INTELLIGENCE ANALYSIS FOR TOMORROW

Advances from the Behavioral and Social Sciences

Committee on Behavioral and Social Science Research to Improve Intelligence Analysis for National Security

Board on Behavioral, Cognitive, and Sensory Sciences

Division of Behavioral and Social Sciences and Education

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COMMITTEE ON BEHAVIORAL AND SOCIAL SCIENCE RESEARCH TO IMPROVE INTELLIGENCE ANALYSIS FOR NATIONAL SECURITY

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To further its understanding of the realities of the IC, the committee engaged in classified panel discussions with working analysts from across the IC. The panelists represented a wide range of experiences, skills, agencies, and length of service. Their comments were critical in allowing the committee to understand the greatest needs of working analysts and thus how the behavioral and social sciences can enhance their strengths and meet their challenges. We thank panel discussants from the ODNI, CIA, Department of Homeland Security (DHS), DIA, National Geospatial Agency, and Pherson Associates.

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This report has been reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise, in accordance with procedures approved by the NRC's Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the institution in making its published report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the deliberative process. We wish to thank the following individuals for their review of this report: Lynn R. Eden, Freeman Spogli Institute for International Studies, Center for International Security and Cooperation, Stanford University; Susan T. Fiske, Department of Psychology, Princeton University; Carl W. Ford, Jr., National Intelligence Council Associate, Office of the Director of National Intelligence and School of Foreign Service, Georgetown University; Katherine J. Hall, Global Analysis, BAE Systems; Thomas Hammond, Department of Political Science, Michigan State University; Thom J. Hodgson, Industrial and Systems Engineering Department, North Carolina State University; Frederick S. Kaplan, Division of Orthopaedic Molecular Medicine, Department of Orthopaedic Surgery, Hospital of The University of Pennsylvania; J. Keith Murnighan, Kellogg School of Management, Northwestern University; and Robert M. Oliver, Operations Research and Engineering Science Emeritus, University of California, Berkeley.

Although the reviewers listed above provided many constructive comments and suggestions, they were not asked to endorse the content of the report nor did they see the final draft of the report before its release. The review of this report was overseen by Richard J. Bonnie, Institute of Law, Psychiatry, and Public Policy, University of Virginia and R. Stephen Berry, Gordon Center for Integrative Studies, Department of Chemistry and

James Franck Institute, University of Chicago. Appointed by the National Research Council, they were responsible for making certain that an independent examination of this report was carried out in accordance with institutional procedures and that all review comments were carefully considered. Responsibility for the final content of this report rests entirely with the author and the institution.

Baruch Fischhoff, *Chair*
Cherie Chauvin, *Study Director*
Committee on Behavioral and Social Science Research
to Improve Intelligence Analysis for National Security

Contents

Preface

In 2008, the Office of the Director of National Intelligence (ODNI) asked the National Research Council (NRC) to establish a committee to synthesize and assess evidence from the behavioral and social sciences relevant to analytic methods and their potential application for the U.S. intelligence community (IC). The NRC thanks the Central Intelligence Agency's Sherman Kent School for Intelligence Analysis, which supported a planning meeting early in the development of this study. Valuable insights, information, and questions resulting from those preliminary discussions greatly contributed to the study's success.

In response to the request from ODNI, the NRC established the Committee on Behavioral and Social Science Research to Improve Intelligence Analysis for National Security, under the oversight of the Board on Behavioral, Cognitive, and Sensory Sciences. This report is the work of that committee. As specified in its charge, the committee restricted its focus to the analytic component of the IC, including development of the analytic workforce. Although the committee recognizes that analysts' work depends on that of collectors and support personnel, these relations are beyond the scope of this report. Consistent with its charge, the committee has focused on the behavioral and social science related to "critical problems of individual and group judgment." We note that the behavioral and social sciences can make contributions to other aspects of the IC's mission (e.g., understanding deception, paths to terrorism, field operations).

Members of the committee were volunteers, carefully selected by the NRC to cover a spectrum of relevant academic specialties and to bring expertise in both basic research and practical applications in diverse set-

tings including private organizations, government, and the military. Several committee members have had significant experience with national security issues, including work with the IC.

The study extended over a 30-month period. During its initial phase, the committee hosted three data-gathering meetings and a 1-day public workshop. At the workshop, committee members heard from speakers in several parallel endeavors, including the application of the behavioral and social sciences in Canadian intelligence and the emergence of evidence-based decision making in medicine. The committee also received briefings from current and former intelligence officers, as well as from consultants to the IC. These briefings provided the committee with critical context for assessing applications of the behavioral and social sciences to the unique needs, challenges, and circumstances of the IC. As a foundation for the deliberations summarized in this consensus report, each committee member authored a paper (in two cases with coauthors) that reviewed the research literature on a topic that the committee identified as central to fulfilling its charge. These papers are published as a companion volume, *Intelligence Analysis: Behavioral and Social Scientific Foundations*.

Throughout its deliberations, the committee considered the realities of the IC as it developed the recommendations presented in the last chapter of this report. As a result, the committee's recommendations focus on changes that are both important and feasible. These recommendations offer practical ways to apply the behavioral and social sciences, which will bring the IC substantial immediate and longer-term benefits with modest costs and minimal disruption. In the course of preparing this report, each committee member took an active role in drafting chapters, leading discussions, and reading and commenting on successive drafts. The committee deliberated all aspects of this report, and its final content is the result of their tremendous effort, vision, and determination.

Baruch Fischhoff, *Chair*
Cherie Chauvin, *Study Director*
Committee on Behavioral and Social Science Research
to Improve Intelligence Analysis for National Security

Executive Summary

The intelligence community (IC) plays an essential role in the national security of the United States, and its success has always depended on being smarter and more agile than America's adversaries. Today's threat environment presents intense pressures to retain this edge through timely assessments and rapid adaptation.

The IC deserves great credit for its commitment to self-scrutiny and improvement, including its investments in lessons-learned, training, and collaboration procedures. Yet these efforts have been only weakly informed by the behavioral and social sciences. At the same time, post-9/11 changes in the IC have created unprecedented demands for that knowledge. In this context, the Office of the Director of National Intelligence (ODNI) asked the National Research Council to conduct a study to

> synthesize and assess the behavioral and social science research evidence relevant (1) to critical problems of individual and group judgment and of communication by intelligence analysts and (2) to kinds of analytic processes that are employed or have potential in addressing these problems.

The study charge also asked for recommendations on analytic practices "to the extent the evidence warrants" and for future research, including the identification of impediments to implementation.

CONCLUSIONS

One of the most important things that the IC can learn from the behavioral and social sciences is how to characterize and evaluate its analytic assumptions, methods, technologies, and management practices. Behavioral and social scientific knowledge can help the IC to understand and improve all phases of the analytic cycle: how to recruit, select, train, and motivate analysts; how to master and deploy the most suitable analytic methods; how to organize the day-to-day work of analysts, as individuals and teams; and how to communicate with its customers. The knowledge presented in this report has evolved through scientific processes that have given it well-understood strengths and limitations. With modest material investment and strong leadership, the IC can derive significant benefit from that knowledge. The committee offers a strategy to first exploit what is already known and then proceed to new programs of basic research that address the IC's unique needs.

The first element involves assessing how well current and proposed analytical methods are supported by scientific evidence. The IC should not rely on analytical methods that violate well-documented behavioral principles or that have no evidence of efficacy beyond their intuitive appeal.

The second element is to rigorously test current and proposed methods under conditions that are as realistic as possible. Such an evidence-based approach to analysis will promote the continuous learning needed to keep the IC smarter and more agile than the nation's adversaries.

RECOMMENDATIONS AND IMMEDIATE ACTIONS

The committee makes five broad recommendations and, for each, specific actions that the IC can adopt immediately with relatively little cost or disruption. Those recommendations and actions presented in Chapter 7 are summarized here.

Use Behavioral and Social Science

The committee's first recommendation calls on the Director of National Intelligence (DNI) to apply the principles, evidentiary standards, and findings of the behavioral and social sciences to the IC's analytic methods, workforce development, collaborations, and communications.

To implement this recommendation, the committee offers five immediate actions: (1) use the Intergovernmental Personnel Act for expertise on a short-term basis; (2) give IC analysts short-term academic assignments to deepen their methodological and subject matter expertise; (3) develop specialized behavioral and social science expertise cells across the IC to provide

methodological assistance and to network with outside scientists; (4) use behavioral and social science expertise in the IC Associates Program; and (5) create and widely disseminate an Analytical Methods Resource Guide.

Use Scientific Analytical Methods

The committee's second recommendation calls on the DNI to ensure that the IC adopts scientifically validated analytical methods and subjects its methods to performance evaluation.

To implement this recommendation, the committee offers three immediate actions: (1) institutionalize an "Analytical Olympics" to test competing analytic methods and foster a culture that values continuous improvement; (2) begin to assess how well-calibrated individual analysts are and provide them with appropriate feedback; and (3) create a research program that reviews current and historic analyses comparing alternative methods under real world conditions.

Use Scientific Methods for Workforce Development

The committee's third recommendation calls on the DNI to ensure that IC agencies use evidence-based methods to recruit, select, train, motivate, and retain an adaptive workforce able to achieve the performance levels required by IC missions.

To implement this recommendation, the committee offers four immediate actions: (1) create a course for IC analysts and managers on the full range of analytical methods with strong scientific foundations; (2) create an inventory of psychometrically validated measures to study which abilities are related to analytical performance and use the results in workforce hiring; (3) set up an independent review of all workforce practices; and (4) develop training programs that engage the entire workforce as teachers and students.

Use Scientific Collaboration Methods

The committee's fourth recommendation calls on the DNI to require systematic empirical evaluation of current and proposed procedures for enhancing the collaboration that is essential to fulfilling the IC's mission.

To implement this recommendation, the committee offers three immediate actions: (1) conduct field evaluations of at least two frequently used collaborative methods; (2) rigorously evaluate collaborative tools such as A-Space to enhance their utility; and (3) develop a database, or modify the Library of National Intelligence, to characterize collaborative analyses in terms of features that might be related to their effectiveness.

Use Scientific Communication Methods

The committee's fifth recommendation calls on the DNI to implement scientific evidence-based protocols for ensuring that analysts and customers understand one another.

To implement this recommendation, the committee offers three immediate actions: (1) develop and evaluate standard protocols for communicating the confidence to place in analytic judgments; (2) evaluate the efficacy of current methods for requesting analyses in terms of how well they convey customers' intentions to analysts; and (3) evaluate the impact of internal review processes on how well the resulting reports convey analysts' intended meaning.

1

Challenges for the Intelligence Community

Measures to improve intelligence analysis have to adapt lessons from the behavioral and social sciences to the unique circumstances of analysts and their national security customers.

The primary missions of the intelligence community (IC) are to reduce uncertainty and provide warning about potential threats to the national security of the United States, the safety of its citizens, and its interests around the world. Decision makers—from the White House and Capitol Hill to battlefields and local jurisdictions around the globe—demand and depend on information and insights from IC analysts. The list of individual and agency customers is long, diverse, and growing. So, too, is the array of issues that analysts are expected to monitor: see Box 1-1; also see Office of the Director of National Intelligence (2009a, 2009b, 2009c).

STRUCTURE OF THE INTELLIGENCE COMMUNITY

The IC is a complex enterprise with approximately 100,000 military and civilian U.S. government personnel (Sanders, 2008). Of this number, roughly 20,000 work as analysts, a category that includes both intelligence analysts who work primarily with information obtained from a single type of source, such as imagery, intercepted signals, clandestine human intelligence, diplomatic and attaché reporting, and "open source" or unclassified information and analysts who routinely work with information obtained from many sources (*all-source* analysts) (for a review, see Fingar, 2011). The distinction between these two types of analyst was once seen as fundamental. Today, it is widely understood that all analysts must use information and insight from multiple sources. For example, imagery analysts must use signals intelligence (SIGINT) and human intelligence (HUMINT) to clarify what they observe in imagery intelligence (IMINT).

BOX 1-1
2009 National Intelligence Strategy Objectives Summary

MISSION OBJECTIVES (MO)

MO1: Combat Violent Extremism
Understand, monitor, and disrupt violent extremist groups that actively plot to inflict grave damage or harm to the United States, its people, interests, and allies.

MO2: Counter Weapons of Mass Destruction Proliferation
Counter the proliferation of weapons of mass destruction and their means of delivery by state and non-state actors.

MO3: Provide Strategic Intelligence and Warning
Warn of strategic trends and events so that policymakers, military officials, and civil authorities can effectively deter, prevent, or respond to threats and take advantage of opportunities.

MO4: Integrate Counterintelligence
Provide a counterintelligence capability that is integrated with all aspects of the intelligence process to inform policy and operations.

MO5: Enhance Cybersecurity
Understand, detect, and counter adversary cyber threats to enable protection of the Nation's information infrastructure.

MO6: Support Current Operations
Support ongoing diplomatic, military, and law enforcement operations, especially counterinsurgency; security, stabilization, transition, and reconstruction; international counternarcotics; and border security.

ENTERPRISE OBJECTIVES (EO)

EO1: Enhance Community Mission Management
Adopt a mission approach as the expected construct for organizing and delivering intelligence support on high-priority challenges.

As an integral part of the intelligence collection cycle, analysts both drive collection of and receive huge—and rapidly increasing—amounts of information. The collectors include both technical systems and human intelligence officers who obtain, process, and disseminate "raw" intelligence. The National Security Agency (NSA), for example, intercepts millions of

EO2: Strengthen Partnerships
Strengthen existing and establish new partnerships with foreign and domestic, public and private entities to improve access to sources of information and intelligence, and ensure appropriate dissemination of Intelligence Community products and services.

EO3: Streamline Business Processes
Streamline IC business operations and employ common business services to deliver improved mission support capabilities and use taxpayer dollars more efficiently and effectively.

EO4: Improve Information Integration and Sharing
Radically improve the application of information technology—to include information management, integration and sharing practices, systems and architectures (both across the IC and with an expanded set of users and partners)—meeting the responsibility to provide information and intelligence, while at the same time protecting against the risk of compromise.

EO5: Advance Science and Technology/Research and Development
Discover, develop, and deploy Science and Technology/Research and Development advances in sufficient scale, scope, and pace for the IC to maintain, and in some cases gain, advantages over current and emerging adversaries.

EO6: Develop the Workforce
Attract, develop, and retain a diverse, results-focused, and high-performing workforce capable of providing the technical expertise and exceptional leadership necessary to address our Nation's security challenges.

EO7: Improve Acquisition
Improve cost, schedule, performance, planning, execution, and transparency in major system acquisitions, while promoting innovation and agility.

SOURCE: Office of the Director of National Intelligence (2009c).

signals every hour (Bamford, 2002), and the National Counterterrorism Center processes thousands of names of potential terrorists every day (Blair and Leiter, 2010). In recent years, the collection, information processing, storage, and retrieval capabilities of the IC have improved dramatically, but the ultimate value of all this information still depends on the capabilities

of the analysts who receive it. They must consider new information against previous analyses, interpret and evaluate evidence, imagine hypotheses, identify anomalies, and communicate their findings to decision makers in ways that help them to fulfill their missions.

Most of the roughly 20,000 analysts in the IC work for one of 16 offices and agencies scattered across the federal government and overseen by the Director of National Intelligence (DNI). In addition, IC analysts work for three entities—the National Intelligence Council, the National Counterterrorism Center, and the National Counterintelligence Executive—that are part of the Office of the Director of National Intelligence (ODNI). One of the 16 agencies overseen by the DNI, the Central Intelligence Agency (CIA), is an independent agency. The other 15 entities are parts of different departments, agencies, and military branches: see Figure 1-1. IC member agencies range in size from the very small (e.g., the analytic component of the Drug Enforcement Administration's Office of National Security Intelligence) to the very large (e.g., the National Security Agency [NSA], the CIA, and the Federal Bureau of Investigation's National Security Branch). The expertise required of analysts in each entity depends on their customers' missions and priorities. For example, the Air Force and the Defense Intelligence Agency require more missile expertise than does the Department of Energy's Office of Intelligence and Counterintelligence. Similarly, the State Department's Bureau of Intelligence and Research and the CIA's analytic component, the Directorate of Intelligence, require more country-specific political expertise than do the military services' intelligence components.

These entities differ in missions and the desire for analysts trained and directly accountable to meet the agencies' needs. The (literal and figurative) proximity of analysts and customers improves communication and trust between them, but having so many specialized intelligence units also creates problems. Chief among the problems are bureaucratic divisions that can isolate intelligence in "stovepipes" and lead to inconsistent standards, practices, and even terminology, which complicates interagency cooperation and confuses customers.

Broadly speaking, the nation's confederated intelligence system has produced specialization at the expense of integration and collaboration. The IC's inability to function as a unified team has been the subject of more than 40 major studies since the CIA's establishment in 1947 (Zegart, 2007). The creation of the ODNI, after 9/11, was the latest and most serious effort in a long line of initiatives to transform the IC from a collection of semi-autonomous agencies into an integrated intelligence system.

Both the strengths and the weaknesses of today's IC structure must be recognized when considering ways to improve analysis. For example, efforts to reduce stovepiping should not undermine analysts' ability to address the specific needs of their customers. The need for tailored intelligence is so

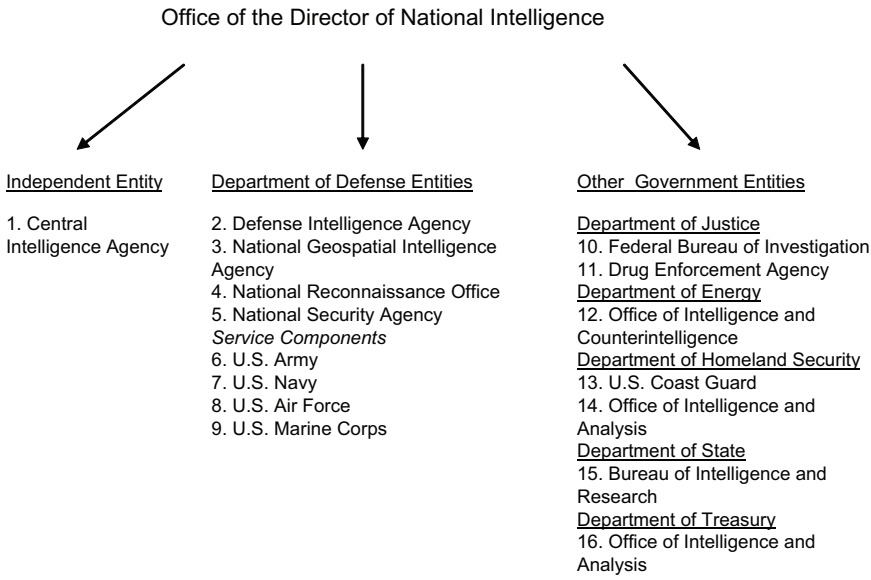

FIGURE 1-1 Members of the U.S. intelligence community.
SOURCE: Data from Office of the Director of National Intelligence (2009a, 2009b).

strong that no agency has advocated abolishing its dedicated unit, and some agencies that do not have such units continue to want them, despite recognizing the price paid for compartmentalization. The unsuccessful bombing attempt of a Northwest Airlines flight on Christmas Day 2009 showed that the IC is still struggling to solve the collaboration and integration problems (Blair and Leiter, 2010).

MISSION-RELATED CHALLENGES

The challenges facing the IC today are of two types: those specifically related to its mission and those facing virtually all complex organizations. Both types have to be considered when seeking to improve intelligence analysis.

The IC is still adjusting to the dramatic shift from the Cold War era to the very different demands of the 21st century. This shift requires moving from one core "target" (the Soviet Union and its allies) to many diverse targets, from existential threats to national survival to threats to specific U.S. targets, and from demands for general information (e.g., country A is providing certain types of weapons to country B or to insurgent group C)

to demands for "actionable intelligence" relevant to interdicting a specific ship, aircraft, or person. Discovering that the Soviet Union had nuclear weapons aimed at every U.S. city greater than a certain size created very different collection and analytic requirements than those needed to discover that a terrorist group plans to explode an improvised radiological device in a city, shopping mall, or school. The United States did not evacuate its cities in response to the nationwide threat of nuclear annihilation, but officials might choose to evacuate a shopping center if the IC reported a 10 percent chance of a terrorist attack during a specified period. Each of these changes in the world has implications for what IC analysts are expected to know and for how they do their jobs.

The Military and Other Customers

The military has long been the IC's dominant customer, with intelligence needs for a wide variety of missions and officials, including the Office of the Secretary of Defense, the Joint Chiefs of Staff, commanders of tactical operations, and designers of equipment and tactics. As a result, much of the IC has evolved to meet military requirements. This focus has, among other things, created a predisposition for the worst-case analyses needed by those designing equipment or preparing for battle (Powell, 2004). It has also created high tolerance for false alarms.

There has, however, been a steady increase in other U.S. government customers seeking the IC's analytic support (Fingar, 2009), extending far beyond the military and other traditional users. The new customers range from the 18,000 state, local, and tribal law enforcement units that now may want terrorism-related intelligence (Perrelli, 2009); to the U.S. Department of Health and Human Services, which wants disease-related intelligence; to the U.S. Agency for International Development (USAID) and others involved in emergency relief around the world. These customers ask different questions, require different intelligence support, and have different tolerance levels for false alarms and ability to plan for worst-case scenarios than the IC's traditional military customers. Their questions require analyses on complex, interrelated domestic and foreign issues; with players from multiple countries and nongovernmental entities; and with a wide range of political, economic, social, and technical dimensions. These questions may need different perspectives than the more traditional transnational and country-specific perspectives (e.g., whether North Korea's nuclear weapons program is viewed as a proliferation problem based in North Korea or as a North Korea problem with a nuclear dimension). In addition to meeting the needs of these new customers, the IC must simultaneously continue to meet the mission support needs of the Department of Defense (to which 8

of the 16 IC agencies belong), wherever and whatever they may be (e.g., from counterterrorism to disaster relief anywhere on the globe).

How well the IC meets these needs depends on the human capital embodied in its people and processes. The IC must recruit, select, train, motivate, and retain the right workforce, whose members must be adept at locating information, identifying potential collaborators, tapping expertise (inside and outside the IC), and using good analytic tradecraft. In order to support these needs, the IC has created such innovations as Intellipedia, A-Space, the Analytic Resources Catalog, and the Library of National Intelligence.[1] In addition to these tools, internal deliberations on the best analytic techniques for different classes of problems, as well as deliberations about the individuals and procedures needed to apply them, are necessary to cultivate analytic skill.

These are all human activities, requiring expertise that resides in the behavioral and social sciences.[2] These sciences include the scientific study of understanding, judgment, and collaboration and communication, within and across organizations. The remainder of this report deals with the opportunity to take advantage of this scientific knowledge to review current IC practices and develop improved ones. The committee is grateful for the invitation to apply the accumulated expertise of these sciences to the IC's challenges and initiatives.

Open Sources

The role of open sources in intelligence analysis demonstrates the analytical changes that the behavioral and social sciences can inform. The IC has long recognized the value of open source intelligence (OSINT). From 1941 to 2004, the Foreign Broadcast Information Service (FBIS) provided near real-time translations and republication of articles, speeches, and writings from foreign sources, giving information to intelligence officers, others in the U.S. government, reporters, and scholars. Since 1957, the U.S. Joint Publication Research Service has translated and published unclassified writ-

[1]Intellipedia is a Wikipedia-like system created by and for members of the IC and used to share information about intelligence-related topics. A-Space is a common collaborative workspace for all analysts in the IC. The Analytic Resources Catalog is a database with information about the analysts in the IC, including contact information and details about their skills, expertise, and experience. The Library of National Intelligence enables integrated searches and cross references of all disseminated intelligence products and allows all analysts to find the reporting on specific subjects.

[2]The behavioral and social sciences include all the sciences that study the behavior of individuals, groups, organizations, and societies. They include anthropology, psychology, sociology, economics, decision science, political science, cognitive science, communication science, history, and epidemiology.

ings from around the world into English. In 2005, ODNI's Open Source Center (OSC) absorbed and expanded FBIS' capabilities distributed through its online World News Connection.

These services position the IC to benefit from the explosion of open-source information, especially for access to networked and cell-based threats. Nonetheless, there is still an ongoing debate about its value relative to clandestine information. Skeptics argue that "the intelligence community's principal mission is to discover and steal secrets; relying on open sources runs counter to that mission" (Best and Cumming, 2007, p. 4; also Lowenthal, 2009; Mercado, 2005; Sands, 2005; Steele, 2000; Thompson, 2006). This position may reflect both experience and the intuitive tendency to place greater value on narrowly held information (Spellman, 2011).

Contrary to this skepticism, multiple government commissions have uniformly advocated greater use of OSINT (e.g., Commission on the Roles and Capabilities of the United States Intelligence Community, 1996; National Commission on Terrorist Attacks upon the United States, 2004). In its call for sweeping changes in the IC, the Intelligence Reform and Terrorism Prevention Act of 2004 described open information as "a valuable source that must be integrated into the intelligence cycle to ensure that United States policymakers are fully and completely informed" (Section 1052.a.2.). A few years later, the DNI Open Source Conference 2008: Decision Advantage convened participants from across the open source community to look at the spectrum of open source issues and best practices.[3] Box 1-2 provides four noteworthy quotations from the debate over the use of clandestine versus open sources.

All these claims embody assumptions about analysts' ability to extract and evaluate information from different sources. Open sources can be particularly useful when analyzing human behavior, such as economic, political, religious, and cultural developments. Moreover, open sources can strengthen the analytical process itself by providing cross-checks on information from clandestine sources and testing the soundness of common wisdom or emerging consensuses. The behavioral and social sciences provide a disciplined way of evaluating such assessments, complementing the intuitions and personal experience that inform them, as well as empirically evaluating their actual performance. The need for such science arises from the inevitable fallibility of human judgment and organizations.

[3]See http://www.dniopensource.org/ [August 2010] for more information on the agenda of the 2008 conference.

CHALLENGES FOR COMPLEX ORGANIZATIONS

Any organization that operates in a complex, fast-paced, high-stakes environment must find ways to learn and adapt, by shaping its personnel, organizational structure, and institutional culture to that changing reality. The IC shares many of the characteristics, strengths, and pathologies of other complex organizations. As a result, despite its unique mission and constraints, the IC stands to learn from research conducted in other settings on how to learn from experience, encourage collaboration, and improve communication with its customers.

Learning from Experience

The IC's quickly changing, complex world makes it vitally important that it be able to learn from experience. However, as psychologists know (e.g., Brehmer, 1980), learning from experience is much harder than it seems.

One barrier is securing systematic feedback regarding analytical performance. Research has shown that outcome feedback is vital to correcting errors and reinforcing accurate performance (e.g., Kluger and DeNisi, 1996). However, IC analysts make predictions for events far in the future without the opportunity for feedback on how well they did and what factors account for their successes and failures. A second barrier arises from changes in world conditions that occur after analyses are made, some of which may be prompted by the analyses themselves (e.g., when national leaders take warnings seriously and act on them). Both the analysts and their customers must evaluate the analyses based on what they would have been if change in the world had been considered. Such counterfactual judgments face obvious challenges.

The behavioral and social sciences have developed ways to address these problems through statistical analyses of multiple forecasts. Such evaluations are common in medicine, which faces similar difficulties with long time frames and changed conditions. Done well, they can provide a picture not available with individual analyses. Sometimes, they show surprising results. For example, although weather forecasters are often criticized, their probability forecasts in the aggregate are accurate (for a review, see Murphy and Winkler, 1984). Decision makers who know about that accuracy (e.g., farmers, military planners) use them as a valuable input to their decision making. The forecasters' accuracy reflects both their knowledge about the weather and their working in organizations that provide them with useful feedback and evaluate them fairly. The need to quantify confidence has been faced by members of other high-stakes professions, including medicine and

BOX 1-2
The Value of Open Source Information

In support of the creation of the Central Intelligence Agency, Allen Dulles, who would become the agency's first director, wrote (Dulles, 1947, p. 525):

> Because of its glamour and mystery, overemphasis is generally placed on what is called secret intelligence, namely the intelligence that is obtained by secret means and by secret agents. During war this form of intelligence takes on added importance but in time of peace the bulk of intelligence can be obtained through overt channels, through our diplomatic and consular missions, and our military, naval, and air attachés in the normal and proper course of their work. It can also be obtained through the world press, the radio, and through the many thousands of Americans, business and professional men and American residents of foreign countries, who are naturally and normally brought in touch with what is going on in those countries. A proper analysis of the intelligence obtainable by overt, normal, and aboveboard means would supply us with over 80 percent, I should estimate, of the information required for the guidance of our national policy. An important balance must be supplied by secret intelligence which includes what we now often refer to as "Magic."

A few years later, Sherman Kent (1951, p. 220) described the essential role of publicly available data:

> An overt intelligence organization . . . cannot hope to acquire all that it needs through its own open methods; there will always be the missing pieces which the clandestine people must produce. But on the other hand, the clandestine people will not know what to look for unless they themselves use a great deal of intelligence which they or some other outfit has acquired overtly. Their identification of a suitable target, their

finance. This report examines the implications of this research for the seemingly similar problems faced by the IC's analysts and customers.

One impediment to such learning is people's unwarranted confidence in their own judgment and decision making (Slovic et al., 1972; Wilson, 2002). A large body of research also documents gaps between how people explain their decisions and statistical analyses of the processes that drive them. Quite often, as a result, people neither see the need for change (because they exaggerate how well they are doing) nor are able to make good use of experience. Thus, exhorting analysts to rely more on one factor and less on another means little if they misunderstand how much they are currently relying on those factors. Research with other high-stakes professionals finds troubling tendencies for experience to increase confidence faster than it increases performance (Dawson et al., 1993) and for people to exaggerate how well they can overcome conflicts of interest (Moore et al., 2005).

Scientific studies have identified other impediments to learning from

> hitting of it, their reporting of their hit—all these activities exist in an atmosphere of free and open intelligence. A good clandestine intelligence report may have a heavy ingredient of overt intelligence.

More recently, and 50 years after Dulles's estimate that more than 80 percent of the nation's needed intelligence would come from open sources, George Kennan, the architect of the U.S. policy of containment during the Cold War, offered an even larger percentage (Kennan, 1997, p. E17):

> It is my conviction, based on some 70 years of experience, first as a Government official and then in the past 45 years as an historian, that the need by our government for *secret* intelligence about affairs elsewhere in the world has been vastly overrated. I would say that something upward of 95 percent of what we need to know could be very well obtained by the careful and competent study of perfectly legitimate sources of information open and available to us in the rich library and archival holdings of this country. Much of the remainder, if it could not be found here (and there is very little of it that could not), could easily be nonsecretively elicited from similar sources abroad.

In 2005, the Commission on the Intelligence Capabilities of the United States Regarding Weapons of Mass Destruction (2005, p. 365) concluded:

> Clandestine sources . . . constitute only a tiny sliver of the information available on many topics of interest to the Intelligence Community. Other sources, such as traditional media, the Internet, and individuals in academia, nongovernmental organizations, and business, offer vast intelligence possibilities. Regrettably, all too frequently these "nonsecret" sources are undervalued and underused by the Intelligence Community.

experience (many detailed in subsequent chapters and in the committee's companion volume, National Research Council, 2011). One prominent example is hindsight bias, the exaggerated belief after an event has occurred that one could have predicted it beforehand (Arkes et al., 1981; Dawson et al., 1988; Fischhoff, 1975; Wohlstetter, 1962). Analyses following Pearl Harbor, the 9/11 attacks, and other prominent events often lead to the conclusion that they should have easily been anticipated, had there not been a "failure to connect the dots." However, research finds that accurate prediction is much harder than it seems in hindsight. The "failure to connect the dots" metaphor is itself a corollary of hindsight bias, which can complicate learning from experience by leading people to overlook other sources of failure, such as not collecting needed information or communicating it clearly.

A complement to hindsight bias is outcome bias, the tendency to judge decisions by how they turned out, rather than by how thoughtfully they were made (Baron and Hershey, 1988). However accurate an analysis, the

analysts cannot be held responsible for the decision makers' actions that follow, unless they have failed to communicate the analysis effectively, including the confidence that should be placed in it. Research has documented these biases, the efficacy of different ways of overcoming them, and the methods for ensuring that analysts and policy makers are judged fairly when making tough calls in uncertain environments.

A third impediment to learning from experience is the "treatment effect" (Einhorn and Hogarth, 1978). Often, predictions lead to actions that change the world (a "treatment") in ways that complicate evaluating the prediction. For example, a prediction of aggression may be wrong, but it may lead to actions that provoke aggression that would not otherwise have happened, thereby falsely confirming an inaccurate prediction.

As discussed below, the IC is acutely aware of the need to learn and adapt. Behavioral and social research provides mechanisms for evaluating the theoretical soundness and the actual performance of current and potential methods to foster good analytic judgment.

Collaboration and Communication

It is widely recognized that increasing collaboration and communication is key to the IC's success in a rapidly changing, complex world. The mission statements of IC entities show the emphasis that the IC leadership places on these capabilities,[4] as do its investments in innovations such as Intellipedia and A-Space. When the IC is the target of public criticism, the error most commonly cited is failure to communicate, within itself and with its customers. This was the case with the 9/11 attacks and more recently with the failure to warn of the Christmas Day 2009 bombing attempt. President Obama's homeland security adviser, John O. Brennan (2010) said, "We could have brought it together, and we should have brought it together. And that is what upset the President."

One of the biggest challenges in improving collaboration and communication within the IC is its organizational structure. As noted, the existence of 16 separate intelligence agencies (in addition to the ODNI) is a natural consequence of the specialized knowledge that each agency needs. However, these organizational structures create "silos" or "stovepipes" with boundaries that impede collaboration and communication.

These problems, too, are not unique to the IC. The failure to prevent the 1986 *Challenger* disaster stemmed from the inability of various subunits

[4]See, for examples, remarks by the director of national intelligence (Office of the Director of National Intelligence, 2008b); the IC information-sharing strategy (Office of the Director of National Intelligence, 2008a); the strategic plan of the Defense Intelligence Agency (n.d.); and the CIA mission statement (Central Intelligence Agency, n.d.).

in the National Aeronautics and Space Administration to integrate what each knew and from their different methods for processing information (Zegart, 2011). Research has identified these and other organizational factors that can impair information integration, as well as the efficacy of ways to overcome them. These barriers include the need for secrecy, "ownership" of information, everyday turf wars, intergroup rivalry, and differing skill sets—none of which is unique to the IC. For example, research shows how close-knit groups can become so homogeneous that they do not realize their limits to their in-group perspectives. Indeed, the IC has begun several efforts to overcome these barriers and to take advantage of its distributed expertise. Here, too, research has resulted in methods to evaluate the theoretical soundness of these measures, to evaluate their success, and to develop improvements (e.g., Lawrence and Lorsch, 1967; Weick, 1995).

CHARGE TO THE COMMITTEE

The IC recognizes that throwing more money and people at problems or exhorting analysts to work harder will not meet its challenges. The only viable course of action is to work smarter. The Intelligence Reform and Terrorism Prevention Act of 2004 created new opportunities to reduce organizational impediments to working smarter by empowering the Director of National Intelligence to transform the IC from a collection of semiautonomous special-purpose organizations into a single integrated enterprise.

In response to the need to explore new analytic processes and practices for the IC, the Office of the Director of National Intelligence asked the National Research Council to establish a committee to synthesize and assess evidence from the behavioral and social sciences relevant to analytic methods and their potential application for the IC: see Box 1-3 for the full charge. This report, along with a companion collection of papers, *Intelligence Analysis: Behavioral and Social Scientific Foundations*, is the committee's response to that charge. Our report focuses on strategic analysis at the national level, although many of its findings may apply to combat environments where tactical or actionable intelligence may receive a higher priority or emphasis than strategic intelligence. Due to the unique circumstances of analysts, collectors, and decision makers often working side-by-side in combat environments, that application requires separate work beyond the scope of this committee's charge. The same is true for analysis of the institutional structure of the IC. Our recommendations are meant to improve the quality of analyses within the constraints of the current structure.

Framed by this chapter's introduction to the challenges for the IC, the rest of this report presents the behavioral and social science knowledge that can improve intelligence analysis. Chapter 2 looks broadly at two tasks central to the work of the IC, learning and evaluation. Chapter 3 identifies a

BOX 1-3
Committee Charge

The panel will synthesize and assess the behavioral and social science research evidence relevant (1) to critical problems of individual and group judgment and of communication by intelligence analysts and (2) to kinds of analytic processes that are employed or have potential in addressing these problems. To the extent the evidence warrants, the panel will recommend kinds of analytic practices that intelligence analysts should adopt or at least explore further.

The panel will also recommend an agenda of further research that is needed to better understand the problems analysts face and to establish a base of evidence for current and potential solutions. Finally, the panel will identify impediments to implementing the results of such research, especially new tools, techniques, and other methods, and suggest how their implementation could be more effectively achieved.

In assessing the strength of the evidence, the panel will consider questions bearing upon the type of study (for example, case studies, large-scale field studies, laboratory studies, observational studies, or randomized control studies), the type of subject (for example, intelligence analysts, experts in areas similar to intelligence analysis, other experts, students, or other populations), and the attendant uncertainty (for example, robustness to different assumptions, confidence intervals and other measures, meta-analyses, exploration of alternative hypotheses or explanations of the data, extent of agreement in the scientific community).

suite of proven scientific analytical methods available for application within the IC. Chapter 4 addresses the human resource policies needed to recruit, select, train, motivate, and retain employees able to do this demanding work. Chapter 5 considers how to optimize internal collaboration, allowing analysts to share information and learn from one another, thereby making best use of the community's resources. Chapter 6 considers the communications needed for customers to inform analysts about their changing needs and for analysts to inform customers about the changing world. The final chapter presents the committee's recommendations. The committee's companion volume offers more details on the research summarized in this consensus report. The companion volume is designed to be suited to individual reading or courses incorporating the behavioral and social sciences in the work and training of intelligence analysts.

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2

Learning and Evaluation

Continuous learning and sustainable improvement require systematic procedures to assess performance and provide feedback.

The success of the intelligence community (IC) depends on achieving sound judgments, drawing on the best available analytical methods, workforce, internal collaboration, and external communication. Chapters 3-6 describe the science relevant to each task. Chapter 2 sets the stage by briefly describing the challenges, viewed from the perspective of the continuous learning that the IC needs to fulfill its missions.

LEARNING

Learning from experience is central to the IC, which must stay ahead of adversaries committed to exploiting weaknesses in U.S. national security. The IC's commitment is seen in its after-action lessons-learned procedures and in the voluminous literature produced by former senior intelligence officers, former directors of the Central Intelligence Agency (CIA), government commissions, and others (Berkowitz and Goodman, 1991, 2002; Betts, 2007; Diamond, 2008; Firth and Noren, 1998; Gates, 1996; George and Bruce, 2008; Godson et al., 1995; Helms and Hood, 2004; Jervis, 2010; Keegan, 2003; Kirkpatrick, 1968; Lowenthal, 2009; MacEachin, 1994, 1996, 2002; Matthias, 2007; May and Zelikow, 2007; Paseman, 2005; Prados, 1982; Tenet, 2007; S. Turner, 1991, 2005; M. Turner, 2006; Wright, 1987; Zegart, 1999, among many others).

A continuing thread in these studies has been the natural barriers to learning faced by the IC. One of those barriers is the IC's secrecy needs, which can limit its ability to examine its performance when that risks revealing its sources and uncertainties. A second barrier is the reactive

nature of the IC's work, whose predictions can change the world, so that they become self-fulfilling or self-defeating prophesies. A third barrier is being judged in the court of public opinion, where the details of its work may be unknown or even deliberately distorted.

Two examples illustrate the difficulty of extracting a clear signal regarding the IC's performance. One is that the apparent U.S. surprise at the end of the Cold War obscured the fact that the IC had consistently given strategic warnings about the Soviet Union's instability during the final year of U.S.-Soviet competition and had correctly predicted the coup attempt against Mikhail Gorbachev that took place in August 1991 (MacEachin, 1996). A second example is the U-2 spy plane shot down by the Soviet Union on May 1, 1960: the IC is often blamed for the risks it took in having the U-2 fly over Soviet territory, but it is not given credit for the information gained by using the U-2's unique technical capabilities.

The IC has taken notable steps toward improving its ability to learn from its experiences. The National Defense Intelligence College[1] began granting a master's degree in strategic intelligence in 1980. The CIA's Sherman Kent School for Intelligence Analysis opened in 2000, followed 2 years later by the CIA University. The CIA's Center for the Study of Intelligence produces reflective reports based on declassified data, which are published in *Studies in Intelligence*. The *Defense Intelligence Journal* is another source of new analytical and scientific techniques. The IC has also supported the numerous publications reviewing the contribution to learning from structured analytical techniques, such as analysis of competing hypotheses, team A/B work, and alternative futures (Heuer and Pherson, 2010; U.S. Government, 2009). The success of these efforts depends on how well they accommodate the strengths and weaknesses of the human judgment needed to accomplish this learning.

Judgment

The conditions for learning are well understood. Central to them are prompt, unambiguous feedback, with proper incentives. The threats to learning are also well understood. They arise at the levels of individuals, teams, and organizations. A brief reprise of these threats will set the stage for the solutions proposed in the succeeding chapters of this report. Fuller exposition of the research can be found in the companion volume.

Analysis is an exercise in judgment under conditions of uncertainty. The failings of those judgments are well documented (Ariely, 2008; Gilovich

[1]The National Defense Intelligence College was founded in 1962 as the Defense Intelligence School. It was renamed in 1981 as the Defense Intelligence College and again in 1993 as the Joint Military Intelligence College.

et al., 2002; Kahneman et al., 1982). The research also identifies theoretically founded ways to improve judgment (Phillips et al., 2004; Weiss and Shanteau, 2003). For example, Slovic and Fischhoff (1977) and Arkes et al. (1988) found that hindsight bias could be reduced by requiring individuals with outcome knowledge to explain how they would have predicted other outcomes. Arkes et al. (1988) implemented this simple "debiasing" procedure with physicians, who were required to list reasons that each of several possible diagnoses might have been correct, before assessing the probabilities that they believe that they would have given in foresight. This procedure is similar to "what if?" analysis (U.S. Government, 2009), in which analysts reason backwards to identify events critical to the assumed outcome. However, as a learning tool or a reevaluation of current analysis, Arkes' debiasing procedure would require analysts to consider alternatives to a known (or assumed) outcome and identify events or data which would support alternative assessments.

Effective debiasing procedures build on the strengths of individuals' normal ways of thinking, while avoiding known weaknesses. Thus, people are naturally good at recruiting reasons that support favored explanations, but they can produce contrary reasons if required to do so. Arkes' procedure does just that, allowing physicians to take better advantage of what they know. Milkman and colleagues (2009) offer a recent summary of debiasing research; Fischhoff (1982) offers an earlier one, reaching similar conclusions. Creating conditions that counter hindsight bias is one way to improve intelligence analysis, by helping analysts to make better use of the evidence at hand and to recognize its limits.

Similar patterns are found in another judgment task central to intelligence analysis: assessing the confidence to place in analyses. Appropriate confidence, or calibration, was a key topic in Heuer's (1999) *The Psychology of Intelligence Analysis*, with much additional research having emerged since then (see Chapter 3). That research shows the central role of feedback in learning. Without orderly feedback, a common outcome is overconfidence, with experts and laypeople expressing greater confidence than their knowledge warrants (e.g., Dawson et al., 1993; Tetlock, 2006). However, some experts are well calibrated, including meteorologists, expert bridge players, and professional horserace handicappers (Arkes, 2001). What these experts have in common is receiving large quantities of high-quality feedback on their judgments.

Building on this research, elements of the Canadian intelligence community have implemented a strategy to provide its analysts with feedback about the quality of their judgments. In a presentation before the committee, David Mandel of Defence Research and Development Canada described how simple training resulted in significant improvement in analysts' perfor-

mance, with minimal disruption to normal work flows (Mandel, 2009; see Murphy and Daan, 1984, for another successful example).

Kahneman and Lovallo (1993) offer another approach to improving judgment by restructuring tasks. They contrast the "inside view" with the "outside view" for analyzing the probability that missions will succeed. The former considers all aspects of the mission from the perspective of the people performing it, including plausible obstacles and future scenarios. The latter view ignores all the specifics, while considering just the success rate of similar missions in the past. The outside view generally produces superior predictions (Buehler et al., 1994). Kahneman and Tversky (1979) offer a related procedure for integrating inside and outside views. Spellman (2011) reviews the literature more generally. Chapter 3 treats these issues in greater detail.

Analytical Methods

One recurrent element in successful debiasing procedures is helping individuals to organize their thought processes without losing the intuition and judgment that their tasks require. For example, the contrast between inside and outside views helps users to combine case-specific information (inside) with base-rate information (outside). This fundamental perspective is often nonintuitive or unknown, like other rules of thought that are not part of most curricula. Analysts need familiarity with such fundamental analytical perspectives if they are to understand the rationale of debiasing procedures. Such familiarity is valuable, even without mastery. Basic familiarity will not provide analysts with enough skill to fully apply the methods in complex situations. However, an important element of analytical judgment is recognizing situations in which additional analyses or methods are needed, going beyond the limits of intuitive judgment. Therefore, analysts who know about a variety of analytical methods can appropriately ask for the services of experts in the most relevant ones. The benefits of understanding when and how to seek out expert assistance far outweigh any minimal risk that a familiar, although nonexpert, analyst might attempt to apply the method beyond his or her understanding.

Chapter 3 describes the set of analytical methods that, in the committee's judgment, all analysts should understand. The committee's companion volume (National Research Council, 2011), as a resource for individual analysts and training courses, provides discussion of these methods at the level necessary to benefit analytic work. For each method, mere familiarity will protect analysts from errors in judgment, while opening the door to fuller applications. Two examples will suggest the learning that is possible only with knowledge of analytical methods.

The first example is from game theory. Game theory predicts choices

in strategic situations, where choices depend on what other actors are expected to do. Individuals familiar with its basic rationale can avoid naïve projections from one side's plans (adopting, in effect, a purely inside view). In the IC, fuller applications have revealed nonintuitive aspects of economic sanctions (Smith, 1995) and terrorist threats to peace processes (Bueno de Mesquita, 2005; Kydd and Walter, 2002).

The second example is from signal detection theory. Signal detection theory makes the fundamental, and often nonintuitive, distinction between what people know and what they reveal in their behavior. The former depends on their discrimination ability, the latter on their incentives for avoiding particular kinds of error (e.g., appearing to cry wolf). Just knowing about these distinctions can limit naïve interpretations, such as giving too much credit to investment advisers who predicted a market crash, without knowing how many times they had erroneously predicted crashes. Fuller analyses have been essential to assessing the validity of polygraph testing (National Research Council, 2003) and improving the usefulness of mammography (Swets et al., 2000).

Teams

Much IC analysis is done by teams or groups. Here, too, behavioral and social science research has identified ways to improve learning, by taking advantage of the shared knowledge that group members can contribute if their work is organized effectively. For example, teams' productivity depends on their composition and decision-making procedures. Diversity in members' knowledge can be very helpful (Page, 2007) if their specialization is recognized (Austin, 2003; see also Hastie, 2011). Decision making can be more effective if "unblocking" techniques allow members to develop novel solutions, achieving a balance between creative thought and undisciplined speculation.

Chapter 4 discusses research into the barriers to effective teamwork and ways to overcome them. For example, one such barrier arises from intergroup rivalries, which can form very quickly and become remarkably resilient. One way to make the boundaries between disparate groups more permeable is by temporary assignments to other groups. Indeed, even asking people to imagine being in the position of a person from the other group can reduce denigration of that group's inputs (Dearborn and Simon, 1958; Galinsky and Moskowitz, 2000).

As an example of an intervention designed to overcome such barriers, the National Aeronautics and Space Administration's (NASA's) Goddard Space Flight Center instituted a "pause and learn" process in which teams or groups discuss what they have learned, prompted by reaching a project milestone—and not as a sign that something has "gone wrong." These

sessions are reinforced by workshops in which teams share their lessons with other project teams, so as to diffuse learning in a noncrisis, nonblame environment. A familiar counterexample is the *Challenger* disaster, in which decision makers were physically separated and constrained by a division of labor that fostered needed specialization, but without facilitating the synthesis needed to take full advantage of it (see Zegart, 2011).

EVALUATION

Whether organizations learn depends on their commitment to evidence-based evaluation. Even medicine has examples of procedures being practiced for many years before being tested and found to be wanting. One example is right-heart catheterization: when it was rigorously evaluated, after it was standard practice, it was found to increase mortality rates (Connors et al., 1996). As another example, physicians used patient behaviors to diagnose the damage caused by closed-head injuries, before research showed that those behaviors revealed little (Gouvier et al., 1988). The advent of "evidence-based medicine" has revolutionized medical practice by speeding this process of finding out what works rather than relying exclusively on personal intuition and experience.

Other fields have gradually begun to adopt such approaches. For example, a summary of studies investigating police techniques found that the Drug Abuse Resistance Education (DARE) program designed to persuade youngsters not to use illegal drugs was ineffective, whereas police-probation collaborations have been shown to reduce criminal recidivism (Lum, 2009). Other systematic evaluations have found little evidence to support lie detection techniques (e.g., National Research Council, 2003; Szucko and Kleinmuntz, 1981) or voice-stress evaluation (Rubin, 2009). Ineffective techniques not only waste resources, but also incur the opportunity costs of not looking for effective ones.

The well-known 1993 Supreme Court case (*Daubert v. Merrell Dow Pharmaceuticals* [509 U.S. 579]) established empirical testing, peer review, and the use of the scientific method as the acceptable bases for admitting evidence into court. Conversely, the Court's decision lowered the value of conventional practice and intuition unless they are supported by evidence. These "Daubert criteria" establish a default standard for any organization committed to evaluating the methods that it is currently using or considering adopting. Throughout this report, we adopt these evidentiary standards in proposing ways to strengthen the scientific foundations of intelligence analysis.

Such evaluation encounters natural opposition. As discussed above, intuition is a misleading guide to the actual effectiveness of analytical methods. In addition, many people are threatened by any change and so resist

evaluation. To counter these natural oppositions, research on organizational behavior has identified conditions conducive to ensuring proper evaluation. One of those conditions is strong leadership. A second is creating incentives that allow admitting mistakes and changing approaches without blame or punishment. A third is hiring individuals suited to the job. For many analyst positions, that will mean individuals with strong intellectual skills, perhaps in preference over individuals with strong domain-specific knowledge.

Organizations' ability to adopt such practices depends, in part, on their customers' willingness to allow them. The public nature of some of the IC's work can limit its ability to admit to the need to learn. The constraints on its ability to communicate with diverse, harried clients can further limit its ability to do its job. As a result, effective communication is a strategic necessity for performing the most relevant analyses and making their results most useful. Chapter 6 discusses the science of communication, along with its application to defining analyses and conveying the content, rationale, and authoritativeness of their results.

A REALISTIC AGENDA FOR CHANGE

Although the agenda proposed in the following chapters is ambitious, the committee concludes that, in many cases, the IC can make the needed changes with modest modifications in its procedures. Indeed, an evidence-based approach to analysis should be within its grasp, based on the changes already under way in the IC and the knowledge that the behavioral and social sciences can immediately bring to bear on them. In medicine, the adoption of evidence-based medicine has accelerated with the increased support of the community's leaders and the increased accumulation of evidence demonstrating its value (Dopson et al., 2001). The IC is in a position to achieve similar success.

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3

Analysis

The complexity of the world precludes one-size-fits-all analytic approaches. Knowing which techniques to use for different problems is essential to sound analysis.

Analysts in the intelligence community (IC) have to perform many different tasks, including—but not limited to—answering the questions posed by their customers, providing warnings, and monitoring and assessing current events and new information (Fingar, 2011). In performing these tasks, they must consider the quality of information; the meaning of observed, reported, or assessed developments; and sources for additional information. The quality of each judgment is a function of the evidence, assumptions, analytic methods, and other aspects of the "tradecraft" at each stage of the process. As a result, IC analytic judgments are no better than the weakest link in any of the chains of analysis.

The IC has a long track record of successfully applying a wide variety of approaches to its tasks. It has, however, made limited use of behavioral and social sciences approaches used by other professions that face analogous problems. Those neglected approaches include probability theory, decision analysis, statistics and data analysis, signal detection theory, game theory, operations research, and qualitative analysis. This chapter begins by characterizing the cognitive challenges that analysts face, then provides brief descriptions of approaches designed to meet these challenges.

The committee concludes that basic familiarity with the approaches discussed in this chapter is essential to effective analysis. That familiarity should be deep enough to allow analysts to recognize the kinds of problems that they face and to secure the support that they need from experts for detailed applications of particular approaches. Analysts need not be game theorists, for example, in order to see a game theoretic situation and seek input from someone with the relevant expertise. However, without basic

familiarity of a range of analytic approaches, they are unlikely to identify the basic kinds of interdependency between actors' decisions inherent in game theoretic situations.

EXPERT JUDGMENT

Often, analysts are left to reach conclusions by applying their own expert judgment to situations about which they have deep knowledge. Indeed, many analysts spend years, even decades, developing substantive expertise on specific countries or geographic regions, cultures, languages, religions, terrorist organizations, political movements, weapons systems, or industrial processes. This expertise will always be the primary resource in intelligence analysis.

Taking full advantage of domain-specific knowledge requires being able to apply it to new situations, to combine it with other forms of expertise, and to assess the definitiveness of the result. As discussed in Chapter 2, evidence from other areas finds that even knowledgeable individuals may make poor inferences and have unwarranted confidence in them (for reviews, see Arkes and Kajdasz, 2011; Spellman, 2011). For example, experienced stock analysts often do little better than chance in selecting profitable stock portfolios (Malkiel, 1999). The same has been found for doctors' predictions of how faithfully individual HIV-infected drug users would adhere to antiretroviral therapy (Tchetgen et al., 2001). Foreign policy subject-matter experts do little better than well-informed lay people (or simple extrapolation from recent events) when predicting future political scenarios (Tetlock, 2006).

One condition that contributes to such overconfidence is the lack of task structure. Experts outperform novices (and chance) when tasks have well-structured cues, but when tasks are ill structured—as occurs with the ambiguous cues that often confront intelligence analysts—experts perform no better than novices (Devine and Kozlowski, 1995). A second condition that contributes to overconfidence is hindsight bias, which leads even experts to exaggerate how much they know or would have known if they had had to make others' predictions (Fischhoff, 1975; Wohlstetter, 1962). A third condition is the ambiguity of many forecasts, allowing people to give themselves the benefit of the doubt when interpreting their predictions (Erev and Cohen, 1990).

A cornerstone of the behavioral and social sciences is a suite of analytical methods designed to address these conditions by structuring tasks, reducing their ambiguity, and providing evaluative criteria. The committee believes that all analysts should have basic familiarity with these analytical methods, taking advantage of the rigorous evaluation that they have undergone. Analysts' familiarity should be minimally sufficient to identify the

fundamental structure of different classes of problems and to communicate with experts capable of fully applying them.

STRUCTURED ANALYTIC TECHNIQUES

It is not news to the IC that relying on expert judgment and intuition has drawbacks, and, indeed, the IC has long recognized characteristic analysts' biases in judgment and decision problems (see Arkes and Kajdasz, 2011; Spellman, 2011). These biases include "mindset" or "group think," in which a team prematurely converges on one hypothesis (or small set of hypotheses) and then confirms that hypothesis by seeking out supportive data or interpreting existing data in ways favorable to it, rather than seeking data that might disprove it.

A number of methods, known collectively as structured analytic techniques, have been developed specifically to overcome or at least limit such biases. These methods, devised largely by former intelligence officers, date back to the pioneering writings of Richards Heuer, Jr. (1999; recently expanded and updated in Heuer and Pherson, 2010; Heuer, 2009). They have been included in introductory classes in intelligence analysis offered in the IC,[1] in recently created intelligence studies programs,[2] and in IC intelligence analysis tradecraft primers (Defense Intelligence Agency, 2008; U.S. Government, 2009). Besides avoiding some of the biases of judgment and intuition, these structured methods seek to improve teamwork and document the reasoning that underlies intelligence judgments (Heuer, 2009).

Perhaps the best known structured analytic technique, the analysis of competing hypotheses, has analysts create a matrix, with rows for individual data and columns for alternative hypotheses (Heuer, 1999). The method directly addresses the problems just described, by directing an analyst's attention at the full sets of data and hypotheses and requiring an explicit tally of data consistent with each hypothesis. However, it is open to several possible objections (see National Research Council, 2010, pp. 18-21). One is that it gives no weight to the hypotheses' *a priori* plausibility. Approaches grounded in probability theory (see the next section) require an assessment of the prior probability of each hypothesis's being correct (e.g., relations between two countries staying constant, improving, or deteriorating).

Second, the usefulness (or diagnosticity) of data depends on how con-

[1]See, e.g., the syllabus for the ODNI's Analysis 101, available by request from this study's public access file. The syllabus was created by Science Applications International Coorporation (SAIC) for Session 0914_51-52-53, August 2009.

[2]The Spring 2009 curriculum of the intelligence studies program at Mercyhurst College in Erie, Pennsylvania, included a course on improving intelligence analysis (RIAP 315/INTL 650), whose syllabus is the intellectual property of Stephen Marrin, based on his own research and writing. The syllabus is available by request from this study's public access file.

sistent they are with different hypotheses. For example, recalling diplomats or putting forces on alert could be consistent with both intending hostilities and hoping to prevent them. That ambiguity might be missed without more explicit assessment of conditional probabilities. Alternatively, the presence of many unlikely hypotheses may give a misleading tally to a favored hypothesis.

The committee heard presentations advocating wider use of various forms of structured analytic techniques. In our view, all potential methods should be evaluated in light of their plausibility, given basic science, and their performance, in conditions as close as possible to those faced by analysts. The remainder of this chapter briefly reviews that science; the companion volume provides further details on the research.

PROBABILITY THEORY

Although analysts routinely entertain hypotheses that might explain particular observations and are trained to seek alternative explanations (see previous section), they rarely formalize those beliefs in the probabilities needed to communicate their *degrees of belief* and evaluate them in the light of future events.

Even though probability computations can become complicated, the basic ideas are quite simple. First, probability is a measure of an analyst's belief that an event will occur (probability can also measure an analyst's belief that something is true; e.g., an observed event has a particular significance). Second, the probability that *something* will happen equals 1. Third, if two events are mutually exclusive (the occurrence of one event precludes the occurrence of the other), then the chance that one or the other of these two events will occur equals the sum of the two probabilities. The rules of Bayesian inference build on these simple principles, leading to orderly judgments about uncertain events. As analysts understand the basic logic, their judgments are likely to improve. (For more information on the logic and value of probability theory, see, among other, Drake, 1999.)

Contrast this orderly use of probability with the estimative language (or verbal quantifiers) used to ascribe degrees of likelihood in National Intelligence Estimates; see Figure 3-1. Although the likelihood of an event clearly increases as one moves from the left to the right on the scale in Figure 3-1, it is very difficult to say anything more than that. (For an early discussion on estimative language, see Kent, 1964.) Suppose one needed to know the chance that something other than two mutually exclusive events would occur, when one was "unlikely" and the other "even chance." How much should one worry about the remaining possibilities?

Some skeptics argue that using probabilities in intelligence analysis is inappropriate. For example, the National Intelligence Council (2007b, p. 4)

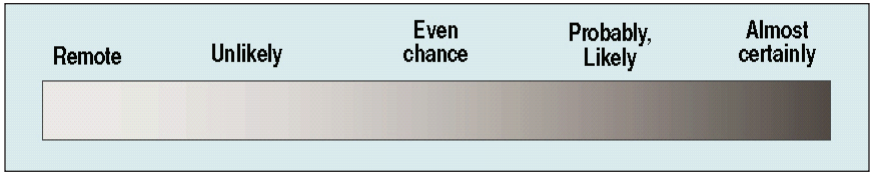

FIGURE 3-1 Terms used to describe the likelihood of events in National Intelligence Estimates.
SOURCE: Reprinted from National Intelligence Council, 2007b. A slightly more extensive scale was included in an assessment of Iran (National Intelligence Council, 2007a).

explicitly states, "Assigning precise numerical ratings to such judgments would imply more rigor than we intend." Similarly, a National Intelligence Estimate on Iran (National Intelligence Council, 2007a, p. 4) said, "Because analytic judgments are not certain, we use probabilistic language to reflect the community's estimates."

The committee disagrees with these blanket dismissals of considering probabilities. If analytic rigor and certainty are to be improved, probability has to be included in the analytic process. In his classic essay "Words of estimative probability," Sherman Kent (1964) captured a truth whose details have been studied extensively by behavioral scientists: numeric probabilities convey expectations clearly, while verbal quantifiers (e.g., likely, rarely, a good chance) do not (see Budescu and Wallsten, 1995). Verbal quantifiers can mean different things to different people—and even to the same person in different situations (e.g., unlikely rain, unlikely surgical complication).

Consider, for example, possible interpretations of the statement, "When military exercises are performed, the president rarely attends." The meaning of "rarely" might be interpreted to include a wide range of numeric values. Although this particular example is easily solved by providing a percentage of known historical events, the implications for national security become clear if an analyst does not clarify the historical certainty and follow it with additional verbal quantifiers of an expected future event on which a decision maker may act. For example, "Because the president announced he will attend next week's exercise, it is likely an offensive provocation rather than a routine exercise." By assigning a numerical value to historically known events, an analyst can more easily apply numeric probability to future events and thus improve clarity and value of assessments provided to decision makers (see discussion about communication in Chapter 6).

Concerns that teaching probability theory and application to analysts is too difficult are not well founded, as evidenced in the numerous academic

programs that include it as a core subject. Probability (and the other formal methods discussed in this chapter) is regularly taught to master's degree students in applied programs in business administration, public health, and other fields, as well as being required for undergraduates in economics, political science, psychology, and other behavioral and social sciences. That is, students with intellectual talents like those of intelligence analysts routinely develop skills at the level the committee recommends. The committee sees no reason that analysts cannot be made familiar with these approaches through a combination of in-house training for working analysts and hiring new analysts whose education includes the relevant training. The committee also notes that many, if not most, people can make orderly probability judgments (see O'Hagen et al., 2006), including representative samples of U.S. 15- and 16-year olds (Bruine de Bruin et al., 2006; Fischhoff et al., 2000) and adults judging disease risks (Woloshin et al., 2008). The committee is confident that intelligence analysts, if provided with basic familiarity, are capable of both understanding and applying probability theory in their work.

Indeed, basic probability principles such as Bayes' rule have occasionally been used in intelligence analysis. Zlotnick (1972) reports an application to the Cuban missile crisis; Schweitzer (1978) discusses how Bayesian reasoning was applied to continual assessment of the probability that there would be an outbreak of hostilities in the Middle East; Mandel (2009) reports well-calibrated probabilities from Canadian analysts.

A suitable protocol for probability judgments should address potential concern that precise numbers convey unwarranted precision in analytic assessments. One approach is embodied in the "confidence in assessments" characterizations that currently accompany the verbal likelihood statements in National Intelligence Estimates. A second approach is to systematically summarize the quality of the underlying evidence, to consider such issues as: the kind of data used, the rigor of the review processes, and the maturity of the underlying theory (e.g., the numerical unit spread assessment pedigree [NUSAP]) system, Funtowicz and Ravetz, 1990). A third approach is to conduct sensitivity analyses, showing how summary probability judgments would change with plausible variations in underlying assumptions (e.g., if economic growth were 7 percent instead of 3 percent). Properly formulated, such analyses might support meaningful ranges of summary probabilities (e.g., 60-70 percent chance of elections before the end of the year).

In addition to having individual analysts express their personal beliefs in probability terms, there are methods for eliciting such judgments from groups. One promising method is the prediction market. In it, participants trade positions on "securities" on the basis of well-defined events, such that the value of the security depends on whether the event occurs. The security might be worth $1 if it occurs and nothing if it does not occur.

The security's trading price represents the market's probability that the event will occur. Prediction markets have been found to ". . . increase the accuracy of poll-based forecasts of election outcomes, official corporate experts' forecasts of printer sales, and statistical weather forecasts used by the National Weather Service" (Arrow et al., 2008, p. 877; see also Chen et al., 2008; Wolfers and Zitzewitz, 2004, 2006). Many companies, including Google (Cowgill, 2005) and Intel (Intel, 2007), now use prediction markets internally to forecast the likelihood of future events of corporate interest. In popular culture, on January 20, 2010, Intrade's market value was 70 cents for the security "Tiger Woods will play in a PGA Tour Event before April 30, 2010." It was 7-9 cents for "Osama Bin Laden will be captured/neutralized before midnight ET on 30 Jun 2010."[3]

Despite the misadventure by the Defense Advanced Research Projects Agency in first proposing, then canceling, a policy analysis futures market (Hanson, 2003), the committee concludes that the use of prediction markets in the IC bears systematic empirical evaluation.

DECISION ANALYSIS

Decision analysis provides another family of methods potentially suited to intelligence problems (Howard and Matheson, 1983; Raiffa, 1968). Decision analysis offers systematic procedures for formulating and solving problems that involve choices under uncertainty. Decision analysis could provide a vehicle for structuring and analyzing intelligence problems that require analysts to infer or interpret the choices of adversaries and others, both of interest in their own right and as inputs to game theory analyses (see below).

A central concept in decision analysis is the "value of information" (Fischhoff, 2011; Howard and Matheson, 1983; Raiffa, 1968), that is, how much better can decisions be made if analysts have some information than if they do not have it. Decision analysis provides a way to formalize this assessment for various kinds of decisions and information. However, just thinking in these terms can help customers to determine what they really need to know, so that they can make more precise requests for information, while at the same time helping analysts to assess their customers' needs. Decision analysis can also provide a check against collecting and reporting information simply because "we've always done it" or because it seems like it would be good to know.

As with probability theory, decision analysis is regularly taught as a core subject in professional programs to students with no prior exposure and even modest analytical aptitude. Readily available computer software

[3] See http://www.intrade.com [November 2010].

(e.g., Pallisade's precision tree or Treeage's product of the same name[4]) can guide training and applications. These programs are often compatible with common spreadsheet programs, such as Excel, which makes it possible for students with minimal mathematical training to use standard decision analysis tools, such as decision trees and influence diagrams. As with the other methods in this chapter, the committee concludes that familiarity with these basic concepts of decision analysis is essential to intelligence analysis.

STATISTICS AND DATA ANALYSIS

Of all social science research methods, statistics and data analysis probably represent the most recognized family of tools. The committee concludes that basic (not expert) data analytic and statistical familiarity should be a requirement for any intelligence analyst. This familiarity would include such knowledge as how to organize and display data, how to calculate descriptive measures of central tendency (e.g., means, medians, and modes) and variability (e.g., range, variance, standard deviation, and mean absolute deviation), how to construct simple point and interval estimates (e.g., confidence intervals), how to perform simple statistical hypothesis tests, and how to search for relationships among variables (e.g., correlation and regression).

The committee recognizes that intelligence work has constraints that can complicate statistical analysis. For example, analysts may have less opportunity to ensure the representativeness of the data that they have to analyze. But even in such cases, they can benefit from statistical approaches for characterizing imperfect samples (e.g., length-biased sampling, truncation, censoring, or multiple systems analysis). Intelligence analysts often must work with data that have been deliberately manipulated to deceive them. Here, too, they may benefit from statistical procedures for identifying outliers and inconsistencies. However, many intelligence issues involve the routinely challenging problems of data quality that statistics can clarify; studies on climate change, economic development, or election forecasts face many of the same problems.

SIGNAL DETECTION THEORY

Although perhaps less well known than the other methods discussed in this chapter, signal detection theory deals with a fundamental problem when making judgments under uncertainty: how to differentiate between an analyst's *knowledge* and *response biases* (for a review, see McClelland,

[4]For details, see http://www.palisade.com/PrecisionTree/ [June 2010] and http://www.treeage.com [June 2010].

2011). Two people looking at the same evidence regarding an uncertain event (e.g., a political crisis, a change in military readiness, or an impending hurricane) may make different predictions either because one has a better understanding of the situation or because one is more willing to predict the event (e.g., warn decision makers about a political crisis, military readiness problem, or a hurricane).

Signal detection theory can be used externally to sort out why people say different things or why sensors have different response patterns. Indeed, signal detection theory is a standard technique in signals intelligence (SIGINT). However, it can also be used to provide clear reporting incentives for all-source analysts so that they know what level of surety is needed before they issue a signal. Signal detection theory embodies the principles of Bayesian reasoning in that it establishes the importance of expectations in predictions. If an event is very unlikely, it should not be predicted unless there is a very strong signal or there is very strong need not to miss it.

GAME THEORY

Of all social science methods, game theory best captures many of the arenas in which intelligence analysis take place. Game theory is a formal structure to anticipate decisions, taking into account each decision maker's expectations about how others will respond to alternative choices and always picking the action expected to yield the greatest net return. It assumes that whenever individuals interact, they do so on the basis of rational calculations that maximize their own self-interests (Bueno de Mesquita, 2009a, 2011; Dixit and Nalebuff, 2008; Myerson, 1991). Game theory assumes, further, that people (agents) conduct decision analyses of their circumstances, with one important extension—each player imagines how the other agents make the same calculations on their own behalf. Game theory models then determine what happens in equilibrium—that is, when no agent can improve his or her position by choosing another action. Rather than extrapolating forward from the past, as with common statistical time-series analysis (Box and Jenkins, 1976), game theory models look forward and reason backwards.

Imagine a country that has developed a new weapon or strategy to counter terror attacks, such as Israel's development of the "Iron Dome" system to counter Qassam rockets and other missiles (Frenkel, 2010). A naïve forecast of the future use of that system might extrapolate past trends in rocket attacks and presume preventive fire in proportion to the rate of incoming projectiles. A game theory model, however, might conclude that if the new system is truly effective, then it would rarely, if ever, be used. The reasoning is that those responsible for firing rockets would realize the futility of their efforts in the face of an effective air defense system. Hence,

they would switch tactics from rocket fire to something different, meaning that the new system would never be used in response to terrorist threats.

Similar logic was at the heart of the "mutually assured destruction" strategy that characterized the nuclear standoff between the United States and the former Soviet Union during the Cold War. The game theoretic analysis associated with U.S. policy at the time was classified, but it has since been made public (see Aumann et al., 1995). One of the key developers was awarded the 2005 Nobel prize in economics. For specific aspects of game theory with special relevance for intelligence and foreign policy analysis, see Bueno de Mesquita (2011).

Game theory models can quickly become quite complicated, but, as with decision analysis, software tools facilitate the formulation and solution of elementary game models (e.g., Gambit, 2007; Bueno de Mesquita, 2009b). As with the other methods, the committee does not advocate that all analysts become expert game theorists; rather, it concludes that a basic familiarity with key concepts and constructs from game theory can help analysts better formulate and think through the problem sets they confront and help them recognize when more advanced technical knowledge is needed.

OPERATIONS RESEARCH

Operations research refers both to the scientific study of operations for the purpose of making better decisions (see Kaplan, 2011) and to the collection of quantitative methods tailored for such study. The "operations" can involve the repetitive procedures and tasks that individuals and organizations undertake in order to achieve their goals. Familiar examples include the activities involved in the manufacture of cars or other physical products, the processing of patients in hospitals or other health care centers (including the details of needed medical procedures), the distribution and routing of people or materiel across transportation networks, and the procedures that bank tellers, phone operators, or Internet help desk advisers use in serving customers. The main methods include optimization models used to determine how to minimize costs, maximize profits, maximize lives saved, or minimize the time required to complete a project; stochastic processes, which build on basic probability theory to address situations where randomness and uncertainty dominate; and decision analysis (e.g., Hillier and Lieberman, 2010).

For intelligence analysts, these methods could answer questions concerning the operations, capabilities, or procedures underlying adversaries' (or allies') systems of interest. Although the mathematical methods that underlie operations research methods are deep, the basic concepts can be grasped without advanced mathematics. Moreover, easy-to-use com-

puter software allows formulating and solving simple models with modest training. Examples of such software include Frontline System's Solver, the standard version of which ships as part of Microsoft Excel; the operations research modeling suite contained in SAS; and Microsoft Project.[5]

QUALITATIVE ANALYSIS

Qualitative analysis is a major part of what the IC produces. Most intelligence analysts spend a substantial portion of their careers doing qualitative investigations of countries, regions, issue areas, nonstate actors, and transnational threats. When performed correctly, qualitative research can be as objective and rigorous as quantitative research (King et al., 1994). Because qualitative analysis is more easily read than quantitative analysis, it can seem less demanding. As a result, sophisticated qualitative research has been the exception, not the rule, especially for studies with a small number of cases. However, accurate description and reliable explanation are fundamental to science—and are the hallmark of analytic, structured qualitative research.

The same basic rules of research design hold for qualitative research that seeks to describe and explain past events as for any research that strives to make informed forecasts. Central to such studies is the "plot" (Cronon, 1992), the integrative perspective that can bias stories. One safeguard is to ask theoretical questions about the variables and relationships in the narrative, regarding whether the claimed process is generally true. Analysts can provide that essential service because of their unique position, between information collectors and customers (policy makers), allowing them to help customers reframe their questions into testable hypotheses.

Structured qualitative analysis goes beyond a focus on individual hypotheses to generate observable implications, clarifying their meaning and suggesting additional data and hypotheses. That structure reduces the natural tendency to "condition on consequences," treating the outcome as the natural result of a linear chain of events (Dawes, 1993, 2005; Fischhoff, 1975, 1978), while also guarding against hindsight bias. It is part of the game theory method of looking off the equilibrium path (Bueno de Mesquita, 2011), which requires analysts to consider what might have happened had different events and decisions occurred, providing a more complete understanding of the challenges and constraints that decision makers face. Thus, structured qualitative research incorporates elements of the quantitative intellectual tool kit (e.g., game theory, decision theory) (see Skinner, 2011). Even when these strategies do not eliminate biases (e.g.,

[5]For details, see http://www.sas.com/technologies/analytics/optimization/or/ [June 2010] and http://www.microsoft.com/project/en/us/default.aspx [June 2010].

mind set, ideology, creeping determinism), they help analysts be more mindful of their assumptions and cautious about their conclusions (Fischhoff, 1980).

For example, applied to open source information (Chapter 1), analysts would likely benefit from the application of basic scientific research methods to the identification and use of public domain data including:

- following open sources routinely, developing the mastery needed to compare their practices and detect changes in their reporting;
- searching for observable implications of hypotheses derived from secret sources that can be tested in open sources, and vice versa;
- deriving hypotheses from open sources, then cross-checking them with "trusted" secret sources, and vice versa; and
- explicitly reporting open sources in assessments provided to policy makers, so as to reveal their provenance.

Following these methods would subject qualitative intelligence analyses to the discipline imposed on scholarly research, but without the irrelevant encumbrances of academic research (see Skinner, 2011).

SUMMARY

The behavioral and social sciences have a large number of analytic methods that have been developed through the interplay of theory and applications, conducted in the harsh light of open scientific peer review. The best of these methods belong in the IC's tool kit. The IC's analysts need to know enough about these fundamental ways of looking at the world to enrich their own thinking and to secure the services of experts when needed. In order to serve its customers, the IC needs to be a critical consumer of analytical methods, both identifying those best suited to its needs and avoiding the temptation to rely on unproven methods that promise to do the impossible.

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4

The Workforce

The quality of analyses depends on the intellect, talents, and skills of the analysts and the efficacy of their training and career development.

The intelligence community (IC) operates in an increasingly complex, turbulent, and fast-changing threat environment (see Fingar, 2011). This environment has important implications for recruiting, training, organizing, retaining, and managing the IC workforce. In stable environments, organizations can rely on stable work practices overseen by a relatively rigid administration that directs a generally hierarchical and compliant workforce. In turbulent environments, organizations require innovative work practices, flexible administration, and a creative, inventive workforce, given rein to find new approaches and novel solutions.

This chapter considers the findings on workforce issues from the behavioral and social sciences. Specifically, it looks at the discipline of strategic human resource management, whose focus is determining the best ways to create and manage a workforce that meets an organization's needs. Building an IC workforce that is well suited for the challenges of the 21st century will require two broad efforts: (1) recruiting and selecting analysts—and other specialists—with the abilities, skills, and temperaments needed for success in this new environment; and (2) building the capabilities of that workforce by enhancing continuous learning, motivation, and collaboration (see Crook et al., 2011, for an analysis of the relationship between human capital and organization performance).

RECRUITMENT AND SELECTION

The IC employs approximately 20,000 analysts with a wide range of talents and expertise, and it has begun to define the array of competencies that analysts will need through their careers (e.g., Director of National Intelligence, 2008). However, the IC definitions rely on "face validity" or intuitive appeal rather than on an evidence-based evaluation.

Strategic human resource management offers an objective, scientific approach to developing the best possible workforce. It is grounded in the findings that individuals differ on a wide range of psychological characteristics—such as cognitive ability, personality, and values—that predict corresponding differences in educational achievement, job performance, and career success. Some of these characteristics are relatively stable, such as cognitive ability, personality, and values, while others are more malleable, such as job knowledge, job-specific skills, attitudes, and motivational characteristics.[1] Stable characteristics can influence the malleable ones. For example, it is well established that individuals with relative higher cognitive ability gain more from experience and training than those with relatively lower cognitive ability (e.g., Judge et al., 2010; Schmidt and Hunter, 2004).

To assemble and develop individuals with the optimal collection of characteristics, the IC needs to pay attention to recruiting and selecting the right people, as well as to their training, motivation, and support. Both of these efforts will be important, but recruitment and selection is especially important because the quality of the human resources pool assembled in this first step facilitates or constrains an organization's subsequent ability to build and develop its workforce. A failure to maximize the talent pool at this step cannot be rectified by subsequent efforts.

Psychological research has identified a wide range of characteristics that differ from individual to individual and can help to identify people with the greatest potential to become successful analysts. It is important to note that the optimal qualities for IC analysts may turn out to be quite different from the current criteria. For example, current practices may undervalue raw cognitive ability (a stable characteristic) and overvalue historical or political area knowledge (a malleable characteristic). Furthermore, the IC may need to shift from proxy measures, such as having a college degree, to direct measures of cognitive ability, as there is generally substantial variation in the cognitive abilities of college degree holders even from the same institution. Direct measures with strong psychometric validation are readily

[1]Attainments such as an advanced graduate degree or extensive domain-specific expertise, although technically malleable, may entail a sufficiently long developmental period as to be considered stable characteristics for practical purposes.

available. Ignoring them will cause the IC to lose the opportunity to ensure the highest quality pool of human resources for its needs.

The IC should also design its recruitment strategies to reach the best possible pool of potential recruits, from which the best candidates can then be selected. Finding the best candidates will require overcoming the common tendency of organizations to rely on "traditional" sources or pathways by which potential recruits become part of the applicant pool. These practices can create insufficiently diverse and talented applicant pools. There are well-developed recruitment methods (e.g., Rynes and Cable, 2003) to help ensure that applicants to the IC offer a wide range of the capabilities needed for intelligence analysis.

Given the difficulty and importance of its mission, the IC needs to use methods that have been evaluated and proven to be effective. For example, it is very common for an unstructured interview to be one component or even the only component of a selection system. But unstructured interviews are known to suffer from significant problems (see Huffcutt and Arthur, 1994; Kozlowski, 2011; McDaniel et al., 1994). One such problem is that interviewers select candidates they like personally, who tend to be people who are similar to themselves. In the current fast-changing intelligence environment, that tendency could be costly in terms of the diversity of people and skills needed.

DEVELOPMENT

In addition to improving its recruitment and selection practices, the IC needs to provide its workforce with the training, management, and organization needed to maximize their potential. Recruitment and selection establish the quality of the human resources pool, but the knowledge, skills, abilities, and other characteristics of potential new analysts are desirable to a wide range of jobs and organizational settings and makes potential analysts desirable to other potential employers as well. It is the specialized training that analysts should receive from the IC that develops the unique skills necessary to be successful analysts. The IC needs to make optimal use of its information advantages, its knowledge of what national security decision makers need from the IC, and its ability to tap into expertise both inside and outside the federal government. To do so successfully, it needs to create knowledge and skills in its workforce that are specific to the organizational mission and that provide an advantage in innovation and agility (i.e., to ensure U.S. intelligence is superior to that of its adversaries) (Barney and Wright, 1998; Crook et al., 2011; Ployhart, 2006).

In contrast to recruitment and selection, the process of workforce development will unfold over a long period of time and should evolve as scientific knowledge and IC experience dictate. A new approach to work-

force development requires not a one-time fix, but, rather, a basic shift in managerial practices to enhance the value and effectiveness of the IC workforce. The rest of this section discusses three key elements of development: continuous learning, motivation and assessment, and collaboration.

Continuous Learning

As demands on analysts shift, their performance will be largely determined by the extent to which the IC embraces and values continuous learning and training in the face of the normal pressures to give higher priority to the demands of the moment. Training should not be viewed as an impediment to "getting work done," nor should it be provided only to entry-level personnel. Instead, it must be seen as a career-long commitment, as much a part of the job as preparing analyses or providing guidance to intelligence collectors.

A good starting place would be the creation of a common curriculum of essential analytic tradecraft skills in joint settings, such as those taught in Analysis 101 by the Office of the Director of National Intelligence (ODNI) and its newer companion Analysis 101 for managers, which trains managers to support the use of new analytic methods. Neither of these are nor can be viewed as taking time away from analysts' "real work." These two starting elements would be important steps toward enhancing skills and overcoming organizational and cultural barriers to collaboration. But more needs to be done to develop a culture of continuous learning. All such efforts at improving performance should receive publication-quality evaluation—even if the results of those studies will never be shared outside the IC.

One key element of training is a proper range of procedures and contents. Chapter 3 identifies basic behavioral and social science knowledge that would be helpful to analysts. In addition to this basic skills training, there is a science of training effectiveness that has well-developed methods for identifying training needs, designing instructional methods, and evaluating their validity (for a review, see Kozlowski, 2011).

Analysts would also benefit from hands-on experience on a wide range of problems to improve their analytic tradecraft skills. Analysts today face several obstacles to improving their judgments (for a review, see Fingar, 2011). First, feedback regarding the accuracy and value of assessments is often limited, which makes learning from experience difficult and ambiguous. It has been extensively documented that effective feedback is necessary for learning (e.g., Kluger and DeNisi, 1996; for a review, see McClelland, 2011). Second, many critical analytic problems have a relatively low base rate (i.e., they are encountered only rarely), which creates great pressure to analyze them right the first time. Analysts should not be forced to "feel their way" through major challenges.

One way to address both issues is to use simulations to create synthetic experiences, providing exposure to infrequently encountered events along with timely, precise feedback. Simulations also make it possible to role play in situations in which "failure" can be used for reflection, learning, and innovation, rather than being a source of blame. As noted in Chapter 3, research shows that more learning generally accrues from failure than from success. The science of simulation-based training is well established and in widespread use by the aviation industry, the military, the medical community, the National Aeronautics and Space Administration, and other organizations that face analogous challenges (e.g., Bell et al., 2008; Cannon-Bowers and Bowers, 2010; Salas et al., 2011).

The culture of training should also include informal practices that provide opportunities for learning on the job (e.g., socialization, mentoring, cross training, job rotation, and career progression paths), strengthening institutional supports (e.g., time, money, and encouragement) for continuing education, both inside or outside the organization, and removing institutional barriers that inhibit continuous learning.

Several features of the IC environment require substantive and systematic training. Analysts must communicate with others both up and down the information chain, and they must collaborate with others who have different information and different types of expertise. At the same time, the IC environment can change swiftly. This situation suggests the need for various types of cross training, from acting in a different role during a training simulation to serving in different organizations and even on different types of assignments. Experiencing other people's jobs and situations from their perspectives can help analysts better know how to communicate with people in those roles, and the expertise that one develops from experiencing a variety of situations leads to greater flexibility and insight when dealing with a new situation.

Everyone should be involved in training. Those who "know the most" should teach what they know. Teaching is itself a learning experience: in trying to explain things to other people, a teacher must first see those things from the student's point of view, which can lead to a questioning of one's own knowledge and assumptions.[2]

The IC does not now embody strong self-reflective norms in its teaching and mentoring programs. Rather, the programs seem to emphasize the transfer and preservation of institutional knowledge and practices. Although that is certainly an important task (especially given the expected

[2]Imparting the wisdom of more experienced analysts is an effective way to broadly leverage knowledge. However, experience alone does not make one an effective trainer (see Marsh, 1995). It is necessary to "train the trainer" so that experience can be translated into learning for others.

high turnover because of the IC's younger, more fluid analytic workforce), it is also important for those doing the teaching to receive feedback from the new generation of analysts and for senior managers to create conditions that foster and capitalize on the skills and backgrounds of both current and future analysts.

Promoting continuous learning requires serious investments in training and development. It also requires the systematic elimination of practices that inhibit continuous learning, such as insufficient time, resources, and incentives. If the IC is to develop a scientific approach to continuous learning, its senior and middle managers need to be committed to the concept and communicate that commitment in their goals and programs.

Motivation and Assessment

Once valuable, unique, and difficult-to-replicate capabilities have been developed in a workforce, management practices can help shape employee attention, provide motivation, reward effectiveness, and encourage continuous improvement. Some widely practiced strategies, such as annual evaluations, often produce inaccurate feedback (Murphy and Cleveland, 1995), and it is difficult to ensure the factors being rated are aligned with organizational goals (for further discussion see Kerr, 1995; Lawler and Rhode, 1976). In contrast, research shows the value of ensuring that supervisors have appropriate training in continuous performance management, including skill at setting goals, providing frequent feedback, coaching, and development (e.g., Aguinis, 2007; Smither, 2011).

One important factor in motivation is that the reward system that is most effective is different for different types of employees. With extrinsically motivated employees—that is, employees who are motivated mostly by external factors, such as pay, recognition, and advancement—it is important to link compensation to desired performance (see Bartol and Locke, 2000). With employees who are intrinsically motivated by their work—that is, those for whom internal satisfaction is more important than external recognition—signs of the inherent value of their work is the key.

In the IC, intrinsic motivation is quite common, with analysts and other staff motivated by such things as the opportunity to save lives, serve their country, or solve important and interesting puzzles. For such workers, the most important approach is often to let them use and expand their skills with as few obstacles as possible. Fortunately, although extrinsic rewards are always constrained and limited in supply, intrinsic rewards are not.

Several structured rating methods for assessing performance effectiveness could be adapted for use by the IC (for further discussion of performance appraisals, see Murphy and Cleveland, 1991, 1995). It has long been known that, if assessments fail to address organizational needs, employees

will focus on only those things that they see as being rewarded, to the detriment of other goals (Lawler and Rhode, 1976), or they will seek workplaces that better fit their needs. For the IC, a particular challenge will be to design performance evaluations that take into account both individual actions and teamwork.

Collaboration

When organizations face complex problems in changing and uncertain environments, teamwork and collaboration are essential. Team-based work systems locate decision making closer to the source of problems (in the IC, this refers to analytic decisions), capitalize on diverse perspectives and expertise, and encourage innovation and agility[3] (Ilgen et al., 2005; Kozlowski et al., 1999). Team-based intelligence analysis can bring more information to bear on the analytic task and allow teams to dampen errors (for a review, see Hastie, 2011). If done correctly, expanding the information search and generating more alternatives have been shown to improve the effectiveness of forecasting (e.g., Dailey and Mumford, 2006). Creating communities of practice can allow like-minded analysts and others to focus on common interests, pool their knowledge, generate more alternatives for problem solving, and disseminate innovations.

The issue of collaboration is explored more thoroughly in the next chapter, but it is worth noting here that increasing teamwork and collaboration—in appropriate ways—can improve analysts' performance. For example, differentiation of expertise—that is, distributing knowledge and abilities among numerous individuals, each with specific areas of expertise—promotes greater exploration and innovation (Argote, 2011; Jansen et al., 2006). In order to harness this potential, the IC has to integrate diverse expertise (Miller et al., 2007; Fang et al., 2010).

A positive example of the IC's growing focus on teamwork and collaboration is the *Analytic Resources Catalog*, which allows intelligence officers to locate other IC personnel with particular knowledge and skills. Another recent development, A-Space, is aimed at helping the development of collaborative, self-organizing networks of analytic activity. In particular, A-Space allows analysts to query the community, share information and perspectives, and collaborate on solving problems.

Electronic communities of practice initially grow and improve more slowly than other knowledge management tools, such as knowledge portals and team rooms, but over the long term they demonstrate more continual

[3]The National Intelligence Strategy states the IC must be "*agile*: an enterprise with an adaptive, diverse, continually learning, and mission-driven intelligence workforce that embraces innovation and takes initiative" (Office of the Director of National Intelligence, 2009, p. 2).

improvement (Kane and Alavi, 2007). A-Space allows the formation of flexible networks for linking disparate expertise, allowing a self-organizing, exploratory, and agile integration of skills and knowledge that makes it possible to take advantage of the IC's differentiation. A-Space is conceptualized as an ongoing "experiment," so it is particularly important that A-Space be studied and improved over time and that the results be disseminated as a way of helping the IC embrace high-quality teamwork in a continuous learning environment.

EVALUATION

As discussed in Chapter 2, objective evaluation is key to organizational learning. Given the importance of the IC's missions and the complexity of the issues it deals with, the IC's adoption and application of outcome-based evaluation has the potential to significantly improve its various workforce-related practices, from recruitment and hiring to training and incentives.

Applying scientific methods to understanding its own work environment will allow the IC to make appropriate changes to recruitment, selection, and training. One key topic is identifying the specific factors that affect analysts' ability to learn and be successful in their job, such as cognitive ability, personality, education, and training. These can then be sought when recruiting and selecting employees. It is important to note, however, that the IC should carry out its evaluations in a way that focuses on systemic learning rather than on the assessments of individual analysts. Evaluation should be seen as a positive factor for the community—a process that will enable the entire IC to become more effective—rather than as a punitive process to be dreaded and, if possible, avoided. Effective evaluation, reflection, and continuous improvement are the underpinnings of organizational learning, innovation, and agility.

The IC, like any organization or group, must decide how to balance process evaluation (how well correct procedures are followed) and outcome evaluation (the quality of the analyses). This balancing act is especially difficult in environments, like that of the IC, in which there appears to be little scientific foundation for the best practices embodied in many current procedures, however sincerely and conscientiously they are applied (for a review, see Tetlock and Mellers, 2011).

It is notoriously difficult to devise either process or outcome evaluation procedures that do not create perverse incentives (Kerr, 1975; Wilson 1989). In the case of intelligence analysis, a natural risk is emphasizing the number of work products, which is easily assessed, over their quality, which is very difficult to assess. Indeed, poorly designed evaluation processes can undermine morale and productivity by encouraging extrinsically motivated employees to game the system and discouraging intrinsically motivated

employees, who just want to do interesting work and be treated fairly. Conversely, well-designed evaluations look separately at the performance of the organizations, given its methods and structures, and at the performance of individuals, given the opportunities and constraints that the organization presents them.

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5

Collaboration

Analysis improves when analysts with diverse perspectives and complementary expertise collaborate to work on intelligence problems.

The fragmented nature of the intelligence community (IC) did not arise by accident. As Chapter 1 describes, different agencies specialize in processing different forms of intelligence, serve different customers, and need workforces with different skills. Although this "structure" allows IC entities to have close working relationships with their primary customers, the resulting specialization and "stovepipes" can frustrate the integration needed to take full advantage of diverse competencies for tackling complex problems.

In order to realize the full potential of its material and human resources, the IC has invested in improving collaboration among analysts and agencies. One example, mentioned before, is the *Analytic Resources Catalog*, which helps analysts to locate relevant knowledge and skills within the IC. A second example is A-Space, which allows analysts to query the community, share information and perspectives, and collaborate on problem solving. A-Space specifically facilitates self-organizing networks that take advantage of expertise spread across the IC, providing agility that is impossible with conventional organizational arrangements.

This chapter first considers the forms and dimensions of collaboration, then reviews the research on the benefits of collaboration, the right level of collaboration, and barriers to collaboration. The last section takes up the issue of evaluation that is relevant to improving collaboration in the IC.

FORMS AND DIMENSIONS

In its broadest sense, collaboration in the IC occurs whenever one analyst seeks assistance from another analyst, outside contractor, or unpaid expert. Such collaborations vary along several dimensions that, when matched appropriately to situational needs, can improve their effectiveness. One is group duration, which can range from an ad hoc one-time arrangement to long-standing working groups. A second is the number of analysts involved. A third is how direct communications are, ranging from face-to-face meetings to anonymous electronic exchanges. Fourth, collaboration can be either cooperative (seeking shared conclusions) or competitive, maintaining alternative views either deliberately (e.g., red teaming or devil's advocacy) or naturally (e.g., genuine disagreement).

Although all collaborations involve some integration of independent perspectives, consensus is not necessary for the outcome to be useful. Indeed, research in private corporations finds that people are most satisfied with collaboration that strives for "consensus with qualification," in the sense that the final product reflects a majority view, while preserving dissenting views as "qualifications" (e.g., Eisenhardt et al., 1997). Useful integrated outcomes need not be produced by analysts themselves, but might be aggregated by an external team or even software "robots" (as in a prediction market). Box 5-1 describes an emerging form of parallel collaboration: "idea tournaments" for producing the best ideas for solving a problem.

Intelligence in the age of global counterterrorism requires effective collaboration with groups both inside and outside the IC, including domestic and international agencies, private contractors, industry experts, and academics. These relationships can range from informal calls for advice to formal contracts.

Assessment of the value of collaborations face the same evaluation challenges that arise with individually produced analyses (Chapter 2). Independent review committees can provide empirical evaluations (e.g., those conducted by the National Institutes of Health, National Science Foundation, Institute of Education Sciences, and Office for Judicial Research; for an example in private business, see Sharpe and Keelin, 1998). The Intelligence Advanced Research Projects Activity (IARPA) performs some of this function for the IC, by evaluating new high-risk/high-payoff methods with a small probability of producing an overwhelming intelligence advantage. However, IARPA does not support research on current analytic practices. The Office of Analytic Integrity and Standards in the Office of the Director of National Intelligence (ODNI), along with units in other IC agencies, intensely evaluates analytical work done internally, but typically their pro-

BOX 5-1
Idea Tournaments: A collaborative tool

The private sector is increasingly relying on "idea tournaments," providing rewards to the best solution proposed for a problem. The concept of tournaments, however, is hardly new, with antecedents reaching back at least as far as the Longitude Prize offered by the British Parliament in 1714.

Drawing on the fundamentals of agency theory in microeconomics and on other research, Morgan and Wang (2010) identify three conditions in which tournaments are most likely to prove useful, all of which are often satisfied in the world of intelligence analysis.

1. Individual workers' effort is hard to monitor. For example, in intelligence analysis, it can be difficult to distinguish deep thinking from idling or open-mindedness from reluctance to take positions (Tetlock and Mellers, 2011).
2. The absolute quality of the work product is hard to judge, encouraging evaluations based on relative performance, which reduce pressure to excel in absolute terms. For example, in intelligence analysis, satisfaction with the best currently available analyses can obscure the possibility of "expanding the envelope" of prediction capability (Tetlock, 2005).
3. Judgments of the quality of final work products can be swayed by exogenous shocks that are often relatively foreseeable. For example, in intelligence analysis, there is the danger of "overlearning" from history and fixing on lessons of limited generalizability (March, 2010).

Tournaments can be a potent tool for helping organizations break out of suboptimal coping patterns. The science of behavior in tournaments is growing and offers options that could be adapted to the conditions of the IC; the results could then be subjected to empirical tests, compared with other methods of collaboration.

cedures rely only on expert judgment to assess analyses and the value of collaboration.

BENEFITS

Although organizational specialization and separation have some advantages, enhancing collaboration across the IC has several expected benefits for analyses that demand knowledge and skills distributed among analysts and across organizational boundaries. For example, consider analysts trying to determine whether a gathering of 20 people in a Yemeni village indicates the presence of terrorists. Although knowledge of Yemeni culture is vital, so, too, might be knowledge of recent terrorist recruitment methods and illegal international financial transfers (if there have been

unusual flows of funds into the village). Experts in each area could guess at what the others know. However, they are better off consulting, especially given individuals' tendency to underestimate how much their own knowledge is limited (Fischhoff et al., 1978; Lichtenstein et al., 1982). One reason for this bias is that the absence of information is less salient than its presence (e.g., Agnostinelli et al., 1989). Thus, the set of hypotheses an analyst entertains (e.g., about the village gathering) will be limited to what the analyst can imagine. Collaboration can add missing perspectives.

Analysts often face virtually unbounded sets of potentially relevant knowledge. Because no one can search through all relevant knowledge (Newell and Simon, 1972; Simon, 1979), people take mental shortcuts, in the form of schemas and heuristics that focus, but naturally limit, their information search and processing (Bobrow and Norman, 1975; Fiske and Taylor, 1991; Hayes and Simon, 1974; Ohlsson, 1992).

When people with heterogeneous backgrounds work together, their perspectives filter information in different ways, allowing more knowledge and solutions to emerge. Diversity can be sought in subject-matter expertise, functional background (Dearborn and Simon, 1958; Sarasvathy, 2001), personal experience (Shane, 2000), and mission perspective (Anderson and Pichert, 1978). Such sharing allows analyses to be richer and deeper, with better understood strengths and weaknesses, whereas individuals working in isolation are more limited by their assumptions and myopic about the limits to their own knowledge (Cheng et al., 2008; Leung et al., 2008; Williams and O'Reilly, 1998). Simply communicating one's assumptions, which is more likely when team members with different backgrounds collaborate, can expose gaps in logic and information (Nemeth, 1986). Exposure to contrasting perspectives can reveal errors and promote re-conceptualization (Bobrow and Norman, 1975).

A broader definition of collaboration includes not just groups that interact directly, but also teams that work in parallel, with customers (or managers) aggregating their conclusions. In such arrangements, it may be productive to have the teams work independently and even competitively before their individual products are integrated by a manager or customer.

THE RIGHT LEVEL

Although there are benefits to increased collaboration, there are also costs, traditionally labeled "process losses." Figure 5-1 illustrates these benefits and costs and their net impact (subtracting costs from benefits). The result is a single-peaked performance function that has a maximum value at intermediate levels of collaboration.

One cause of "process loss" is not related to collaboration, but is exacerbated by it: overloading analysts and their organizations with more

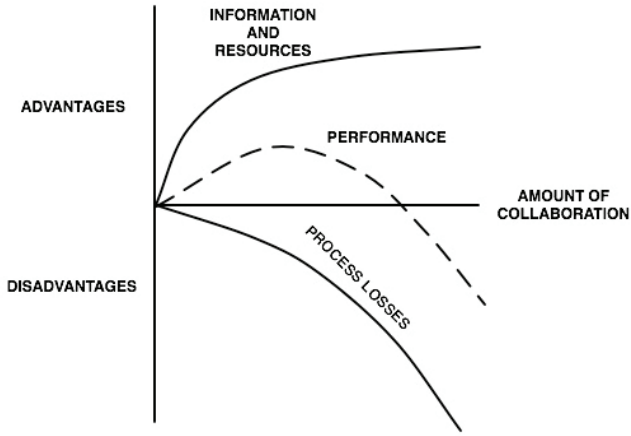

FIGURE 5-1 Schematic summary of the tradeoffs between the advantages and disadvantages of collaboration in complex systems.

information than they can handle, especially when they must struggle to identify the relatively few relevant bits. Such overload appears to have been part of some of the most public failures of intelligence, such as the failure to detect the 9/11 attacks, the confused efforts regarding the 2009 Christmas Day bomb plot, and even Pearl Harbor (Wohlstetter, 1962). A second cause of process loss, which is a direct result of collaboration, is the time and effort invested in coordinating activities.

Some process loss is essential to achieving the benefits of collaboration, as people work to understand one another's perspectives (Dearborn and Simon, 1958; Dougherty, 1992). Indeed, the greater the heterogeneity, the greater the potential benefit and potential process loss, in terms of intellectual effort and sometimes emotional turmoil. Would-be collaborators who cannot understand one another may fight over resources, hoard information, and interfere with others' activities (Bonacich, 1990). In the IC context, there are often tensions regarding the value of different information sources (e.g., whether signals intelligence or human intelligence is more accurate). At some point, the gaps become too wide and the process losses too great for collaboration to be efficiently beneficial. One way to reduce that threat is to ensure that analysts have basic familiarity with one another's expertise before they begin a collaborative process. A common training curriculum across the IC can help in that regard (see Chapter 3).

Social and emotional conflicts can be so intense that negative stereotypes about potential collaborators prevent cooperative collaboration (e.g., "*Those* people don't understand . . . have the wrong priorities . . . are look-

ing for answers to the wrong questions . . . are lost in the weeds"). Such positions reflect the tendency to underestimate the subjectivity of one's own perspectives (e.g., Griffin and Ross, 1991) and to overestimate the extent to which others think similarly (Dawes, 1994). Realizing that other people have totally different perspectives can be threatening, with the natural response of devaluing not only the perspectives, but also the people.

In theory, *cognitive conflicts*, which arise from differences in beliefs and perceptions, are different from *affective conflicts*, which arise from emotional differences (Guetzkow and Gyr, 1954). However, recent research on discord within teams finds that these two often go together (e.g., DeDreu and Weingart, 2003). As cognitive conflict increases, it can stimulate emotional arousal that, then, interferes with cognitive flexibility and creative thinking (Carnevale and Probst, 1998). There can be a tipping point, after which the conflict is so intense that it undermines productive teamwork.

Fortunately, team members need not share perspectives as long as they are not diametrically opposed. For example, effective teams often have members with highly differentiated roles and areas of expertise (but not direct conflict; see Hutchins, 1991). Indeed, such teams can perform better than ones whose members have more similar perspectives (Liang et al., 1995; Wegner, 1986). A study in the software development industry found that members of successful teams had perspectives that diverged over time as they took on more specialized tasks (Levesque et al., 2001). It takes careful organizational design to create the right balance between similar and divergent views for collaborative work.

Because IC entities, like all organizations, operate in a resource-constrained environment, the costs of collaboration can outweigh its benefits. A good rule of thumb is the "law of requisite variety": a group's heterogeneity should match the complexity of the problems it is tasked to solve. With heterogeneous teams, process losses can outweigh the benefits of collaboration for simple problems, with the balance shifting for complex problems. Of course, this principle is easier to advocate in the abstract than to execute in the world of imperfect perceptions, incomplete knowledge, and limited time.

BARRIERS

Within the IC, many barriers to collaboration fall into two main categories: the behavior of individuals, and agency divisions and specializations that isolate intelligence into "stovepipes." In assessing individual behavior, one barrier to collaboration is not recognizing the need to collaborate, because people do not recognize the extent to which their training, socialization, and professional activities have shaped their world views and mental schemas (for a review, see Tinsley, 2011)—and not realizing the

overconfidence that comes with that narrowness (Ariely, 2008; Arkes and Kajdasz, 2011).

A second barrier arises from not knowing where to find needed complementary knowledge. A feature of successful teams is *transactive* memory: members learn who knows what, effectively making others' knowledge a part of their repertoire, ready when they need it (Wegner et al., 1985). Without that shared experience, other means are needed to ensure that individuals know about one another's expertise. Such deliberate means are essential to the IC, in which the needed knowledge can be widely distributed, inside and outside an agency and the IC itself. One deliberate way to develop transactive memory is to have potential collaborators train together (Liang et al., 1995). A second is explicitly giving team members information about one another's domains of expertise (Moreland and Myaskovsky, 2000). The IC's emerging databases of general expertise and specific knowledge are designed to address these needs. However, these databases need to reflect critical behavioral and social science in their design, such as ensuring that analysts can access this data (e.g., with search fields appropriate to diverse users) and can evaluate its authoritativeness (e.g., with evidence of source reliability).

A third barrier to collaboration arises when analysts resist outside perspectives because of social factors, such as intergroup rivalries. Collaboration appears to work best when collaborators' areas of expertise (and perspectives) do not overlap and are mutually compatible, in the sense of not threatening one another's legitimacy (Hutchins, 1991). Collaboration presupposes trust, as the parties make themselves somewhat vulnerable. The analyst who requests information exposes a need, while the responding analyst divulges information. In order to create such trust, organizations need to create general conditions favorable to the success of initial requests and responses, such as instilling norms of fulfilling promises and reciprocal disclosure.

The compartmented institutional structure of the IC poses an inherent barrier to collaboration. With many agencies having different specializations, histories, recruitment, and training methods, the IC lends itself to intergroup categorization processes that impede collaboration (see Tinsley, 2011). Those processes can encourage analysts to treat members of other groups categorically, as though they have similar, simplistic views, promoting stereotypes that spawn reciprocal antipathy (Kramer, 2005).

Categorization is one reason that information tends to be localized within dense restricted social networks, or "stovepipes," rather than distributed throughout a community (Burt, 1992; Granovetter, 1973; Krackhardt and Brass, 1994). These natural processes may be exacerbated by IC practices that involve secrecy classifications and sharing information on a need-to-know basis, further limiting awareness of what others know. Recent IC

efforts to replace the tradition of "need to know" with a policy of "responsibility to share" are consistent with effective collaborative environments (Office of the Director of National Intelligence, 2007).

A further institutional barrier to collaboration arises when incentives are lacking. Many commentators have noted that credit in the IC seems to be assigned mainly for direct contributions to intelligence products, with no explicit mechanisms for recognizing "assists" (O'Connor et al., 2009). Indeed, the committee observed little support for collaboration in performance evaluations and, sometimes, saw incentives for the opposite. Studies have shown the pitfalls of poorly created incentive schemes and ways to avoid unintended negative consequences (e.g., Baron and Kreps, 1999).

The IC has recognized these institutional obstacles to collaboration, with a primary mission of the ODNI being to reduce them. To that end, several visible programs have been implemented, including joint agency training exercises, joint-duty job assignments, cross-functional and multiagency project teams, and promotion of superordinate goals of the IC as a whole (see Tinsley, 2011).

Paradoxically, one way to enhance collaboration in the IC may be to increase its differentiation and specialization. Publicly signaled differentiation legitimates an analyst turning to other analysts for help, while pointing out the specific individuals who might provide it—thereby identifying them with their knowledge, rather than with their agency. Increased recognition of analysts' expertise would make it easier to recognize complementary expertise and the importance of recognizing gaps in knowledge. Moreover, narrower domains for analysts reduce the risks of analysts appearing to intrude on one another's domains. Having analysts identified by their specialties can also help managers to think systematically about team composition (see Hastie, 2011). Thus, it should be possible to enhance collaboration by defining, cataloging, and publicizing analysts' specialties.

EVALUATION

Research clearly shows that effective collaboration need not entail achieving consensus or even working together in groups. Rather, collaboration requires a balance, having enough tension between perspectives to elicit productive reflection, but not so much tension as to generate intergroup hostility. Creating those conditions requires recognizing the different kinds of expertise needed for particular problems. As with all other aspects of organizational design, productive collaboration requires hard-headed, outcome-based evaluations of collaborative projects, perhaps with some deliberate experimentation—followed by implementing the lessons learned from these evaluations, recognizing that the best practices may vary by problem.

Many questions can be addressed by evaluation. For example, when should a project manager task two independent teams with producing analyses that will be compared or aggregated? When is it best to keep information sources as rich and separate as possible until a final integration stage, rather than producing tentative integrative solutions early, then subjecting them to rigorous critiques from multiple perspectives? What are the best procedures for winnowing out information, in terms of balancing overload and preserving facts that might reveal flaws in reasoning? A strong commitment to empirical assessment would provide definite answers to currently unresolved questions concerning the value of adversarial methods (e.g., red team versus blue team simulations) and nominal group information integration procedures (e.g., the Delphi Method, in which experts iteratively provide independent estimates, then see pooled group judgments).

Although many in the IC express enthusiasm for collaborative aids like A-Space, there have been no rigorous evaluations of what works well and what does not. Such evaluations might reveal the value of creating programs that prompt and support collaboration between analysts who have not recognized their mutual interests. One possibility is a system like the web-based *Delicious*, whose users voluntarily share web bookmarks, helping others to identify shared interests.[1] Even without such deliberate tagging, individual analysts' search queries might be matched using "nearest neighbor" matching algorithms, so that the system would cue them about mutual interests. Although there are theoretical reasons to think that this solution, along with many potential innovations, might work, only empirical evaluation will provide concrete evidence about their value and about needed refinements.

Effective, innovative collaboration will not happen without incentives and strong management. Analysts need to know that they will be supported if they spend time learning other units' perspectives, share their information, and express ranges of opinion in their reports. The various IC mission statements demonstrate that the IC's senior leadership views such collaboration as central to its mission (see Chapter 1). The science exists to guide its implementation and evaluate its success. But to be effective, collaboration must be supported with strong, positive incentives, given the natural tendency for organizations to compartmentalize, especially when analyzing sensitive information under high-stress conditions.

[1] *Delicious* is a Yahoo! company with free membership that allows users to save web bookmarks online, organize bookmarks by multiple categories, share personal bookmarks with friends, and see the most popular bookmarks across users. For more information about this social bookmarking site, see http://www.delicious.com [August 2010].

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6

Communication

Clear, open communication between analysts and customers is essential for analyses that are timely, targeted, and useful.

Good communication can be challenging under the best of conditions. Even with extended direct interaction and incentives for candor, customers and analysts may not know what to ask one another or how to detect residual misunderstandings. Communication challenges increase when time is short and the interactions are constrained (e.g., by status relations, politically charged topics, or time pressures). They are tougher still when there is no direct communication between analysts and customers. In such cases, analysts and their customers need organizational procedures that effectively guide requesting, formulating, editing, and transmitting analyses.

Additional pressures arise when analysts know that people other than their direct customers may read, judge, and act on their assessments (e.g., tactical military commanders may access national level strategic analyses by Central Intelligence Agency analysts). The opportunities for miscommunication grow if these secondary readers lack shared understanding and opportunities to ask clarifying questions. Even when analysts have no obligation to serve these other readers, they have an interest in protecting the integrity of their work from others' inadvertent or deliberate misinterpretations.

This chapter first looks at common obstacles to communication and then at two directions of communication in the intelligence community (IC): from analysts to customers and from customers to analysts. The last section considers issues in organizing for effective communication.

OBSTACLES TO EFFECTIVE COMMUNICATION

Misunderstandings between analysts and customers can arise from the same sources that complicate any communication. For example, people tend to exaggerate how well they have understood others and vice versa (for a review, see Arkes and Kajdasz, 2011). People unwittingly use jargon and everyday terms (e.g., risk, accountable, secret) in special ways, not realizing that others use them differently. People use verbal quantifiers ("unlikely," "most," "widespread") for audiences that want numeric ones (Erev and Cohen, 1990). People guess wrong about what "goes without saying" for their communication partners, sometimes repeating the obvious, sometimes omitting vital facts and assumptions (e.g., Schwarz, 1999). People speak vaguely when they are not sure what to say, hoping that their partners or audience will add clarity. People resolve ambiguities in self-serving ways, hearing what they want to hear (for a review, see Spellman, 2011).

A well-known philosophical account (Grice, 1975) holds that good communications say things that are (a) relevant, (b) concise, (c) clear, and (d) truthful. Fulfilling these conditions can, however, be difficult unless the parties interact directly, allowing the trial-and-error interaction needed to identify and eliminate ambiguities. Without feedback, for example, individuals can unintentionally violate truthfulness (condition d) when their messages are not interpreted as intended. Achieving relevance and conciseness requires understanding what problems the customers are trying to solve and what facts they already know. Achieving that understanding requires assessing customers' information needs in a disciplined way, then determining how well those needs have been met (see Fischhoff, 2011, for a review of research on communication).

COMMUNICATING ANALYTICAL RESULTS

Current and forward-looking intelligence analyses contain assessments about events and expectations about possible future events. Those assessments and expectations inevitably involve uncertainty. Analyses are conditional on assumptions about the world, which must be recognized in order to know when analyses need to be reviewed. In this section we briefly describe the research on each of these features as it applies to the IC's communication needs. Some of that research, such as studies on how to communicate probabilities, is directly usable by the IC (e.g., Beyth-Marom, 1982). Other research is embedded in findings on research methods, which depend on successfully communicating with the individuals being studied: posing questions and interpreting answers (e.g., Ericsson and Simon, 1993; Murphy and Winkler, 1987; Poulton, 1994).

Expectations As discussed in Chapter 3, numeric probabilities convey expectations clearly, while verbal quantifiers (e.g., likely, rarely, a good chance) do not. Well-established *probability elicitation* methods can avoid known problems, such as overstating hard-to-express low probabilities, expressing probabilities inconsistently with formally equivalent questions, or saying "50" in the sense of 50-50 rather than as a numerical value. These procedures lead to probabilities that capture experts' beliefs in clearly understood terms (Morgan and Henrion, 1990; O'Hagan et al., 2006; Woloshin et al., 1998).

Events Intelligence analyses cannot be evaluated unless the assessments are clear enough that one could eventually know whether they were true (e.g., Iraq disbanded its nuclear program in 1991) or expected events have occurred (e.g., North Korea will test a long-range missile within 6 months). Even seemingly common terms (e.g., risk, safe sex) have been found to have multiple meanings that individuals often fail to realize or clarify (Fillenbaum and Rapoport, 1971; Fischhoff, 2009; Schwarz, 1999). Well-established research methods provide approaches that can be used in communicating analytic results (see Fischhoff, 2011, for descriptions and references). One such method for minimizing misunderstanding is the *manipulation check*, asking customers to interpret a given analysis in order to assess its consistency with the analysts' intent (Mitchell and Jolley, 2009). A second such method is *back translation,* in which an independent analyst translates a customer's interpretation, hoping to reproduce the meaning of original analysis (Brislin, 1970). A third is the *think-aloud protocol*, in which customers say whatever comes to mind when reading an analysis in order to reveal unexpected misinterpretations (Ericsson and Simon, 1993).

Uncertainty Because no analysis is guaranteed, decision makers must understand the underlying uncertainties. How solid is the evidence? How reliable are the supporting theories? Different kinds of evidence have different expressions of uncertainty (Politi et al., 2007). For example, ranges can be used to express uncertainties in quantitative estimates (O'Hagan et al., 2006). Uncertainty about theories can be expressed in terms of the extent of controversies in the field and the maturity of its underlying science (Funtowicz and Ravetz, 1990). In medical research, the study design (e.g., randomized controlled trials, clinical observations) conveys important information about uncertainties (Schwartz et al., 2008). The probabilistic language used in National Intelligence Estimates (e.g., National Intelligence Council, 2007) invites empirical evaluation of the uncertainty understood by decision makers (see Figure 3-1).

Rationale Customers often need to know not only what analysts have concluded, but also why they have reached those conclusions. This knowledge affords customers deeper mastery of the analysis and the ability to explain their decisions to others. A scientific formulation of this challenge is ensuring that customers have accurate *mental models* of the key drivers of the events. Psychology has a long history of studying mental models in different domains (Bartlett, 1932; Ericsson and Simon, 1993; Furnham, 1988). Typically, such studies begin with think-aloud protocols asking people to explain their implicit theories, allowing communications to build on what they already know and fill critical gaps (Morgan et al., 2001).

Assumptions Analyses always depend on assumptions about underlying conditions. The communication process is not complete unless customers know what changes in the world, or beliefs about the world, should trigger redoing an analysis. These boundary conditions should make sense given the rationale of the analysis (explaining why the assumptions matter) and its uncertainty (providing the probability of their being violated). Stating these assumptions explicitly protects customers from having to deduce them and alerts customers to changes that warrant attention. Doctors' warnings about the potential side effects of a prescribed drug are meant to play the same role.

COMMUNICATING ANALYTICAL NEEDS

Communication from customers to experts (including analysts) has been studied far less than communication from experts to customers. Yet, failure in this direction can lead to analysts' addressing the wrong problems as a result of not understanding customers' needs.

The same basic behavioral and social processes complicate communication in this direction. One such factor is status differences, which make it difficult for analysts to ask clarifying questions. A second is assumptions about common knowledge, which lead experts to assume that customers see the world in more common terms than is actually the case, as occurs in ineffective doctor-patient communication (Epstein et al., 2008).

From the perspective of decision theory (see Kaplan, 2011; McClelland, 2011), the most valuable information is that which will have the greatest effect on a decision maker's choices or predictions. The field of decision analysis has methods for identifying those needs (e.g., Clemen and Reilly, 2002; von Winterfeldt and Edwards, 1986). Formal applications of these methods can be quite technical (e.g., optimal sampling of information for assessing the quality of products or the size of an oil reservoir). However,

their logic applies to any situation in which there are limits to analysts' ability to create information and customers' ability to absorb it. The first step is sketching the customers' decision tree and asking what might be missing (e.g., options that have escaped their notice, precise probability assessments, and challenges to unrecognized assumptions): for treatment of graphical analyses, see Clemen and Reilly (2002).

ORGANIZATION AND EVALUATION

Most of the scientifically validated methods for improving communication can be implemented with modest expense and effort. They could be incorporated into routine training so that analysts have a better understanding of the challenges and pitfalls in communicating about analyses. The methods might even be taught to customers, perhaps during introductory briefings for new office holders. Some of the issues are already relatively well known from popularizations of the research (e.g., Ariely, 2008; Gawande, 2002; Thaler and Sunstein, 2008).

As for other types of organizations, there is no substitute for empirical evaluation of specific communications with actual customers. If a formal evaluation under these conditions is impossible, an informal one is likely to be better than nothing: for example, having someone uninvolved with an analysis write a summary and answer some manipulation checks, as a way of showing analysts how well their message has been understood. The intensive internal review, coordination, and approval processes used by the IC are designed to improve clarity and accuracy. However, the committee found no evidence on how these processes affect how well analyses are understood—and did hear concerns about the problems that can arise when too many people edit an analytic product.

Communication about technical issues has been addressed by several reports from the National Research Council (e.g., 1989, 1996) and other bodies (e.g., Canadian Standards Association, 1997; Presidential/Congressional Commission on Risk Assessment and Risk Management, 1997). In addition to calling for the use of methods such as those cited here, these reports recommend organizational processes that ensure continuing communication between experts and customers in order to ensure the relevance and comprehensibility of analytical products. For example, the Food and Drug Administration (2009) recently issued a strategic communication plan that may provide a partial road map for other agencies that deal with sensitive information and have multiple audiences that scrutinize their actions.

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7

Conclusions and Recommendations

The behavioral and social sciences provide a foundation for the knowledge and continuous learning that the intelligence community needs to provide the highest level of analysis, with applications that can be implemented now with modest cost and minimal disruption.

As the intelligence community (IC) seeks to reduce uncertainty and provide warning about potential threats to the national security of the United States, it faces increasing demands for analyses that are accurate, actionable, and properly qualified, so that decision makers know how much confidence the analyses warrant. Producing those analyses requires great institutional and intellectual agility as threats emerge from new quarters and require different kinds and combinations of expertise.

Today's rapidly changing conditions have also created new opportunities for data collection, both classified (e.g., electronic surveillance) and open (e.g., chat rooms, public calls to action). Furthermore, after years of limited hiring following the end of the Cold War, the significant influx of new employees to the IC after 9/11 has created a major workforce transition, with new analysts bringing diverse skills, backgrounds, and experiences. In order to fulfill its mission, the IC leadership must successfully train, motivate, and retain that workforce, as well as continue to recruit and select new analysts with needed skills.

The conditions the IC faces involve issues that have been long studied in the behavioral and social sciences, particularly the behavior of individuals and groups and the working conditions that foster effective analysis. Although that work has yielded significant, usable findings, little of that knowledge has found a place in the IC. As a result, there is a large body of scientific theory, method, and results that could—and should—be applied to IC tasks.

The committee concludes that the IC can derive great benefit, in short time and at relatively low cost, by building on available behavioral and

social science knowledge. As a result, the committee's recommendations focus on strengthening the scientific foundations of the IC's analytical methods and the organizational processes needed to support them.

The committee recommends that the IC adopt a two-fold strategy to take full advantage of existing behavioral and social science research. First, it should review its current analytic methods and procedures, in terms of how compatible they are with what is known about how people think and work, as individuals and groups. Second, it should conduct systematic empirical evaluations of current and proposed procedures, assessing their efficacy under normal working conditions as much as possible. Those assessments will allow the IC to know how much confidence to place in these procedures and where to focus its efforts on developing improved ones. These evaluations will not only strengthen the evidentiary base of the IC's analytical work, but also provide the feedback necessary for continuous learning and improvement.

Over time, this strategy will provide a powerful impetus to basic research critical to the IC's needs. The former head of a major research unit in the United Kingdom has argued that basic science advances through integrated programs of applied basic and basic applied research (Baddeley, 1979). The former tests how well basic research generalizes to different applied settings. The latter identifies new theoretical questions and then translates them into terms suited to basic research (e.g., experiments, modeling).

Such an integrated research strategy will derive the full benefit of the behavioral and social sciences for the IC's analytical enterprise. In some cases, the resulting research will be on topics unique to the IC, such as the linguistic conventions of violent extremists. In other cases, it will be on general topics that are central to the IC's needs, such as electronic collaboration among analysts with heterogeneous information.

The committee's recommendations are designed to deliver maximum improvement with minimal disruption, helping analysts to do their normal work better. We believe that dramatic improvements in the analytic process are possible within existing organizational constraints. We recognize that many people in the IC feel reorganization fatigue, so we propose ways of working more effectively within whatever structure the IC assumes. We also know that all organizations succeed, in part, by allowing their staff to learn how to work around their inevitable imperfections. Achieving such mastery takes time. If an organization changes too rapidly, its staff cannot function effectively. Thus, we emphasize orderly, measured improvements.

Because they build on existing technologies and organizational structures, our recommendations should not be expensive to implement. They do require both deeply knowledgeable scientists and strong leaders. The scientists will need to know the existing research and ensure its faithful application to the IC's circumstances. The leaders will need to ensure that

enhancing the IC's human capital is seen as central to the IC's success and, therefore, to the nation's security.

Intelligence analysis is, at its heart, an intensely individual intellectual effort, as analysts synthesize facts of diverse origins. As a result, one focus of our report and recommendations is research regarding how individuals think. However, individual analysts do not operate in a vacuum; they have to collaborate with other analysts. As a result, a second focus of our report and recommendations is the support that they need from their organizations. We thus recommend asking the same questions about collaboration, workforce development, communication, and analytical methods:

1. What does the science say about current and proposed methods?
2. How do those methods fare when evaluated under the IC's conditions?

HISTORIC CONTEXT

The committee's study has determined that there is knowledge from the behavioral and social sciences that is ready for application within the IC. That claim invites an explanation of why the opportunity exists. We believe that it reflects properties of the behavioral and social sciences and of the IC.

During much of its life, the IC has been intensely concerned with questions of military materiel, standing armies, and large-scale weapons. Its behavioral foci have been fairly narrow, such as the notoriously difficult task of reading leaders' intentions and the somewhat more tractable tasks of interpreting national and international politics. As a result, the IC has developed little internal expertise on many behavioral and social science issues. Indeed, the IC has so little expertise in some areas that it sometimes struggles to recruit needed scientists, although efforts like its IC Associates Program can provide partial solutions. The computationally intensive demands of many IC analyses have also contributed to its paying relatively little attention to the human side of the analytical enterprise.

For its part, the behavioral and social science community has been a distant, sometimes reluctant partner for the IC. Its science has often involved controlled experiments that foster the discovery of basic behavioral principles, while discouraging study of applications. Social conflicts in the second half of the 20th century have also distanced the academic and intelligence communities from one another in the United States. Fortunately, these barriers have fallen with the rise in national unity following the 9/11 attacks.

A noteworthy exception to this historic pattern has been the landmark work of Richards Heuer, Jr., whose *Psychology of Intelligence Analysis*

(1999) demonstrates the relevance of behavioral research to the work of the IC. Equally remarkable has been the success of Heuer and his associates in getting structured analytical techniques (SATs), based on behavioral research, accepted in the IC and even having versions of SATs installed on IC computer systems. However, the IC has not pursued this effort through to the point of performing systematic empirical evaluation of SATs. There are theoretical reasons for predicting both that SATs improve analysis and that they interfere with it. Without empirical evaluation, one can only speculate about when improvement or interference will dominate under different conditions and analytic questions.

A BEHAVIORAL AND SOCIAL SCIENCES FOUNDATION

Traditionally, the IC has adopted a practice-based approach to analysis. It has relied primarily on apprenticeship-like processes to train new analysts in methods that have evolved almost exclusively through intensive attempts to learn from experience. We propose a complementary commitment to evidence-based analysis, drawing on the behavioral and social sciences to evaluate current and create new approaches to analysis, collaboration, workforce development, and communication. Such evidence-based analysis should be used both to examine existing and proposed approaches, in order to determine their compatibility with the science, and to study their actual performance empirically, under normal working conditions.

Although this recommendation reflects Enterprise Objectives 2 and 5 of the *National Intelligence Strategy* (Office of the Director of National Intelligence, 2009; see Box 1-1 in Chapter 1), conducting such evaluations is a brave step for any organization, because the evidence needed for internal learning can also be used for external criticism. It is, therefore, critical that the Director of National Intelligence (DNI) be the sponsor for the initiative and the audience for its results, in order to demonstrate commitment, at the highest level, to evidence-based analytical methods.

Evaluation research is methodologically demanding. Poor evaluations can undermine good initiatives (e.g., by failing to recognize that they have been poorly implemented) or promote poor ones (e.g., by subjecting them to soft tests). Poor evaluations can even undermine performance (e.g., if paperwork requirements dominate analytical accuracy). A central task in evaluation research is assessing how well a program has been implemented. Unless a program has been properly implemented, it will not receive a fair test (although if a program cannot be implemented faithfully, it has little value).

In order to meet these commitments, the IC needs staff qualified to identify, implement, and evaluate the best opportunities for improving its analytical processes. To that end, we propose designating a senior officer,

reporting to the DNI and supported by an independent advisory panel of behavioral and social scientists with strong basic and applied credentials. Such individuals are in short supply. The IC's ability to recruit and retain expert advisors will provide a measure of its success in strengthening the scientific base of its analyses.

Recommendation 1

The Director of National Intelligence should ensure that the intelligence community applies the principles, evidentiary standards, and findings of the behavioral and social sciences to its analytic methods, workforce development, collaborations, and communications. Success will require strong leadership, active engagement with the academic community, and the creation of a robust reporting mechanism (such as a biennial report from each agency) to identify residual problems and plans to remedy them. The Director of National Intelligence should be supported by a senior officer and an independent advisory committee with appropriate scientific expertise.

Immediate Actions

1. Use the Intergovernmental Personnel Act to embed independent experts in the IC for limited terms.
2. Embed IC analysts in academic research environments to participate in research and to network with scientists who can be consulted later.
3. Develop specialized behavioral and social science expertise cells across the IC, coordinated through the Office of the Director of National Intelligence (ODNI).
4. Ensure that the IC Associates Program actively uses behavioral and social science expertise.
5. Create and widely disseminate an *Analytical Methods Resource Guide* that introduces key methods, shows how to choose methods suited to specific intelligence questions, and identifies experts who can apply each method, from inside and outside the IC.

ANALYTIC METHODS

The conditions that support learning are among the best understood aspects of human behavior. Those conditions include large quantities of unambiguous feedback, with properly aligned incentives. Achieving these conditions is consistent with Enterprise Objectives 5 and 7 of the *National Intelligence Strategy* (Office of the Director of National Intelligence,

2009; see Box 1-1 in Chapter 1), as well as with the IC's tradition of lessons-learned and after-action reports and with the voluminous literature produced by government commissions, former intelligence officers, and academic researchers (see Chapter 2).

Unambiguous feedback requires predictions that can be evaluated in light of subsequent history. A straightforward and necessary step is attaching numeric probabilities to explicitly defined events (e.g., "There is a 75 percent chance that country A has a stockpile of biological weapons"; "There is a 90 percent chance of X being in power at year's end"). Significant amounts of feedback are needed to provide stable performance measures. In order to create such feedback, we recommend compiling a database of assessments and predictions, indexed by properties that might affect their quality (e.g., the analysts' background and analytical method), and further annotating the analyses archived in the Library of National Intelligence. Doing so would also facilitate research on confounding factors (such as self-fulfilling and self-defeating prophesies) whereby analyses lead to (political or military) actions that change the world, so that it is no longer possible to evaluate their accuracy.

We recognize that there has historically been resistance to numeric probability estimates from analysts who believe that they imply artificial precision. However, as discussed in Chapter 2, the scientific evidence, including Canada's real-world success with numeric probabilities in intelligence analysis (Mandel, 2009), suggest that, with proper training and feedback, such judgments could substantially improve analytic products and customer understanding of them. Proper incentives seek to encourage learning, not to determine culpability. They reward positive performance and cultivate the natural desire to do well, a desire that is especially prevalent in the IC. In addition, numeric probabilities allow feedback that is essential to learning. Proper incentives discourage both overconfidence (intended perhaps to carry an argument) and underconfidence (intended perhaps to avoid responsibility). They encourage good calibration: being as confident as one's understanding warrants. Thus the DNI must ensure that numeric probabilities are implemented in a constructive way, using them for useful feedback, not destructive criticism.

Recommendation 2

The Director of National Intelligence should ensure that the intelligence community adopts scientifically validated analytical methods and subjects all of its methods to performance evaluation. To that end, each analytical product should report, in a standardized format, the elements necessary for such evaluation, including its analytical method, domain, conclusions, analysts' background, and the collaborations that

produced it. Analyses must include quantitative judgments of the probability and uncertainty of the events that they forecast. These reports should be archived in a database that is routinely used to promote institutional learning and individual training and as input to the Director of National Intelligence's ongoing review efforts of analytic shortfalls and plans to address them.

Immediate Actions

1. Institutionalize an "Analytical Olympics," with analysts and analytical methods competing to provide the best calibrated probabilities (i.e., showing appropriate levels of confidence) in assessments and predictions made for well-specified outcomes that have occurred or will occur in the near future.
2. Begin assessing how well-calibrated individual analysts are, using the results as personal feedback that will allow analysts to improve their own performance and the IC to learn how this performance is related to workforce factors, such as personal capabilities, training, and incentives.
3. Create a research program that reviews current and historic assessments, looking for correlates of accuracy and calibration, considers properties such as the method used, collaboration process, classification level, substantive domain, and team composition.

WORKFORCE DEVELOPMENT

The quality of the human resource pool places greater constraints on an organization's human capital than any other single factor. It is the focus of Enterprise Objective 6 of the *National Intelligence Strategy* (Office of the Director of National Intelligence, 2009; see Box 1-1 in Chapter 1). Currently, the IC typically recruits analysts on the basis of their substantive expertise and rewards them on the basis of process-based performance (e.g., workflow). Research finds that both practices are inadequate by themselves. We recommend a systematic review of the theoretical soundness of current practices, followed by empirical evaluation of the efficacy of current practices and alternative ones.

Clearly, the IC needs analysts with deep substantive knowledge of countries, cultures, transnational relations, and myriad other issues. However, it also needs analysts capable of integrating knowledge across domains, working with experts from other fields, and coping with shifting assignments. As a result, the IC needs analysts with both the intellectual capacity for synthetic thinking and substantive familiarity with the full range of analytical methods. The former is a stable individual trait, which must

be pursued in the IC's recruitment and selection processes. The latter is a malleable individual skill that can be acquired through training. The goal of such training is not mastery of alternative methods; rather, the goal is enough familiarity to recognize different kinds of problems and to work with others who have technical mastery of the methods.

Thus, every analyst should have a basic understanding of the fundamental ways of thinking captured by probability theory, game theory, operations research, qualitative analysis, and other analytic methods (see Chapter 3). Each method provides a different way to look at the world and organize data. Each has been refined through decades (even centuries) of rigorous peer review and has well-understood strengths and limitations. Making them part of IC analysts' basic intellectual repertoire will increase analysts' ability to address their customers' needs.

Recommendation 3

The Director of National Intelligence should ensure that intelligence community agencies use evidence-based methods to recruit, select, train, motivate, and retain an adaptive workforce able to achieve the performance levels required by intelligence community missions. On the basis of that research:

- **(a) The intelligence community should recruit and select individuals who have the stable individual attributes (e.g., cognitive ability, personality, values) known through research to be associated with better performance.**
- **(b) The intelligence community's training, motivation, and performance feedback should focus on improving malleable individual attributes (e.g., job-specific skills) associated with better performance.**
- **(c) The intelligence community should expand opportunities for continuous learning that will enhance collaboration, innovation, and growth in the application of analytical skills.**

Immediate Actions

1. Create a course to provide all IC analysts with basic familiarity with the full range of analytical methods with strong scientific foundations (e.g., probability theory, statistics, game theory, qualitative analysis).
2. Create an inventory of psychometrically validated measures of intellectual ability that can be administered to current and pro-

spective analysts, in order to study which abilities are related to analytical performance.

3. Convene an independent working group of human resource scientists to review current recruitment, selection, motivation, and retention practices in light of the relevant behavioral and social science.
4. Develop on-the-job training programs to cultivate a culture of continuous learning, whereby the entire workforce is actively involved as both teachers and students.

COLLABORATION

Recognizing that essential information is often scattered across individuals and units, the IC has made collaboration central to its current efforts. The need for collaboration is recognized in Enterprise Objectives 1, 2, and 4 of the *National Intelligence Strategy* (Office of the Director of National Intelligence, 2009; see Box 1-1 in Chapter 1) and has been the motivation for such innovations as A-Space, Intellipedia, the *Analytical Resources Catalogue* (ARC), the Library of National Intelligence, and joint IC duty positions (see Intelligence Community Directive 601 [Office of the Director of National Intelligence, 2006]). All of these innovations are intended to familiarize intelligence officers with a wide variety of intelligence requirements, methods, users, and capabilities (see Intelligence Reform and Terrorism Prevention Act of 2004, P.L. 108-458). These innovations seek to create the agility needed to cope with adversaries who have rapidly shifting identities and operations.

Behavioral and social science findings provide reason to believe that these innovations do, in fact, promote the collaboration that the IC seeks. They are flexible, allowing analysts to adapt them to their own purposes. They are open, allowing analysts to create self-organizing groups that are adapted to specific tasks. They are complementary, allowing analysts to choose the methods best suited to their needs. At the same time, however, those behavioral and social science findings also provide reasons to question the efficacy of these innovations. For example, these methods can be time consuming and provide information from unfamiliar sources, with uncertain quality. Given these contradictory possibilities, we recommend that the IC undertake systematic empirical study of these "natural experiments," assessing the impacts of the various methods for different uses and users. Although not expensive, such evaluations require methodological sophistication in order to create fair tests and to provide useful guidance on how the innovations could be improved.

Recommendation 4

The Director of National Intelligence should require systematic empirical evaluation of current and proposed procedures for enhancing the collaboration that is essential to fulfilling the intelligence community's mission. That evaluation should be based on scientific principles that prescribe the extent and form of collaborative methods for effective performance under the intelligence community's operating conditions. This approach will require ongoing innovation, evaluation, and learning about collaborative methods.

Immediate Actions

1. Conduct field evaluations of at least two collaborative methods, assessing their uses, users, and impacts. Create and implement an evaluation methodology that can then be used more broadly.
2. Collaborative aids like A-Space should be subjected to rigorous evaluation of what they do well and poorly. That evaluation should examine the possibility of enhancing A-Space with programs that prompt collaboration between analysts who are working on related problems, but are unaware of their mutual interests.
3. Develop a database, or modify the Library of National Intelligence, to characterize analyses in terms of features that might be related to their effectiveness, such as the methods used, the contacts consulted, and the collaborations undertaken.

COMMUNICATION

Effective communication is essential to ensuring that analysts understand their customers' information needs and that their customers understand the analysts' conclusions and confidence levels. These needs are recognized in Enterprise Objective 2 of the *National Intelligence Strategy* (Office of the Director of National Intelligence, 2009; see Box 1-1 in Chapter 1). However, there are many potential barriers to effective communication, including the natural tendency to exaggerate how well one communicates, the frequent lack of direct contact between analysts and their customers, and the many steps in the IC review, coordination, and approval process, each capable of improving or degrading how well the resulting report conveys the original analysts' intent.

The clarity demanded by the evaluation processes that the committee proposes in Recommendation 2 will provide a foundation for better communication, by requiring analysts to be explicit about their terms, predictions, uncertainty, rationale, and conditions of validity. Standardization

will facilitate creating communication protocols that convey the intended meaning of the analyses to customers, as well as permitting the elicitation of customers' needs in clear terms. These kinds of protocols can build on the science of communication and use its methods to evaluate analysts' success in establishing the needed situational awareness. Over time, a disciplined approach to communication will make analysts and customers more sophisticated about one another's worlds, improving the collaboration between them.

Recommendation 5

The Director of National Intelligence should implement scientific, evidence-based protocols for ensuring that analysts and customers understand one another. Achieving this goal will require standard protocols for communicating the uncertainties and limitations of analyses, expanded opportunities for analysts to learn about customers' needs, and feedback evaluating the usefulness and presentation of analyses.

Immediate Actions

1. Develop and evaluate standard protocols for communicating the confidence that should be placed in analytic judgments (following Recommendation 2).
2. Evaluate the efficacy of current methods for requesting analyses in terms of how well they convey customers' intentions to analysts.
3. Evaluate the impact of internal review processes on how well the resulting reports convey analysts' intending meaning.

CONCLUSION

The IC has recently undergone its most sweeping structural changes since 1947, including the creation of the ODNI. The IC is also undergoing a demographic transition, with new analysts bringing different backgrounds and capabilities into the community. At the same time, new technologies offer new capabilities for data gathering, data sharing, and collaboration which might aid or distract analysts. The IC has received additional resources, along with growing public awareness of its importance.

Taking full advantage of these opportunities will require carefully planned strategies. New analysts must be trained in tradecraft, rewarded for high-quality performance, and provided access to veteran analysts' wisdom and tacit knowledge. New methods and technologies have to be designed with analysts in mind, subjected to rigorous evaluation, and kept from interfering with normal individual and collective thought processes.

Even if the world were static, complex activities that involve people, like intelligence analysis, will never be perfect. As a result, the IC must continually evaluate its own performance, both to learn from its experience and to provide policy makers with realistic expectations of its capabilities.

The committee's recommendations are interdependent. Without appropriate human resource policies, analysts cannot create the communication networks needed to share information. Without regularly updating their theoretical knowledge, analysts cannot take advantage of the evidence and information sources available to them. Without sound, informative performance evaluation, no one can know how well any methods are working.

Any change involves a gamble, sacrificing the relative stability of current practices in return for the promise of improved future performance. Change is necessary today, because traditional analytical methods and institutional arrangements are increasingly challenged by the demands on IC analysis. Pursuing such disciplined, evidence-based change will require strong leadership. Analysts need to know that their organization will support them if they innovate and if they rigorously evaluate their own performance.

Strong leadership is needed to acknowledge that intelligence analysis is inherently imperfect, then to create realistic standards of accountability, demanding the best feasible performance. Leadership is needed to recognize that even the best systems lose their efficacy if the world changes faster than they do. That leadership must be manifested externally, by subjecting performance to well-designed tests and rejecting unfair ones; it must be manifested internally, by showing that "evaluation" denotes learning and not fixing blame. The behavioral and social sciences provide a foundation for taking the best possible gambles, regarding analytical and management processes, then objectively evaluating their success.

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Appendix A

Contents
Intelligence Analysis: Behavioral and Social Scientific Foundations

Appendix B

Biographical Sketches of Committee Members and Staff

Baruch Fischhoff (*Chair*) is Howard Heinz university professor in the Departments of Social and Decision Sciences and of Engineering and Public Policy at Carnegie Mellon University. His research includes risk communication, analysis, and management; adolescent and medical decision making; national security; and environmental protection. He is a past president of the Society for Risk Analysis and a recipient of its Distinguished Achievement Award, and he is a past president of the Society for Judgment and Decision Making. He is a fellow of the American Psychological Society and of the American Psychological Association, and an elected member of the Institute of Medicine. He chairs the Food and Drug Administration's Risk Communication Advisory Committee. He is a current member of the Department of Homeland Security's Science and Advisory Committee and past member of the Environmental Protection Agency Scientific Advisory Board where he chaired its Homeland Security Advisory Committee. He holds a B.S. in mathematics and psychology from Wayne State University and an M.A. and Ph.D. in psychology from the Hebrew University of Jerusalem.

Hal Arkes is a professor in the Department of Psychology and a fellow at the Moritz College of Law at Ohio State University. His research focuses on judgment and decision making, medical decision making, and economic decision making. He serves on the editorial boards for the *Journal of Behavioral Decision Making*, the *Journal of Judgment and Decision Making*, the *Journal of Medical Decision Making*, and *Psychological Science*. He is an elected fellow of the American Psychological Society and

has served as president for the Society for Judgment and Decision Making. He has received the Outstanding Teaching Award from Ohio University's College of Arts and Sciences and two Teaching Recognition Awards from Ohio University. He has a B.A from Carleton College, an M.S. in psychology from the University of Michigan, and a Ph.D. in psychology from the University of Michigan.

Bruce Bueno de Mesquita is a senior fellow at the Hoover Institution at Stanford University and the Silver professor of politics at New York University. In the broad context of international conflict, foreign policy formation, and nation building, his current research focuses on the links between political institutions, economic growth, and political change. He is also investigating the causes and consequences of international conflict, as well as national security policy forecasting and analysis. He is an elected member of the American Academy of Arts and Sciences and a member of the American Political Science Association, the International Studies Association, and the Peace Science Society. He is also a member of the board of advisers of the James A. Baker III Institute for Public Policy at Rice University. He has a B.A. from Queens College, an M.A. and a Ph.D. in political science from the University of Michigan, and an honorary doctorate from the University of Groningen in the Netherlands.

Cherie Chauvin (*Study Director*) is a program officer at the National Research Council, working on several studies and workshops relevant to defense and national security issues. Previously, she held several positions with the U.S. Department of Defense's Defense Intelligence Agency (DIA), where her work included support for military operations and liaison relationships in Japan, South Korea, and Mongolia, as well as conducting intelligence collection operations in Afghanistan to answer strategic and tactical military intelligence requirements. In recognition of her service, she was awarded the DIA Civilian Expeditionary Medal, the Department of the Army Commander's Award for Civilian Service, and the Office of the Director of National Intelligence National Meritorious Unit Citation. She holds a B.S. in cognitive science from the University of California at San Diego, an M.A. in international relations from The Maxwell School at Syracuse University, and an M.S. in strategic intelligence from the National Defense Intelligence College.

Thomas Fingar is a research scholar at Stanford University. Previously, he served as deputy director of national intelligence for analysis at the Office of the Director of National Intelligence and chairman of the National Intelligence Council, and as assistant secretary of the Bureau of Intelligence and Research at the U.S. Department of State. Prior to joining the State

Department, he held several research appointments at Stanford University, including senior research associate in the Center for International Security and Arms Control and director of the Stanford U.S.-China Relations Program. His many books and articles have focused mostly on national security and aspects of Chinese politics and policy making. He is a recipient of the Presidential Rank Award of Distinguished Executive. He has a B.A. in government and history from Cornell University and an M.A. and a Ph.D. in political science from Stanford University.

Reid Hastie is Robert S. Hamada professor of behavioral science in the Graduate School of Business at the University of Chicago. Previously, he held positions at Harvard University, Northwestern University, and the University of Colorado. His primary research interests are in the areas of judgment and decision making (managerial, legal, medical, engineering, and personal), memory and cognition, and social psychology. Currently, he is studying the psychology of investment decisions; the role of explanations in category concept representations (including the effects on category classification, deductive, and inductive inferences); civil jury decision making (punitive damages and sexual harassment); the primitive sources of confidence and probability judgments; decision-making competencies across the adult life span; and neural substrates of risky decisions. He has a Ph.D. in psychology from Yale University.

Edward H. Kaplan is the William N. and Marie A. Beach professor of management sciences at the School of Management, a professor of public health at the School of Public Health, and a professor of engineering in the School of Engineering and Applied Science, all at Yale University. He also codirects the Daniel Rose Technion-Yale Initiative in counterterror and homeland security operations research. His work is in operations research, mathematical modeling, and statistics, focusing on problems in public policy and management. His recent research has focused on issues in counterterrorism, including the tactical prevention of suicide bombings, bioterror preparedness, and response logistics in the event of a smallpox or anthrax attack. His work on smallpox received the 2003 Koopman Prize of the Institute for Operations Research and the Management Sciences, and his research evaluating suicide bomber detector schemes received the same award in 2005. He is an elected member of the National Academy of Engineering and of the Institute of Medicine. He has a B.A. from McGill University in economic and urban geography and M.A. degrees in operations research, city planning, and mathematics along with a Ph.D. in urban studies from the Massachusetts Institute of Technology.

Steven W.J. Kozlowski is professor of organizational psychology at Michi-

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