Operational Net Assessment:
A Framework for Social Network Analysis

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Editorial Abstract: *LCDR Michael Hannan examines the Operational Net Assessment process. He draws from current literature on the ONA template and reviews the construct in order to create a "truth in lending" approach. LCDR Hannan attempts to identify the present limitations of ONA and provide recommendations and areas for improvement. He contends for ONA to be relevant, its level of confidence must be clearly understood by the warfighter.*

> ***"The difficulty of accurate recognition constitutes one of the most serious sources of friction in war.[1] "***
>
> *- Carl von Clausewitz*

Operational Net Assessment (ONA) is an analytical process designed within the Department of Defense to enhance decision-making superiority for the warfighting Commander. ONA plans to integrate people, processes, and tools using multiple information sources and collaborative analysis. The goal is a shared knowledge environment, with supporting information tools, for planners and decision-makers to focus capabilities. The ONA process uses collaboration technologies and subject matter expertise to transform data into actionable intelligence. Link and network analyses are harnessed to assess the adversary and his systems.[2]

ONA is a core competency planned for the new Standing Joint Force Headquarters (SJFHQ) concept. The SJFHQ is a team of operational planners and information specialists who form the core of a Regional Combatant Commander's Joint Task Force command structure. Using collaborative planning tools, the SJFHQ develops a pre-crisis knowledge base of the adversary's systems and capabilities for the creation of ONA. The SJFHQ becomes a repository for theater perspective and knowledge of the Commander's area of responsibility, key issues, and regional players.[3]

Unfortunately, doctrinal explanations of ONA focus on results (ends) to the exclusion of process (ways or means). Discussion of potential bias within information or analyst perceptions is lacking. Human nature prevents total objectivity: "The process of intelligence analysis and assessment is a very personal one. There is no agreed-upon analytical schema, and the analyst must use his belief system to make assumptions and interpret information."[4] As Robert Deutsch notes about American culture: "Attempts at image creation are now an invasive part of our environment; some pollute and some enhance human experience."[5] Whether the image created is driven by the ONA process itself, information provided by outside Agencies, or the way we apply modern technology; limitations must be observed and understood. The level of confidence in the analysis must be a core component of the end product for the warfighter. We must be always wary of the "hard facts of capability and the soft assumptions of intention."[6]

ONA and the SJFHQ: Background and Definitions

> ***The secret of a sound, satisfactory decision…has always been that the responsible official has been living with the problem before it becomes acute.[7]***
>
> *--- President Dwight D. Eisenhower*

Joint Forces Command (JFCOM)'s ultimate goal for ONA is to predict adversary actions as resultant effects from our own efforts. Doctrine explains this as a long-term analytical process where the SJFHQ and its ONA element delve into a Commander's prioritized regional concerns long before a crisis brews. Current literature frames ONA as interpreting significance from an adversary through the lens of systems.[8] A critical portion of ONA is System-of-Systems Analysis (SoSA), which seeks to "identify, analyze, and relate the goals and objectives, organization, dependencies … inter-dependencies [and] influences" of an adversary under investigation.[9] The SoSA process is heavily reliant upon information provided to the ONA team by groups within and outside the U.S. Government. Non-governmental organizations (NGOs) are listed as core elements of ONA input, along with Centers of Excellence: Academic institutions, laboratories, and think tanks.[10] Measurement identifies causal relationships between friendly actions and enemy effects within all elements of national power: Diplomatic, Information, Military, and

Economic (DIME).[11] Adversary capabilities or organizations are analyzed in six areas: Political, military, economic, social, information, and infrastructure (PMESII).[12]

Data Requirements for ONA

We could have talked about the science of Intelligence, but … the science of Intelligence is yet to be invented.[13]

--- Charles Allen

Generating "a mature ONA for a single focus area will likely entail thousands of nodes and associated relationships, tasks, and potential effects."[14] Voluminous data compiled for analysis in a network construct requires sophisticated technical assistance through computer simulation modeling. Emphasis on computational analysis constrains the understanding of social and cultural nuances; however, most conceptual modeling is not suitable for crisis action planning. Transitioning data sets from a static (but robust) conceptual model to a more dynamic (and rapid) computational effort is required.

The tools available now cannot handle both types of information at a fidelity required by ONA.[15] The layers of conceptual detail gathered by human intelligence are lost. This skews true effects determination, which is the rationale for ONA within Effects Based Operations. One must not lose focus on conceptual processes when technology assists. The effort must be a "concept-driven activity rather than an external data-driven activity."[16] The System-of-Systems Analysis process cannot be slanted toward a single discipline.

There are various examples of programs created within the last few years to enhance social network analysis (SNA).[17] Simulation designers have addressed the need to plug in rule sets derived from conceptual modeling. This can be accomplished by translating conceptual-derived data into computational algorithms and programmable agents in a synthetic environment, so the conceptual model (and its social fabric information) is embedded in the procedures.[18] Although this capability is assumed in doctrinal ONA publications, the technology is not yet there. Owen Cate, the Assistant Director of Security Studies Program at MIT, lauds the continuing research into SNA advances, but notes:

> I think it's one of these cases when all the methodology, all the fancy software and all the other stuff—if it's garbage in, it's going to be garbage out, so the question boils down to how much do we know about these groups … if we don't know much about these groups, then I don't think these models will have much utility.[19]

While Cate's statement may seem negative, his point does support the need for integrated conceptual, humanistic, and cultural knowledge applied within any SNA simulation tool.

The "ONA brochure" glosses over current limitations and imparts an almost infallible capability: "… [ONA provides] pertinent expertise and information for *holistic analysis* [emphasis mine] of adversaries and the potential effects operations might have on them."[20] The issue remains that "current technologies cannot account for behavior related to the social or political context."[21] Information Operations personnel engaged in the Millennium Challenge 2002 exercise noted this shortfall: "Inadequate resources existed for producing … integration of cultural intelligence, psychological operations, public affairs, and civil affairs" into simulation models.[22]

Future simulation and modeling systems must pull in these disparate variables. Dr. Kathleen Carley of Carnegie Mellon University, a leading researcher of next-generation social network systems, is also concerned:

> At the theoretical level, little is known about individual differences in balancing social, political, and group level concerns and goals. At the empirical level, the validity, collection, and bias issues … are distinct and little is known about how to calibrate data across levels.[23]

The assumption that current off-the-shelf nodal analysis tools can provide "complete, accurate data" is simply wrong.[24] Missing and erroneous information must be accounted for during application. ONA doctrine lacks discussion on information vetting processes and quality assurance measures. Understanding the limitations of data input must be addressed to shape the boundaries of resultant computations.

Understanding Data: Quality, Quantity, and Value

One should never use elaborate scientific guidelines as if they were a kind of truth machine."[25]

--- Carl von Clausewitz

In any computational model, validity of information must be calculated or weighed. Analysts must identify the data as "valid for whom?"[26] This is especially true when calculating metrics of success. ONA doctrine labels interagency and Center of Excellence coordination as a validation metric.[27] Some may argue the amount of data provided or the number of organizations involved is significant for System of Systems Analysis. In reality, quality assurance of the information analyzed and prepared for dissemination should be a considerable part of the effort, and subsequently made part of the process.

This is difficult for social network analysis. Traditional analytic tools are "data greedy": Very detailed information is required to establish nodal understanding and rudimentary relationships.[28] When one contemplates shifting analysis from static to dynamic networks (such as terrorist organizations or economic agents), data requirements become even more demanding. The ONA organization subsequently concentrates on quantity of input in order to "keep up" with the changes. Analysts must resist this desire to create the largest string of data and instead focus on information selection and quality. "An effect of pushing intelligence down the road of science is the tendency to view quantifiable capabilities as more accurate and also more important then qualitative intentions."[29]

Current network modeling fixates on rapid calculations and data compilation.[30] This approach establishes speed of information input as the metric of choice, leveraging the "exploitation" phase of the Process, Exploitation, and Dissemination (PED) intelligence cycle. While analysts may have more time to review the simulation output, the mantra of "trust, but verify" should be remembered. If analysis does not begin until the initial simulation runs are complete, how much error (or deception) has the product already absorbed?

Some may argue the reduction of all adversary mechanisms into a network model is the most effective procedure to create rapid, computational products through social network analysis. Cognitive, conceptual analysis takes time, and narrative research does not translate into quick action. In a crisis situation, a purely qualitative approach would be detrimental, even infeasible. However, boiling down all of an adversary's relationships or organizations through a network "cookie cutter" can be a square-peg-in-round-hole situation.

> Many (particularly economic, social and political systems) may also be usefully represented other ways, for example as hierarchies/organizations, small group decision-making bodies, individuals engaged in bargaining … collective action … [and all] subject to social and cognitive biases.[31]

Black markets within an economy, illegal imports and exports, social demographics, and physical and political structural changes affect our ability to determine cause.[32] This discussion is particularly relevant when a JTF is involved in Security and Stability or Flexible Deterrent Operations. During these conditions, *influence* and not destruction is the prime objective. In these situations, a network model must weigh values based on social and conceptual information – precisely where the Intelligence Community falls short.

This is a challenge, as cultural factor weights are very difficult to shape, and they involve some level of subjectivity.[33] Because ONA drives a network-mapping focus, some may argue that System-of-Systems Analysis should simply "connect the dots [and] isolate the key actors who are often defined in terms of their 'centrality' to the network."[34] This approach, however, may be unacceptably austere. Nodes and ties resulting from a simulation are influenced by the inherent biases obtained by a given sampling procedure.[35] The model (or the analyst) can over- or under-sample certain types of relations, which in the output will "strategically misreport" specific ties and links.[36]

As ONA capabilities mature, they must be linked to improved social network model simulations, taking into account the dynamic, cognitive data faced throughout the spectrum of military tasks, not just higher-level war-making. Models also need to respect a "significant degree of irreducible uncertainty associated with the psychological, inter-personal, and bureaucratic processes within future US adversaries…."[37] Globalization, failed states, and economic changes all lead to increased uncertainty in today's world. Not only must newer generation network simulation models factor in these scenarios, but intelligence professionals must also operate under a scalable threshold of certainty for relevancy to the warfighter.

Potential for Bias and Error

The facts are mugged long before they reach decision-makers.[38]

--- *Alexander Butterfield*

That cultural differences exist to a certain degree between military services within the Defense Department is a given; however, the differences between governmental agencies are vast, and those outside of government are even further removed. One organization's view of mission, legal definitions, and constraints may all vary from that of the Standing Joint Force Headquarters.[39] This is especially true outside of government, where NGOs, academia, and think tanks (the Center of Excellence core for ONA input) become involved. Desire for independence and non-alignment may prevent certain organizations from working with the military altogether or cloud the information provided. Each agency or organization will have a specific "solution space" they can provide for analysis; whether that "space" is fully exhausted or contiguous with the question will affect the reliability of analysis.[40]

Value weight dissonance among different Subject Matter Experts and Centers of Excellence requires debate among the ONA analysts and the collaborative network group. Models may be laden with information "intentionally misleading, inaccurate, out-of-date, and incomplete."[41] Faulty assumptions become inherent and skew any displayed relationships among the proposed network and negatively affect results that will be used for decision-making. The "quantity is quality" factor must be eliminated: The number of experts consulted does not a fool-proof simulation make.[42] Bias and analyst perceptions are factors that cannot be adjusted in any simulation modeling process. "You can't just wish it away or algorithm it outta there."[43]

Social Network Analysis: The Limitations of Uncertainty

Models are to be used, not believed.[44]

--- *H. Theil*

In order to conduct analysis to determine "what-if" scenarios, we can look to social and business decision aids as examples.[45] System simulations have the ability to test various policies (actions and influences) to determine effects.[46] However, the analyst and the warfighter must always understand the simulation is nothing more than just a model. There are specific limitations, fully understood by programmers and researchers, but routinely ignored or dismissed as assumptions in ONA doctrine.

Current applications used by government agencies in the field deal with traditional social systems comprised of small, bounded networks.[47] There are problems when one is tasked to run analysis upon covert networks (such as a terrorist organization) or other security and stability situations involving significant missing information. The current network analysis tools do not scale well in these cases, and grow exponentially flawed due to error with increased network size. There is no "graceful degradation" catch within the algorithms.[48] The missing data can be somewhat mitigated by increasing the amount of empirical knowledge used; however, that requires many specifics (back to the "data greedy" concept) and can be extremely difficult.[49] Evaluating data in order to tailor effects and results across a Regional Combatant Commander's area of responsibility can be increasingly tricky.

Additionally, the current DIME construct within ONA does not effectively factor other sources of U.S. national power that can affect the simulation model, such as Special Operations Forces activities, intelligence collection, humanitarian assistance, and law enforcement.[50] With many variable factors, one must be cautious when relying upon the network as a template for analysis under every situation. Philip Cerny touches on this premise in his theory of a growing "neomedievalism" among societies:

> As in the Middle Ages, occupational solidarity, economic class, religious or ethnic group, ideological preference, national or cosmopolitan values, loyalty to or identity with family, local area, region, etc., will no longer be so easily subsumed in *holistic images* [emphasis mine] or collective identities … National identities are likely to become increasingly … divorced from real legitimacy, "system affect," or even instrumental loyalty.[51]

Maintaining accurate computations in light of ever greater qualitative change is the challenge for future social network analysis tools. Prediction is difficult and can be dangerous when presenting surmised resultant effects. Any missing data or uncertainty will degrade the prediction as "holes" are extrapolated throughout the model. Tools are required to analyze *why* and *how* algorithms compute what they do. Identifying higher (or lower) confidence values and cueing further examination should be measurement objectives. Although Joint and Service advocates for ONA and network modeling desire a tool for use *now*, science cannot yet support this level of capability.

Analysts and planners must not only be conscious of simulation and data limitations, but also cognizant of the level of error or model adaptability permitted. Because ONA cannot only be focused on baseline, long-term data analysis, the construct applied must be scalable to support the Commander's timeline for decision. An example is what the author has termed the "Butterfield Scale," based on a prior study of analysis and judgment indicators by Alexander Butterfield:[52]

SITUATION	TOLERANCE	EXAMPLE
Peacetime	Low Tolerance for error Low rate of change	ONA baseline efforts
Tensions	Medium tolerance for error Medium rate of change	Crisis build-up
Wartime	Friction accepted Metric is speed of assessments	OIF Phase III

The Butterfield Scale

Understanding the cognitive aspect of simulation model input improves the capability to discern potential "fault lines" within the results. As the intensity of action increases, simultaneously with the desire for rapid assessments, scalability must be applied and some fidelity tossed over the side.

The "Butterfield Scale" provides a framework for ONA and its requisite tools to remain relevant across the spectrum from major combat to Security and Stability Operations. Analysts can generate "truth in lending" confidence levels for the Commander. Promising peacetime levels of granularity and prediction when speed of dissemination is paramount places the analyst in a situation of writing checks he cannot cash. Indeed, many PMESII effects require a significant amount of time to materialize. Substantial Intelligence, Surveillance, and Reconnaissance planning efforts are necessary to coordinate the sensing of those effects.[53]

Conclusion and Recommendations

> ***When I have a particular case in hand, I … love to dig up the question by the roots and hold it up and dry it before the fires of the mind.***[54]
>
> --- *Abraham Lincoln*

Improving ONA requires the acknowledgement of shortfalls. Bias, error, and subjectivity will always remain;

therefore, future work in ONA is needed to understand limitations and provide degrees of confidence. Social network analysis tools cannot be honestly sold as the sole determinant for success. Ideas, systems, and metrics are moving in the right direction, but gaps remain.[55] While analysts cannot fully eliminate preconceptions and error, they can leverage effort to tamp it down.[56] One must select the models that best fit and ignite the white heat of analysis.

Joint Forces Command, in concert with the Intelligence Community, must engage Centers of Excellence to develop more adaptive social network research capabilities. We do not yet have reliable "devil's advocate" analytical systems, and work is needed to improve analytical tools for military decision-making and planning.[57] A realistic ONA process, subsequent to a baseline of critical self-analysis and validity knowledge, must be the goal for future research at Joint Forces Command and within the developing Standing Joint Force Headquarters.

Endnotes:

[1] Carl von Clausewitz, *On War*, ed. and trans. Michael Howard and Peter Paret, indexed ed. (Princeton: Princeton University Press, 1984), 117.

[2] Joint Forces Command, "About Operational Net Assessment," Electronic document, available from http://www.jfcom.mil/about/fact_ona.htm; Internet, accessed 12 January 2005.

[3] Joint Forces Command, "About the Standing Joint Force Headquarters," Electronic document, available from http://www.jfcom.mil/about/fact_sjfhq.htm; Internet, accessed 12 January 2005.

[4] Rob Johnston, "Developing a Taxonomy of Intelligence Analysis Variables," *CIA Studies in Intelligence* 47, no. 3 (2003), available from http://www.cia.gov/csi/studies/vol47no3/article05.html; Internet, p. 3, quoting Ephraim Kam, *Surprise Attack: The Victim's Perspective* (Cambridge, MA: Harvard University Press, 1988), 120.

[5] Robert D. Deutsch, "Probing Images of Politicians and International Affairs: Creating Pictures and Stories of the Mind," *Indoctrinability, Ideology, and Warfare: Evolutionary Perspectives*, ed. Irenaus Eibl-Eibesfeldt and Frank K. Salter (New York: Berghahn Books, 1998), 303.

[6] Alexander Butterfield, "The Accuracy of Intelligence Assessment: Bias, Perception, and Judgment in Analysis and Decision" (Advanced Research Project student paper, United States Naval War College, Newport, RI: 1993), 16.

[7] President Dwight Eisenhower, quoted in William B. Pickett, *George F. Kennan and the Origins of Eisenhower's New Look: An Oral History of Project Solarium*, Princeton Institute for International and Regional Studies, monograph series, no. 1 (2004): 11.

[8] Johnston, "Developing a Taxonomy of Intelligence Analysis Variables," 3.

[9] Joint Chiefs of Staff, *Doctrinal Implications of Operational Net Assessment (ONA)*, Joint Warfighting Center Doctrine Pamphlet 4 (Washington, DC: 24 February 2004), 5.

[10] Joint Chiefs of Staff, *Standard Operating Procedure & Tactics, Techniques and Procedures for the Standing Joint Force Headquarters (Core Element)*, draft version (Washington, DC: 14 July 2004), 2-8. Many of these "Center of Excellence" groups would not be pleased knowing they were de facto intelligence sources.

[11] Joint Chiefs of Staff, Draft *Standard Operating Procedure for the Standing Joint Force Headquarters*, 2-5.

[12] Ibid.

[13] Johnston, "Developing a Taxonomy of Intelligence Analysis Variables," p. 2, quoting Charles Allen, Associate Director of Central Intelligence for Collection, at a public seminar on intelligence at Harvard University, Spring 2000. Available from http://pirp.harvard.edu/pdf-blurb.asp? id+518; Internet.

[14] Douglas K. Zimmerman, "Understanding the Standing Joint Force Headquarters," *Military Review* (July-August 2004), 31.

[15] Kathleen M. Carley, "Estimating Vulnerabilities in Large Covert Networks" (paper presented as part of the Dynamic Networks project supported by the Office of Naval Research, 2004), available from http://experiments.tepper.cmu.edu/speakers/Carley1.pdf; Internet, pp. 2-3.

[16] Johnston, "Developing a Taxonomy of Intelligence Analysis Variables," p. 3, quoting J.R. Thompson, R. Hopf-Weichel, and R. Geiselman, *The Cognitive Bases of Intelligence Analysis* (Alexandria, VA: Army Research Institute, Research Report 1362, 1984), AD-A146, 132, 7.

[17] "Computer Programs for Social Network Analysis," available from www.insna.org/INSNA/soft_inf.html; Internet; 03 November 2004. These include Apache Agora (for visual representation), daVinci (which draws ordered relations for users), the Ecosystem Network Analysis (providing "quantitative methods that systematically teases most pertinent information from the full, complicated network"), KeyPlayer (nodal removal analysis), and MetaSight (a SNA toolset that derives relationships via e-mail traffic).

[18] Rebecca Goolsby, <GoolsbR@ONR.NAVY.MIL>, "Further Research Information," [E-mail correspondence with the author], 31 January 2005.

[19] Karen Roebuck, "CMU Project Targets Terrorism," *Pittsburgh Tribune Review*, 19 June 2004; available from http://www.pittsburghlive.com/x/search/s_199550.html; Internet, p. 1.

[20] Zimmerman, "Understanding the Standing Joint Force Headquarters," 30.

[21] Carley, "Estimating Vulnerabilities in Large Covert Networks," 15.

[22] Mark W. Maiers and Timothy L. Rahn, "Information Operations and Millennium Challenge," *Joint Forces Quarterly*, no. 35 (2004): 84.

[23] Carley, "Estimating Vulnerabilities in Large Covert Networks," 15.

[24] Rebecca Goolsby, "Developing Social Science Based Applications for the Navy: Lessons from ONR" (PowerPoint briefing presented to the Navy Enterprise Conference, 05 August 2004), available from http://www.onr.navy.mil/about/

conferences/rd_partner/docs/misc/aug5/02goolsby.pdf; Internet, slides 9-10.

[25] Clausewitz, *On War*, 168.

[26] L. R. Gay, *Educational Research: Competencies for Analysis and Application*, 5th ed. (Saddle River, NJ: Prentice-Hall, 1996), 139.

[27] Joint Forces Command, "Interagency Working Group E-Newsletter," Electronic document, September 2004; available from http://www.ndu.edu/ITEA/storage/558/September%2004%20Newsletter.pdf; Internet, p. 5.

[28] Ronald Breiger, Kathleen Carley, and Philippa Pattison, ed., *Dynamic Social Network Modeling and Analysis: Workshop Summary and Papers* (Washington, DC: National Academies Press, 2003), 4.

[29] Butterfield, "The Accuracy of Intelligence Assessment," 20.

[30] Defense Advanced Research Projects Agency, "Integrated Battle Command"; available from http://www.darpa.mil/ato/solicit/IBC/faq.htm; Internet; accessed 22 January 2005.

[31] Jim Miller, "Operational Net Assessment: What Are the Real Challenges?" *Defense Adaptive Red Team Working Paper 03-1* (Arlington, VA: Hicks and Associates, Inc., 2003).

[32] Ibid.

[33] Barry Render and Ralph M. Stair, Jr., *Quantitative Analysis for Management*, 6th ed. (Saddle River, NJ: Prentice-Hall, 1997), 562.

[34] Carley, "Estimating Vulnerabilities in Large Covert Networks," 2.

[35] Ibid., 13.

[36] Ibid.

[37] Miller, "Operational Net Assessment".

[38] Butterfield, "The Accuracy of Intelligence Assessment," 17.

[39] Rebecca Goolsby, <GoolsbR@ONR.NAVY.MIL>, "Research Request," [E-mail correspondence with the author], 29 December 2004.

[40] Goolsby, "Further Research Information," e-mail correspondence, 31 January 2005.

[41] Ibid.

[42] Carley, "Estimating Vulnerabilities in Large Covert Networks," 3.

[43] Goolsby, "Further Research Information," e-mail correspondence, 31 January 2005.

[44] Henri Theil, *Principles of Econometrics* (New York: Wiley, 1971).

[45] Render and Stair, Jr., *Quantitative Analysis for Management*, 714.

[46] Ibid.

[47] Carley, "Estimating Vulnerabilities in Large Covert Networks," 6.

[48] Ibid.

[49] Goolsby, "Further Research Information," e-mail correspondence, 31 January 2005.

[50] Miller, "Operational Net Assessment," 7.

[51] Philip G. Cerny, "Terrorism and the New Security Dilemma," *Naval War College Review* 58, no. 1 (Winter 2005): 26-27.

[52] Butterfield, "The Accuracy of Intelligence Assessment," 71-75.

[53] Defense Advanced Research Projects Agency, "Integrated Battle Command."

[54] Abraham Lincoln, quoted in Gene Griessman, *The Words Lincoln Lived By* (New York: Fireside, 1997), 99.

[55] Breiger, Carley, and Pattison, *Dynamic Social Network Modeling and Analysis*, 14.

[56] Butterfield, "The Accuracy of Intelligence Assessment," 66.

[57] Goolsby, "Further Research Information," e-mail correspondence, 31 January 2005.