

Improved Intelligence Warning in an Age of Complexity

A Monograph

by

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Abstract

Improved Intelligence Warning in an Age of Complexity, by Mr. Bryon D. Mushrush, 58 pages.

The degree of complexity and rate of change found in the global security environment is increasingly leaving senior policymakers surprised and US national interests potentially at risk. As a result, decision makers are increasingly faulting the Intelligence Community for failure to provide adequate warning. A review of professional and academic literature finds intelligence failures are not the result of not having the proper information. Instead, it identifies three primary causes for intelligence failures. First, the Intelligence Community structure prevents information from getting to the right analysts to identify a threat. Secondly, analysts have the necessary information but lack the creativity to “connect the dots” to identify the threat. Finally, analysts may identify the threat but fail to communicate with sufficient effectiveness to convince policymakers to take action. This paper proposes that complexity theory, and understanding of the characteristics of complex adaptive systems offer insights into how the Intelligence Community can address all three types of intelligence failure. It expounds this proposition by looking at, and applying complexity science to this problem, which is represented by a multidiscipline study of large networks comprised of interdependent variables; and then exploring the dominant features of complex systems, namely their lack of centralized control, ability to process information from the environment, and their ability to develop novel responses and adapt to indicate the sources of the problem.

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Acronyms

ACH	Analysis of Competing Hypothesis
CIA	Central Intelligence Agency
DIA	Defense Intelligence Agency
DNI	Director of National Intelligence
FBI	Federal Bureau of Investigation
IARPA	Intelligence Advanced Research Projects Activity
IC	Intelligence Community
ICD	Intelligence Community Directive
NIO-W	National Intelligence Officer for Warning
ODNI	Office of the Director of National Intelligence

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Introduction

I heard, but I did not understand. So I asked, “My Lord, what will the outcome of all this be?”

– Daniel 12:8

The desire to receive and understand warning of future threats has been a part of all human societies. In the United States, the task to warn political leaders and military commanders of threats falls to the Intelligence Community. Christopher M. Andrew, a professor of modern and contemporary history at Cambridge University, described the relationship between the Presidents and their Intelligence Communities as three separate ages – ages of innocence, transformation, and uncertainty. From President Washington to the Second World War operated in an “Age of Innocence,” where the Presidents relied on the United States’ relative isolation and self-sufficiency to manage international affairs and did not maintain standing intelligence agencies. The presidencies of Franklin D. Roosevelt, Harry S. Truman, and Dwight D. Eisenhower consist of the “Age of Transformation” in which the United States created a standing Intelligence Community and incorporated it into the policy making process. President Kennedy to President Clinton’s first term consists of the “Age of Uncertainty,” where the Intelligence Community failed to meet unrealistic expectations and the pressure of the Cold War maintained tensions between the President and his intelligence advisors.¹ This paper suggests that since the end of the Cold War the Intelligence Community and policy makers have transitioned into an “Age of Complexity,” where the rapidly changing and complex global security environment creates new types of threats and requires new understanding of the environment to identify the threats and address them. For analysts and policy makers, complexity science offers methods to improve this understanding. As said by Ms. Irene Sanders, director of the Washington Center for

¹Roger Z. George and Robert D. Kline, eds., *Intelligence and the National Security Strategist: Enduring Issues and Challenges* (Lanham, MD: Rowman & Littlefield Publishers, 2006), 431-444.

Complexity and Public Policy, “We’re all learning to think this way. None of us have lived in the kind of world we live in today... we are all exploring and we have new tools of exploration.”²

This monograph seeks to address how the intelligence community can apply aspects of the complex global environment and complexity science to improve intelligence warning. The initial section describes how policy makers and national security leaders understand the current security environment to being increasingly complex, but remain frustrated by a lack of reliable warning analysis. The following section describes how the academic and professional literature on intelligence warning and failures identifies three primary sources of failure: the Intelligence Community’s structure; analyst’s ability to make sense of the information before them; and lastly, the policy maker’s ability to act. After a brief description of the methodologies and limitations in the research, this monograph reviews the transformation of the Intelligence Community from the Cold War to the present and how systems developed in the Cold War are no longer adequate to address the increased demands from policy makers. A description of complexity science follows as a lens to describe the current environment and how it can be applied to improve the three identified causes of intelligence failure. The last section briefly discusses additional implications of the complex environment on the intelligence community and potential areas of further research.

Additionally, warning intelligence has been historically referred to by multiple names, to include indicator and anticipatory intelligence.³ For this paper warning intelligence will be defined, as described in Joint Publication 2-0 Joint Intelligence, as providing “a distinct communication to a decision maker about threats against US security, interests, or citizens. Warning carries a sense of urgency, implying the decision maker should take action to deter or

²Wilson Center, “Chaos, Complexity, And, Public Policy” (video), April 22, 2013, accessed February 11, 2015, <https://www.youtube.com/watch?v=KXxs-JtvkkQ>.

³Cynthia Grabo, *Handbook of Warning Intelligence: Assessing the Threat to National Security* (Lanham, MD: Scarecrow Press, 2010), 1.

mitigate the threat's impact.”⁴ Additionally, warning intelligence is divided into emerging warning concerns and enduring warning problems. Emerging warning issues may be ambiguous, and may be formalized as an “enduring warning problem” based on a risk evaluation to national security and planning guidance. The latter is usually linked to contingency plans, which are defined and longstanding potential threats to US interests.⁵

A Complex Global Environment

Chaos was the law of nature; Order was the dream of man.

– Henry Adams, *The Education of Henry Adams*⁶

Senior American civilian, defense, and intelligence leaders understand the global security environment is complex and filled with uncertainty. However, over the last decade policymakers and senior leaders increasingly describe the security environment as complex, uncertain, rapidly changing, challenging, connected, and dangerous. Understanding the complex environment is foundational to developing national policy and formulating strategic documents for the government. Senior policymakers and commanders rely on the Intelligence Community to provide timely, reliable, and actionable analysis to provide adequate warning in support of policy decision making.⁷ The United States Intelligence Community needs to gain greater understanding of complexity in order to overcome the structural, cognitive, and communicative challenges to providing warning analysis.

⁴Joint Publication (JP) 2-0, *Joint Intelligence* (Washington, DC: Government Printing Office, 2013), I-18.

⁵Ibid.

⁶Henry Adams, *The Education of Henry Adams* (New York: Oxford University Press, 1999), 377.

⁷For a complete list of Intelligence Community members, see Appendix A.

In 2008, then director of the Defense Intelligence Agency (DIA), Lieutenant General Michael D. Maples, in Congressional testimony described the global strategic environment in which the United States was operating as, “unusually complex... marked by an accelerating operational pace and broad spectrum of potential threats.”⁸ Lieutenant General Michael Flynn, Maple’s successor at the DIA, in a 2014 Congressional testimony, described the global security environment as “a growing list of increasingly complex challenges, conventional adversaries, and numerous asymmetric threats.”⁹ Lieutenant General Vincent R. Stewart, the current DIA director, testified in February 2015 that, “A confluence of global political, military, social, and technological developments, which, taken in aggregate, have created security challenges more diverse and complex than those we have experienced in our lifetimes... This strategic environment will be with us for some time, and the threat’s increasing scope, volatility, and complexity will be the ‘new normal.’”¹⁰ In March 2013, Federal Bureau of Investigation director, Robert S. Mueller III, delivered his statement entitled “Protecting the Nation in Today’s Complex Threat Environment” to the House Appropriations Committee, Subcommittee on Commerce, Justice, Science, and Related Agencies.¹¹ Prior to his nomination for Secretary of Defense, Chuck Hagel stated in 2012 that “America and the world face unprecedented, complex, and interconnected twenty-first century challenges.”¹² In his 2013 response to questions presented by

⁸Hearing before the S Committee on Armed Services, *Current and Projected National Security Threats to the United States*, 110th Cong., 2d sess., 2008, S. Doc., 1.

⁹Hearing before the HR Committee on Armed Services, *Current and Future Worldwide Threats to the National Security of the United States*, 113th Cong., 2nd Sess., February 11, 2014.

¹⁰Hearing before the HR Committee on Armed Services, *World Wide Threats*, 111th Cong., 1st Sess., February 3, 2015.

¹¹Hearing before the Subcommittee on Commerce, Justice, Science, and Related Agencies, *Protecting the Nation in Today’s Complex Threat Environment*, 113th Cong., 1st sess., March 19, 2013.

¹²Lisa Hymas, “Could Chuck Hagel, Defense Secretary Nominee, Turn Out to Be a Climate Hawk?” *grist.org*, January 7, 2013, accessed November 30, 2014,

the senate during his confirmation hearing, Hagel answered “the next Secretary of Defense will be confronted with a myriad of challenges stemming from an ever more complex global environment.”¹³

Elected officials, focused on national security in bipartisan agreement, also emphasized the complexity facing the United States in the global environment. During 2014 testimony on current and future worldwide threats to the national security of the United States the Senate Armed Services Committee Chairman, Senator Carl Levin (Democrat – Michigan), said the United States finds itself in “a time of diverse and complex national security threats”¹⁴ During the same hearing Senator James Inhofe (Republican – Oklahoma), the ranking committee member said “... talking with troops, the diplomats, the foreign partners, the global security environment is more precarious and complex as any time in the memory, and growing more dangerous every day.”¹⁵ Senator Robert Menendez (Democrat-New Jersey) Chairman of the Senate Foreign Relations Committee Hearing on “National Security and Foreign Policy Priorities in the fiscal year 2015 International Affairs Budget “in this complex and rapidly changing global environment, we also know that our national security interests are priority number one and they cannot be jeopardized.”¹⁶ Lastly and more succinctly, US President Barack Obama, while

<http://grist.org/politics/could-chuck-hagel-likely-defense-secretary-nominee-turn-out-to-be-a-climate-hawk/>.

¹³“Advance Policy Questions for the Honorable Chuck Hagel: Nominee to be Secretary of Defense,” *The Atlantic*, accessed February 11, 2015, http://cdn.theatlantic.com/static/mt/assets/steve_clemons/BGOV%20Hagel%20Adv%20Policy%20Questions.pdf.

¹⁴Hearing before the Senate Committee on Armed Services, *Current and Projected National Security Threats to the United States*, 111th Cong., 2d sess., February 2, 2010.

¹⁵Hearing before the HR Committee on Armed Services, *Current and Future Worldwide Threats to the National Security of the United States*, 113th Cong., 2nd Sess., February 11, 2014.

¹⁶Hearing before the Senate Foreign Relations Committee, *National Security and Foreign Policy Priorities in FY 15 International Affairs Budget*, 113th Cong., 2nd Sess., April 8, 2014.

addressing the press on the multitude of foreign crises facing the United States said, “We live in a complex world and at a challenging time.”¹⁷

American policy leaders also established the complex security environment as the foundation in official national security policies and strategies. These documents provide guidance to government departments, enabling them to set priorities and shape policy. The 2010 National Security Strategy (NSS) sets the priorities and framework for the whole of American government. The NSS opens, “At the dawn of the 21st century, the United States of America faces a broad and complex array of challenges to our national security.”¹⁸ In accordance with the NSS the Office of the Director of National Intelligence released the National Intelligence Strategy 2014 stating in the current environment, “The United States faces a complex and evolving security environment with extremely dangerous, pervasive, and elusive threats.”¹⁹ Lastly, the United States Department of State-USAID fiscal year 2014-2017 Joint Strategic Plan states, “Today, the United States faces diverse and complex security challenges [which] ... directly threaten U.S. interests and foreign policy objectives.”²⁰

The Department of Defense also incorporates the NSS with several strategic papers framing and expanding the understanding of the global environment as complex. The 2010 Quadrennial Defense Review states, “The United States faces a complex and uncertain security landscape in which the pace of change continues to accelerate. The distribution of global political,

¹⁷Cheryl K. Chumley, “Obama Pleads for Patience On His Foreign Policy: 'We Live in a Complex World',” *Washington Times*, July 17, 2014, accessed November 6, 2014, <http://www.washingtontimes.com/news/2014/jul/17/obama-pleads-patience-his-foreign-policy-we-live-c/>.

¹⁸Barack Obama, *National Security Strategy* (Washington, DC: The White House, May 2010), 1.

¹⁹James R. Clapper, *National Intelligence Strategy of the United States of America* (Washington, DC: Office of the Director of National Intelligence, September 2014), 4.

²⁰John Kerry, *Department of State and USAID Strategic Plan FY 2014-2017* (Washington, DC: Department of State, April 2, 2014), 1.

economic, and military power is becoming more diffuse.”²¹ The 2012 Defense Strategic Guidance states, “Global security environment presents an increasingly complex set of challenges and opportunities to which all elements of U.S. national power must be applied.”²² In accordance with the 2014 Quadrennial Defense Review, “The global trends that will define the future security environment are characterized by a rapid rate of change and a complexity born of the multiple ways in which they intersect and influence one another. As a result, despite the growing availability and flow of information around the world, it is increasingly challenging to predict how global threats and opportunities will evolve.”²³ Additionally, the 2014 United States Army Operational Concept, titled “Win in a Complex World”, describes a complex environment that is “not only unknown, but unknowable and constantly changing.”²⁴

Statements by public officials and policy documents show a trend in which the global security environment is becoming more complex each year. It is important to note the complexity is not due to multiple threats, but rather increased interconnectedness of the global environment.²⁵ In 1945, following the end of World War II, there were fifty-one member states in the United Nations. With the addition of South Sudan in 2011, there are currently 193 United Nations

²¹Robert M. Gates, *Quadrennial Defense Review* (Washington, DC: U.S. Department of Defense, February 2010), iii.

²²*Sustaining U.S. Global Leadership: Priorities for 21st Century Defense* (Washington, DC: U.S. Department of Defense, January 2012. accessed December 5, 2014, http://www.defense.gov/news/defense_strategic_guidance.pdf.

²³Charles Hagel, *Quadrennial Defense Review* (Washington, DC: U.S. Department of Defense, March 2014), 7.

²⁴Training and Doctrine Command (TRADOC) Pamphlet 525-3-1, *The U.S. Army Operating Concept: Win in a Complex World 2020-2040* (Washington, DC: Government Printing Office, 2013), iii.

²⁵Rosa Brooks, “Warning: Winter Metaphor Alert!,” *Foreign Policy*, February 13, 2014, 1, accessed November 11, 2014, <http://foreignpolicy.com/2014/02/13/warning-winter-metaphor-alert/>.

member states.²⁶ In 1950, the global population was 2.5 billion people. Sixty years later the global population nearly tripled to seven billion people in 2011.²⁷ People and goods are also moving around the world in greater quantities and faster than ever before as well. In the 1950s, 31 million passengers flew annually.²⁸ In 2012, an estimated 2.9 billion passengers used air transportation, and an estimated 13.6 billion passengers are expected to fly in 2016.²⁹ According to the World Trade Organization, the global value of international trade nearly tripled from 6.27 trillion USD in 2000 to 18.3 trillion USD in 2013.³⁰ The transfer of information is increasing even faster. In 1971, computer engineer Ray Tomilson sent the first email on the Department of Defense Advanced Research Projects Agency Network (ARPANET).³¹ In 2013, businesses alone send over 100 billion emails a day.³² Furthermore in 2014, the estimated number of active mobile phone subscriptions is expected to surpass the global population and the total number of objects connected to the internet is to surpass twenty-five billion in 2015 and surpass fifty billion in

²⁶“Growth in United Nations Membership, 1945-Present,” United Nations, accessed December 5, 2014, <http://www.un.org/en/members/growth.shtml>.

²⁷“World Population,” United States Census Bureau, accessed December 5, 2014, http://www.census.gov/population/international/data/worldpop/table_population.php.

²⁸“Global Air Transport Continues to Expand,” Worldwatch Institute, December 17, 2013, accessed December 5, 2014, <http://www.worldwatch.org/global-air-transport-continues-expand>.

²⁹“Annual Passenger Total Approaches 3 Billion According to ICAO 2012 Air Transport Results,” International Civil Aviation Organization, December 18, 2012, accessed December 5, 2014, <http://www.icao.int/Newsroom/Pages/annual-passenger-total-approaches-3-billion-according-to-ICAO-2012-air-transport-results.aspx>.

³⁰“Statistical Database – Total Merchandise Trade,” World Trade Organization, accessed December 5, 2014, <http://stat.wto.org/StatisticalProgram/WSDBStatProgramSeries.aspx?Language=E>.

³¹Todd Cambell, “The First Email Message,” University of Maryland Museum of User Interfaces, accessed December 1, 2014, <http://www.cs.umd.edu/class/spring2002/cmssc434-0101/MUIseum/applications/firstemail.html>.

³²Sara Radicati, *Email Statistics Report, 2013-2017* (London: The Radicati Group, Inc., 2013).

2020.³³ The cumulative effect is the creation of a global network of people that is unprecedented in history.

Despite understanding the complexity in the environment, numerous international events caught senior US officials and policymakers by surprise and quickly turned into policy crises. Senior officials regularly describe these surprises as intelligence failures and failures in warning. The most significant intelligence failure since the end of the Cold War is the failure to identify and warn about the September 11, 2001 terrorist attacks in New York, Pennsylvania, and Washington DC. Since then, a series of warning failures undermined the Intelligence Community's ability to support policymakers. A 2010 Senate report chastised the Intelligence Community for failing to identify the 2009 Christmas day attempted bombing of a US airliner.³⁴ The wave of popular protests across North Africa and the Middle East, beginning in late 2010 and popularly referred to as the "Arab Spring," resulted in the removal of autocratic leaders in Tunisia, Egypt, Yemen; US military action in Libya; and the ongoing civil war in Syria. Deputy Director of the Defense Intelligence Agency David Shedd stated the Intelligence Community failed to provide warning of events that transformed power structures in the region by stating simply, "We missed that."³⁵ Stemming from the "Arab Spring," a US Senate Committee on Homeland Security and Governmental Affairs report found the Intelligence Community failed to

³³Joshua Primas, "Number of Mobile Phones to Exceed World Population by 2014," Digital Trends, February 28, 2013, accessed December 11, 2014, <http://www.digitaltrends.com/mobile/mobile-phone-world-population-2014/>.; Dave Evans, *The Internet of Things: How the Next Evolution of the Internet Is Changing Everything* (San Jose: Cisco IBSG, 2011).

³⁴Senate Select Committee on Intelligence, *Unclassified Exeective Summary of the Committee Report on the Attempted Terrorist Attack on Northwest Airlines Flight 253*, 111th Cong., 2d sess., May 18, 2010.

³⁵Ken Dilanian, "U.S. Intelligence Official Acknowledges Missed Arab Spring Signs," *Los Angeles Times*, July 19, 2012, accessed December 11, 2014, http://latimesblogs.latimes.com/world_now/2012/07/us-intelligence-official-acknowledges-missed-signs-ahead-of-arab-spring-.html.

provide adequate warning of the localized terrorist threat, which resulted in the September 11, 2012 terrorist attack in Benghazi and the death of US Ambassador John C. Stevens.³⁶ Also described as an intelligence failure is the rapid expansion of the Islamic State of Iraq and the Levant (ISIL) into Iraq in mid-2014 and the ensuing collapse of Iraqi Security Forces. In a late September 2014 interview, President Obama claimed the Intelligence Community underestimated the threat posed by the terrorist group.³⁷ Lastly, also in 2014, members of Congress publically lamented their inability to take action to prevent Russia from intervening in Ukraine and annexing the Crimea territory due to a lack of warning of Russian intentions.³⁸

When Warning Fails

Intelligence remains our basic national instrument for anticipating danger: military, political, and economic.

– As former CIA Director, President George Herbert Walker Bush (1991)³⁹

The perception of the Intelligence Community's increasing failure to provide adequate warning is a result of the community's inability to keep pace with the rapidly changing security environment and policymakers' demands. The US Intelligence Community recognizes that its

³⁶Joseph I. Lieberman and Susan M. Collins, "Flashing Red: A Special Report on the Terrorist Attack at Benghazi," United States Senate Committee on Homeland Security and Governmental Affairs, 112th Cong., 2d sess., December 30, 2012.

³⁷Steve Kroft, "President Obama: What Makes Us America," *60 Minutes*, September 28, 2014, 1, accessed December 11, 2014, <http://www.cbsnews.com/news/president-obama-60-minutes/>.

³⁸Josh Gerstein and Burgess Everett, "Ukraine: Why Didn't the U.S. Know Sooner?," *Politico*, March 4, 2014, 1, accessed December 11, 2014, <http://www.politico.com/story/2014/03/united-states-barack-obama-ukraine-crimea-russia-vladimir-putin-104264.html>.

³⁹John Brennan, "Remarks for Central Intelligence Agency Director John O. Brennan as Prepared for Delivery at the Conference On the Ethos and Profession of Intelligence, Georgetown University," Central Intelligence Agency, June 11, 2014, accessed December 11, 2014, <https://www.cia.gov/news-information/speeches-testimony/2014-speeches-testimony/remarks-for-cia-director-brennan-at-georgetown-conference.html>.

highest priority is to provide timely and accurate warning to policymakers and military commanders. In 1992, Robert Gates, then-Director of Central Intelligence (DCI), created a task force to review the US intelligence warning structure following the end of the Cold War. The group's findings, *DCI Task Force Report: Improving Intelligence Warning 29 May 1992*, observed that "providing policymakers with persuasive intelligence warning – in time for them to act in ways that influence a potential foreign development likely to be adverse to the interests of the United States – is the most important service the [Intelligence] Community can perform for the security of the U.S."⁴⁰ Twenty years later, following the terrorist attacks on September 11, 2001, the ability to provide warning remains a fundamental mission. The Director of National Intelligence lists anticipatory intelligence [warning] as a foundational intelligence mission the Intelligence Community must accomplish.⁴¹ Similarly, Dr. Michael G. Vickers, Under Secretary of Defense for Intelligence, calls intelligence "our first line of defense for warning, given the array of global threats we face."⁴² Additionally, the three all-source intelligence producers within the Intelligence Community (the Central Intelligence Agency (CIA), DIA, and Department of State Bureau of Intelligence and Research) and the technical collection members (the National Geospatial-intelligence Agency, National Security Agency, and National Reconnaissance Office) all identify warning as a core mission.⁴³

⁴⁰Gordon Negus, "DCI Task Force Report: Improving Intelligence Warning," Central Intelligence Agency, Washington, DC, 29 May 1992, accessed December 5, 2011, <http://www.documentcloud.org/documents/368903-1992-05-29-dci-task-force-report-improving.html>.

⁴¹Clapper, *2014 National Intelligence Strategy*, 6.

⁴²Atlantic Council, "Intelligence in a Dynamic World" (video), January 21, 2015, accessed February 11, 2015, <http://www.atlanticcouncil.org/events/webcasts/intelligence-in-a-dynamic-world>.

⁴³Ronald L. Burgess, Jr., *2012-2017 Defense Intelligence Agency Strategy* (Washington, DC: Defense Intelligence Agency, 2012), 2.; Keith Alexander, *NSA/CSS Strategy* (Washington, DC: National Security Agency, June 2010), 1.; Letitia Long, *NGA Strategy: 2013-2017* (Washington DC: National Geospatial-intelligence Agency, 2013), 5.

However, the majority of intelligence failures are understood to be linked to a failure to provide adequate warning, as evidenced by the relatively recent string of policymakers feeling surprised by global events and a review of academic and professional literature. Consistently, investigations show that major intelligence failures are the result of the Intelligence Community's inability to make meaningful warning judgments from dispersed raw intelligence. No failures were due to a simple lack of information.⁴⁴ Instead a review of the literature finds the causes for intelligence failures to fall into three basic schools of thought. The first category identifies structural and systemic limitations within the Intelligence Community which prevent the necessary information from being collected, analyzed, and sent to the policymakers who need it. The second category attributes intelligence failures on the cognitive limitations of intelligence analysts to recognize threats until they have already materialized. Lastly, the third category emphasizes the lack of understanding and action by policymakers as the cause for intelligence failures. In addition to identifying root causes for intelligence failures, each school of thought offers differing solutions to the problem.

Failure 1: Structure of the Intelligence Community

The structural failure school of thought focuses on how well (or not) the Intelligence Community receives information, processes it internally, and passes it on to policymakers. The underlying assumption in the arguments is the lack of centralized control and inefficient processes are fundamental to intelligence failures. Reviews by the executive branch identified structural problems within the Intelligence Community shortly after the passage of the National Security Act of 1947 (Public Law 80-162) and the creation of the Director of Central Intelligence,

⁴⁴Negus 2.; National Commission on Terrorist Attacks upon the United States, Thomas H. Kean, and Lee Hamilton. *The 9/11 Commission Report: Final Report of the National Commission on Terrorist Attacks Upon the United States*. (Washington, DC: Government Printing Office, 2004).

formalizing distinct intelligence agencies into a confederated community (consisting of small intelligence components within the Armed Services, Department of State, Department of the Treasury, the Federal Bureau of Investigation, and the CIA).⁴⁵ In 1949 the Task Force on National Security Organization, part of the First Hoover Commission, identified a lack of coordination and transference of information within the nascent Intelligence Community. Also, in 1949, the Intelligence Survey Group, established by the National Security Council, evaluated the CIA's effort and its relationship with other agencies.⁴⁶ The group's findings, also referred to as the Dulles-Jackson-Correa Report, were highly critical of the quality of national intelligence estimates and the failure of the Director of National Intelligence to lead the coordination between the intelligence agencies.⁴⁷ Additional government reports and inquiries from 1955 to 2002 consistently found similar structural faults within the Intelligence Community.⁴⁸ Amy Zegart, a leading scholar on the structural flaws of the Intelligence Community, summarizes these findings by describing the notion of the United States Intelligence Community as a unified actor in the American national security system is a constructed falsity. According to Zegart, the seventeen members of the current Intelligence Community never acted as a unified group. Rather, the various agencies were created at "different times for different purposes without strong unifying authorities or structures; common policies... and cultures to ensure they operated in a coordinated fashion."⁴⁹

⁴⁵House Committee on Permanent Select Committee on Intelligence, IC21 The Intelligence Community in the 21st Century, 104th Cong., 2d sess., 1996, H. Doc., 1.

⁴⁶Ibid.

⁴⁷Ibid.

⁴⁸Ibid.; National Commission on Terrorist Attacks upon the United States.

⁴⁹Joshua Rovner, Austin Long, and Amy B. Zegart, "How Intelligent Is Intelligence Reform?," *International Security* 30, no. 4 (Spring 2006): 206.

The largest obstacles identified preventing information sharing within the Intelligence Community are cultural and bureaucratic. British political scientist Philip H.J. Davies research identified three cultural tendencies within intelligence agencies, not peculiar to the United States, that play a role in reduced information collection and sharing. The first is the desire to maintain secrecy and limit access to information.⁵⁰ Security and classification rules meant to prevent unauthorized disclosures and protect sources and methods create an environment that limits interaction between agencies. The cultural emphasis on secrecy also limits the number of individuals analyzing intelligence by keeping out the perspectives of subject matter experts from discussions due to their lack of a security clearance.⁵¹ Furthermore, cultural and bureaucratic propensities emphasize institutional survival over cooperation. The bureaucracies of the individual Intelligence Community members resist reform efforts in order to preserve autonomy and power. Furthermore, the structure of government agencies internal reward programs incentivize maintaining the status quo of reliability instead of the innovation of private enterprises.⁵²

Structural reforms are the most public because policy makers and the public perceive them to be the easiest to fix through simple bureaucratic and legislative changes. The reforms preferred by the structural failure school favor the centralization of control of the Intelligence Community in order to reshape the culture and reduce bureaucratic barriers to reform. The governmental panels reviewing the Intelligence Community structure regularly recommended creating a position in which coordination within the Intelligence Community was centralized. The

⁵⁰Philip H.J. Davies, "Intelligence Culture and Intelligence Failure in Britain and the United States," *Cambridge Review of International Affairs* 17, no. 3 (October 2004): 496.

⁵¹Richard L. Russell, "Intelligence Failures: The Wrong Model for the War on Terror," *Policy Review*, no. 123 (February-March 2004): 61-62.

⁵²Amy B. Zegart, "An Empirical Analysis of Failed Intelligence Reforms Before September 11," *Political Science Quarterly* 121, no. 1 (Spring 2006): 58-59.

Intelligence Reform and Terrorism Prevention Act of 2004 sought to correct many of the systemic problems identified in the 9/11 Commission Report and other bipartisan and independent government commissions.⁵³ The law's most significant change to the Intelligence Community was the creation of the Office of the Director of National Intelligence (DNI). While lacking full budgetary and personnel authority over the Intelligence Community, the Office of the DNI is responsible for unifying the Intelligence Community through coordinated analysis and collection, developing common professional standards, and removing communication barriers in order to "forge an Intelligence Community that delivers the most insightful intelligence possible."⁵⁴ However, critics argue the DNI reforms are insufficient to enforce the necessary changes and the legislature needs to give greater authority to the DNI.⁵⁵

Failure 2: Analyst's understanding

The cognitive limitations school of thought focuses on how well (or not) analysts are able to discern threats, despite allegedly having all the necessary information available. The press popularly refer to this type of failure as either "failure to connect the dots" or "failure of imagination."⁵⁶ Furthermore, this school of thought emphasizes how analysis is a human endeavor, limited by the human's ability to process information; as described by Dr. Michael

⁵³Eric Rosenbach and Aki J. Peritz, *Confrontation or Collaboration: Congress and the Intelligence Community* (Cambridge: Harvard Kennedy School of Government, 2009).

⁵⁴ "Mission, Vision," Office of the Director of National Intelligence, accessed February 14, 2015, <http://www.dni.gov/index.php/about/mission>.

⁵⁵Amy B. Zegart, "An Empirical Analysis of Failed Intelligence Reforms Before September 11," *Political Science Quarterly* 121, no. 1 (Spring 2006): 58-59.

⁵⁶Robert D. Behn, "The Beguiling Connecting-the-Dots Metaphor," *Bob Behn's Performance Leadership Report* 8, no. 5 (January 2010): 1.; Scott Atran, "A Failure of Imagination (Intelligence, WMDs, and "Virtual Jihad")," *Studies in Conflict and Terrorism* 29, no. 3 (April/May 2006): 285-300.; Thomas H. Kean, and Lee Hamilton. *The 9/11 Commission Report: Final Report of the National Commission on Terrorist Attacks Upon the United States*. (Washington, DC: Government Printing Office, 2004).

Handel, a Professor of National Security Affairs at the US Army War College and founder of the journal *Intelligence and National Security*, “... the weakest link in the intelligence process – is human nature.”⁵⁷ Former Israeli military intelligence officer Zvi Lanir adds, “surprises... come from the limits of people’s knowledge and understanding of their environment and themselves.”⁵⁸ Military historian Roberta Wohlstetter’s book, *Pearl Harbor: Warning and Decision*, describes the analysts challenge as separating “signals” from “noise.” Signal in this case are “clue or a sign or a piece of evidence that tells about a particular danger or a particular enemy move or intention.”⁵⁹ Noise is “the background of irrelevant or inconsistent signals, signs pointing in the wrong directions, that tend always to obscure the signs pointing the right way.”⁶⁰

The analyst’s ability to identify a threat by discerning the “signals” from the “noise” is hindered by the analyst’s own cognitive biases and inability to process large amounts of information. Former CIA officer Richards J. Heuer, Jr. described, in his book *Psychology of Intelligence Analysis*, how people unconsciously use mental shortcuts to deal with complex and ambiguous information. Cognitive bias is when these mental shortcuts are misapplied and result in mental errors.⁶¹ Heuer also described how analyst bring biases to an analytic problem stating, “intelligence analysts do not approach their tasks with empty minds. They start with a set of

⁵⁷Michael I. Handel, *War, Strategy and Intelligence (Studies in Intelligence)* (New York: Franck Cass, 1989), 34.

⁵⁸Zvi Lanir, *Fundamental Surprises* (Eugene, Oregon: Decision Research, 1986): 1.

⁵⁹Roberta Wohlstetter, *Pearl Harbor: Warning and Decision* (Stanford, CA: Stanford University Press, 1962), 2.

⁶⁰Roberta Wohlstetter, “Cuba and Pearl Harbor: Hindsight and Foresight,” *Foreign Affairs* (July 1965): 1, accessed February 11, 2015, <http://www.foreignaffairs.com/articles/23722/roberta-wohlstetter/cuba-and-pearl-harbor-hindsight-and-foresight>.

⁶¹Richards J. Heuer, *Psychology of Intelligence Analysis*, 2nd ed. (Washington, DC: Center for the Study of Intelligence, Central Intelligence Agency, 2001), 111.

assumptions about how events normally transpire in the area for which they are responsible.”⁶² These initial set of assumptions shape analysis in favor of what the analyst expects to see.⁶³ Israeli political scientist Uri Bar-Joseph described how this phenomena directly led to Israeli intelligence’s failure to warn about the Egyptian and Syrian invasion in the 1973 Yom Kippur War. Despite closely monitoring the Egyptian and Syrian war preparations and warned of both countries’ intention for war, Israeli intelligence maintained their belief that the Arab states did not believe they could prevail militarily against Israel. The day before the invasion, Director of Military Intelligence Eli Zeira briefed Prime Minister Golda Meir: “We still see as highly probable the possibility that the Egyptian and the Syrian state of alert derives from fear from us, and as slightly probable the possibility that the real intention of Egypt and Syria is to carry out hostile acts on a limited scale.”⁶⁴

Two solutions provided to counter the analyst’s cognitive blocks to identifying emerging threats are training and procedural structures.⁶⁵ Training programs emphasize the concept of alternative analysis, “techniques that seek to help analysts and policymakers to stretch their thinking by broadening the array of outcomes considered or by challenging underlying assumptions that may constrain thinking”⁶⁶ These techniques are taught at initial and annual

⁶²Ibid., 5.

⁶³Uri Bar-Joseph and Jack S. Levy, “Conscious Action and Intelligence Failure,” *Political Science Quarterly* 124, no. 3 (Fall 2009): 465.

⁶⁴Uri Bar-Joseph, “Israel’s 1973 Intelligence Failure,” *Israel Affairs* 6, no. 1 (Autumn 1999): 11-25.

⁶⁵McKinsey&Company “Focused On Foresight: An Interview with the US’s National Intelligence Officer for Warning” (video), September 2009, accessed February 11, 2015, http://www.mckinsey.com/insights/public_sector/focused_on_foresight_an_interview_with_the_uss_national_intelligence_officer_for_warning.

⁶⁶Fishbein, Warren, and Gregory Treverton. “Making Sense of Transnational Threats.” *The Sherman Kent Center for Intelligence Analysis Occasional Papers* 3, no. 1 (October 2004): 1, Accessed February 14, 2015, <https://www.cia.gov/library/kent-center-occasional-papers/vol3no1.htm>.

training programs for analysts, such as the DIA *Defense Intelligence Strategic Analysis Program* (DISAP), which teach analyst about cognitive biases and heuristics in order to make them aware of mental traps affecting their analysis.⁶⁷ Books like Dr. Richard Paul and Dr. Linda Elder's *The Miniature Guide to Critical Thinking: Concepts and Tools* are standard issue to assist analyst in clearly evaluating the information analyzed.⁶⁸ Furthermore, analysts training in basic and advanced structured analytic techniques, such as network analysis; matrixes; analysis of competing hypothesis; and argument mapping, provide additional supports for analyst to visualize the information and make additional connections.⁶⁹ In addition to individual training, organizational structures also act to check inherent cognitive bias of the analysts. Programs such as red teams and alternative analysis groups provide outside points of view from the desk analyst and challenge key assumptions and make alternative links between the information.⁷⁰

Failure 3: Policymaker's action

The policymaker school of thought focuses on how well (or not) senior leaders understand the warning provided by analysts and are able to take action to mitigate the identified threat. Political scientist Richard K. Betts, in his 1978 article, "Analysis, War, and Decision: Why Intelligence Failures are Inevitable," ultimately places the cause for intelligence failures on policymakers, stating, "In the best-known cases of intelligence failure, the most crucial mistakes

⁶⁷Regional Joint Intelligence Training Facility, *FY 2011 Course Catalog* (RAF Molesworth, UK, RJITF, 2011), 1-29.; Bruce Bennet, "DIA Analyst Training Requirements and Competencies," *Joint Military Intelligence Training Center* (Washington, DC: Defense Intelligence Agency, 2008).

⁶⁸Linda Elder and Richard Paul, *A Miniature Guide for Students and Faculty to the Foundations of Analytic Thinking: How to Take Thinking Apart and What to Look for When You Do; The Elements of Thinking and the Standards They Must Meet* (Dillon Beach, CA: Foundation for Critical Thinking, ©2003): 1.

⁶⁹Shelly Freyn, "Using Structured Intelligence Methods to Improve Indicator and Warning Analysis," *Competitive Intelligence* 15, no. 4 (October/December 2012), 22-29.

⁷⁰McKinsey&Company (video).

have seldom been made by collectors of raw information, occasionally by professionals who produce finished analyses, but most often by the decision makers who consume the products of intelligence services... Intelligence failure is political and psychological more often than organizational.”⁷¹ However, Dr. John A. Gentry, former senior analyst on the staff of the National Intelligence Officer for Warning (NIO-W), does not let analysts off the hook, asserting, “intelligence officers may be partly responsible if they present accurate warning messages unpersuasively.”⁷² Exemplifying this point, former DIA senior analyst Cynthia Grabo recounted an Intelligence Community discussion about strategic warning. During the discussion an analyst described how analytic methods correctly forecasted the North Korean invasion of South Korea in 1950 and the ensuing Chinese intervention. In response a junior analyst responded, “Yes, but you can’t have done a very good job, because no one believed you,” since both events caught policymakers by surprise.⁷³

A review of the professional and academic literature identifies four primary causes for policymakers not to take action when given warning. The first cause identified is policymakers do not understand the capabilities and limits in intelligence collection, analysis, and dissemination, and as a result maintain unrealistic assumptions.⁷⁴ Martin Petersen, a retired senior CIA intelligence officer, found over the course of his career that policymakers form their initial impressions of the Intelligence Community from popular media, the press, and congressional

⁷¹Richard K. Betts “Analysis, War, and Decision: Why Intelligence Failures Are Inevitable,” *World Politics* 31, no. 1 (October 1978): 61.

⁷²John A. Gentry, “Intelligence Failure Reframed,” *Political Science Quarterly* 123, no. 2 (November 2008): 249.

⁷³Cynthia Grabo, *Handbook of Warning Intelligence: Assessing the Threat to National Security* (Lanham, MD: Scarecrow Press, 2010), ix.

⁷⁴Gentry, 247.; Martin Petersen, “What I Learned in 40 Years of Doing Intelligence Analysis for Us Foreign Policy Makers,” *Studies in Intelligence* 55, no. 1 (March 2011): 14.; Kenneth Lieberthal, *The U.S. Intelligence Community and Foreign Policy: Getting Analysis Right* (Washington DC: The Brookings Institute, 2009).

reports – which are “not always the most accurate or sophisticated sources and generally not the most flattering.”⁷⁵ Former CIA director, Robert Gates, further describes the expectations held by senior leaders, stating, “Presidents expect that, for what they spend on intelligence, the product should be able to predict coups, upheavals, riots, intentions, military moves, and the like with accuracy.”⁷⁶ Secondly, due to the multiple demands for their attention and compressed decision cycles, policymakers lack the necessary time to digest available information, much less to pursue understanding assessed threats.⁷⁷ The result is policymakers have what political scientist, Dr. Matthew Wahler, calls conceptual failure – “a failure to perceive the context of the incoming data.”⁷⁸ Thirdly, arising from the previous two causes, a lack of trust between the policymaker and analyst results in warning failure.⁷⁹ The lack of trust arises from a failure of the Intelligence Community to meet expectations described above and from the “ambiguous signals, unconfirmed reports, and the so-called ‘cry-wolf’ syndrome tend to depress confidence in warning forecasts.”⁸⁰ Additionally, when leaders do not get the information in the detail they expect, they believe the Intelligence Community is withholding information or promoting its own agenda.⁸¹ Lastly, failure occurs when warning counters a senior leader’s desired policy or elevates a topic

⁷⁵Petersen 14.

⁷⁶Andrew 439.

⁷⁷Petersen 13; Dietrich Dorner, *The Logic of Failure: Recognizing and Avoiding Error in Complex Situations* (Reading, MA: Basic Books, 1997), 44.

⁷⁸Mary McCarthy “The National Warning System: Striving for an Elusive Goal”; Matthew H. Walther, “The “Motivated Bias” Dilemma in Warfare and Intelligence”, *Defense & Security Analysis*, 28:3, September 2012, 248.

⁷⁹Gentry 254.

⁸⁰Steve Chan, “The Intelligence of Stupidity: Understanding Failures in Strategic Warning,” *The American Political Science Review* 73, no. 1 (March 1979): 172.; Gentry 256.

⁸¹Gentry 267.

of lower priority.⁸² United States' Ambassador Paul D. Wolfowitz provides the policymaker's perspective stating, "The analyst has to understand the policymaker's intense commitment to the success of his policy... Policymakers will not gladly give up hard-fought premises."⁸³ The result is that policy makers may ignore new information that does not support their preconceived notions or challenges the status quo.⁸⁴ Which is their prerogative, as Dr. Gentry describes how intelligence is only one source of many that help shape policy stating, "But even clear, confidently presented, and accurate intelligence warnings cannot place the messages in political contexts; only decision makers can do that, making intelligence one of many decision inputs."⁸⁵

The proposed solution to improving policymaker-caused warning failures is to make policymakers better intelligence consumers.⁸⁶ Dennis C. Wilder, winner of the 2010 Galileo Intelligence Community Award for innovative ideas, recommended an educational program for newly elected leaders and their staffs to increase understanding of the Intelligence Community. Wilder recommended the Office of the DNI manage the program. However, former senior officials from both political parties and multiple agencies would need to assist in developing the program to avoid allegations of the Intelligence Community attempting to interfere with policy development.⁸⁷ Additionally, former Special Assistant to the President for National Security Affairs, Dr. Kenneth Lieberthal, identified the need for policymakers to keep analysts informed of

⁸²Richard K. Betts "Two Faces of Intelligence Failure: September 11 and Iraq's Missing WMD," *Political Science Quarterly* 122, no. 4 (2007-08): 587-588.

⁸³Jack Davis, "The Challenge of Managing Uncertainty: Paul Wolfowitz on Intelligence Policy Relations," *Studies in Intelligence* 35, no. 5 (1996): 40.

⁸⁴Matthew H. Wahlert, "The 'Motivated Bias' Dilemma in Warfare and Intelligence," *Defense and Security Analysis* 28, no. 3 (September 2012): 248.

⁸⁵Gentry, "Intelligence Failure Reframed," 254.

⁸⁶*Ibid.*, 267-69.

⁸⁷Dennis C. Wilder, "An Educated Consumer is Our Best Customer," *Studies in Intelligence*, 55, no. 2 (June 2011): 23.

discussions with foreign leaders to make sure the analysts have relevant information on intentions and motivations; not simply assuming the analysts already know.⁸⁸

Methodology

Research for this monograph focused on a review of the literature covering intelligence, warning, intelligence failures, surprise, and complexity. This monograph fills a gap in the literature by identifying how complexity science principles can be used to address the three previously identified causes of intelligence warning failures. This paper argues that complexity science provides greater understanding that can be applied to mitigate the three identified causes of intelligence failures – structure of the Intelligence Community, cognitive understanding of the environment and identifying emerging threats, and communicating complex threats to policymakers to support decision making. Due to the classification restrictions the research does not include warning assessments, techniques, or systems currently in use. Instead the research relies heavily on declassified documents from the Intelligence Community.

Cold War Systems in a Post-Cold War World

The Berlin Wall wasn't the only barrier to fall after the collapse of the Soviet Union and the end of the Cold War. Traditional barriers to the flow of money, trade, people, and ideas also fell.

– Fareed Zakaria⁸⁹

When the Cold War ended, we thought the world had changed. It had – but not in the way we thought.

– Thomas P.M. Barnett, *The Pentagon's New Map*⁹⁰

⁸⁸Lieberthal, 63.

⁸⁹Agnes Sachsenroeder, *Cultureshock! Berlin: A Survival Guide to Customs and Etiquette* (New York: Marshall Cavendish Corporation, 2009), 231.

⁹⁰Thomas P.M. Barnett, *The Pentagon's New Map: War and Peace in the Twenty-First Century* (New York: Penguin, 2005), 1.

Warning failures are a result of the US Intelligence Community relying on linear, static processes to address nonlinear, dynamic environments. The US Intelligence Community, as it is recognized today, was created to address the lack of warning available to the President and senior government officials in the lead up to World War II and to address the challenge posed by the Soviet Union following the war. In 1946, the Joint Committee on the Pearl Harbor Attack recommended the establishment of a unified and permanent intelligence effort by the United States. This recommendation became a reality on July 26, 1947 with the passage of the National Security Act of 1947 which created the National Security Council, Department of Defense, a Director of Central Intelligence (DCI), and the CIA. Executive orders, such as the one which created the National Security Agency (NSA) in 1952, and National Security Council Intelligence directives (NSCIDs), which allowed the creation of “departmental” intelligence activities, further expanded the early Intelligence Community.⁹¹

The intelligence warning system during the Cold War focused on the military threat posed by the Soviet Union and aligned communist states. Following the lack of warning of the Berlin blockade in 1948 and the start of the Korean War in 1950, the DCI Walter Bedell Smith, established the National Indications Center to focus on the military mobilization of the Soviet Union, China, North Korea, or other potential areas of global conflict.⁹² By the early 1970s the focus for strategic intelligence warning remained unchanged. Former senior analyst at the DIA, Cynthia Grabo identified the three primary focus areas for warning analysis during the Cold War: military action by Communist states against the United States or its allies, major developments in which Communist states may become involved, and military action by Communist states against

⁹¹Senate Committee on Select Committee to Study Governmental Operations with Respect to Intelligence Activities, *Final Report*, 94th Cong., 2d sess., 1976, S. Rep. 94-75, pt. 1.

⁹²Mary McCarthy, “The National Warning System: Striving for an Elusive Goal,” *Defense Intelligence Journal* 3, no. 1 (Spring 1994): 5-19.

countries not allied with the United States.⁹³ Kenneth Knight, National Intelligence Officer for Warning (NIO-W) from 2004 to 2010, described the Cold War threat as “static”, state centric, and with an emphasis on the military – where the bad outcome could be determined before the outcome and monitor against it.⁹⁴ Additionally, former CIA analyst Bruce D. Berkowitz described the analytic and collection tasks during this time as establishing a source or placing a sensor to watch a military base and wait for a signal that activity was taking place. The ability to gain the necessary access to the information and the threat of deception made the work challenging, but the overall process was relatively simple and straightforward. Further aiding the warning analyst Berkowitz added the Soviet Union was slow, moving “at the speed of bureaucracy.”⁹⁵ For forty years, the US warning system developed a structure isolated from the rest of the Intelligence Community with a focus on military threats and senior leaders to prevent a nuclear world war.

By the end of the Cold War, the purpose of warning analysis expanded “to avoid surprise to the President, the National Security Council, and to the Armed Forces of the United States by foreign events of major importance to the security of the U.S.”⁹⁶ To support warning in the new environment, the DCI established the National Intelligence Warning System. The constraints placed on establishing a warning problem in the new system were vague to allow analyst to examine threats from unpredictable or unimaginable sources.⁹⁷ However, according to Mary McCarthy, NIO-W in the mid-1990s, the focus on identifying threats remained weighted toward

⁹³Grabo, 3.

⁹⁴McKinsey&Company (video).

⁹⁵James Goodale, “Digital Age - Why Is There Intelligence Failure in the Digital Age? - Bruce Berkowitz” (video), October 1, 2003, accessed February 11, 2015, <https://www.youtube.com/watch?v=0G7e4hlt5Pw>.

⁹⁶Task Force on Intelligence Warning, *DCI Task Force Report: Improving Intelligence Warning* (Washington, DC: Central Intelligence Agency, 29 May 1992), 2.

⁹⁷McCarthy, 7.

identifying events that would require the use of military force, “from the scale of embassy evacuations to larger military activities,” but also included events that would negatively affect US foreign policy, to include coup d’etat, third party wars, and refugee surges.⁹⁸

In 2006, the DNI, via Intelligence Community Directive (ICD) 201, expanded the scope of warning intelligence further to provide “national leaders advance warning of foreign developments, events, or conditions that could threaten or adversely affect US interests, objectives, policies, or actions.”⁹⁹ The movement away from purely military and security threats is an attempt to address how the warning system is not sufficient to address the new global environment, consisting of emerging dynamic problems that do not reside solely in nation states and do not solely involve military or defense threats.¹⁰⁰ Secretary of Defense Chuck Hagel stated, “our future security challenges will be defined less by the wars of the past decade and more by emerging complex threats.”¹⁰¹ Additionally, the National Defense Strategy of 2008 described the Long War against violent extremist movements as a “more long-term, episodic, multi-front, and multi-dimensional conflict more complex and diverse than the Cold War confrontation with communism.”¹⁰² Focusing on the intelligence challenges, Under Secretary of Defense for Intelligence Dr. Vickers described, during an early 2015 presentation, how during the Cold War the Intelligence Community faced a single enduring threat in the Soviet Union. However, in the

⁹⁸Ibid.

⁹⁹John Negroponte, *Intelligence Community Directive Number 201: National Foreign Intelligence Warning System* (Washington, DC: Office of the Director of National Intelligence, June 6, 2006).

¹⁰⁰McKinsey&Company (video).

¹⁰¹“Advance Policy Questions for the Honorable Chuck Hagel - Nominee to Be Secretary of Defense,” *Atlantic*, January 24, 2013, accessed February 11, 2015, http://cdn.theatlantic.com/static/mt/assets/steve_clemons/BGOV%20Hagel%20Adv%20Policy%20Questions.pdf.

¹⁰²National Defense Strategy 2008, 8.

current environment the Intelligence Community struggles to confront multiple emerging threats which are becoming enduring problems.¹⁰³

The shift from threats during the Cold War to the current global environment are unprecedented and recognized by senior policy officials. As Secretary of Defense Robert M. Gates wrote in 2010, “the global security environment changed radically since then [the Cold War], and today it is more complex, more unpredictable, and even without a superpower adversary, in many ways more dangerous.”¹⁰⁴ DNI James R. Clapper, in comments given Senate Intelligence hearing on national security threats in early 2014, “... looking back over my more than half a century in intelligence, I don’t think we’ve ever faced more challenges... suffice to say we live in a complex, dangerous world.”¹⁰⁵ DIA Director Lieutenant General Michael Flynn “what I see each day is the most uncertain, chaotic, and confused international environment that I’ve witnessed in my entire career.”¹⁰⁶ Lastly, Secretary of State John Kerry in an April 2014 speech said, “During the Cold War... it was easier than today – simpler is maybe a way to put it... The choices were less varied, less complicated, more stark, more clear.”¹⁰⁷

¹⁰³Atlantic Council “Intelligence in a Dynamic World” (video), January 21, 2015, accessed February 11, 2015, <http://www.atlanticcouncil.org/events/webcasts/intelligence-in-a-dynamic-world>.

¹⁰⁴Robert M. Gates, “Helping Others Defend Themselves: The Future of U.S. Security Assistance,” *Foreign Affairs* 89, no. 3 (May/June 2010), accessed February 11, 2015, <http://www.foreignaffairs.com/articles/66224/robert-m-gates/helping-others-defend-themselves>.

¹⁰⁵“Transcript: Senate Intelligence Hearing On National Security Threats,” *Washington Post*, January 29, 2014, accessed February 11, 2015, http://www.washingtonpost.com/world/national-security/transcript-senate-intelligence-hearing-on-national-security-threats/2014/01/29/b5913184-8912-11e3-833c-33098f9e5267_story.html.

¹⁰⁶James Kitfield, “Flynn's Last Interview: Iconoclast Departs Dia with a Warning,” *Breaking Defense*, August 7, 2014, accessed February 11, 2015, <http://breakingdefense.com/2014/08/flynns-last-interview-intel-iconoclast-departs-dia-with-a-warning/>.

¹⁰⁷“US Secretary of State John Kerry Says Politics 'easier During Cold War',” *News Corp Australia*, April 23, 2014, accessed February 14, 2015, <http://www.news.com.au/world/us-secretary-of-state-john-kerry-says-politics-easier-during-cold-war/story-fndir2ev-1226892946616>.

The threats to the United States, presented by DNI Clapper to the Senate Select Committee on Intelligence, highlight the changes in the threat environment. Which now include cyber, counterintelligence, terrorism, weapons of mass destruction proliferation, transnational organized crime, economic trends, natural resources, and health risks as global threats.¹⁰⁸ The World Economic Forum, an international institution seeking to promote public-private cooperation to address global problems, identified similar threats in its Global Risks 2014 report covering ten global risks of highest concern. The list includes: fiscal crises in key economies, structurally high unemployment-underemployment, water crises, severe income disparity, failure of climate change mitigation and adaptation, greater incidence of extreme weather events, global governance failure, food crises, failure of a major financial mechanism-institution, and profound political and social instability.¹⁰⁹ Both lists describe threats that are complex and closely interrelated. Furthermore, Figure 1 shows how the separate threats are also connected, providing additional complexity to the global environment and how to identify which threat a crisis will arise in order to provide adequate warning.

¹⁰⁸Hearing before the Senate Select Committee on Intelligence, *Worldwide Threat Assessment of the US Intelligence Community*, 113th Cong., 2d sess., 2014.

¹⁰⁹World Economic Forum, *Global Risks 2014: Ninth Edition* (Geneva: World Economic Forum, 2014), 9.

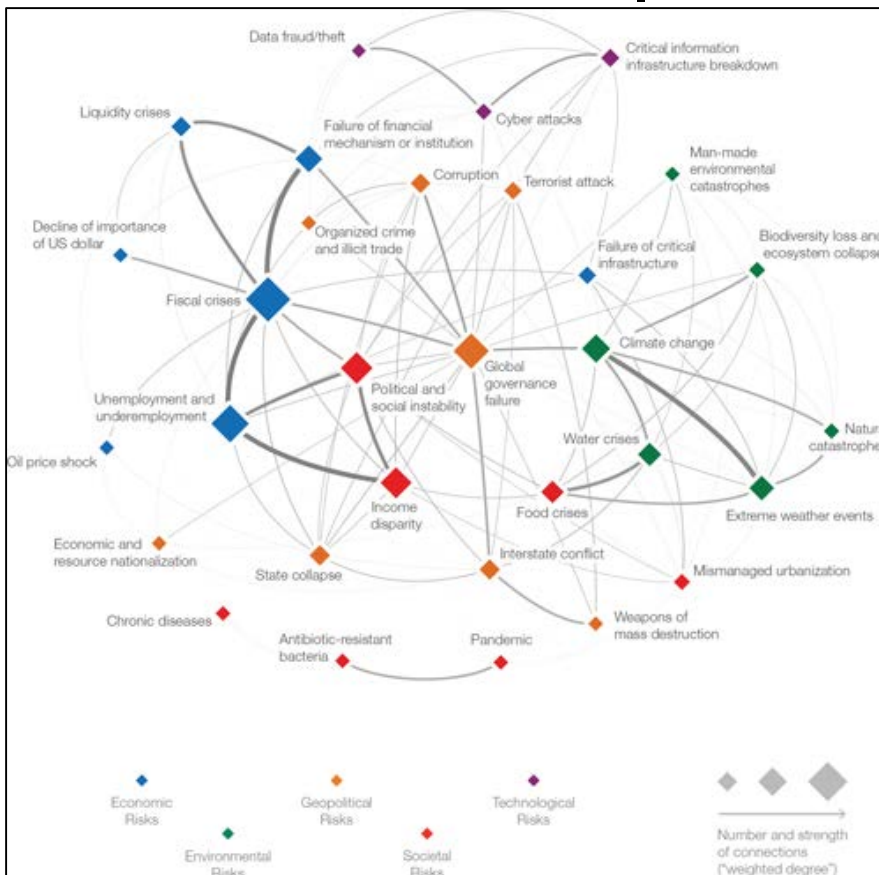


Figure 1: The interconnections of threats in the global security environment
Source: Global Risk Survey 2014: Ninth Edition

Application of complexity

Good analysis makes the complex comprehensible, which is not the same as simple.

– Martin Petersen, former senior CIA Directorate of Intelligence officer¹¹⁰

Complexity science describes how nonlinear, dynamic systems operate and offers insight into the current security environment and how to improve warning analysis. Mathematician Dr. Warren Weaver, in his 1948 paper “Science and Complexity,” described scientific advancements as the solving of three types of problems. Scientists in the 17th to 19th centuries focused on solving

¹¹⁰Petersen, 18.

the first problem set, which Weaver called problems of simplicity. These problems consist of two variables with close interactions. Solving them, led to the discovery of basic laws of gravity, motion, and electromagnetism; along with the technology that runs most of the modern world, to include the lightbulb, automobiles, and airplanes.¹¹¹ Scientists then solved the second problem set, which Weaver called problems of disorganized complexity. These problems consist of millions or more variables interacting haphazardly, such as helium atoms colliding in a balloon, and are described by statistical mechanics. The solutions to these problems led to the discovery of the laws of thermodynamics and applied to improve efficiency at large telephone call centers and in the development of life insurance actuary tables.¹¹² For scientists in the twentieth and going into the twenty-first century, Weaver describes the challenge of the third problem set, which he calls problems of organized complexity. Weaver describes problems of organized complexity as the middle ground where a moderate number of variable are closely related through their interactions. Furthermore he describes organized complex problems as “dealing simultaneously with a sizable number of factors which are interrelated into an organic whole.”¹¹³

In the sixty years since Weaver wrote his article, scientific attempts to answer his third problem set developed into a cutting edge and multi-discipline field of study called complexity science. The field incorporates mathematics, physics, chemistry, biology, economics, meteorology, computer science, social sciences, philosophy, art, and others.¹¹⁴ The focus of the field is to gain understanding of complex adaptive systems, which scientist Melanie Mitchell

¹¹¹Warren Weaver, “Science and Complexity,” *American Scientist* 36 (1948): 536.

¹¹²*Ibid.* 538.

¹¹³*Ibid.* 539.

¹¹⁴Philip Galanter and Ellen K. Levy, “Leonardo,” *Leonardo* 36, no. 4 (2003): 259-67.; Melanie Mitchell, *Complexity: a Guided Tour* (New York: Oxford University Press, 2011), 1.; Ilana Schoenfeld “Introduction to Complex Systems: Patterns in Nature” (video), May 20, 2013, accessed February 11, 2015, <https://www.youtube.com/watch?v=g5evD6AQeCQ>.

defines in her book *Complexity: A Guided Tour* as a “system in which large networks of components with no central control and simple rules give rise to complex collective behavior, sophisticated information processing, and adaptation via learning or evolution.”¹¹⁵ The variety found in complex systems is numerous and occur from the micro-cellular level to global networks. Examples of complex systems include insect colonies, flocks of birds, schools of fish, the brain, the immune system, the financial system and markets, cities, and the World Wide Web.¹¹⁶

Put more colloquially, complex systems are systems in which the whole is greater than the sum of its parts. In contrast, Spanish complexity scientist, Ricard Solé, believes “the whole is different from the sum of its parts,” with multiple interactions creating new phenomena that cannot be explained by the properties of the individual isolated units.¹¹⁷ The key properties of complex systems, according to Solé, are self-organization and emergence. Self-organization is a bottom-up phenomena where all individual units within a system assume roles and complete tasks based solely on their interactions with their neighbors and their immediate environment. This contrasts with top-down systems where a few individual units assign tasks and control their execution through a hierarchy.¹¹⁸ When numerous interactions of individual units occur in a self-organized system, new properties emerge that are distinct from any characteristics of the individuals. The overall effects can be very complex.¹¹⁹ Ant colonies, the human brain, and flocks of birds exemplify emergent properties in self-organizing systems. Individual ants are

¹¹⁵Mitchell, 13.

¹¹⁶Ibid. 4-12.

¹¹⁷Ricard Solé, “On Networks and Monsters: The Possible and the Actual in Complex Systems,” *Leonardo* 41, no. 3 (2008): 253.

¹¹⁸Steven Johnson, *Emergence: the Connected Lives of Ants, Brains, Cities, and Software*, Reprint ed. (New York: Scribner, 2002), 18.

¹¹⁹Solé, 253.; Mitchell, 6.

unsophisticated animals. Research in ant behavior shows one hundred army ants will walk in circles until they die. However, when ants are a member of a colony of several hundred thousand they become part of a self-organized system.¹²⁰ A colony of ants build complex structures, gather food, defend the colony from other ants, care for young, and conduct cleaning and maintenance in the colony. The collective work of the individual ants accomplishes all of those tasks without a central authority prioritizing work or assigning duties. Instead, the ants determine their tasks based on the interaction of the ants they come in contact. Additionally, the ants conduct their tasks with amazing efficiency by quickly identifying the shortest path to food sources and by moving waste products the optimal distance from the colony.¹²¹ Similarly, the human brain consists of 100 billion neurons. Each neuron by itself is relatively simple and limited to the signals it sends and receives from its direct neighbors.¹²² However, as part of the brain, the neurons collectively form a system that is the most complex system known to man.¹²³ The neurons combined create the emergent properties that allow the brain to store information, regulate and control the body, process information, repair itself, dream, and create.¹²⁴ Lastly, the emergence of complex behavior is also the result of simple rules. Birds in a flock create a complex system where their synchronized movement emerges and resembles an organic whole. Three simple rules are able to describe the flock's emergent behavior: the birds need to avoid collisions with nearby flockmates, match the velocity and direction of nearby flockmates, and stay close to nearby flockmates.¹²⁵

¹²⁰Mitchell, 4-5.

¹²¹Ibid.; Johnson 30-33.

¹²²Mitchell, 6.

¹²³Solé, 258.

¹²⁴Ibid.

¹²⁵Melanie Mitchell "Complexity Explorer: Intro 101.07.02 Flocking and Schooling" (video), November 12, 2013, accessed February 11, 2015,

The multiple interactions and components in a complex adaptive system, which give rise to self-organization and emergence, also make the system dynamic and its behavior difficult to predict. Dynamic complex systems change as they interact and adapt to their environment through a system of feedback loops, meaning the current condition of the system will affect its future behavior.¹²⁶ Positive feedback promotes change while negative feedback works to maintain equilibrium. The key aspect to the change in complex systems is that change is nonlinear, meaning it consists of exponential relationships and generally cannot be solved.¹²⁷ Author James Gleick describes nonlinear systems as walking in a maze in which the walls rearrange themselves with each step.¹²⁸ As a result, the dynamics of complex adaptive systems make their behavior difficult to precisely predict and small changes can create large changes.¹²⁹ The following nursery rhyme highlights the nonlinear and dynamic properties of complex systems:

For Want of a Nail

For want of a nail, the shoe was lost.
 For want of a shoe, the horse was lost.
 For want of a horse, the rider was lost.
 For want of a rider, the message was lost.
 For want of a message, the battle was lost.
 For want of a battle, the kingdom was lost.
 And all for the want of a horseshoe nail.¹³⁰

<https://www.youtube.com/watch?v=cner95HCTwY>.; Joe Simkins, “The Complexity of Emergent Systems: Joe Simkins at Tedxcolumbus” (video), January 26, 2014, accessed February 11, 2015, <https://www.youtube.com/watch?v=htmntSoCasg>.

¹²⁶Mitchell, 15-16.; Antoine Bousquet, *The Scientific Way of Warfare: Order and Chaos On the Battlefields of Modernity* (New York: Columbia University Press, 2009), 168.; Nate Silver, *The Signal and the Noise: Why So Many Predictions Fail – but Some Don’t* (New York: The Penguin Press, 2012), 118.

¹²⁷Silver, 118; James Gleick, *Chaos: Making a New Science* (New York: Penguin Books, 1987), 23.

¹²⁸Gleick, 24.

¹²⁹Robert Axelrod and Michael D. Cohen, *Harnessing Complexity: Organizational Implications of a Scientific Frontier* (New York: The Free Press, 2000), 14.

¹³⁰Gleick, 23.

The output of one stage becomes the input for the next and the loss of one nail permeated exponentially and unpredictably through the system resulting in the loss of the kingdom.

The nonlinear dynamics make complex systems chaotic and provides further challenges in attempting to predict their behavior. Chaotic systems have “sensitive dependence on initial conditions.”¹³¹ In the words of nineteenth century French mathematician Henri Poincaré “small differences in the initial conditions produce very great ones in the final phenomenon. A small error in the former will produce an enormous error in the latter.”¹³² Meteorologist and mathematician Edward Lorenz discovered the phenomena of sensitive dependency in 1963 when he found small variations in the input of his deterministic weather modeling program created vast changes in outcomes.¹³³ His discovery commonly referred to as the Butterfly Effect – a butterfly flaps its wings in Brazil and the small variations create a tornado in Texas – highlights how even deterministic systems have predictability limits.¹³⁴ Since all measurements are approximations, the differences in tenth, hundredth, thousandths, and more of a decimal point have the ability to create large changes to the final output in a complex system. The result, again, in the description of Poincaré, “Predictions become impossible.”¹³⁵

A simple example highlighting how small differences in initial conditions produce large difference in the final outcome is iterative doubling. Iterative doubling is simply function in which the initial input is doubled, and the output becomes the input for the next doubling. Figure 2 shows how the initial change of five tenths and one tenth can quickly result in orders of

¹³¹Mitchell, 20.

¹³²Mitchell, 21.

¹³³Mitchell, 22; Gleick, 12-18.

¹³⁴Gleick, 12-20.; Silver, 119-120.; Mitchell, 38.

¹³⁵Mitchell, 21.

magnitude difference in output. The divergence begins after six steps and by step twelve there is a ten percent difference between an initial starting point of 1.0 and 1.1. In a more complex system, the divergence develops from even smaller differences in inputs and permeates through multiple iterations.

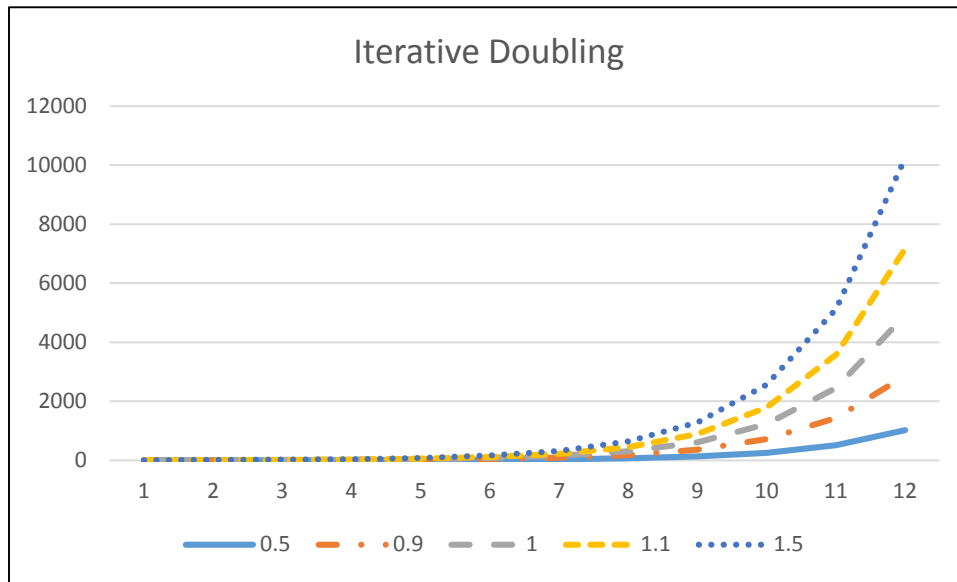


Figure 2: Iterative doubling series shows how small changes in initial conditions quickly results in divergent outcomes

Source: Created by author

However, the nonlinear interactions of complex systems and lack of predictability does not mean randomness or disorder.¹³⁶ The multiple connections made by the components of complex systems form networks. Dr. Ricard Solé argues in his 2008 paper, “On Networks and Monsters: The Possible and the Actual in Complex Systems,” that networks are a unifying theme of complex systems and “pervade complexity at multiple scales.”¹³⁷ From natural to man-made complex systems, networks create a common structural framework that result in order and organizing principles.¹³⁸ British Complexity scientist, Dr. John Gribbin, describes how the

¹³⁶Axelrod, 16.

¹³⁷Solé, 254.

¹³⁸Ibid., 256.

network is a fundamental component of complexity stating, “Having stripped the study of complexity down to its bare essentials... we discover that it is all built on networks, interconnections between the simple parts that make up a complex system.”¹³⁹ Figures 3, 4, and 5 demonstrate, the greater the complexity of the system, the more developed the structure. The arrangement of atoms within proteins, the relationship between words in a book, and the Internet all create networks of similar structures. This networked structure can be used to identify how to manipulate the interactions to change the environment.¹⁴⁰ Additionally, chaotic systems, despite their inability to predict detailed behavior, also form order that allows for system level predictability.¹⁴¹

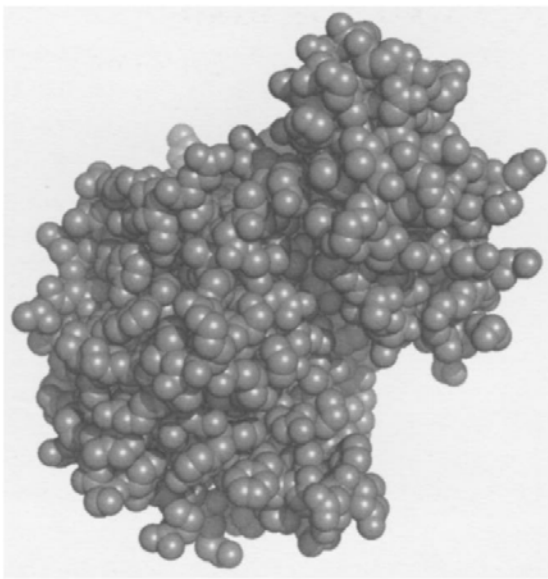


Figure 3: Protein shows the network structure between atoms

Source: Ricard Sole, “On Networks and Monsters: The Possible and Actual in Complex Systems”

¹³⁹John Gribbon, *Deep Simplicity: Bringing Order to Chaos and Complexity* (London: Random House, 2004), 163.

¹⁴⁰*Ibid.*

¹⁴¹Mitchell, 38.

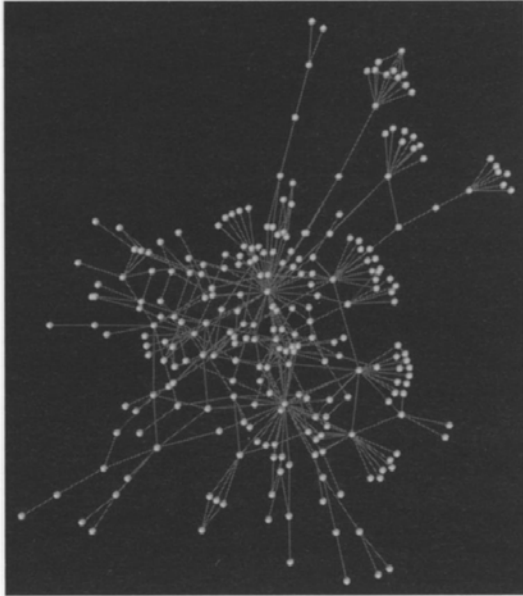


Figure 4: Language web: word-word interactions from the first chapter of Moby Dick
 Source: Ricard Sole, “On Networks and Monsters: The Possible and Actual in Complex Systems”

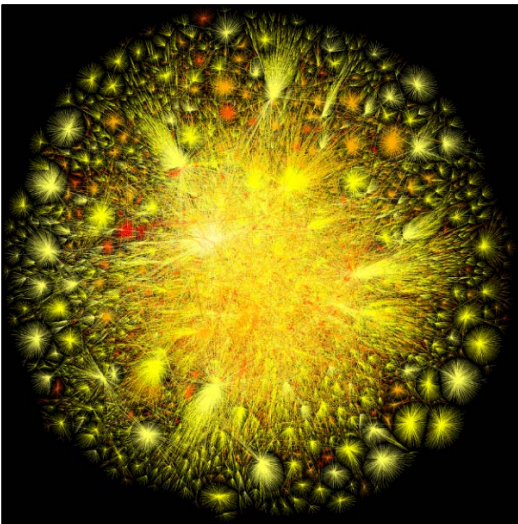


Figure 5: The internet in 2010
 Source: <http://www.opte.org/>, accessed February 14, 2015.

Complexity science is the study of complex adaptive systems from multiple disciplines. Complex adaptive systems consist of relatively simple, interconnected base units, allowing them to self-organize and create emergent properties that are distinct and more complex than the individual units. Complex systems are also nonlinear and difficult to use in predicting future behavior due to small variations propagating through the system and the inability to precisely

measure initial conditions. However, complex systems also create order and structures that allow for analysis in the form of networks, periodic doubling, fractals, and the ability to manipulate the system.

Application 1: Complexity applied to the structure

The number of threats and the speed in which they operate are increasing and places greater demands on the Intelligence Community. Amy Zegart wrote, “National Security in a post-9/11 world hinges more on what we can learn than what we can destroy – understanding adversaries’ intentions, capabilities, preferences, fears, and weaknesses faster and better than they can understand ours.”¹⁴² Zegart’s concept closely matches retired General Stanley McChrystal’s revelation “In bitter, bloody fights in both Afghanistan and Iraq, it became clear to me and to many others that to defeat a networked enemy we had to become a network ourselves. We had to figure out a way to retain our traditional capabilities of professionalism, technology, and, when needed, overwhelming force, while achieving levels of knowledge, speed, precision, and unity of effort that only a network could provide.”¹⁴³ From a business viewpoint, Peter M. Senge, an American systems scientist and a Massachusetts Institute of Technology lecturer, offers a similar perspective, stating, “As the world becomes more interconnected and business becomes more complex and dynamic, work must becoming more ‘learningful’.”¹⁴⁴ The Intelligence Community can apply the concepts of complex adaptive systems to further reform its structure and improve

¹⁴²Amy B. Zegart, “Let the C.I.A. Do What it is Suppose to Do',” *New York Times*, December 22, 2014, accessed February 11, 2015, <http://www.nytimes.com/roomfordebate/2014/12/21/do-we-need-the-cia/let-the-cia-do-what-it-is-suppose-to-do>.

¹⁴³Stanley A. McChrystal, “It Takes a Network: The New Front Line of Modern Warfare,” *Foreign Policy* (February 21, 2011): 1, accessed February 11, 2015, http://foreignpolicy.com/2011/02/21/it-takes-a-network/?wp_login_redirect=0.

¹⁴⁴Peter M. Senge, *The Fifth Discipline: the Art and Practice of the Learning Organization*, rev. ed. (New York: Doubleday, 2006), 4.

the warning process by allowing itself to quickly adapt to changing demands through self-organization and emergence.

The notion of a complex adaptive Intelligence Community is not a new one. Jeffrey R. Cooper wrote in his 2005 article, “Curing Analytic Pathologies: Pathways to Improved Intelligence Analysis” how “the Intelligence Community is an exemplar, even if not a healthy one, of a truly complex adaptive system.”¹⁴⁵ The unhealthy aspects within the Intelligence Community, Cooper argues, are the result of a lack of self-reflection, insular security barriers, and bureaucratic self-protection signals.¹⁴⁶ In the terms of complexity science, these tendencies produce negative feedback that suppress the external pressures to change to the new environment. Additionally, Dr. D. Calvin Andrus, an intelligence officer in the CIA’s Directorate of Support, addressed the Intelligence Community’s need to better adapt to the changing environment in his 2007 article “Toward a Complex Adaptive Intelligence Community: The Wiki and the Blog.”¹⁴⁷ In the article, Andrus contends, “The only way to meet the continuously unpredictable challenges ahead of us is to match them with continuously unpredictable changes of our own. We must transform the Intelligence Community into a community that dynamically reinvents itself by consciously learning and adapting as the national security environment changes.”¹⁴⁸

Andrus’ proposed recommendations for making the Intelligence Community a complex adaptive system integrate the use of information and social media technology with the analytic process to increase the links between analysts. This will allow for greater self-organization and

¹⁴⁵Jeffrey R. Cooper, *Curing Analytic Pathologies: Pathways to Improved Intelligence Analysis* (Washington, DC: Center for the Studies of Intelligence, 2005): 9.

¹⁴⁶*Ibid.*

¹⁴⁷D. Calvin Andrus, “Toward a Complex Adaptive Intelligence Community: The Wiki and the Blog”, *Studies in Intelligence* 49, no. 3 (April 15, 2007).

¹⁴⁸*Ibid.*

improved internal feedback.¹⁴⁹ The Intelligence Community incorporated several of Andrus' ideas including blogs, wiki, social networking, communities of interests, and other collaboration tools.¹⁵⁰ Of particular note is Intellipedia, an Intelligence Community version of Wikipedia that allows collaborative editing of its content and structure that resides on both classified and unclassified networks.¹⁵¹ Additionally, the Intelligence Community developed a Library of National Intelligence to increase access to finished intelligence products across the IC for increased collaboration.¹⁵² The Intelligence Community Information Technology Enterprise (IC ITE) strategy is also moving forward with greater integration of information systems and cloud computing in order to provide a shared environment: thus further interconnecting the community.¹⁵³ Collectively, these reforms are the cornerstone for "Intelligence Community Directive 501: Discovery and Dissemination or Retrieval of Information within the Intelligence Community" which is meant to "Provide an improved capacity to warn of and disrupt threats to the United States (U.S.) homeland, and U.S. persons and interests."¹⁵⁴

Subsequently, these reforms, as described by former senior DIA intelligence officer, the first Deputy Director of National Intelligence for Intelligence Integration, and current National Geospatial-Intelligence Agency director Robert Cardillo, have created a new emergent culture

¹⁴⁹Ibid.

¹⁵⁰Ibid.; Massimo Calabresi, "Wikipedia for Spies: The CIA Discovers Web 2.0," *Time*, April 8, 2009, 1, accessed February 11, 2015, <http://content.time.com/time/nation/article/0,8599,1890084,00.html>; Cardillo, 7.

¹⁵¹Robert Hink, "Intellipedia," Center for Strategic & International Studies, accessed February 11, 2015, <http://csis.org/blog/intellipedia>.

¹⁵²Cardillo, 4.

¹⁵³Office of the Director of National Intelligence, "Chief Information Officer: What We Do," Office of the Director of National Intelligence, accessed February 11, 2015, <http://www.dni.gov/index.php/about/organization/chief-information-officer-what-we-do>.

¹⁵⁴John Michael Mitchell, *Intelligence Community Directive Number 501: Discovery and Dissemination or Retrieval of Information Within the Intelligence Community* (Washington, DC: Office of the Director of National Intelligence, January 21, 2009).

within the Intelligence Community. Cardillo recognizes the transition to the new technologies has been largely driven by younger intelligence officers who are more comfortable with social media.¹⁵⁵ However, despite an uneven start, programs like Intellipedia produced results. For example, Tom Fingar, who headed the National Intelligence Council from 2005 to 2008, described how an Intellipedia request, for collecting evidence on the first use of chlorine in improvised explosive device in Iraq, resulted in the development of serviceable set of instructions in 48 hours. The request drew responses of twenty-three people, from nearly twenty locations around the world.¹⁵⁶

Despite identified successes and progress made, the Intelligence Community remains a relatively closed system due to security requirements and similarities in analytic tradecraft. The effect is a significant reduction in the value of the network created within the Intelligence Community and the information it can process. According to Metcalfe's Law (see Figure 6) a maxim developed by Robert Metcalfe – the founder of 3Com and inventor of the Ethernet protocol, "The value of a network increases exponentially with the number of nodes."¹⁵⁷ Furthermore, "Reed's Law", developed by computer scientist David P. Reed contends that expanding the number of nodes in a system is even more powerful than Metcalfe realized. Instead of just focusing on the individual nodes, the people in the network are able to form sub-groups that also interact creating even more ability to collaborate and share.¹⁵⁸

¹⁵⁵Robert Cardillo, "Intelligence Community Reform: A Cultural Evolution," *Studies in Intelligence* 54, no. 3 (September 2013): 1-7.

¹⁵⁶Massimo Calabresi, "Wikipedia for Spies: The CIA Discovers Web 2.0," *Time*, April 8, 2009, 1, accessed February 11, 2015, <http://content.time.com/time/nation/article/0,8599,1890084,00.html>.

¹⁵⁷"Encyclopedia: Definition of Metcalfe's Law," PCMag.com, accessed February 11, 2015, <http://www.pcmag.com/encyclopedia/term/46867/metcalfe-s-law>.

¹⁵⁸"Encyclopedia: Definition of Reed's Law," PCMag.com, accessed February 11, 2015, <http://www.pcmag.com/encyclopedia/term/64217/reed-s-law>.

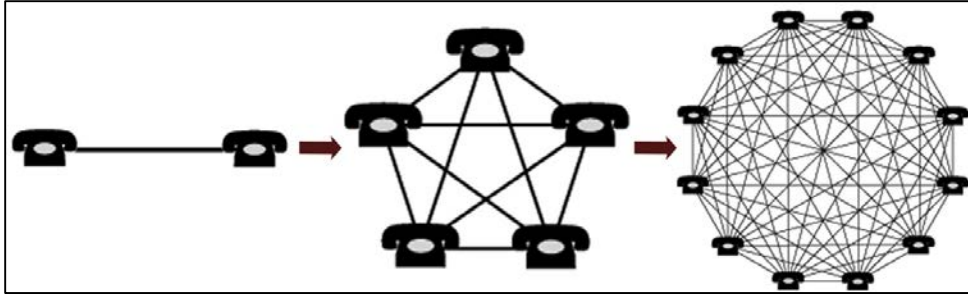


Figure 6: Metcalfe's Law – The Network Effect for Telecommunication Networks
Source: <http://www.mkbergman.com/1788/the-value-of-connecting-things-part-i-a-foundation-based-on-the-network-effect/>, accessed February 14, 2015.

Additionally, when attempting to develop understanding of complex systems it is necessary to have cross-discipline collaboration. Dr. Warren Weaver described the success the British and Americans had during World War II through their use of teams called operational analysis groups. The most successful of these groups did not consist solely of mathematicians, physicists, and engineers, but also physiologist, biochemists, psychologists, and other representatives from biochemical and social sciences. Weaver stated, “It was found, in spite of the modern tendencies toward intense scientific specialization, that members of such diverse groups could work together and could form a unit which was much greater than the mere sum of their parts. It was shown these groups could tackle certain problems of organized complexity, and get useful answers”¹⁵⁹

A University of Pennsylvania research team found the same principle, as observed by Dr. Weaver, can also be applied to predicting geopolitical events. The research team, while participating in an Intelligence Advanced Research Projects Activity (IARPA) forecasting tournament, found the predictions made by people working in groups were ten percent more accurate than predictions made by individuals. Furthermore, working in a team increased open mindedness due to the opportunity for dissent to arise and expanded the diversity of knowledge

¹⁵⁹Weaver, 536-544.

within the team.¹⁶⁰ Additionally, the team findings showed that non-subject matter experts can be trained to be effective forecasters, even without access to classified reporting.¹⁶¹ That team members were able to share information and discuss their various justifications, yet still submit their forecasts anonymously, supports other studies that aggregating judgments or predictions across individuals can be surprisingly accurate in a variety of domains – to include prediction markets, political polls, game shows, and forecasting¹⁶² These conclusions support Carmen Medina's, Director for the CIA's Center for the Study of Intelligence, identified trends that, "the traditional model of the individual analyst at the center of the intelligence process is receding. Expertise will matter more in terms of how it describes the complete expertise of a collaborative group. Expertise in collaboration will become more important. ... there would also be increased demand for collaborative communities of analysts that can bring greater mental resources to bear on a problem."¹⁶³

Application 2: Complexity applied to the analyst

CIA veteran Richard J. Heuer, Jr. stated, "When we speak of improving intelligence analysis, we are usually referring to the quality of writing, types of analytical products, relations between intelligence analysts and intelligence consumers, or organization of the analytic process.

¹⁶⁰Barbara Mellers et al., "The Psychology of Intelligence Analysis: Drivers of Prediction Accuracy in World Politics," advanced online issue, *Journal of Experimental Psychology: Applied* (January 12, 2015): 1, accessed February 11, 2015, <http://www.apa.org/pubs/journals/releases/xap-0000040.pdf>.

¹⁶¹American Psychological Association, "Teams Better Than Individuals at Intelligence Analysis, Research Finds," Press Releases, January 13, 2015, accessed February 11, 2015, <http://www.apa.org/news/press/releases/2015/01/intelligence-analysis.aspx>.

¹⁶²*Ibid.*; Clinton P. Davis-Stober et al., "When Is a Crowd Wise?," *Decision* 1, no. 2 (April 2014): 79-101.

¹⁶³Center for Security Studies, "*Emerging Threats in the 21st Century*" - *Strategic Foresight and Warning Seminar Series* (Zurich: Center for Security Studies, 2007), 12.

Little attention is devoted to improving how analysts think.”¹⁶⁴ Within the descriptor “how analysts think” should include “how analysts understand the current security environment.” Analysts can use complexity science principles of non-linearity, self-organization, emergence, and chaos to improve their understanding of the security environment and the nature of emerging threats to provide warnings earlier and with greater detail.

Former NIO-W Kenneth Knight described why analysts delay in delivering warning forecasts stating, “Too often... our analysts try to make an either-or call. So, you know, leader A is going to be removed from power or he’s not. And again, since nobody wants to be wrong, when you’re down to that either-or approach I think you are waiting until the confirming evidence is overwhelming.”¹⁶⁵ However, complexity science describes how, due to the sensitivity of initial conditions; interdependence; and nonlinearity, precise predictions are impossible. Analyst pressured not to make mistakes, don’t want to make mistakes. Complexity science gives analysts the ability to understand prediction is not possible due to sensitivity in initial conditions and nonlinearity within the network.

Many of the emerging threats to American national interests are social phenomena that result in a change in government, the rise of non-state actors, or an intervention by another country. The Intelligence Community’s failure to warn policy makers of the 1979 fall of the Shah in Iran, the 1994 end of apartheid in South Africa, the 2010 Arab Awakening, and the 2014 Kiev protests and Russian annexation of Crimea show a pattern of not understanding self-organizing patterns and emergent behaviors. Ms. Irene Sanders, the executive director of the Washington Center for Complexity and Public Policy, described how the CIA did not see the end of apartheid because they focused on what the South African leaders were saying and rather than paying

¹⁶⁴Heuer, 1-2.

¹⁶⁵McKinsey&Company (video).

attention to what was going on in the streets and the neighborhoods across the country.¹⁶⁶ Nearly twenty years later, former DIA Deputy Director, Mr. Shedd, described how the Intelligence Community similarly missed the subtleties in the populations living in the countries affected by the Arab Spring. He stated how those bottom-up indicators would have “shown us, that there was a growing dissatisfaction and then at the same time the conditions to address that dissatisfaction in the general population.” Again, a reason for the gap, Shedd added, was collection of information by the Intelligence Community from those in power in the region and not from opposition groups.¹⁶⁷

Nassim Taleb, in his book *The Black Swan: The Impact of the Highly Improbable*, calls events that are only predictable after the fact and carry extreme impacts Black Swans.¹⁶⁸ Kristan J. Wheaton, an associate professor of Intelligence Studies at the Tom Ridge School of Intelligence Studies and Information Science, argues that while Black Swans are by their nature unpredictable and, they are the cumulative result of events building over time. He asserts, if analysts shift focus to the links between events and not just the events themselves they would be able to identify patterns. These patterns may follow power law distributions and will not allow for predicting a specific occurrence, does allow for the ability to forecast the likelihood an event will take place.¹⁶⁹

¹⁶⁶Wilson Center (video).

¹⁶⁷Cheryl Pellerin, “DIA Five-Year Plan Updates Strategic Warning Mission,” *DoD News*, July 18, 2012, accessed February 11, 2015, <http://www.defense.gov/news/newsarticle.aspx?id=117160>.

¹⁶⁸Nassim Nicholas Taleb, *The Black Swan: the Impact of the Highly Improbable*, 2nd ed. (New York: Random House Trade Paperbacks, 2007), 1.

¹⁶⁹ Kristan J. Wheaton, “How to Analyze Black Swans,” *Sources and Methods* (blog), April 21, 2014, accessed February 11, 2015, <http://sourcesandmethods.blogspot.com/2014/04/how-to-analyze-black-swans.html>.

Lastly, complex systems can shape how analysts understand cause and effect in nonlinear systems, with lags in time and location. In classic forecasting models, the future is merely an extension of existing conditions, trends, and models are based on deterministic cause-and-effect beliefs.¹⁷⁰ However, due to the greater interconnectedness in global transportation and communication systems, events in one part of the world can trigger the emergence of threats in distant locations. President Carter's National Security Advisor, Zbigniew Brzezinski, described this effect in the global environment saying, "We are facing a kind of dynamically spreading chaos in parts of the world. Now in the Middle East, but that could spread to other portions of West Asia, to Central Asia, even into Russia, perhaps even to China."¹⁷¹

Application 3: Complexity applied to the policymaker

The challenge remains how to describe complex systems to decision makers. Jerry Sabloff, President of Santa Fe Institute stated "Policy makers and people in Congress, in city hall, etc... still don't understand complex systems because they still think 'if I do A I will get result B, and then are always surprised when they get result C, D'"¹⁷² Additionally, when briefers sketched the complexity of the Afghanistan operational environment (see Figure 7) to then commander of US and International Security Assistance Force in Afghanistan, General Stanley McChrystal, he jokingly stated "When we understand that slide, we'll have won the war."¹⁷³ The briefing slide

¹⁷⁰Wilson Center (video).

¹⁷¹Benjamin Landy, "Zbigniew Brzezinski On Isis, Ukraine, and the Future of American Power," *MSNBC*, September 10, 2014, accessed February 11, 2015, <http://www.msnbc.com/msnbc/zbigniew-brzezinski-isis-ukraine-and-the-future-american-power>.

¹⁷²Santa Fe Institute, "Complexity: Life, Scale," (video), August 29, 2012, accessed February 11, 2015, https://www.youtube.com/watch?v=0yL8j37SI0w&list=PLC_Rf_NXNvvOIbCS_7UtDXEITiWPb-8pw;..

¹⁷³Elisabeth Bumiller, "We Have Met the Enemy and He Is Powerpoint," *New York Times*, April 26, 2010, accessed February 11, 2015, http://www.nytimes.com/2010/04/27/world/27powerpoint.html?_r=0.

also created concerns, as presenting the complex nature of the environment raised doubts on the ability to make progress in Afghanistan.

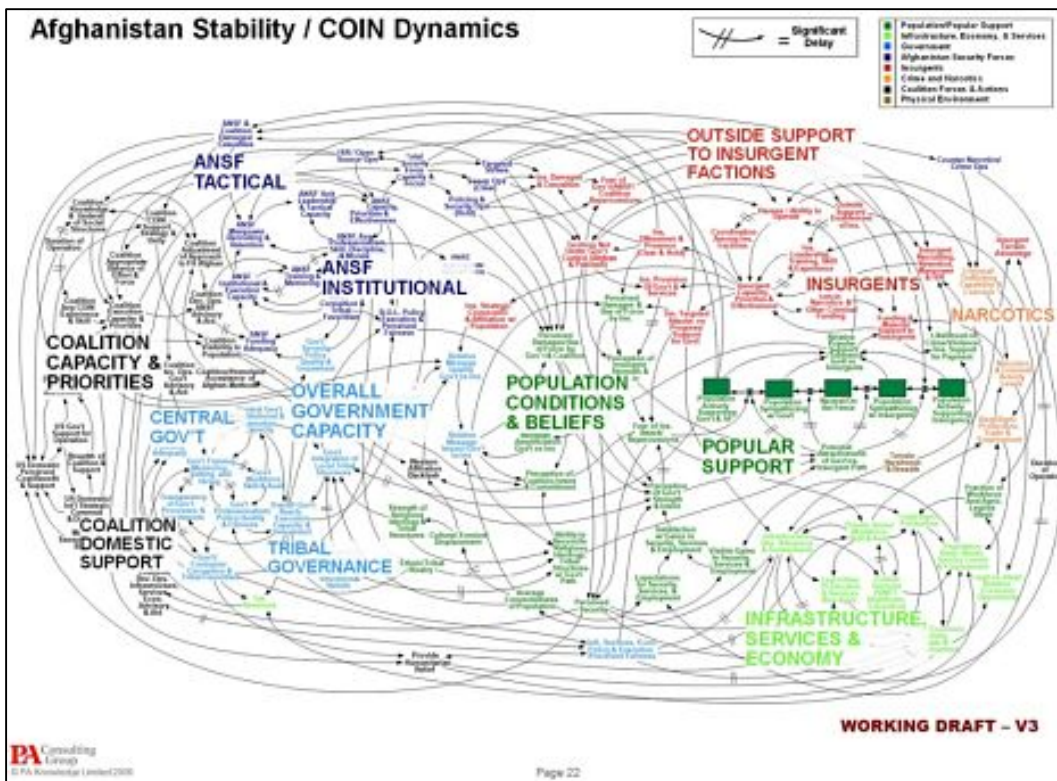


Figure 7: “Afghanistan Stability / Counter Insurgency Dynamics” graphic
Source: http://www.nytimes.com/2010/04/27/world/27powerpoint.html?_r=0, accessed February 14, 2015.

When people face an increasingly complex environment, they rely predominately on experience and intuition in decision-making.¹⁷⁴ Dr. Alex Bennet, former Chief Information Officer for the Department of the Navy Enterprise Integration, and David Bennet, consultant to support sustained growth and decision making in complex environments, argue that logic-based decision-making in complex adaptive systems arises from framework building based on the

¹⁷⁴Erik J. Dahl, *Intelligence and Surprise Attack: Failure and Success from Pearl Harbor to 9/11 and Beyond* (Washington, DC: Georgetown University Press, 2013), xv; Alex Bennet and David Bennet, “The Decision-Making Process for Complex Situations in a Complex Environment,” in *Handbook On Decision Support Systems*, ed. F. Burstein and C.W. Holsapple (New York: Springer-Verlag, 2008).

concepts of complexity to include emergence, butterfly effect, tipping point, feedback loops, and power laws.¹⁷⁵ Furthermore, Marketing Professor, J. Edward Russo, and pioneer in decision sciences, Paul J.H. Schoemaker, identify the importance of developing the proper framework as the necessary first step to decision-making.¹⁷⁶ Additionally, German theoretical psychologist Dietrich Dörner, in his book *The Logic of Failure: Recognizing and Avoiding Error in Complex Situations* states, “Formless collections of data about random aspects of a situation merely add to the situation’s impenetrability and are no aid to decision making.”¹⁷⁷ Rather the information needs to be arranged into a cohesive picture that models the reality of the system to give the information meaning and allow the user to find order in apparent chaos.¹⁷⁸

“Intelligence Community Directive 203: Analytic Standards” established the standard requirements for all Intelligence Community analytic products. These requirements include the five analytic standards: objective analysis, independent of political considerations, timely, based on all available sources of intelligence information, and implements and exhibits Analytic Tradecraft Standards.¹⁷⁹ In addition to these standards, analysts should incorporate descriptions of the complexity of the environment to support greater logic-based decision making. Furthermore, a policymaker’s level of familiarity with complexity principles will shape how they face complex environments and will require tailored intelligence products. Dörner also described how complexity is a subjective experience. Through their individual experiences, people become

¹⁷⁵Ibid.

¹⁷⁶J. Edward Russo and Paul J.H. Schoemaker, *Decision Traps: Ten Barriers to Brilliant Decision-Making and How to Overcome Them* (New York: Fireside, 1990), 15.

¹⁷⁷Dörner, 44-45.

¹⁷⁸Ibid.

¹⁷⁹James Clapper, *Intelligence Community Directive Number 203: Analytic Standards* (Washington, DC: Office of the Director of National Intelligence, January 2, 2015).

able to group multiple variables together to form “supersignals.”¹⁸⁰ “Complexity must be understood in terms of a specific individual and his or her supply of supersignals.”¹⁸¹ It is incumbent for the analyst to shape intelligence products to the policymakers’ specific “supersignals” to allow for quicker understanding of threats and greater likelihood to take action.

Conclusion

Beware the ides of March

– William Shakespeare, *Julius Caesar*

In an age of increasing complexity and a corresponding expansion of threats to American interests, the demand for the Intelligence Community to provide senior leaders with adequate warning also increases. As a result, the traditional understanding of the system and fixes to the intelligence structure, analytic tradecraft, and communication to policymakers is no longer adequate. Amy Zegart stated, “dramatic improvements in the U.S. intelligence capabilities require changing organizational routines and cultures as well as structures.”¹⁸² According to Robert Cardillo, a cultural change is taking place in information sharing and analytic quality due to the creation of the Office of the Director of National Intelligence and lessons learned following the September 11, 2001 terrorist attacks.¹⁸³ However, according to Kenneth Knight, the incorporation of modeling complex systems and large data problems continues to lag due to “a bias that says this stuff is too complex to model.”¹⁸⁴ While not a silver bullet to the warning problem, the

¹⁸⁰Dorner, 39.

¹⁸¹Dorner, 39.

¹⁸²Zegart, “September 11 and the Adaptation Failure of the U.S. Intelligence Agencies,” 80.

¹⁸³Cardillo, 1-7.

¹⁸⁴Jay Ulfelder, “How Makers of Foreign Policy Use Statistical Forecasts: They Don’t, Really,” *Dart-Throwing Chimp* (blog), June 8, 2012, accessed February 11, 2015, <https://dartthrowingchimp.wordpress.com/tag/ken-knight/>.

application of complexity theory principles offers a framework to encourage the Intelligence Community to adapt in the new environment.

Applying complexity science principles to both the Intelligence Community and warning intelligence will also have broader cultural implications. The Intelligence Community needs to review the requirement for all analysts to have a clearance and incorporate more unclassified open source information. By doing so the Intelligence Community can increase the size of its network and incorporate greater external expertise and differing points of view. Additionally, the need to monitor “bottom-up” emergent behavior will require a change in technical and human intelligence collection focus and clear policies balancing collection requirements and civil-liberty protections at home and abroad. Lastly, complexity concepts will require more dynamic finished intelligence and intelligence cycle; with greater interaction between analyst, collectors, and policymakers.

Appendix A: The United States Intelligence Community

The United States Intelligence Community is a coalition of 17 agencies within the Executive Branch that work independently and collaboratively to gather and analyze intelligence necessary to conduct foreign relations and national security activities.¹⁸⁵ 17 members of the Intelligence Community include:

Central Intelligence Agency

Department of Energy

Department of Homeland Security

Department of State

Department of Treasury

Defense Intelligence Agency

Drug Enforcement Administration

Federal Bureau of Investigation

National Geospatial Intelligence Agency

National Reconnaissance Office

National Security Agency

Office of the Director of National Intelligence

Air Force Intelligence

Army Intelligence

Coast Guard Intelligence

Marine Corps Intelligence Activity

Naval Intelligence

¹⁸⁵Office of the Director of National Intelligence, "Intelligence Community," Director of National Intelligence, accessed February 11, 2015, <http://www.dni.gov/index.php>.

Appendix B: The Intelligence Cycle

The Intelligence Cycle is the process of developing raw information into finished intelligence for use by policymakers, military commanders, and other consumers in decision making. This six-step cyclical process is highly dynamic, continuous, and never-ending. The sixth step, evaluation (which includes soliciting feedback from users) is conducted for each of the other five steps individually and for the Intelligence Cycle as a whole. The six steps that constitute the Intelligence Cycle are as follows:¹⁸⁶

Planning and Direction: Establish the consumer's intelligence requirements and plan intelligence activities accordingly

Collection: Gather the raw data required to produce the finished product.

Processing and Exploitation: Convert the raw data into a comprehensible format that is usable for production of the finished product.

Analysis and Production: Integrate, evaluate, analyze, and prepare the processed information for inclusion in the finished product.

Dissemination: Deliver the finished product to the consumer that requested it and to others as applicable.

Evaluation: Continually acquire feedback during the Intelligence Cycle and evaluate that feedback to refine each individual step and the cycle as a whole.



Figure 8: The Intelligence Cycle

Source: <http://www.fas.org/irp/cia/product/facttell/intcycle.htm>, accessed February 14, 2015.

¹⁸⁶Director of National Intelligence, *U.S. National Intelligence: An Overview 2011* (Washington, DC: Office of the Director of National Intelligence, 2011), 10-12.

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