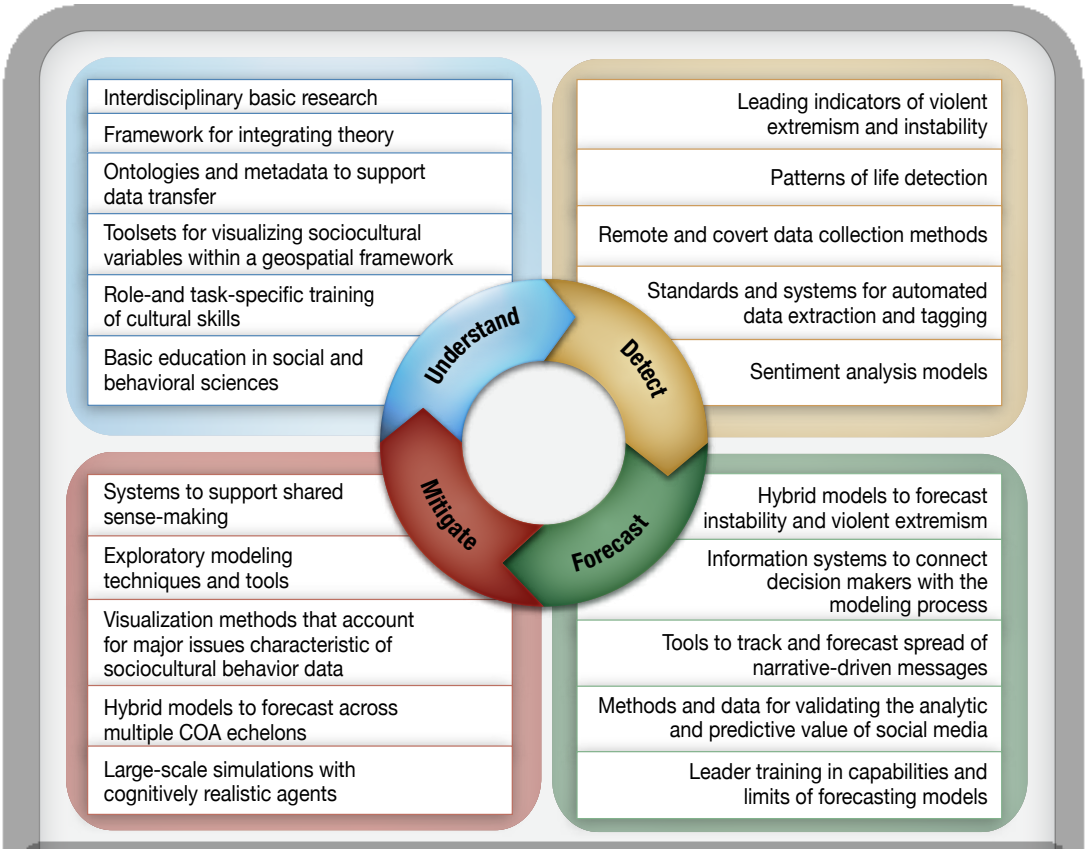
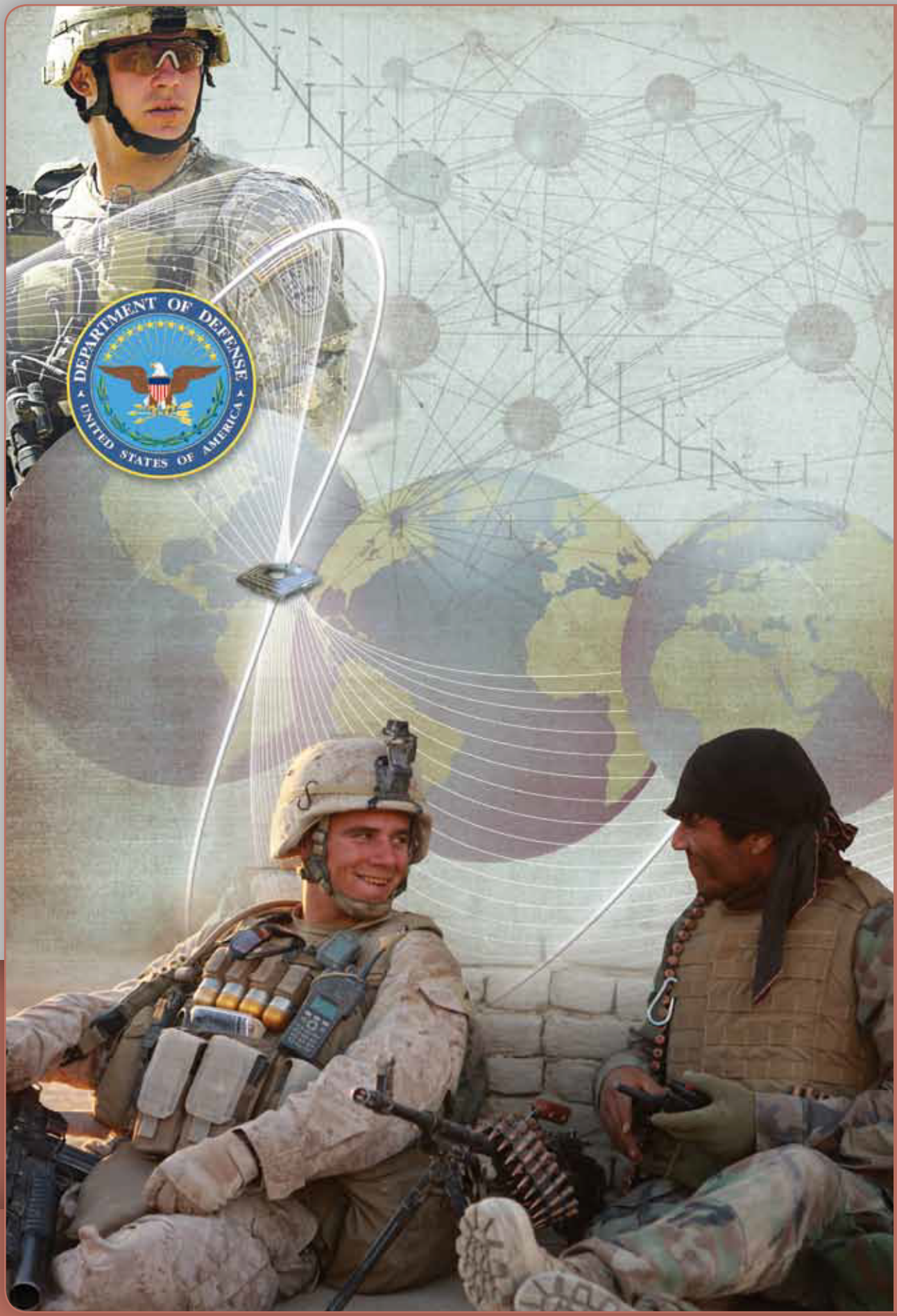


Figure 7. Areas of Opportunity

Conclusion

This section has emphasized needs that DoD should address for long-term success. As noted, in many cases innovative work is already underway, and the imperative is to sustain and extend that work. In other cases, the needs are gaps that ideally will be filled. Section VI offers a set of recommendations for a long-term way forward.



Conclusion

VI. Conclusion

The U.S. Armed Forces have an unprecedented need for advanced capabilities to understand and forecast sociocultural behavior as it bears on development and execution of effective COAs across the spectrum of military operations. Those capabilities must be developed and sustained by a DoD-wide R&E enterprise, appropriately tailored to the needs of individual services, and directed at meeting the nation's strategic challenges. This paper has articulated a vision for DoD capability, presented a framework for sociocultural behavior R&E, and identified many priorities for work to develop knowledge products, data, tools, and training. Figure 8 provides a summary view of the place that sociocultural behavior R&E can have in the overall mission and strategic context.

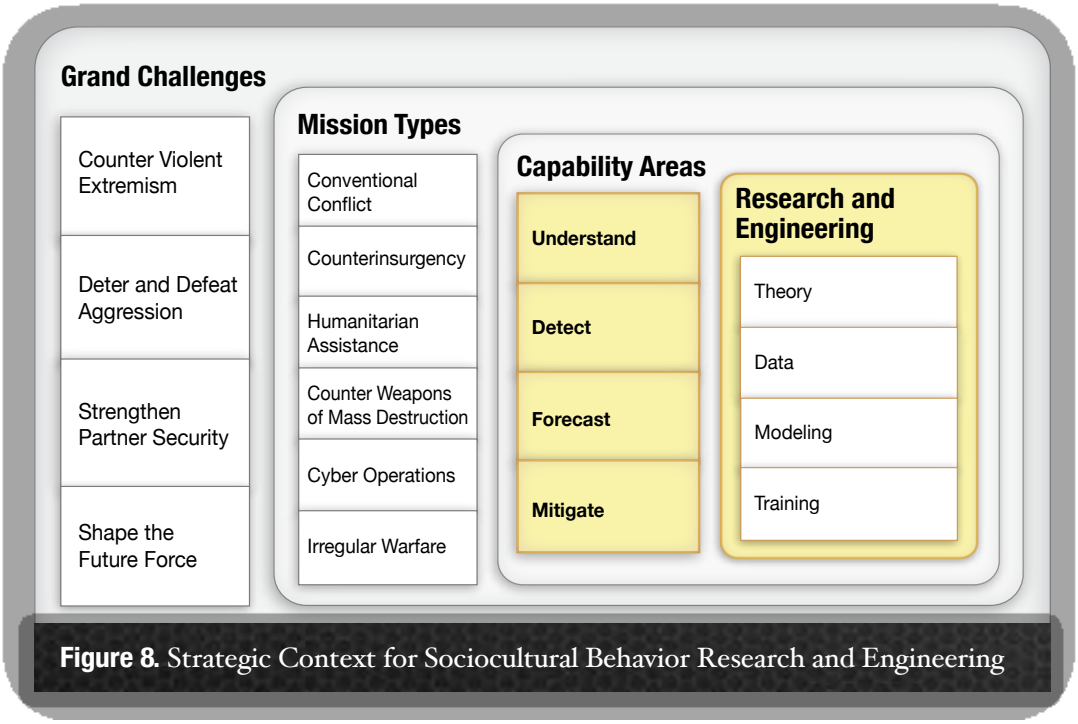


Figure 8. Strategic Context for Sociocultural Behavior Research and Engineering

Significant progress has already been made toward building the DoD's capacity in this space, but many challenges and opportunities remain. Based on discussion and analysis presented in this paper, the guidelines presented below highlight some of the best opportunities for helping DoD extend its success in this domain.

1. Increase interdisciplinary basic research that will build foundational understanding of sociocultural behavior in military contexts, and enable applied research and development.

2. Build quantitative scientific underpinnings for a DoD sociocultural behavior capability, with the goal of achieving rigor on par with that of the physical sciences. This would include establishing and building consensus on methods for validating and verifying computational models of sociocultural behavior as it applies to military operations.

3. Establish and sustain a DoD-wide repository of sociocultural behavior data, along with the ontologies, standards, and systems necessary to ensure enterprise-wide access for military intelligence and operations analysis.

4. Develop new methodologies, tools, and training that will measurably increase the military's capacity to collect valid sociocultural behavior data in denied environments and those with low levels of literacy and/or information technology penetration.

5. Develop technologies that enable more comprehensive and higher fidelity automated exploitation of open source material, with particular emphasis on social media and integration across multiple modalities (e.g., tweets versus newswire versus blogs).

6. Research and engineer a "social radar"— a global and persistent indications and warnings capability consisting of integrated technologies for detecting and monitoring operationally relevant sociocultural behavior signatures. This capability would include data, resources, tools, and training that will enable rapid recognition, tracking, and countering of adversarial narratives. It will also serve as a framework for the integration of other capabilities.

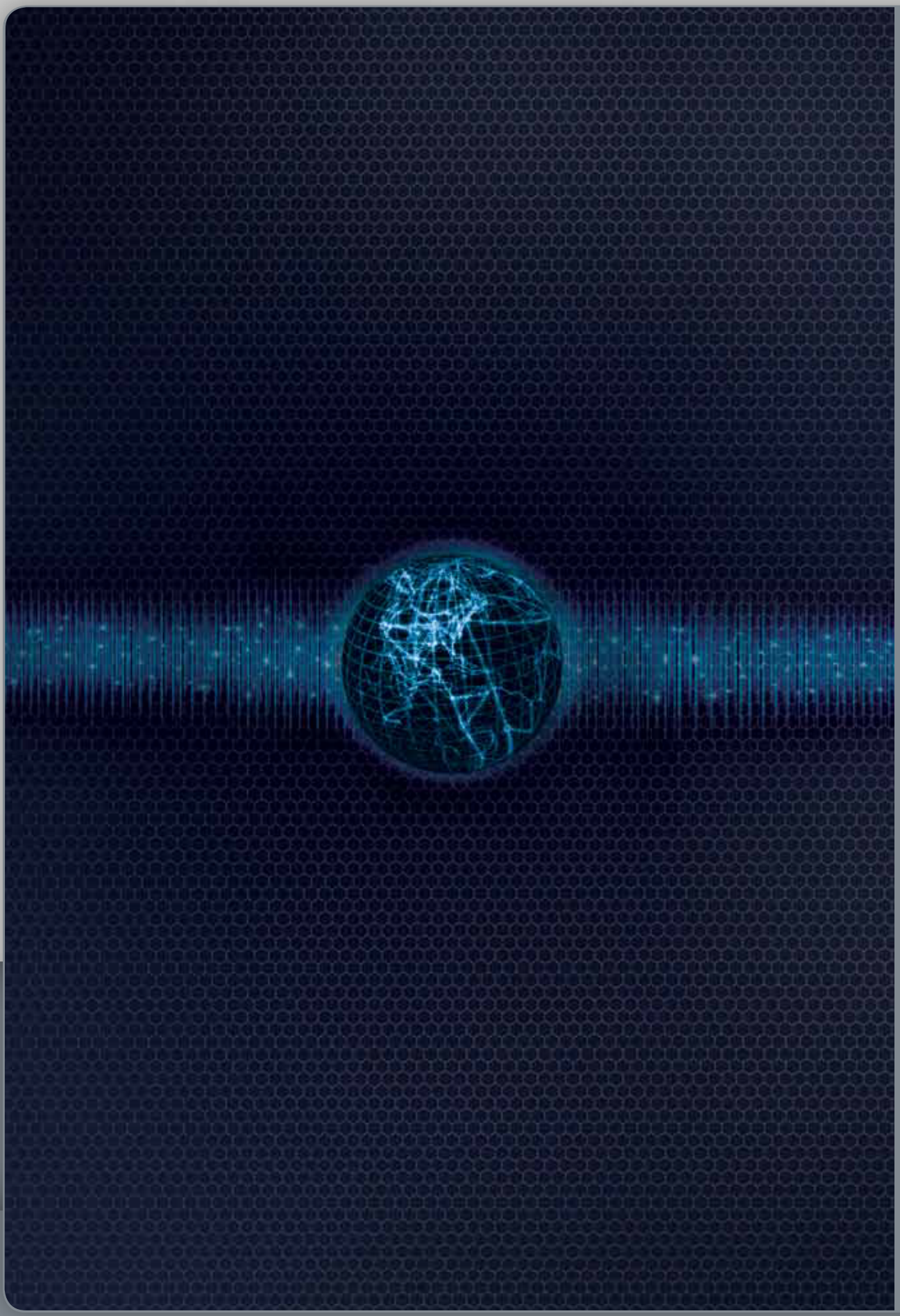
7. Engineer hybrid modeling systems (integrating game-theoretic, system-dynamic, and agent-based modalities) that operational decision makers can use to forecast the emergence of instability and violent extremism and to explore alternative COAs for both types of challenges.

8. Develop and validate metrics for gauging effects of non-kinetic COAs, along with tools and systems for planning integrated implementation of kinetic and non-kinetic COAs.

9. Design and engineer decision support system interfaces that provide visual analytics of sociocultural behavior integrated with conventional and geospatial data layers, and enable data drill-down.

10. Foster and support venues designed to share information, assess progress in the state of the art and, importantly, enable collaboration to enhance multi-disciplinary approaches to problems and challenges.

In the simplest circumstances, human behavior defies easy understanding or reliable forecasting. In the context of contemporary mission demands, that behavior—driven by a variety of social and cultural variables—engenders complexity in situation awareness and the military decision space that an unaided human cannot process. Better data, methodologies, technology, and training are essential to build understanding, enable operationally relevant forecasting, and support effective decision making. As has been stressed, models and other technology must be rooted in well-validated, interdisciplinary theory and must be applied appropriately, with full awareness of their strengths and limitations. Ultimately, the value of the DoD sociocultural behavior R&E effort will be measured by the extent to which it helps the United States meet the grand challenges of warfighters and interagency partners, and how it helps to develop the future force—warfighters, analysts, and leaders who can out-think and out-innovate adversaries by bringing all instruments of power to bear.



Appendix A. Sociocultural Behavior Research and Engineering Community

Appendix A. Sociocultural Behavior Research and Engineering Community

The information in this section is derived from publicly available materials produced by the described offices and programs, retrieved from online sources in August 2011.

Office of the Secretary of Defense (OSD)

- **Assistant Secretary of Defense Research and Engineering (ASD(R&E))**
  The Assistant Secretary of Defense for Research and Engineering provides S&T leadership throughout the Department of Defense; shaping strategic direction and strengthening the research and engineering coordination efforts to meet tomorrow's challenges. The Human Performance, Training, and BioSystems Directorate (HPT&B) of ASD R&E provides executive and technical leadership and authoritative scientific and technical advice on the entire DoD effort in the area of HPT&B to provide future forces the requisite knowledge, science, and technology to support critical warfighting capabilities. The HSCB Modeling Program is among the initiatives overseen by HPT&B.

- **Defense Advanced Research Projects Agency (DARPA)**
  DARPA was established to prevent strategic surprise from negatively impacting U.S. national security and create strategic surprise for U.S. adversaries by maintaining the technological superiority of the U.S. military. To fulfill its mission, the Agency relies on diverse performers to apply multi-disciplinary approaches to both advance knowledge through basic research and create innovative technologies that address current practical problems through applied research. The DARPA Information Innovation Office (I2O) supports a number of programs bearing on sociocultural behavior R&E, including the Integrated Crisis Early Warning System (ICEWS), a system to monitor, assess, and forecast (in near real time) movements toward or away from stability at the nation-state level. Another initiative is the Strategic Social Interactions Modules or "Good Stranger" program, which was created to research and develop novel methods to train warfighters in the fundamental human dynamics skills that they need to approach and enter into any social encounter, regardless of its cultural, linguistic, or other particular contextual parameters.

- **Under Secretary of Defense for Intelligence (USD(I))**
  The Office of the Under Secretary of Defense for Intelligence is the principal staff element of the Secretary of Defense for matters relating to intelligence. The Under Secretary also serves as the Director of Defense Intelligence, acting as the primary military intelligence advisor to the Office of the Director of National Intelligence (ODNI). USD(I) chartered and chairs the Defense Intelligence Socio-Cultural Dynamics Working Group (DISCCC), which pursues the establishment of sociocultural capabilities that meet the requirements of commanders, staffs, and policymakers at all levels of DoD.

- **Under Secretary of Defense for Policy (USD(P))**
  USD(P) works to provide responsive, forward-thinking, and insightful policy advice and support to the Secretary of Defense, and the Department of Defense, in alignment with national security objectives. USD(P) works with the Under Secretary of Defense for Acquisition, Technology and Logistics USD(AT&L) to lead the Minerva Research Initiative. The Minerva Initiative is a DoD-sponsored, university-based social science research initiative launched by the Secretary of Defense in 2008 focusing on areas of strategic importance to U.S. national security policy. The goal of the Minerva Initiative is to improve DoD's basic understanding of the social, cultural, behavioral, and political forces that shape regions of the world of strategic importance to the U.S. USD(P) also has oversight and management responsibility for U.S. information operations and is strategic communication co-lead with the Assistant Secretary of Defense for Public Affairs.

- **Principal Deputy Under Secretary of Defense for Personnel and Readiness (PDUSD(P&R))**
  PDUSD(P&R) is the principal staff element of the Secretary of Defense for Total Force Management as it relates to readiness; National Guard and Reserve component affairs; health affairs; training; and personnel requirements and management, including equal opportunity, morale, welfare, recreation, and quality of life matters. PDUSD(P&R) administers the Defense Language Office (DLO). The DLO's mission is to provide strategic direction and programmatic oversight to the military departments, defense field activities and the Combatant Commands on present and future requirements related to language, regional expertise, and culture.

The U.S. Armed Services

- **Air Force Research Laboratory - Office of Scientific Research (AFOSR)**
  AFOSR works to expand the horizon of scientific knowledge through its leadership and management of the Air Force's basic research program. AFOSR's mission is to support Air Force goals of control and maximum utilization of air, space, and cyberspace. AFOSR accomplishes its mission by investing in basic research efforts for the Air Force in relevant scientific areas. Central to AFOSR's strategy is the transfer of the fruits of basic research to industry, the supplier of Air Force acquisitions; to the academic community which can lead the way to still more accomplishment; and to the other directorates of AFRL that carry the responsibility for applied and development research leading to acquisition. In the Mathematics, Information, and Life Sciences Directorate is the Collective Behavior and Socio-Cultural Modeling program. This program is devoted to developing a basic research foundation for using computational and modeling approaches to study behavior of groups and communities. This program seeks fundamental understanding of the interactions between demographic groups both to create understanding for technology developments for enhanced cooperation, such as operational decision making with coalition partners, and to explain and predict outcomes between competing factions within geographic regions.

- **Air Force Research Laboratory - Human Effectiveness Directorate (RH)**
  The Anticipate and Influence Behavior Division (RHX) develops and researches human-centered technologies, processes and organizational strategies for cyber, Intelligence, Surveillance and Reconnaissance (ISR), and information/influence operations. Research supports Air Force warfighters by improving situational awareness and threat detection through the understanding and exploitation of human "patterns of life," and by conducting advanced technology development to predict adversarial activities, derive courses of action, and ultimately understand, influence and defeat enemy behavior. The branches in this division are: Behavior Modeling (RHXB), Information Operations and Applied Mathematics (RHXM), and Sensemaking and Organizational Effectiveness (RHXS). One major output of AFRL RH is the National Operational Environment Model (NOEM).

- **U.S. Army Corps of Engineers (USACE)**
  USACE works to provide vital public engineering services in peace and war to strengthen our Nation's security, energize the economy, and reduce risks from disasters. USACE, the OSD Rapid Response Technology Office, and the U.S. Agency for International Development (USAID) funded the Measuring Progress in Conflict Environments (MPICE)—a hierarchical metrics system of outcome-based goals, indicators, and measures that offers a comprehensive framework for measuring progress during stabilization and reconstruction operations. The U.S. Army Geospatial Center (AGC), one of the USACE Centers of Expertise, provides a single focal point for the Army Geospatial Enterprise, focusing on all Army geospatial information and services functions from policy to warfighting. The AGC mission is to coordinate, integrate and synchronize geospatial information requirements and standards across the Army, develop and field geospatial enterprise enabled systems and capabilities to the Army and the Department of Defense, and to provide direct geospatial support and products to Warfighters. AGC has been a leader in the human dynamics arena since 2006. In support of the OSD HSCB Modeling Program, AGC has carried out and tested HSCB technologies and capabilities, developed a sociocultural data model, and established a cultural web-mapping portal.

- **U.S. Army Research Institute for the Behavioral and Social Sciences (ARI)**
  ARI is a leading research institute for training, leader development, and soldier research and development. The ARI mission is to maximize individual and unit performance and readiness to meet the full range of Army operations through advances in the behavioral and social sciences. Recently, ARI introduced a new program of research on measures and methods to enhance cultural capability for stability, security, reconstruction, and transition missions. The goal of this program, Learning and Operating in Culturally Unfamiliar Settings (LOCUS), is to identify, assess, and develop the knowledge, skills, and abilities that enable soldiers to perform their missions in diverse sociocultural settings.

- **U.S. Army Research Laboratory (ARL)**
  ARL, of the U.S. Army Research Development and Engineering Command (RDECOM), is the Army's corporate, or central, laboratory. Its diverse assortment of unique facilities and dedicated workforce of government and private sector partners make up the largest source of world-class integrated research and analysis in the Army. The ARL Human Research and Engineering Directorate (ARL HRED) recently launched an applied research effort focused on understanding and modeling the cognitive aspects of sociocultural

influences on soldier/commander decision making and communication. ARL HRED will work to identify sociocultural influences on decision making and communication and build a cognitive framework representing them, and then develop and validate guiding principles and concepts for effective depiction and understanding of relevant sociocultural information. In this work, ARL HRED partners with ARI and the U.S. Army Engineering Research and Development Center.

- **U.S. Army Training and Doctrine Command (TRADOC)**
  TRADOC develops the Army's soldier and civilian leaders and designs, develops, and integrates capabilities, concepts and doctrine in order to build an Army that is a versatile mix of tailorable, adaptable, and networked organizations. TRADOC leads the OSD-supported Human Terrain System (HTS) project to provide sociocultural teams to commanders and staffs at the Army Brigade Combat Team, Marine Corps Regimental Combat Team, Army Division/ Marine Expeditionary Force, and Corps/Theater levels, in order to improve the understanding of the local population and apply this understanding to the Military Decision-Making Process. Another element of TRADOC, the Intelligence Support Activity (TRISA), is leading the effort to stand up a Cultural Knowledge Consortium (CKC). The (CKC) will provide a Socio-cultural Knowledge Infrastructure (SKI) to operationalize access to and leverage multi-disciplinary worldwide social science expertise for collaborative engagement in support of Combatant Command (COCOM) sociocultural analysis requirements.

- **Office of Naval Research (ONR)**
  ONR coordinates, executes, and promotes the science and technology programs of the United States Navy and Marine Corps. ONR is among the service leaders in sociocultural behavior basic (6.1) and applied (6.2) research, and advanced technology development (6.3). Work is led by two departments, Expeditionary Maneuver Warfare & Combating Terrorism (Code 30) and Warfighter Performance (Code 34). The Code 30 ONR Human Social, Culture and Behavior Modeling Program invests in research on building capability through the development of a knowledge base, building models, and creating training capacity in order to understand, predict, and shape human behavior cross-culturally. The Program lead is also Deputy Director for the OSD HSCB Modeling Program. In Code 34, the Human and Bioengineered Systems Division (341) supports basic through applied research in a variety of areas, including Social, Cultural and Behavioral Modeling. Affordable Human Behavior Modeling (AHBM) is a multidisciplinary program of basic and applied research, involving cognitive and computer science, aimed at the

creation of techniques and tools to increase the affordability and usability of human behavior models for application as computer-generated forces (CGFs) or intelligent agents in simulations for military training and analysis. ONR also sponsors the Multidisciplinary University Research Initiative (MURI), which provides grants for basic science and/or engineering research by teams of investigators that intersect more than one traditional science and engineering discipline. Grants support a wide variety of efforts, from traditional engineering projects to social scientific research in areas such as network analysis and game theory. Other MURI sponsors include the Army Research Office (ARO), and AFOSR.

Joint Organizations

- **Combatant Commands (COCOMs)**
  Each one of the Unified Combatant Commands is a command with a broad continuing mission under a single commander and composed of significant assigned components of two or more Military Departments that is established and so designated by the President, through the Secretary of Defense with the advice and assistance of the Chairman of the Joint Chiefs of Staff. Given their leading role in strategic engagement and building partner capacity in their respective Areas of Operation (AOR), the COCOMs are increasing their attention to sociocultural behavior data development and analytic capabilities. Some have participated in programs and/or stood up analytic cells focused on areas that include patterns of life analysis, countering violent extremism, social media, forecasting instability, social networks, and others.

- **Combating Terrorism Technical Support Office (CTTSO)**
  CTTSO fields rapid combating terrorism solutions to meet continually evolving requirements defined by end users. Working closely with more than 100 Government agencies, State, and local government, law enforcement organizations, and national first responders, CTTSO leverages technical expertise, operational objectives, and interagency sponsor funding. This collective approach to resource and information sharing positions the CTTSO to gather front line requirements that service multiple users — a distinct advantage in the combating terrorism community. CTTSO operates as a program office under the Assistant Secretary of Defense (ASD) for Special Operations and Low-Intensity Conflict (SO/LIC). CTTSO sponsors the Irregular Warfare Support Program (IWS), which develops adaptive and agile ways and means to support irregular warfare in current and evolving strategic environments. IWS supports joint, interagency, and international partners who conduct irregular

warfare through indirect and asymmetric approaches with solutions to erode an adversary's power, influence, and will. IWS identifies material and nonmaterial solutions via operational analysis, concept development, field experimentation, and spiral delivery of capabilities to defeat the motivations, sanctuaries, and enterprises of targeted state and non-state actors.

- **Joint Improvised Explosive Device Defeat Organization (JIEDDO)**
  JIEDDO works to support Combatant Commanders in their counter-IED efforts. To achieve that goal, the organization funds, develops, and fields initiatives and programs designed to identify, uncover and disrupt enemy IED networks. From a strategic perspective, these offensive efforts are designed to substantively decrease the enemy's ability to quickly adapt and alter IED designs and employment methods. JIEDDO also provides a broad level of connectivity with the science and technology communities within its extended partnership networks to support the full range of military and national countermeasures to IED threats.

Associated and Other Agencies

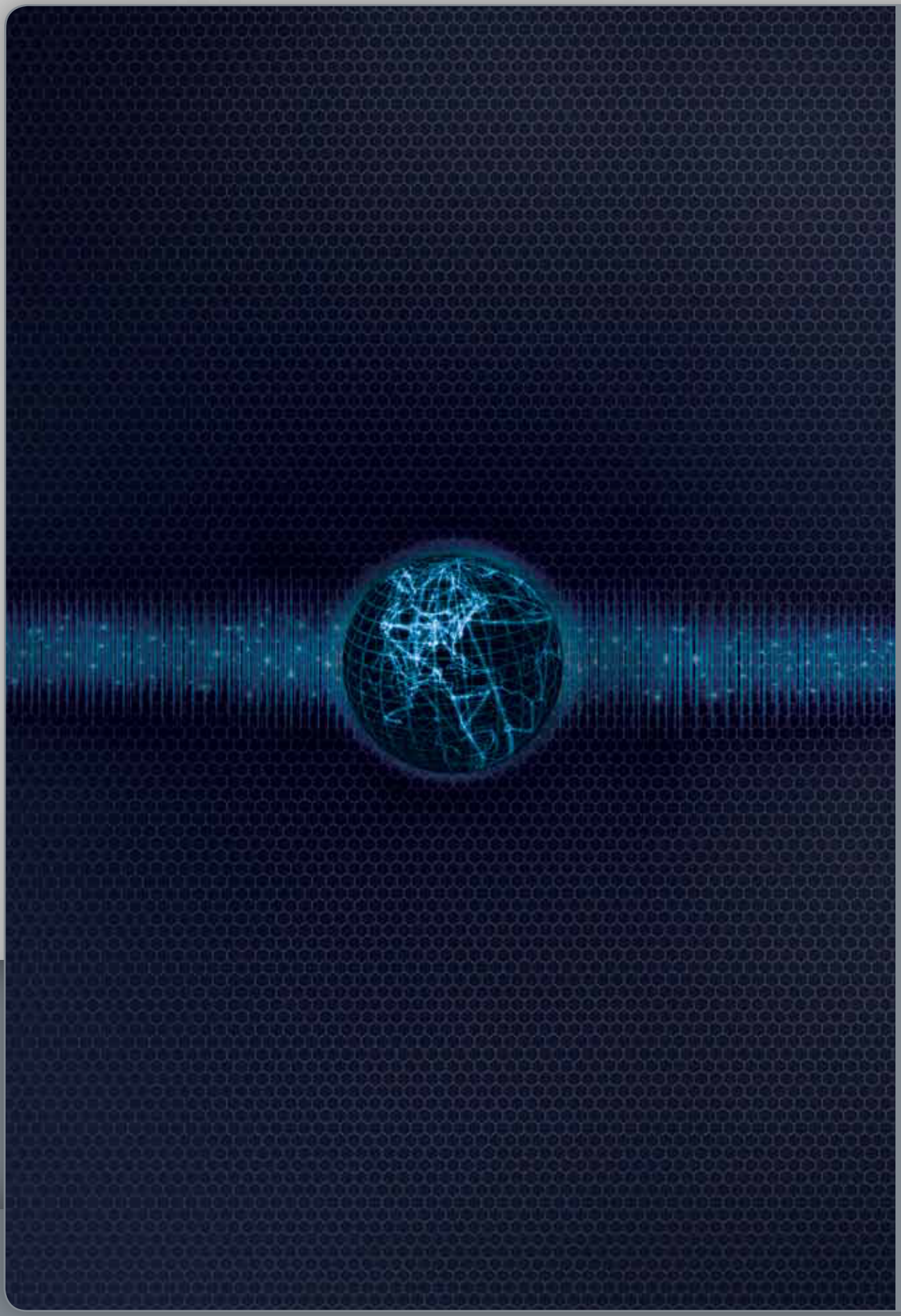
- **Department of Homeland Security (DHS)**
  The DHS mission is to ensure a homeland that is safe, secure, and resilient against terrorism and other hazards. There are five DHS missions: prevent terrorism and enhance security; secure and manage our borders; enforce and administer our immigration laws; safeguard and secure cyberspace; and ensure resilience to disasters. The mission of the Human Factors/Behavioral Sciences Division of the DHS Science and Technology Directorate is to advance national security by developing and applying the social, behavioral, and physical sciences to improve identification and analysis of threats, to enhance societal resilience, and integrate human capabilities into the development of technology. Specifically, the Division addresses three thrust areas: Personal Identification Systems, Human Technology Integration, and Social and Behavioral Threat Analysis (SBTA).

- **Intelligence Advanced Research Projects Activity (IARPA)**
  The Intelligence Advanced Research Projects Activity (IARPA) invests in high-risk/high-payoff research programs that have the potential to provide our nation with an overwhelming intelligence advantage over future adversaries. IARPA has three Program Offices; one of these, the Incisive Analysis Office, focuses on maximizing insight from the information collected, in a timely fashion. Capabilities pursued include advanced data analysis tools and techniques that can handle large volumes of multiple and disparate sources of

information, the use of virtual worlds and shared workspaces to dramatically enhance insight and productivity, and advanced tools and methods that incorporate socio-cultural and linguistic factors into analyses. IARPA sponsors several programs conducting research relevant to building defense-related capabilities in sociocultural behavior. The Socio-Cultural Content in Language (SCIL) Program explores and develops novel designs, algorithms, methods, techniques and technologies to extend the discovery of the social goals of members of a group by correlating these goals with the language they use. The Aggregative Contingent Estimation (ACE) program develops and tests methods for generating accurate and timely probabilistic forecasts, leading indicators, and early warning for events, by aggregating the judgments of many widely-dispersed analysts. The program focuses on developing and testing methods that elicit forecasts from analysts, aggregate these forecasts using existing and emerging data about the analysts and their judgments that are predictive of accuracy, and communicate these forecasts to a wide variety of users. The Open Source Indicators Program, started late in 2011, seeks to develop methods for continuous, automated analysis of publicly available data in order to anticipate and/or detect societal disruptions, such as political crises, disease outbreaks, economic instability, resource shortages, and natural disasters.

- **National Science Foundation (NSF)**
  NSF is an independent federal agency dedicated to scientific progress, advancement of national health, prosperity, and welfare, and to securing the national defense. NSF is the funding source for approximately 20 percent of all federally supported basic research conducted by America's colleges and universities. The agency's Directorate for Social, Behavioral and Economic Sciences supports fundamental research and education regarding human behavior, interaction, and social and economic systems, organizations and institutions. Per a Memorandum of Understanding with the Department of Defense, the NSF participates in the Social and Behavioral Dimensions of National Security, Conflict, and Cooperation (NSCC) research activity. Part of the Minerva Initiative, this research activity was created to: (1) develop the DoD's social and human science intellectual capital in order to enhance its ability to address future challenges; (2) enhance the DoD's engagement with the social science community; and (3) deepen understanding of the social and behavioral dimensions of national security issues. In pursuit of these objectives, NSF and DoD have brought together universities, research institutions, and individual scholars for disciplinary, interdisciplinary and collaborative projects addressing areas of strategic importance to national security policy.

- **National Laboratories**
  The Department of Energy's (DOE) National Laboratories and Technology Centers are a system of facilities and laboratories whose purpose is to advance science, and promote the economic and defensive national interests of the United States. Most of the DOE national laboratories are federally funded research and development centers administered, managed, operated, and staffed by private corporations and academic universities. Through the national laboratory system, the DOE provides funding for physics, chemistry, materials science, and other areas of the physical sciences. The U.S. national laboratories have long been an important resource for executing quality research in the physical sciences. Increasingly, those institutions are also leveraging their capacity to conduct leading-edge sociocultural behavior research. Los Alamos, Oak Ridge, Pacific Northwest, and Sandia have all led or been part of research teams supported by the OSD HSCB Modeling Program.



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Appendix B. Sources

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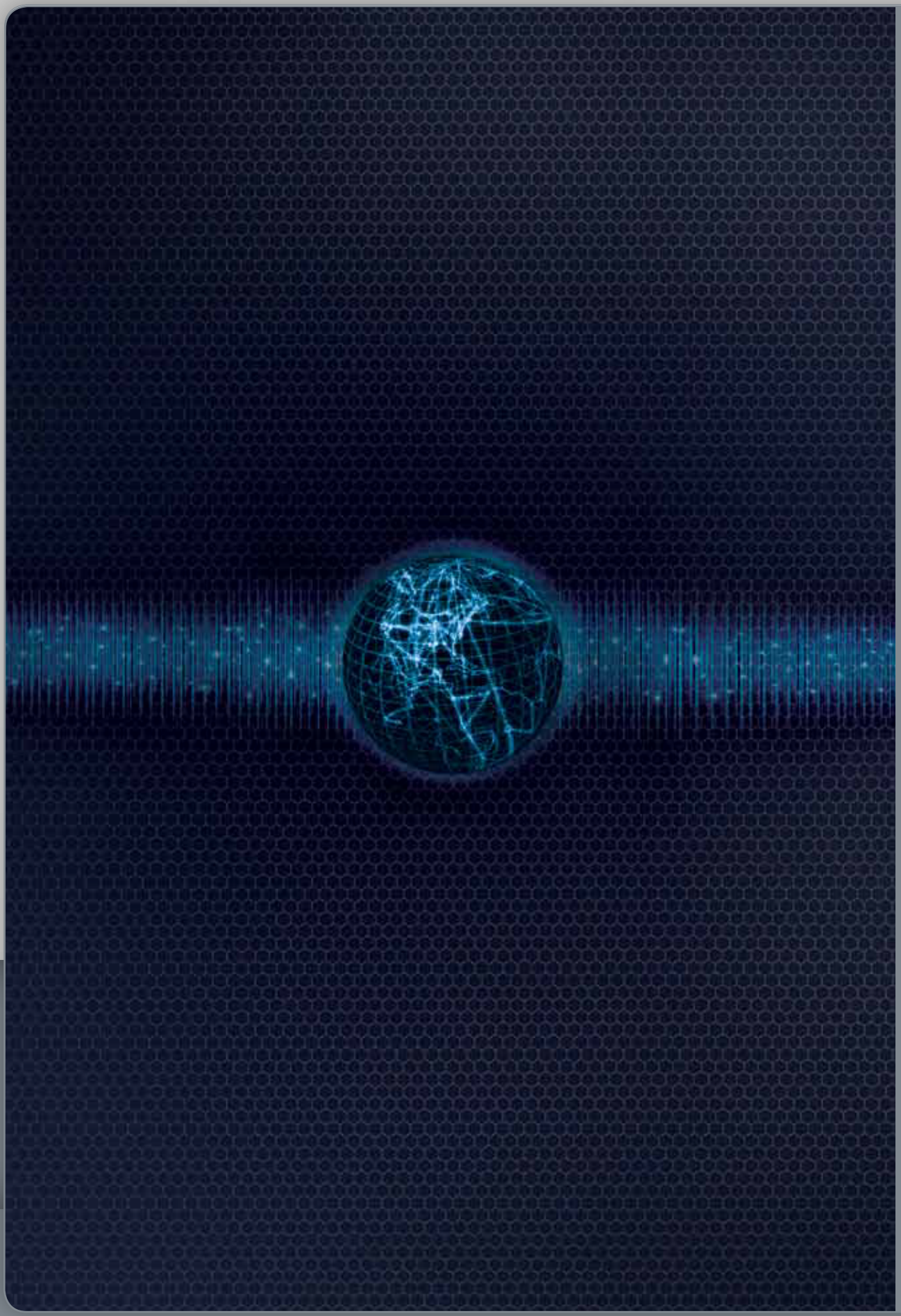

Appendix C. Acronyms

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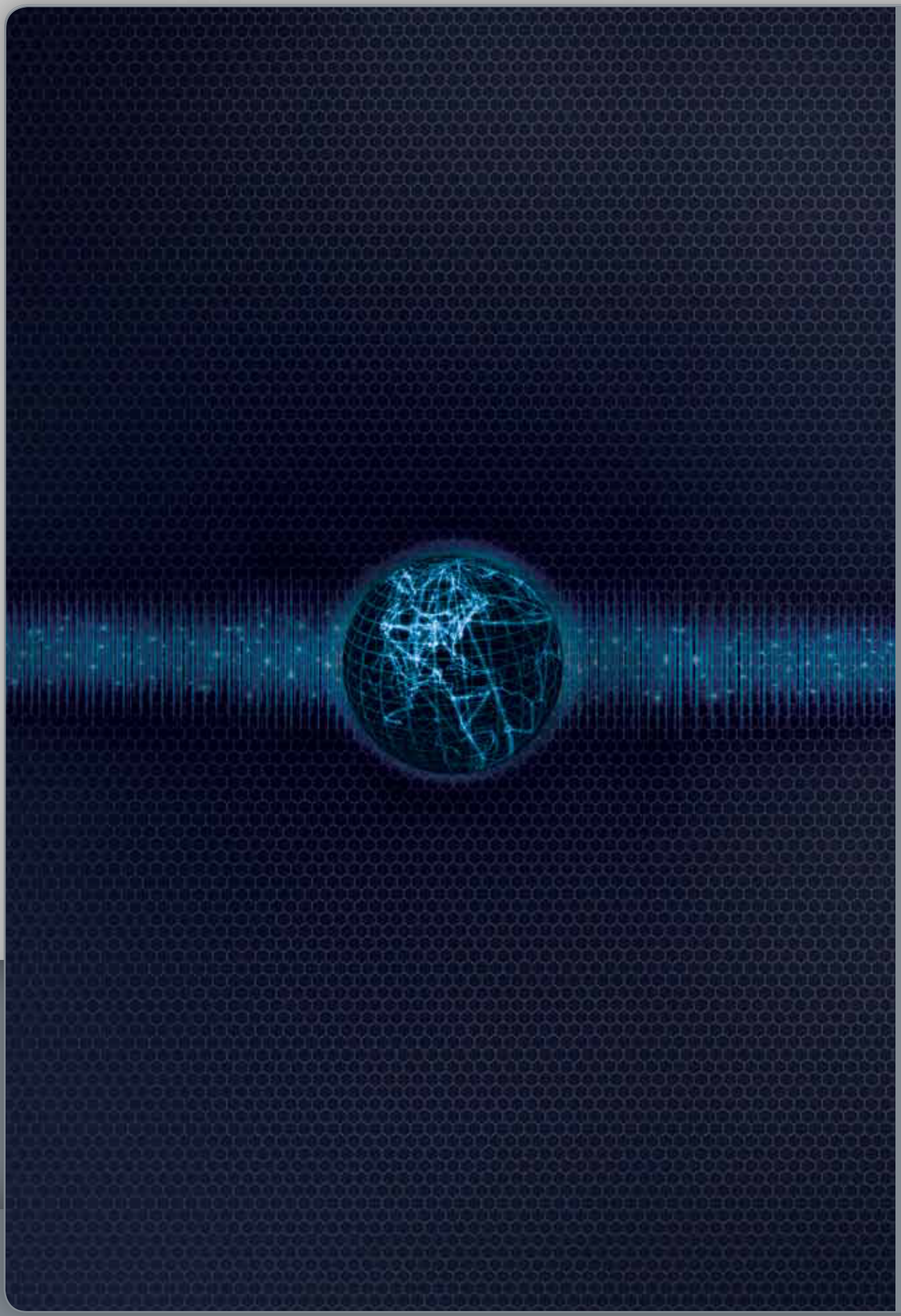
ACE	Aggregative Contingent Estimation
AFOSR	Air Force Office of Scientific Research
AFRL	Air Force Research Laboratory
AFRL RH	Air Force Research Laboratory Human Effectiveness Directorate
AGC	Army Geospatial Center
AHBM	Affordable Human Behavior Modeling
AO	Area of Operations
AOR	Area of Responsibility
ARI	U.S. Army Research Institute
ARL	U.S. Army Research Laboratory
ARL HRED	Army Research Laboratory Human Research and Engineering Directorate
ARO	Army Research Office
ASD	Assistant Secretary of Defense
ASD(R&E)	Assistant Secretary of Defense for Research and Engineering
BAA	Broad Agency Announcement
BCT	Brigade Combat Team
BSC	Building Security Capacity
CA	Comprehensive Approach
CAPE	Cost Assessment and Program Evaluation
CGFs	Computer-Generated Forces
CIG	Consolidated Intel Guidance
CISD	Computational and Information Sciences Directorate
CKC	Cultural Knowledge Consortium
COAs	Courses of Action
COCOMs	Combatant Commands
CoE	Corps of Engineers
COIN	Counterinsurgency
CTTSO	Combatting Terrorism Technical Support Office
C-WMD	Countering Weapons of Mass Destruction
DARPA	Defense Advanced Research Projects Agency
DDR&E	Director of Defense Research and Engineering
DHS	Department of Homeland Security
DIA	Defense Intelligence Agency
DIE	Defense Intelligence Enterprise
DISCCC	Defense Intelligence Socio-Cultural Capabilities Council
DLO	Defense Language Office
DLSC	Defense Language Steering Committee
DNI	Director of National Intelligence
DoD	Department of Defense
DoD S&T EXCOM	DoD Science and Technology Executive Committee
DoDD	Department of Defense Directive
DoS	Department of State

DSB	Defense Science Board
ERDC	Engineering Research and Development Center
FFRDC	Federally Funded Research and Development Center
HADR	Humanitarian Assistance and Disaster Relief
HD	Human Dynamics
HRED	Human Research and Engineering Directorate
HS CoI	Human Systems Community of Interest
HSCB	Human Social Culture Behavior
HTTs	Human Terrain Teams
I2O	Information Innovation Office
IARPA	Intelligence Advanced Research Projects Activity
ICEWS	Integrated Crisis Early Warning System
ICT	Institute for Creative Technologies
IR&D	Internal Research and Development
ISAF	International Security Assistance Force
ISPAN	Integrated Strategic Planning and Analysis Network
ISR	Intelligence, Surveillance and Reconnaissance
IW	Irregular Warfare
IW M&S SCG	Irregular Warfare Modeling and Simulation Senior Coordinating Group
IWSP	Irregular Warfare Support Program
JIEDDO	Joint Improvised Explosive Device Defeat Organization
KMAs	Key Mission Areas
LOCUS	Learning and Operation in Culturally Unfamiliar Settings
LREC	Language, Regional Expertise, and Cultural Experience
MDMP	Military Decision-Making Process
MEF	Marine Expeditionary Force
MISO	Military Information Support to Operations
MPICE	Measuring Progress in Conflict Environments
MURI	Multidisciplinary University Research Initiative
NATO	North Atlantic Treaty Organization
NGO	Nongovernmental Organization
NOEM	National Operational Environment Model
NPS	Naval Postgraduate School
NS CTA	Network Science Collaborative Technology Alliance
NSCC	National Security, Conflict, and Cooperation
NSF	National Science Foundation
ONR	Office of Naval Research
OODA	Observe, Orient, Decide, Act
OSD	Office of the Secretary of Defense
OUSD(AT&L)	Office of the Under Secretary of Defense for Acquisition, Technology and Logistics
PCAs	Potential Capability Areas
PKSOI	Peacekeeping and Stability Operations Institute
POR	Program of Record
PDUSD(P&R)	Principal Deputy Under Secretary of Defense Personnel and Readiness

QDR	Quadrennial Defense Review
R&E	Research & Engineering
RACO	Research and Advanced Concepts Office
RCT	Regimental Combat Team
RDECOM	U.S. Army Research Development and Engineering Command
RDT&E	Research Development Testing and Evaluation
RH	AFRL Human Effectiveness Directorate
RHX	AFRL Anticipate and Influence Behavior Division
RHXB	Behavior Modeling Branch of RHX
RHXM	Information Operations and Applied Mathematics Branch of RHX
RHXS	Sensemaking and Organizational Effectiveness Branch of RHX
ROE	Rules of Engagement
RRC	Reach-back Research Center
S&T	Science & Technology
SBIR	Small Business Innovation Research
SBTA	Social and Behavioral Threat Analysis
SCFs	Service Core Functions
SCIL	Socio-cultural Content in Language Program
SES	Senior Executive Service
SMA	Strategic Multi-Layer Assessment
SNARC	Social Network Analysis Reachback Capability
SO/LIC & IC	Special Operations and Low-Intensity Conflict and Interdependent Capabilities
SPG	Strategic Planning Guidance
SSTR	Support to Stability Transition and Reconstruction
TCO	Total Cost of Ownership
TRAC	TRADOC Analysis Center
TRADOC	Training and Doctrine Command
TRISA	TRADOC Intelligence Support Activity
TTCP	The Technical Cooperation Program
TTPs	Tactics, Techniques and Procedures
USACE	U.S. Army Corps of Engineers
USAFRICOM	U.S. Africa Command
USAID	U.S. Agency for International Development
USCENTCOM	U.S. Central Command
USD(AT&L)	Under Secretary of Defense for Acquisition, Technology, and Logistics
USD(I)	Under Secretary of Defense for Intelligence
USD(P)	Under Secretary of Defense for Policy
USD(P&R)	Under Secretary of Defense for Personnel and Readiness
USEUCOM	U.S. European command
USG	U.S. Government
USPACOM	U.S. Pacific command
USSOCOM	U.S. Special Operations Command
USSOUTHCOM	U.S. Southern Command
WMD	Weapons of Mass Destruction



Endnotes

Endnotes

1. The decision cycle (Observe, Orient, Decide, Act) developed by John Boyd and incorporated in various Service doctrines, including Joint Publication 3–13.1, *Joint Doctrine for Command and Control Warfare* (1996), Appendix A.
2. See *Joint Publication, 3–60, Joint Targeting* (2007).
3. See *Report of the Defense Science Board Task Force on Strategic Communication* (2008).
4. These are the National Military Objectives as specified in the *National Military Strategy of the United States 2011* and based on the *Quadrennial Defense Review* (2010) and *National Security Strategy* (2010).
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18. For further discussion on this point, see *Understanding Human Dynamics*, p. 9.
19. OSD 12401-101, *Memorandum on Strategic Communication and Information Operations* (2011).
20. *Understanding Human Dynamics*, p.10.
21. Flynn, et al. (2010), p.7.
22. *Report of the Defense Science Board Task Force on Defense Intelligence, Counterinsurgency (COIN) Intelligence, Surveillance, and Reconnaissance (ISR) Operations* (2011), p. vii.
23. *U.S. Army Field Manual 3-0* (2008), p.1-1.
24. *Irregular Warfare Joint Operating Concept*, version 2.0.17 (May 2010), p. 5.
25. *Marine Corps Vision and Strategy* (publication date unknown), p. 10.

26. O'Rourke, R. (2011).
27. *Chief Naval Officer's Guidance 2011*, pp. 7–8.
28. *Technology Horizons: Visions for Air Force Science & Technology During 2010–2030* (2010), p. 59.
29. See Alberts and Hayes (2003), p. 89.
30. Focus 2010 and Focus 2011 each attracted more than 600 participants from across the U.S. Government, industry, academia, and from international organizations.
31. *Department of Defense Directive 5134.3* (November 3, 2003).
32. Per *Understanding Human Dynamics*, "…the term 'human dynamics' comprises the actions and interactions of personal, interpersonal, and social/contextual and their effects on behavioral outcomes" (page vii).
33. The decision cycle (Observe, Orient, Decide, Act) developed by John Boyd and incorporated in various doctrine, including *Joint Publication 3-13.1, Joint Doctrine for Command and Control Warfare*.
34. See *Joint Publication 3-60, Joint Targeting* (2007).
35. See *Report of the Defense Science Board Task Force on Strategic Communication* (2008).
36. A forecasting process of systematically executing multiple variations of a model to assess the results of the interaction among plausible values of the models' parameters. See Bankes, S. (1993).
37. See Klein, et al. (2010).
38. See Lempert, et al. (2006) for a discussion of deep uncertainty.

SOCIOCULTURAL BEHAVIOR RESEARCH AND ENGINEERING
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